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FTAs for Global Free Trade: Through Trade Liberalization Game

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Abstract

Purpose – This paper explains how free trade agreements (FTAs) work as a building block to achieve global free trade and be better than other trade regimes.

Design/methodology – This paper utilizes a trade liberalization game setup. Three countries choose a trade agreement strategy based on a given trade regime. Trade agreement is made only when all member countries agree. The paper evaluates each trade regime concerning FTAs and customs union (CU) by area size of global free trade equilibrium on the technology or demand gap between countries.

Findings – FTAs make global free trade easier. In this game, there are two main reasons for failure to reach global free trade. First, a trade regime with FTAs makes non-member face difficulties in refusing trade agreements in the existence of a technology gap than a trade regime without FTAs. Also, a trade regime with FTAs causes it harder to exclude non-members in the existence of a demand gap than a trade regime with only CUs. Therefore, a trade regime with FTAs can work better in reaching global free trade.

Originality/value – The concept of "implicit coordination" was used, which assumes that FTA members keep external tariffs for non-members the same as before an FTA. Without this consideration, FTA members lower their tariffs to non-members, and it makes non-member refuse free trade easier. FTA can prevent it sufficiently only with implicit coordination. This makes the trade regime with FTAs more effective to reach global free trade.

Keywords: Customs Union, Free Trade Agreement, Trade Liberalization Game
JEL Classifications: F12, F13, F15

1. Introduction

An issue of concern to countries undergoing economic integration is whether preferential trade agreements (PTAs), such as FTAs or CUs, will help world trade organization (WTO) countries reach global free trade. Bhagwati (1993) raised a famous question; will these arrangements be "building blocks" or "stumbling blocks" for global free trade? Some argue that PTAs work as building blocks by making overall tariffs lower, and then more trade agreements will make tariffs approach zero. However, when "imperfect" global trade based on PTAs improve the welfare of member countries or non-member countries, and that gain is higher than what can be achieved under global free trade, those countries will reject free trade. This is how PTAs become stumbling blocks.

This paper addresses how free trade agreements (FTAs) work well to achieve global tariff-free trade and support the building block hypothesis. To answer this question, a trade liberalization game setup is utilized with a three-country oligopoly goods market. Each country determines its trade agreement strategy to maximize its total surplus. The strategy and equilibrium results depend upon whether PTAs are possible or banned. FTA and CU

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members have zero internal tariffs between members. CU members must have the same external tariffs for goods from a non-member country, but FTA members can decide external tariffs independently.

How external tariffs for non-member country are determined is essential. When external tariffs are low, a non-member country can export more goods to member countries without opening their domestic market. If the gains from exports are high enough, a non-member refuses to be a member of trade agreements, and global free trade becomes unachievable. This refusal is called "free-riding" because this non-member country can gain from more exports without increased competition with imports on the domestic market.[1]

In contrast, when an external tariff is high enough, sometimes member countries can gain more by trading among themselves and not accepting another country as a new member than from accepting other countries and reaching global free trade. An "exclusive trade bloc" is established when PTA members do not accept non-members and reject free trade. Free-riding and exclusive trade blocs are the two main routes outside global free trade.

This paper compares the equilibrium results of different trade regimes[2] when each of two kinds of asymmetry (technology and demand) between countries exists, and as a result, each member country has different optimal external tariffs. First, permitting FTAs reduce the free riding of non-member countries effectively in the case of a technology gap. When FTAs and CUs are banned, countries can make a trade agreement and agree to a tariff decrease, but it must be applied to all countries under the most favored nation (MFN) rule. Under this trade regime, the free riding of non-members becomes prevalent. However, permitting FTAs are better to reduce free riding than prohibiting FTAs.

Second, permitting FTAs reduce the exclusive trade bloc possibility of member countries in the case of a demand gap. When FTAs are banned and only CUs are permitted, two countries make a CU, exclude non-members, and complete an exclusive bloc, failing to reach global free trade. This is because to add additional members to a trade agreement, both members must agree in a CU. In contrast, one FTA member can make another FTA with a non-member country, regardless of the opinion of other FTA members. Therefore, an FTA is less likely to be an exclusive bloc, and a trade regime with an FTA makes global free trade easier to reach.

Also, this paper considers an "implicit coordination" assumption for FTAs, which assumes that FTA members keep external tariffs for non-members the same as before an FTA. This assumption is deeply related to the tariff complementarity effect.[3] The model of this paper assumes tariff complementarity; the optimal external tariffs of FTA members are lower than external tariffs before reaching an FTA. However, member countries can keep an external tariff even with tariff complementarity, not lowering external tariffs for implicit coordination. If implicit coordination is considered, a trade regime permitting FTAs becomes more effective in reducing free riding. Implicit coordination cannot be considered in CUs because CU members must have identical external tariffs.[4]

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[1] The expression of free-riding is popular for papers on the most favored nation (MFN) rule, such as Ludema and Mayda (2009). Also, Maggi (2014) used the term to explain how non-members of trade agreement refuse to be a member.

[2] Trade regime includes all kinds of trade agreements and trade rules on those agreements. This paper analyzes the MFN regime, trade regimes with FTAs, and trade regimes with CU. Other trade regimes are not covered in this paper.

[3] For more details on tariff complementarity, check Bagwell and Staiger (1999) and Bond et al. (2004).

[4] CU members set external tariffs together. Therefore, it can be considered "explicit coordination"

How trade agreements work on the path to global free trade is an essential question for international trade economics, as mentioned by Maggi (2014). Trade creation and the trade diversion effect are important to explain the effects of PTAs, as mentioned in Baldwin and Venables (1995). Grossman and Helpman (1995) found that trade-diverting FTAs are more prevalent due to enhanced protection incentive. In contrast, Krugman (1991) insisted that FTAs formed among natural trade partners were more likely to increase welfare through trade creation. Also, McLaren (2002) focused on the rule of irreversible investments for the achievement of trade agreements. Goyal and Joshi (2006) and Furusawa and Konishi (2007) utilized a network-formation approach.

This paper uses a simple three-country oligopoly model and combines it with a trade liberalization game, which is similar Ornelas (2007) and Saggi and Yildiz (2010). This model is simple but useful in analyzing how countries make or refuse trade agreements and equilibrium changes in various environments. Saggi and Yildiz (2010) support the building block hypothesis of FTA regimes to reduce free riding with asymmetry in endowments for each country. Saggi et al. (2013) supported the stumbling block hypothesis of CUs using similar framework.

However, these papers do not consider implicit coordination. The basic setup of this paper is same as Nahm (2019). However, the main goal of Nahm (2019) was different. Nahm (2019) showed the popularity of FTAs through the concept of implicit coordination. In contrast, the main goal of this paper is a comparison of trade regime by comparing the equilibrium results of each trade liberalization game, which were not considered in Nahm (2019). Also, this paper shows how equilibrium results change with technology and demand asymmetry. The main route for the results of this model is setting external tariffs. High external tariffs decrease the likelihood of free riding, and low external tariffs decrease the likelihood of an exclusive trade bloc. Saggi and Yildiz (2010) used endowments asymmetry, but in this paper, optimal external tariffs are a function of the technology and demand parameters. These asymmetries make optimal external tariffs different between countries.

In this study, it is assumed that international transfers are impossible.[5] Then, each FTA or CU can make non-members lose welfare, which is harmful in the short-run, but this loss of welfare is helpful for the world to reach global, tariff-free trade in the long-run. It can prevent free-riding and cause non-members try to jointly reduce tariff levels by establishing another trade agreement. In this sense, this paper supports the "domino theory" or "contagion" of trade agreements. Riezman (1999) approached this problem similarly. Trade agreements can create trade diversion or a loss to non-member countries, and it makes global free trade more accessible. This was also empirically shown in Baldwin and Jaimovich (2012)[6].

Debates on tariff complementarity are not related to the main goal of this paper, but are heavily related to implicit coordination assumption. This assumption fits with the conflicting empirical work of Limão (2006) and Estevadeordal et al. (2008) on tariff complementarity for external tariffs after a trade agreement is made.[7] In addition, implicit coordination is optimal

compared to FTAs.

[5] Therefore, failure to reach global free trade may not achieve the maximization of total welfare, but can achieve Pareto-efficiency. To focus on the main objective, this paper assumes that the maximization of total welfare is the most desirable goal of the global economy.

[6] However, this paper uses only three countries and has only limited implications on domino theory.

