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Trade Costs and Welfare-worsening Free Trade Agreement

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Abstract

This paper examines the effects of concluding a free trade agreement (FTA) in the presence of international trade costs between countries. In the traditional arguments, the optimal external tariffs set by the FTA members are always lower than the pre-FTA optimal tariffs, which implies that there are the tariff complementarity effects as the FTA forming. To reexamine this argument, we construct a simple three-country model of imperfect competition with endogenously determined (external) tariffs, and demonstrate that in the presence of trade costs, the member countries may employ the higher external tariff as they form the FTA. That is the tariff complementarity effects disappear. We also find that in contrast to traditional argument, the non-member country's welfare may worsen even if there are tariff complementarity effects. Furthermore, the findings show that the FTA is likely to result in the deterioration of the member countries' welfare, depending on the trade costs.

JEL classification F13, F15

Keywords Trade Costs, Free Trade Agreement, Tariff Complementarity Effect.

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1 Introduction

Over the last 2 decades, we have observed the significant surge of regional trade agreements (RTAs) the purpose of which is to eliminate the trade barriers between the signatories. Among the several forms of RTAs, most existing arrangements take the form of free trade agreement (FTA), while less than 10% are represented by customs unions (CUs).[1] Actually, there are now over 250 FTAs in force and a lot of negotiation is on going toward the enforcement. Given their widespread appearance, the relationship between international trade and the FTA formation is enhanced rapidly, so that economic analysis on FTAs provides us with a plenty insight for the world trading system.

Indeed, many researchers have addressed issues related to the surge of FTAs, and in particular, have argued the impact of an FTA on its member's external tariff and on multilateral trade liberalization.[2] A number of studies have highlighted the *tariff complementarity effect* that the enforcement of an FTA induces the member countries to employ the lower tariff on the non-member countries, resulting in multilateral trade liberalization(e.g., Richardson,1993; Bagwell and Staiger, 1999; Yi, 2000; Bond et al, 2004; Ornelas, 2005 and Saggi and Yildiz, 2010). An intuition behind this trade-liberalizing property of FTAs is that the member countries have less incentive to manipulate their terms of trade vis-à-vis non-members since an FTA leads its member countries to import less from non-member countries. In addition, it is more important that tariff complementarity effects lead to positive welfare consequences of FTAs with endogenously determined external tariffs (e.g., Bagwell and Staiger, 1999; Yi, 2000; Bond et al., 2004; Ornelas, 2005). These studies have shown that the tariff complementarity effect is large enough to place the external tariffs below the Pareto-improving external tariffs, and consequently, both members and non-members of FTAs become better off.[3]

Although the previous literature in international trade has explored a lot

[1] Facchini et al. (2012) develop a political economy model of trade policy under imperfect competition to provide a positive explanation for the prevalence of FTAs rather than CUs.

[2] See, for example, Maggi (2014, §4) for a survey of recent developments.

[3] The well-known Vanek–Ohyama–Kemp–Wan theorem (Vanek, 1965; Ohyama, 1972; Kemp and Wan, 1976) establishes that if two or more countries form a CU by fixing their net external trade vector through a common external tariff and eliminating internal trade barriers, the union as a whole and the rest of the world cannot be worse off than before. Ohyama (2002) and Panagariya and Krishna (2002) extend the Vanek–Ohyama–Kemp–Wan theorem to the case of FTAs; they show the existence of FTAs that lead to Pareto improvements in world welfare.

of properties in favor of an FTA, but it has paid the less attention to all costs except for tariff incurred between countries, so that its analysis has been limited to the economy where there is no cost to trade with abroad. In view of the fact that economic activities are separated in some form, the trade costs incurred from various factors must be considered beyond economic factors. As stated by Anderson and Van Wincoop (2004), trade costs are defined as all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself (e.g., transportation costs, policy barriers, information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs).[4] In addition, they roughly estimate the trade costs for industrialized countries at 170% in terms of ad valorem tax equivalent.[5] Thus, this empirical evidence that broadly-defined trade costs are considerably large leads us to recognize the importance of incorporating trade costs into the analysis of trade policy. Furthermore, in new trade theory or new economic geography developed by Helpman and Krugman (1985) and Fujita et al. (1999), the analysis on distribution of economic activities is permitted by incorporating the trade costs between countries. The several studies in these fields have discussed the relationship between the capital tax and the firms' agglomeration, but not consider the tariff policy (Ludema and Wooton, 2000; Baldwin and Krugman, 2004; and Ottaviano and Van Ypersele, 2005).

The objective of this paper is to dissolve the limitation of trade costs in a simple three-country model of imperfect competition and explore how trade costs affect the desirability of FTA formation. We treat three policy regimes: tariff discrimination, a most-favored nation (MFN) principle, and an FTA, and we investigate the effects of trade costs on the tariff determined in each regime. Although the tariff discrimination regime may violate the principle of non-discrimination prescribed in the General Agreement on Tariffs and Trade (GATT)/World Trade Organization (WTO) rule, it allows us to understand the basic mechanism under which trade costs affect a country's tariff unconstrained by any rule.

As for the results of comparing the tariff in the MFN with the external tariff in the FTA, it is found that the tariff complementarity effects may disappear with the higher trade costs between the FTA member countries. This implies that considering the trade costs in the economy, the RTA does not always facilitate multilateral trade liberalization, which is in contrast

[4]See also Hummels and Skiba (2004), Hummels (2007) and Hummels et al. (2009) for the detail about transportation cost.

[5]This ad valorem tax equivalent includes 55% local distribution costs as well as international trade costs; the latter are composed of 21% transport costs and 44% border-related trade barriers ($1.7 = 1.55 \times 1.21 \times 1.44 - 1$).

to the previous studies. In the absence of trade costs, tariff elimination by an FTA leads the government to reduce the tariff on other country (non-member) so as to hold balanced consumption between domestic and foreign production, resulting in the tariff complementarity effects.[6] An incorporation of trade costs into the model brings about different outcomes. When the model incorporates the costs to trade with a foreign country, the governments achieve balanced consumption depending on trade cost level. Then, high trade costs within the FTA mean more consumption from non-member countries rather than from the partner country, and thus, discourage the members to decrease the tariff on the non-member country.[7]

We now highlight the results of welfare analysis. As opposed to previous literature, our study demonstrates that an FTA under trade costs may worsen the welfare of member countries and the non-member country. In the analysis of welfare effects of an FTA on member countries, we first consider the case of symmetric countries in which all three countries share the same trade costs. Under such an environment, the member countries are worse off with sufficiently high trade costs. An FTA formation reduces the tariff revenue of member countries and increases the volume of international trade, leading an increase in the payment of trade costs. Thus, under the high trade costs, the serious loss of income for the payment to trade costs induced by signing the FTA. Subsequently, we consider cases in which the countries face asymmetric trade costs and confirm that FTA conclusion can worsen the member's welfare even with the asymmetry in trade costs.

Our results bring about the preserve wisdom of FTA related to trade costs. Supposing that international trade costs arise according to the distance between the countries, the formation of FTA have more beneficial effects on the countries who are located close to each other. Actually, many FTAs are formed by neighboring countries in Americas, European countries, or Asian countries. Although there are some exceptions such as Japan-Chile, and Japan-Mexico FTA, our analysis could explain these cases using the degree of substitutability between domestic and foreign products. As a result of welfare analysis, FTA conclusion has more beneficial effects on the member countries under the low degree of substitutability. Accordingly, since

[6]Under a similar environment to ours, Yi (2000) has demonstrated that the welfare function of each country is *super-modular* in tariffs that have high welfare with a balanced consumption level, and has shown that if an FTA is formed, the member country imposes lower external tariffs in order to achieve balanced consumption.

