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Implications of multilateral tariff bindings on the formation of preferential trade agreements and quest for global free trade

Moïse Nken* and Halis Murat Yildiz†

Abstract

Using an endogenous preferential trade agreement (PTA) formation model under all possible multilaterally negotiated bound tariff rates, we examine the effects of multilateral trade liberalization on the role of PTAs in achieving global free trade. We first show that, when countries are completely symmetric, no country has an incentive to unilaterally deviate (free ride) from free trade network while exclusion incentives arise when bound tariffs are sufficiently low. Due to the relatively flexible nature of the FTA formation, such exclusion incentives go unexercised and free trade always obtains as the coalition-proof Nash equilibrium (CPNE) of the FTA game. However, such flexibility does not exist under the CU game and thus countries are able to exercise the exclusion incentive and free trade fails to be CPNE when the bound tariff rates are sufficiently low. We then consider a scenario where countries are asymmetric with respect to their comparative advantage. The country with a weaker comparative advantage has an incentive to free ride on trade liberalization of the other two countries and lower bound tariff rates disciplines this incentive via limiting the ability to set optimal tariffs. As a result, multilateral free trade is more likely to be a CPNE as the multilateral negotiated bound tariff rates decline. This result provides support for the idea that multilateral trade liberalization acts as a complement to the FTA formation in achieving global free trade.

Keywords: Bound Tariff Rates, Coalition proof Nash equilibrium, Free Trade Agreement, Customs Union, Exclusion Incentive, Free Riding Incentive.

JEL Classifications: F11, F13, F15.

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1 Introduction

Since the creation of the 1948 General Agreement on Tariffs and Trade (GATT), trade liberalization has proceeded along two major fronts: (i) periodic rounds of multilateral negotiations that are open to all member countries and (ii) the formation of preferential trade agreements (PTAs) that entails the exchange of trade policy concessions amongst only a subset of WTO members. GATT/WTO concluded eight rounds of multilateral trade negotiations, reducing the average ad valorem tariffs on industrial goods to below 4 percent and expanding the multilateral system's membership from 23 to 164 economies. Especially, after the Uruguay round of tariff negotiations in 1994, MFN principle along with country-by-country lower tariff binding commitments had successfully generated significant trade liberalization. However, multilateral trade liberalization process has ground to a halt with the Doha round that has failed to yield a bargain that is acceptable to all sides despite sixteen years of intense negotiations. By contrast, preferential trade liberalization has become increasingly popular in recent years, with the number of PTAs increased five-fold since the completion of the Uruguay round of the WTO negotiations in 1994.[1]

Economists and policy-makers have long suspected that the contrasting fortunes of these two types of trade liberalization may be inter-related. Dealing with the widespread concern that the formation of PTAs may undermine multilateral liberalization and serve as an alternative, rather than a complement, to multilateral trade liberalization, there exists an extensive literature that has addressed the impact of PTAs on optimal tariffs, multilateral tariff reduction, and on the prospects of global free trade.[2] However, the reverse analysis on how multilateral tariff reduction affects the formation of PTAs and alters the role of Article XXIV of the GATT in achieving global free trade is relatively scarce.[3] This paper aims at filling this gap in the literature using an endogenous PTA formation model in examining equilibrium agreements as the multilaterally negotiated bound tariff rates bound tariff rates fall.

As explained in detail in Bown and Crowley (2016), membership in the WTO requires that countries take on commitments with respect to their tariffs. The first such commitment is the application of symmetric tariff rates on imports from all other WTO members via the most-favored-nation (MFN) principle of nondiscrimination. Second, a WTO member agrees to take on legally binding commitment on chosen set of products that is a cap above which it promises not to raise its applied tariff. For each of those products with some legally binding commitment, the member chooses an exact value for this upper limit that is referred to as the "tariff binding" or "tariff cap". A WTO member country's MFN applied rate must therefore be less than or equal to the bound

[1] Roughly 90% of the existing PTAs take the form of FTAs, with CUs comprising the rest (Freund and Ornelas, 2010). However, the existing CUs do involve major trading areas of the world: the EU and much of Latin America (where MERCOSUR resides).

[2] Prominent examples in this strand of literature include papers by Krugman (1991), Bhagwati (1991), Yi (1996), Bagwell and Staiger (1997a, 1997b, 1998, 2005a, 2005b), Krishna (1998), Riezamn (1999), Goyal and Joshi (2006), Konishi and Furusawa (2007), Aghion et. al (2007), Ornelas (2005, 2007), Saggi (2006), Saggi and Yildiz (2010, 2011), Saggi et. al (2013, 2016), Stoyanov and Yildiz (2015) and Lake (2017).

[3] In a detailed survey, Freund and Ornelas (2010) documents the scarcity of analyses on how multilateralism affects regionalism. Very few examples include Ethier (1998), Freund (2000) and Lake and Roy (2017).

tariff rate (tariff binding) in order to be legal under the WTO.[4] While MFN constitutes the very first Article of the GATT and is widely viewed as the central pillar of the world trading system, its salience is called into question by the existence of Article XXIV of GATT – the legal clause that sanctions preferential and/or discriminatory trade liberalization amongst WTO members subject to certain conditions, the most important of which are that PTA members must eliminate internal tariffs on "substantially all trade" with each other and also refrain from increasing their external MFN tariffs on non-members.

Our point of departure is a world in which all countries are the WTO members that face exogenously given multilaterally negotiated bound tariff rates and thus their applied rates under any trade regime must therefore be less than or equal to the tariff bindings. Under these tariff bindings, countries endogenously choose whether to form PTAs. Here, it is important to note that the level of the bound tariff rates significantly affects the ability of countries to impose optimal tariffs and thus the preferences of both member and non-member countries regarding PTA formation. As a result, it has strong implications on whether PTA formation ultimately leads to global free trade or ends prematurely with a fragmented trading world with "gated globalization". Does the reduction in the multilaterally negotiated tariff bindings enhance the role of the PTA formation for the prospects of global free trade? In other words, does the multilateral trade liberalization complement preferential trade liberalization in achieving global free trade? Do the answers to these questions depend on the nature of the PTAs (FTA versus CU)? To address these questions, we develop an equilibrium theory of trade agreements and use it to shed light on the interaction between bilateral and multilateral approaches to trade liberalization with a finer lens.

We utilize an adapted version of the comparative advantage based framework of Horn *et al.* (2010) where there are three countries and every country is a competing exporter with each of the other two countries in two goods and imports a unique good. Our conceptual approach to the formation of trade agreements follows Saggi and Yildiz (2010) who develop an equilibrium theory of FTAs. Each country is free to pursue either no trade liberalization or bilateral trade liberalization or multilateral free trade and set their optimal tariffs endogenously as long as bound tariff rates are sufficiently high.[5] Most of the existing literature on trade agreements fails to explain when and why countries might deliberately choose to *free ride* on trade liberalization by other countries or *exclude* others from their mutual trade liberalization. To address the free riding and exclusion incentives in a convincing manner, one needs a model of an endogenous formation of trade agreements in which countries are active participants in trade agreement negotiations. This way, one can determine whether a country has an incentive to free ride while the others have an incentive to include it in the free trade network or some countries prefer to exclude others from their mutual trade liberalization even though they wish to be included. This paper aims to provide such a model and

[4]If a country raises its tariff beyond its bound rate, the countries adversely affected are able to seek remedy via the dispute settlement process through which they may obtain the right to retaliate against an equivalent value of the offending country's exports or the right to receive compensation, usually in the form of reduced tariffs on other products they export to the offending country.

[5]Since all countries have market power in our model, allowing for unilateral liberalization is not necessary: no country will choose to pursue such liberalization in our model.

use it to assess not only the strength of the free riding and exclusion incentives under both types of PTAs but also the ability of member countries to exercise such incentives in equilibrium when bound tariff rates are exogenously given.

We first examine the coalition proof Nash equilibrium agreements of the PTA formation game between symmetric countries for all possible levels of bound tariff rates. This exercise allows to isolate the consequences of the interaction of the multilateral reduction in bound tariff rates and PTA formation in achieving global free trade. Then, we extend our analysis into a setting where countries are asymmetric with respect to their degree of comparative advantage.

We first find that the formation of a bilateral PTA (both FTA and CU) induces each member to lower its tariff on the non-member country relative to the status quo, i.e. the model exhibits tariff complementarity. As a result, exogenously given bound tariff rates lead to three distinct scenarios: (i) *no tariff binding scenario* where the bound tariff rate exceeds the optimal Nash tariffs and countries are free to impose their optimal tariffs under all trade regimes; (ii) *partial tariff binding scenario* where the bound tariff rate exceeds the optimal tariff of a member country under a PTA but falls below the optimal Nash tariffs and thus the member countries under a PTA are free to impose their optimal external tariffs while the non-member country under a PTA is required to apply the bound tariff rate and (iii) *full tariff binding scenario* where the bound tariff rate falls below the optimal tariffs of member countries under a PTA and thus countries lose their freedom to impose optimal external tariffs under all possible trade regimes and are required to apply their bound tariff rates. Note that while the tariff binding overhang exists in the first two scenarios, it disappears in the final scenario.[6] Most of the research in the existing literature on trade agreements ignores the bound tariff rates and thus focus on the very first scenario where countries impose their optimal tariffs.[7] In this paper, we go one step further and examine more realistic cases where countries are not able to impose their optimal tariffs due to sufficiently low bound tariff rates.

Our analysis on how the reduction in the bound tariff rates affects countries' preferences for PTA formation delivers several interesting insights. We first show that, when countries are completely symmetric, no country has an incentive to unilaterally deviate (free ride) from free trade network regardless of the level of bound tariff rates and the type of PTAs (FTA or CU) while two countries have incentives to jointly exclude the third one via FTA or CU from free trade network when bound tariffs are sufficiently low. The intuition behind these results can be explained as follows. On one hand, when the bound tariff rates fall below the optimal Nash tariffs, the non-member country under a bilateral PTA loses its ability to set its optimal MFN tariff and is required to impose the bound tariff rate that is lower than the optimal MFN rate. On the other hand, the PTA member countries fully enjoy free access in each others market and are either (i) fully able to impose their optimal external tariffs (as under the *partial tariff binding scenario*) or (ii) impose the same external tariff as the non-member country (as under the *full tariff binding scenario*). These forces together

[6]The tariff binding overhang literature includes Bagwell and Staiger (2005a), Amador and Bagwell (2013) and Beshkar et. al (2015) who argue that uncertianty over governments' future political economy motivations during trade negotiations can justify the demand for the flexibility over future applied tariffs.

[7]See Furusawa and Konishi (2007), Saggi and Yildiz (2010) and Saggi et. al (2013), Lake and Yildiz (2016).

imply that the free riding incentives become weaker while the exclusion incentives arise as the bound tariff rates fall. Here, it is important to note that Saggi and Yildiz (2010) show that there exists no exclusion incentive under symmetry in a competing exporters model. Our result suggests that this result fails to hold when countries are constrained in imposing their optimal tariffs due to sufficiently low bound tariff rates. In an oligopoly model of trade, Freund (2000) shows that multilateral tariff reduction affects the formation of PTAs, enhancing the incentives to form a PTA relative to free trade. In this paper, we confirm that this result also holds in a comparative advantage model where trade is inter-industry in nature. However, one should note that the PTA formation is not endogenously modeled in Freund (2000) and the possibility of forming a hub and spoke regime is ignored. As will be discussed below, these differences lead to an important divergence in the results of Freund (2000) and the present paper.

As is well known, the central difference between a bilateral FTA and a bilateral CU is that FTA members impose individually optimum external tariffs while members of a CU impose common external tariffs. This difference in tariff setting behavior between the two types of PTAs has important consequences. The requirement that CU members set a common external tariff implies that individual CU members do not have the ability to form an additional PTA without the consent of other CU members while FTA members are free to enter into additional FTAs with non-member countries without requiring consent from its existing FTA partners. In other words, FTA members enjoy more *flexibility* than CU members. We show that this crucial difference between a CU and an FTA has important consequences for the prospect of global free trade. First, it is immediate to note under the *no tariff binding* and *partial tariff binding* scenarios that, the joint external tariff determination under a CU leads to higher external tariffs relative to the ones under an FTA. Therefore, under such a case, the free riding incentive of a country is weaker when facing a CU relative to an FTA while the exclusion incentive of CU members is stronger than the one of FTA members. Under the *full tariff binding* scenario, since all countries impose the exogenously given bound tariff rates, a bilateral CU is identical to a bilateral FTA from both member and non-member countries' perspectives. It is important to note here that the flexibility of FTA formation implies that hub and spoke type of regime is an option under FTA formation only and thus FTAs are more susceptible to opportunistic unilateral deviations by member countries than CUs. As stated above, when countries are symmetric, countries have no incentives to free ride while exclusion incentives arise under both FTA and CU games when bound tariffs are sufficiently low. We find that free trade always obtains as the CPNE of the FTA game since exclusion incentives go unexercised in the equilibrium due to the flexibility in FTA formation. However, unlike the FTA formation game, countries are able to exercise the exclusion incentive under the CU game and free trade fails to be a CPNE when the bound tariff rates are sufficiently low and thus the pursuit of CUs undermines global free trade.

To understand the intuition behind this key result, suppose we start with announcements leading to free trade. Due to the existence of an exclusion incentive in our model, two countries benefit if they jointly deviate to announcements wherein they call for an FTA with only each other when tariff bindings are low. As per the concept of a CPNE, for this joint deviation to be self enforcing, one of these initially deviating countries should not have an incentive to further deviate, taking the announcement of the complement as fixed. We find that the initial deviation is never self-enforcing since the welfare of a hub country under a hub and spoke regime exceeds that of the member of a single FTA and thus free trade is always a CPNE under the FTA game when countries are symmetric. By contrast, two independent CUs (a hub and spoke type arrangement) are not feasible due to common external tariff requirement and thus the initial joint deviation of two countries that converts free trade to a bilateral CU is self-enforcing and free trade fails to be a CPNE in the CU game when bound tariffs are sufficiently low. As a result, whereas the exclusion incentive is reflected in the equilibrium of the CU game, it goes unexpressed in the FTA game due to the lure of a hub and spoke arrangement and the flexibility that FTA members have in pursuing such an arrangement.

Given that free trade always arises as a CPNE under the FTA game when countries are completely symmetric, we next examine under what circumstances, if any, free trade fails to be a CPNE. We show that such a possibility arises only when countries are asymmetric with respect to their comparative advantage.[8] It turns out that, due to smaller export and larger import volumes, the country with a weaker comparative advantage in the exporting goods has an incentive to free ride on trade liberalization between the other countries. Lower bound tariff rates disciplines this incentive via limiting the ability of setting optimal tariffs. As before, due to the lure of a hub and spoke arrangement and the relatively flexible nature of FTA formation, exclusion incentives go unexercised and free riding incentive becomes pivotal for multilateral free trade to be a CPNE. As a result, multilateral free trade is more likely to be a CPNE as the multilateral negotiated bound tariff rates decline. This result provides support for the idea that multilateral trade liberalization acts as a complement to the FTA formation in achieving global free trade: FTA formation is more likely to act as a building bloc when it is accompanied by lower bound tariff rates.