[7] Their empirical works support the opinion that developing countries are more likely to lower external tariffs after making trade agreements than developed countries. Freund and Ornelas (2010) and Maggi (2014) asserted that when external tariffs were high enough, as in most developing countries, strong

for both FTA members in a specific parameter range, as shown in Nahm (2019).

This paper is organized as follows. In Chapter 2, model setup is explained. This details how market equilibrium is created for given tariffs, how each country chooses optimal tariffs for each trade agreement structure, and how the trade liberalization game is made. Chapter 3 analyzes the case of free riding. Trade agreement negotiations and equilibrium results for different trade regimes are compared with or without FTAs based on the trade liberalization game setup, and equilibrium results with exogenous technology differences are described and establish a parameter range to reach global free trade. Chapter 4 concerns exclusive blocs. It applied a similar tool to compare trade regimes with FTAs and trade regimes with CUs, and compare equilibrium results with a demand gap. Conclusions are presented in Chapter 5.

2. Model

The model has three stages.[8] Stage 1 is a cooperation game. In Stage 1, countries can negotiate trade agreements. Before Stage 1, the kinds of trade agreements are determined. This paper assumes that the social planner (or international organization) decides the trade regime, which permits or bans an FTA or CU. Then, each country can establish a trade agreement to maximize national welfare as the total surplus, which contains consumer surplus, producer surplus, and tariff revenue. Producer surplus consists of firm profits from domestic and foreign markets.

There are three countries, 1,2, and 3, and they establish trade agreements in this game. Trade agreements are assumed to be made only when all countries agree. This assumption is based on the character of agreements. There are four possible types of equilibrium results: (1) no agreement (trade war); (2) one agreement between two countries and another country becomes a non-member; (3) two agreements are made, and one country becomes a 'hub' of two agreements (possible only for FTAs); and (4) global tariff-free trade.

Stage 2 is the tariff decision of each country. Each country decides its tariff to maximize total welfare, but it must follow the equilibrium result made as the form of trade agreement in Stage 1. When global free trade is achieved, every tariff becomes zero and nothing can change. When free trade is not perfect, FTA and CU members set the internal tariff to zero and need to decide optimal external tariffs. FTA members set external tariffs independently, but CU members set the same external tariff for both members. If both FTAs and CUs are banned before Stage 1, two of three countries can make a trade agreement which sets identical internal and external tariffs under the MFN rule.

Stage 3 is the production decision of firms. They determine production to maximize profits based on production cost, demand, and tariff conditions in Stage 2. It is assumed there are two firms for each good, and the competition is a Cournot equilibrium.

The tariff decision of each country in Stage 2 reflects its own information about firm production and Cournot equilibrium in Stage 3. Similarly, the negotiation strategy of each country in Stage 1 rests on information about decisions in Stages 2 and 3. In this chapter, the model is explained starting with Stage 3 and goes backward. The full derivation of the model is in an Appendix available upon request.

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tariff complementarity appears. Implicit coordination assumption fits with this empirical research and supports this assertion.

[8] The model setup of this paper is same as Nahm (2019). A detailed solution is available upon request.

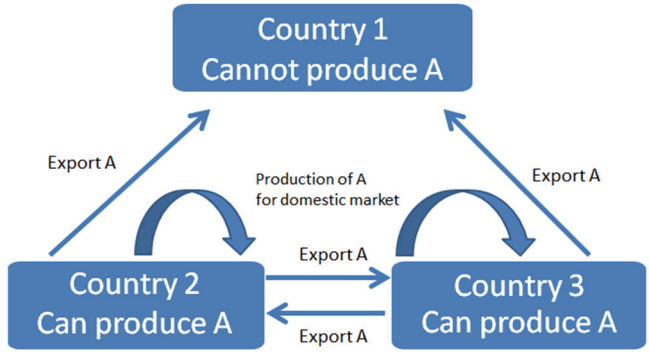
2.1. Market Equilibrium

There are three non-numeraire goods: A, B, and C. Consumers in three countries have the same preference for the three goods.

$$U_i = \alpha_{iA}x_{iA} - \frac{1}{2}x_{iA}^2 + \alpha_{iB}x_{iB} - \frac{1}{2}x_{iB}^2 + \alpha_{iC}x_{iC} - \frac{1}{2}x_{iC}^2 + \psi_i \quad (1)$$

for each country i =1, 2, and 3. ψ_i is the consumption of a numeraire good. Then, demand is derived from the utility function of $d(p_{ix}) = \alpha_{ix} - p_{ix}$ in each country i = 1,2, and 3, where X = A, B, and C. Demand is linear, and its slope is fixed to 1. Intercept α_{ix} represents the market size of each good X in country i.

Fig. 1. Trade Flows for Good A between the Three Countries



Each country can produce two of three non-numeraire goods.[9] Country 1 cannot produce Good A, Country 2 cannot produce Good B, and Country 3 cannot produce Good C. Each country has only one domestic firm for each product, and therefore 6 firms exist in this model: 2 firms for each good. All firms sell their goods domestically and export to foreign markets. Trade flows for Good A are described in Figure 1. Two firms for each good compete in three countries. From the viewpoint of the countries, each country produces and exports two kinds of goods, and imports all three goods. Also, two foreign firms compete in Country 1, but one domestic firm and one foreign firm compete in Countries 2 and 3.

Next, each country levies a tariff on imported goods. Then, the profit of each firm in this model is revenue minus production and tariff costs. π_{ijX} is the profit of the firm that produces good X in country j and sells those in country i. The profit is

$$\pi_{ijX} = p_{iX}q_{ijX} - q_{ijX}(c_{jX} + \tau_{ijX}) \quad (2)$$

for i, j = 1, 2, and 3 and X=A, B, and C. p_{iX} is the price of good X in country i. q_{ijX} is the sale

[9] When each country can produce all three non-numeraire goods and their productivity differs enough, the conclusion of the model is similar to the original. This model assumes that the production cost does not change with scale. This model setup focuses on how each member has different optimal external tariffs.

of good *X* in country *i*, which is produced in country *j*. c_{jX} is the unit production cost of the firm in country *j* that produces good *X*. c_{jX} represents the production technology of firms, and its difference represents the technology gap between firms. τ_{ijX} is the tariff determined in Stage 2 that country *i* levies on good *X* from country *j*. τ_{iiX} is assumed to be zero, and it means that positive tariff rates are only applied to the imported and subsidy as a negative tariff is banned.

Now, there are nine independent markets, and three goods for three countries. During Stage 3, firms compete in each market from optimal production decisions. The decisions constitute a Cournot equilibrium, and results depend on tariffs determined in Stage 2. When two firms from country *j* and country *k* produce good *X* and sell their goods in country *i*, the Cournot equilibrium productions are

$$q_{ijX} = \frac{1}{3}\left(\alpha_{iX} - 2c_{jX} + c_{kX} - 2\tau_{ijX} + \tau_{ikX}\right) \tag{3}$$

for each country *i*, *j*, and *k* = 1, 2, and 3, and each good X = A, B, and C, except combinations where a country cannot produce a specific good (*jX* and *kX* ≠ 1A, 2B, and 3C). These are function of the three set of parameters. First, α_{iX} represents the market size of each country and the difference between countries represents the demand gap. Second, c_{jX} represents the cost of each firm and its difference between firms represents the technology gap. τ_{ijX} represents tariffs, and these will be determined from the optimal decision of countries in Stage 2.

Consumer surplus and tariff revenue are identified as a function of the above parameters as well. Firm profits are the square of equilibrium production.

$$\pi_{ijX} = \left(p_{iX} - c_{jX} - \tau_{ijX}\right)q_{ijX} = \frac{1}{9}\left(\alpha_{iX} - 2c_{jX} + c_{kX} - 2\tau_{ijX} + \tau_{ikX}\right)^2 \tag{4}$$

As the production cost and tariff of a firm are low, that firm earn more profit. In contrast, as a competing firm has lower production costs and pays lower tariffs, the firm has less profit because consumers choose goods from the competing firm. If this market is the domestic market, the firm pays no tariff and earns more profit.

