Free Trade Agreements as dynamic farsighted networks

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January 2016

Abstract

In the presence of multilateral negotiations, are Free Trade Agreements (FTAs) necessary for, or will they prevent, global free trade? I answer this question using a dynamic farsighted model of network formation among asymmetric countries. Ultimately, FTAs prevent global free trade when there are two larger countries and one smaller country but FTAs can be necessary for global free trade when there are two smaller countries and one larger country. The model provides insights into the dynamics of recent real world negotiations and recent results in the literature on the empirical determinants of trade agreements.

JEL: C71, F12, F13

Keywords: Free Trade Agreements, FTA exclusion incentive, concession diversion, multilateralism, global free trade, networks, farsighted

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1 Introduction

Recent decades have witnessed an unprecedented proliferation of Free Trade Agreements (FTAs). Although sanctioned by the WTO in GATT Article XXIV, FTAs are discriminatory by construction and contradict the central principle of non–discrimination articulated in the Most Favored Nation (MFN) principle of GATT Article I.[1] Thus, the proliferation of FTAs has stimulated substantial debate on whether FTAs hinder or facilitate greater liberalization, especially given the lack of multilateral liberalization since the 1994 Uruguay Round. That is, are FTAs "building blocs" or "stumbling blocs" to global free trade?

In essence, the issue of whether FTAs are building blocs or stumbling blocs is a *dynamic* issue concerning the evolution of trade agreements over time. Nevertheless, much of the literature uses *static* three country models. For example, many papers ask if an arbitrarily chosen pair of countries want to form an FTA and, if so, how this affects incentives for expansion of the agreement to include the third country, thus achieving global free trade (e.g., Levy (1997), Krishna (1998), Ornelas (2005a,b)). In this paper, I extend the literature by using a dynamic model of farsighted network formation to ask the fundamentally dynamic question of whether FTAs are building blocs or stumbling blocs to global free trade.

Viewing links between players as trade agreements between countries, the dynamic farsighted network formation model has three defining features. First, at most one agreement can form in a period. That is, I interpret a period as the length of time needed to complete FTA negotiations; in practice, completion of FTA negotiations typically takes many years.[2] Second, agreements formed in previous periods are binding. Ornelas (2008, p.218) and Ornelas and Liu (2012, p.13), among others, have argued the binding nature of trade agreements is pervasive in the literature and realistic.[3] Third, in the spirit of Aghion et al. (2007), I impose a protocol where, in each period, a "leader" country can make trade agreement proposals to the "follower" countries. However, unlike Aghion et al. (2007), I allow the follower countries to make proposals in periods where the proposal of the leader country is rejected or the leader chooses to make no proposal. Within this dynamic network formation framework, countries are farsighted because they base their actions on the continuation payoff of forming an agreement rather than the one period payoff.

[1]GATT Article I requires any tariff reductions afforded to one country are afforded to all countries. But GATT Article XXIV provides an escape clause: FTA members can eliminate tariffs between themselves if they do not raise tariffs or non tariff barriers on other countries.

[2]For example, NAFTA diplomatic negotiations date back to 1988 (Odell (2006, p.193)) despite the agreement being implemented in 1994.

[3]They argue realism both from the perspective of practical observation and as a reduced form for a more structural explanation. For example, see McLaren (2002) for sunk costs as an explanation and, among others, Freund and McLaren (1999) for empirical support.

Rather than assume a particular trade model to generate payoffs and solve the equilibrium path of network formation, I posit a general specification of one period payoffs and show these payoffs fit a variety of popular underlying trade models used in the literature. Despite the obvious appeal of this approach in terms of its generality and robustness, it is a rather novel approach relative to the existing literature. The essence of the one period payoff specification, although the exact conditions are weaker, is twofold. First, FTAs benefit members but may harm non–members. Second, and most importantly, a pair of "insider" countries (i.e. countries who have the sole FTA in existence) hold an "FTA exclusion incentive": formally, in terms of their one period payoff, insiders enjoy a higher payoff than under global free trade. That is, insiders want to exclude the "outsider" country from a direct move to global free trade. Although not present in all standard trade models, I show FTA exclusion incentives arise in numerous models. Moreover, Section 6 discusses how an observable implication of FTA exclusion incentives finds empirical support in Chen and Joshi (2010).

The FTA exclusion incentive creates the key dynamic tradeoff in the model, one faced by insiders. By forming an additional FTA, an insider becomes the "hub" and has sole preferential access to both of the other "spoke" countries. But, the spokes then form their own FTA, taking the world to global free trade and eroding the value of sole preferential access enjoyed by the hub. Prior literature has termed this erosion "concession diversion" (e.g. Ethier (2001, 2004); Goyal and Joshi (2006)) and, crucially, the FTA exclusion incentive says the extent of concession diversion is large enough that a country's one period payoff under global free trade falls below that as an insider.[4] Thus, the myopic appeal to an insider of becoming the hub outweighs an insider's fears of future concession diversion, and hence an insider becomes the hub on the path to global free trade, only when the discount factor is sufficiently small. Conversely, future fears of concession diversion lead insiders to remain insiders when the discount factor is sufficiently large. Thus, the FTA exclusion incentive, and the underlying fear of concession diversion, undermine an insider's incentive to engage in subsequent FTA formation and, hence, the eventual attainment of global free trade.

To classify the role played by FTAs in the attainment of global free trade, I follow Saggi and Yildiz (2010, 2011). They compare a "bilateralism game", where countries choose between forming bilateral FTAs or moving directly to global free trade, to a "multilateralism game", where countries cannot form FTAs.[5] FTAs are "strong building blocs" if global free trade is only attained in the presence of FTAs but "strong stumbling blocs" if global free trade is only attained in the absence of FTAs. When countries are symmetric in my model,

[4] To see the intuition for the "concession erosion" terminology, note the outsider-turned-spoke initially grants tariff concessions to the insider-turned-hub but then diverts these concessions to the other spoke.

[5] This approach was first adopted by Riezman (1999).

FTAs can be strong stumbling blocs but not strong building blocs. On one hand, global free trade is attained in the multilateralism game because each country views the world market as attractive enough that it does not veto a direct move to global free trade. On the other hand, as discussed above, global free trade is attained in the bilateralism game only when the discount factor is sufficiently small because then an insider's fear of future concession diversion is small relative to the myopic attractiveness of exchanging further reciprocal market access and becoming the hub. Thus, FTAs are strong stumbling blocs and prevent global free trade when the discount factor exceeds a threshold.

More generally, the role of FTAs depends crucially on asymmetries. To model asymmetry, I assume a parameter α determines a country's "attractiveness" as an FTA partner. This interpretation includes, among others, market size or technology asymmetries. For want of better terminology, I interpret countries with a higher α as "larger". Asymmetry has intuitive implications for the outcome of the multilateralism game. Global free trade emerges with two larger countries and one smaller country because the larger country views the world market as attractive enough that it does not veto global free trade. However, global free trade does not emerge with two smaller countries and one larger country because the largest country views the world market as too small and vetoes global free trade.

Asymmetry mediates the outcome of the bilateralism game through its impact on the critical discount factor governing the emergence of global free trade (global free trade emerges below the critical discount factor). With two larger countries and one smaller country, the value of sole preferential access protected by the two larger countries as insiders is substantial. This generates strong fears over future concession diversion, producing a low critical discount factor and restraining global free trade. Conversely, with two smaller countries and one larger country, the value of sole preferential access protected by the two largest countries (i.e. the largest and the biggest smaller country) is low. This generates weak fears over future concession diversion, producing a high critical discount factor and helping facilitate global free trade.

The strong building bloc-stumbling bloc dichotomy now falls into place. With two sufficiently larger countries and one sufficiently smaller country, FTAs are strong stumbling blocs. In the multilateralism game, the largest country views the world market as attractive and does not veto global free trade. But, in the bilateralism game, the larger countries protect substantial preferential access as insiders and the strong fears over future concession diversion lead them to remain insiders. Here, FTAs prevent global free trade. Conversely, FTAs are strong building blocs with two sufficiently smaller countries and one sufficiently larger country. The largest country now views the world market as unattractive in the multilateralism game and vetoes global free trade. But, in the bilateralism game, the two largest countries (i.e. the largest country and the bigger smaller country) no longer protect substantial preferential access as insiders and the weak fears over concession diversion facilitate FTA expansion to global free trade. Here, FTAs are necessary for global free trade.

Importantly, the model helps shed some light on real world FTA formation and non-formation. The model relates the path of FTA formation to (i) country asymmetries (matching empirical evidence of Chen and Joshi (2010)) and (ii) the order FTA negotiations commence. These predictions match recent negotiations involving the US, EU, Japan and numerous partners. Moreover, as discussed above, an observable implication stemming from the result that FTA exclusion incentives, and the underlying fear of concession diversion, drive FTA non-formation receives empirical support from Chen and Joshi (2010).

While they do not refer to it as an FTA exclusion incentive or a fear of concession diversion, Mukunoki and Tachi (2006) identify the associated trade off faced by FTA insiders. But, they do not address the strong building bloc–strong stumbling bloc issue nor do they model country asymmetries. Indeed, Krugman (1991), Grossman and Helpman (1995) and Saggi and Yildiz (2010, p.27) have emphasized the importance of country asymmetries. To this end, my model delivers a clear and intuitive explanation linking country asymmetries and the role of FTAs as strong building blocs or strong stumbling blocs.

The strong stumbling bloc role of FTAs is the key difference with Saggi and Yildiz (2010, 2011). Not only is their static framework unable to capture the dynamic farsighted logic of concession diversion, but their trade models do not exhibit FTA exclusion incentives which are crucial to my strong stumbling bloc result.[6] While Saggi et al. (2013) find that Customs Unions (CUs) can be strong stumbling blocs, the WTO requirement that CU members impose a common tariff on non–members implies CUs and FTAs are very different types of agreements. Moreover, FTAs make up 90% of all preferential trade agreements (i.e. FTAs and CUs) which places utmost importance on the FTA analysis.[7]

Using network formation models to address FTA formation dates back to Goyal and Joshi (2006). In a symmetric oligopolistic setting they show the complete network (i.e. global free trade) is pairwise stable (Jackson and Wolinsky (1996)) and the unique efficient network. Furusawa and Konishi (2007) employ a model with a continuum of differentiated goods and show that, when consumers view goods as unsubstitutable, the pairwise stable network involves an FTA between two countries if and only if the countries have a similar level of industrialization (i.e. similar number of firms). Using a dynamic, but myopic best response, network formation model, Zhang et al. (2014) show the attainment of global free

[6]Saggi and Yildiz (2010) use the popular "competing exporters model" with endowment asymmetry. Interestingly, this setting does not feature FTA exclusion incentives but Lemma 1 here will show that the competing exporters model with market size asymmetry does feature FTA exclusion incentives.

[7]`http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx`

trade can hinge on the special case of three countries.

Finally, my model shares similar features to the three country dynamic model of Seidmann (2009), but the question of interest differs. His interest lies in whether the equilibrium type of trade agreement is a CU or an FTA. But, my interest rests on whether global free trade is eventually attained which is a moot issue for Seidmann (2009) because transfers imply global free trade always emerges in equilibrium since it is efficient (i.e. maximizes world welfare). In contrast, I assume transfers are not available to countries so global free trade need not obtain even if global free trade is efficient.[8]

2 Payoffs

This section devotes significant effort to develop general properties on one period and continuation payoffs that fit a variety of underlying trade models but are also sufficient to explicitly solve the equilibrium path of networks. After describing numerous underlying trade models used in the recent literature, I present general properties on one period payoffs and continuation payoffs and show these properties arise naturally in the various models.[9] Thus, importantly, the results do not rely on a particular model of trade. Rather, the results rely on payoff properties that are pervasive across popular underlying trade models.

Before proceeding, some notation and terminology is needed. The set of countries is $N = \{s, m, l\}$ and g denotes a network of trade agreements. Figure 1 illustrates the possible networks and terminology. Generally, a link between two nodes indicates an FTA. But, the free trade network could represent either three FTAs or a three country MFN agreement. When countries are asymmetric, each country i has a payoff-relevant characteristic α_i which could represent, for example, market size or technological conditions in country i.

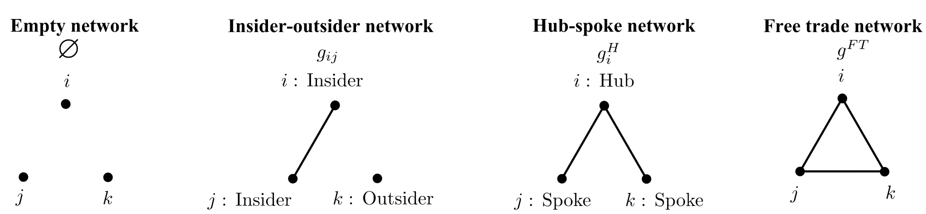

Figure 1: Networks and position terminology

[8]According to Bagwell and Staiger (2010, p.50), reality is "... positioned somewhere in between the extremes of negotiations over tariffs only and negotiations over tariffs and [transfers]...". Aghion et al. (2007) and Bagwell and Staiger (2010) allow transfers while others including Riezman (1999), Furusawa and Konishi (2007), and Saggi and Yildiz (2010) do not.

[9]Appendix A contains closed form welfare expressions.

2.1 Underlying trade models

Oligopoly model. Three countries, each with a single firm, produce a homogenous good in segmented international markets. x_{ij} denotes the quantity sold by country i in country j's market (this allows $j = i$). Country i's demand is $d_i(p_i) = \bar{d}_i - p_i$ where $\bar{d}_i$ denotes country i's market size and p_i denotes the price in country i. Thus, country i's characteristic is $\alpha_i \equiv \bar{d}_i$. Ruling out prohibitive tariffs, country i imposes a tariff τ_{ij} on country $j \neq i$.

Assuming a common and constant marginal cost (normalized to zero), country i's maximization problem in country j has the standard form: $\max_{x_{ij}} \left[\left(\bar{d}_j - \sum_{i\in N} x_{ij}\right) - \tau_{ji}\right] x_{ij}$. Given a network g, the equilibrium quantity $x^*_{ij}(g)$ is

$$x^*_{ij}(g) = \frac{1}{4}\left[\bar{d}_j + (3 - \eta_j(g))\,\bar{\tau}_j(g) - 4\tau_{ji}(g)\right] \tag{1}$$

where (i) $\eta_j(g)$ is the number of countries facing a zero tariff in country j (including country j itself) and, per WTO rules, (ii) $\bar{\tau}_j(g)$ is the non-discriminatory tariff faced by countries who do not have an FTA with country j, and (iii) $\tau_{ji}(g) = 0$ if i and j have an FTA. Country i's equilibrium profits in country j are $\pi_{ij}(g) = \left(x^*_{ij}(g)\right)^2$ and country i's total profits are $\pi_i(g) = \sum_{j\in N} \pi_{ij}(g)$.

The oligopoly model has been used extensively in the trade agreements literature. Krishna (1998) represents an early example. There, tariffs are exogenous and government i's one period payoff is merely firm profits. That is, letting $v_i(g)$ denote the payoff to the government of country i from a network g, Krishna assumes $v_i(g) = \pi_i(g)$. However, following Ornelas (2005b), many authors assume the payoff to the government of country i is national welfare and governments set tariffs endogenously to maximize national welfare. That is, $v_i(g) = W_i(g) \equiv CS_i(g) + PS_i(g) + TR_i(g)$ where W_i, CS_i, PS_i and TR_i denote country i's national welfare, consumer surplus, producer surplus and tariff revenue. To distinguish between these models, I subsequently refer to the former as the political economy oligopoly model and the latter merely as the oligopoly model.

Competing exporters model. The original version of the competing exporters model dates back to Bagwell and Staiger (1999). Three countries are denoted by $i = s, m, l$ and three (non-numeraire) goods are denoted by $Z = S, M, L$. Demand for good Z in country i is given by $d_i\left(p_i^Z\right) = \bar{d}_i - p_i^Z$ where p_i^Z is the price of good Z in country i.[10] Again, country i's characteristic is $\alpha_i \equiv \bar{d}_i$. Each country i has an endowment $e_i^Z > 0$ of goods $Z \neq I$ and an endowment $e_i^Z = 0$ of good $Z = I$. I assume symmetric endowments so that $e_i^Z = e$ for

[10]Countries are assumed to have sufficient endowments of a numeraire good to balance trade. The demand functions can be derived from a quasi-linear utility function that is linear in the numeraire good and additively separable in subutility functions that depend on consumption of the non-numeraire goods.

$Z \neq I$. Thus, country i has a "comparative disadvantage" in good I while countries j and k have a "comparative advantage" in good I and, in equilibrium, compete with each other when exporting good I to country i.

Ruling out prohibitive tariffs, no-arbitrage conditions link the equilibrium price of good I across countries: $p_i^I = p_j^I + \tau_{ij} = p_k^I + \tau_{ik}$. International market clearing conditions then deliver equilibrium prices. Letting $x_i^Z = e_i^Z - d_i\left(p_i^Z\right)$ denote country i's *net* exports of good Z, market clearing in good Z requires $\sum_i x_i^Z = 0$. This yields

$$p_i^I = \frac{1}{3}\left[\sum_{h \in N} \bar{d}_h - 2e + \tau_{ij} + \tau_{ik}\right] \text{ and } p_j^I = \frac{1}{3}\left[\sum_{h \in N} \bar{d}_h - 2e + \tau_{ik} - 2\tau_{ij}\right] \text{ for } j \neq i.$$

Finally, I assume $v_i(g) = W_i(g)$ and that governments set tariffs to maximize $W_i(g)$.