[7]Also, our result could provide the hypothesis for empirical analysis about the disappearance of tariff complementarity effect. Some studies empirically analyze the existence of tariff complementarity effects (Limão, 2006 Estevadeordal et al, 2008, and Karacaovali and Limão, 2008), but it is controversial yet. The knowledge provided by our analysis helps to construct the valid hypothesis.

the tendency of international trade between developed country (Japan) and developing country (Chile or Mexico) is to exchange the very differentiated goods with low substitutability between each other, they have more incentive to sign the FTA even if the long distance generate the high trade costs between them.

The remainder of this paper is organized as follows. Next section shows the simple intra-industrial trade model composed of three countries. In section 3, we explore the optimal tariff in each regime and investigate whether there are tariff complementarity effects. Section 4 conducts welfare analysis on the FTA members and non-member. Section 5 concludes this paper.

2 The economy

2.1 Settings

We construct an intra-industry trade model following Furusawa and Konishi (2007).[8] There are three symmetric countries (indexed by i, j, k) in the economy. Each country has two sectors, the agricultural sector and manufacturing sector. Consumers in all countries have identical preferences for agricultural and manufacturing goods. We assume that each consumer supplies one unit of labor and, thus, the population size μ in each country is equal to labor force endowment.

The agricultural sector operates under perfect competition and constant returns to scale using only labor. To produce one unit of the agricultural good, one unit of labor needs to be employed in this sector. Assuming that agricultural goods are numeraire, the price and wage rates are equal to one.

The firms in the manufacturing sector produce horizontally differentiated goods that are imperfectly substitutable for each other. The production of manufacturing goods operates under imperfect competition. One variety ω is produced by one manufacturing firm, which is negligibly small and does not influence the behavior of other firms in the sector. Formally, there is a continuum Ω of manufacturing firms in the economy. Note that the set Ω also represents the set of all varieties of manufacturing goods in the economy. Assuming no entry to this sector, we normalize the size of the set, $|\Omega| = 1$. In this study, the distribution of manufacturing firms is symmetric between countries, so that domestic consumers own one third of the total number of

[8]Furusawa and Konishi (2007) employ a network formulation game and analyze whether global free trade is stable among n countries with an intra-industry trade model. Unlike their study, we introduce trade costs and explore the properties of trade policy in the presence of trade costs.

firms in the economy. The set of firms located in country i is denoted by $\Omega_i \subset \Omega$, whose size is one third, $|\Omega_i| = 1/3$.

To purchase one unit of the manufacturing good from abroad, consumers have to pay the trade costs, in addition to the good's price and the tariff imposed by the government.[9] We refer to the trade costs of transportation from country i to country j as τ_{ij}, which is independent on the direction of transportation, that is, $\tau_{ij} = \tau_{ji}$. The tariff rate imposed on imports from country j by the government of country i is represented as t_{ij}. While the trade costs are given exogenously, the import tariff rate is determined by the government and its revenue is distributed evenly to consumers in each country.[10] To simplify the analysis, agricultural goods are assumed to be shipped without trade costs.

2.1.1 Preference

All consumers in the economy are assumed to be identical. We formulate the preferences of consumers with a quadratic utility function as follows:

$$\begin{aligned} & u(q(\omega), q_0; \omega \in \Omega) \\ &= \int_\Omega q(\omega) d\omega - \frac{1-\gamma}{2} \int_\Omega q(\omega)^2 d\omega - \frac{\gamma}{2} \left(\int_\Omega q(\omega) d\omega \right)^2 + q_0, \end{aligned} \tag{1}$$

where $q(\omega)$ (q_0) is the amount of manufacturing (agricultural) goods consumption and γ denotes the degree of substitutability between manufacturing goods. A lower γ means that consumers recognize manufacturing goods as more differentiated. If $\gamma = 0$, manufacturing goods are perfectly different from one another. If $\gamma = 1$, every manufacturing good is recognized as identical.

From the utility maximization problem, we can deduce the demand functions for manufacturing goods as follows:

$$q(\omega) = \frac{1}{1-\gamma}[1 - \tilde{p}(\omega) - \gamma(1 - \tilde{P})], \tag{2}$$

[9] An assumption of tariff incidence is not crucial in our model. Even if the manufacturing firms burden the tariff, same outcomes can be deduced.

[10] If we suppose the trade costs are compensation for transportation services supplied by the private sector, which is perfectly competitive, transportation services are delivered inelastically with marginal cost pricing. It is reasonable that the trade costs τ are given exogenously as constant marginal costs in the competitive transportation sectors. Some studies introduce the mechanism that transportation costs are determined endogenously and explore its effects on the economy (see, e.g., Takahashi, 2006; Mun and Nakagawa, 2010; Tsubuku, 2014).

where $\tilde{p}(\omega)$ represents the consumer price of manufacturing goods ω and $\tilde{P}$ is a price index. If consumers import the manufacturing goods, they have to pay the tariff and trade costs in addition to the price set by the manufacturing firm. As an example, the consumer prices in country r is represented by

$$\tilde{p}(\omega) = \begin{cases} p_{rr}(\omega) & if \ \ \omega \in \Omega_r, \\ p_{sr}(\omega) + t_{sr} + \tau_{sr} & if \ \ \omega \in \Omega_s, \ \ r \neq s, \end{cases} \tag{3}$$

where $p_{rs}(\omega)$ denotes the price of manufacturing goods in country r produced in country s $(r, s = i, j, k)$ and Ω_r is the set of manufacturing firms located in country r. The price index is defined by the sum of consumer prices that is $\tilde{P} \equiv \int_\Omega \tilde{p}(\omega) d\omega$. Thus, based on Eq. (3), the price index for consumers in country r, P_r, is written by

$$P_r = \int_{\Omega_r} p_{rr}(\omega) d\omega + \int_{\Omega_s} [p_{sr}(\omega) + t_{sr} + \tau_{sr}] d\omega. \tag{4}$$

2.1.2 Manufacturing sector

The manufacturing firm producing a variety of ω supplies to both the domestic country and two foreign countries. Supposing no marginal costs for production, the operating profit $\pi_i(\omega)$ of the firm located in country i is

$$\pi_i(\omega) = \sum_{r=i,j,k} \mu p_{ir}(\omega) q_{ir}(\omega), \tag{5}$$

where $q_{rs}(\omega)$ represents the quantity of manufacturing goods supplied to country s produced in country r $(r, s = i, j, k)$ and Ω_r is the set of manufacturing firms located in country r. Given the price index P_r and other firms' behavior in the economy, each firm maximizes its own profit by setting the price.[11] According to the first-order conditions of the profit maximization problem, all the firms in country i set their own prices as follows:

$$p_{ii} = \frac{1}{2}[1 + \gamma(1 - P_i)], \tag{6}$$

$$p_{ir} = p_{rr} - \frac{t_{ir} + \tau_{ir}}{2}, \ \ r = j, k. \tag{7}$$

[11] The assumption that differentiated goods in the manufacturing sector are denoted by the continuum of manufacturing firms results in the same equilibrium being deduced regardless of price or quantity competition, so that our model excludes strategic interaction among manufacturing firms.

Regardless of the variety of differentiated goods, manufacturing goods are symmetrically priced by firms. Thus, hereafter, we omit an expression of the variety of ω. The export price set by the firms is cheaper than the domestic price, but the consumer price including the trade costs and tariff $p_{ir} + t_{ir} + \tau_{ir}$ exceeds the domestic price, so that there is no arbitration between countries. In addition, we find half of the trade costs and tariff absorbed by manufacturing firms. From (6) and (7), the difference between the prices faced by domestic and foreign consumers is $(p_{ir} + t_{ir} + \tau_{ir}) - p_{ii} = (t_{ir} + \tau_{ir})/2.$, which is smaller than the trade costs and tariff paid by consumers.