Next is identifying the total surplus. Total surplus is the sum of consumer surplus, tariff revenue, and firm profits. This paper categorizes total surplus into domestic surplus and profits from exports. The total surplus is described as

$$TS_1 = \sum_{X=A,B,C}\left(CS_{1X} + TR_{1X} + \pi_{11X}\right) + \sum_{Y=B,C}\left(\pi_{21Y} + \pi_{31Y}\right) = \sum_{X=A,B,C} DS_{1X} + \sum_{Y=B,C} EX_{1Y} \tag{5}$$

for Country 1. Domestic surplus is the sum of consumer surplus, tariff revenue, and firm profit from the domestic market for each good. Export profit is the sum of exports to Countries 2 and 3. Domestic surplus is from three goods, but exports are from only two goods because Country 1 cannot produce Good A. Also, considering equation (4), domestic surplus depends on the tariff decision of the home country, but exports depend on the tariff decision of foreign countries. This surplus structure is crucial in understanding the trade agreement strategy in Stage 1.

2.2. Stage 2: Optimal Tariff Choices in Trade Agreements

This section identifies the optimal tariff decisions. They try to maximize total surplus by setting optimal tariffs. The decision must follow the trade agreements made in Stage 1. For example, internal tariffs between FTA members must be zero, and members need to decide optimal external tariffs for non-members. Each country decides optimal tariffs under the constraints given in Stage 1. However, exports are part of total surplus, but do not depend on the home tariff decision. Therefore, each country maximizes domestic surplus DS_{iX} under the trade agreement structure given in Stage 1. Before calculating optimal tariffs, one assumption is added to makes results non-negative.

Assumption 1: $\alpha_{iX} + 4c_{jX} - 5c_{kX} \geq 0$ for all goods X = A, B, C and countries i, j, k = 1, 2, 3

This assumption confirms all production and optimal tariffs under all types of trade agreements are non-negative. When all countries agree with global tariff-free trade, all tariffs must be zero, and there is no decision in Stage 2. When any trade agreement is not made in Stage 1 (trade war), each country maximizes domestic surplus without constraint.

However, optimal tariffs are different for each good. At first, this is due to parameter differences such as the demand and technology gaps. Trade flow structure is different for each good. See Fig. 1 again and consider the case of Good A. Countries 2 and 3 produce good A, but also import Good A. Hence, they maximize the sum of consumer surplus, profit of domestic firms, and tariff revenue from trade. In contrast, Country 1 cannot produce Good A, and hence does not need to care about the profit of domestic firms. Also, Country 1 imports Good A from two countries and needs to set two optimal tariffs. Identified optimal tariffs in a trade war state are as below:

- $\tau_{ijX}(\Phi) = \frac{1}{8}(2\alpha_{iX} - 3c_{jX} + c_{kX})$ for each (i, X) = (1, A), (2, B), (3, C)
- $\tau_{ijX}(\Phi) = \frac{1}{3}(\alpha_{iX} - c_{jX})$ otherwise

Φ denotes a trade war, wherein any kind of trade agreement is not made. Four total tariffs need to be determined for each country. First optimal tariffs occur when the home country cannot produce a good and are applied to one good from two countries. Second optimal tariffs are an import that competes with domestic goods and is applied to two types of good. For example, Country 2 need to set two tariffs for Good B, which they cannot produce, and import from Countries 1 and 3 and need to set two tariffs for Good A from Country 3 and Good C from Country 1. All tariffs are positive under assumption 1.

This paper explained four types of equilibrium and showed optimal tariffs for two cases, the trade war and global free trade. Optimal tariffs for the 'hub of two FTAs' case are in the next chapter. Below are the optimal tariffs when equilibrium is one member and another non-member country, with different types of trade agreement. In these cases, the non-member country puts the same tariffs as a trade war state, but the optimal tariff structure of member countries heavily depend on the type of trade agreement.

First is the FTA case. When country *i* and country *j* reach an FTA, their internal tariffs become zero. Country *i* sets two tariffs with country *j* to zero and needs to choose two external

tariffs for Country k to maximize domestic surplus. Assume that Countries 1 and 2 make an FTA. Now, Country 1 sets tariffs to zero with Country 2 for Goods A and C which Country 2 produces. Consider τ_{13B}. Country 2 cannot produce Good B, and hence any condition for an optimization decision on τ_{13B} does not change. Therefore, τ_{13B} with an FTA for Countries 1 and 2 is the same as $\tau_{13B}(\Phi)$. This is applied to τ_{23A} and it is also same for $\tau_{23A}(\Phi)$. The optimization condition is changed only for τ_{13A} and τ_{23B}. Country 1 can decide τ_{13A}, and Country 2 can decide τ_{23B} for their own domestic surplus.

This paper proposes "implicit coordination". FTA members do not cooperate explicitly by deciding optimal tariffs to help exporting foreign firms. However, they can coordinate tariffs implicitly by keeping external tariffs the same as before an FTA. This strategy stipulates the status-quo as the focal point for coordination. When country *i* and country *j* establish an FTA *each other*, *I denote* (ij|FTA-in) denotes the strategy with independent optimal external tariff decision and (ij|FTA-co) is the strategy with implicit coordination on external tariffs.

- $\tau_{ikX}(ij|FTA-in) = \frac{1}{11}(\alpha_{iX} + 4c_{jX} - 5c_{kX})$ if country *i* cannot produce good *X*
- $\tau_{ikX}(ij|FTA-co) = \tau_{ikX}(\Phi) = \frac{1}{8}(2\alpha_{iX} + c_{jX} - 3c_{kX})$ if country *i* cannot produce good *X*
- $\tau_{ikX}(ij|FTA-in) = \tau_{ikX}(ij|FTA-co) = \frac{1}{3}(\alpha_{iX} - c_{kX})$ otherwise

$\tau_{ikX}(ij|FTA-in)$ is lower than $\tau_{ikX}(\Phi)$ under Assumption 1. Hence, exports from a non-member country to members decrease under implicit tariff coordination than a case without coordination. The non-member country loses from this tariff coordination. In comparison to a case without coordination, member countries lose some domestic surplus, but gain exports between members. When parameters are similar between countries, gains from exports are higher than the domestic surplus loss.

This structure is the famous prisoner's dilemma. Setting a lower external tariff is better for the domestic surplus, but these strategies hurt members with decreased trade volume. However, with coordination, they can gain more. Both members must satisfy conditions because this works only when both countries keep their tariff strategies. This paper calculated parametric conditions for both countries that prefer implicit coordination in Nahm (2019), and it is satisfied for most of the numerical analysis.

Establishing a CU is "explicit" coordination. CU members must have identical external tariffs for a non-member country, and hence they choose an identical optimal tariff to maximize the member surplus. In this process, they internalize trade between members, which are not considered in an optimal external tariff decision in an FTA. (ij|CU) denotes a case with a CU of country *i* and *j*. Optimal tariff decision is defined below, and optimal tariffs are identified when country *k* cannot produce *Z*.

- $\tau_{\cdot kX}(ij|CU) \equiv \text{argmax}(DS_{iX} + DS_{jX} + \pi_{ijX})$ with $\tau_{ijX} = 0$
- $\tau_{\cdot kY}(ij|CU) \equiv \text{argmax}(DS_{iY} + DS_{jY} + \pi_{jiY})$ with $\tau_{jiY} = 0$
- $\tau_{\cdot kX}(ij|CU) = \frac{1}{6}(\alpha_{iX} + \alpha_{jX} - 2c_{kX})$

When FTAs and CUs are banned, two countries can reach another kind of trade agreement

to increase surplus. FTA and CU are categorized as a PTA (Preferential Trade Agreement), with lower tariffs for members and higher tariffs for non-members. Under the MFN rule, PTAs are banned, and a new trade agreement under strict multilateralism is possible option. Now members must apply lower tariffs for all countries, regardless of whether they are members. This is denoted (ij|multi). The optimization and identified tariffs are below when country *k* cannot produce *Z*.

- $\tau_{\cdot X}(ij|multi) \equiv argmax(DS_{iX} + DS_{jX} + \pi_{ijX})$ with $\tau_{\cdot X}(ij|multi) = \tau_{ijX} = \tau_{ikX} = \tau_{jkX}$
- $\tau_{\cdot Y}(ij|multi) \equiv argmax(DS_{iY} + DS_{jY} + \pi_{jiY})$ with $\tau_{\cdot Y}(ij|multi) = \tau_{jiX} = \tau_{ikX} = \tau_{jkX}$
- $\tau_{\cdot X}(ij|multi) = \frac{1}{5}(\alpha_{jX} + c_{jX} - 2c_{kX})$ and $\tau_{\cdot Y}(ij|multi) = \frac{1}{5}(\alpha_{iY} + c_{iY} - 2c_{kY})$

This trade agreement also considers trade flows between members. This is the same as the optimization of CU members. However, constraints that low tariffs must be applied to non-members are strong. Optimal tariffs are consequently changed.