Competing importers model. The competing importers model was introduced by Horn et al. (2010) and extended to a three country setting by Missios et al. (2014). Again, three countries are denoted by $i = s, m, l$ and three (non-numeraire) goods are denoted by $Z = S, M, L$ with demand identical to the competing exporters model. However, unlike the competing exporters model, the competing importers model presented here features flexible supply with the supply of good Z by country i given by $x_{ii}^Z\left(p_i^Z\right) = \lambda_i^Z p_i^Z$. Thus, $\frac{1}{\lambda_i^Z}$ represents the slope of this supply curve. More specifically, $\lambda_i^Z = 1$ for $Z \neq I$ but $\lambda_i^I = 1 + \lambda_i$ where $\lambda_i > 0$. Thus, countries j and k have a "comparative disadvantage" in good I and, in equilibrium, compete for imports of good I from country i who has a "comparative advantage" in good I and, in equilibrium, is the sole exporter of good I. In this model, country i's characteristic is $\alpha_i \equiv \bar{d}_i$ under market size asymmetry and symmetric technology but $\alpha_i \equiv \frac{1}{\lambda_i^I}$ under asymmetric technology and symmetric market size.

Ruling out prohibitive tariffs, no-arbitrage conditions link the equilibrium price of good I across countries: $p_j^I = p_i^I + \tau_{ji}$ and $p_k^I = p_i^I + \tau_{ki}$. International market clearing conditions then deliver equilibrium prices. Letting $m_{ji}^I = d_j\left(p_j^I\right) - x_{jj}^I\left(p_j^I\right)$ denote country j's imports of good I from country i and $x_{ij}^I = x_{ii}^I\left(p_i^I\right) - d_i\left(p_i^I\right) - m_{ki}^I$ denote country i's exports of good I to country j, market clearing in good I requires $x_{ij}^I = m_{ji}^I$ and $x_{ik}^I = m_{ki}^I$. This yields

$$p_i^I = \frac{1}{6+\lambda_i}\left(\sum_{h \in N} \bar{d}_h - 2\tau_{ji} - 2\tau_{ki}\right) \text{ and } p_j^I = \frac{1}{6+\lambda_i}\left(\sum_{h \in N} \bar{d}_h - 2\tau_{ki} + (4+\lambda_i)\,\tau_{ji}\right) \text{ for } j \neq i.$$

Finally, I assume $v_i(g) = W_i(g)$ and that governments set tariffs to maximize $W_i(g)$.

2.2 General payoff properties

I now present the general properties on one period payoffs that underlie later results and show these properties emerge across the four trade models just described.

The general properties that I impose on one period payoffs fall into four categories: (i) the effect of FTAs on members, (ii) whether countries prefer global free trade over the status quo of no agreements, (iii) the effect of FTAs on non-members, and (iv) the FTA exclusion incentive. While categories (i) and (iii) feature prominently in existing models of FTA formation, category (ii) underlies the outcome of trade liberalization in the absence of FTAs and, hence, the strong building bloc-stumbling bloc analysis. Moreover, category (iv) relates to the FTA exclusion incentive which is central to subsequent results.

Under symmetry, Condition 1 describes the general properties on one period payoffs.

Condition 1. *(i)* $v_h(g+ij) > v_h(g)$ *for* $h = i, j$
(ii) $v_i\left(g^{FT}\right) > v_i(\emptyset)$
(iii) $v_i\left(g_i^H\right) > v_i\left(g^{FT}\right)$
(iv) $v_i(g_{ij}) > v_i\left(g^{FT}\right)$

Letting $g+ij$ denote the network that adds the FTA between countries i and j to g, part (i) governs the effect of FTAs on members. Specifically, the reciprocal exchange of preferential market access makes FTAs mutually beneficial for members.

Part (ii) governs the attractiveness of global free trade relative to the status quo of the empty network. Specifically, global free trade benefits each country: the gains from exchanging pairwise preferential access with the other two countries outweighs the negative effects of other countries exchanging preferential access between themselves.

Part (iii) governs the effect of FTAs on non-members. Specifically, given a hub-spoke network g_i^H, FTA formation by two spoke countries takes the world to global free trade and makes the hub worse off due to concession diversion. Notice that part (iii) is rather weak as it does not impose any restrictions on the effect that FTAs have on non-members when FTA formation takes place at the empty or insider-outsider networks.

Part (iv) represents the "FTA exclusion incentive". That is, insiders want to exclude the outsider from expansion to global free trade to avoid eroding their reciprocal preferential market access. Note, the FTA exclusion incentive implies an insider's gain from forming an additional FTA and becoming the hub is dominated by the costs of concession diversion suffered upon a subsequent spoke-spoke FTA: $v_i\left(g_i^H\right) > v_i(g_{ij}) > v_i\left(g^{FT}\right)$.[11]

[11] Part (iv) has a subtle implication for the degree of tariff complementarity upon FTA formation at the insider–outsider network: the non-member, i.e. the insider–turned–spoke, cannot benefit from tariff complementarity. To see this, note that $v_i\left(g_j^H\right) > v_i(g_{ij})$ together with part (i) would then imply $v_i\left(g^{FT}\right) >$

Condition 1 describes simple, and rather weak, properties under symmetry. But, asymmetry generally invalidates these properties in the trade models of Section 2.1. Thus, characterizing the equilibrium path of networks with asymmetric countries requires relaxing various parts of Condition 1.

Intuitively, asymmetry creates a ranking of attractiveness across countries. Indeed, this is how I model asymmetry: FTA formation is more attractive with a more attractive, i.e. "larger", partner with a country's characteristic α_i determining its attractiveness.[12]

Condition 2.A. *$v_i(g+ij) > v_i(g+ik)$ if and only if $\alpha_j > \alpha_k$*

Differences in the attractiveness of countries have intuitive implications for the properties in Condition 1. In terms of the effect of FTAs for members, FTA formation tends to be less attractive for a larger country (e.g. because of the greater domestic market access conceded). Thus, a larger country may suffer from FTA formation. Hence, Condition 2.B relaxes the extent that FTA formation benefits a large member country.

Condition 2.B. *Part (i) of Condition 1 holds except that (i) $v_i\left(g_j^H\right) \gtrless v_i(g_{jk})$ if $\alpha_i > \alpha_j$ and (ii) $v_i(g_{ik}) \gtrless v_i(\emptyset)$ if $\alpha_i > \alpha_j > \alpha_k$*

Part (i) says an outsider may not benefit from an FTA with an insider that is "less attractive" than itself. Part (ii) says the "most attractive" country may not benefit from becoming an insider with the "least attractive" country.

Moreover, the weaker appeal of FTAs for more attractive countries may spill over to a weaker appeal of global free trade. Specifically, the most attractive country may no longer prefer global free trade over the status quo of the empty network.

Condition 2.C. *Part (ii) of Condition 1 holds except that $v_i\left(g^{FT}\right) \gtrless v_i(\emptyset)$ if $\alpha_i > \alpha_j > \alpha_k$ with $\frac{\partial\left[v_i\left(g^{FT}\right)-v_i(\emptyset)\right]}{\partial(\alpha_j/\alpha_k)} > 0$ and $\frac{\partial\left[v_i\left(g^{FT}\right)-v_i(\emptyset)\right]}{\partial(\alpha_i/\alpha_k)} < 0$*

Not only does Condition 2.C weaken part (ii) of Condition 1, it also specifies a tension underlying the preference of the most attractive country i. On one hand, the attractiveness of global free trade increases with the relative attractiveness of the moderately attractive country j. This has the spirit of Condition 2.A: a more attractive partner makes an agreement more appealing. On the other hand, the attractiveness of global free trade decreases with the relative attractiveness of the most attractive country. This has the spirit of Condition 2.B: agreements become less appealing to more attractive countries.

$v_i\left(g_j^H\right) > v_i(g_{ij})$. Nevertheless, this implication is rather weak. Unlike when FTA formation occurs at the empty network and the non-member can benefit from tariff complementarity in *both* member markets, an insider–turned–spoke can *only* benefit from tariff complementarity in the outsider's market.

[12] Note, in common trade models (e.g. the models of Section 2.1), the perception of what makes another country attractive is independent of a country's perspective.

While Conditions 2.B-2.C weaken parts (i) and (ii) of Condition 1, Condition 2.D leaves part (iii) of Condition 1, which governs the effect of FTAs on non-members, unaltered.

Condition 2.D. $v_i\left(g_i^H\right) > v_i\left(g^{FT}\right)$

Finally, asymmetry impacts the FTA exclusion incentives. Intuitively, the insiders' incentive to exclude an outsider from expansion to global free trade rises with the attractiveness of their joint market and falls with the attractiveness of the outsider. Thus, some pairs of insiders may not hold FTA exclusion incentives. Condition 2.E weakens part (iv) of Condition 1, allowing situations where insiders may not hold FTA exclusion incentives.

Condition 2.E. *Part (iv) of Condition 1 holds except (i)* $v_i\left(g_{ij}\right) \gtreqless v_i\left(g^{FT}\right)$ *if* $\alpha_i = min\{\alpha_i, \alpha_j, \alpha_k\}$ *or* $\alpha_j = min\{\alpha_i, \alpha_j, \alpha_k\}$ *and (ii)* $v_h\left(g^{FT}\right) > v_h\left(g_{jk}\right)$ *for* $h = j, k$ *if* $\alpha_i > \alpha_j > \alpha_k$ *and* $v_i\left(g_{jk}\right) > v_i\left(g_j^H\right)$.

Part (i) says insiders may not hold FTA exclusion incentives when the least attractive country is an insider. Part (ii) is quite weak: the least attractive countries j and k do not hold FTA exclusion incentives when the most attractive country i is the outsider and i is attractive enough that it does not benefit from FTA formation with the most attractive insider j.

Condition 1 imposes relatively weak restrictions on one period payoffs under symmetry and Condition 2 relaxes these restrictions further under asymmetry. Thus, Conditions 1-2 impose insufficient structure to solve the equilibrium path of networks in my *dynamic* model. Hence, Condition 3 imposes properties on continuation payoffs where δ denotes the discount factor.

Condition 3. *(i)* $v_j\left(g_{ij}\right) + \delta v_j\left(g_i^H\right) + \frac{\delta^2}{1-\delta} v_j\left(g^{FT}\right) > \frac{1}{1-\delta} v_j\left(\emptyset\right)$ *if* $\alpha_i \geq \alpha_j$

(ii) $v_i\left(g_{ij}\right) + \delta v_i\left(g_i^H\right) + \frac{\delta^2}{1-\delta} v_i\left(g^{FT}\right) > \frac{1}{1-\delta} v_i\left(\emptyset\right)$ *if* $\alpha_i \geq \alpha_j \geq \alpha_k$

(iii) $v_h\left(g_{ih}\right) + \delta v_h\left(g_i^H\right) + \frac{\delta^2}{1-\delta} v_h\left(g^{FT}\right) > \frac{1}{1-\delta} v_h\left(g_{jk}\right)$ *for* $h = j, k$ *if* $\alpha_i > \alpha_j > \alpha_k$ *and* $v_i\left(g_{jk}\right) > v_i\left(g^{FT}\right)$.

Parts (i) and (ii) are "participation constraints". Relative to the permanent status quo of the empty network, they govern whether two countries i and j want to participate in the path of FTAs leading to global free trade where they are insiders and the more attractive country i is the hub. Part (i) says the less attractive country j wants to participate with the more attractive country i and part (ii) says the most attractive country i wants to participate with the moderately attractive country j. These participation constraints are fairly weak.[13]

[13]Given Conditions 1 and 2, two implications follow. First, part (i) must hold if $v_i\left(g_j^H\right) > v_i\left(\emptyset\right)$. Indeed, $v_i\left(g_j^H\right) > v_i\left(\emptyset\right)$ holds if tariff complementarity leads FTA formation to confer a positive externality on the outsider because then $v_i\left(g_j^H\right) > v_i\left(g_{jk}\right) > v_i\left(\emptyset\right)$. Second, part (ii) must hold under symmetry and can only fail under asymmetry if $v_i\left(g^{FT}\right) < v_i\left(\emptyset\right)$.

Part (iii) is also fairly weak. When $v_i(g_{jk}) > v_i(g^{FT})$, the most attractive country i will reject any subsequent agreement as an outsider and the two least attractive countries j and k remain permanent insiders upon becoming insiders. Given the spirit of Condition 2.B, i.e. agreements become less appealing to more attractive countries, this likely happens when the most attractive country is very attractive. In this case, part (iii) says j and k prefer to be an insider with the most attractive country and then a spoke on the path to global free trade rather than remain permanent insiders together. For j and k, the loss of sole preferential access with each other and the discrimination faced as a spoke are outweighed by the benefit of tariff free access to the most attractive country as an insider and under global free trade.

2.3 General payoff properties and underlying trade models

As discussed above, subsequent results rely on the general properties presented in Section 2.2 (and Condition 4 in Section 5.1) rather than any particular trade model. Nevertheless, these general properties are pervasive features of the trade models from Section 2.1. The following lemma formally establishes this link (see Appendix B for proof).

Lemma 1. *Under symmetry, Conditions 1 and 3 are satisfied by (i) the political economy oligopolistic model and (ii) the competing importers model. Under asymmetry, there are ranges of the parameter space where Conditions 2-4 are satisfied by (i) the political economy oligopolistic model with market size asymmetry, (ii) the oligopolistic model with market size asymmetry, (iii) the competing exporters model with market size asymmetry and (iv) the competing importers model with either market size or technology asymmetry.*

3 Dynamic network formation games

3.1 Network transitions and preferences over transitions

Like the three country game in Seidmann (2009), I assume (i) at most one agreement (i.e. bilateral FTA or three country MFN agreement) can form in a period and (ii) agreements formed in previous periods cannot be severed. Thus, given the networks depicted in Figure 1, Table 1 illustrates the feasible network transitions within a period.[14] Hereafter, $g_{t-1} \to g_t$ denotes the feasible transition within the current period from g_{t-1} to g_t.

Having used backward induction to solve the equilibrium transitions in subsequent periods, players have preferences over current period feasible transitions. Given a network at

[14]These transitions differ from Seidmann (2009) only because Seidmann's question of interest leads to an environment where countries can form CUs or FTAs.

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

Table 1: Networks and feasible transitions within a period

the beginning of the current period g_{t-1} and a pair of transitions $g_{t-1} \to g_t$ and $g_{t-1} \to g_t'$, player i *prefers* g_t over g_t' if and only if $g_{t-1} \to g_t$ yields a strictly higher continuation payoff for player i than $g_{t-1} \to g_t'$. This preference is denoted $g_t \succ_i g_t'$. Further, g_t is *(strictly) most preferred* for country i in period t if $g_{t-1} \to g_t$ generates a (strictly) higher continuation payoff than any other transition $g_{t-1} \to g_t'$ where $g_t' \neq g_t$.

3.2 Actions, strategies and equilibrium concept

Each period can be characterized by the network g that exists at start of the period. Given an exogenous protocol specifying how countries make trade agreement proposals in a period, I refer to this "proposal game" as the subgame at network g (as in Seidmann (2009)).

I adopt a protocol where a *proposer* country proposes a trade agreement and the proposed members, i.e. *recipients*, then respond by accepting or not accepting. In each period, country l is the first proposer (stage 1), followed by country m (stage 2) and then country s (stage 3). If each recipient country accepts the proposal in a given stage, the proposed agreement forms and the period ends. But, if at least one of the recipient countries rejects the proposal, or the proposer makes no proposal, then the protocol moves to the subsequent stage. Thus, the period ends after either (i) an agreement forms or (ii) no agreement forms despite each country having the opportunity to be the proposer.

As the proposer, a country can propose an agreement that has not yet formed and to which it will be a member. In the "bilateralism game", Table 2 illustrates the available proposals for each country i and for each subgame at network g with $P_i(g)$ denoting the set of such proposals and $\rho_i(g) \in P_i(g)$ denoting a proposal. In Table 2, ij denotes the FTA between i and j, FT denotes the three country MFN agreement that takes the world to global free trade, and ϕ denotes the proposer elects to make no proposal. In the "multilateralism game", the only possible agreement is the three country MFN agreement taking the world to global free trade. Thus, the game essentially reduces to a single period game with $P_i(\emptyset) = \{\phi, FT\}$ for each i. Upon receiving a proposal $\rho_i(g)$, each recipient country j (i.e. a country of the proposed agreement) responds by announcing $r_j(g, \rho_i(g)) \in \{Y, N\}$ where Y (N) denotes j accepts (does not accept) the proposal.