Substituting (6) and (7) into the definition of price index $\tilde{P}$, equilibrium prices are determined as follows:

$$p_{ii} = \frac{1}{2-\gamma}\left[1 - \gamma + \frac{\gamma}{2}(\bar{t}_i + \bar{\tau}_i)\right], \tag{8}$$

$$p_{ir} = \frac{1}{2-\gamma}\left[1 - \gamma + \frac{\gamma}{2}(\bar{t}_r + \bar{\tau}_r)\right] - \frac{t_{ir} + \tau_{ir}}{2}, \;\; r = j, k. \tag{9}$$

where $\bar{t}_i, (\bar{\tau}_i)$ is defined by the weighted average of tariffs (trade costs) as

$$\bar{\tau}_i \equiv \frac{1}{3}\sum_{r=j,k} \tau_{ri}, \qquad \bar{t}_i \equiv \frac{1}{3}\sum_{r=j,k} t_{ri}.$$

We can obtain the equilibrium quantities from the relationship, $p_{rs} = (1 - \gamma)q_{rs}$, which can be provided by the firm's first-order condition.

2.2 Welfare decomposition

We now characterize the welfare of each country that has symmetric economic structure, consumer's preference, firm behavior, and the sizes of population and manufacturing firms, except for the trade costs and tariffs faced by them. Because of the symmetric assumption, only the welfare of country i is shown. Per capita income in country i is constituted by the total of the wage rate, $w_i(= 1)$, rents of manufacturing production activities, and distributed tax revenue:

$$y_r = 1 + \frac{1}{3}\frac{\pi_r}{\mu} + \frac{1}{3}\sum_{r=j,k} t_{ri} q_{ri}, \tag{10}$$

where the third term represents tariff revenue distributed by the government. Based on the budget constraint of consumers, the demand function for agricultural goods can be represented by manufacturing demand as fol-

lows:

$$\begin{aligned} q_0 &= y_r - \frac{1}{3}\left[p_{ii}q_{ii} + \sum_{r=j,k}(p_{ri} + t_{ri} + \tau_{ri})q_{ri}\right] \\ &= 1 + \sum_{r=j,i}(p_{ri} + \tau_{ri})q_{ri} + \sum_{r=j,i} p_{ir}q_{ir}. \end{aligned} \tag{11}$$

Assuming $\boldsymbol{\tau}_i = (\tau_{ji}, \tau_{ki})$ and $\mathbf{t}_i = (t_{ji}, t_{ki})$ as the vector of trade costs and tariffs, respectively, we can decompose the welfare in equilibrium, that is

$$\begin{aligned} &V_i(\mathbf{t}_i, \mathbf{t}_j, \mathbf{t}_k, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) \\ &\qquad = U_i(\mathbf{t}_i, \boldsymbol{\tau}_i) - IM_i(\mathbf{t}_i, \boldsymbol{\tau}_i) + EX_i(\mathbf{t}_j, \mathbf{t}_k, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k), \end{aligned} \tag{12}$$

where $U_i(\mathbf{t}_i, \boldsymbol{\tau}_i)$ refers to gross utility and $EX_i(\mathbf{t}_j, \mathbf{t}_k, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k)$ ($IM_i(\mathbf{t}_i, \boldsymbol{\tau}_i)$) denotes the total value of exports (imports) of country i. Each term is defined by

$$U_i(\mathbf{t}_i, \boldsymbol{\tau}_i) \equiv \frac{1}{3}\sum_{r=i,j,k} q_{ir} - \frac{1-\gamma}{6}\left[\sum_{r=i,j,k} q_{ir}^2\right] - \frac{\gamma}{18}\left[\sum_{r=i,j,k} q_{ir}\right]^2 + 1, \tag{13}$$

$$IM_i(\mathbf{t}_i, \boldsymbol{\tau}_i) \equiv \sum_{r\neq i} IM_{ri}(\mathbf{t}_i, \boldsymbol{\tau}_i) = \frac{1}{3}\sum_{r\neq i}(p_{ri} + \tau_{ri})q_{ri}, \tag{14}$$

$$EX_i(\mathbf{t}_j, \mathbf{t}_k, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) \equiv \sum_{r\neq i} EX_{ri}(\mathbf{t}_r, \boldsymbol{\tau}_r) = \frac{1}{3}\sum_{r\neq i} p_{ir}q_{ir}, \tag{15}$$

where the productions and prices are evaluated at the equilibrium value, which depends on trade costs and tariffs, so that the difference in the welfare level of each country is characterized by trade costs and tariffs paid by consumers.

It is worth referring to the impacts of trade costs and tariffs on Eqs. (13), (14), and (15). First, consider gross utility, which depends on the consumption level of domestic production and the imports from two foreign countries. The effects of a decrease in trade costs or tariffs on gross utility, $U_i(\mathbf{t}_i, \boldsymbol{\tau}_i)$, is ambiguous owing to the substitution effect caused by the reduction. For example, high trade costs τ_{ji} raise the domestic and import demands from country k at the expense of imports produced in country j. Due to this substitution effect, it is not necessary that gross utility is improved by trade cost reduction.

Second, we consider the response of import value $IM_i(\mathbf{t}_i, \boldsymbol{\tau}_i)$ to trade costs and tariffs. For a similar reason to the case of gross utility, it is obscure

whether a high tariff leads consumers to decrease payments for imports from abroad. An increase in the tariff imposed on imports from country j induces consumers to decrease the import value from country j, $IM_{ji}(\mathbf{t}_i, \boldsymbol{\tau}_i)$ and to increase imports from country k, $IM_{ki}(\mathbf{t}_i, \boldsymbol{\tau}_i)$. These import values consist of two factors; the payment for imported goods and international transportation. If the trade costs increase, it directly increases the latter. In addition, the increase in trade costs reduces the former.

Third, the export value of country i is always lowered by high trade costs and tariffs since export values supplied to each foreign country, $EX_{ji}(\mathbf{t}_j, \boldsymbol{\tau}_j)$ and $EX_{ki}(\mathbf{t}_k, \boldsymbol{\tau}_k)$, are independent of each other with regard to trade costs and tariffs.

3 Trade costs and tariff policy in three regimes

Here, we explore the relationship between trade costs and optimal tariffs determined by government under three regimes; a tariff discrimination regime, the MFN principle, and an FTA. These optimal tariffs are reduced to maximize national welfare depending on trade costs emerging between countries. In this section, the effect of trade costs on optimal tariffs is investigated and it is shown that the tariff complementarity effects do not appear under certain conditions of trade costs.

3.1 Tariff discrimination regime

In order to make clear the incentive to set tariffs, we analyze the tariff discrimination regime as a benchmark case. In this subsection, each government can choose the tariff rate on each import independently. It follows that the maximization problem for each government is

$$\max_{t_{ji}, t_{ki}} \ V_i.$$

From, Eqs. (13), (14), and (15), the first-order conditions can be written as

$$\frac{\partial U_i}{\partial t_{ri}} - \frac{\partial IM_{ki}}{\partial t_{ri}} - \frac{\partial IM_{ji}}{\partial t_{ri}} = 0, \quad r = j, k. \tag{16}$$

The first term on the left-hand side of Eq. (16) shows tariff effects on gross utility, of which the sign is ambiguous, as mentioned at the end of previous section. The second and third terms are the effect on imports from two

foreign countries. We can identify the signs of the second and third terms. Considering the effects of t_{ji}, $\partial IM_{ji}/\partial t_{ji}$ is negative and $\partial IM_{ki}/\partial t_{ji}$ is positive. From Eq. (16), we find that the tariff level imposed by the government does not depend on the tariff level imposed by the other government, and so, there is no strategic interdependence, as shown in Yi (1996). The discriminatory tariff imposed by country i on imports from country j is denoted as t_{ji}^D. Superscript D means the discrimination regime. Solving Eq. (16) for tariffs, we obtain country i's optimal discriminatory tariffs on each foreign country as follows:

$$t_{ji}^D = \frac{36(1-\gamma)(3-2\gamma) - (61\gamma^2 - 168\gamma + 108)\tau_{ji} + 4\gamma(3-2\gamma)\tau_{ki}}{159\gamma^2 - 468\gamma + 324}. \quad (17)$$

From Eq. (17), it is easy to derive t_{ki}^D owing to the assumption of a symmetric country. The discriminatory tariffs are always positive as long as international trade is feasible. Comparing two discriminatory tariffs, it is found that

$$t_{ji}^D > t_{ki}^D \Leftrightarrow \tau_{ji} < \tau_{ki}. \quad (18)$$

This result is summarized as the following Proposition 1.