The link between multilateral trade liberalization and PTA formation has also been examined in the earlier literature. Ethier (1998) addresses the relationship between multilateralism and the formation of PTAs in a small country–large country model. He argues that regionalism is a benign consequence of the success of multilateralism since it allows small countries to benefit from formation of FTAs with large countries to gain a marginal advantage over other small countries in attracting foreign direct investment. In this paper, we abstract from foreign investment and simply focus on international trade between three large open economies. One of the closely related paper to the present paper is Freund (2000) that takes bilateral PTAs and multilateral free trade as exogenously given, ignoring the hub and spoke regime in a symmetric oligopoly model of trade. By contrast, we employ an endogenous FTA formation approach in a perfectly competitive comparative advantage model in which multilateral free trade is a collection of free trade agreements. While our results extend support to Freund (2000) in that, as bound tariffs fall, the forces pulling

[8] Our results extend support to Krugman (1991) and Grossman and Helpman (1995) who argue that asymmetries across countries can play a crucial role in determining incentives for preferential and multilateral trade liberalization.

countries away from free trade into bilateral agreements strengthen implying that the exclusion incentive rises with the multilateral tariff reduction. Unlike Freund (2000), we show that the exclusion incentive goes unexercised and free riding incentive becomes pivotal in a model where FTA formation is endogenous. Another important difference is that, rather than employing a repeated game framework as in Freund (2000), we use CPNE concept to sort out the trade agreements that are immune to self-enforcing coalitional deviations.[9]

Our paper is also very closely related to the recent paper by Lake and Roy (2017) that uses a model where multilateral tariff negotiations precede sequential FTAs and show that FTA formation expands to global free trade in the absence of global tariff negotiations but global free trade never emerges when global tariff negotiations precede FTA formation. It is argued that preceding multilateral negotiations can be the cause of so called "gated globalization". In fact, "gated globalization" is very similar to our exclusion incentive discussion in a static framework and thus our CU game leads to a very similar result as in Lake and Roy (2017). However, the dynamic farsighted model in Lake and Roy (2017) along with preceding endogenous multilateral negotiations make exclusion incentives more pivotal and lead to different equilibrium outcome in the FTA formation game. While the motivation and trade models are quite similar, the major difference is that we use exogenous bound tariffs to capture all possible tariff binding scenarios whereas Lake and Roy (2017) endogenizes the multilateral tariff negotiations. In linking the multilateral and preferential trade liberalization in an endogenous way, the use of sequential nature of the game in Lake and Roy (2017) assumes that governments are forward looking and when undertaking global tariff negotiations they anticipate the possibility of FTA formation even though they do not yet know the precise sequential order in which country pairs will form FTAs. We take a totally different standpoint, arguing that it is hard to believe that countries were anticipating the proliferation of PTAs and rather there were several other determinants and policy priorities during the last successful round of multilateral trade negotiations (Uruguay round) and thus taking the bound tariff rates exogenously given seems to be a more reasonable approach.

2 Trade model

Our underlying economic framework is an adapted version of the two-country model of Horn *et al.* (2010). We consider a perfectly competitive world with three large countries: $z = i, j$, and k and three (non-numéraire) goods: $g = I$, J, and K and a numéraire good v_0. On the demand side, the representative citizen's utility function is assumed to be quasi-linear:

$$U(\mathbf{v}, v_0) = u(\mathbf{v}) + v_0, \tag{1}$$

where $\mathbf{v} = [v_I, v_J, v_K]$ is the consumption vector for the three non-numéraire goods, v_0 denotes the consumption of the numéraire good, and $u(\mathbf{v})$ is quadratic and additively separable in the three

[9] Other papers that examine the relationship between preferential and multilateral liberalization in models of repeated interaction between countries include Bagwell and Staiger (1997a, 1997b), Bond et. al. (2001) and Saggi (2006).

non-numéraire goods. The demand for good g in country z is then given by

$$d_z^g(p_z^g) = \alpha - p_z^g \quad (2)$$

where p_z^g denotes the consumer price of good g in country z. Assuming that the population in each country is a continuum of measure one, we can write the consumer surplus associated with good g in country z as:

$$CS_z^g(p_z^g) = u_z^g[d_z^g(p_z^g)] - p_z^g d_z^g(p_z^g) \quad (3)$$

On the supply side, as in Horn *et al.* (2010), labour (ℓ) is the only factor of production which is employed in the production of the numéraire good that is produced one-for-one from labor. The supply of labor is assumed to be large enough that the numéraire good is always produced in a positive amount; therefore the equilibrium wage is equal to one. Each non-numéraire good is produced from labor with diminishing returns. In particular, we assume the following production function for non-numéraire good g in country z: $Q_z^g = \sqrt{2\lambda_z^g \ell_g}$, where Q_z^g is the production of good g in country z and ℓ_g is the labor employed in the production of good g. The supply function of good g in country z is as follows:

$$s_z^g(q_z^g) = \lambda_z^g q_z^g \quad (4)$$

where q_z^g denotes the producer price for good g in country z.

We assume the following comparative advantage structure across countries: $\lambda_i^I = \lambda_j^J = \lambda_k^K = 1$ while $\lambda_i^J = \lambda_i^K = 1 + \lambda_i$; $\lambda_j^I = \lambda_j^K = 1 + \lambda_j$ and $\lambda_k^I = \lambda_k^J = 1 + \lambda_k$. In other words, each country has a comparative advantage in two goods while having a comparative disadvantage in the other good: each country imports the good that is indexed by the same uppercase letter as the identity of the country. For example, country i imports good I while exporting good J to country j and good K to country k. Thus, there are two *competing exporters* for each non-numéraire good. Country z's producer surplus in good g as follows:

$$PS_z^g(q_z^g) = \int s_z^g(q_z^g) dq_z^g = \frac{1}{2}\lambda_z^g (q_z^g)^2 \quad (5)$$

Due to the absence of any tariff in country i on goods J and K, the consumer and producer prices of goods J and K in country i are equal: $q_i^J = p_i^J$ and $q_i^K = p_i^K$. As there is no domestic taxation for the import competing sector, producer and consumer prices are also equal in this sector: $q_i^I = p_i^I$.

As a representative scenario for all goods and countries, consider good I (i.e. the good in which country i is has a comparative disadvantage). Let t_{ij} be the tariff imposed by country i on its imports of good I from country j. Ruling out prohibitive tariffs yields the following no-arbitrage conditions for good I:

$$p_i^I = p_j^I + t_{ij} \ = p_k^I + t_{ik} \quad (6)$$

Let m_i^I be country i's imports of good I:

$$m_i^I = d(p_i^I) - s_i^I(p_i^I) = \alpha - 2p_i^I \quad (7)$$

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

$$x_j^I = (1+\lambda_j)p_j^I - [\alpha - p_j^I] \text{ and } x_k^I = (1+\lambda_k)p_k^I - [\alpha - p_k^I] \tag{8}$$

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

$$m_i^I = \sum_{z \neq i} x_z^I \tag{9}$$

Equations (6) through (9) imply that the equilibrium prices of good I in the importing country i and an exporting country (say J) equal:

$$p_i^I = \frac{3\alpha + \sum_{z\neq i} t_{iz}(2+\lambda_z)}{(\lambda_j + \lambda_k + 6)} \text{ and } p_j^I = \frac{3\alpha + t_{ik}(\lambda_k+2) - t_{ij}(\lambda_k+4)}{(\lambda_j+\lambda_k+6)} \tag{10}$$

As it is clear from equation (10), the price of good I in country i increases in its tariffs (pass through effect) and decreases in the degree of comparative advantage of the other two countries (supply effect). The effect of a country's tariff on its terms of trade (say t_{ij} on country j) is evident from equation (10): only $\frac{2+\lambda_j}{(\lambda_j+\lambda_k+6)} < 1$ of a given increase in either of its tariffs is passed on to domestic consumers with exactly $\frac{(\lambda_k+4)}{(\lambda_j+\lambda_k+6)} < 1$ of the increase falling on the shoulders of country j's exporters.

Using the above prices, finding the export of each country is straightforward:

$$x_j^I = \frac{(2+\lambda_j)\left[3\alpha + t_{ik}(\lambda_k+2) - t_{ij}(\lambda_k+4)\right]}{(\lambda_j+\lambda_k+6)} - \alpha$$

Note that the export of country j to country i (x_j^I) rises with the degree of comparative advantage country j (λ_j) and the tariff the rival exporter faces (t_{ik}) while it falls with the degree of comparative advantage of the rival exporter (λ_k) and the tariff it itself faces in country i (t_{ij}).

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

$$w_z = \sum_g CS_z^g + \sum_g PS_z^g + \sum_{z\neq h} t_{zh} x_h^Z \tag{11}$$

Using equations (6) through (10) one can easily obtain welfare of country i as a function of the degrees of comparative advantage and tariffs.

2.1 Optimal Tariffs (sufficiently high bound tariffs)

Before describing optimal tariffs, let country i's welfare as a function of trade regime r be denoted by $w_i(r)$ and let $\Delta w_i(r-v)$ denote the difference between country i's welfare under trade regimes r and v: $\Delta w_i(r-v) \equiv w_i(r) - w_i(v)$. First, we assume that bound tariffs are sufficiently high and countries are not constrained in imposing their optimal tariffs under all possible trade regimes (i.e. there exists a tariff binding overhang under all trade regimes).

2.1.1 No agreement (empty network)

To examine the interaction between the external tariffs of a country, for now, we allow countries to be able to discriminate and later impose the MFN constraint. At the empty network $\varnothing$, we find that tariffs are strategic complements:

$$\frac{\partial^2 w_i(\varnothing)}{\partial t_{ij}\partial t_{ik}} = \frac{2(\lambda_j+2)(\lambda_k+2)(\lambda_j+\lambda_k+7)}{(\lambda_j+\lambda_k+6)^2} > 0$$

In other words, an increase (decrease) in external tariff on one exporter raises the incentive to impose higher (lower) external tariff on the other exporter. The intuition is as follows. As country i imposes higher tariff on country j, export supply of country k into country i becomes less elastic and thus the tariff on country k also rises.

When countries are not constrained by the multilaterally negotiated tariff bindings, each country i chooses a non-discriminatory tariff (in accordance with GATT Article I) $t_i = t_{ij} = t_{ik}$ to maximize its welfare:

$$t_i(\varnothing) = Arg\max w_i(\varnothing) = \frac{\alpha(\lambda_j+\lambda_k)}{(\lambda_j+\lambda_k+4)(\lambda_j+\lambda_k+8)} \tag{12}$$

Note that $t_i(\varnothing)$ rises with the degrees of comparative advantage of the exporters (λ_j and λ_k). Next, we examine how an FTA formation affects members' external tariffs.

2.1.2 Free Trade Agreements

When countries are not constrained by the multilaterally negotiated bound tariff rates, upon FTA formation, member countries remove their internal tariffs on each other and impose their individually optimal external tariff on the non-member. Under a single FTA between i and j we have $t_{ij} = t_{ji} = 0$ and the optimal external tariff of country i on the non-member country k is given by:[10]

$$t_{ik}(ij) \equiv Arg\max w_i(ij) = \frac{(\lambda_j+\lambda_k+8)\alpha(\lambda_k-\lambda_j)+\alpha\lambda_k}{(\lambda_k+2)[(\lambda_j+3)(\lambda_j+\lambda_k+7)+1]} \tag{13}$$

As indicated above, the model exhibits tariff complementarity so that the formation of a bilateral FTA induces each member to lower its tariff on the non-member country relative to the status quo: $\Delta t_{ik}(\varnothing - ij) = t_i(\varnothing) - t_{ik}(ij) > 0$. This tariff complementarity becomes deeper as the degree of comparative advantage of the FTA partner rises and the one of the non-member country falls: $\frac{\partial \Delta t_{ik}(\varnothing - ij)}{\partial \lambda_j} > 0$ while $\frac{\partial \Delta t_{ik}(\varnothing - ij)}{\partial \lambda_k} < 0$.[11]

We next proceed as follows. First, we focus on the scenario where countries are completely symmetric with respect to their degrees of comparative advantage. Within this scenario, we employ an endogenous FTA formation game in which each country is free to pursue either no trade

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

[11] See Bagwell and Staiger (1997a, 1997b, 1999) and Saggi and Yildiz (2009) for a detailed discussion of the tariff complementarity effect and Estevadeordal et. al. (2008) for empirical evidence in its support. It is worth noting that tariff complementarity also arises in simple general equilibrium models of trade agreements such as Bond et. al. (2004).

liberalization or bilateral trade liberalization or multilateral free trade.[12] Our objective is to isolate the consequences of the interaction of the multilateral reduction in bound tariff rates and FTA formation in achieving global free trade. To this end, we assume that multilaterally negotiated bound tariff rates are exogenously given and countries are constrained by these bound rates in setting their optimum external tariffs, i.e. a country can not raise its tariff to a higher level than its bound rate. Under such an environment, we examine the coalition proof Nash equilibrium agreements of the FTA formation game for all possible levels of bound tariff rates. Then, we extend our analysis to two different settings: (i) where countries are asymmetric with respect to their degree of comparative advantage and (ii) where countries are symmetric while PTA under consideration is a customs union.

3 Endogenous trade agreements

We now describe our game of preferential trade liberalization. In the first stage, each country simultaneously announces the names of countries with whom it wants to sign an FTA. Let Ω^r denote the announcement profile that leads to regime r. Country i's announcement is denoted by σ_i and its strategy set S_i consists of four possible announcements:

$$S_i = \{\{\phi, \phi\}, \{j, \phi\}, \{\phi, k\}, \{j, k\}\}$$

where $\{\phi, \phi\}$ denotes an announcement in favor of no FTA with either trading partners, $\{j, \phi\}$ in favor of an FTA with only country j; $\{\phi, k\}$ in favor of an FTA with only country k; and $\{j, k\}$ in favor of FTAs with both of them.

It is important to note that we employ a game of announcements or proposals. In our game, a country does not announce in favor of a specific trade agreement but rather names partners with whom it wants to form such agreements**.** Since a trade agreement requires consent from both sides, the mapping between various announcements profiles that occurs and the types of trade agreements that countries can form are as follows:

(i) No two announcements match or the only matching announcements are $\{\phi, \phi\}$. Such announcement profiles $\Omega^{\varnothing}$ yield No agreement $\varnothing$ under which all countries impose their optimal Nash tariffs on one another as long as they are not constrained by the multilateral bound tariff rates (optimal MFN tariff falls below the bound rates). If they are constrained, they are required to apply the exogenously given bound tariff rates.

(ii) Two countries announce each others' name and there is no other matching announcement: i.e., $j \in \sigma_i$ and $i \in \sigma_j$ while $i \notin \sigma_k$ and/or $k \notin \sigma_i$ and $j \notin \sigma_k$ and/or $k \notin \sigma_j$. All of these announcement profiles Ω^{ij} yield an FTA between countries i and j denoted by $\langle ij \rangle$ under which members impose zero tariffs on each other and the optimal external tariff $t_{ik}(ij)$ and $t_{jk}(ij)$ on the non-member if these tariffs fall below the bound rates. Otherwise, they apply the exogenously given bound tariff rates.

[12] Since all countries have market power in our model, allowing for unilateral liberalization is not necessary: no country will choose to pursue such liberalization in our model.

(iii) Country i announces in favor of signing an FTA with countries j and k while countries j and/or k announce only in favor of signing an FTA with country i: i.e. $j \in \sigma_i$ and $i \in \sigma_j$ and $k \in \sigma_i$ and $i \in \sigma_k$ while $k \notin \sigma_j$ and/or $j \notin \sigma_k$. This set of announcement profiles Ω^{ih} yields a pair of independent FTAs (i.e. a hub and spoke trading regime) with i is the common member denoted by $\langle ij, ik \rangle$ (or simply $\langle ih \rangle$) under which countries j and k impose the tariff $t_{jk}(ih)$ and $t_{kj}(ih)$ on each other if these tariffs fall below the bound rates while practicing free trade with the hub country i. As before, if $t_{jk}(ih)$ and $t_{kj}(ih)$ exceed the bound rates, spoke countries impose these bound tariff rates on each other.

(iv) All countries announce each others' names. The corresponding announcement profile Ω^F yields global free trade, denoted by $\langle F \rangle$, under which all countries eliminate their tariffs on each other.

Note that since an FTA between two countries can arise only if it is mutually acceptable to both sides, multiple announcement profiles can map into the same agreement. For example, the FTA $\langle ij \rangle$ obtains when (i) countries i and j call only each other, regardless of the nature of country k's announcement: if $\sigma_i = \{j, \phi\}$ and $\sigma_j = \{i, \phi\}$, then $\langle ij \rangle$ obtains for all four possible announcements on the part of country k, i.e., for $\sigma_k \epsilon \{\{\phi, \phi\}, \{i, \phi\}, \{\phi, j\}, \{i, j\}\}$ so that country k's announcement has no bearing upon the outcome when neither of the other two countries' announce its name; (ii) countries i and j announce each other's name and either one or both of them also announce country k but country k does not reciprocate: $\sigma_i = \{j, k\}$ and $\sigma_j = \{i, \phi\}$ but $i \notin \sigma_k$ or $\sigma_i = \{j, \phi\}$ and $\sigma_j = \{i, k\}$ but $j \notin \sigma_k$ or $\sigma_i = \{j, k\}$ and $\sigma_j = \{i, k\}$ but $i, j \notin \sigma_k$.