Now all conditional tariffs are identified. As a result, all total surpluses are identified as a function of the technology $\{c_{iX}\}$ and demand parameters $\{\alpha_{iX}\}$ for all types and equilibriums. With this information about Stages 2 and 3, countries in Stage 1 choose trade agreement strategies to maximize total welfare.

2.3. Stage 1: Trade Liberalization Game

At Stage 1, countries become players in a trade liberalization game. They know what the equilibrium result will be in Stages 2 and 3 under each trade agreement relationship. There are four possible types of equilibrium results in Stage 1: trade war (Φ), one agreement and a non-member (ij), two agreements and one hub country (i-hub), and global free trade (G). Also, this game must follow a given trade regime which determines permission or bans a type of trade agreements. There are three types of trade regime: (1) both FTA and CU are not possible (no PTA: strict multilateralism), (2) only the FTA is possible, (3) only the CU is possible.[10]

Each player can decide whether to propose a trade agreement with the two other countries with the goal of maximizing total surplus. It is assumed that international transfer is impossible, and that each country arrives at its decision by comparing the surpluses produced under each game result, considering Stages 2 and 3. When only one type of trade agreement is possible, there are four possible strategies in Stage 1: (1) do not propose a trade agreement (∅), (2 and 3) propose a trade agreement with only one country (ρ_j and ρ_k), and (4) propose a trade agreement with both countries (ρ_G). For example, the strategy set of Country 1 is $\{\emptyset, \rho_2, \rho_3, \rho_G\}$.

The countries undertake strategies simultaneously, and a trade agreement is established only when two countries propose an agreement . For example, when only FTA is possible, assume that Countries 1, 2, and 3 choose strategies $\{\rho_2\}$, $\{\rho_G\}$, and $\{\rho_1\}$, respectively. Then, an FTA between Countries 1 and 2 is made because both countries want it. Countries 1 and 3 do not reach agreement because Country 3 wants it, but Country 1 does not. Countries 2 and 3 cannot arrange an FTA because Country 3 does not want it. Global tariff-free trade

[10] Trade regime which permit both of FTA and CU are possible option. But that result is not much different from the one of trade regime which permit only FTAs.

between these countries is possible only when all three players choose $\{\rho_G\}$.

It is assumed that global tariff-free trade is desirable and conditions to reach global free trade as equilibrium under each trade regime will be indentified. There are three kinds of potential deviations from free trade.

- Free Riding: occurs when one non-member country refuses a trade agreement with other countries.
- Exclusive Bloc: occurs when two member countries refuse participation of a non-member country.
- Hub-and-Spoke: occurs when one country refuses a trade agreement with another country, and the remaining country becomes a hub of two trade agreements.

These deviations occur from the optimization decisions of countries. That is, a certain deviation is beneficial for one country over global free trade, and that country chose that deviation naturally, which causes free riding or a hub-and-spoke structure as equilibrium. However, making an exclusive bloc is different. It is not possible from the decision of one country. A trade agreement becomes an exclusive bloc only when both members deviate and cut ties with another non-member country. For example, to make trade agreements of 1 and 2 exclusive blocs, both countries must cut ties with Country 3, and both get a higher total surplus than the total surplus under global free trade. In short, deviation from global free trade can proceed from a coalition of Countries 1 and 2.

This cooperative deviation is not considered in the simple Nash equilibrium, which needs to block all deviations of each player, but does not consider coalition deviation. Hence, in this game, the concept of the "Coalition-proof" Nash equilibrium (CPNE) is employed, which Bernheim et al. (1987) defined.

This paper concentrates on how free riding and exclusive blocs are harder under a trade regime in which FTAs are possible. These two deviations may become prevalent when more than three countries exist and work as a stumbling block in reaching global free trade. Free riding is analyzed first and compares a trade regime with FTAs and trade regime with no PTAs in the next chapter. This paper analyzes the exclusive bloc, gives more detail on CPNE, a hub-and-spoke, and CUs later.

3. Free Riding and FTAs

Each country can refuse any trade agreement and becomes a free rider of a trade agreement with other countries based on a comparison of welfare. It is assumed that Country 3 chooses whether to become a free rider. When choosing to be a free rider, the domestic gain of Country 3 is from an increase of tariff revenue and firm profit for the domestic market. Instead, Country 3 loses some of the consumer surplus. What about exports? Current GATT/WTO Article XXIV regulates trade agreement members to not raise external tariffs. Therefore, Country 3 can export more to the member countries as a free rider.

To identify how decision by Country 3 changes with a different trade regime, we need to find how the welfare of Country 3 changes by trade agreement. At first, when Countries 1 and 2 establish a trade agreement, the type of trade agreement does not have any effect on the domestic welfare of Country 3. Therefore, when choosing to be a free rider, Country 3 levies

the same tariffs as the trade war state, regardless of the type agreement. Hence, the free riding decision of each case depends on the domestic welfare difference, but the free riding welfare difference between different trade agreements with Countries 1 and 2 does not depend on the domestic welfare difference. As a result, we can identify which trade regime makes free riding easier by comparison of the exports of Country 3.

When external tariffs of member countries are low, Country 3 can see higher exports and higher welfare, and more easily choose to be a free rider. Country 3 is a free rider because they can enjoy increased exports without opening domestic markets. Opening to trade is overall beneficial for many real-world cases, but there are many incentives to raise tariffs. This model is based on oligopoly, and each country can earn more welfare by shifting the profit from foreign firms to domestic firms or as tariff revenue. Considering increased exports from global free trade, the gain of global free trade becomes larger. However, when other countries make a trade agreement, incentives for a unilateral tariff decrease for Country 3 may not be high.

When Country 3 chooses not to be a member of trade agreement, it is a unilateral deviation from global free trade, and global free trade cannot be a Nash equilibrium. In this chapter, how trade regimes with FTAs are better to reduce free riding over trade regimes without FTAs is evaluated.

3.1. Theoretical Analysis on Free Riding

Within an FTA between two countries, two external tariff policy options are possible: the separate decision of each country, or an implicit coordination that both countries keep the status-quo. Country 3 chooses free riding based on total surplus, and therefore we need to compare the total surpluses for two different tariff policies.

Proposition 1. (Implicit Coordination and Free Riding) If countries *i* and *j* established an FTA, $TS_k(ij|FTA-in) > TS_k(ij|FTA-co)$.

Detailed proof is in the Appendix. To explain it briefly, domestic surplus areas are same for two cases, and the decision on free riding depends on the external tariff decisions of member countries. External tariffs are lower when they decide external tariffs independently than under implicit coordination. Therefore, the non-member country exports less when members choose implicit coordination.

The proposition indicates that when countries in an FTA coordinate implicitly, they can prevent free riding and push outside countries to negotiate another FTA to come close to free trade, in comparison to separate external tariff decisions. Then, will they choose implicit coordination? Nahm (2019) offered these conditions and indicated that two countries will coordinate implicitly when it provides a better result than a separate decision for both countries. (ij|FTA*) is denoted an endogenous decision of the external tariff policy in an FTA. Then, each country considers the endogenous external tariff policy decisions of all members before deviation.

- (ij | FTA*) denotes (ij|FTA-co) if $TS_x(ij|FTA-in) > TS_x(ij|FTA-co)$ for each x = i, j

- (ij | FTA*) denotes (ij|FTA-in) otherwise.

Next, the study identifies the case of trade regimes without PTAs. The conditions of free riding are similar. Each country can compare surpluses with free trade and surpluses from cutting ties. Free riding decision depends on exports to member countries. For proposition 1, a comparison of the external tariffs of member countries for each case is enough proof. However, optimal external tariffs under strict multilateralism contain the demand of each country that produces a good. When FTA members decide optimal tariffs, they only consider their own demand. In contrast, under multilateralism, members decide the same optimal tariffs for all external and internal tariffs, and they need to consider the demand of both member countries. Therefore, the next proposition works under additional conditions.

Proposition 2. (Free Riding under an FTA and Multilateralism) If countries *i* and *j* make a trade agreement and their market sizes are the same, $\mathrm{TS_k(ij|multi)} > \mathrm{TS_k(ij|FTA-co)}$.