	$P_i(g)$	$P_j(g)$	$P_k(g)$
$\emptyset$	$\{\phi, ij, ik, FT\}$	$\{\phi, ij, jk, FT\}$	$\{\phi, ik, jk, FT\}$
g_{ij}	$\{\phi, ik, FT\}$	$\{\phi, jk, FT\}$	$\{\phi, ik, jk, FT\}$
g_i^H	$\{\phi, FT\}$	$\{\phi, jk, FT\}$	$\{\phi, jk, FT\}$
g^{FT}	$\{\phi\}$	$\{\phi\}$	$\{\phi\}$

Table 2: Proposer country's action space for each subgame in the bilateralism game

Given the protocol, country i's Markov strategy in the bilateralism game must do two things for every subgame at network g: (i) assign a proposal $\rho_i(g) \in P_i(g)$ for the stage where it is the proposer and (ii) assign a response $r_i(g, \rho_j(g)) \in \{Y, N\}$ to any proposal it may receive from some other country $j \neq i$. I now use backward induction to solve for a pure strategy Markov Perfect Equilibrium.[15]

4 Symmetric countries

4.1 Bilateralism game

To begin the backward induction with symmetric countries (i.e. $\alpha_l = \alpha_m = \alpha_s$), consider a subgame at a hub–spoke network $g = g_i^H$. Since each FTA is mutually beneficial by Condition 1, spokes form their own FTA.

Lemma 2. *Consider the subgame at a hub-spoke network g_i^H and suppose $v_j\left(g^{FT}\right) > v_j\left(g_i^H\right)$ for $j \neq i$. Then, spokes form their own FTA and global free trade is attained (i.e. $g_i^H \to g^{FT}$).*

Now roll back to a subgame at an insider–outsider network $g = g_{ij}$. Here, insiders face a trade off. Myopically, becoming the hub is attractive due to reciprocal preferential access exchanged with the outsider: $v_i\left(g_i^H\right) > v_i(g_{ij})$. However, the would–be hub anticipates the subsequent spoke-spoke FTA erodes the value of reciprocal preferential access enjoyed as the hub with *each* spoke country. Indeed, the degree of concession diversion is sufficiently large that insiders have an FTA exclusion incentive: $v_i(g_{ij}) > v_i\left(g^{FT}\right)$. Thus, an insider i wants to become the hub rather than remain a permanent insider with j if and only if

[15] For convenience, I make two assumptions that restrict attention to certain Markov Perfect Equilibria. First, given the simultaneity of responses to a proposal for a three country MFN agreement, I assume countries respond to such proposals affirmatively if they prefer global free trade over the status quo. That is, $r_i(g, FT) = Y$ if $g^{FT} \succ_i g$ in the subgame at network g. I also assume a recipient country responds with $r_i(g, \rho_j(g)) = Y$ when responding with $r_i(g, \rho_j(g)) = N$ would merely delay formation of the proposed agreement to a later stage of the current period. This can be motivated by the presence of an arbitrarily small cost involved in making a response.

$v_i\left(g_i^H\right) + \frac{\delta}{1-\delta} v_i\left(g^{FT}\right) > \frac{1}{1-\delta} v_i\left(g_{ij}\right)$ which reduces to the No Exclusion (NE) condition:

$$\delta < \bar{\delta}_{i,j}^{NE}(\alpha) \equiv \frac{v_i\left(g_i^H\right) - v_i\left(g_{ij}\right)}{v_i\left(g_i^H\right) - v_i\left(g^{FT}\right)} = \frac{v_i\left(g_i^H\right) - v_i\left(g_{ij}\right)}{\left[v_i\left(g_i^H\right) - v_i\left(g_{ij}\right)\right] + \left[v_i\left(g_{ij}\right) - v_i\left(g^{FT}\right)\right]} \tag{2}$$

where $\alpha \equiv (\alpha_s, \alpha_m, \alpha_l)$ and, given symmetry, $\bar{\delta}^{NE} \equiv \bar{\delta}_{i,j}^{NE}(\alpha)$. When an insider's No Exclusion condition holds (fails) then $\delta < (>) \bar{\delta}^{NE}$ and the myopic attractiveness of becoming the hub dominates (is dominated by) the subsequent concession diversion. Thus, an insider wants to become the hub (remain an insider forever). Lemma 3 formalizes the role of the No Exclusion condition.

Lemma 3. *Suppose Condition 1 holds and consider a subgame at an insider–outsider network g_{ij}. The equilibrium outcomes of the subgame are: (i) no agreement (i.e. $g_{ij} \to g_{ij}$) when $\delta > \bar{\delta}^{NE}$, (ii) an FTA between the outsider and either insider (i.e. $g_{ij} \to g_i^H$ and $g_{ij} \to g_j^H$) when $\delta < \bar{\delta}^{NE}$ and the outsider is the first proposer and (iii) an FTA between the outsider and the first insider in the protocol (i.e. $g_{ij} \to g_i^H$) when $\delta < \bar{\delta}^{NE}$ and the outsider is not the first proposer.*

When the No Exclusion condition is violated, i.e. $\delta > \bar{\delta}^{NE}$, each insider prefers remaining an insider over becoming the hub on the path to global free trade. Regardless of an insider's position in the protocol, it anticipates the other insider will reject any future proposal from the outsider. In turn, each insider refrains from making a proposal. Thus, the mutual fear of concession diversion leads insiders to remain insiders when $\delta > \bar{\delta}^{NE}$.

However, each insider wants to become the hub when the No Exclusion condition holds, i.e. $\delta < \bar{\delta}^{NE}$, because the fear of concession diversion is sufficiently small. Thus, while the FTA exclusion incentive implies each insider would reject a proposed move directly to global free trade, each insider wants to form an FTA with the outsider and thereby enjoy the hub benefits of preferential access with each spoke country on the path to global free trade. However, which hub-spoke network(s) emerge in equilibrium depends on the outsider's position in the protocol. If an insider i is the first proposer, it proposes an FTA with the outsider k who accepts and the hub-spoke network g_i^H emerges. But, if the outsider is the first proposer then its indifference regarding the identity of its partner, and the fact that either insider will accept an FTA proposal, generates multiplicity. Now an FTA between the outsider and either insider is an equilibrium outcome and thus either hub-spoke network, g_i^H or g_j^H, could emerge. Nevertheless, $\delta < \bar{\delta}^{NE}$ implies the fear of concession diversion is sufficiently small that some hub-spoke network emerges in the subgame at an insider-outsider network.

Rolling back to the subgame at the empty network $g = \emptyset$ and solving the equilibrium outcome in this subgame reveals the equilibrium path of networks. To do so, define $\bar{\delta}$ such that $v_i\left(g_{ij}\right)+\delta v_i\left(g_j^H\right)+\frac{\delta^2}{1-\delta}v_i\left(g^{FT}\right)<\frac{1}{1-\delta}v_i\left(g^{FT}\right)$ if and only if $\delta>\bar{\delta}$.[16] That is, $\delta>\bar{\delta}$ implies a country prefers a direct move to global free trade over being an insider–turned–spoke on the path to global free trade. Proposition 1 now follows, remembering the protocol specifies country l as the first proposer followed by country m and then country s.

Proposition 1. *Suppose Conditions 1 and 3 hold. The equilibrium path of networks is (i)* $\varnothing\rightarrow g_{sl}$ *or* $\varnothing\rightarrow g_{ml}$ *when* $\delta>\bar{\delta}^{NE}$*, (ii)* $\varnothing\rightarrow g^{FT}$ *when* $\delta\in\left(\bar{\delta},\bar{\delta}^{NE}\right)$*, and (iii)* $\varnothing\rightarrow g_{sl}\rightarrow g_l^H\rightarrow g^{FT}$ *when* $\delta<\bar{\delta}^{NE}$*.*

When the No Exclusion condition is violated, $\delta>\bar{\delta}^{NE}$, the mutual fear of concession diversion is sufficiently large that remaining insiders is strictly most preferred for any pair of insiders. However, either insider–outsider network g_{sl} or g_{ml} can emerge because symmetry creates indifference on the part of country l, the first proposer, regarding its FTA partner.

When the No Exclusion condition holds, i.e. $\delta<\bar{\delta}^{NE}$, any bilateral FTA eventually leads to global free trade via a hub-spoke network. An insider-turned-spoke now faces a trade-off between this path and a direct move to global free trade. While the FTA exclusion incentive makes being an insider-turned-spoke myopically attractive, a direct move to global free trade eliminates the future discrimination faced as a spoke. When $\delta>\bar{\delta}$, the discrimination faced as a spoke dominates the FTA exclusion incentive and a country prefers a direct move to global free trade. Because country s is the third proposer in the protocol and thus can never be the hub in equilibrium (see Lemma 3), it proposes global free trade when $\delta\in\left(\bar{\delta},\bar{\delta}^{NE}\right)$ knowing that the other countries will accept given $v_h\left(g^{FT}\right)>v_h\left(\varnothing\right)$ for any h. In turn, any country receiving a proposal that results in becoming an insider-turned-spoke will reject the proposal. Thus, a direct move to global free trade emerges when $\delta\in\left(\bar{\delta},\bar{\delta}^{NE}\right)$.

Once $\delta<\bar{\delta}$, the FTA exclusion incentive dominates any discrimination faced as a spoke. Thus, a country prefers being an insider-turned-spoke on the path to global free trade over a direct move to global free trade. Hence, country l proposes an FTA with country s and country s accepts. Country s accepts knowing it will never be the hub (Lemma 3). Further, country l does not propose an FTA with country m knowing m will reject the proposal so it can then propose an FTA with s and be the insider-turned-hub on the path to global free trade. Thus, $\varnothing\rightarrow g_{sl}\rightarrow g_l^H\rightarrow g^{FT}$ is the unique equilibrium path of networks once $\delta<\bar{\delta}$.

[16]Simple manipulation reveals $\bar{\delta}=\frac{v_i(g_{ij})-v_i\left(g^{FT}\right)}{v_i(g^{FT})-v_i\left(g_j^H\right)}$.

4.2 Role of FTAs under symmetry

To isolate the role of FTAs, I follow Saggi and Yildiz (2010, 2011) by comparing the equilibrium outcome of (i) the "bilateralism game" of the previous section and (ii) the "multilateralism game" which removes the possibility of FTAs. FTAs are strong building (stumbling) blocs when global free trade is only attained in the bilateralism (multilateralism) game. FTAs are weak building (stumbling) blocs when global free trade is attained in both games (not attained in either game).

Since the only possible agreement in the multilateralism game is the three country MFN agreement, each country has veto power and the equilibrium characterization is simple.

Proposition 2. *Suppose countries are symmetric and Condition 1 holds. The equilibrium path of networks in the multilateralism game is a direct move to global free trade* $\emptyset \rightarrow g^{FT}$.

Corollary 1 now follows from Propositions 1 and 2 and summarizes the role of FTAs.

Corollary 1. *Suppose countries are symmetric and Condition 1 holds. FTAs are strong stumbling blocs when* $\delta > \bar{\delta}^{NE}$ *but weak building blocs when* $\delta < \bar{\delta}^{NE}$.

Under symmetry, no country vetoes global tariff elimination when non-discriminatory liberalization is the only form of liberalization. When concession diversion fears are sufficiently weak, i.e. $\delta < \bar{\delta}^{NE}$, FTA formation also leads to global free trade and FTAs are weak building blocs. However, Corollary 1 emphasizes the destructive role that FTAs can play when insiders fear concession diversion. When these fears are sufficiently strong, i.e. $\delta > \bar{\delta}^{NE}$, the opportunity to form discriminatory FTAs leads to a single FTA. Thus, FTAs are strong stumbling blocs when $\delta > \bar{\delta}^{NE}$.

Corollary 1 is a strong result given FTAs can be strong stumbling blocs under symmetry. Saggi and Yildiz (2010, 2011) find FTAs are never strong stumbling blocs and, under symmetry, FTA formation yields global free trade. Moreover, Saggi et al. (2013) find Customs Unions (CUs) can be strong stumbling blocs only when countries are sufficiently asymmetric. Thus, my strong stumbling bloc result under symmetry emphasizes the dynamic role played by concession diversion gives a fundamentally different mechanism for the destructive role of preferential trade agreements (i.e. FTAs or CUs) than Saggi et al. (2013).

5 Asymmetric countries

I now extend the symmetric analysis of Section 4 to model asymmetric countries where s, m and l denote the "small", "medium" and "large" countries and, hence, $\alpha_s < \alpha_m < \alpha_l$. Section 5.1 begins by analyzing the bilateralism game. Remember, as described in Section 3.2, the protocol is that, in each period, country l is the first proposer (stage 1), followed by country m (stage 2) and then country s (stage 3). A subsequent stage of the protocol is reached in a given period only if an agreement has not formed in prior stages. Section 5.2 then analyzes the multilateralism game and, by comparing the equilibrium of the multilateralism and bilateralism games, establishes the role of FTAs under asymmetry.

5.1 Bilateralism game

Asymmetry substantially increases the analytical difficulty of solving the equilibrium path of networks. While symmetry implied the analysis at each of the three insider-outsider networks and each of the three hub-spoke networks was identical, asymmetry implies each of these networks are distinct and require separate analysis. In turn, the number of possible equilibrium paths of networks rises from 5 under symmetry to 17 under asymmetry.[17]

The remainder of Section 5.1 proceeds as follows. Section 5.1.1 begins the backward induction by describing how asymmetry affects the subgames at hub-spoke and insider-outsider networks. Asymmetry has non-trivial implications for the latter. Sections 5.1.2 and 5.1.3 then roll back to the empty network and solve the equilibrium path of networks. Section 5.1.2 shows global free trade does not emerge when, as insiders, the No Exclusion incentive for two largest countries is violated (i.e. the analog of $\delta > \bar{\delta}^{NE}(\alpha)$ in Section 4). Section 5.1.3 shows global free trade *can* emerge in equilibrium once, as insiders, the No Exclusion incentive for two largest countries holds (i.e. the analog of $\delta < \bar{\delta}^{NE}(\alpha)$ in Section 4). Moreover, in this case, the path of networks $\emptyset \to g_{ml} \to g_l^H \to g^{FT}$ is a pervasive equilibrium outcome.

5.1.1 Subgames at hub-spoke and insider-outsider networks

Condition 2 implies that, like the symmetric case, hub-spoke networks expand to global free trade because FTAs mutually benefit spokes. However, asymmetry creates three important differences in subgames at insider–outsider networks.

First, the strength of an insider's FTA exclusion incentive depends on the characteristics of itself and its insider partner. Hence, each insider has a distinct No Exclusion condition and $\bar{\delta}_{i,j}^{NE}(\alpha)$ no longer reduces to $\bar{\delta}^{NE}$. In turn, the eventual emergence of global free trade from a subgame at an insider-outsider networks depends on the insiders' identity.

[17] Under symmetry, the five possibilities are $\emptyset \to g_{ij}$, $\emptyset \to g_{ij} \to g_i^H$, $\emptyset \to g_{ij} \to g_i^H \to g^{FT}$, $\emptyset \to \emptyset$ and $\emptyset \to g^{FT}$. Under asymmetry, fixing a pair of insiders i and j, five possibilities are $\emptyset \to g_{ij}$, $\emptyset \to g_{ij} \to g_i^H$, $\emptyset \to g_{ij} \to g_i^H \to g^{FT}$, $\emptyset \to g_{ij} \to g_j^H$ and $\emptyset \to g_{ij} \to g_j^H \to g^{FT}$. Cycling over the three possible pairs of insiders gives 15 possibilities. The final two possibilities are $\emptyset \to \emptyset$ and $\emptyset \to g^{FT}$.

Second, a larger insider may engage in FTA formation with the outsider, and thereby become the hub, merely to avoid becoming a spoke. To illustrate, suppose (i) s is the outsider and willing to form an FTA with either insider m or l, but (ii) m wants to become the hub (i.e. $\delta < \bar{\delta}^{NE}_{m,l}(\alpha)$) even though l wants to remain a permanent insider (i.e. $\delta > \bar{\delta}^{NE}_{m,l}(\alpha)$). Then, given global free trade emerges from any hub-spoke network and s prefers FTA formation with a larger country, the anticipation of being discriminated against as a spoke induces l to become the hub by proposing an FTA with s. Thus, as long as the outsider k wants to form an FTA with both insiders i and j, an insider-outsider network eventually reaches global free trade once $\delta < \hat{\delta}^{NE}_{i,j}(\alpha) \equiv \max\left\{\bar{\delta}^{NE}_{i,j}(\alpha), \bar{\delta}^{NE}_{j,i}(\alpha)\right\}$.

But, third, Condition 2.B(ii) implies an outsider may have a myopic incentive to refuse an FTA with a country smaller than itself. That is, $v_i(g_{jk}) - v_i\left(g^H_j\right) > 0$ can hold if $\alpha_i > \alpha_j$. Given spokes form their own FTA, an outsider i prefers forming an FTA with an insider j and becoming a spoke rather than remaining a permanent outsider if and only if $v_i\left(g^H_j\right) + \frac{\delta}{1-\delta} v_i\left(g^{FT}\right) > \frac{1}{1-\delta} v_i(g_{jk})$. This reduces to the Free Trade–Outsider (FT–O) condition:

$$\delta > \bar{\delta}^{FT-O}_{i,j}(\alpha) \equiv \frac{v_i(g_{jk}) - v_i\left(g^H_j\right)}{v_i\left(g^{FT}\right) - v_i\left(g^H_j\right)}. \tag{3}$$

When $\bar{\delta}^{FT-O}_{i,j}(\alpha) \in (0,1)$, an outsider faces a dynamic tradeoff between the *future* appeal of global free trade and a *myopic* incentive to resist becoming a spoke. Thus, an outsider i benefits from an FTA with an insider j when $\delta > \bar{\delta}^{FT-O}_{i,j}(\alpha)$ but refuses an FTA with the insider j when $\delta < \bar{\delta}^{FT-O}_{i,j}(\alpha)$. Under symmetry, the FT–O condition was irrelevant because $\bar{\delta}^{FT-O}_{i,j}(\alpha) < 0$ since all FTAs were mutually beneficial. But, Condition 2.B(ii) says an outsider may refuse an FTA with an insider smaller than itself and, hence, $\bar{\delta}^{FT-O}_{i,j}(\alpha) > 0$ can arise when (i) l is the outsider or (ii) m is the outsider contemplating an FTA with s.