3.1 Symmetric Comparative Advantage

Throughout the remainder of this section, we maintain the following complete symmetry assumption:[13]

Assumption 1:

$$\lambda_z = \lambda \textit{ for all } z = i, j, k. \qquad \text{(symmetry)}$$

Under symmetry, when countries are not constrained by the bound tariff rate, each country imposes a non-discriminatory tariff on its trading partners: $t_z(\varnothing) = t^{\varnothing}$, for all $z = i, j, k$ and due to market segmentation the non-member country under a bilateral FTA (say $\langle ij \rangle$) imposes the same external tariff on the member countries as the one under No agreement: $t_{ki}(ij) = t_{kj}(ij) = t^{\varnothing}$ where

$$t^{\varnothing} = \frac{\alpha\lambda}{2(\lambda+2)(\lambda+4)} \text{ where } z = i, j, k$$

Similarly, when member countries under a bilateral FTA (say $\langle ij \rangle$) and spoke countries under a hub and spoke regime (say $\langle ih \rangle$) are not bound, their optimal external tariffs are as follows: $t_{ik}(ij) = t_{jk}(ij) = t_{jk}(ih) = t_{kj}(ih) = t^f$ where

[13] Calculations supporting the results reported in this section as well as the rest of the paper are contained in the appendix.

$$t^f = \frac{\alpha\lambda}{(\lambda+2)(2\lambda^2+13\lambda+22)}$$

3.1.1 Different Tariff Binding Scenarios - Symmetry

Let τ denote the bound tariff rate resulting from multilateral negotiations and countries are not allowed to raise their tariffs to a higher level than their bound rates. Thus, given the above optimal tariffs and feasible bound rates, we have three possible scenarios (illustrated in Figure 1):

(i) no tariff binding scenario where the bound tariff rate exceeds the optimal tariff under No agreement: $\tau > t_z(\varnothing)$ so that countries are free to impose their optimal tariffs under all trade regimes;

(ii) partial tariff binding scenario where the bound tariff rate exceeds the optimal tariff under an FTA but falls below the optimal tariff under No agreement: $t^f < \tau < t^{\varnothing}$. Under such a case, countries under $\varnothing$ and the non-member country under an FTA impose the bound rate τ while the member countries under an FTA and spoke countries under a hub and spoke regime are free to impose their optimal external tariffs and

(iii) full tariff binding scenario where the bound tariff rate below the optimal tariff under an FTA: $\tau < t^f$. Under this scenario, countries lose their freedom to impose optimal tariffs under all trade regimes and apply their bound tariff rates (no tariff binding overhang).

- Insert Figure 1 -

3.1.2 Equilibrium Trade Agreements- Symmetry

Before deriving equilibrium agreements, we report a useful lemma that is easy to establish:

Lemma 1: *Under symmetry, we have:*

(i) $\Delta w_i(ij-\varnothing) = \Delta w_j(ij-\varnothing) > 0$ *for all* τ *and* λ while $\Delta w_k(ij-\varnothing) > 0$ only when $\tau > \overline{\tau}(\lambda)$ where $t^f < \overline{\tau}(\lambda) < t^{\varnothing}$;

(ii) $\Delta w_k(F-ij) > 0$ *for all* τ *and* λ;

(iii) $w_i(ih) > \max\{w_i(F), w_i(ij), w_i(\varnothing)\}$ and $\Delta w_j(F-ih) = \Delta w_k(F-ih) > 0$ *for all* τ *and* λ;

(iv) $\Delta w_j(ih-ik) = \Delta w_k(ih-ij) > 0$ only when $\tau < \underline{\tau}(\lambda)$ where $t^f < \underline{\tau}(\lambda) < t^{\varnothing}$ and

(v) $\overline{\tau}(\lambda) > \underline{\tau}(\lambda)$ for all λ.

The first part of the above lemma implies that, a pair of symmetric countries under $\varnothing$ always have an incentive to form a bilateral FTA and thus neither member country (i or j) has an incentive to unilaterally break its FTA link since doing so only leads to no agreement $\varnothing$, under which its welfare is lower. Part (i) also informs us that the formation of a bilateral FTA makes the non-member country better-off only when the bound tariff rate is sufficiently high: $\tau > \overline{\tau}(\lambda)$. Thus, when $\tau > \overline{\tau}(\lambda)$ holds, we argue that the formation of a bilateral FTA is Pareto improving. Here it is important to note that, relative to no agreement $\varnothing$, the benefit from staying outsider under a bilateral FTA gets weaker as bound tariffs fall since it restricts the ability of the non-member country to impose its optimal tariff and it completely disappears when $\tau < \overline{\tau}(\lambda)$ holds. Therefore, when $\tau < \overline{\tau}(\lambda)$ holds, the formation of an FTA makes member countries better off at the expense of the non-member.

Similar discussion applies to the second part of the above Lemma. We first note that no symmetric country has incentive to unilaterally break its link with both partners that leads to a deviation from multilateral free trade to an FTA in which it itself is not a member provided that countries are free to impose their optimal tariffs as under the *no tariff binding scenario*. As the bound tariff rates fall, this unilateral incentive gets even weaker since it restricts the ability of the non-member country to impose its optimal tariff. Part (*iii*) says that the hub country i under $\langle ih \rangle$ is better off relative to free trade $\langle F \rangle$ while each spoke country is worse off. Note that the hub country i enjoys privileged access in both spoke countries under $\langle ih \rangle$ – neither spoke country imposes a tariff on the hub country whereas both impose external tariffs on each other. As a result of this favorable treatment, country i is strictly better off under $\langle ih \rangle$ relative to $\langle F \rangle$. To see why the spokes are worse off under $\langle ih \rangle$ relative to $\langle F \rangle$, first note that aggregate global welfare is strictly higher under $\langle F \rangle$ relative to $\langle ih \rangle$. Since the hub is strictly better off under $\langle ih \rangle$ relative to $\langle F \rangle$ and welfare of the two spoke countries is equal due to symmetry, both spokes must be worse off under $\langle ih \rangle$ relative to $\langle F \rangle$.

Furthermore, part (iii) also informs us that the welfare of a hub country is higher than that of the member of a single bilateral FTA (and thus the under no agreement due to part (*i*)). Starting from a single FTA, the hub country's second FTA lowers the domestic welfare and raises the export surplus due to the privileged access in another country and the latter effect dominates the former regardless of the bound tariff rates. Part (*iv*) of the above Lemma implies that a spoke country has an incentive to revoke its FTA with the hub and become an outsider facing an FTA between the other two countries unless the bound tariff rates are sufficiently low. When the bound tariff rates are sufficiently low ($\tau < \underline{\tau}(\lambda)$), the non-member country's ability to impose optimal MFN tariff is restricted and staying outside an FTA becomes less attractive.

The above discussion in parts (ii) and (iii) argues that free riding incentives do not play any role for the equilibrium condition for free trade. One question remains to be answered: do countries have incentives to jointly exclude a country from free trade network?

Proposition 1a (exclusion incentive-symmetry): *Suppose Assumption 1 holds. Even though there exist no free riding incentives, exclusion incentive arises when bound tariff rates are sufficiently low:* $\Delta w_i(F - ij) = \Delta w_j(F - ij) < 0$ *when* $0 < \tau < \widehat{\tau}(\lambda)$ *where* $t^f < \widehat{\tau}(\lambda) < t^{\varnothing}$.

The above proposition establishes the existence of an *exclusion incentive* when bound tariff rates are sufficiently low: under such a case, a pair of countries prefer a bilateral FTA to free trade. The forces that give rise to the exclusion incentive can be understood as follows. First note that when countries are free to set their optimal tariffs as under the no tariff binding scenario ($\tau > t_z(\varnothing)$), exclusion incentive does not exist and $\Delta w_i(F - ij) > 0$ holds. Relative to free trade, each member country of an FTA has the ability to manipulate its terms of trade vis-à-vis the non-member while facing optimal Nash tariffs in the non-member's market. As the bound tariff rates fall below $t_z(\varnothing)$, the non-member country loses its ability to set its optimal MFN tariff under a bilateral FTA and is required to impose the bound tariff rate that is lower than the optimal MFN tariff rate while the member countries are fully able to impose their optimal external tariff (as under the *partial tariff binding scenario*). Thus, $\Delta w_i(F-ij)$ declines as τ falls and $\Delta w_i(F-ij) = 0$ obtains when $\tau = \widehat{\tau}(\lambda)$. As τ falls below $\widehat{\tau}(\lambda)$, we find that a pair of countries benefit if they can successfully exclude the third country from free trade network. Note from part (ii) of Lemma 1 that the exclusion incentive exists at the expense of the excluded country.

Using Lemma 1, we can show that the Nash equilibria of the FTA game are as follows:

Proposition 2 (Symmetry-Nash): *Suppose Assumption 1 holds. Then, the following announcement profiles are Nash equilibrium of the FTA game:*

(i) $\Omega^{\varnothing} \equiv \{\sigma_i = \{\phi, \phi\},\ \sigma_j = \{\phi, \phi\},\ \sigma_k = \{\phi, \phi\}\}$ *leading to* $\varnothing$ *for all* τ *and* λ;

(ii) $\Omega^{ij} \equiv \{\sigma_i = \{j, \phi\},\ \sigma_j = \{i, \phi\},\ \sigma_k = \{\phi, \phi\}\}$ *leading to* $\langle ij \rangle$ *for all* τ *and* λ;

(iii) $\Omega^{F} \equiv \{\sigma_i = \{j, k\},\ \sigma_j = \{i, k\},\ \sigma_k = \{i, j\}\}$ *leading to* $\langle F \rangle$ *for all* τ *and* λ while

(iv) $\Omega^{ih} \equiv \{\sigma_i = \{j, k\},\ \sigma_j = \{i, \phi\},\ \sigma_k = \{i, \phi\}\}$ *leading to* $\langle ih \rangle$ *is a Nash equilibrium only when* $\tau < \underline{\tau}(\lambda)$.

The logic behind Proposition 1 is as follows. It is straightforward that the announcement profile $\Omega^{\varnothing}$ is a Nash equilibrium since no country has an incentive to announce another's name if the latter does not announce its name in return. Next consider Ω^{ij}. Note from part (i) of Lemma 1 that neither member country (i or j) has an incentive to unilaterally change its announcement from that which it makes under Ω^{ij} since doing so only leads to no agreement $\varnothing$, under which its welfare is lower. Similarly, given that neither country i nor country k announces its name, country k has no incentive to alter its announcement from $\sigma_k = \{\phi, \phi\}$ since doing so has no bearing on the resulting trade agreement. Thus, the announcement profile Ω^{ij} yielding a bilateral FTA is a Nash equilibrium.

Now consider the announcement profile Ω^{F} that yields global free trade $\langle F \rangle$. Parts (ii) and (iii) of Lemma 1 together imply that a country (say k) has no incentive to unilaterally deviate from its announcement $\{i, j\}$ since doing so alters the trade regime from from $\langle F \rangle$ to $\langle ij \rangle$ or $\langle ih \rangle$ or $\langle jh \rangle$ under which it is worse off. Therefore, the announcement profile Ω^{F} that yields global free trade $\langle F \rangle$ is always a Nash equilibrium.

Finally, consider the announcement profile Ω^{ih} associated with the hub and spoke regime $\langle ih \rangle$. First note from part (iii) of Lemma 1 that, the hub country i has no incentive to unilaterally change its announcement from $\{j, k\}$ to $\{j, \phi\}$ or $\{\phi, k\}$ or $\{\phi, \phi\}$ since doing so translates into a deviation from the hub and spoke regime $\langle ih \rangle$ where i is the hub country to $\langle ij \rangle$ or $\langle ik \rangle$ or $\varnothing$ respectively. Now consider the unilateral incentive of a spoke country to deviate from Ω^{ih}. Part (iv) of Lemma 1 states that, only when $\tau > \underline{\tau}(\lambda)$ holds, either spoke country (say j) has an incentive to unilaterally deviate from its announcement $\{i, \phi\}$ to $\{\phi, \phi\}$ since this deviation translates into a deviation from

$\langle ih \rangle$ where j is a spoke country to $\langle ik \rangle$ where j is a non-member country. As a result, when $\tau \leq \underline{\tau}(\lambda)$ holds, neither the hub nor the spokes have an incentive to unilaterally alter their announcements from Ω^{ih} so that hub and spoke regime $\langle ih \rangle$ is indeed supported by a announcement profile that constitutes a Nash equilibrium of the FTA game.

It is immediate to note from Proposition 1 that there is a unique announcement profile that supports each agreement as a Nash equilibrium and that the profile itself is the most *parsimonious* one. For example, even though $\{\sigma_i = \{\phi, j\}, \sigma_j = \{\phi, \phi\}, \sigma_k = \{\phi, \phi\}\}$ also maps to $\varnothing$, such an announcement profile does not constitute a Nash equilibrium. To see why, simply note that given these announcements, country j has an incentive to alter its announcement from $\sigma_j = \{\phi, \phi\}$ to $\sigma_j = \{i, \phi\}$ in order to form the bilateral FTA $\langle ij \rangle$. Similarly, it is worth considering briefly as to why $\{\sigma_i = \{j, \phi\}, \sigma_j = \{i, \phi\}, \sigma_k = \{i, \phi\}\}$ is not a Nash equilibrium profile even though, just as the announcement profile Ω^{ij}, its maps into the FTA $\langle ij \rangle$. Under this announcement profile, given the announcements of countries j and k, as per part (*iii*) of Lemma 1, country i has an incentive to alter its announcement to $\sigma_i = \{j, k\}$ so as to obtain the trade agreement $\langle ih \rangle$ under which it is the hub. Using analogous reasoning, we can rule out all other non-parsimonious announcements as candidates for Nash equilibria.

Coalition Proof Nash Equilibria To deal with the multiplicity problem and to capture the process of FTA formation in a more realistic fashion, we refine the set of Nash equilibria by isolating those Nash equilibria that are coalition proof. Bernheim *et al.* (1987) state that "in an important class of "noncooperative" environments, it is natural to assume that players can freely discuss their strategies, but cannot make binding commitments. In such cases, any meaningful agreement between the players must be self-enforcing. Although the Nash best-response property is a necessary condition for self-enforceability, it is not sufficient - it is in general possible for coalitions to arrange plausible, mutually beneficial deviations from Nash agreements." Allowing countries to discuss their strategies regarding which trade agreements they intend to form is eminently desirable in the present context since countries considering bilateral trade agreements certainly have the capacity to communicate with one another without necessarily having the ability to make binding commitments regarding their future plans. Following Bernheim *et al.* (1987): "*... an agreement is coalition-proof if and only if it is Pareto efficient within the class of self-enforcing agreements. In turn, an agreement is self-enforcing if and only if no proper subset (coalition) of players, taking the actions of its complement as fixed, can agree to deviate in a way that makes all of its members better off.*" Therefore, a coalition proof Nash equilibrium (CPNE) is immune to all self-enforcing coalitional deviations.

Which, if any, of the Nash equilibrium announcement profiles described above are CPNE? We begin by considering whether the announcement profile Ω^F that leads to global free trade $\langle F \rangle$ is a CPNE. Since world welfare is the highest under $\langle F \rangle$, each country prefers $\langle F \rangle$ to $\varnothing$ and thus we can immediately rule out any coalitional announcement deviations that would lead to a deviation from $\langle F \rangle$ to $\varnothing$. Similarly, we know from part (iii) of Lemma 1 that no two countries (say j and

k) have incentives to jointly alter their announcements from $\{i, k\}$ to $\{i, \phi\}$ and $\{i, j\}$ to $\{i, \phi\}$, respectively since doing so would lead to a deviation from $\langle F \rangle$ to $\langle ih \rangle$ where both are spokes (and spokes are worse of relative to free trade).