Proposition 1 (Tariff discrimination) *Each country under a tariff discrimination regime imposes higher tariffs on foreign goods imported with lower trade costs.*

To explain this result, we provide the following intuition. Under low trade costs incurred in the process of trading with country j, consumers in country i demand more imports from country j. This implies that imposing tariff on the imports from country j rather than country k have more beneficial effect by protecting the domestic firms, so that the government of country i imposes a higher tariff on imports from country j. On the other hand, when the trade costs between countries i and j are low, imports from country k are small owing to substitution effect. In order to encourage imports from country k, governments have incentive to reduce tariffs imposed on that country.

In addition, we find that the change in trade costs between a certain two countries out of the three have two effects on tariff policy. For example, the reduction of trade costs between countries i and j increases imports from country j, and at the same time decreases import from country k since

consumers substitute imports.[12] Under the tariff discriminatory regime, governments can respond to these effects independently and, thus, the discriminatory tariffs, t_{ji}^D and t_{ki}^D, are affected oppositely by the same trade costs.

3.2 Most-favored nation principle

In this subsection, we explore the tariff determined by complying with the MFN principle, where each government imposes the same tariff on the other countries. The maximization problem of country i under the MFN principle is defined as

$$\begin{aligned} \max_{t_{ji},t_{ki}} \quad & V_i \\ s.t. \quad & t_{ji} = t_{ki} \end{aligned}$$

According to the first-order condition of this problem, the MFN tariff satisfies the following condition.

$$\begin{aligned} & \sum_{r=j,k} \left(\frac{\partial U_i}{\partial t_{ri}} - \frac{\partial IM_{ki}}{\partial t_{ri}} - \frac{\partial IM_{ji}}{\partial t_{ri}} \right) = 0 \\ \Leftrightarrow \quad & \underbrace{\left(\frac{\partial U_i}{\partial t_{ji}} + \frac{\partial U_i}{\partial t_{ki}} \right)}_{\ominus\text{: Loss of the utility}} \underbrace{- \left(\frac{\partial IM_{ji}}{\partial t_{ji}} + \frac{\partial IM_{ji}}{\partial t_{ki}} \right)}_{\oplus\text{: The income gain}} \underbrace{- \left(\frac{\partial IM_{ki}}{\partial t_{ki}} + \frac{\partial IM_{ki}}{\partial t_{ji}} \right)}_{\oplus\text{:The income gain}} = 0. \quad (19) \end{aligned}$$

This condition, Eq. (19), reveals that when the government increases t_{ji} and t_{ki} simultaneously, its net benefit should be equal to zero and consist of three parts: the loss of utility owing to decreased consumption, and two income gains caused by decreased import payments to foreign countries. The MFN tariff rate imposed by country i is obtained as follows:

$$t_i^{MFN} = \frac{24(1-\gamma)(3-2\gamma) - (23\gamma^2 - 60\gamma + 36)(\tau_{ji} + \tau_{ki})}{106\gamma^2 - 312\gamma + 216}. \quad (20)$$

Based on the assumption that international trade is feasible, the MFN tariff rate can be shown to be positive. Eq. (20) shows that what matters is the sum of trade costs, $\tau_{ji} + \tau_{ki}$, not each level of trade costs, since the three countries are symmetric. Compared with the discrimination regime, the

[12] This unilateral reduction in trade costs is induced by the establishment of transport infrastructure that is accessed mainly by the firms in those countries, for example, opening of a highway or railway.

linear demand functions yield the MFN tariff in the middle point between two discriminatory tariffs, as shown in Saggi (2009).

Consider the impacts of trade costs on the MFN tariff. The MFN tariff depends on only the sum of trade costs, and a shift in each trade cost is indifferent to the MFN tariff. However, the effect is ambiguous and characterized by the degree of substitutability γ as

$$\frac{dt_i^{MFN}}{d\tau_{ri}} \gtrless 0 \Leftrightarrow \gamma \gtrless \frac{6}{23}\left(5-\sqrt{2}\right) \approx 0.935,$$

and, thus, we obtain Proposition 2.

Proposition 2 (Most-favored nation tariff) *When the substitutability between domestic and foreign products is sufficiently high, then trade cost reduction fosters the elimination of tariff.*

The intuition behind Proposition 2 is that large γ amplifies the marginal benefits of imposing tariffs, which is the domestic income gains induced by substituting imports for domestic products, so that the MFN tariff increases as trade costs rise. In our model, a reduction in trade costs, for instance τ_{ji}, causes the reduction in import demand from country j as well as the expansion of demand for domestic production and import from country k through the substitution effects. When the manufacturing goods is sufficiently substitutable, the indirect effects like increasing the domestic demands lead the government to increase the MFN tariff as trade costs increase.

Setting the single tariff rate on two countries under the MFN principle, each government is required to take into account the effects on both tariffs, t_{ji} and t_{ki}, together. Increasing trade costs τ_{ji} have negative (positive) effects on imports from country j (country k), which provides the incentive to reduce (raise) the tariff on imports from country j (country k). Such conflicting incentives yielded by change in trade costs keep the effects of trade costs on the MFN tariffs unclear and it is dependent on the degree of substitutability between the products.

3.3 Free trade agreement

Supposing that countries i and j enforce the FTA and impose a zero tariff rate on each other, we investigate the external tariff imposed by them on the non-member country (country k).[13] The FTA member governments

[13]The maximization problem of the non-member country is equivalent to the case of the tariff discrimination regime or the MFN principle owing to the independence of the government's policy strategy.

eliminate the tariff barrier within the member countries and set the external tariff on the non-member country in order to maximize their own national welfare. As stated in Articles XXIV of GATT/WTO, the countries signing an FTA are required not to raise the tariff on countries that are not members of the FTA. Thus, the maximization problem is given as

$$\begin{aligned} \max_{t_{ki}} \quad & V_i \\ s.t. \quad & t_{ji} = t_{ij} = 0 \\ & t_{ki} \leq t_i^{MFN} \end{aligned}$$

In this maximization problem, the third constraint reflecting the requirement of GATT/WTO's Articles XXIV forces the government of member country to employ the same or lower tariff on the non-member country.