Ultimately, whether global free trade eventually emerges from an insider-outsider network g_{ij} depends on the interplay between the No Exclusion conditions $\bar{\delta}^{NE}_{i,j}(\alpha)$ and the Free Trade-Outsider conditions $\bar{\delta}^{FT-O}_{k,i}(\alpha)$ and $\bar{\delta}^{FT-O}_{k,j}(\alpha)$. Because this produces numerous possible combinations of outcomes across the insider-outsider networks, which substantially complicates the analysis, Condition 4 restricts the relationship between the No Exclusion and Free Trade-Outsider conditions.

Condition 4. *(i)* $\hat{\delta}^{NE}_{m,l}(\alpha) < min\left\{\hat{\delta}^{NE}_{s,l}(\alpha), \hat{\delta}^{NE}_{s,m}(\alpha)\right\}$

(ii) $min\left\{\hat{\delta}^{NE}_{m,l}(\alpha), \bar{\delta}^{FT-O}_{m,s}(\alpha)\right\} < \bar{\delta}^{NE}_{l,s}(\alpha)$

(iii) $\frac{\partial \hat{\delta}^{NE}_{m,l}(\alpha)}{\partial \alpha_{hs}} < 0$ *for* $h = m, l$ *or* $\frac{\partial \hat{\delta}^{NE}_{m,l}(\alpha)}{\partial \alpha_{ms}} + \frac{\partial \hat{\delta}^{NE}_{m,l}(\alpha)}{\partial \alpha_{ls}} < 0$ *where* $\alpha_{ij} \equiv \frac{\alpha_i}{\alpha_j}$.

Parts (i) and (ii) imply that g_{sm} is the only insider-outsider network that may fail to eventually reach global free trade once $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$. Part (i) says that no pair of insiders can remain permanent insiders due to a mutual fear of concession diversion once $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$. Intuitively, the largest insiders, m and l, have the greatest incentive to remain permanent insiders: the relatively low attractiveness of the outsider s strengthens the FTA exclusion incentives of m and l (i.e. raises $v_i(g_{ij}) - v_i(g^{FT})$) and weakens the appeal of becoming the hub via an FTA with the outsider s (i.e. lowers $v_i(g^H_i) - v_i(g_{ij})$).

While a mutual fear of concession diversion by insiders cannot prevent FTA expansion from any insider-outsider network once $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$, the discussion of the Free Trade-Outsider condition indicates that FTA expansion from an insider-outsider network also depends on the outsider's incentives. While g_{ml} eventually expands to global free trade once $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$ because the outsider s always wants to engage in FTA formation with m and l (i.e. $\bar{\delta}^{FT-O}_{s,j}(\alpha) < 0$ for $j = m, l$), g_{sl} may not expand to expand because the outsider m may be unwilling to form an FTA with the smaller insider s. Nevertheless, in the subgame at g_{sl}, part (ii) of Condition 4 says m and l form an FTA for one of two reasons once $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$. First, m wants to form an FTA with s (i.e. $\delta > \bar{\delta}^{FT-O}_{m,s}(\alpha)$) and, in turn, l forms an FTA with m to avoid becoming a spoke even though it would prefer remaining a permanent insider (i.e. $\delta > \bar{\delta}^{NE}_{l,s}(\alpha)$). Or, second, l wants to form an FTA with m (i.e. $\delta < \bar{\delta}^{NE}_{l,s}(\alpha)$) even though m may not want to form an FTA with s (i.e. $\delta < \bar{\delta}^{FT-O}_{m,s}(\alpha)$).

Thus, the only insider-outsider network that may fail to eventually reach global free trade once $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$ is g_{sm}. Moreover, since concession diversion is not driving such failure once $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$ then such failure occurs if and only if, as the outsider, l refuses *any* subsequent agreement.

Part (iii) of Condition 4 is irrelevant for Section 5.1, but allows Section 5.2 to see how greater asymmetry affects the strong building bloc-strong stumbling bloc analysis. Given the spirit of part (i), i.e. the largest insiders have the greatest incentive to remain permanent insiders, part (iii) follows naturally: greater asymmetry strengthens the desire of m and l to remain permanent insiders where greater asymmetry means either (i) rising α_{ls} *or* α_{ms} or (ii) a simultaneous marginal increase in α_{ls} *and* α_{ms}.

5.1.2 Equilibrium path of networks: absence of global free trade

Rolling back to the subgame at the empty network and solving this subgame reveals the equilibrium path of networks. Proposition 3 characterizes the equilibrium path of networks when the No Exclusion condition is violated for the two largest countries. Remember $g \succ_i g'$ embodies a comparison of *continuation payoffs* resulting from transitions to g and g'.[18]

[18]Note, Proposition 3 does not depend on Condition 4. Thus, since Proposition 3 characterizes when global free trade does not emerge in the bilateralism game, the strong stumbling bloc result in Section 5.2 does not depend on Condition 4.

Proposition 3. *Suppose Conditions 2-3 hold and let* $\delta > \hat{\delta}^{NE}_{m,l}(\alpha)$. *Then, global free trade does not emerge in equilibrium. The equilibrium path of networks is* $\emptyset \rightarrow g_{ml}$ *unless* $v_l(g_{sm}) > v_l(g_{ml})$ *and* $\emptyset \succ_l g$ *for* $g = g_{sl}, g^{FT}$ *in which case the equilibrium path of networks is* $\emptyset \rightarrow g_{sm}$.

Proposition 3 emphasizes that, like Proposition 1 under symmetry, No Exclusion conditions remain crucial for determining whether global free trade emerges in the presence of FTAs.

When $\delta > \hat{\delta}^{NE}_{m,l}(\alpha)$ and m and l are insiders, the mutual fear of concession diversion allows m and l to refrain from making proposals and, hence, remain permanent insiders. Indeed, $\delta > \hat{\delta}^{NE}_{m,l}(\alpha)$ implies that, in the subgame at the empty network, this is strictly most preferred for m regardless of the outcomes in subgames at the insider-outsider networks g_{sl} and g_{sm}. Moreover, Condition 2 implies the same is true for l when $v_l(g_{ml}) > v_l(g_{sm})$. Thus, in these cases, the equilibrium path of networks is $\emptyset \rightarrow g_{ml}$.

However, l refuses *any* subsequent agreement as the outsider when $v_l(g_{sm}) > v_l(g_{ml})$ because this implies $v_l(g_{sm}) > v_l(g)$ for $g = g^{FT}, g^H_s, g^H_m$. Thus, s and m remain permanent insiders conditional on becoming insiders. Moreover, in this case, free riding on the permanent FTA between s and m is strictly most preferred for l in the subgame at the empty network. Nevertheless, given s is the third and final proposer, l may not be able to free ride. Indeed, Conditions 2-3 imply s prefers a direct move to global free trade or an FTA with l over a permanent FTA with m. Thus, the equilibrium path of networks is $\emptyset \rightarrow g_{sm}$ only if, as the outsider, l credibly refuses proposals from s for an FTA and the three country MFN agreement; otherwise, $\emptyset \rightarrow g_{ml}$ again emerges.

5.1.3 Equilibrium path of networks: emergence of global free trade

While Proposition 3 said global free trade does not emerge when $\delta > \hat{\delta}^{NE}_{m,l}(\alpha)$, it did not characterize the equilibrium when $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$. Thus, global free trade may eventuate in equilibrium when $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$. Proposition 4 characterizes this possibility.

Proposition 4. *Suppose Conditions 2-4 hold and* $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$. *Then global free trade emerges on any equilibrium path of networks unless* $g_{sm} \succ_l g_{ml}$ *and* $\emptyset \succ_l g$ *for* $g = g_{sl}, g^{FT}$ *in which case the equilibrium path of networks is* $\emptyset \rightarrow g_{sm}$. *Moreover, when global free trade emerges, there exists a range of the parameter space where the unique equilibrium path of networks is* $\emptyset \rightarrow g_{ml} \rightarrow g^H_l \rightarrow g^{FT}$.

Proposition 4 has a similar flavor to Proposition 1 under symmetry. But, while $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$ is necessary for the emergence of global free trade, it is not sufficient.

How can global free trade fail to emerge in equilibrium once $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$? Some agreement must form in equilibrium given m and l mutually benefit, relative to no agreements, from

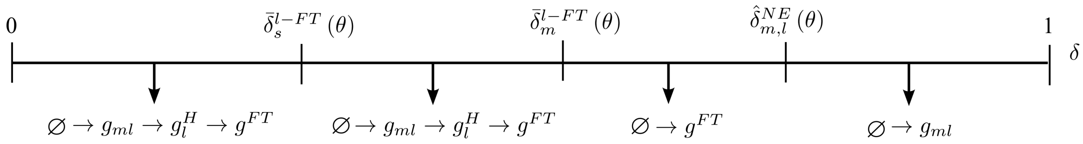

Figure 2: Example of equilibrium path of networks

their own FTA (see Condition 3). Moreover, the only insider-outsider network that may not eventually reach global free trade is g_{sm} which can only happen if, as the outsider, l refuses participation in any subsequent agreement. Thus, the permanent FTA between s and m emerges in equilibrium if: (i) as the outsider, l credibly refuses *any* proposal (i.e. FTA and three country MFN agreement) and (ii) l prefers free riding on this permanent FTA over the reciprocal preferential market access enjoyed as an insider with m and then as the hub.

Nevertheless, Proposition 4 says there is a range of the parameter space where global free trade emerges in equilibrium and, in particular, where the unique equilibrium path of networks is $\varnothing \to g_{ml} \to g_l^H \to g^{FT}$. Figure 2 illustrates the equilibrium structure where, for concreteness, I assume $g_{sl} \succ_l \varnothing$ so that l prefers FTA formation with s over a permanent status quo of the empty network.

When making a proposal in stage 3, s faces a dynamic trade off. Relative to FTA formation with m or global free trade, the attractiveness of l makes proposing an FTA with l *myopically* appealing. Conversely, avoiding *future* discrimination as a spoke after an FTA with l makes it appealing for s to propose global free trade or, if g_{sm} expands directly to global free trade, an FTA with m. Thus, s proposes (does not propose) an FTA with l when δ falls below (exceeds) a threshold, denoted by $\bar{\delta}_s^{l-FT}(\alpha)$ in Figure 2.[19]

Whether m faces a dynamic trade off regarding its proposal in stage 2 depends on the proposal s will make in stage 3. When s proposes FTA formation with l, i.e. $\delta < \bar{\delta}_s^{l-FT}(\alpha)$, m does not face a trade off. To avoid being an outsider on the path to global free trade, m proposes (in stage 2) and accepts (in stage 1) FTA formation with l and $\varnothing \to g_{ml} \to g_l^H \to g^{FT}$ emerges. However, m faces a trade off when s proposes FTA formation with m or global free trade. Proposing an FTA with l provides the *myopic* benefit of reciprocal preferential access with l. But, proposing global free trade eliminates the *future* discrimination that m faces as a spoke. Thus, m proposes (in stage 2) and accepts (in stage 1) the FTA with l when $\delta < \bar{\delta}_m^{l-FT}(\alpha)$ but global free trade when $\delta > \bar{\delta}_m^{l-FT}(\alpha)$.

While this example establishes the existence of $\varnothing \to g_{ml} \to g_l^H \to g^{FT}$ as an equilibrium

[19] In particular, if l will accept a proposal of global free trade, s proposes global free trade when $\delta > \bar{\delta}_s^{l-FT}(\alpha)$ but an FTA with l when $\delta < \bar{\delta}_s^{l-FT}(\alpha)$. Conversely, if l refuses a proposal of global free trade, s proposes an FTA with m when $\delta > \bar{\delta}_s^{l-m}(\alpha)$, which then expands directly to global free trade, but an FTA with l when $\delta < \bar{\delta}_s^{l-m}(\alpha)$.

path of networks when global free trade emerges and $g_{sl} \succ_l \emptyset$, Proposition 6 in Appendix B presents sufficient conditions establishing that $\emptyset \to g_{ml} \to g_l^H \to g^{FT}$ is the unique equilibrium path of networks when $g_{sl} \succ_l \emptyset$ does not hold. Thus, the equilibrium outcome $\emptyset \to g_{ml} \to g_l^H \to g^{FT}$ is quite pervasive, with the logic similar to that described above. The following section now revisits the role of FTAs when countries are asymmetric.

5.2 Role of FTAs under asymmetry

To begin, Proposition 5 characterizes the equilibrium of the multilateralism game under asymmetry. This is simple because the only possible agreement in the multilateralism game is the three country MFN agreement which gives each country veto power.

Proposition 5. *Suppose countries are asymmetric and Condition 2.C holds. The equilibrium path of networks in the multilateralism game is (i) a direct move to global free trade (i.e. $\emptyset \to g^{FT}$) if $v_l\left(g^{FT}\right) > v_l(\emptyset)$, but (ii) the empty network (i.e. $\emptyset \to \emptyset$) if $v_l\left(g^{FT}\right) < v_l(\emptyset)$.*

Given the equilibrium characterization of the multilateralism game, establishing how the role of FTAs depends on asymmetry requires knowing how the attainment of global free trade in the bilateralism game depends on the degree of asymmetry. Lemma 4 answers this issue by stating how greater asymmetry affects $\hat{\delta}_{m,l}^{NE}(\alpha)$. Put simply, greater asymmetry strengthens the fear of concession diversion which increases (decreases) the extent that m and l remain insiders (global free trade is attained).

Lemma 4. *Suppose Conditions 2-4 hold. Then greater asymmetry increases the extent to which m and l remain permanent insiders in equilibrium and reduces the extent to which global free trade is eventually attained in equilibrium. If $\frac{\partial \hat{\delta}_{m,l}^{NE}(\alpha)}{\partial \alpha_{hs}} < 0$ for $h = m, l$ then greater asymmetry via a higher α_{ls} or α_{ms} reduces $\hat{\delta}_{ml}^{NE}(\alpha)$. If $\frac{\partial \hat{\delta}_{m,l}^{NE}(\alpha)}{\partial \alpha_{sm}} + \frac{\partial \hat{\delta}_{m,l}^{NE}(\alpha)}{\partial \alpha_{ls}} < 0$ then greater asymmetry via a simultaneous marginal increase in α_{ls} and α_{ms} reduces $\hat{\delta}_{ml}^{NE}(\alpha)$.*

Corollary 2, following directly from Propositions 3-5, now summarizes how the role of FTAs depends on asymmetry and is the central result of the paper. Note that Condition 2.C implies $v_l\left(g^{FT}\right) > v_l(\emptyset)$ reduces to $\alpha_{ms} > \bar{\alpha}_{ms}(\alpha)$ where $\frac{\partial \bar{\alpha}_{ms}(\cdot)}{\partial \alpha_{ls}} > 0$.