Finally, taking the announcement of their complement (country k) fixed, consider the joint deviation of two countries (say i and j) from their announcements $\{j, k\}$ and $\{i, k\}$ to $\{j, \phi\}$ and $\{i, \phi\}$ respectively. This joint deviation implies a coalitional deviation from free trade $\langle F \rangle$ to a bilateral FTA $\langle ij \rangle$. From Proposition 1 we know that, taking the announcement of their complement (country k) fixed at $\sigma_k = \{i, j\}$, the above coalitional deviation in announcements would occur when $\tau < \overline{\tau}(\lambda)$ holds. The question then becomes whether this joint deviation is self-enforcing. The next proposition argues that *it is not*:

Proposition 1b (unexercised exclusion incentive): *Suppose Assumption 1 holds and* $\tau < \widehat{\tau}(\lambda)$ *holds. Then, even though a pair of countries benefit from excluding the third country from their own free trade network, the lure of becoming hub under a hub and spoke regime and the flexibility that FTA members have to pursue such an arrangement yield that such incentive goes unexercised in the equilibrium.*

The intuition behind the above proposition is as follows. When $\tau < \widehat{\tau}(\lambda)$ holds, two countries (say i and j) have incentives to jointly deviate from their free trade announcements $\{j, k\}$ and $\{i, k\}$ to $\{j, \phi\}$ and $\{i, \phi\}$ respectively. Note that taking the announcement of the excluded country as given $\sigma_k = \{i, j\}$, we know from Lemma 1 part (*iii*) that country i has an incentive to alter its announcement $\{j, \phi\}$ to $\{j, k\}$ further in order to create the trading regime $\langle ih \rangle$ where it becomes the hub. Similarly, country j has an incentive to alter its announcement $\{i, \phi\}$ to $\{i, k\}$ so as to itself become the hub. Thus, the initial coalitional announcement deviations that can cause free trade $\langle F \rangle$ to be replaced by the bilateral FTA $\langle ij \rangle$ is not self-enforcing. The key message of this result is that even though a pair of countries benefit from excluding the third country from their trade agreement, *they are unable to exercise this exclusion incentive in equilibrium.*

The above discussion and propositions together imply that there exists no unilateral and self enforcing coalitional incentives to deviate from the announcement profile Ω^F and thus the following result obtains:

Proposition 2 (Symmetry-CPNE): *Suppose Assumption 1 holds. Then, the announcement profile leading to* $\langle F \rangle$ *is CPNE for all* τ *and* λ.

As in Saggi and Yildiz (2010), the above result implies that if global trade liberalization were to confer equal gains upon all countries (which is what happens when countries are completely symmetric), the pursuit of FTAs is compatible with the goal of achieving global free trade. Unlike Saggi and Yildiz (2010), we go one step further and obtain this result for all possible bound tariff rates. The flexible nature of FTAs plays a crucial role in ensuring that the exclusion incentive goes unexercised in the FTA game: the lure of a hub and spoke trading arrangement ends up delivering free trade as a CPNE of the FTA game.

Next, we consider whether the announcement profiles that lead to the other agreements are CPNE. First, consider no agreement $\varnothing$. Note from Lemma 1 part (i) that any two countries (say i and j) have an incentive to coalitionally change their announcements from $\{\phi, \phi\}$ and $\{\phi, \phi\}$ to $\{j, \phi\}$ and $\{i, \phi\}$ respectively, taking country k's announcement fixed: $\sigma_k = \{\phi, \phi\}$. This initial deviation is self-enforcing since no proper subset of the initially deviating countries (neither i nor j) has an incentive to alter its announcement unilaterally (i.e. announcement profile that leads to $\langle ij \rangle$ is a Nash equilibrium). Therefore, the announcement profile that leads to $\varnothing$ is not a CPNE.

Is the announcement profile that leads to a hub and spoke regime (say $\langle ih \rangle$) a CPNE? Note from part (iii) of Lemma 1 that countries j and k have an incentive to coalitionally change their announcements from $\{i, \phi\}$ and $\{i, \phi\}$ to $\{i, k\}$ and $\{i, j\}$ respectively, taking country i's announcement fixed at $\sigma_i = \{j, k\}$. This coalitional deviation would convert the hub and spoke regime $\langle ih \rangle$ to free trade $\langle F \rangle$. Furthermore, this initial coalitional deviation is self-enforcing since no proper subset of the initially deviating countries (neither j nor k) has an incentive to further unilaterally deviate since $\langle F \rangle$ is a Nash equilibrium. Therefore, the announcement profile that leads to a hub and spoke regime is not a CPNE.

Finally, we examine whether the announcement profile that leads to a bilateral FTA $\langle ij \rangle$ is a CPNE. From parts (iii) and (iv) of Lemma 1 we know that, taking country j's announcement fixed at $\sigma_j = \{i, \phi\}$, countries i and k have an incentive to coalitionally change their announcements from $\{j, \phi\}$ and $\{\phi, \phi\}$ to $\{j, k\}$ and $\{i, \phi\}$ respectively when $\tau < \underline{\tau}(\lambda)$ holds. This initial coalitional deviation would convert FTA $\langle ij \rangle$ to the hub and spoke regime $\langle ih \rangle$ where i is the hub and j and k are spokes. Furthermore, when $\tau < \underline{\tau}(\lambda)$ holds, this initial coalitional deviation is self-enforcing since no proper subset of the initially deviating countries (neither i nor k) has an incentive to unilaterally alter its announcement since the announcement profile that leads to $\langle ih \rangle$ is a Nash equilibrium. Moreover, all three countries have incentives to jointly deviate from their announcements Ω^{ij} to Ω^F when $\tau > \widehat{\tau}(\lambda)$ holds and this coalitional deviation is self enforcing since no proper subset of the initially deviating countries has an incentive to deviate further. Combining these two self enforcing deviations with part (iv) of Lemma 1, it is immediate that the announcement profile that leads to a bilateral FTA is a CPNE only when $\underline{\tau}(\lambda) \leq \tau \leq \widehat{\tau}(\lambda)$ holds and under such a case we have multiple CPNE and theory offers no guidance which of these equilibria would arise.

Given Proposition 2, it is natural to ask: under what circumstances, if any, free trade fails to be a CPNE? We show next that such a possibility arises (only) when countries are asymmetric with respect to their comparative advantage.

4 Asymmetric Comparative Advantage

From hereon, we drop the assumption that the degrees of comparative advantages are symmetric across countries. In what follows, the size of a country is measured by the degree of comparative advantage in the exporting sectors, translating directly into asymmetries of volume of exports. In other words, since the model is partial equilibrium in nature and lacks any income effects, an increase in a country's degree of comparative advantage in this model increases its exports of non-numéraire/protected goods. Since import demand functions are symmetric, the larger the comparative advantage of the other countries in their exporting goods, the larger the import volume of a country. Thus, the smaller exporting countries are also the larger importing countries. It is worth emphasizing that in our model no country is a price taker on world markets – in fact each country is the unique importer of a single good and therefore has market power that it can exploit via an external tariff.

How does the asymmetry affect the preferences of countries for trade agreement formation?

4.1 Two larger one smaller exporters

To highlight the role played by asymmetric comparative advantage, it proves instructive to consider a scenario where two countries ('larger' exporting countries denoted by l and l') have higher degrees of comparative advantages in their exporting sectors than the third (denoted by s; refereed to as the 'smaller' exporting country).[14] Accordingly, let the pattern of asymmetry be given by:[15]

Assumption 2:

$$\underline{\lambda} \leq \lambda_s < \lambda_l = \lambda_{l'} = \lambda \tag{14}$$

Here it is important to note from (13) that, in order to guarantee non-negative tariffs, we assume that the degree of asymmetry is not very large: $\lambda_s \geq \underline{\lambda} = \sqrt{\lambda^2 + 8\lambda + 25} - 5$.

The following lemma informs us how the incentive of a larger exporting country to form an FTA depends on the degree of comparative advantage of the smaller trading partner:

Lemma 2: *Let country s be an FTA partner of country l under regime r but not under regime v. Then, the following holds:* $\frac{\partial \Delta w_l(r-v)}{\partial \lambda_s} < 0$.

The intuition underlying the inequality $\frac{\partial \Delta w_l(r-v)}{\partial \lambda_s} < 0$ is as follows. The weaker the comparative advantage of a smaller exporting country, the larger the increase in the export surplus of larger importing country as an FTA partner from the elimination of its smaller partner's optimal tariff and the smaller the loss due to its own trade liberalization since the tariff reduction applies to a smaller volume of imports (due to the smaller export capacity of its partner). This immediately implies that a larger exporting country prefers to form a bilateral FTA with the smaller of its two trading partners:

$$w_l(sl) \geq w_l(ll') \tag{15}$$

From hereon, let $\lambda_i(r-v)$ denotes the critical degree of comparative advantage of country s at which country i is indifferent between regimes r and v.

[14] As noted earlier, in our model no country is 'small' in the traditional sense since all three can influence their terms of trade. Hence we use the word 'smaller' as opposed to 'small'.

[15] In the next section, we show that our results extend to the case where there are two smaller and one larger exporters.

4.1.1 Different Tariff Binding Scenarios - Asymmetry

The optimal tariffs reported above in section 2 combined with Assumption 2 leads to the following ranking of the optimal tariffs under all feasible trade regimes, assuming that bound tariff rates do not bind:[16]

$$t_s(\varnothing) > t_l(\varnothing) > t_{ll'}(sl) > t_{sl'}(sl) > t_{ls}(ll') > 0$$

As before, let τ denote the bound tariff rate. Given the above ranking, "no tariff binding" and "full tariff binding" scenarios are similar to the one under complete symmetry while the partial tariff binding scenario has four distinct sub-scenarios as illustrated in Figure 2:

(i) no tariff binding scenario arises when $\tau > t_s(\varnothing)$ holds. Under such a case, all countries are free to impose their optimal tariffs under all feasible trade regimes (tariff binding overhang under all regimes).

(ii) partial tariff binding scenarios:

- $t_l(\varnothing) < \tau < t_s(\varnothing)$: except for country s under $\varnothing$ and as a non-member under the bilateral FTA $\langle ll' \rangle$, countries are free to impose their optimal tariffs under all feasible trade regimes. Country s under $\varnothing$ and $\langle ll' \rangle$ is constrained to impose the bound tariff rate τ.

- $t_{ll'}(sl) < \tau < t_l(\varnothing)$: countries under $\varnothing$ (and non-member countries under a bilateral FTA) are constrained to impose their bound tariff rates while FTA member countries are free to impose their optimal tariffs.

- $t_{sl'}(sl) < \tau < t_{ll'}(sl)$: countries under $\varnothing$ (and non-member countries under a bilateral FTA) and larger member country under $\langle sl \rangle$ or $\langle sl' \rangle$ (and as a spoke under $\langle sh \rangle$) are constrained to impose their bound tariff rates while the other FTA member countries are free to impose their optimal tariffs.

- $t_{ls}(ll') < \tau < t_{sl'}(sl)$: except for the member countries under $\langle ll' \rangle$ (and larger spoke country under $\langle lh \rangle$), countries are constrained to impose their bound tariff rates.

(iii) full tariff binding scenario arises when $\tau < t_{ls}(ll')$ holds. Under this scenario, all countries lose their freedom to impose optimal tariffs under the entire set of trade regimes and they are required to apply their bound tariff rates (no tariff binding overhang).

- Insert Figure 2 -

4.1.2 Preferences for FTAs under Asymmetry

To avoid redundancy, we focus directly on free trade and examine when free trade is a CPNE under the scenario with asymmetric comparative advantage. To this end, we first state the following lemma that is useful in deriving the CPNE condition for free trade:

[16] Note that, due to market segmentation, the following holds: $t_s(\varnothing) = t_{sl}(ll')$; $t_l(\varnothing) = t_{ls}(sl')$; $t_{ll'}(sl) = t_{ll'}(sh)$; $t_{sl'}(sl) = t_{sl'}(lh)$ and $t_{ls}(ll') = t_{ls}(l'h)$.

Lemma 3: *Suppose that Assumption 2 holds. Then, we have*

(i) $\Delta w_l(sl - \varnothing) > 0$; $\Delta w_l(F - \phi) > 0$; $\Delta w_l(F - sl') > 0$; $\Delta w_l(F - sh) > 0$ and $\Delta w_l(F - l'h) > 0$ *for all* τ, λ and λ_s *and*

(ii) $\Delta w_l(lh - ll') > 0$ and $\Delta w_s(sh - sl) > 0$ *for all* τ, λ and λ_s.

The first part of the above lemma is an extension Lemma 1 into an asymmetric setting for large countries. Note that since $\Delta w_l(F - sl') > 0$; $\Delta w_l(F - sh) > 0$ and $\Delta w_l(F - l'h) > 0$ *for all* τ, λ and λ_s, a larger exporting country has no incentive to unilaterally deviate from its announcement that leads to free trade. Lemma 3 implies that the only announcement deviation a larger exporting country (say l) would participate is the joint deviation with the other larger exporting country (country l') or with the smaller exporting country (country s) from their announcements that lead to free trade to announcements that lead to a bilateral FTA between each other. However, even when such incentives exist, it is immediate from part (ii) of the above Lemma that they are not self-enforcing since $\Delta w_l(lh - ll') > 0$ and $\Delta w_s(sh - sl) > 0$ always hold. To see it more clearly, taking the announcement of country s as given, consider the joint deviation of two larger exporting countries from their respective announcements $\sigma_l = \{s, l'\}$ and $\sigma_{l'} = \{s, l\}$ to $\sigma_l = \{\phi, l'\}$ and $\sigma_{l'} = \{\phi, l\}$ leading to deviation from $\langle F \rangle$ to $\langle ll' \rangle$. Such deviation happens only when $\lambda_s > \lambda_l(F - ll')$. In other words, two larger exporting countries have incentives to jointly exclude the small exporting country only when the degree of comparative advantage asymmetry is sufficiently small. However, since $\Delta w_l(lh - ll') > 0$ always holds, taking the announcement of country s as given: $\sigma_s = \{l, l'\}$, either of the initially deviating larger exporting countries (say country l) has incentive to further deviate from $\sigma_l = \{\phi, l'\}$ to $\sigma_l = \{s, l'\}$ to become the hub country under $\langle lh \rangle$. As a result, the initial announcement deviation is not self enforcing. Similarly, since $\Delta w_s(sh - sl) > 0$ always holds as well, the same logic applies for the coalitional announcement deviations of country s and one of the larger exporting countries to exclude the other larger exporting country. Even when such deviation occurs, it is not a self-enforcing one since country s has an incentive to further deviate to become a hub country. Then, the following result is an immediate extension of Propositions 1a and 1b into the asymmetric setting:

Proposition 3 (exclusion incentive-asymmetry): *Suppose Assumption 2 holds. While exclusion incentives arise, the flexibility that FTA members have in forming an additional FTA yields that such incentive goes unexercised in the equilibrium.*

Lemma 3 and Proposition 3 together imply that there exists no self-enforcing coalitional deviation in which a larger exporting country is involved. As a result, the unilateral announcement deviation of the smaller country from Ω^F is pivotal for Ω^F for being a CPNE. Thus, we have to consider the following two unilateral deviations of country s:

(i) unilateral announcement deviation of country s from $\sigma_s = \{l, l'\}$ to $\sigma_s = \{l, \phi\}$ (or $\sigma_s = \{\phi, l'\}$) leading to deviation from $\langle F \rangle$ to $\langle lh \rangle$ (or $\langle l'h \rangle$).

(ii) unilateral announcement deviation of country s from $\sigma_s = \{l, l'\}$ to $\sigma_s = \{\phi, \phi\}$ leading to deviation from $\langle F \rangle$ to $\langle ll' \rangle$.

Consider the unilateral deviation (i) first. We know from our previous discussion that, when countries are completely symmetric, no country has an incentive to unilaterally deviate irrespective of the bound tariff rates. However, the asymmetry in comparative advantages leads to asymmetric preferences for trade liberalization. We can easily show that, due to the smaller volume of its exports, country s benefits less from tariff reductions granted by a larger exporting country and it loses relatively more from eliminating its own optimal tariff since it applies to relatively larger import volumes and thus we can show that $\frac{\partial \Delta w_s(F-lh)}{\partial \lambda_s} > 0$ always holds. We find that there exists a critical threshold degree of asymmetry beyond which country s has an incentive to unilaterally deviate from its free trade announcement $\sigma_s = \{l, l'\}$ to $\sigma_s = \{l, \phi\}$ (or $\sigma_s = \{\phi, l'\}$) leading to deviation from $\langle F \rangle$ to $\langle lh \rangle$ (or $\langle l'h \rangle$):

$$\Delta w_s(F-lh) < 0 \text{ when } \lambda_s < \lambda_s(F-lh) \text{ where } \frac{\partial \lambda_s(F-lh)}{\partial \tau} > 0$$

The above result argues that the incentive of country s to unilaterally deviate from $\sigma_s = \{l, l'\}$ to $\sigma_s = \{l, \phi\}$ (or $\sigma_s = \{\phi, l'\}$) gets weaker as the multilaterally negotiated bound tariff rates fall.