First, we consider the case of inner solution in which the equality condition holds strictly, that is, $t_{ki} < t_i^{MFN}$. If the optimal external tariff set by the member is lower than the MFN tariff, the first-order condition can be represented by

$$\left.\frac{\partial U_i}{\partial t_{ki}}\right|_{t_{ji}=t_{ij}=0} - \left.\frac{\partial IM_{ki}}{\partial t_{ki}}\right|_{t_{ji}=t_{ij}=0} - \left.\frac{\partial IM_{ji}}{\partial t_{ki}}\right|_{t_{ji}=t_{ij}=0} = 0. \tag{21}$$

In contrast to the MFN principle, the FTA member governments can choose the external tariff t_{ki} independently since the tariffs between the member countries, t_{ij} and t_{ji}, is zero. In this case, the external tariff determined by the member governments is written by

$$t_{ki}^{FTA} = \frac{12(1-\gamma)(3-2\gamma) + (12-7\gamma)\gamma\tau_{ji} - 4(3-2\gamma)^2\tau_{ki}}{4(3-2\gamma)(9-5\gamma)}. \tag{22}$$

In addition, this tariff is positive under the feasibility of international trade. From Eq.(22), we can show the effects of trade costs on the external tariff, $dt_{ki}^{FTA}/d\tau_{ki} < 0$ and $dt_{ki}^{FTA}/d\tau_{ji} > 0$, which is summarized in Proposition 3 as follows:

Proposition 3 (External tariff in FTA) *The external tariff is increased by the higher trade costs between the FTA member countries as well as the lower trade costs between the member and non-member countries.*

We here explain the intuition behind Proposition 3. The high trade costs τ_{ji} yield more trade between the members and non-member due to the substitution effects, leading the member country to protect the domes-

tic manufacturing firms from competition with firms in the non-member country. Therefore, under high τ_{ji}, the member governments increase the external tariff in order to avoid competition with firms in the non-member country and to increase domestic firms' profit. Another intuition of this result is that imports from the member country are lowered as trade costs τ_{ji} increase, and thus, the FTA member governments increase the external tariff in order to foster import demand from the member country at the expense of the non-member country. On the other hand, we can provide similar intuitions regarding the trade cost between the member and non-member countries. Lower trade costs, τ_{ki}, induce the government under the FTA to impose a higher external tariff due to intense competition with firms in the non-member country.

The case of inner solution is that under the FTA, the member has no incentive to set the higher tariff than the MFN tariff. If the optimal external tariff lies at a higher level than the MFN tariff, then the inequality condition holds with equality, that is, $t_{ki} = t_i^{MFN}$. This means that the external tariff under the FTA is equivalent to the MFN tariff, implying the tariff complementarity effects disappear. If the following condition is satisfied, then the government of the member country does not decrease the external tariff after the FTA formed.

$$\left.\frac{\partial U_i}{\partial t_{ki}}\right|_{\substack{t_{ji}=t_{ij}=0,\\ t_{ki}=t_i^{MFN}}} - \left.\frac{\partial IM_{ki}}{\partial t_{ki}}\right|_{\substack{t_{ji}=t_{ij}=0,\\ t_{ki}=t_i^{MFN}}} - \left.\frac{\partial IM_{ji}}{\partial t_{ki}}\right|_{\substack{t_{ji}=t_{ij}=0,\\ t_{ki}=t_i^{MFN}}} > 0$$

$$\Leftrightarrow \quad \tau_{ji} > \tilde{\tau}_i\left(\tau_{ki}\right). \tag{23}$$

where $\tilde{\tau}_i$ is the upper bound of τ_{ji} achieving the equilibrium in which the member, country i, imposes a lower tariff than under the MFN principle. If the trade costs between members exceed this thresholds $\tilde{\tau}_i$, then the members keep the external tariff rate at the same level as the MFN tariff. This implies that tariff complementarity effects do not occur when condition Eq. (23) is satisfied. In the absence of trade costs, the external tariff always declines by FTA formation relative to under the MFN principle. Thus, when international trade is not costless, the FTA formation provides the incentive to raise the external tariff.

See the disappearance of tariff complementarity effects about both member countries in a graphic form. From the equilibrium quantities, the requirement for trade costs that assume the feasibility of international trade can

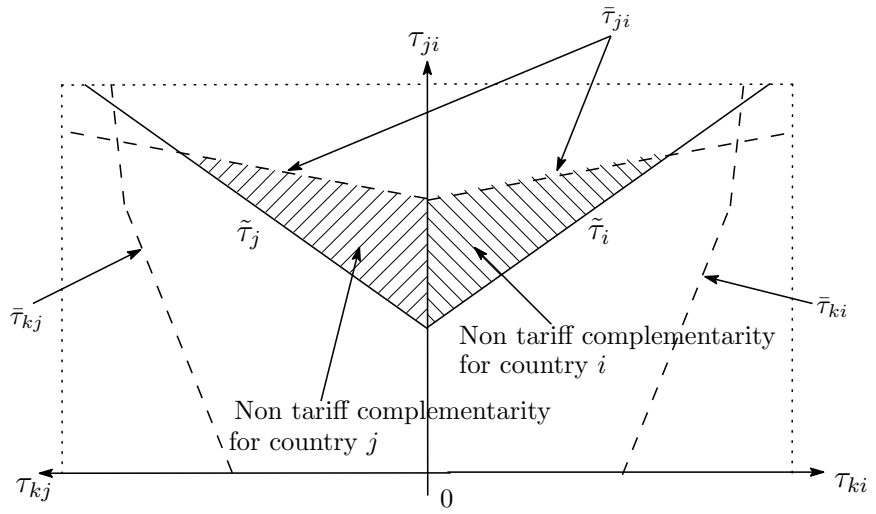

Figure 1: Trade costs and tariff complementarity effects

be represented as

$$\min\{q_{ji}^{MFN}(\boldsymbol{\tau}_i), q_{ji}^{FTA}(\boldsymbol{\tau}_i)\} \geq 0 \Leftrightarrow \tau_{ji} \leq \bar{\tau}_{ji}(\tau_{ki}), \tag{24}$$

$$\min\{q_{ki}^{MFN}(\boldsymbol{\tau}_i), q_{ki}^{FTA}(\boldsymbol{\tau}_i)\} \geq 0 \Leftrightarrow \tau_{ki} \leq \bar{\tau}_{ki}(\tau_{ji}). \tag{25}$$

Based on Eqs.(23), (24) and (25), we can illustrate Figure 1 regarding the tariff complementarity effects when international trade is feasible. Figure 1 shows the two cases of each member, countries i and j, in the first and second quadrant, respectively.[14] The dotted lines represent the upper bounds at which international trade is feasible, $\bar{\tau}_{ji}$ and $\bar{\tau}_{ki}$.

In the shaded area in Figure 1, the condition Eqs.(23), (24), and (25) are satisfied and, thus, the tariff complementarity effect does not appear in each country.

Proposition 4 (Disappearance of complementarity effects) *Under the larger trade costs between the FTA member countries and the smaller trade costs between the member and non-member countries, the external tariff rate remains under the MFN principle.*

Proposition 4 shows the possibility that tariff complementarity effects disappear, once we focus on the economy with trade costs occurring in international trade. Under the MFN principle, governments face the constraint of setting the same tariff on the two countries and cannot adjust tariffs,

[14]Each threshold for country j is developed in the same way as country i.

t_{ji} and t_{ki}, to trade costs shifting independently. By contrast, governments concluding an FTA choose the external tariff without such a constraint, and thus, they can employ the tariff policy corresponding to each trade cost independently. Thus, when τ_{ji} and τ_{ki} satisfy Eq. (23), then the governments signing an FTA have an incentive to raise the tariff from that under the MFN. Despite such incentive of the members existing, they are restricted to raise the tariff on the non-member country and thus and set it at the same level as the MFN tariff, resulting in no tariff complementarity effect.