Corollary 2. *Suppose Conditions 2-4 hold. FTAs are strong stumbling blocs when l and m are sufficiently symmetric but m and s are sufficiently asymmetric (i.e. two "larger" and one "smaller" country): $\alpha_{ms} > \bar{\alpha}_{ms}(\alpha)$ and $\delta > \hat{\delta}_{m,l}^{NE}(\alpha)$. FTAs are strong building blocs when l and m are sufficiently asymmetric but m and s are sufficiently symmetric (i.e. one "larger" and two "smaller" countries): $\alpha_{ms} < \bar{\alpha}_{ms}(\alpha)$ and $\delta < \hat{\delta}_{m,l}^{NE}(\alpha)$ and either (i) $g_{ml} \succ_l g_{sm}$ or (ii) $g_{sl} \succ_l \emptyset$.*

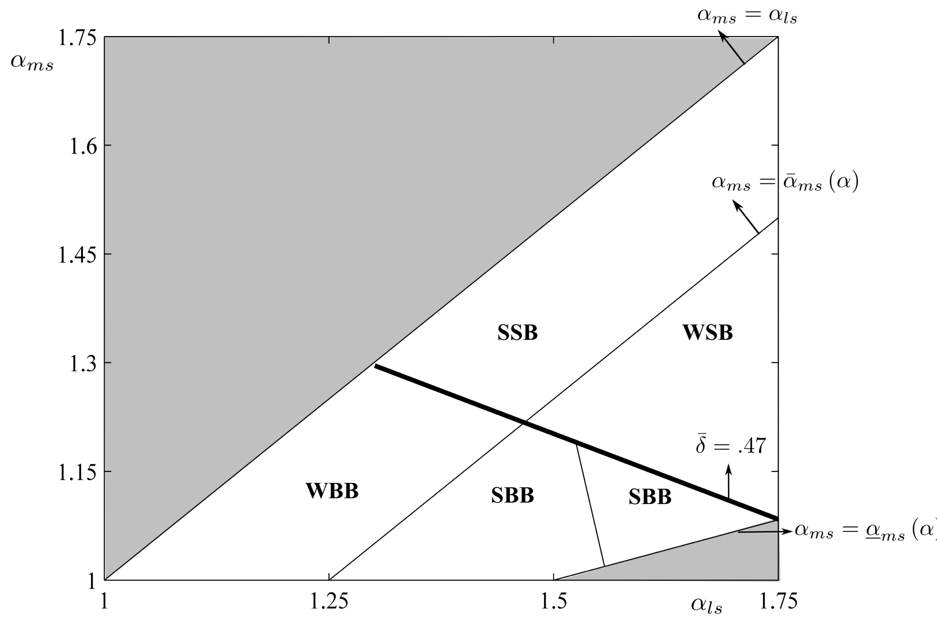

Figure 3: Role of FTAs under asymmetry when $\delta = .47$

Lemma 1 implies Corollary 2 is robust to various trade models. But, for illustration, Figure 3 depicts Corollary 2 using the political economy oligopolistic model with an exogenous common tariff $\tau = \frac{1}{4}\alpha_s$ and δ fixed at $\bar{\delta} \equiv .47$. In Figure 3, $v_l(g_{ml}) > v_l(g_{sm})$ and thus global free trade emerges in the bilateralism game if and only if $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$.[20]

To begin, consider the multilateralism game. By Proposition 5, g^{FT} is the unique equilibrium path of networks in the band between the $\alpha_{ms} = \alpha_{ls}$ and $\alpha_{ms} = \bar{\alpha}_{ms}(\alpha)$ lines. That is, l does not block global free trade when l and m are sufficiently similar in size because the world market is attractive enough that the market access received compensates for the domestic market access given up. Outside the band, l blocks global free trade so the empty network is the unique equilibrium path of networks. That is, when m and l are sufficiently different in size, the world market is so small that the market access received by l does not compensate for the domestic market access given up.

Now consider the bilateralism game. Given $\frac{\partial \hat{\delta}^{NE}_{m,l}(\alpha)}{\partial \alpha_{hs}} < 0$ for $h = m, l$, the downward sloping bold line is a contour curve with $\hat{\delta}^{NE}_{m,l}(\alpha)$ constant.[21] In Figure 3, $\hat{\delta}^{NE}_{m,l}(\alpha) = \bar{\delta} \equiv .47$. Moreover, higher contour curves represent a lower $\hat{\delta}^{NE}_{m,l}(\alpha)$ because greater asymmetry

[20] $\alpha_{ls} < 1.75$ ensures Condition 2 holds. $\alpha_{ms} > \underline{\alpha}_{ms}(\alpha)$ ensures $v_l(g^{FT}) > v_l(g_{sm})$ which renders part (iii) of Condition 3 irrelevant and, together with $v_l(g_{ml}) > v_l(g^{FT})$, also implies $v_l(g_{ml}) > v_l(g_{sm})$.

[21] As shown in the proof of Lemma 1, $\frac{\partial \hat{\delta}^{NE}_{m,l}(\alpha)}{\partial \alpha_{hs}} < 0$ for $h = m, l$ is true of all trade models therein except the competing importers model where $\frac{\partial \hat{\delta}^{NE}_{m,l}(\alpha)}{\partial \alpha_{ls}} < 0$ but $\frac{\partial \hat{\delta}^{NE}_{m,l}(\alpha)}{\partial \alpha_{ms}} > 0$. But, the same economic intuition still applies except rising asymmetry must be either a rise in α_{ls} only or a joint increase in α_{ls} and α_{ms}. Graphically, the $\hat{\delta}^{NE}_{m,l}(\alpha)$ contour curve is upward sloping and so the interpretation of above (below) the Figure 3 contour curve would apply to the right (left) of the contour curve.

reduces $\hat{\delta}^{NE}_{m,l}(\alpha)$. Hence, $\bar{\delta} = .47 \underset{(<)}{>} \hat{\delta}^{NE}_{m,l}(\alpha)$ above (below) the contour curve in Figure 3. Propositions 3-4 imply, given $v_l(g_{ml}) > v_l(g_{sm})$, global free trade is attained if and only if $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$. Thus, given $\delta = .47$, global free trade is attained below, but not above, the $\bar{\delta} = .47$ contour curve. That is, global free trade is not attained (is attained) in the bilateralism game when m and l are sufficiently larger than s (sufficiently similar to s). Intuitively, by strengthening concession diversion fears, greater asymmetry via a higher α_{ms} and α_{ls} increases the value of reciprocal preferential market access protected by m and l as insiders. The strong building–strong stumbling bloc dichotomy now emerges easily.

FTAs are strong stumbling blocs (SSB) when global free trade is attained in the multilateralism but not the bilateralism game. This is the area above the $\bar{\delta} = .47$ contour curve and inside the band between the $\alpha_{ms} = \alpha_{ls}$ and $\alpha_{ms} = \bar{\alpha}_{ms}(\alpha)$ lines. Here, m is sufficiently larger than s (i.e. above the contour curve) while m and l are sufficiently similar (i.e. inside the band). Thus, FTAs are strong stumbling blocs with two "larger" and one "smaller" country. Conversely, FTAs are strong building blocs (SBB) when global free trade is attained in the bilateralism but not the multilateralism game which is the area below the $\bar{\delta} = .47$ contour curve and outside the band between the $\alpha_{ms} = \alpha_{ls}$ and $\alpha_{ms} = \bar{\alpha}_{ms}(\alpha)$ lines. Here, m is sufficiently similar to s (i.e. below the contour curve) but sufficiently different than l (i.e. outside the band). Thus, FTAs are strong building blocs with two "smaller" and one "larger" country.

The relationship between market size asymmetry and the role of FTAs is intuitive. FTAs are strong stumbling blocs with two larger and one smaller country for two reasons. First, the world market is large enough that l does not veto global free trade in the multilateralism game where the only form of liberalization is a direct move to global free trade. Second, m and l protect valuable preferential market access as insiders, creating strong concession diversion fears and preventing global free trade in the bilateralism game. Conversely, FTAs are strong building blocs with two smaller and one larger country for opposite reasons. A small world market means l vetoes a direct move to global free trade in the multilateralism game. But, m and l protect a low degree of preferential market access as insiders and the weak concession diversion fears allow FTA expansion to global free trade.

Figure 3 also depicts the role of FTAs in the remaining areas of the parameter space. When FTAs are not strong building blocs or strong stumbling blocs, the bilateralism and multilateralism games lead to the same outcome in terms of whether global free trade is attained. When global free trade is attained in both games, FTAs are weak building blocs (WBB). This happens when the three countries are sufficiently symmetric. In this case, the world market is big enough that l does not veto a direct move to global free trade while the fear of concession diversion is weak enough that global free trade emerges via a path of

FTAs. Conversely, FTAs are weak stumbling blocs (WSB) when global free trade is attained in neither game. This happens when l is sufficiently larger than m (i.e. outside the band) and m is sufficiently larger than s (i.e. above the contour curve) meaning there really is one "larger", one "medium" and one "smaller" country. In this case, the world market is small enough that l vetoes a direct move to global free trade while the value of preferential market access protected by m and l as insiders is big enough that fears of concession diversion prevent expansion of their FTA to global free trade.

6 Discussion

6.1 Application to real world negotiations

While one must acknowledge that real world counterexamples will surely defy the predictions of any model, recent real world negotiations are consistent with my model. Thus, my model helps shed some light on the complex and evolving web of FTAs.

First, Proposition 4 and Figure 2 (and Proposition 6 in Appendix B) predict the pervasiveness of $\emptyset \to g_{ml} \to g_l^H \to g^{FT}$ as the equilibrium path of FTAs leading to global free trade. This is consistent with the empirical finding of Chen and Joshi (2010, p.243-244) where two countries are more likely to form an FTA when their joint market size is larger and the larger insider is more likely to become the hub.

Obvious real world examples include situations where the US is the large country and Canada is the medium country (the 1989 Canada–US FTA made them insiders) with the small country either Israel, Peru, Colombia, Jordan, Panama, Honduras or Korea.[22] Additionally, as the large country, the US implemented sequential FTAs with the smaller countries of (i) Australia (2005) and Korea (2012) prior to the Australia–Korea FTA (2014) and (ii) Chile (2004) and Australia (2005) prior to the Australia–Chile FTA (2009). Many examples also exist beyond US negotiations. Viewing the EU as the large country, it signed sequential FTAs with the following pairs of small countries before these pairs of small countries formed their own FTA: (i) Tunisia (1995) and Syria (1977), (ii) Jordan (1997) and Morocco (1996), (iii) Tunisia and Morocco, (iv) Palestine (1997) and Jordan, (v) Palestine and Lebanon (2002), (vi) Palestine and Syria, and (v) Palestine and Morocco.[23] And, viewing Japan as

[22]See below for details regarding Colombia and Korea. For the other countries, the US implemented FTAs with Israel, Peru, Jordan, Panama and Honduras in (respectively) 1985, 2007, 2001, 2012 and 2005 while Canada implemented FTAs with these countries in (respectively) 1997, 2009, 2012, 2013 and 2014.

[23]The years in parentheses correspond to the years in which the FTA with the EU was signed. Tunisia, Syria, Morocco and Lebanon signed FTAs in 1997 as part of the Greater Arab Free Trade Agreement (GAFTA). Palestine acceded to the GAFTA in 2005. Jordan signed an FTA with Morocco in 2004 as part of the Morocco–Arab Countries Trade Agreement.

the large country, it implemented sequential FTAs with the following pairs of smaller countries prior to these smaller countries forming their own FTAs: (i) Malaysia (2006) and Chile (2007), (ii) Chile (2007) and Vietnam (2007), and (iii) Chile (2007) and Thailand (2007).[24]

Second, the model gives an interpretation of the relationship between the order negotiations commence and the order they conclude: while the outsider begins *negotiations* with the smaller insider before the larger insider, the outsider *forms* the first FTA with the larger insider. Consider US–Canada–Colombia negotiations. Pre 2002, consistent with the equilibrium when $\delta > \hat{\delta}^{NE}_{m,l}(\alpha)$ where the largest countries remain insiders, Colombia was the outsider. However, the Colombian market oriented reforms of the 1990s and early 2000s plausibly made the Colombian market more attractive relative to the larger insider markets. Once α_{ms} and α_{ls} fall enough that $\delta < \bar{\delta}^{NE}_{m,l}(\alpha)$, the temporary hub benefits of sole reciprocal preferential access with Colombia compensate Canada for subsequent concession diversion. An interpretation is Canada beginning negotiations with Colombia, which happened in 2002. Assuming $\delta > \bar{\delta}^{NE}_{l,m}(\alpha)$, the US will not initiate negotiations with Colombia if Canada does not. But, given a pre-existing US–Canada FTA, the unique equilibrium is the US becomes the hub upon anticipating a Canada–Colombia FTA.

Indeed, this is consistent with history. Following commencement of Canada–Colombia negotiations in 2002, the US initiated discussions with Colombia in 2004 that led to the 2006 US–Colombia FTA prior to the 2008 Canada–Colombia FTA. Moreover, similar interpretations apply to US, Canada, Australia and Korea negotiations. Formal Canada–Korea negotiations began in 2005 after which US–Korea negotiations began in 2006 that led to the US–Korea FTA in 2007 before the Canada–Korea FTA in 2014. For the US–Australia–Korea case, the 2005 US–Australia FTA makes them insiders. Further, the 2007 US–Korea FTA lay dormant in the US Congress while Australia–Korea negotiations began in 2009 yet the US–Korea FTA passed through Congress in 2011 before the 2014 Australia–Korea FTA.

Interestingly, the model suggests an observable implication regarding FTA exclusion incentives, and the underlying fear of concession diversion, as an explanation for why FTAs do not form. Since spoke–spoke FTAs do not suffer from the fear of concession diversion that insider–outsider FTAs suffer, spoke–spoke FTAs should have a higher conditional probability of formation than insider–outsider FTAs.[25] Indeed, this observable implication receives empirical support from Chen and Joshi (2010) who find the conditional probability of a spoke–spoke FTA exceeds that of an insider–outsider FTA by a factor of four.

Finally, the discount factor δ mediates the effects of FTA exclusion incentives by affecting

[24] Chile formed FTAs with Malaysia in 2012, Vietnam in 2014 and Thailand in 2015.

[25] To be clear, the observable implication is $\text{pr}\left(g + jk \mid g = g^H_i\right) > \text{pr}\left(g + jk \mid g = g_{ij}\right)$. In the model, $\text{pr}\left(g + jk \mid g = g^H_i\right) = 1$ with the presence of FTA exclusion incentives implying that $\text{pr}\left(g + jk \mid g = g_{ij}\right) = 0$ when $\delta > \hat{\delta}^{NE}_{i,j}(\alpha)$.

how much countries care about future concession diversion fears. But, what real world factors determine δ? Importantly, a period in the model is the time, say T years, needed to negotiate an agreement. Thus, denoting the one year discount factor by β, δ is really $\delta = \beta^T$. Hence, T is an important determinant of δ. An important determinant of β could be the stability of the political regime with governing parties placing more weight on future events when they are more certain they could hold power in the future. Within stable political regimes, term limits and other legislative rules shaping time in office could drive β.

6.2 Sensitivity to model assumptions

I now discuss four ways that my results are insensitive to the model's assumptions. First, my protocol is similar in spirit to Aghion et al. (2007) where a leader country (e.g. the US) makes proposals to two follower countries who cannot make proposals themselves. Indeed, by allowing the follower countries to make proposals, and thus form spoke–spoke FTAs, my protocol is more general than Aghion et al. (2007). Nevertheless, it is straightforward to see the main results are insensitive to alternative protocol orderings.

Underlying the strong stumbling–strong building bloc analysis is that, in the bilateralism game, global free trade does not emerge when $\delta > \hat{\delta}^{NE}_{m,l}(\alpha) \equiv \max\left\{\bar{\delta}^{NE}_{m,l}(\alpha), \bar{\delta}^{NE}_{l,m}(\alpha)\right\}$ but can emerge once $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$. The former case arises because the permanent FTA between m and l is strictly most preferred for m and, except for the possibility of remaining a permanent outsider, for l also. Thus, g_{ml} emerges unless: (i) l credibly refuses subsequent agreements as an outsider (i.e. $v_l(g_{sm}) > \max\left\{v_l\left(g^{FT}\right), v_l\left(g^H_m\right)\right\}$) and (ii) l rejects any proposal in the subgame at the empty network (i.e. $g_{sm} \succ_l g$ for $g = g_{ml}, g_{sl}, g^{FT}$) anticipating s and m will form a permanent FTA. Further, global free trade fails to emerge when $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$ if and only if these same two conditions hold.

The possibility of a permanent FTA between s and m in equilibrium is unaffected by switching m and l in the protocol ordering but, regardless of $\delta \gtrless \hat{\delta}^{NE}_{m,l}(\alpha)$, does crucially depend on s being the third proposer. Note that $g_{ml} \succ_l g$ for $g = g_{sl}, g^{FT}, \emptyset$ and $g_{ml} \succ_m g$ for $g = g_{sm}, \emptyset$ when $g_{sm} \to g_{sm}$. Thus, as the third proposer, l would propose an FTA with m while m would prefer proposing an FTA with l rather than s. Thus, if s is not the third proposer, the results actually become cleaner by removing the possibility of a permanent FTA between s and m emerging in equilibrium.

Second, the assumption of at most one agreement in a period eliminates (and only eliminates) the possibility that countries could move directly to the hub–spoke network. However, this is not driving my main result which is the strong stumbling bloc result. This result arises when $\delta > \hat{\delta}^{NE}_{m,l}(\alpha)$ and, thus, m and l remain insiders forever upon forming their FTA. But moving directly to the hub–spoke network rather than remaining an insider forever is attractive for, say, m only if $v_m\left(g_m^H\right) + \frac{\delta}{1-\delta} v_m\left(g^{FT}\right) > \frac{1}{1-\delta} v_m\left(g_{ml}\right)$ which reduces to $\delta < \bar{\delta}_{m,l}^{NE}(\alpha)$. Thus, m and l prefer becoming (and remaining) insiders over a direct move to the hub–spoke network if and only if $\delta > \hat{\delta}_{m,l}^{NE}(\alpha)$.

Third, Zhang et al. (2014) show the attainment of global free trade as a stochastically stable state can depend upon the special case of three countries. However, this is not true in my model. Consider four countries A, B, C, D where each country can form one FTA per period. Take the "hub–spoke" network $g^H \equiv (AB, AC, BD, CD)$ where the FTAs AD and BC are the only unformed FTAs. Like earlier sections, suppose each country forms its final FTA in g^H so that $g^H \rightarrow g^{FT}$. Now take an "insider–outsider" network $g^{IO} \equiv (AB, CD)$. Notice that A prefers to form the FTA with D over the permanent status quo of g^{IO} if $v_A\left(g^H\right) + \frac{\delta}{1-\delta} v_A\left(g^{FT}\right) > \frac{1}{1-\delta} v_A\left(g^{IO}\right)$ which reduces to the analog of the No Exclusion condition (2) presented earlier. Thus, No Exclusion conditions and FTA exclusion incentives will still drive whether global free trade eventuates in a four country model. Put differently, the key insights stemming from the role of the FTA exclusion incentive extend to more general settings than the three country model used in earlier sections.