Now, consider the unilateral deviation (ii). First, we should note that a similar intuitive discussion applies as above and we find that, when country s is sufficiently smaller exporter, the benefit from being able to impose import tariffs dominates the benefit from free market access and thus it has an incentive to unilaterally deviate from its free trade announcement $\sigma_s = \{l, l'\}$ to $\sigma_s = \{\phi, \phi\}$ leading to deviation from $\langle F \rangle$ to $\langle ll' \rangle$:

$$\Delta w_s(F-ll') < 0 \text{ when } \lambda_s < \lambda_s(F-ll') \text{ where } \frac{\partial \lambda_s(F-ll')}{\partial \tau} > 0$$

Two observations leads to our main result: (i) $\lambda_s(F-ll') > \lambda_s(F-lh)$ and thus the incentive of country s to unilaterally deviate from $\sigma_s = \{l, l'\}$ to $\sigma_s = \{\phi, \phi\}$ leading to deviation from $\langle F \rangle$ to $\langle ll' \rangle$ determines the CPNE condition for $\langle F \rangle$ and (ii) since $\frac{\partial \lambda_s(F-ll')}{\partial \tau} > 0$, the incentive of country s to unilaterally deviate from free trade announcement and free ride under $\langle ll' \rangle$ gets weaker as the bound tariff rates fall. We can now state our main result that is illustrated in Figure 3:

Proposition 4: *Suppose Assumption 2 holds. Then,* $\Omega^F \equiv \{\sigma_s = \{l, l'\},\ \sigma_l = \{s, l'\},\ \sigma_{l'} = \{s, l\}\}$ *leading to* $\langle F \rangle$ *is CPNE only when* $\lambda_s \geq \lambda_s(F-ll')$ *and it is more likely to be a CPNE as bound tariff rates fall.*

- Insert Figure 3-

Based on the above discussion, as countries negotiate lower bound tariff rates, it disciplines the ability of the smaller exporting (and thus larger importing) country in imposing external tariffs and thus weakens its incentive to free ride on trade liberalization by the larger exporting countries. Therefore, free riding incentive falls as bound tariff rates decline. Since FTA formation is flexible in signing independent FTAs and exclusion incentives go unexercised, it is the free riding incentive that determines the CPNE condition for multilateral free trade. The above finding suggests that multilateral free trade is more likely to be a CPNE as the multilateral negotiated bound tariff rates decline. Therefore, this result provides support for the idea that multilateral trade liberalization acts as a complement to the FTA formation in achieving global free trade: FTA formation is more likely to act as a building bloc when it is accompanied with lower bound tariff rates.

Next, we examine the following question: what if $\lambda_s < \lambda_s(F - ll')$ and global free trade fails to obtain? First, consider no agreement $\varnothing$. Since $\Delta w_l(ll' - \varnothing) > 0$ *for all* τ, λ and λ_s, two larger exporting countries (l and l') have an incentive to coalitionally change their announcements from $\{\phi, \phi\}$ and $\{\phi, \phi\}$ to $\{\phi, l'\}$ and $\{\phi, l\}$ respectively, taking country s's announcement fixed: $\sigma_s = \{\phi, \phi\}$. This initial deviation is self-enforcing since no proper subset of the initially deviating countries (neither l nor l') has an incentive to alter its announcement unilaterally (i.e. announcement profile that leads to $\langle ll' \rangle$ is always a Nash equilibrium). Therefore, the announcement profile that leads to $\varnothing$ is not a CPNE. We next examine whether announcement profile that leads to a $\langle sh \rangle$ is a CPNE. Note from Lemma 3 part (i) that $\Delta w_l(F - sh) > 0$ *for all* τ, λ and λ_s and thus countries l and l' have an incentive to coalitionally change their announcements from $\{s, \phi\}$ and $\{s, \phi\}$ to $\{s, l'\}$ and $\{s, l\}$ respectively, taking country s's announcement fixed at $\sigma_s = \{l, l'\}$. This coalitional deviation would convert the hub and spoke regime $\langle sh \rangle$ to free trade $\langle F \rangle$ and it is a self-enforcing deviation since a larger exporting country has no incentive to unilaterally deviate from its announcement that leads to free trade as established in Lemma 3. Now consider the announcement profile that leads to a $\langle lh \rangle$. Note first that we already established the following above: $\lambda_s(F - ll') > \lambda_s(F - lh)$ for all τ and λ, and thus the unilateral deviation incentive of country s under Ω^F from $\sigma_s = \{l, l'\}$ to $\sigma_s = \{\phi, \phi\}$ leading to deviation from $\langle F \rangle$ to $\langle ll' \rangle$ is stronger than the the unilateral deviation incentive of country s from $\sigma_s = \{l, l'\}$ to $\sigma_s = \{l, \phi\}$, leading to deviation from $\langle F \rangle$ to $\langle lh \rangle$. This immediately implies that, when $\lambda_s < \lambda_s(F - ll')$ holds, country s under Ω^{lh} always has an incentive to unilaterally deviate from from $\{l, \phi\}$ to $\{\phi, \phi\}$ converting $\langle lh \rangle$ to $\langle ll' \rangle$ and thus $\langle lh \rangle$ is not even a Nash equilibrium (therefore not a CPNE).

Finally, we examine whether the announcement profiles that lead to a bilateral FTAs are CPNE when $\lambda_s < \lambda_s(F - ll')$. First consider the announcement profile $\Omega^{ll'}$. We have established above that $\Delta w_l(ll' - \varnothing) > 0$ *for all* τ, λ and λ_s and thus $\Omega^{ll'}$ is always a Nash equilibrium. When $\lambda_s < \lambda_s(F - ll')$ holds, small country has no incentive to participate in the coalitional announcement deviation converting $\langle ll' \rangle$ into $\langle F \rangle$. Moreover, as we discussed above, country s under $\Omega^{ll'}$ has no incentive to jointly deviate with country l from their respective announcements $\{\phi, \phi\}$ and $\{\phi, l'\}$ to $\{l, \phi\}$ and $\{s, l'\}$ leading to a deviation from $\langle ll' \rangle$ to $\langle lh \rangle$. Finally note from Lemma 3 that even when coalitional deviations leading to deviation from $\langle ll' \rangle$ to $\langle sl \rangle$ and $\langle ll' \rangle$ to $\langle sh \rangle$ occur, they are not self-enforcing since a proper subset of initially deviating countries has incentive to further deviate. As a result, when free trade fails to a CPNE (when $\lambda_s < \lambda_s(F - ll')$), $\Omega^{ll'}$ arises as a CPNE. We conclude our discussion with the discussion of whether Ω^{sl} is a CPNE. It turns out to be that the critical deviation under Ω^{sl} is the joint announcement deviation of countries s and l' from their respective announcements $\{l, \phi\}$ and $\{\phi, \phi\}$ to $\{l, l'\}$ and $\{s, \phi\}$ converting $\langle sl \rangle$ into

$\langle sh \rangle$. We know from part (ii) of Lemma 3 that country s always has an incentive to participate in such a coalitional deviation while country l' does so only when $\lambda_s < \lambda_{l'}(sh - sl)$. This joint announcement deviation is self-enforcing since neither s nor l' has an incentive to further deviate taking the announcement of complements as given. When $\lambda_{l'}(sh - sl) < \lambda_s < \lambda_s(F - ll')$ holds, there exists no other self-enforcing deviation from Ω^{sl} and thus it is a CPNE. Based on the above discussion, the following result is immediate:

Proposition 5: *Suppose Assumption 2 holds and $\lambda_s < \lambda_s(F - ll')$. Then, the following result holds:*

(i) $\Omega^{ll'} \equiv \{\sigma_s = \{\phi, \phi\},\ \sigma_l = \{\phi, l'\},\ \sigma_{l'} = \{\phi, l\}\}$ *leading to $\langle ll' \rangle$ is always CPNE while*

(ii) announcement profiles leading to any bilateral FTA is *CPNE when* $\lambda_{l'}(sh - sl) \leq \lambda_s \leq \lambda_s(F - ll')$.

- Insert Figure 4-

The above proposition and Figure 4 imply that when the degree of asymmetry in comparative advantage is sufficiently large and free trade fails to be a CPNE, bilateral FTAs emerge in the equilibrium while hub and spoke regimes never arise. An asymmetric FTA $\langle sl \rangle$ is a CPNE only when the degree of asymmetry is moderate and the bound tariff rates are sufficiently high. When the degree of asymmetry rises and/or the bound tariff rates fall sufficiently, the unique CPNE is the FTA between two larger exporters. Here, it is important to emphasize that exclusion incentive does not play any role in the equilibrium and thus we can not interpret these trade agreements as "gated globalization" as in Lake and Roy (2017). Another important takeaway from the above result is that, unlike Freund (2000), bilateral FTAs become less likely to be a CPNE as the bound tariff rates decline. As explained in detail before, the endogeneity in FTA formation and the flexibility of forming independent FTAs were absent in Freund (2000) and this creates the divergence in the results.

Next, we show that our main result continues to hold under different structure of asymmetry

4.2 Two smaller one larger exporters

Consider now the case where two countries ('smaller' exporting countries denoted by s and s') have lower degrees of comparative advantages in their exporting sectors than the third (denoted by l; refereed to as the 'larger' exporting country). Accordingly, let the pattern of asymmetry be given by:

Assumption 3:

$$\underline{\lambda} \leq \lambda_s = \lambda_{s'} < \lambda_l = \lambda \tag{16}$$

Assuming that bound tariff rates are large enough so that they do not bind, the optimal tariff ranking under Assumption 3 is as follows

$$t_s(\varnothing) > t_l(\varnothing) > t_{sl}(ss') > t_{ls'}(sl) > t_{ss'}(sl) > 0$$

Thus, as before, we have four distinct sub-scenarios as illustrated in Figure 5:

(i) no tariff binding scenario arises when $\tau > t_s(\varnothing)$ holds. Under such a case, all countries are free to impose their optimal tariffs under all feasible trade regimes (tariff binding overhang under all regimes).

(ii) partial tariff binding scenarios:

- $t_l(\varnothing) < \tau < t_s(\varnothing)$: except for country s under $\varnothing$ and as a non-member under the bilateral FTA $\langle s'l \rangle$, countries are free to impose their optimal tariffs under all feasible trade regimes. Country s under $\varnothing$ and $\langle s'l \rangle$ is constrained to impose the bound tariff rate τ.

- $t_{sl}(ss') < \tau < t_l(\varnothing)$: countries under $\varnothing$ (and non-member countries under a bilateral FTA) are constrained to impose their bound tariff rates while FTA member countries are free to impose their optimal tariffs.

- $t_{ls'}(sl) < \tau < t_{sl}(ss')$: countries under $\varnothing$ (and non-member countries under a bilateral FTA) and smaller member countries under $\langle ss' \rangle$ (and as a spoke under $\langle sh \rangle$ or $\langle s'h \rangle$) are constrained to impose their bound tariff rates while the member countries under the FTA between larger and smaller countries, i.e. $\langle sl \rangle$ and $\langle s'l \rangle$, are free to impose their optimal tariffs.

- $t_{ss'}(sl) < \tau < t_{ls'}(sl)$: except for the smaller member country under $\langle sl \rangle$ and $\langle s'l \rangle$ (and smaller spoke country under $\langle lh \rangle$), countries are constrained to impose their bound tariff rates.

(iii) full tariff binding scenario arises when $\tau < t_s(sl)$ holds. Under this scenario, all countries lose their freedom to impose optimal tariffs under the entire set of trade regimes and they are required to apply their bound tariff rates (no tariff binding overhang).

- Insert Figure 5 -

To save space, we directly move to the following lemma that proves to be useful in deriving when free trade is a CPNE:

Lemma 4: *Suppose that Assumption 3 holds. Then, we have*

(i) $\Delta w_i(ij - \varnothing) > 0$, $i, j = s, s', l$ *for all* τ, λ and λ_s;

(ii) $w_i(ih) > \max\{w_i(F), w_i(ij), w_i(\varnothing)\}$, $i, j = s, s', l$ and $\Delta w_s(F - lh) = \Delta w_{s'}(F - lh) > 0$ *for all* τ, λ *and* λ_s;

(iii) $\Delta w_l(F - sh) = \Delta w_l(F - s'h) > 0$ *for all* τ, λ and λ_s *while* $\Delta w_s(F - s'h) = \Delta w_{s'}(F - sh) > 0$ *only when* $\lambda_s > \lambda_s(F - s'h)$;

(iv) $\Delta w_l(F - ss') > 0$ *for all* τ, λ *and* λ_s *while* $\Delta w_s(F - s'l) = \Delta w_{s'}(F - sl) > 0$ *only when* $\lambda_s > \lambda_s(F - s'l)$ *and*

(v) $\lambda_s(F - s'l) > \lambda_s(F - s'h)$ *for all* τ *and* λ.

It is immediate from the parts (iii) and (iv) of the above lemma that the larger exporting country has no incentive to unilaterally deviate from its announcement that leads to free trade.

Focusing on the coalitional deviations from the announcement profile leading to global free trade, the first and second part of Lemma 4 implies that, even when two countries have incentives to jointly deviate, such coalitional deviation is never self-enforcing. To see it more clearly, taking the announcement of country l as given, consider the joint deviation of two smaller exporting countries from their respective announcements $\sigma_s = \{s', l\}$ and $\sigma_{s'} = \{s, l\}$ to $\sigma_s = \{s', \phi\}$ and $\sigma_{s'} = \{s, \phi\}$ leading to deviation from $\langle F \rangle$ to $\langle ss' \rangle$. Such deviation happens only when $\lambda_s > \lambda_s(F - ss')$. However, the second part of Lemma 4 informs us that, taking the announcement of country l as given: $\sigma_l = \{s, s'\}$, either of the initially deviating smaller exporting countries (say s) has an incentive to further deviate from $\sigma_s = \{s', \phi\}$ to $\sigma_s = \{s', l\}$ to become the hub country under $\langle sh \rangle$. The similar intuition applies for the coalitional deviation of one of the smaller exporting countries and the larger exporting country to exclude the other smaller exporting country. Either of the initially deviating countries has incentive to further deviate, making the initial deviation not self-enforcing.[17] Therefore, we restate our previous finding: *although exclusion incentives exist when bound tariff rates are sufficiently low, the flexibility that FTA members have in forming an additional FTA yields that such incentive goes unexercised in the equilibrium.*

The above discussion together with part (v) of Lemma 4 informs us that, as before, the unilateral announcement deviation of a smaller exporting country (say s) from $\sigma_s = \{s', l\}$ to $\sigma_s = \{\phi, \phi\}$ leading to deviation from $\langle F \rangle$ to $\langle s'l \rangle$ determines whether Ω^F is a CPNE:

Proposition 6: *Suppose Assumption 3 holds. Then,* $\Omega^F \equiv \{\sigma_s = \{l, l'\},\ \sigma_l = \{s, l'\},\ \sigma_{l'} = \{s, l\}\}$ *leading to* $\langle F \rangle$ *is CPNE only when* $\lambda_s > \lambda_s(F - s'l)$ *and it is more likely to be a CPNE as bound tariff rates fall.*

- Insert Figure 6-

The above result, represented in Figure 6, argues that our main finding is robust to the structure of asymmetry: free riding incentive of smaller exporting countries is pivotal for free trade to arise in the equilibrium while exclusion incentives go unexercised. As bound tariff rates decline, free riding incentives fall and multilateral free trade becomes more likely to be a CPNE.[18]

So far, our findings suggest that, due to the flexibility of FTA formation, exclusion incentives go unexercised in the equilibrium. What if the preferential trade agreement is a customs union rather than an FTA and hub and spoke regimes are not feasible? Next, we examine this question under complete symmetry to shed light on the implications of common external tariff requirement of CU.