4 Welfare analysis

At first glance, the formation of an FTA improves all countries' welfare because international trade is fostered as tariff barriers are eliminated by each government. However, if trade costs occur in the process of international trade, FTA formation is likely to worsen the welfare of member countries under certain conditions. In this section, we explore the effects of the conclusion of an FTA on welfare in the presence of trade costs. Once we focus on the economy in which trade costs exist, perfect market integration cannot be achieved by FTA conclusion in contrast to the previous literature. Without loss of generality, we analyze the case in which countries i and j agree to eliminate tariffs on each other ($t_{ji} = t_{ij} = 0$). Let $\mathbf{t}^{FTA}$ ($\mathbf{t}^{MFN}$) represent the tariff schedules set by each government in the FTA (MFN) regime, that is, $\mathbf{t}^{FTA} = (\mathbf{t}_i^{FTA}, \mathbf{t}_j^{FTA}, \mathbf{t}_k^{MFN})$ and $\mathbf{t}^{MFN} = (\mathbf{t}_i^{MFN}, \mathbf{t}_j^{MFN}, \mathbf{t}_k^{MFN})$. As discussed above, these tariff rates depend on trade costs, so that the welfare impact of FTA conclusion is also influenced through the tariff change caused by trade costs.

4.1 Non-member

Here, we consider the welfare of the non-member country affected by the FTA conclusion. In our setting, there is no strategic relationship between governments when they determine the tariff rate. Accordingly, country k (non-member country) retains the tariff rates under the MFN principle, even if countries i and j form an FTA and eliminate the tariff on each other. Thus, the FTA formation affects the non-member's welfare only through the change in tariff rate set by the member countries. In fact, the non-member's

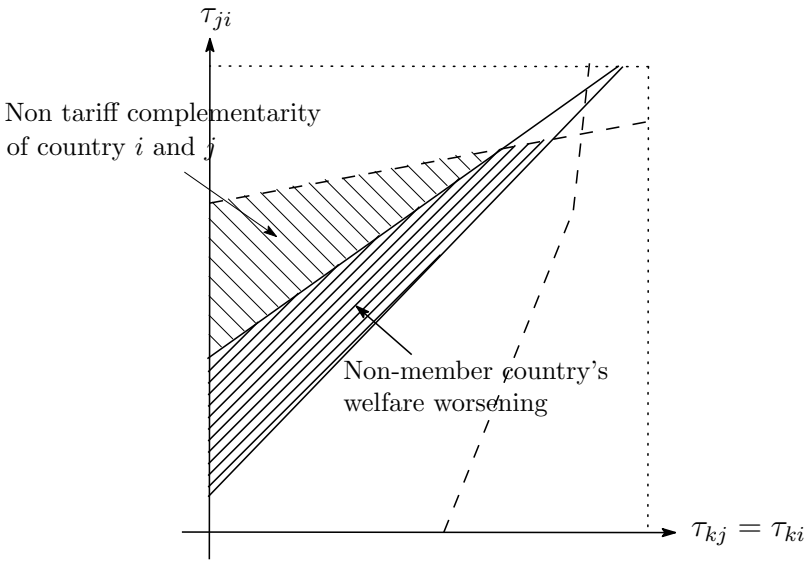

Figure 2: Welfare effects on non-member country

welfare effects induced by the FTA can be denoted as follows:

$$\begin{aligned}\Delta V_k(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) &\equiv V_k(\mathbf{t}^{FTA}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) - V_k(\mathbf{t}^{MFN}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) \\ &= EX_k(\mathbf{t}_i^{FTA}, \mathbf{t}_j^{FTA}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j) - EX_k(\mathbf{t}_i^{MFN}, \mathbf{t}_j^{MFN}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j),\end{aligned} \tag{26}$$

where ΔV_k is the difference between the FTA welfare and MFN welfare of country k, which consists of export values in each state. Eq. (26) shows that a change in tariff schedules of the members only matters for non-member country's welfare since the non-member does not change the tariff policy as a response to the FTA formation. In other words, if exports from country k to countries i and j are expanded as they conclude the FTA, the non-member's welfare is sufficiently improved. As Eq. (26) shows, the welfare effects are dependent on the tariff schedule of member countries, so that they are closely related to the tariff complementarity effects. If the tariff complementarity effects disappear when the non-member trades with both members, then the non-member's welfare always declines owing to decreases in exports to both members from the non-member.

Supposing the two trade costs faced by the non-member, τ_{ki} and τ_{kj}, are the same level, we can illustrate Figure 2 based on Figure 1. Figure 2 depicts the thresholds for the tariff complementarity effects and the FTA worsening the non-member's welfare. If the tariff complementarity effects disappear,

which the member countries do not change the external tariff after the FTA concludes, then the exports from non-member country are not influenced by FTA formation. Thus, in the absence of tariff complementarity, the FTA conclusion does not affect the welfare of non-member country. However, the non-member country could be worse off even if tariff complementarity effects appear. This is because it is not necessary that exports from the non-member country increase even though the FTA formation induces the firms in the non-member country to face a lower external tariff. As the FTA is formed, consumers in both member countries substitute imports from the non-member with those from each other, so that the non-member's exports could decrease even under the tariff complementarity effects. Provided the pair of trade costs bringing sufficiently strong tariff complementarity effects, e.g., perfectly symmetric trade costs, $\tau_{ji} = \tau_{ki} = \tau_{kj} = \tau$, then non-member country's welfare is improved by the FTA formation.

4.2 FTA members

In this subsection, we explore the welfare effects on the member countries induced by FTA formation. The difference between welfare under the FTA and MFN for the member country (country i) is

$$\begin{aligned}\Delta V_i(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) &\equiv V_i(\mathbf{t}^{FTA}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) - V_i(\mathbf{t}^{MFN}, \boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) \\ &= \Delta U_i(\boldsymbol{\tau}_i) + \Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j) \\ &\quad -\Delta IM_{ki}(\boldsymbol{\tau}_i) - \frac{\tau_{ji}}{3}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right], \quad (27)\end{aligned}$$

where ΔU_i and ΔIM_{ki} are the differences between gross utility and the values of imports from country k in each regime and are defined as

$$\Delta U_i(\boldsymbol{\tau}_i) \equiv U_i(\mathbf{t}_i^{FTA}, \boldsymbol{\tau}_i) - U_i(\mathbf{t}_i^{MFN}, \boldsymbol{\tau}_i), \quad (28)$$

$$\Delta IM_{ki}(\boldsymbol{\tau}_i) \equiv IM_{ki}(\mathbf{t}_i^{FTA}, \boldsymbol{\tau}_i) - IM_{ki}(\mathbf{t}_i^{MFN}, \boldsymbol{\tau}_i). \quad (29)$$

Moreover, the welfare effects of member countries depend on the change in trade surplus between them and is represented by $\Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j)$, which is

$$\begin{aligned}\Delta NE_i(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j) \equiv \frac{1}{3}\Big\{ &\left[p_{ij}^{FTA}(\boldsymbol{\tau}_j) q_{ij}^{FTA}(\boldsymbol{\tau}_j) - p_{ji}^{FTA}(\boldsymbol{\tau}_i) q_{ji}^{FTA}(\boldsymbol{\tau}_i)\right] \\ &- \left[p_{ij}^{MFN}(\boldsymbol{\tau}_j) q_{ij}^{MFN}(\boldsymbol{\tau}_j) - p_{ji}^{MFN}(\boldsymbol{\tau}_i) q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right] \Big\}. \quad (30)\end{aligned}$$

In addition, Furusawa and Konishi (2007) demonstrate that the welfare

effects by the FTA conclusion can be divided into gross utility effects (ΔU_i), a direct surplus effect (ΔNE_i), and third-country effects (ΔIM_{ki}) like Eq. (27). However, supposing that it costs to trade with foreign countries, we should consider another effect caused by FTA conclusion, namely, a trade cost effect $\left(\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3\right)$. This effect could be negative for the country to conclude an FTA. With the formation of an FTA between countries i and j, an increase in imports from country j induces the amount of consumers' payment for importing goods as well as the trade costs. Thus, the consumers in member countries should pay the additional trade costs under the FTA, which is called by the trade cost effect.