Fourth, unlike my multilateralism game, Saggi and Yildiz (2010) and Saggi et al. (2013) allow two country MFN agreements whereby two countries agree *partial* tariff cuts but extend these to the non–member third country. Importantly, this can undermine global free trade in the absence of FTAs, thus mitigating the role of FTAs as strong stumbling blocs, by creating incentives for free riding on the MFN tariff reductions of others. However, when (i) global free trade is the equilibrium of my multilateralism game and (ii) each country prefers global free trade over being a member of a two country MFN agreement that allows the non-member country to free ride on the MFN tariff concessions, Proposition 7 in Appendix B shows free riding on a two country MFN agreement is not an equilibrium in my three country model. These conditions are satisfied for the areas of the parameter spaces identified in Lemma 1. Thus, adding the possibility of two country MFN agreements to my three country model does not affect my strong stumbling bloc result.[26]

7 Conclusion

This paper uses a dynamic farsighted network formation model to analyze the long standing issue of whether FTAs prevent or facilitate the attainment of global free trade, i.e. whether

[26]Intuitively, the last proposer in the protocol proposes FT and the other countries accept. In turn, no country accepts a proposal earlier in the protocol that allows the non-member to free ride on the MFN concessions embodied in the proposal.

FTAs are building blocs or stumbling blocs. Like Saggi and Yildiz (2010, 2011), I infer the role of FTAs by comparing the equilibrium outcomes of two games: one where countries can form FTAs or move directly to global free trade and one where FTAs are not possible.

Unlike Saggi and Yildiz (2010, 2011), I find FTAs can be strong stumbling blocs meaning that global free trade is only attained in the game where FTAs are not possible. This result emerges because a pair of insider countries have an FTA exclusion incentive: the insiders want to exclude the outsider from a direct move to global free trade. Fears of concession diversion create the FTA exclusion incentive; while exchanging additional reciprocal preferential access with the outsider makes becoming the hub attractive, the would-be hub anticipates an FTA between the spokes will then erode the reciprocal preferential access enjoyed as the hub. The strong stumbling bloc result emerges under symmetry but, more generally, FTA exclusion incentives interact with asymmetry such that FTAs are strong stumbling blocs with two larger countries and one smaller country but FTAs are strong building blocs with two smaller countries and one larger country.

While Saggi and Yildiz (2010, 2011) cannot find my strong stumbling bloc result because insiders do not hold FTA exclusion incentives in their models, I show FTA exclusion incentives emerge in numerous trade models. Moreover, while Saggi et al. (2013) find that Customs Unions can be strong stumbling blocs to global free trade, FTAs outnumber CUs by a ratio of 9:1 which places fundamental importance on the FTA analysis.

Importantly, the model yields predictions consistent with real world FTA formation and FTA non–formation. The model provides interpretations of recent FTA negotiations by relating the path of FTAs to (i) country asymmetries, matching empirical findings of Chen and Joshi (2010) and anecdotal paths of FTA formation featuring the US, EU and Japan, and (ii) the order that FTA negotiations commence. In particular, commencement of negotiations between the outsider and the smaller insider induce the larger insider to become the hub. Moreover, the model suggests FTA exclusion incentives, and the underlying fear of concession diversion, help explain FTA non-formation. An observable implication is the conditional probability of spoke–spoke FTAs should exceed that of insider–outsider FTAs which receives empirical support from Chen and Joshi (2010).

Finally, the model suggests ambiguities in GATT Article XXIV could promote global free trade by mitigating concession diversion fears. Allowing FTA members to omit some industries from an FTA and phase in tariff removal over time may increase the immediate benefit of the FTA to the extent that the hub benefits outweigh concession diversion fears.

Supplemental appendix (not for publication)

A Underlying trade models

Political economy oligopolistic model. Let $\tilde{\alpha}^2 \equiv \sum_{i \in N} \alpha_i^2$ and let the common exogenous tariff be τ. Then, $\pi_i(g_{ij}) = \frac{1}{16}\left[(\alpha_i+\tau)^2 + (\alpha_j+\tau)^2 + (\alpha_k-2\tau)^2\right]$ which reduces to $\pi_i(g_{ij}) = \frac{1}{16}[\tilde{\alpha}^2 + 2\tau(\alpha_i+\alpha_j) - 4\tau\alpha_k + 6\tau^2]$. Similarly, $\pi_i\left(g_i^H\right) = \frac{1}{16}[\tilde{\alpha}^2 + 2\tau(\alpha_j+\alpha_k)$ $+2\tau^2]$, $\pi_i\left(g^{FT}\right) = \frac{1}{16}\tilde{\alpha}^2$, $\pi_i(\emptyset) = \frac{1}{16}[\tilde{\alpha}^2 + 4\tau\alpha_i - 4\tau(\alpha_j+\alpha_k) + 12\tau^2]$, $\pi_i\left(g_k^H\right) = \frac{1}{16}[\tilde{\alpha}^2 + 2\tau\alpha_i - 6\tau\alpha_j$ $+10\tau^2]$, $\pi_i(g_{jk}) = \frac{1}{16}[\tilde{\alpha}^2 + 4\tau\alpha_i - 6\tau(\alpha_j+\alpha_k) + 22\tau^2]$. Note, $\pi_i(g) - \pi_i(g')$ always reduces to a simple expression like $\pi_i(g_{ij}) - \pi_i\left(g^{FT}\right) \propto \alpha_i + \alpha_j - 2\alpha_k + 3\tau$. Moreover, non-prohibitive tariffs require $\tau < \frac{\alpha_s}{3}$ since the binding constraint on $x_{ij}^*(g) > 0$ is given by $x_{ij}^*(g_{jk}) = \frac{1}{4}[\alpha_j - 3\tau] > 0$.

Oligopolistic model. For arbitrary tariffs: $CS_i = \frac{1}{32}\left(3\alpha_i - \sum\limits_{h=j,k}\tau_{ih}\right)^2$, $PS_i = \frac{1}{16}\left(\alpha_i + \sum\limits_{h=j,k}\tau_{ih}\right)^2 +$ $\frac{1}{16}\sum\limits_{h=j,k;h'\neq h,i}(\alpha_h + \tau_{hh'} - 3\tau_{hi})^2$ and $TR_i = \frac{1}{4}\sum\limits_{h=j,k;h'\neq h,i}\tau_{ih}(\alpha_i + \tau_{ih'} - 3\tau_{ih})$. Country i's optimal tariffs are $\bar{\tau}_i(g) = \frac{3\alpha_i}{11\eta_i(g)-1}$ which reduces to $\bar{\tau}_i(\emptyset) = \bar{\tau}_i(g_{jk}) = \frac{3}{10}\alpha_i$ and $\bar{\tau}_i(g_{ij}) =$ $\bar{\tau}_i\left(g_j^H\right) = \frac{1}{7}\alpha_i$.

Competing exporters model. For arbitrary tariffs: $CS_i = \frac{1}{18}(2\alpha_i - \alpha_k - \alpha_j + 2e - \tau_{ij} - \tau_{ik})^2 +$ $\frac{1}{18}\sum\limits_{h=j,k;h'\neq h,i}(2\alpha_i - \alpha_k - \alpha_j + 2e + 2\tau_{hi} - \tau_{hh'})^2$, $PS_i = \frac{1}{3}e\sum\limits_{h=j,k;h'\neq h,i}(\alpha_i + \alpha_j + \alpha_k - 2e - 2\tau_{hi} + \tau_{hh'})$ and $TR_i = \frac{1}{3}\sum\limits_{h=j,k;h'\neq h,i}\tau_{ih}(\alpha_i + \alpha_{h'} - 2\alpha_h + e - 2\tau_{ih} + \tau_{ih'})$. Optimal tariffs are given by $\tau_{ik}(\emptyset) = \tau_{ik}(g_{jk}) = \frac{1}{8}(2\alpha_i - \alpha_j - \alpha_k + 2e)$ and $\tau_{ik}(g_{ij}) = \tau_{ik}\left(g_j^H\right) = \frac{1}{11}(\alpha_i + 4\alpha_j - 5\alpha_k + e)$. Making the normalization $e = 1$, non-negative tariffs require $\alpha_{ls} < 1 + \frac{1}{5}\alpha_{ms}$. Together with the requirement of $\alpha_{ls} \geq \alpha_{ms}$, this implies $\alpha_{ls} \leq \frac{5}{4}$.

Competing importers model. For arbitrary tariffs: $CS_i = \frac{1}{2}\left(\frac{1}{6+\lambda_i}\right)^2\left[(5+\lambda_i)\bar{d}_i - \bar{d}_j - \bar{d}_k\right.$ $\left.2(\tau_{ji}+\tau_{ki})\right]^2 + \frac{1}{2}\sum\limits_{h=j,k;h'\neq h,i}\left(\frac{1}{6+\lambda_h}\right)^2\left[(5+\lambda_h)\bar{d}_i - \bar{d}_j - \bar{d}_k + 2\tau_{h'h} - (4+\lambda_h)\tau_{ih}\right]^2$, $PS_i = \frac{1}{2}\frac{1+\lambda_i}{(6+\lambda_i)^2}\left(\bar{d}_i - 2(\tau_{ji}+\tau_{ki})\right)^2 + \frac{1}{2}\sum\limits_{h=j,k;h'\neq h,i}\frac{1}{(6+\lambda_h)^2}\left(\bar{d}_h - 2\tau_{h'h} + (4+\lambda_h)\tau_{ih}\right)^2$ and $TR_i =$ $\sum\limits_{h=j,k;h'\neq h,i}\frac{\tau_{ih}}{6+\lambda_h}\left[(4+\lambda_h)\bar{d}_i - 2\bar{d}_j - 2\bar{d}_k + 4\tau_{h'h} - 2(4+\lambda_h)\tau_{ih}\right]$. Optimal tariffs are given by $\tau_{ik}(\emptyset) = \tau_{ik}(g_{ij}) = \frac{\bar{d}_i\left(\lambda_k^2+10\lambda_k+20\right) - 2\bar{d}_j(4+\lambda_k) - 2\bar{d}_k(6+\lambda_k)}{(6+\lambda_k)\left(\lambda_k^2+12\lambda_k+28\right)}$ and $\tau_{ik}(g_{jk}) = \tau_{ik}\left(g_j^H\right) = \frac{\bar{d}_i(4+\lambda_k) - 2\left(\bar{d}_j+\bar{d}_k\right)}{(4+\lambda_k)(8+\lambda_k)}$. Under symmetric market size, optimal tariffs and exports are always strictly positive. Under symmetric technology, with $\lambda_i = 1$ for all i and $\bar{d}_s$ normalized to 1, non-negative exports require $\alpha_{ls} < \frac{3}{2}$.

B Proofs

Proof of Lemma 1

Political economy oligopoly model. Under symmetry, it is straightforward to verify Condition 1 and Condition 3.

Under asymmetry, it is straightforward to verify Conditions 2.A, 2.C, 2.D and 2.E(i) and that the binding constraint on Condition 2.B is $\pi_l\left(g^{FT}\right) > \pi_l\left(g_m^H\right)$ which reduces to $\alpha_l < 3\alpha_s - 5\tau$. However, one can also impose $\pi_l\left(g_m^H\right) > \pi_l\left(g_{sm}\right)$ which reduces to $\alpha_l < 3\alpha_m - 6\tau$. Then, Condition 2.E(ii) is irrelevant and $\pi_l\left(g^{FT}\right) > \pi_l\left(g_m^H\right) > \pi_l\left(g_{sm}\right)$ makes Condition 3(iii) irrelevant. Numerically, one can show Condition 3(i) holds because it holds for $\delta = \underline{\delta}$ where $\underline{\delta}$ is the minimum of 1 and $\underset{\delta}{\operatorname{argmin}} \pi_i\left(g_{ij}\right) + \delta\pi_i\left(g_j^H\right) + \frac{\delta^2}{1-\delta}\pi_i\left(g^{FT}\right) - \frac{1}{1-\delta}\pi_i\left(\emptyset\right)$. Condition 3(ii) holds for any δ when $\pi_l\left(g^{FT}\right) > \pi_l\left(\emptyset\right)$ but $\pi_l\left(g^{FT}\right) > \pi_l\left(\emptyset\right)$ implies some critical δ, say $\tilde{\delta}\left(\alpha\right) < 1$, such that part (ii) fails for $\delta > \tilde{\delta}\left(\alpha\right)$. Nevertheless, this never binds in equilibrium because $\tilde{\delta}\left(\alpha\right) > \hat{\delta}_{m,l}^{NE}\left(\alpha\right)$. For Condition 4, part (i) follows from $\bar{\delta}_{i,j}^{NE}\left(\alpha\right) < \bar{\delta}_{j,i}^{NE}\left(\alpha\right)$ when $\alpha_i > \alpha_j$ and $\bar{\delta}_{j,i}^{NE}\left(\alpha\right) < \bar{\delta}_{k,i}^{NE}\left(\alpha\right) < \bar{\delta}_{k,j}^{NE}\left(\alpha\right)$ when $\alpha_i > \alpha_j > \alpha_k$. Part (ii) follows given one can verify that $\bar{\delta}_{l,s}^{NE}\left(\alpha\right) > \bar{\delta}_{m,s}^{FT-O}\left(\alpha\right)$ when $\alpha_{ls} \geq \alpha_{ms}$. Finally, for part (iii), it is trivial to verify $\frac{\partial\bar{\delta}_{i,j}^{NE}(\alpha)}{\partial\alpha_{hk}} < 0$ for $h = i, j$.

Oligopoly model. For the purposes of Conditions 2.C, 3 and 4, let $\alpha_1 \equiv \left(\alpha_{ls}, \alpha_{ms}\right) = (1.35, 1.25)$ and $\alpha_2 = (1.6, 1.25)$ denote two particular parameter vectors noting that $W_l\left(g^{FT}\right) > W_l\left(\emptyset\right)$ only for α_1 and $\alpha_{ij} \equiv \frac{\alpha_i}{\alpha_j}$.

Condition 2: For Condition 2.B, first note that $W_i\left(g_{ij}\right) - W_i\left(\emptyset\right) \propto -1.37\alpha_i^2 + 2.29\alpha_j^2 > 0$. Thus, $\alpha_{ms} \lesssim 1.29$ and $\alpha_{ls} \lesssim 1.29\alpha_{ms} \lesssim 1.67$ imply $W_i\left(g_{ij}\right) > W_i\left(\emptyset\right)$ except potentially when $i = l$ and $j = s$. Hereafter, let $\alpha_{ms} \lesssim 1.29$ and $\alpha_{ls} \lesssim 1.29\alpha_{ms} \lesssim 1.67$. More generally, an FTA between i and j has the following effects on members: $W_i\left(g_i^H\right) - W_i\left(g_{ij}\right) \propto -.43\alpha_i^2 + 2.29\alpha_j^2 > 0$, $W_i\left(g_j^H\right) - W_i\left(g_{jk}\right) \propto -1.37\alpha_i^2 + 1.35\alpha_j^2 > 0$ for $\alpha_j \gtrsim 1.01\alpha_i$ and $W_i\left(g^{FT}\right) - W_i\left(g_k^H\right) \propto -.43\alpha_i^2 + 1.35\alpha_j^2 > 0$. Condition 2.E follows because $W_i\left(g_{ij}\right) - W_h\left(g^{FT}\right) \propto .43\alpha_i^2 + .61\alpha_j^2 - 1.68\alpha_k^2$ which is > 0 for $g_{ij} = g_{ml}$ given α_1 or α_2 but < 0 for $g_{ij} = g_{sm}$. Condition 2.A now follows since $W_i\left(g + ij\right)$ is increasing in α_j. For Condition 2.D, $W_i\left(g^{FT}\right) - W_i\left(g_i^H\right) \propto -.61\left(\alpha_j^2 + \alpha_k^2\right) < 0$. Condition 2.C follows because $W_i\left(g^{FT}\right) - W_i\left(\emptyset\right) \propto -1.8\alpha_{ik}^2 + 1.68\left(\alpha_{jk}^2 + 1\right)$ is < 0 only if $i = l$ and is decreasing in α_{ik} and increasing in α_{jk}.

Conditions 3-4: First consider Condition 3. For any α satisfying Condition 2, part (i) holds given $W_h\left(g_l^H\right) > W_h\left(\emptyset\right)$ for $h = s, m$. Part (ii) holds for any α satisfying Condition 2 and $W_l\left(g^{FT}\right) > W_l\left(\emptyset\right)$, including α_1, but only for $\delta \lesssim .82$ given α_2 (which is not binding in equilibrium given $\hat{\delta}_{m,l}^{NE}\left(\alpha_2\right) \approx .76$). Part (iii) is only relevant for α_2 given $W_l\left(g^{FT}\right) > W_l\left(g_{sm}\right)$ for α_1 and holds for all δ when $h = s, m$. Finally, consider Condition 4. Part (iii) holds because, for any α satisfying Condition 2, $\frac{\partial \bar{\delta}_{i,j}^{NE}(\alpha)}{\partial \alpha_{hk}} < 0$ for $h = i, j$. Parts (i)-(ii) follow from $\hat{\delta}_{m,l}^{NE}(\alpha) < 1$, $\bar{\delta}_{m,s}^{NE}(\alpha) > 1$ and $\bar{\delta}_{l,s}^{NE}(\alpha) > 1$ for $\alpha = \alpha_1, \alpha_2$.