[17] Two smaller countries can have incentives to coalitionally deviate from their free trade announcements to announcements leading to no agreement. This coalitional deviation is not self-enforcing as well due to part (i) of Lemma 4.

[18] What if $\lambda_s(F - s'l)$ and global free trade fails to obtain? Under such a case, we find that the announcement profile leading to a bilateral FTA between a smaller exporting country and the larger exporting country ($\langle sl \rangle$ or $\langle s'l \rangle$) is the CPNE.

5 Customs Union

Suppose the PTA under consideration is a CU as opposed to an FTA and countries are symmetric with respect to their comparative advantage (Assumption 1 holds). To have a comparable result and figure to the ones under the FTA game, we assume that $\lambda \leq \frac{1}{2}$.[19]

As under the FTA game, at the first stage of the CU formation game each country announces the names of countries with whom it wants to form a CU. Country i's announcement is denoted by σ_i and its strategy set S_{iu} consists of four possible announcements:

$$S_{iu} = \{\{\phi, \phi\}, \{j_u, \phi\}, \{\phi, k_u\}, \{j_u, k_u\}\} \tag{17}$$

where $\{\phi, \phi\}$ denotes an announcement in favor of no CU with either trading partners, $\{j_u, \phi\}$ in favor of a CU with only country j; $\{\phi, k_u\}$ in favor of a CU with only country k; and $\{j_u, k_u\}$ in favor of a CU that includes both its trading partners (announcement in favor of free trade). The mapping between various announcements profiles and the CUs that can arise is as follows: (i) when no two announcements match or the only matching announcements are $\{\phi, \phi\}$ we obtain no agreement $\varnothing$; (ii) a CU between countries i and j denoted by $\langle ij_u \rangle$ is formed if they announce each others' names and there is no other matching announcement: i.e. $\langle ij_u \rangle$ is formed if $j_u \in \sigma_i$, $i_u \in \sigma_j$ and both (a) $k_u \notin \sigma_i$ and/or $i_u \notin \sigma_k$ and (b) $k_u \notin \sigma_j$ and/or $j_u \notin \sigma_k$ hold; (iv) free trade $\langle F \rangle$ obtains iff all countries announce each other's names. Recall that the equivalent of a hub and spoke trading regime cannot arise under the CU game due to the fact that CU members coordinate their external tariffs.

As is well known, the central difference between an FTA and a CU is that members of a CU impose common external tariffs on non-members whereas FTA members adopt individually optimal tariffs. This difference in tariff setting behavior between the two types of PTAs has an important consequence affecting the role of exclusion incentive in the equilibrium determination. It is crucial to note that, while an FTA member is free to enter into additional trade agreements (such as hub and spoke trading regimes) with non-member countries without requiring consent from its existing FTA partners, a CU member can only do so if all other members also agree to participate in the new agreements. In other words, FTA members enjoy more *flexibility* in agreement formation than CU members.

While the optimal tariff analysis under no agreement stays the same as before, optimal tariff determination under a bilateral CU is different due to the common external tariff requirement. Here, it is worth mentioning that since each country is the unique importer of a good in our competing exporters model, the "market power effect" of a CU emphasized by Bagwell and Staiger (1997a) does not arise since that effect arises only when CU members "compete" for imports.[20] As a result, the coordination of tariffs is beneficial to CU members only because each members internalizes the

[19] Note that when λ is suffiently large, free trade fails to be a CPNE under the CU game regardles of bound tariff rates since exclusion incentives always arise.

[20] See Missios et al. (2016) and Saggi et al. (2018) for details of tariff setting behavior in a competing importers model.

effect of its tariff on the export surplus of the other member. If two countries form a CU, they remove tariffs on each other and impose jointly optimal external tariffs (denoted by t_i^u and t_j^u) on the non-member country.[21] The tariff pair (t_i^u, t_j^u) is chosen to solve:[22]

$$\max_{t_i^u,\, t_j^u} w_i(ij) + w_j(ij) \text{ subject to } t_{ij} = t_{ji} = 0 \tag{18}$$

Since countries are symmetric, we have $t_i^u = t_j^u = t^u$ and the optimal external tariff of each CU member is given by

$$t^u = \frac{\alpha\lambda}{(\lambda+2)(3\lambda+10)} \tag{19}$$

Note that, under symmetry, the formation of a CU induces each member country to *lower* its tariff on the non-member relative to the status quo (i.e. the model exhibits tariff complementarity): $t^u < t^{\phi}$.[23] Moreover, unlike an FTA, member countries under a CU internalize each other's export surplus under the joint welfare maximization and thus higher external tariff (weaker tariff complementarity) arises: $t^f < t^u < t^{\phi}$. Similar to the FTA game under symmetry, we have three tariff binding scenarios (illustrated in Figure 6):

(i) no tariff binding scenario where the bound tariff rate exceeds the optimal tariff under No agreement: $\tau > t_z(\varnothing)$ so that countries are free to impose their optimal tariffs under all trade regimes (the above optimal tariffs apply);

(ii) partial tariff binding scenario where the bound tariff rate exceeds the optimal tariff under a CU but falls below the optimal tariff under No agreement: $t^u < \tau < t^{\varnothing}$. Under such a case, countries under $\varnothing$ and the non-member country under a CU impose the bound rate τ while the member countries under a CU are free to impose their optimal external tariffs.

(iii) full tariff binding scenario where the bound tariff rate below the optimal tariff under an FTA: $\tau < t^u$. Under this scenario, countries lose their freedom to impose optimal tariffs under all trade regimes and apply their bound tariff rates (no tariff binding overhang).

- Insert Figure 7 -

It is immediate from the preceding tariff discussion that while *no tariff binding scenario* stays the same under both FTA and CU formation games, the bound tariff rate ranges shrink under the

[21] Our simple formulation of a CU's tariff choice problem is intuitively appealing and in line with much of existing literature. However, Syropoulos (2003) has shown that the nature of the sharing rule of a CU with respect to tariff revenue can affect tariff preferences as well as the trade patterns of CU members in ways that can prevent the implementation of jointly optimal tariffs. An important insight of his analysis is that CU members have an incentive to influence their common tariffs not just for external terms-of-trade reasons but also for internal distributional purposes. Given the focus of our paper, we abstract from such considerations.

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

[23] It is noteworthy that tariff complementarity also arises in the general equilibrium model of Bond et. al. (2004). For empirical evidence regarding tariff complementarity in the context of the Latin American CU MERCOSUR, see Estevadeordal et. al. (2008).

partial tariff binding scenario and expands under the *full tariff binding scenario* when the PTA is a CU relative to an FTA since $t^f < t^u$.

Before deriving the equilibrium trade agreements under the CU formation game, we establish the following lemma:

Lemma 5: *Suppose that countries have symmetric comparative advantage. Then, we have:*
(i) $\Delta w_i(ij^u - \varnothing) = \Delta w_j(ij^u - \varnothing) > 0$ *and* $\Delta w_k(ij^u - \varnothing) < 0$ *for all* τ *and* λ;
(ii) $\Delta w_i(F - ij^u) = \Delta w_j(F - ij^u) > 0$ only when $\tau > \widehat{\tau}^u(\lambda)$ where $t^u < \widehat{\tau}^u(\lambda) < t^{\varnothing}$;
(iii) $\Delta w_k(F - ij^u) > 0$ *for all* τ *and* λ;

Note that, relative to an FTA formation game, each member country internalizes the negative externality of each other's external tariff via common external tariff determination under the CU and thus benefits more from a bilateral CU formation. Therefore, as under the FTA game, a pair of symmetric countries under $\varnothing$ always have an incentive to form a bilateral CU and thus the announcements leading to a bilateral CU is always a Nash equilibrium and $\Omega^{\varnothing}$ is not a CPNE of the CU game. Unlike the FTA game, the formation of a bilateral CU always makes the non-member country worse-off irrespective of the bound tariff rates and thus the formation of a CU is never Pareto-improving since it always makes member countries better off at the expense of the non-member. Consistent with this intuition, part (iii) of the above lemma informs us that there exists no free riding incentive on trade liberalization of the other two member countries via CU. As a result, the announcement profile Ω^F leading to $\langle F \rangle$ is always a Nash equilibrium.

Similar to the FTA game, the second part of the above lemma argues in favor of the idea that two countries have incentives to exclude the third country from free trade network when bound tariff rates are sufficiently low. Note that when the bound tariff rates fall below $t_z(\varnothing)$, the non-member country loses its ability to set its optimal MFN tariff under a bilateral CU while facing a larger tariff under a CU relative to an FTA. Joint welfare maximization implies that the exclusion incentive is stronger under a CU relative to an FTA and thus $\widehat{\tau}^u(\lambda) > \widehat{\tau}(\lambda)$ for all λ. Here, it is important to note that Saggi *et al.* (2013) show that there exists no exclusion incentive under a CU formation game in a competing exporters model when bound tariff rates are not taken into account and thus all external tariffs are optimally set. Our result confirms this finding under "no tariff binding scenario" but goes one step further and suggests that this result fails to hold when countries are constrained in imposing their optimal tariffs due to sufficiently low bound tariff rates.

Recall that the key message in the FTA game was that even though a pair of countries benefit from excluding the third country from their trade agreement, *they are unable to exercise this exclusion incentive in equilibrium*. The flexible nature of FTAs plays a crucial role in ensuring that the exclusion incentive goes unexercised in the FTA game. Since hub and spoke regimes cannot arise under the CU formation game, are countries able to exercise the exclusion incentive in equilibrium?

It is immediate from Lemma 4 that Ω^F is a CPNE of the CU game only when $\tau \geq \widehat{\tau}^u(\lambda)$ where $t^u < \widehat{\tau}^u(\lambda) < t^{\varnothing}$. To see why, taking the complement's announcement as given, simply consider the coalitional deviation of countries i and j from Ω^F to $\Omega^{ij_u} \equiv \{\sigma_i = \{j_u, \phi\}, \sigma_j = \{i_u, \phi\}$ $\sigma_k = \{i_u, j_u\}\}$. Observe from Lemma 4 that this coalitional deviation happens when $\tau < \widehat{\tau}^u(\lambda)$, altering the trade regime from free trade to the CU $\langle ij_u \rangle$ and since CU members enjoy higher welfare than that under no agreement, neither member country has an incentive to further unilaterally alter its announcements and thus the initial deviation is self-enforcing.

Finally, we argue that the announcement profile leading to a bilateral CU is a CPNE only when $\tau \leq \widehat{\tau}^u(\lambda)$. Starting with any Nash equilibrium announcement profile that yields the CU $\langle ij_u \rangle$, member countries have no incentive to jointly alter their announcements to either obtain $\varnothing$ or $\langle F \rangle$ since they are worse off under either of these outcomes. Thus, we can state the following result, illustrated in Figure 8:

Proposition 7: *Suppose that countries have symmetric comparative advantage. Then, in a CU formation game*

(i) Ω^F leading to global free trade is a CPNE only when $\tau \geq \widehat{\tau}^u(\lambda)$ and

(ii) Ω^{ij_u} leading to a bilateral CU is a CPNE only when $\tau \leq \widehat{\tau}^u(\lambda)$

The main difference between the results in the FTA game (Proposition 2) and the CU game (Proposition 6) is driven by the relatively flexible nature of FTAs compared to CUs. In the FTA game, when two countries (i and j) have incentives to jointly exclude the third country from free trade by forming a bilateral FTA, each member has an incentive to sign an independent FTA with the excluded country thereby making itself a hub. The ability to act on this incentive acts as a deterrent for the other initially deviating country (say j) since it is worse off as a spoke under $\langle ih \rangle$ relative to free trade and thus the initial joint deviation from the announcement profile Ω^F to Ω^{ij} does not occur. However, unlike the FTA game, no such deterrent exists under the CU game since a CU member cannot form an independent agreement with the excluded country without the consent of its CU partner.

- Insert Figure 8 -

It is immediate from Figure 6 that global free trade is less likely to be a CPNE as the bound tariff rates fall. Here, we should emphasize that while our FTA results diverges from Freund (2000), Proposition 6 provides support for Freund (2000) when preferential trade agreement is a customs union rather than an FTA: multilateral tariff reduction enhances the incentives to form a bilateral CU relative to free trade since the set-up in Freund (2000) converges to our CU formation game where hub and spoke regime is not feasible and exclusion incentive plays a crucial role in equilibrium. While the PTA formation and multilateral tariff reduction are modeled differently, another important observation would be that the above result is also consistent with Lake and Roy (2017), arguing that "gated globalization" becomes more likely as the multilateral tariff reduction gets deeper when the PTA under consideration takes the form of a CU rather than an FTA.

6 Conclusion

Following the last successful multilateral round, the last few decades have witnessed a dramatic explosion in the numbers and membership of preferential trade agreements. The widespread concern that the formation of PTAs may undermine multilateral liberalization led to an extensive literature that has addressed whether PTA formation help or hinder the prospects of global free trade. However, the reverse analysis on how multilateral tariff reduction affects the formation of PTAs and alters the role of Article XXIV of the GATT in achieving global free trade is relatively scarce. It is highly important given that multilateral trade liberalization constrains the ability of countries to impose their external tariffs and thus change their preferences for participating in preferential trade agreements. In an extensive survey by Freund and Ornelas (2010), they laid out the concerns regarding the lack of research on the effect of global tariff negotiations on PTA formation. Motivated these concerns, the present paper employs an endogenous PTA formation model in which countries face exogenously given multilaterally negotiated bound tariff rates. It is important to note that the entire literature on the role of PTAs ignores the role of bound tariff rates in the tariff setting behavior and examine the PTA formation assuming that countries are free in setting their optimal tariffs. This paper aims to overcome this shortcoming by examining PTA formation under different tariff binding scenarios.

The main objective of the present paper is to examine how multilateral trade liberalization via reduction in the bound tariff rates affects the preferences of both member and non-member countries regarding PTAs and whether PTA formation ultimately leads to global free trade or ends prematurely with a fragmented trading world with gated globalization. To this end, we examine both FTA and CU formation games and try to shed light on the interaction between bilateral and multilateral approaches to trade liberalization with a finer lens.

We argue that the flexible nature of FTA formation due to the independent external tariff setting relative to CU plays a major role in identifying whether free riding or exclusion incentives play pivotal role in equilibrium. We first show that, when countries are completely symmetric, no country has an incentive to free ride on trade liberalization by the other two countries while two countries have incentives to exclude the third one free trade network when bound tariffs are sufficiently low. Due to the flexibility in FTA formation, such exclusion incentives go unexercised and free trade always obtains as the coalition proof Nash equilibrium (CPNE) of the FTA game. However, since hub and spoke regimes are not allowed in the CU game, countries are able to exercise the exclusion incentive and thus free trade fails to be CPNE when the bound tariff rates are sufficiently low. This result suggests that, when countries are symmetric, the pursuit of CUs undermines global free trade when bound tariffs are sufficiently low while FTA formation always act as building blocs irrespective of the bound tariff rates. We then question when and why, if any, global free trade fails to obtain in FTA formation game. To this end, we consider a scenario where countries are asymmetric with respect to their comparative advantage. Our findings suggest that the country with a weaker comparative advantage in the exporting goods (thus larger importer country) has incentive to free ride on trade liberalization of the other two countries and this incentive is critical for whether multilateral free trade obtains as a CPNE. Since the reduction in bound tariff rates disciplines the ability of the free riding smaller exporting country in setting its external tariffs, multilateral free trade arises more likely as a CPNE (and thus act as a building bloc). This result provides support for the idea that multilateral trade liberalization acts as a complement to the FTA formation in achieving global free trade.

It is important to note that FTA formation and CU formation games are examined in isolation and the choice between these two types of PTAs is not endogenously determined. The next step would be to examine the similar question in a dynamic set-up employed by Lake and Yildiz (2016) where we can also endogenize the choice of PTA type and examine a pure farsighted PTA formation under exogenously given bound tariff rates. We leave this for future research.

7 Appendix

In this Appendix we provide the necessary supporting calculations and proofs.