The proof is in the Appendix. For each good, country *k* exports to the country which can produce the good and the country which cannot produce the good. When market sizes are same, both exports are lower under a trade regime with an FTA than under strict multilateralism. Therefore, free riding becomes easier under strict multilateralism.

In respect to free riding, a trade regime with an FTA with implicit coordination is better than strict multilateralism. However, a hub-and-spoke deviation is possible under an FTA, and this deviation is not possible under strict multilateralism. How a hub-and-spoke type deviation is made is identified in the next section.

3.2. Hub-and-Spoke Structure of an FTA

When countries i and *j* make an FTA and countries *i* and *k* made another FTA, country *i* becomes a hub of two FTAs. This state is denoted the 'i-hub'. When at least one of *j* and *k* refuse a trade agreement between *j* and *k*, the (i-hub) becomes the equilibrium state. The hub country sets all tariffs to zero and exports goods to spoke countries without tariffs. Only two spoke countries maintain a positive tariff with each other.

This hub-and-spoke structure is possible only under a trade regime with FTAs. Under the CU, members must have the same external tariffs. When countries *i* and *j* made the CU, the negotiation of the trade agreement between *j* and non-member *k* conflict with the external tariff rule of the CU without including country *k* as a member and reaching global free trade. Under strict multilateralism, external and internal tariffs are the same. In this case, when countries *i* and *j* made the trade agreement, only the external tariffs of country *k* were different. Under the i-hub structure, all tariffs become the same, and the three countries can lower tariffs to zero. As a result, the i-hub structure does not exist under strict multilateralism.

Implicit coordination does not work with a hub-and-spoke structure. Implicit coordination strategy works only when all FTA members keep external tariffs with the status-quo. Hence, when one country becomes a hub, it means the collapse of coordination. Therefore, under the hub-and-spoke structure, spoke countries set external tariffs independently. Optimal tariffs between spoke countries are same as the tariffs under an FTA without coordination because country *i* has zero tariffs for all imports, and it cannot coordinate with any country.

- $\tau_{jkX}(i-\text{hub}) = \frac{1}{11}(1\alpha_{jX} + 4c_{iX} - 5c_{kX})$ for each (i, X) = (1, A), (2, B), (3, C)
- $\tau_{jkX}(i-\text{hub}) = \frac{1}{3}(\alpha_{jX} - c_{kX})$ otherwise

Being a hub country is very attractive because it can get the same domestic surplus as under global free trade and have higher exports due to non-zero tariffs between two spoke countries.

Proposition 3. (Superiority of the Hub Country) $TS_i(i-\text{hub}) > TS_i(G)$.

The proof is in the Appendix. With two spoke countries, imports from the hub country and the other spoke country compete, but the tariff is only on the other spoke country. As a result, the hub country can export more of the good that the spoke country cannot produce than under global free trade. The total surplus gained in a hub of two FTAs is always larger than the surplus gained as a member of global free trade.

What about spoke countries? Assume that Countries 1 and 2 make an FTA, and Country 1 becomes a hub by making another FTA with Country 3. Country 3 can gain from an FTA with Country 1, but this does not provide exclusive advantages because Country 1 has an FTA with Country 2. Hence, gains from this FTA are limited in this sense. Country 2 loses some of its ability to export to Countries 1 and 3 from the FTA of Countries 1 and 3. Implicit coordination is not possible here. Country 2 lowers its tariff on Country 3, and its domestic surplus can increase as a result.

In comparison to free trade, spoke countries have zero tariffs with a hub country, and only low tariffs with the other spoke country. A spoke country exports less to other countries and gains domestic surplus from external tariffs on the other spoke country. If this gain is higher than the loss, the spoke country will not negotiate a trade agreement with the other spoke country, and a hub and spoke state become the equilibrium. That is, when an FTA is possible, each country can choose to be not only a free rider by nullifying FTAs with both countries, but also a spoke country by cutting only one FTA with one country.

3.3. Numerical Application for Free Riding: Technology Gap

This section describes the equilibrium result of the trade liberalization game above with a technology gap. When three countries have similar unit costs and market size, it become easier to reach global free trade. However, asymmetry between countries makes global free trade harder to achieve. In this section, how equilibrium result changes in some parametric regions under different trade regimes is identified. The focus is on the technology gap and cost difference here. Equilibrium change from the demand gap will be identified in the next chapter.

It is hard to visualize the change of all parameters in one graph. Below is the assumption to focus on the relative technology difference between firms in different countries and skip other factors.

Assumption 2-1.
(i) $\alpha_i \equiv \alpha_{iA} = \alpha_{iB} = \alpha_{iC}$ and $c_j \equiv c_{jA} = c_{jB} = c_{jC}$ for i and j = 1, 2, and 3.
(ii) $e \equiv \alpha_1 - c_1$ and $\alpha = \alpha_1 = \alpha_2 = \alpha_3$

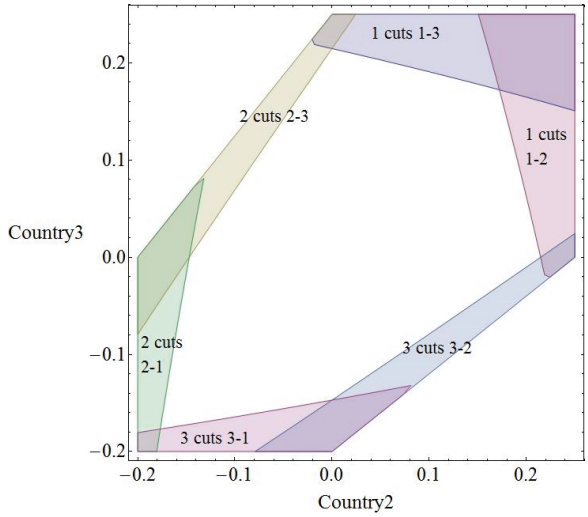
(iii) $t_k = \frac{(\alpha_1 - c_k) - (\alpha_1 - c_1)}{\alpha_1 - c_1}$

(iv) $-0.2 < t_2, t_3 < 0.25, 4t_2 - 5t_3 < 1, -5t_2 + 4t_3 < 1.$

All demand and cost difference between three goods were left out through assumption (i). Each country has same demand size and same unit cost for all three goods. Under assumption (ii), the demand sizes of all countries are the same for all three goods. Absolute cost parameters were exchanged $\{c_i\}$ into the relative technology parameter $\{t_i\}$ for i=2,3. If c_2 is higher than c_1, t_2 is less than zero. If the cost of firms in Country 2 is higher than cost of firms in Country 1, the relative technology of Country 2 become negative. t_1 is always set to zero. Now, we can check the change of equilibrium results in the (t_2, t_3) plane. An assumption is added for the parameter range in (iv), and this is technology version of Assumption 1. Also, the condition of implicit coordination[11] is satisfied under the range in (iv). That is, when two countries make an FTA at any point of given parametric space, they choose implicit coordination.

Global, tariff-free trade is desirable in the sense that the joint surplus of the three countries in a free trade state is higher than in any other state among the results of trade liberalization games in all parametric ranges. When $t_2 = t_3 = 0$, the three have the same cost and demand size, and they reach global free trade in any case. However, when asymmetry is assumed, the region in which free trade is achievable depends on the possible type of trade agreement. As that region is wide, that type of trade regime is better for reaching global free trade.

Fig. 2. Hub-and-Spoke Deviation: Technology Gap



At first, Fig. 2 describes hub-and-spoke type deviations. This type of deviation is not dependent on implicit coordination, and only appears in an FTA trade regime. Six shaded

[11] $\sqrt{\frac{77}{206}}(2 + 3t_2) < 2 + 3t_3 < \sqrt{\frac{206}{77}}(2 + 3t_2)$

areas appear, and each area stands for the deviation if one country nullifies one FTA and makes the other country a hub. If Country 1 cuts an FTA with Country 3, Country 2 becomes a hub of two FTAs.