Competing exporters model with market size asymmetry. Consider the parameter vector $\alpha_1 \equiv (\alpha_{ls}, \alpha_{ms}) = (1.11, 1.04)$ noting that $W_l(g^{FT}) - W_l(\varnothing) > 0$ for α_1.

Condition 2: This is straightforward to verify. In particular, only m and l have an FTA exclusion incentive. Moreover, for any α satisfying non-negative optimal tariffs, Condition 2.A follows because $W_i(g_j^H) - W_i(g_k^H) \propto \alpha_j - \alpha_k > 0$ iff $\alpha_j > \alpha_k$ and $W_i(g_{ij}) - W_i(g_{ik}) \propto \alpha_j - \alpha_k > 0$ iff $\alpha_j > \alpha_k$ and, for the purposes of Condition 2.C, $\frac{\partial [W_l(g^{FT}) - W_l(\varnothing)]}{\partial \alpha_{ls}} \propto 10\alpha_{ls} - 5\alpha_{ms} - 41 < 0$ and $\frac{\partial [W_l(g^{FT}) - W_l(\varnothing)]}{\partial \alpha_{ms}} \propto -5\alpha_{ls} + \alpha_{ms} + 22 > 0$.

Conditions 3-4: For α_1, parts (i)-(ii) of Condition 3 hold given Condition 2, $W_i(g_j^H) > W_i(\varnothing)$ when $\alpha_j > \alpha_i$, and $W_l(g^{FT}) > W_l(\varnothing)$. Part (iii) holds for all δ when $h = s, m$. For Condition 4, parts (i) and (ii) follow from Condition 2 and $\bar{\delta}_{i,s}^{NE}(\alpha_1) > 1$ for $i = m, l$ while part (iii) holds because $\frac{\partial \bar{\delta}_{i,j}^{NE}(\alpha_1)}{\partial \alpha_{hk}} < 0$ for $k = s$ and $h \neq k$.

Competing importers model. Under symmetry, Missios et al. (2014) have shown Condition 1. Thus, only part (i) of Condition 3 needs verification. Indeed, this holds given it holds for $\delta = \underline{\delta}(\lambda, \alpha)$ where $\underline{\delta}(\lambda, \alpha) \equiv \underset{\delta}{\text{argmin}}\, v_i(g_{ij}) + \delta v_i(g_j^H) + \frac{\delta^2}{1-\delta} v_i(g^{FT}) - \frac{1}{1-\delta} v_i(\varnothing)$.

For market size and technology asymmetry respectively, a parameter vector is $\alpha^d \equiv (\bar{d}_l, \bar{d}_m, \bar{d}_s, \lambda)$ and $\alpha_1^\lambda \equiv (\lambda_l, \lambda_m, \lambda_s, \bar{d})$. Consider the parameter vectors $\alpha_1^d = (1.01, 1.005, 1, 1)$, $\alpha_2^d = (1.03, 1.005, 1, 1)$, $\alpha_1^\lambda = (.95, .96, 1, 1)$ and $\alpha_2^\lambda = (.85, .96, 1, 1)$. Note, $W_i(g^{FT}) < W_i(\varnothing)$ only for α_2^d and α_2^λ and only for $i = l$.

Condition 2: This is straightforward to verify for α_1^d, α_2^d, α_1^λ and α_2^λ. Any FTA is mutually beneficial for members but imposes negative externalities on non-members. Thus, Conditions 2.B and 2.D hold and part (ii) of Condition 2.E is irrelevant. Condition 2.A holds for α_1^λ and α_2^λ and holds for any α^d satisfying non-negative optimal tariffs. Part (i) of Condition 2.E holds for α_1^d, α_2^d, α_1^λ and α_2^λ. For Condition 2.C, $\frac{\partial [W_l(g^{FT}) - W_l(\varnothing)]}{\partial \alpha_{ls}} \propto -1894(1 + \alpha_{ms}) + 1212\alpha_{ls} < 0$ and $\frac{\partial [W_l(g^{FT}) - W_l(\varnothing)]}{\partial \alpha_{ms}} \propto 1792 + 1432\alpha_{ms} - 1894\alpha_{ls} > 0$ for any α^d satisfying non-negative optimal tariffs while $\frac{\partial [W_l(g^{FT}) - W_l(\varnothing)]}{\partial \alpha_{ls}} < 0$ and $\frac{\partial [W_l(g^{FT}) - W_l(\varnothing)]}{\partial \alpha_{ms}} > 0$ for α_1^λ and α_2^λ.

Conditions 3-4: For Condition 3, part (i) holds for any δ given α_1^d, α_2^d, α_1^λ or α_2^λ. Part (ii) holds for any δ given α_1^d or α_1^λ but part (ii) only holds for α_2^d or α_2^λ when $\delta \lesssim .89$ and $\delta \lesssim .94$ respectively (which are not binding in equilibrium given $\hat{\delta}_{m,l}^{NE}(\alpha_2^d) \approx .57$ and $\hat{\delta}_{m,l}^{NE}(\alpha_2^\lambda) \approx .6$). Part (iii) and part (ii) of Condition 4 are irrelevant because $W_i(g^{FT}) > W_i(g_j^H) > W_i(g_{jk})$ (and thus $\bar{\delta}_{i,j}^{FT-O}(\alpha) < 0$) for any i, j, k and α_1^d, α_2^d, α_1^λ or α_2^λ. Finally, it is trivial to verify part (i) of Condition 4 and $\frac{\partial \hat{\delta}_{m,l}^{NE}}{\partial \alpha_{ls}} + \frac{\partial \hat{\delta}_{m,l}^{NE}}{\partial \alpha_{ms}} < 0$ for α_1^d, α_2^d, α_1^λ or α_2^λ.

Proof of Lemma 2

Given $v_h\left(g^{FT}\right) > v_h\left(g_i^H\right)$ for $h \neq i$ and $v_i\left(g_i^H\right) > v_i\left(g^{FT}\right)$ then, regardless of the position of i, j and k in the protocol, $r_i\left(g_i^H, FT\right) = N$ and $r_h\left(g_i^H, jk\right) = Y$ for $h = j, k$. Thus, $\rho_h\left(g_i^H\right) = jk$ for $h \neq i$ and $\rho_i\left(g_i^H\right) = \phi$. Therefore, in any case, $g_i^H \to g^{FT}$.■

Proof of Lemma 3

Let $\delta > \bar{\delta}^{NE}$. Then, by definition, g_{ij} is strictly most preferred for i and j. Thus, in stage 3, $\rho_h\left(g_{ij}\right) = \phi$ if $h \neq k$ and $r_h\left(g_{ij}, \rho_k\left(g_{ij}\right)\right) = N$ for $h \neq k$. The same logic also applies in stage 2 and stage 1. Therefore, $g_{ij} \to g_{ij}$.

Now let $\delta < \bar{\delta}^{NE}$. Then, (i) $g_h^H \succ_h g_{ij} \succ_h g^{FT} \succ_h g_{h'}^H$ for $h \neq k$, $h' \neq k$ and $h \neq h'$ and (ii) $g^{FT} \succ_k g_h^H \succ_k g_{ij}$ for $h \neq k$. Without knowing k's position i the protocol, there are three cases to consider. But, without loss of generality, let i be the proposer before j.

First, let the outsider k be the proposer in stage 3. In stage 3, $r_i\left(g_{ij}, FT\right) = N$ for $h = i, j$. But, $r_h\left(g_{ij}, hk\right) = Y$ for $h = i, j$ and thus $\rho_k\left(g_{ij}\right) = hk$ for some $h \neq k$. In stage 2, $\rho_j\left(g_{ij}\right) = jk$ given that $r_k\left(g_{ij}, jk\right) = Y$ and, similarly, $\rho_i\left(g_{ij}\right) = ik$ in stage 1 given that $r_k\left(g_{ij}, ik\right) = Y$. Therefore, $g_{ij} \to g_i^H$. Second, let the outsider k be the proposer in stage 2. Similar logic reveals $g_{ij} \to g_i^H$. Third, let the outsider k be the first proposer. Similar logic reveals $g_{ij} \to g_i^H$ or $g_{ij} \to g_j^H$.■

Proof of Proposition 1

For the subgame at hub-spoke networks g_i^H, Condition 1 and Lemma 2 imply $g_i^H \to g^{FT}$. Now roll back to subgames at insider-outsider networks. Lemma 3 implies $g_{ij} \to g_{ij}$ if $\delta > \bar{\delta}^{NE}$. However, given the protocol, Lemma 3 and $\delta < \bar{\delta}^{NE}$ imply $g_{ij} \to g_l^H$ if $g_{ij} \in \{g_{sl}, g_{ml}\}$ but either $g_{ij} \to g_s^H$ or $g_{ij} \to g_m^H$ if $g_{ij} = g_{sm}$.

Now roll back to the subgame at the empty network. First, let $\delta > \bar{\delta}^{NE}$. Then, Condition 1 implies $g_{ij} \succ_i g$ for $g = g_{jk}, g^{FT}, \varnothing$. Thus, due to symmetry, $\rho_s(\varnothing) = sh$ for some $h = m, l$ in stage 3 given that $r_h(\varnothing, sh) = Y$ for $h = m, l$. Similar logic applies in stage 2 and stage 1 and therefore, due to symmetry, $\varnothing \to g_{sl}$ or $\varnothing \to g_{ml}$. Thus, the equilibrium path of networks is $\varnothing \to g_{ml}$ or $\varnothing \to g_{sl}$.

Second, let $\delta \in \left(\bar{\delta}, \bar{\delta}^{NE}\right)$. Then, given Conditions 1 and 3, (i) $g_{hl} \succ_l g^{FT} \succ_l g$ for $h \neq l$ and $g = g_{sm}, \varnothing$, (ii) $g_{sm} \succ_m g^{FT} \succ_m g$ for $g = g_{ml}, g_{sl}, \varnothing$, and (iii) g^{FT} is strictly most preferred for s. In stage 3, $\rho_s(\varnothing) = FT$ given that $r_h(\varnothing, FT) = Y$ for $h \neq s$. In stage 2, given the FT outcome in stage 3, $r_s(\varnothing, sm) = N$ but $r_h(\varnothing, FT) = Y$ for $h = s, l$. Thus, $\rho_m(\varnothing) = FT$. In stage 1, given the FT outcome in stage 2, $r_h(\varnothing, hl) = N$ for $h \neq l$ but $r_h(\varnothing, FT) = Y$ for $h = s, m$. Thus, $\rho_l(\varnothing) = FT$. Therefore, $\varnothing \to g^{FT}$. Thus, $\varnothing \to g^{FT}$ is the equilibrium path of networks.

Finally, let $\delta < \bar{\delta}$. This leaves l's preferences unchanged relative to $\delta \in \left(\bar{\delta}, \bar{\delta}^{NE}\right)$ but now (i) $g_{sm} \succ_m g_{ml} \succ_m g^{FT} \succ_m g$ for $g = g_{sl}, \varnothing$, and (ii) $g_{sh} \succ_s g^{FT} \succ_s g$ for $h \neq s$ and $g = g_{ml}, \varnothing$. In stage 3, $r_h(\varnothing, sh) = Y$ for $h \neq s$ and thus $\rho_s(\varnothing) = sl$ or $\rho_s(\varnothing) = sm$. In stage 2, $\rho_m(\emptyset) = sm$ given that $r_s(\emptyset, sm) = Y$. In stage 1, the outcome of sm in stage 2 implies $r_m(\emptyset, ml) = N$ but $r_s(\emptyset, sl) = Y$. Thus, $\rho_l(\emptyset) = sl$ and therefore $\emptyset \to g_{sl}$. Hence, the equilibrium path of networks is $\emptyset \to g_{sl} \to g_l^H \to g^{FT}$.■

Proof of Proposition 2

See proof of part (i) of Proposition 5.■

Proof of Proposition 3

In subgames at hub-spoke networks g_i^H, Condition 2 and Lemma 2 imply $g_i^H \to g^{FT}$. In subgames at insider-outsider networks g_{ij}, the logic of Lemma 3 implies $g_{ij} \to g_{ij}$ if $\delta > \hat{\delta}_{i,j}^{NE}$. Thus, $g_{ml} \to g_{ml}$ given $\delta > \hat{\delta}_{m,l}^{NE}$. Now roll back to the subgame at the empty network.

Regardless of the network paths emanating from subgames at g_{sm} and g_{sl}, Condition 2 implies (i) $g_{ml} \succ_m g$ for $g = g_{sl}, g_{sm}, g^{FT}, \emptyset$ and (ii) $g_{ml} \succ_l g$ for $g = g_{sl}, g^{FT}, \emptyset$. Conditions 2-3 also imply (iii) $g \succ_s \emptyset$ for $g = g_{sl}, g_{sm}, g^{FT}$. Thus, regardless of the outcome in stage 3, $\rho_m(\emptyset) = ml$ in stage 2 iff $r_l(\emptyset, ml) = Y$ noting that $r_l(\emptyset, ml) = Y$ if $g_{ml} \succ_l g_{sm}$. Hence, let $g_{ml} \succ_l g_{sm}$. Then, in stage 1, $\rho_l(\emptyset) = ml$ given that $r_m(\emptyset, ml) = Y$. Thus $\emptyset \to g_{ml}$ and, hence, $\emptyset \to g_{ml}$ is the equilibrium path of networks.

Now let $g_{sm} \succ_l g_{ml}$. Given Condition 2, $v_l(g_{sm}) > v_l(g^{FT}) > v_l(g_m^H)$ and hence $g_{sm} \to g_{sm}$ in the subgame at g_{sm}. In turn, (i) $v_l(g_{sm}) > v_l(g_{ml})$ and (ii) Condition 2 imply $v_s(g^{FT}) > v_s(g_{sm})$ and hence, given Condition 3, $g \succ_s g_{sm}$ for $g = g_{sl}, g^{FT}$. Thus, in stage 1, $\rho_s(\emptyset) = sm$ iff $r_l(\emptyset, sl) = r_l(\emptyset, FT) = N$ and, hence, $\emptyset \succ_l g$ for $g = g_{sl}, g^{FT}$. Letting $g \succ_l \emptyset$ for some $g = g_{sl}, g^{FT}$ then $r_l(\emptyset, ml) = Y$ and $\rho_m(\emptyset) = ml$ in stage 2 and $r_m(\emptyset, ml) = Y$ and $\rho_l(\emptyset) = ml$ in stage 1. Thus, $\emptyset \to g_{ml}$ and $\emptyset \to g_{ml}$ is the equilibrium path of networks. Conversely, let $\emptyset \succ_l g$ for $g = g_{sl}, g^{FT}$. Then, (i) $\rho_m(\emptyset) = sm$ in stage 2 given $r_l(\emptyset, ml) = r_l(\emptyset, FT) = N$ but $r_s(\emptyset, sm) = Y$ and (ii) and $\rho_l(\emptyset) = \phi$ in stage 1. Thus, $\emptyset \to g_{sm}$ and $\emptyset \to g_{sm}$ is the equilibrium path of networks.■

Proof of Proposition 4

In subgames at hub-spoke networks g_i^H, Condition 2 and Lemma 2 imply $g_i^H \to g^{FT}$. In turn, the only way that g^{FT} does not eventually emerge from some insider-outsider network g_{ij} is if $g_{ij} \to g_{ij}$. The next part of the proof shows that, once $\delta < \hat{\delta}_{m,l}^{NE}(\alpha)$, this is only possible for the subgame at $g_{ij} = g_{sm}$.

First, consider $g_{ij} = g_{ml}$ noting that (i) $g^{FT} \succ_s g_l^H \succ_s g_m^H \succ_s g_{ml}$, (ii) $g_h^H \succ_h g_{ml}$ for some $h = m, l$ and (iii) $g \succ_h g^{FT} \succ_h g_{h'}^H$ for $g = g_{ml}, g_h^H$ and $h \neq s$, $h' \neq h$. In stage 3, $r_h(g_{ml}, FT) = N$ for $h = m, l$ but $r_h(g_{ml}, sh) = Y$ for some $h = m, l$. Thus, $\rho_s(g_{ml}) = sh$ for some $h = m, l$. Noting that $r_l(g_{ml}, FT) = N$ or $\rho_m(g_{ml}) \neq FT$ in stage 2 then, regardless of the equilibrium outcome in stage 2, $r_s(g_{ml}, sl) = Y$ and $\rho_l(g_{ml}) = sl$ in stage 1. Therefore, $g_{ml} \to g_l^H$.