7.1 Welfare levels

We begin by reporting welfare levels under different policy regimes as a function of tariffs and comparative advantage. For an arbitrary tariffs vector $\mathbf{t}$=$(t_{ij}, t_{ik}, t_{ji}, t_{jk}, t_{ki}, t_{kj})$, we can write country i's welfare as

$$w_i = \sum_g CS_i^g + \sum_g PS_i^g + \sum_{z \neq i} t_{iz} x_z^I,$$

where consumer surplus in country i equals

$$\sum_g CS_i^g = \frac{1}{2}\left[\left(\alpha - P_i^I\right)^2 + \left(\alpha - P_j^J + t_{ji}\right)^2 + \left(\alpha - P_k^J + t_{ki}\right)^2\right],$$

its producer surplus equals

$$\sum_g PS_i^g = \frac{1}{2}\left[\left(P_i^I\right)^2 + (1+\lambda_i)\left(P_j^J - t_{ji}\right)^2 + (1+\lambda_i)\left(P_k^K - t_{ki}\right)^2\right]$$

and the tariff revenue is given by

$$\sum_{z \neq i} t_{iz} x_z^I = t_{ij}[(2+\lambda_j)\, P_j^I - \alpha] + t_{ik}[2+\lambda_k) P_k^I - \alpha]$$

Using the above formulae and the optimal tariff levels reported in the text, we can easily calculate welfare levels under all possible trade regimes. To save space, we do not include the algebraic details underlying these straightforward calculations.

Proof of Lemma 1

Using the welfare and optimum tariff levels (when feasible) reported in the text and setting $\lambda_z = \lambda$, where $z = i, j, k$, we can show the following for all τ and λ:

$$\triangle w_i(ij - \varnothing) = \triangle w_j(ij - \varnothing) > 0$$

$$\Delta w_k(F - ij) > 0; w_i(ih - F) > 0; w_i(ih - ij) > 0; w_i(ih - \varnothing) > 0; \text{and } \Delta w_j(F - ih) > 0.$$

We also have:

$$\triangle w_k(ij - \varnothing) > 0 \text{ when } \tau > \overline{\tau}(\lambda) \text{ where } t^f < \overline{\tau}(\lambda) < t^{\varnothing}$$

$$\Delta w_j(ih - ik) = \Delta w_k(ih - ij) > 0 \text{ when } \tau < \underline{\tau}(\lambda) \text{ where } t^f < \underline{\tau}(\lambda) < t^{\varnothing}$$

and

$$\overline{\tau}(\lambda) \geq \underline{\tau}(\lambda) \text{ for all } \lambda$$

Proof of Proposition 1a

Under symmetry, $\Delta w_i(F - ij) = \Delta w_j(F - ij) < 0$ when $\tau < \widehat{\tau}(\lambda)$ where $t^f < \widehat{\tau}(\lambda) < t^{\varnothing}$ and $\frac{\partial \Delta w_i(F-ij)}{\partial \tau} > 0$.

Proof of Proposition 2

It is immediate from the above welfare and reported optimum tariff levels (when feasible) and Lemma 1.

Proof of Proposition 1b

While $\Delta w_i(F-ij) = \Delta w_j(F-ij) < 0$ and two symmetric countries have an incentive to exclude the third when $\tau < \widehat{\tau}(\lambda)$, it is immediate from part (iii) of Lemma 1 that each of the excluding countries have incentives to further deviate and thus the initial deviation is not self-enforcing, implying that the exclusion incentive goes unexercised.

Proof of Proposition 2

Using the Lemma 1 and Proposition 1a, there exists no self-enforcing deviation from the announcement profile leading to free trade.

Proof of Lemma 2

Using the welfare and optimum tariff levels (when feasible) reported above and setting $\underline{\lambda} \leq \lambda_s < \lambda_l = \lambda_{l'} = \lambda$, we can show the following for any τ and λ:

$$\begin{aligned} \frac{\partial w_l(F-\varnothing)}{\partial \lambda_s} &< 0; \frac{\partial w_{l'}(F-sl)}{\partial \lambda_s} < 0; \frac{\partial w_l(F-ll')}{\partial \lambda_s} < 0; \frac{\partial w_{l'}(F-lh)}{\partial \lambda_s} < 0; \\ \frac{\partial w_l(sl-\varnothing)}{\partial \lambda_s} &< 0; \frac{\partial w_{l'}(sh-sl)}{\partial \lambda_s} < 0 \text{ and } \frac{\partial w_l(lh-ll')}{\partial \lambda_s} < 0 \end{aligned}$$

Proof of Lemma 3

Using the welfare and reported optimum tariff levels (when feasible) and setting $\underline{\lambda} \leq \lambda_s < \lambda_l = \lambda_{l'} = \lambda$, we can show the following for any τ and λ:

$$\Delta w_l(sl-\varnothing) > 0; \Delta w_l(lh-ll') > 0; \Delta w_l(F-\phi) > 0; \Delta w_l(F-sl') > 0 \text{ and } \Delta w_l(F-l'h) > 0$$

and

$$\Delta w_l(F-sh) > 0 \text{ and } \Delta w_s(sh-sl) > 0.$$

Proof of Proposition 3

Using parts (i) and (ii) of Lemma 3, even when two countries have incentives to jointly exclude the third, this joint deviation from the announcement profile leading to free trade is not self-enforcing since each of the initially deviating country has an incentive to further deviate to become the hub country: $\Delta w_l(lh-ll') > 0$ and $\Delta w_s(sh-sl) > 0$ for all τ and λ.

Proof of Proposition 4

As clearly shown in the text, using Lemma 3 and Proposition 3, the binding self-enforcing deviation from the announcement profile leading to global free trade is the unilateral deviation of the smaller exporting country from $\sigma_s = \{l, l'\}$ to $\sigma_s = \{\phi, \phi\}$ leading to deviation from $\langle F \rangle$ to $\langle ll' \rangle$: $\Delta w_s(F-ll') \leq 0$ when $\lambda_s < \lambda_s(F-ll')$ where $\frac{\partial \lambda_s(F-ll')}{\partial \tau} \geq 0$.

Proof of Proposition 5

When $\lambda_s < \lambda_s(F-ll')$ holds, the announcement profile leading to global free trade fails to be CPNE. Announcement profile leading to no agreement $\varnothing$ is never a CPNE since $\Delta w_l(ll'-\varnothing) > 0$

for all τ, λ and λ_s. Similarly, the announcement profile leading to $\langle lh \rangle$ is never a CPNE as well. To see it more clearly, it is immediate from Lemma 3 part (i) that $\Delta w_l(F - sh) > 0$ *for all* τ, λ and λ_s and thus two larger exporters always have an incentive to coalitionally change their announcements from $\{s, \phi\}$ and $\{s, \phi\}$ to $\{s, l'\}$ and $\{s, l\}$ respectively, taking country s's announcement fixed at $\sigma_s = \{l, l'\}$. It is a self-enforcing deviation since a larger exporting country has no incentive to unilaterally deviate from its announcement that leads to free trade as established in Lemma 3. When we consider the announcement profile that leads to a $\langle lh \rangle$, we first note that $\lambda_s(F - ll') > \lambda_s(F - lh)$ and thus country s under Ω^{lh} always has an incentive to unilaterally deviate from from $\{l, \phi\}$ to $\{\phi, \phi\}$ converting $\langle lh \rangle$ to $\langle ll' \rangle$ and thus the announcement profile leading to $\langle lh \rangle$ is not even a Nash equilibrium (therefore not a CPNE). Note that there exists no self enforcing coalitional deviations from the announcement profile $\Omega^{ll'}$ and thus it is a CPNE when $\lambda_s < \lambda_s(F - ll')$. Finally, the critical deviation under Ω^{sl} is the joint announcement deviation of countries s and l' from their respective announcements $\{l, \phi\}$ and $\{\phi, \phi\}$ to $\{l, l'\}$ and $\{s, \phi\}$ converting $\langle sl \rangle$ into $\langle sh \rangle$. We know from part (ii) of Lemma 3 that country s always has an incentive to participate in such a coalitional deviation while country l' does so only when $\lambda_s < \lambda_{l'}(sh - sl)$. This joint announcement deviation is self-enforcing since neither s nor l' has an incentive to further deviate taking the announcement of complements as given. When $\lambda_{l'}(sh - sl) < \lambda_s < \lambda_s(F - ll')$ holds, there exists no other self-enforcing deviation from Ω^{sl} and thus it is a CPNE.

Proof of Lemma 4

Using the welfare and optimum tariff levels (when feasible) reported in the text and setting $\underline{\lambda} \leq \lambda_s = \lambda_{s'} < \lambda_l = \lambda$, we can show the following *for all* τ, λ and λ_s:

$$\Delta w_i(ij - \varnothing) > 0, i, j = s, s', l$$

$$w_i(ih) > \max\{w_i(F), w_i(ij), w_i(\varnothing)\},\ i, j = s, s', l \text{ and } \Delta w_s(F - lh) = \Delta w_{s'}(F - lh) > 0$$

$$\Delta w_l(F - sh) = \Delta w_l(F - s'h) > 0$$

$$\Delta w_l(F - ss') > 0$$

$$\lambda_s(F - s'l) > \lambda_s(F - s'h) \text{ and } \frac{\partial \lambda_s(F - s'l)}{\partial \tau} \geq 0$$

and we have:

$$\Delta w_s(F - s'h) = \Delta w_{s'}(F - sh) > 0 \text{ when } \lambda_s > \lambda_s(F - s'h)$$

$$\Delta w_s(F - s'l) = \Delta w_{s'}(F - sl) > 0 \text{ when } \lambda_s > \lambda_s(F - s'l)$$

Proof of Proposition 6

As clearly shown in the text, using Lemma 4, the binding self-enforcing deviation from the announcement profile leading to global free trade is the unilateral deviation of the smaller exporting country from $\sigma_s = \{s', l\}$ to $\sigma_s = \{\phi, \phi\}$ leading to deviation from $\langle F \rangle$ to $\langle s'l \rangle$: $\Delta w_s(F - s'l) \leq 0$ when $\lambda_s < \lambda_s(F - s'l)$ where $\frac{\partial \lambda_s(F-s'l)}{\partial \tau} \geq 0$.

Proof of Lemma 5

Using the welfare and optimum tariff levels (when feasible) reported in the text and setting $\lambda_z = \lambda$, where $z = i, j, k$, we can show the following:

$$\Delta w_i(ij^u - \varnothing) = \Delta w_j(ij^u - \varnothing) > 0;\ \Delta w_k(ij^u - \varnothing) < 0 \text{ and } \Delta w_k(F - ij^u) > 0 \text{ for all } \tau \text{ and } \lambda$$

and

$$\Delta w_i(F - ij^u) = \Delta w_j(F - ij^u) > 0 \text{ when } \tau > \widehat{\tau}^u(\lambda) \text{ where } t^u < \widehat{\tau}^u(\lambda) < t^{\varnothing}$$

Proof of Proposition 7

As clearly shown in the text, using Lemma 5, the binding self-enforcing deviation from the announcement profile leading to global free trade is the coalitional deviation of two symmetric countries to exclude the third one from the free trade network: $\Delta w_i(F - ij^u) = \Delta w_j(F - ij^u) > 0$ when $\tau > \widehat{\tau}^u(\lambda)$ where $t^u < \widehat{\tau}^u(\lambda) < t^{\varnothing}$. When $\tau < \widehat{\tau}^u(\lambda)$ holds, the announcement profile leading to global free trade fails to be CPNE. Announcement profile leading to no agreement $\varnothing$ is never a CPNE since $\Delta w_i(ij^u - \varnothing) = \Delta w_j(ij^u - \varnothing) > 0$ *for all* τ *and* λ. The announcement profile leading to a bilateral CU is a CPNE only when $\tau \leq \widehat{\tau}^u(\lambda)$.

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Figure 1: FTA tariff schedule - Symmetry