Fig. 3. Equilibrium Result for the FTA Trade Regime (Without Coordination): Technology Gap

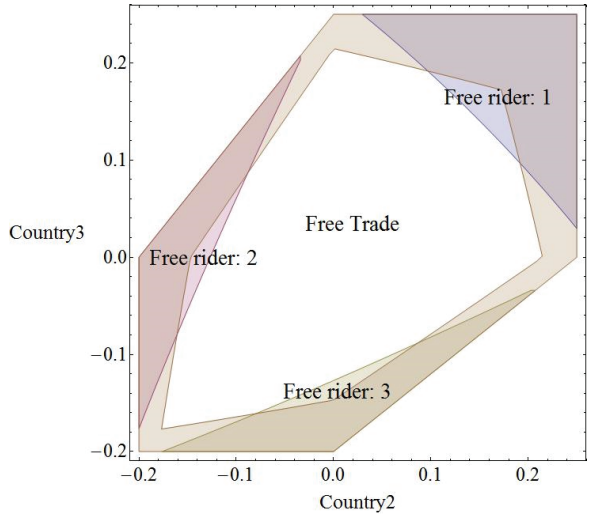


Fig. 3 describes free riding under the FTA trade regime where implicit coordination is not considered. Under the parametric range in Assumption 2-4, all FTA members choose implicit coordination, but this graph was chosen to compare the difference with the results under implicit coordination. There are three shaded areas which describe the free riding of each country. In contrast, when implicit coordination is considered, additional shaded areas disappear, and more free-riding beyond the hub-and-spoke type deviation does not happen. This is the same result as Proposition 1 predicts.

When each FTA member does not coordinate, they choose their own optimal external tariff. If this is low enough, non-members choose not to join the trade agreement and enjoy export increases with no cost in their domestic markets. In contrast, when two countries can choose coordination and keep the status quo, there is no free riding. Each country must lose export profit if they choose to be a non-member, and then deviation becomes more costly.

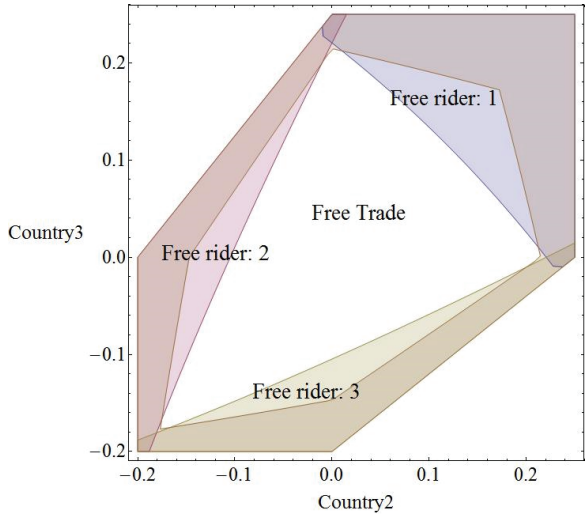
Fig. 4. Equilibrium Result for Strict Multilateralism: Technology Gap

Fig. 4 shows that the free riding of a non-member country becomes prevalent under strict multilateralism. In this case, a hub-and-spoke type deviation is impossible, but free riding areas are larger than the shaded area in Figure 2 (10). This is in line with Proposition 2. Under strict multilateralism, tariffs should be the same for members and non-members. Therefore, free riding becomes easier because members cannot reduce imports from non-member. This regime is dominated by an FTA regime in respect to global free trade.

Fig. 2 shows that a country with less developed technology tends to nullify an FTA with a country that has the most developed technology and become a spoke. Similarly, Figures 3 and

4 show that a country with less developed technology tries more to be a free rider. As a country has a higher production cost, the loss of exports from tariffs are smaller. They become free riders because gains from tariff revenue and the consumer surplus increase. Other developed countries see more gains from export profits, and becoming a free rider is costly. A less developed country becomes unfavorable to free trade, and the trade regime with an FTA can make these countries more accepting of global free trade, especially under consideration of the implicit coordination of FTA members.

In the above cases, an exclusive bloc does not appear. How this exclusive bloc decreases in the FTA trade regime from demand gap is shown in next chapter.[12]



4. Exclusive Bloc and FTA

When two countries made a trade agreement and exclude the other country, then that trade agreement becomes an exclusive trade bloc and reaching global free trade fails. Assume Country 1 and Country 2 make a trade agreement. They can set external tariffs to maximize their own welfare based on the type of trade agreement, and it may be higher than welfare from global free trade. Making an exclusive bloc offers gains such as more profits from evading competition in domestic markets, markets in member countries, and more tariff revenue. This may be higher than the reduced consumer surplus and reduced exports to the non-member country.

This gain and loss depends on the level of external tariffs and the type of trade agreement. In contrast with the free riding case, the type of exclusive bloc changes all domestic welfare of a country and has a different effect on exports to members and non-members. Therefore, the welfare difference of an exclusive bloc between different types of trade agreement is more

[12] When the technology gap is applied to a trade regime with a CU, an exclusive bloc appears, but free riding disapperas. As a result, the size of the region to achieve free trade is hard to compare with the case of an FTA. It was added to the online Appendix.

complex than the free riding decision.

Also, this deviation from global free trade is a joint strategic move. An exclusive bloc is made from the decision of both countries. If Country 1 breaks the FTA with Country 3, but Country 2 does not, this FTA structure makes Country 2 a hub, not an exclusive bloc. To identify the equilibrium with consideration to joint deviation, the concept of CPNE is applied here. The paper will identify the condition of deviation from global free trade with CPNE first, compare the conditions of the FTA and a CU, and perform a numerical application with a demand gap.

4.1. CPNE and Exclusive Bloc on FTA

When two countries jointly deviate from global free trade, is that bloc is stable? This paper identified the joint deviation above, but did not identify the stability of the bloc. Under the trade regime in which an FTA is possible, a hub-and-spoke structure is possible. Becoming a hub allows more welfare than free trade does for any country, as shown in Proposition 3. When the current state is one FTA and one non-member, such as when an exclusive bloc is made, each FTA member can become a hub of two FTAs by making another FTA with a non-member. That is, an exclusive bloc becomes fragile when an FTA is possible.

When the current state is global free trade, a country can be a hub only when two others break FTAs. Each country cannot become a hub from its own choice when free trade is already made. In contrast, when the current state is one bloc and another non-member, a country can be a hub with negotiation with another non-member. Making themselves a hub country is possible only when the country is the member of one bloc and another non-member exists. Also, a hub-and-spoke state can be moved to global tariff-free trade when two spoke countries reach an FTA, regardless of the opinion of a hub country.

In short, there are three states and deviations {G} → {12 | FTA*} → {1-hub} → {G} in which circling deviation is possible. Below, the conditions for each deviation are summarized.

- {G} → {12 | FTA*} : $\mathrm{TS}_1(\mathrm{G}) < \mathrm{TS}_1(12|\mathrm{FTA}*)$ and $\mathrm{TS}_2(\mathrm{G}) < \mathrm{TS}_2(12|\mathrm{FTA}*)$
- {12 | FTA*} → {1-hub} : $\mathrm{TS}_1(12|\mathrm{FTA}*) < \mathrm{TS}_1(1-\mathrm{hub})$ and $\mathrm{TS}_3(12|\mathrm{FTA}*) < \mathrm{TS}_3(1-\mathrm{hub})$
- {1-hub} → {G}: $\mathrm{TS}_2(1-\mathrm{hub}) < \mathrm{TS}_2(\mathrm{G})$ and $\mathrm{TS}_3(1-\mathrm{hub}) < \mathrm{TS}_3(\mathrm{G})$

Condition 1 prevents global free trade from being a stable equilibrium. Condition 2 prevents the exclusive bloc from becoming a stable equilibrium, and Condition 3 prevents the hub-and-spoke state from being a stable equilibrium. Therefore, any state looks unstable if the three conditions are satisfied. All three conditions can be satisfied together. Consider the case of $\mathrm{TS}_1(\mathrm{G}) < \mathrm{TS}_1(12|\mathrm{FTA}*) < \mathrm{TS}_1(1-\mathrm{hub})$. $\mathrm{TS}_1(\mathrm{G}) < \mathrm{TS}_1(12|\mathrm{FTA}*)$ is always satisfied by Proposition 3. When the value of $\mathrm{TS}_1(12|\mathrm{FTA}*)$ is in the middle of other two, all inequalities are satisfied.