Second, consider $g_{ij} = g_{sl}$ noting that (i) $g^{FT} \succ_m g_l^H \succ_m g$ for $g = g_{sl}, g_s^H$, (ii) $g_h^H \succ_h g_{sl}$

for some $h = s, l$ by Condition 4(i), and (iii) $g_l^H \succ_l g^{FT} \succ_l g_s^H$. Let FT be the outcome in stage 3. Then, $r_h(g_{sl}, FT) = Y$ for $h = s, l$ in stage 2 and thus $\rho_m(g_{sl}) = FT$. In turn, in stage 1, $r_h(g_{sl}, FT) = Y$ for $h = s, m$ but $r_m(g_{sl}, \rho_l(g_{sl})) = N$ for $\rho_l(g_{sl}) = ml$. Hence, $\rho_l(g_{sl}) = FT$. Now let ϕ or sm be the outcome in stage 3. In turn, in stage 2, $r_h(g_{sl}, FT) = N$ for some $h = s, l$ but $r_l(g_{sl}, ml) = Y$ either because $\delta < \bar{\delta}_{m,s}^{FT-O}(\alpha)$ and, by Condition 4(ii), $\delta < \bar{\delta}_{l,s}^{NE}(\alpha)$ or because the outcome in stage 3 is sm. Thus, $\rho_m(g_{sl}) = ml$. In turn, $\rho_l(g_{sl}) = ml$ in stage 1. Thus, either $g_{sl} \to g^{FT}$ or $g_{sl} \to g_l^H$.

Third, consider $g_{ij} = g_{sm}$ noting that (i) $g_m^H \succ_m g_{sm}$ because $\bar{\delta}_{m,l}^{NE}(\alpha) < \bar{\delta}_{m,s}^{NE}(\alpha)$, and (ii) $v_h(g^{FT}) > v_h(g_{sm})$ for $h = s, m$ if $v_l(g_m^H) > v_l(g_{sm})$ by Condition 2.E(ii). If $v_l(g_{sm}) > v_l(g^{FT})$ then $g_{sm} \succ_l g$ for $g = g_m^H, g_s^H, g^{FT}$ and hence $r_l(g_{sm}, \rho_h(g_{sm})) = N$ for $\rho_h(g_{sm}) \neq \phi$ in stages 3 and 2. In turn, $\rho_l(g_{sm}) = \phi$ in stage 1 and, therefore, $g_{sm} \to g_{sm}$. If $v_l(g^{FT}) > v_l(g_{sm}) > v_l(g_m^H)$ then Condition 2.E(ii) says $v_h(g^{FT}) > v_h(g_{sm})$ for $h = s, m$. Hence, $r_h(g_{sm}, FT) = Y$ for $h \neq s$ in stage 3 and thus $g_{sm} \to g$ for some $g \neq g_{sm}$. If $v_l(g^{FT}) > v_l(g_m^H) > v_l(g_{sm})$ then $g_{sm} \to g$ for some $g \neq g_{sm}$ either by the logic of the previous sentence or similar logic to the case for $g_{ij} = g_{ml}$. Thus, $g_{sm} \to g_{sm}$ iff $v_l(g_{sm}) > v_l(g^{FT})$, and this is the only case where global free trade does not eventually emerge from a subgame at an insider-outsider network.

Now roll back to the subgame at the empty network noting that $g \succ_s \emptyset$ for $g = g_{sl}, g_{sm}, g^{FT}$ and $g_{sm} \succ_m \emptyset$. Given Condition 3 says $g_{ml} \succ_h \emptyset$ for $h = m, l$ then $\emptyset \to g$ for some $g \neq \emptyset$ because there is some proposal $\rho_m(\emptyset) \neq \phi$ such that $r_h(\emptyset, \rho_m(\emptyset)) = Y$ for all recipients h in stage 2. Thus, global free trade emerges eventually unless $\emptyset \to g_{sm} \to g_{sm}$. Hence, for the remainder of the proof, let $g_{sm} \to g_{sm}$ in the subgame at g_{sm} noting that this implies $g_{ml} \succ_m g_{sm}$ by Condition 3(iii).

Suppose $\emptyset \succ_l g$ for $g = g_{sl}, g^{FT}$. Then, in stage 3, $r_l(\emptyset, FT) = r_l(\emptyset, sl) = N$ but $r_m(\emptyset, sm) = Y$ and hence $\rho_s(\emptyset) = sm$. In stage 2, $r_s(\emptyset, sm) = Y$ but $r_l(\emptyset, FT) = N$ and $r_l(\emptyset, ml) = Y$ iff $g_{ml} \succ_l g_{sm}$. Thus, $\rho_m(\emptyset) = ml$ iff $g_{ml} \succ_l g_{sm}$ but $\rho_m(\emptyset) = sm$ otherwise. Thus, in stage 1, $r_m(\emptyset, ml) = Y$ and $\rho_l(\emptyset) = ml$ iff $g_{ml} \succ_l g_{sm}$ but $\rho_l(\emptyset) = \phi$ otherwise. Therefore, the equilibrium path of networks is $\emptyset \to g_{ml} \to g_l^H \to g^{FT}$ if $g_{ml} \succ_l g_{sm}$ but $\emptyset \to g_{sm}$ otherwise. Conversely, now suppose $g \succ_l \emptyset$ for some $g = g_{sl}, g^{FT}$. Then, Conditions 2.E(ii) and 3(iii) say $g \succ_s g_{sm}$ for $g = g_{sl}, g^{FT}$. Hence, $r_l(\emptyset, \rho_s(\emptyset)) = Y$ for some $\rho_s(\emptyset) \in \{sl, FT\}$ and thus $\rho_s(\emptyset) = sl$ or $\rho_s(\emptyset) = FT$. Moreover, in stage 2, $r_s(\emptyset, sm) = N$ and thus $\rho_m(\emptyset) \neq sm$. Therefore, regardless of the outcome in stage 1, $\emptyset \to g$ for some $g \neq \emptyset, g_{sm}$ and global free trade eventually emerges.■

Proof of Proposition 5

Let $v_i(g^{FT}) > v_i(\emptyset)$ for all i. In stage 3, $r_i(\emptyset, FT) = Y$ for $i \neq s$ and thus $\rho_s(\emptyset) = FT$. Similar logic applies in stage 2 and stage 1. Therefore $\emptyset \to g^{FT}$ is the equilibrium path of networks. Now let $v_l\left(g^{FT}\right) < v_l(\emptyset)$ for some i. In each stage, either $r_l(\emptyset, FT) = N$ or $\rho_l(\emptyset) = \phi$. Therefore $\emptyset \to \emptyset$ and the equilibrium path of networks is $\emptyset \to \emptyset$.■

I now provide a more substantial characterization of the equilibrium when countries are asymmetric and $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$.

Proposition 6. *Suppose Conditions 2-4 hold and FTAs emerge on an equilibrium path of networks leading to global free trade. Further suppose that either (i) $g_{sl} \succ_l \emptyset$, or (ii) $g^{FT} \succ_l \emptyset \succ_l g_{sl}$ and either $g^{FT} \succ_s g_{sm}$ or $g_{ml} \succ_m g_{sm}$, or (iii) $\emptyset \succ_l g$ for $g = g_{sl}, g^{FT}$ and $g_{ml} \succ_m g$ for $g = g_{sm}, g^{FT}$. Then, the unique equilibrium path of networks is $\emptyset \to g_{ml} \to g^H_l \to g^{FT}$.*

Proof. Proposition 3 implies global free trade can only emerge once $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$. Thus, let $\delta < \hat{\delta}^{NE}_{m,l}(\alpha)$ for the remainder of the proof. Further, the proof of Proposition 4 established that (i) $g^H_i \to g^{FT}$ for any g^H_i, (ii) $g_{ml} \to g^H_l$, (iii) $g_{sl} \to g^{FT}$ or $g_{sl} \to g^H_l$ and (iv) $g_{sm} \to g_{sm}$ iff $v_l(g_{sm}) > v_l\left(g^{FT}\right)$. Thus, (i) $g_{ml} \succ_l g$ for $g = g_{sl}, \emptyset$, (ii) $g \succ_s \emptyset$ for $g = g_{sl}, g_{sm}, g^{FT}$ and (iii) $g \succ_m \emptyset$ for $g = g_{ml}, g_{sm}, g^{FT}$. Moreover, these preferences imply $\rho_s(\emptyset) \neq \phi$ in stage 3 and thus some agreement is the outcome in stage 3. Now consider the three cases of the proposition.

(i) Note that $g \succ_s g_{sm}$ for some $g = g_{sl}, g^{FT}$. To see this, first let $g_{sm} \succ_s g_{sl}$. In this case, $g_{sm} \to g$ for some $g \neq g_{sm}$ because $g_{sm} \to g_{sm}$ iff $v_l(g_{sm}) > v_l\left(g^{FT}\right)$ which, by Condition 3(iii), implies $g_{sl} \succ_s g_{sm}$. Further, Condition 2 and $g_{sm} \to g^H_m$ implies $g_{sl} \succ_s g_{sm}$. Thus, $g_{sm} \succ_s g_{sl}$ implies $g_{sm} \to g^{FT}$. But, this requires $v_i\left(g^{FT}\right) > v_i(g_{sm})$ for all i which implies $g^{FT} \succ_s g_{sm}$. Second, let $g_{sm} \succ_s g^{FT}$. $g_{sm} \succ_s g^{FT}$ can only hold if $g_{sm} \to g^H_m$ because (i) $g_{sm} \to g^{FT}$ implies $v_s\left(g^{FT}\right) > v_s(g_{sm})$ and (ii) $g_{sm} \to g_{sm}$ implies $v_l(g_{sm}) > v_l\left(g^{FT}\right)$ which, by Condition 2.E(ii), implies $v_s\left(g^{FT}\right) > v_s(g_{sm})$. But $g_{sm} \to g^H_m$ and Condition 2 imply $g_{sl} \succ_s g_{sm}$. Therefore, $g \succ_s g_{sm}$ for some $g = g_{sl}, g^{FT}$ and, thus, $\rho_s(\phi) = sl$ or $\rho_s(\phi) = FT$.

Let $\rho_s(\emptyset) = sl$. Then $g_{sl} \succ_s g^{FT}$ which requires $g_{sl} \to g^H_l \to g^{FT}$. In turn, Condition 2 implies $g_{ml} \succ_m g_{sl}$. Thus, in stage 2, $r_s(\emptyset, FT) = N$ but $r_l(\emptyset, ml) = Y$ and hence $\rho_m(\emptyset) = ml$. In turn, in stage 1, $r_m(\emptyset, ml) = Y$ and $\rho_l(\emptyset) = ml$. Therefore, $\emptyset \to g_{ml} \to g^H_l \to g^{FT}$ is the equilibrium path of networks. Now let $\rho_s(\emptyset) = FT$. Since this implies $g^{FT} \succ_s g_{sm}$, then $r_s(\emptyset, sm) = N$ in stage 2 but $r_h(\emptyset, FT) = r_l(\emptyset, ml) = Y$ for $h = s, l$ and hence $\rho_m(\emptyset) = FT$ if $g^{FT} \succ_m g_{ml}$ which reduces to $\delta > \bar{\delta}^{l-FT}_m(\alpha)$ but $\rho_m(\emptyset) = ml$ if $g_{ml} \succ_m g^{FT}$ which reduces to $\delta < \bar{\delta}^{l-FT}_m(\alpha)$. In turn, in stage 1, $\rho_l(\emptyset) = FT$ and the equilibrium path of networks is $\emptyset \to g^{FT}$ if $g^{FT} \succ_m g_{ml}$ but $\rho_m(\emptyset) = ml$ and the equilibrium path of networks is $\emptyset \to g_{ml} \to g^H_l \to g^{FT}$ if $g_{ml} \succ_m g^{FT}$.

(ii) $\emptyset \succ_l g_{sl}$ implies $\rho_s(\emptyset) = sm$ or $\rho_s(\emptyset) = FT$ in stage 3. Let $\rho_s(\emptyset) = FT$, i.e. $g^{FT} \succ_s g_{sm}$. Then, as in case (i), the equilibrium path of networks is $\emptyset \to g^{FT}$ if $\delta > \bar{\delta}^{l-FT}_m(\alpha)$ but $\emptyset \to g_{ml} \to g^H_l \to g^{FT}$ if $\delta < \bar{\delta}^{l-FT}_m(\alpha)$. Now let $\rho_s(\emptyset) = sm$ so that $g_{sm} \succ_s g^{FT}$. Also suppose that $g_{ml} \succ_m g_{sm}$. In stage 2, $r_s(\emptyset, FT) = N$ given $\rho_s(\emptyset) = sm$ in stage 3. But, given the logic in case (i), $g_{sm} \succ_s g^{FT}$ implies $g_{sm} \to g_m^H$ which requires $v_l(g_{ml}) > v_l(g^{FT}) > v_l(g_{sm})$ and, in turn, implies $g_{ml} \succ_l g_{sm}$. Thus, in stage 2, $r_l(\emptyset, ml) = Y$ and $\rho_m(\emptyset) = ml$. In turn, $r_m(\emptyset, ml) = Y$ and $\rho_l(\emptyset) = ml$ in stage 1 and $\emptyset \to g_{ml} \to g_l^H \to g^{FT}$ is the equilibrium path of networks.

(iii) $\emptyset \succ_l g$ for $g = g_{sl}, g^{FT}$ implies $\rho_s(\emptyset) = sm$ in stage 3. If $g_{sm} \succ_l g_{ml}$ then $v_l(g_{sm}) > v_l(g^{FT})$ and hence $r_l(\emptyset, \rho_m(\emptyset)) = N$ for $\rho_m(\emptyset) \in \{FT, ml\}$ in stage 2. In turn, $\rho_m(\emptyset) = sm$ given $r_s(\emptyset, sm) = Y$. In turn, in stage 1, $\rho_l(\emptyset) = \phi$ and $\emptyset \to g_{sm}$ is the equilibrium path of networks. If $g_{ml} \succ_l g_{sm}$, then $r_l(\emptyset, ml) = Y$ in stage 2. Thus, $\rho_m(\emptyset) = ml$ given $g_{ml} \succ_m g$ for $g = g_{sm}, g^{FT}$. In turn, in stage 1, $r_m(\emptyset, ml) = Y$ and $\rho_l(\emptyset) = ml$ and therefore $\emptyset \to g_{ml} \to g_l^H \to g^{FT}$ is the equilibrium path of networks. □

Finally, I consider a variant on the multilateralism game that allows for two country MFN agreements. Suppose each proposer country's action space in the multilateralism game is $P_i(\emptyset) = \{\phi, FT, ij^M, ik^M\}$ where, for example, ij^M indicates i announces a two country MFN agreement with j that results in the network g_{ij}^M.

Proposition 7. *Suppose (i) $v_i(g^{FT}) > v_i(\emptyset)$ for all i and (ii) $v_i(g^{FT}) > v_i(g_{ij}^M)$ for any i, j. Then, $\emptyset \to g^{FT}$ is the equilibrium path of networks.*

Proof. In stage 3, $r_h(\emptyset, FT) = Y$ for $h = m, l$. Thus, $\rho_s(\emptyset) = FT$. In stage 2, $r_h(\emptyset, FT) = Y$ for $h = s, l$ and thus $\rho_m(\emptyset) = FT$. In stage 1, $r_h(\emptyset, FT) = Y$ for $h = s, m$ and thus $\rho_l(\emptyset) = FT$. Therefore, the equilibrium path of networks is $\emptyset \to g^{FT}$. □

References

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

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.

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

Ethier, W. J., 2001. Theoretical problems in negotiating trade liberalization. European Journal of Political Economy 17 (2), 209–232.

Ethier, W. J., 2004. Political externalities, nondiscrimination, and a multilateral world. Review of International Economics 12 (3), 303–320.

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.

Goyal, S., Joshi, S., 2006. Bilateralism and free trade. International Economic Review 47 (3), 749–778.

Grossman, G., Helpman, E., 1995. The politics of free-trade agreements. The American Economic Review 85.

Horn, H., Maggi, G., Staiger, R., 2010. Trade agreements as endogenously incomplete contracts. The American Economic Review 100 (1), 394–419.

Jackson, M., Wolinsky, A., 1996. A strategic model of social and economic networks. Journal of Economic Theory 71 (1), 44–74.

Krishna, P., 1998. Regionalism and multilateralism: A political economy approach. Quarterly Journal of Economics 113 (1), 227–251.

Krugman, P., 1991. The move toward free trade zones. policy implications of trade and currency zones: A symposium sponsored by the federal reserve bank of kansas city. Federal Reserve Bank of Kansas City, Kansas City, 7–41.

Levy, P., 1997. A political-economic analysis of free-trade agreements. The American Economic Review 87 (4), 506–519.

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

Missios, P., Saggi, K., Yildiz, H., 2014. External trade diversion, exclusion incentives and the nature of preferential trade agreements. Mimeo.

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

Odell, J. S., 2006. Negotiating trade: Developing countries in the WTO and NAFTA. Cambridge University Press.

Ornelas, E., 2005a. Endogenous free trade agreements and the multilateral trading system. Journal of International Economics 67 (2), 471–497.

Ornelas, E., 2005b. Trade creating free trade areas and the undermining of multilateralism. European Economic Review 49 (7), 1717–1735.

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.

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

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., 2011. Bilateral trade agreements and the feasibility of multilateral free trade. Review of International Economics 19 (2), 356–373.

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

Zhang, J., Cui, Z., Zu, L., 2014. The evolution of free trade networks. Journal of Economic Dynamics and Control 38, 72–86.