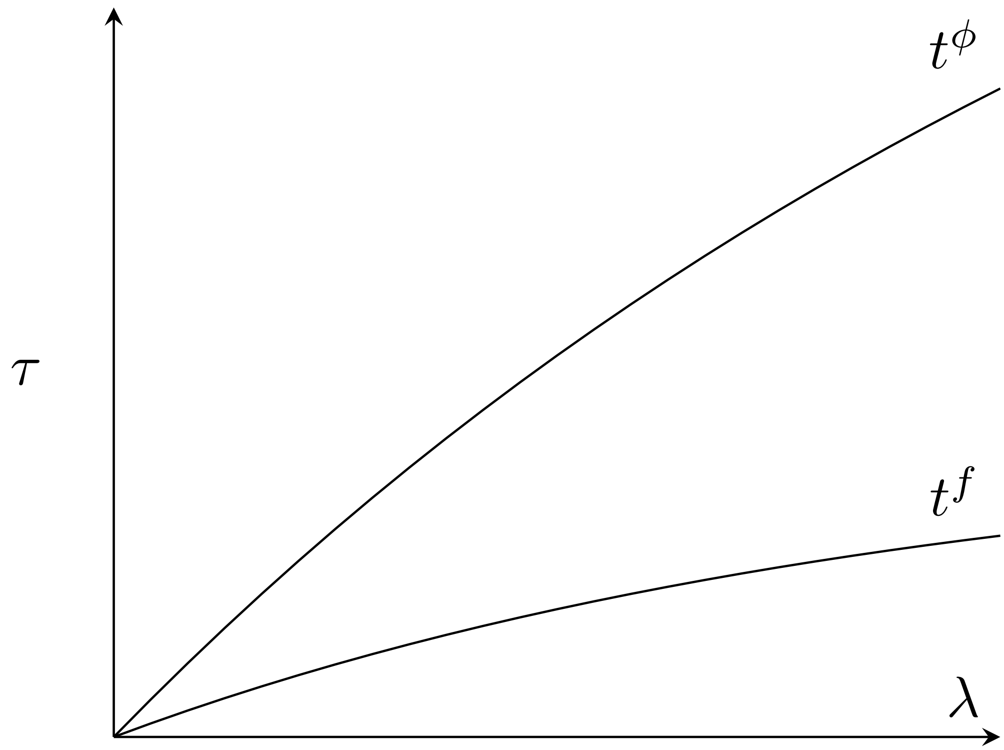


Figure 2: FTA tariff schedule - Asymmetry I

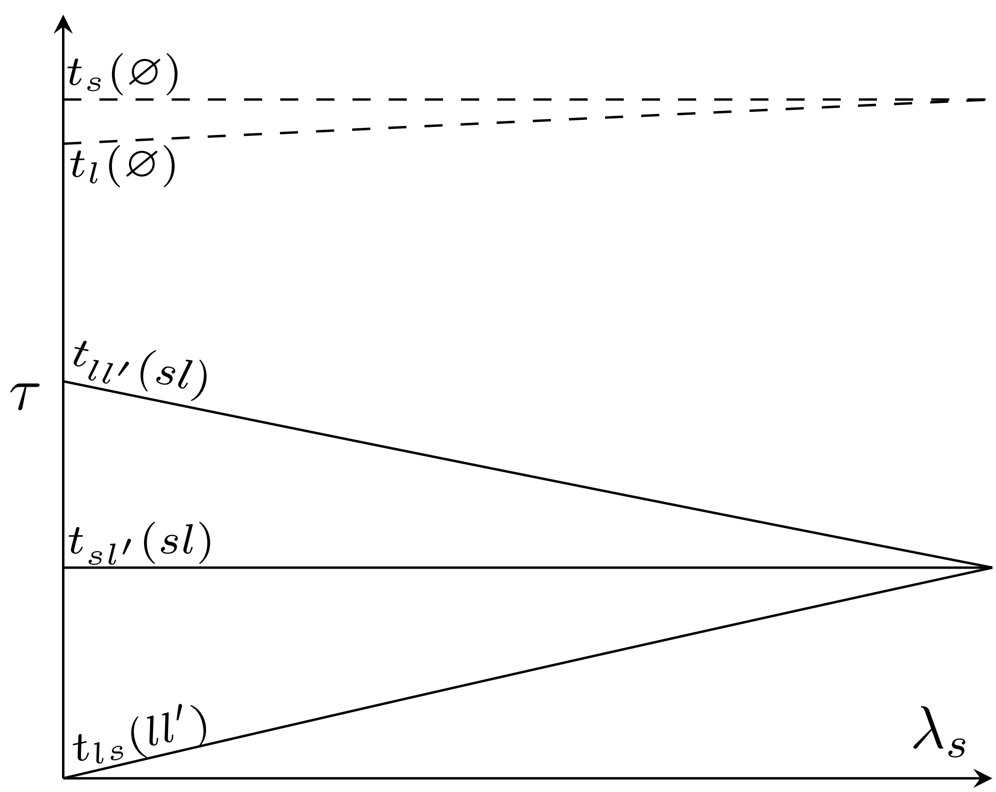


Figure 3: Free Trade is CPNE - Asymmetry I

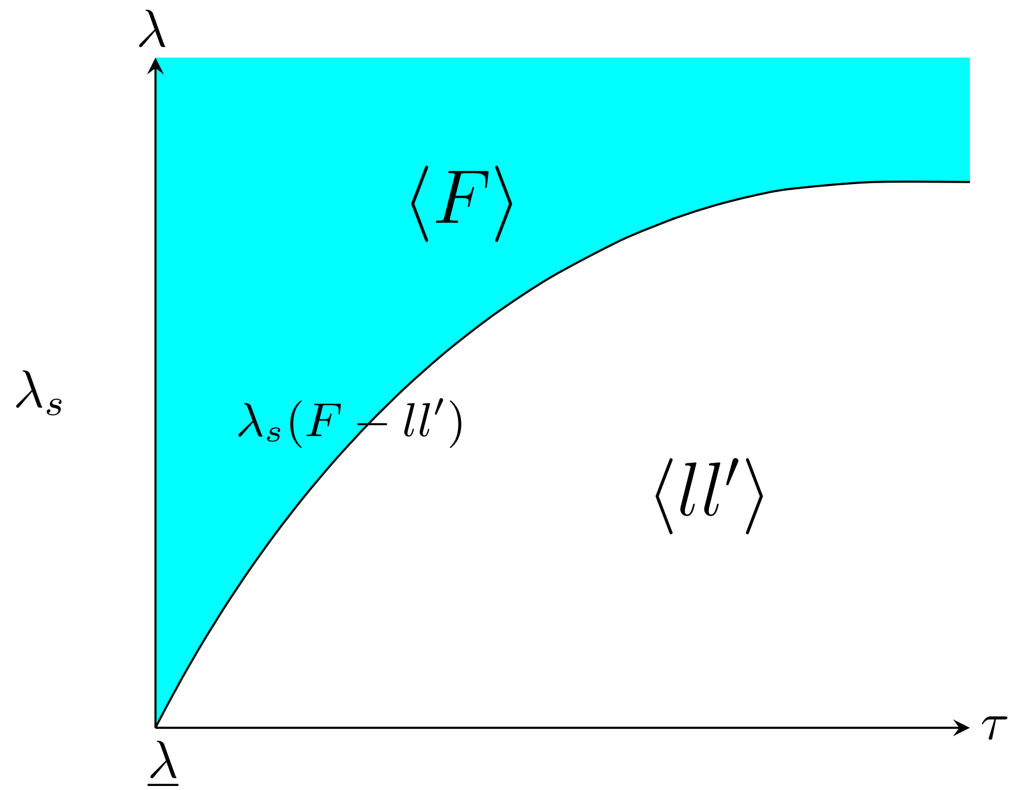


Figure 4: Bilateral FTA(s) is (are) CPNE - Asymmetry I

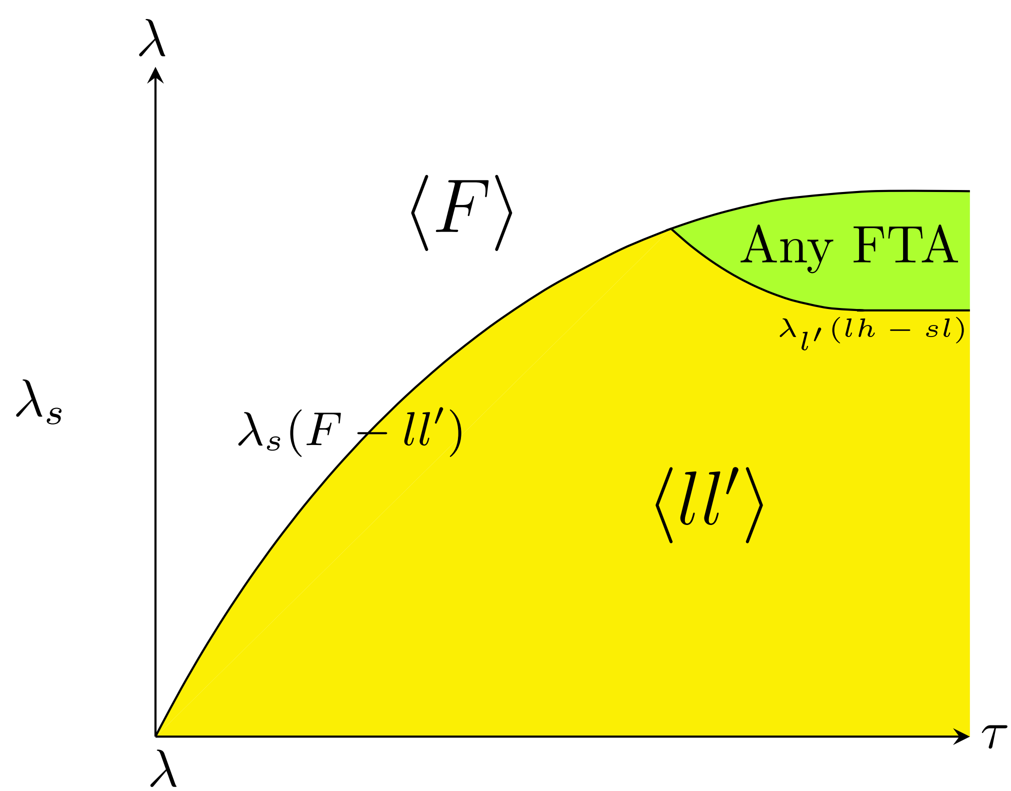


Figure 5: FTA tariff schedule - Asymmetry I

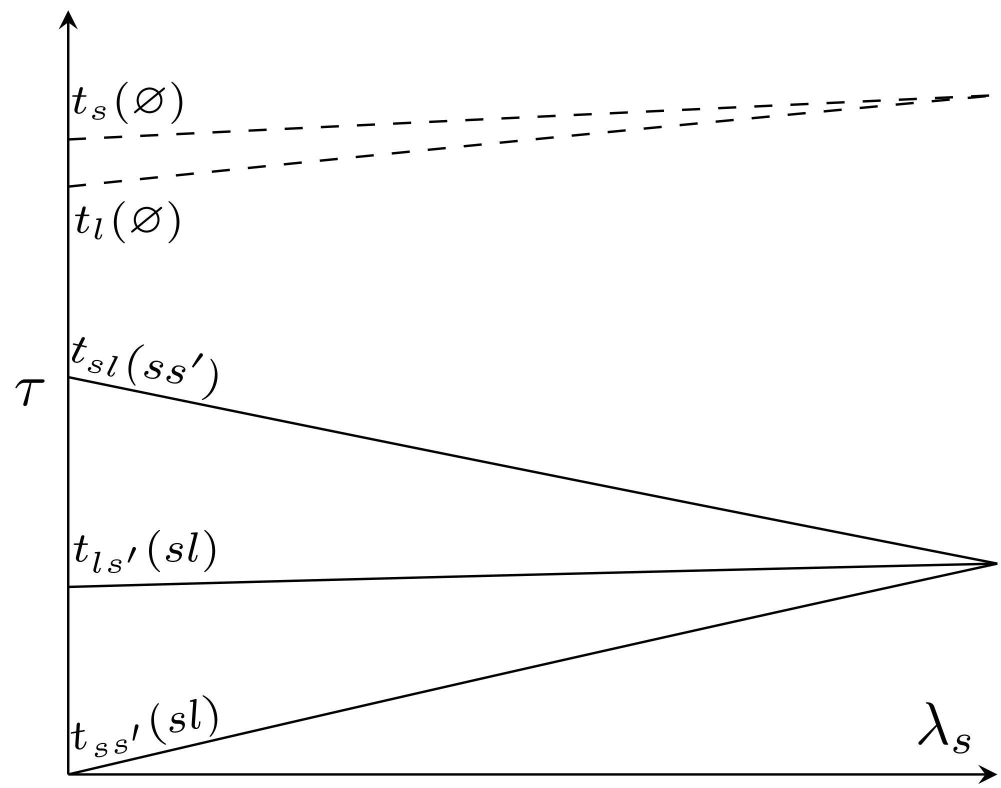
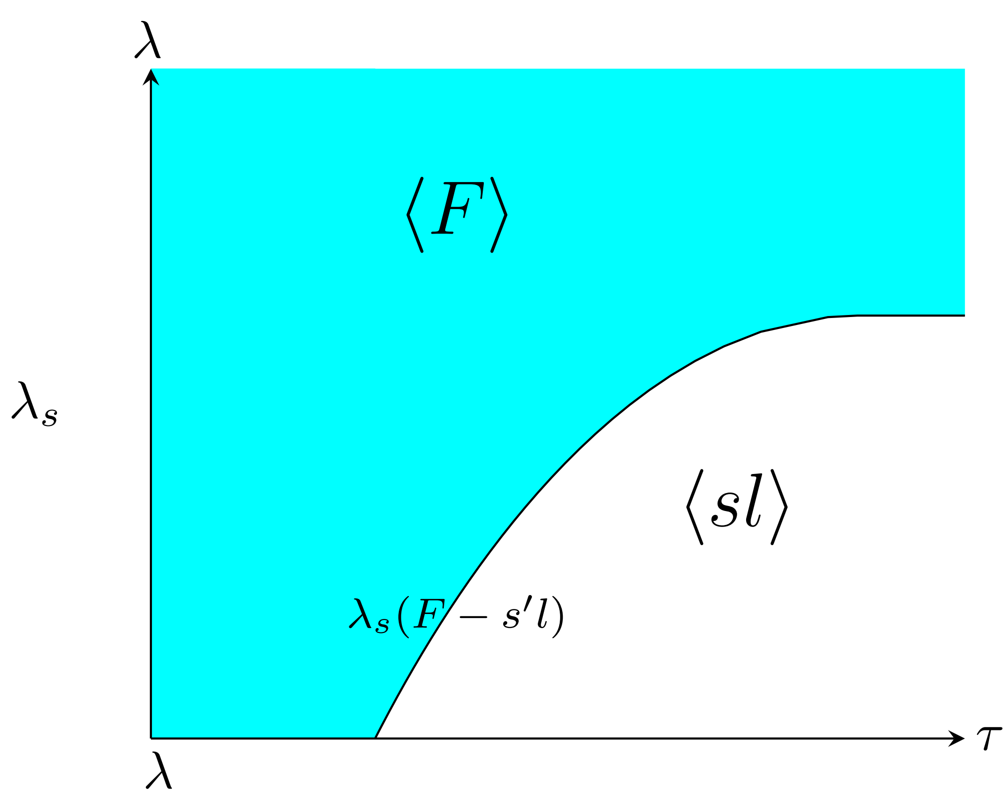


Figure 6: Free Trade is CPNE - Asymmetry II



Bilateral FTA is CPNE - Asymmetry II

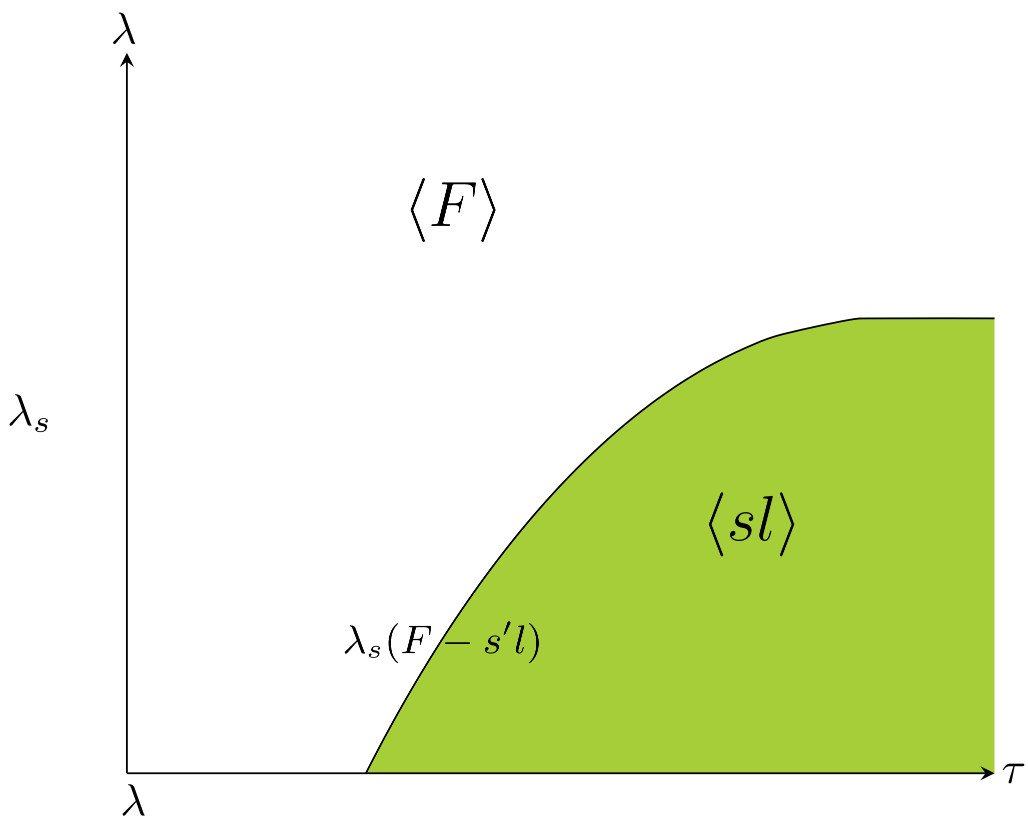


Figure 7: CU tariff schedule - Symmetry

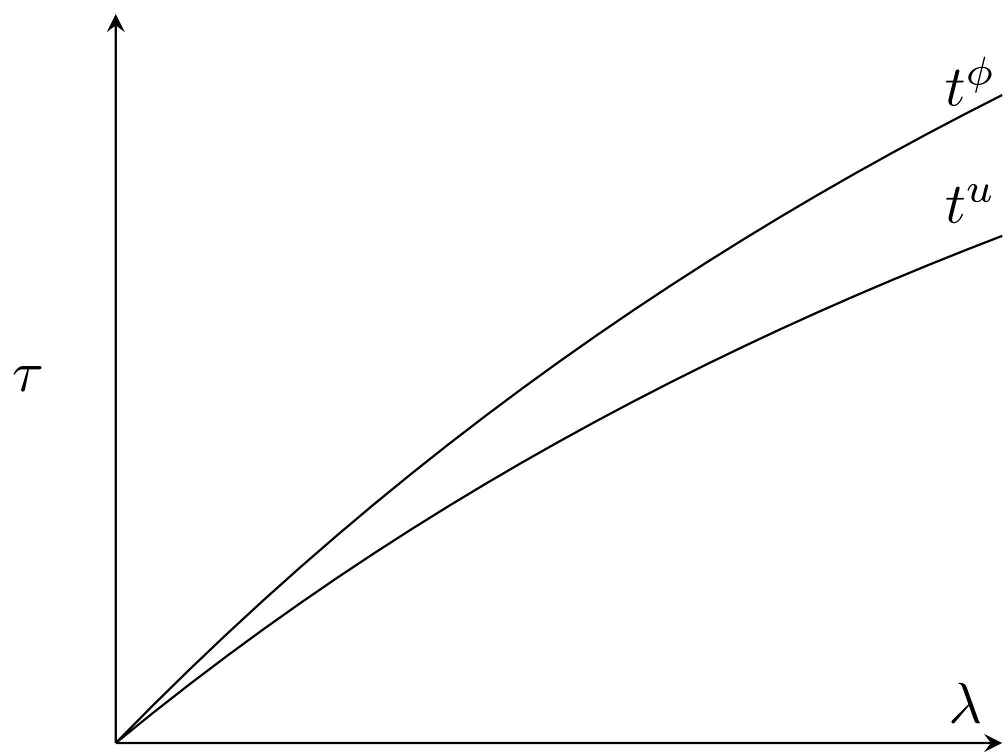


Figure 8: Stable quilibrium under CU - (CU game) Symmetry