The coalition-proof Nash equilibrium (CPNE) concept is employed to solve this kind of problem. A deviation within a coalition of two or three countries is considered only when it is "self-enforcing". The deviation strategy of the coalition is defined as self-enforcing when the coalition strategy creates Nash equilibrium for all coalition members under a given strategy of a player outside of the coalition. When a self-enforcing deviation by one coalition from one

state is possible, that state cannot be a CPNE. A CPNE must be proof to all self-enforcing coalitions.[13]

Assume all three conditions are satisfied, with the establishment of an exclusive bloc against Country 3 from global free trade. For this deviation to occur, both Countries 1 and 2 must cut their FTAs with Country 3. However, for Country 1, a better option is to maintain its connection with Country 3 and let only Country 2 break its connection with Country 3. Then, only the relationship between Countries 2 and 3 will be broken, and Country 1 can become a hub of two FTAs. A deviation strategy is "self-enforcing" when that joint strategy is a Nash equilibrium strategy for a given strategy choice by other countries. When $TS_1(G) < TS_1(12|FTA*) < TS_1(1-hub)$, deviation {G} → {12 | FTA*} is attractive, but {1-hub} is a better state for Country 1, and then Country 1 will betray Country 2. This betrayal does not need cooperation with Country 3. As Country 1 pretends to cut the FTA with Country 3 but does not when Country 2 does, {G} → {1-hub}, deviation is made.

This possibility indicates that deviation {G} → {12 | FTA*} is not self-enforcing when $TS_1(G) < TS_1(12|FTA*) < TS_1(1-hub)$. Only when the total surplus of exclusive the FTA is higher than the total surplus of becoming a hub for both countries, and deviation from global free trade to an exclusive bloc is self-enforcing, global free trade becomes unstable. When this condition is not satisfied for Country 1, joint deviation is not possible because Country 1 will not break the FTA with Country 3 to become a hub, and Country 2 already can predict that and will not believe Country 1. As a result, global free trade becomes stable in this case.

In contrast, {12 | FTA*} → {1-hub} deviation is joint between Countries 1 and 3, but {1-hub} → {G} is another joint move of Countries 2 and 3. Deviation of Countries 1 and 3 is not self-enforcing only when additional deviation of Country 1 or 3 is possible under a given strategy choice of a player outside of the coalition, Country 2. If additional deviation is possible only with the strategy change of Country 2, the initial deviation of Countries 1 and 3 is self-enforcing. Also, {1-hub} → {G} deviation is joint between Countries 2 and 3, but {G} → 'any FTA' also needs move Country 1. This means that this deviation is self-enforcing. Also, {1-hub} → {G} always happen as countries do not choose hub-and-spoke type deviations, which is sorted as another type of deviation.

In conclusion, the below three cases are possible deviations when only an FTA is possible. For any *i*, *j*, and *k* = 1, 2, and 3, but differ from each other;

1. $TS_k(ij|FTA*) > TS_k(G)$: *k* becomes a free rider.
2. $TS_j(i-hub) > TS_j(G)$: *j* deviates and *i* becomes a hub of two FTAs.
3. $TS_i(ij|FTA*) > TS_i(i-hub)$, $TS_j(ij|FTA*) > TS_j(j-hub)$: *i* and *j* make an exclusive bloc.

Otherwise, {G} becomes a unique CPNE.

When countries *i* and *j* do not coordinate, free-riding increases, the second condition does not change, and the exclusive bloc decreases as a result. Therefore, overall equilibrium results considering coordination can only be compared through numerical application in the next

[13] The correct definition of CPNE needs mathematical induction on the number of players. See Bernheim et al.(1987) or Moreno and Wooders(1996) for details.

section.

4.2. Exclusive Bloc with a CU

In a CU, a hub-and-spoke trade agreement structure is impossible. Therefore, {G} → {12 | CU} joint deviation is self-enforcing because betrayal of the hub-and-spoke state is not possible. The two cases below are possible types of deviations when only a CU is possible. For any *i*, *j*, and *k* = 1, 2, and 3, but are different from each other,

1. $TS_k(ij|CU) > TS_k(G)$: *k* becomes a free rider.
2. $TS_i(ij|CU) > TS_i(G)$, $TS_j(ij|CU) > TS_j(G)$: *i* and *j* make an exclusive bloc.

Otherwise, {G} becomes a unique CPNE. In this case, one country cannot deviate to a hub-and-spoke state. Also, free riding is not a severe problem because external tariffs of CU members are relatively high. Comparison of the exclusive bloc is crucial for the evaluation of the two trade regimes. When two countries make a trade agreement, are their total surpluses greater than the total surplus under global free trade? There are three differences between an FTA and CU.

First is the internalization of externality under the CU. When each country set optimal external tariffs, they maximize domestic surplus under the FTA, and exports between members are not considered. However, under the CU, countries set optimal external tariffs together, and exports between members come into the optimization. In this perspective, a CU is easier to become an exclusive bloc than an FTA. Instead, FTA members can help each other through implicit coordination to some extent.

Second is the additional constraint of CU optimization. CU members must have the same external tariffs. If they consider trade between members and each country can set different optimal external tariffs, they can maximize the total surplus of members more efficiently, but the external tariff becomes an additional constraint on optimization. In addition, GATT/WTO Article XXIV does not allow member countries to raise external tariffs as an additional constraint. This makes it harder for a CU to become an exclusive bloc.

Third is the flexibility of the FTA, explained in the previous chapter. The hub-and-spoke structure possibility of the FTA makes an FTA exclusive bloc easier to collapse than a CU. As a result, to become an exclusive bloc, FTA members must have a higher trade surplus than the surplus of the hub of two FTAs. In contrast, CU members can have higher trade surpluses than the free trade state to become an exclusive bloc. As proposition 3 notes, conditions for a CU are easier to satisfy. This makes it harder for an FTA to become an exclusive bloc.

It is hard to propose solutions in this comparison because of the differences. This paper suggests a numerical approach instead in following section.

4.3. Numerical Application for the Exclusive Bloc: Demand Gap

This section identifies how an exclusive bloc is made under different trade regimes from an equilibrium result of the trade liberalization game with a demand gap. As in the technology gap case, three countries reach free trade easier when market sizes are similar. As the demand gap increases, it becomes harder to achieve free trade, and the study compares the parametric region that allows global free trade under different trade regimes, with an FTA or CU.

Below is the assumption applied in this section to focus on the relative demand difference between countries and skip other elements, such as demand and cost differences between the three goods.

Assumption 2-2.
(i) $\alpha_i \equiv \alpha_{iA} = \alpha_{iB} = \alpha_{iC}$ and $c_j \equiv c_{jA} = c_{jB} = c_{jC}$ for i and j = 1, 2, and 3.
(ii) $e \equiv \alpha_1 - c_1$ and $c = c_1 = c_2 = c_3$
(iii) $d_k = \frac{(\alpha_k - c_1) - (\alpha_1 - c_1)}{\alpha_1 - c_1}$
(iv) $-0.5 < d_2, d_3 < 1, d_2 - 2d_3 < 1, -2d_2 + d_3 < 1.$

Assumptions are similar to Assumption 2-1. Every firm has the same production cost for all goods, and each country has the same market size for all three goods. Only a demand size difference between countries remains. Absolute demand parameter α_I was changed into relative demand parameter d_I for Countries 2 and 3. When Country 2 has more market demand than Country 1, d_1, relative market size, becomes positive. We can identify how equilibrium results changes in the (d_2, d_3) plane. The fourth assumption set the parameter range in this setup. Assumption 1 is satisfied, and other tariffs and production are positive under this assumption. Global tariff free trade is desirable in this area in the sense that the total surpluses of the countries in the free trade state are higher than any other state, as in the previous section.