4.2.1 Symmetric case

In this subsection, we show that even in the absence of asymmetry in trade costs, FTA conclusion is likely to worsen the member countries' welfare. We assume that the trade costs between any two countries are symmetric, $\tau_{ji} = \tau_{ki} = \tau_{kj} = \tau$.[15]

Consider a condition for the feasibility of international trade in the present case. Under the assumption of symmetric trade costs, there are always tariff complementarity effects from Figure 1, so that the volume of international trade between any two of the three countries is smaller under the MFN principle than the FTA. Considering the trade volume is the same level for any country under the MFN, the condition for the feasibility of international trade is deduced as

$$q_{ji}(\mathbf{t}_i^{MFN}, \boldsymbol{\tau}) \geq 0 \Leftrightarrow \tau \leq \frac{36 - 69\gamma + 33\gamma^2}{(6 - 5\gamma)^2} \equiv \bar{\tau}. \tag{31}$$

Welfare under the MFN principle is supposed to be $V_r(\mathbf{t}^{MFN}, \boldsymbol{\tau})$ for $\forall r$ in which three vectors of trade costs are summarized to one since each trade cost vector is symmetric. The MFN principle with symmetric trade costs urges all countries to set the same tariff rate, $t_i^{MFN} = t_j^{MFN} = t_k^{MFN}$, so that each country obtains the same level of welfare. On the other hand, when countries i and j conclude the FTA, the member countries (countries i and j) and non-member country (country k) offers different tariff schedules. We obtain the welfare of member countries, $V_r(\mathbf{t}^{FTA}, \boldsymbol{\tau})$ for $r = i, j$. Under symmetric trade costs, the direct trade surplus effects disappear since $\boldsymbol{\tau}_j = \boldsymbol{\tau}_i$, so that the member's welfare effects induced by the FTA conclusion can be represented

[15]The symmetric trade costs induce the same tariff rate regardless of the tariff discrimination regime or MFN principle since all countries have perfectly symmetric structure, including the trade costs they face.

as follows:

$$\begin{aligned}\Delta V_i(\boldsymbol{\tau}) &\equiv V_i(\mathbf{t}^{FTA},\boldsymbol{\tau}) - V_i(\mathbf{t}^{MFN},\boldsymbol{\tau}) \\ &= \Delta U_i(\boldsymbol{\tau}) - \Delta IM_{ki}(\boldsymbol{\tau}) - \frac{\tau}{3}\left[q_{ji}^{FTA}(\boldsymbol{\tau}) - q_{ji}^{MFN}(\boldsymbol{\tau})\right]. \quad (32)\end{aligned}$$

The tariff elimination between member countries and tariff complementarity induce country i to undertake more trading with both the partner and non-member. Hence, the gross utility effects ΔU_i are positive on the welfare of members while the third-country effects ΔIM_{ki} are negative. By comparing Eqs. (28) and (29), we can show that gross utility increases more than import value from the non-member country as the FTA is forming, $\Delta U_i - \Delta IM_{ki} > 0$, which leads to the FTA improving country i's welfare. However, the third term in Eq. (32), trade cost effects $\left(\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3\right)$, work as the FTA conclusion decreases the welfare of country i. It follows that the welfare of the member country can be undermined when the third term is large enough to dominate the positive effects. The threshold of trade costs at which the FTA improves the member's welfare can be deduced as

$$\Delta V_i(\boldsymbol{\tau}) \geq 0 \Leftrightarrow \tau \leq \hat{\tau}. \quad (33)$$

We show such $\hat{\tau}$ is smaller than $\bar{\tau}$, as depicted in Figure 3, and obtain the following result:

Proposition 5 (Welfare-worsening free trade agreement) *Under higher symmetric trade costs between countries, the conclusion of an FTA worsens the welfare of member countries.*

Proposition 5 indicates that higher trade costs lead the FTA formation to undermine its member countries' welfare, although the non-member country's welfare increases. An intuition behind Proposition 5 is stated below. Tariff reduction by the conclusion of the FTA encourages its members to trade with each other as well as the non-member country. Although the expansion of international trade under the FTA improves the welfare of member countries, it also generates the loss of their welfare in the economy in which trade costs exist. The payment of trade costs by each member country is more expensive under the FTA than the MFN principle. Such payment is loss for firms' rent and has the effect of reducing welfare. Therefore, if higher trade costs per unit τ create a larger loss in the process of trade between member countries, then the welfare loss induced from trade costs exceeds that gains induced by trade expansion.

This discussion is reflected in Figure 3. Actually, for each γ, the member's

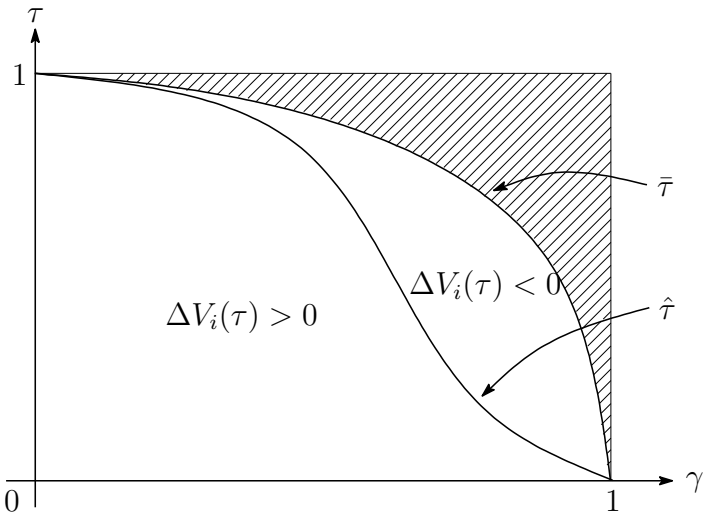

Figure 3: Trade costs and FTA formation

welfare is worse off with high symmetric trade costs in the figure. Figure 3 also shows that low γ tends to improve the member's welfare as the FTA formation even if the symmetric trade costs are high. Since manufacturing products under low γ are recognized as more differentiated goods rather than under high γ, the tariff elimination by FTA signing induces the consumers to substitute less imports product for domestic one. This leads to save an increase in the loss of transportation payments. Thus, the FTA formation is likely to affect the welfare of the members beneficially under the lower substitutable manufacturing goods.

4.2.2 Asymmetric cases

Here, we relax the assumption that trade costs in each country are symmetric. In particular, focusing on the threshold representing the equivalence between the FTA and MFN welfare, $\hat{\tau}$ in Eq. (33), we explore how the threshold value changes response to an asymmetric small change in trade costs. Assuming that each trade cost is set as $\tau_{ij} = \tau + e_m$, $\tau_{jk} = \tau + e_j$ and $\tau_{ki} = \tau + e_i$, the threshold under asymmetry is defined implicitly as follows:

$$\Delta V_i(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j, \boldsymbol{\tau}_k) \geq 0 \Leftrightarrow \tau \leq \hat{\tau}_{asy}(e_m, e_i, e_j), \tag{34}$$

In Eq. (34), if the trade costs are symmetric, $e_m = e_i = e_j = 0$, then $\hat{\tau}_{asy}$ is equal to $\hat{\tau}$, as shown in Eq. (33). Consider three cases of trade costs: (i) $e_m = e$, $e_i = -e$ and $e_j = 0$, (ii) $e_m = e$, $e_i = 0$ and $e_j = -e$ and, (iii) $e_m = 0$,

$e_i = e$ and $e_j = -e$. We differentiate $\hat{\tau}_{asy}$ with respect to e in each case and evaluate its derivative values at $e = 0$, implying the introduction of small asymmetries on trade costs into symmetric equilibrium ($e_m = e_i = e_j = 0$). In general, change in e does not always yield the asymmetry in trade costs, but supposing the symmetric equilibrium as a benchmark, this calculation represents the effects of expanding asymmetry among trade costs on the threshold $\hat{\tau}$. Since the $\hat{\tau}$ is defined as the upper level of trade costs that FTA formation improves the member country's welfare, an increase in $\hat{\tau}$ is to spread the such range and means that the benefit of FTA conclusion expanding. Therefore, such calculation allows us to understand how the benefit of FTA conclusion is affected by the addition of asymmetry in trade costs as compared with symmetric case.