Fig. 5. Hub-and-Spoke Deviation: Demand Gap

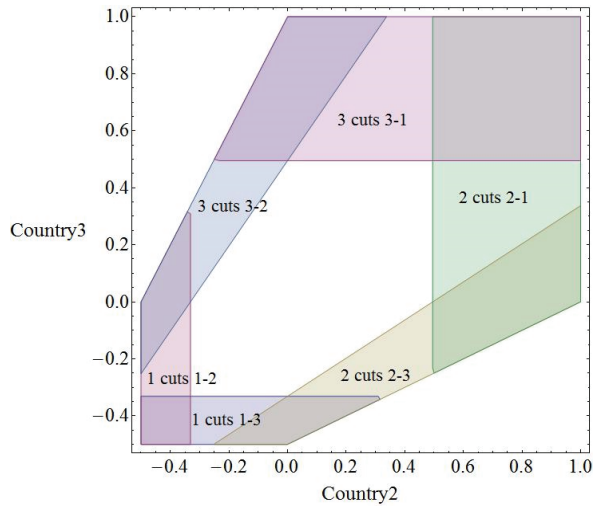


Fig. 5 illustrates hub-and-spoke deviation under an FTA trade regime. As in Fig. 2, six shaded areas appear, and at least one country cuts an FTA with one country in each area. In the central area near $d_2 = d_3 = 0$, equilibrium results are global free trade, but it becomes harder to achieve as each parameter is farther from zero. In the figures below, there is a focus on the central area $(-0.4 < d_2, d_3 < 0.6)$ to compare trade regimes. Also, FTA members

choose implicit coordination in most of this area.[14]

Fig. 6. Equilibrium Result for an FTA Trade Regime (With Coordination): Demand Gap

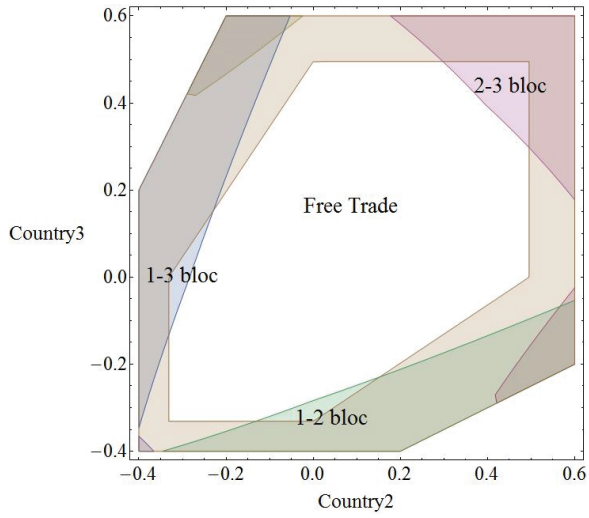


Fig. 7. Equilibrium Result for an FTA Trade Regime (Without Coordination): Demand Gap

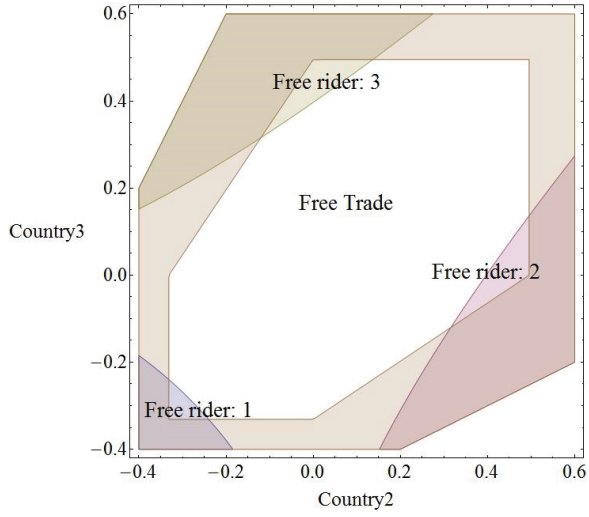


Fig. 6 describes the exclusive bloc under an FTA trade regime where implicit coordination is considered. An exclusive bloc based on an FTA does not appear in the technology gap case,

[14] $\sqrt{\frac{77}{206}} - 1 < d_2, d_3 < \sqrt{\frac{206}{77}} - 1, \sqrt{\frac{77}{206}}(1 + d_2) < 1 + d_3 < \sqrt{\frac{206}{77}}(1 + d_2)$.

but an exclusive bloc is possible in this demand gap case. Fig. 7 shows the case of an FTA trade regime without implicit coordination. An exclusive bloc is not possible, but free riding appears. When implicit coordination is considered, free riding become harder, but making an exclusive bloc is possible when a demand gap exists. This result is in accordance with the propositions in this paper. However, implicit coordination cannot improve the results of global free trade, in contrast to the improvement in the technology gap case.[15]

Fig. 8. Equilibrium Result for a CU Trade Regime: Demand Gap

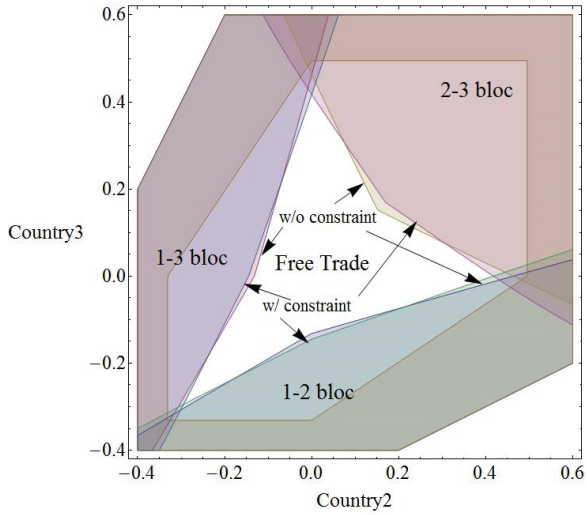


Fig. 8 shows an exclusive bloc under a CU trade regime. An exclusive bloc is prevalent when it can make a CU trade agreement. The region where global free trade is the equilibrium is much wider under an FTA trade regime than a CU trade regime. The fact that a hub-and-spoke is impossible cannot help, and a bloc based on a CU is stable. Similar work was done with additional constraints for GATT/WTO Article XXIV, and this is expressed as "w/constraint" in Fig. 8. It does not make much difference, as Fig. 8 illustrates. In conclusion, an FTA is much better to achieve global free trade than a CU in a demand gap case. [16]

Fig. 5 shows that a country with large demand wants to nullify an FTA with a small country. Through an FTA, each country loses its domestic market share, but increases profits from exports. The large country loses more from opening its domestic market and becomes passive in making agreements. Then the large country wants to deviate. Similarly, in Figures 6 and 8, large countries refuse free trade by creating a bloc because of the higher cost of opening markets.

A trade regime which permits an FTA and CU does not make much difference compared to a trade regime with only FTAs. In consideration of implicit coordination, an FTA offers

[15] Under strict multilateralism, free-riding becomes prevalent, as Fig. 4 predicts. However, a hub-and-spoke deviation does not exist under strict multilateralism, and it makes harder to compare with an FTA trade regime.

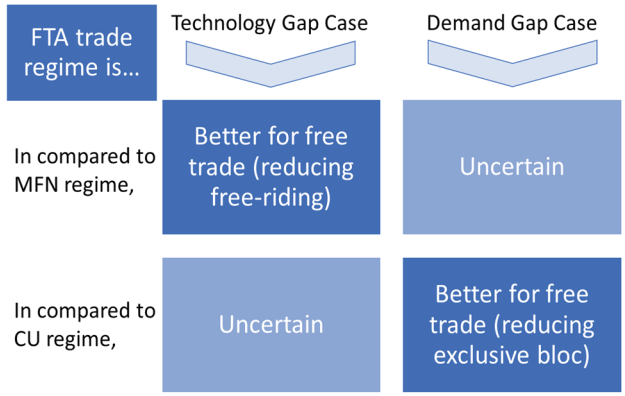
[16] I did similar work for a CU in the technology gap case, but there is not much difference for the region to reach free trade with an FTA trade regime.

more welfare for members, and it becomes harder to agree to reach a CU for both members. As a result, they choose FTAs over CUs, and therefore the numerical application result for the trade regime contains FTAs and CUs, similar to the result of the trade regime with only FTAs. Those results are in the online Appendix.

5. Conclusion

This paper compares different trade regimes for different types of trade agreements via a trade liberalization game with numerical applications. In conclusion, a trade regime with FTAs is best for achieving global free trade. It is better to reduce free riding than strict multilateralism for the technology gap between countries, and better to prevent an exclusive bloc than a trade regime with CUs for the demand gap between countries. In addition, this result is reinforced with consideration of the implicit coordination of FTA members. Results are summarized in Fig. 9.

Fig. 9. Summary



The main objective of this paper was finding optimal rules for trade negotiations. This paper concludes that a trade regime with FTAs, which is the current trade regime under the WTO, is the optimal rule to achieve global free trade. This paper shows that the current trade regime which permits FTAs cannot eradicate the likelihood of an exclusive trade bloc but maximizes the likelihood of reaching global free trade. As a result, this paper supports thee building block hypothesis of FTAs.

This paper does not check additional strategic moves for countries. In the real world, two countries choose not to reach an FTA before persuading a potential free rider to join. Transfer between countries can be possible, but this paper does not consider this option. Also, this paper supports the domino theory of trade agreements, but has only limited implications because the model in this paper has only three countries. These will be follow-up research topics.

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