(i) $e_m = e$, $e_i = -e$ and $e_j = 0$.

First, we investigate the effects cased by a small decrease in trade costs between country i and country k, and a small increase in trade costs between country i and country j from the perfect symmetric trade costs. This case is that the member country (country i) faces the smaller trade costs for trading with the partner country (country j) rather than the non-member country (country k). From Eq. (27), the effects of change in e is represented by

$$\left.\frac{d\hat{\tau}_{asy}(e, -e, 0)}{de}\right|_{e=0} < 0. \tag{35}$$

This implies that a decrease in e induces increases in $\hat{\tau}_{asy}$ and, thus, the range in which the FTA improves the member's welfare expands as the trade costs shift in opposite direction. Therefore, the benefit of concluding the FTA is amplified as the trade costs decline between the member countries and increase between the member and non-member countries. The trade cost effect in Eq. (27) induced by the FTA formation plays an important role in this case.

When the trade costs between countries i and j reduce and those between countries i and k increase, such as shown in Eq. (35), imports from the member country increase and those from the non-member decrease. In addition, its effects are larger under the MFN principle than the FTA since the reduction of e in this case induces the external tariff to decrease in order to increase imports from the non-member country while the MFN tariff is constant. Given these shifts of trade structure for country i, we consider the effects of trade costs on the benefits of the FTA. Such changes increase payment of trade costs under the MFN relative to the FTA, which improve benefits of FTA formation. Thus, the threshold $\hat{\tau}_{asy}$ increases as the trade

costs decline between members and increase between the member and non-member countries.

However, there are some channels in which benefits are not improved. The third-country effects (ΔIM_{ki}) change to become discouraging from concluding the FTA since the member country reduces the external tariff and, thus, the payment to the non-member country under the FTA is more expensive than under the MFN. Furthermore, the gross utility effects (ΔU_i) and the direct trade surplus effects (ΔNE_i) are ambiguous for the benefits of the FTA and depend on the degree of substitutability between the manufacturing goods. Provided the small γ, there are small substitution effects, so that an increase of country i's import from the partner country (country j) caused by the reduction in trade costs between country i and the non-member country (country k) is suppressed. Thus, the decrease in e tends to shrink the gross utility effect (ΔU_i) and expand the direct trade surplus effects (ΔNE_i) under the small γ. Despite such negative effects on the FTA benefits, the trade cost effects that positively influence the FTA dominate the other negative effects under an environment of demand linearity and quasi-linear utility.

(ii) $e_m = e$, $e_i = 0$ and $e_j = -e$.

Second, we consider the effects of a decrease in trade costs between member countries (countries i and j) and an increase in trade costs between the partner country (country j) and the non-member country (country k), which is induced by small reduction in e. Thus, in this case, the member country (country i) faces the small trade costs for trading with the partner country (country j) while the trade costs between own country and the non-member country (country k) are constant. In addition to this, the partner country (country j) faces the large trade costs for trading with the non-member country (country k) in this case. We obtain the following equation in a similar way to the previous case.

$$\left.\frac{d\hat{\tau}_{asy}(e,0,-e)}{de}\right|_{e=0} < 0. \tag{36}$$

Eq. (36) shows that reduction in trade costs between members (countries i and j) and increases in trade costs between the partner and non-member country (country j and k) induce the threshold, $\hat{\tau}_{asy}$, to shift upward. This means that such trade cost change represented by e amplifies the benefits of concluding the FTA between countries i and j.

In contrast to case (i), the trade costs between the member (country i) and non-member (country k) are constant, so that the tariff rate set by

country i is influenced only by the trade costs between members. Thus, the external tariff on the non-member country is induced to decrease by the reduction in e, but it is ambiguous for the MFN tariff. Such a change in tariff rates affects country i's imports from both counties. The reduction in the external tariff causes imports from the non-member to increase, and thus, an increase of imports under the FTA is larger compared with the situation under the MFN principle. This is because the tariff imposed by country i on country k has a greater response to change in e under the FTA than the MFN, that is, $dt_{ki}^{FTA}/de < dt_{i}^{MFN}/de < 0$. On the other hand, imports from the partner country lead to a decrease by trade cost reduction between them under both regimes. Due to the ambiguity of the trade cost effects on the MFN tariff, it is not clear in which regime imports from the partner country decrease more than the other.

Given such shifts in the trade structure caused by trade costs between members and the tariff set by country i, it is found that Eq. (36) is not explained only by the trade cost effects ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$). When the trade costs τ are sufficiently large, the expenditure for trade costs increases by reducing trade costs between members. However, we can understand this case by considering the gross utility effect (ΔU_i) and trade cost effect ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$) simultaneously. Actually, under high trade costs τ, the gross utility effects work to improve the FTA benefits for country i and exceed the negative trade cost effects. On the other hand, the low trade costs τ indicate the trade cost effects enhance the FTA benefits. Although the gross utility effect could decline as the trade costs between members decrease owing to substitution effects, positive trade cost effects outweigh that. These effects, the gross utility effect and trade cost effect, create positive effects for the FTA benefits when trade costs between members decline and when trade costs between the partner and non-member increase from symmetric equilibrium.

Furthermore, in this case, the effects cause FTA benefits to decline. Due to the higher tariff on the non-member country employed in the FTA than under the MFN, country i has larger imports than the non-member when the FTA is formed. Hence, the third-country effect ($\Delta IM_{ki}(\boldsymbol{\tau}_i)$) in this case shifts negatively with an increase in the payment to the non-member country. In addition, country i's trade structure is affected by the change in trade costs between the partner and non-member countries. An increase in those trade costs induces the partner country to substitute imports from the non-member country for those from country i, by which exports from country i to country j are expanded. Thus, the direct trade surplus effects ($\Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j)$) are likely to strengthen the benefits of country i forming the FTA with country j. However, as mentioned above, country i's payments

for imports from country j (the partner for country i) could also increase as the trade costs between members decline. Two such conflicting directional effects about trade between members make it ambiguous whether the direct trade surplus effects ($\Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j)$) are encouraging for forming the FTA. However, supposing demand linearity and quasi-linear utility, these effects that could be negative are dominated by positive effects, the gross utility effect (ΔU_i) and trade cost effect ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$).

(iii) $e_m = 0$, $e_i = e$ and $e_j = -e$.

Third, we consider the effects of reducing the trade costs between the member country (country i) and non-member country (country k), and raising the trade costs between the partner country (country j) and non-ember country (country k). This case shows the situation as below. The member country (country i) faces the lower costs for trading with non-member country (country k) while the trade costs between own country and the partner country (country k) remain. Additionally, there are large trade costs between the partner country (country j) and the non-member country (country k). Unfortunately, it is not clear whether the FTA benefit improves with the change in e, unlike in the other two cases. In this case, the trade costs between members remain constant, so that the trade cost effects ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$) are influenced indirectly from the trade costs with the non-member country. Thus, the influence from the non-member are mitigated relative to the previous two cases, resulting in the effect of trade cost reduction on the FTA benefits remaining unclear.

Given the reduction of costs for trading with country k, the external tariff imposed by country i on country k (non-member country) increases while the effects on the MFN tariff are obscured. The decrease in trade costs between country i and k enhances their trading and, by contrast, country i could employ the higher tariff in both regimes so as to prevent such enhanced trade and to save payments to the non-member. The change of the external tariff is large enough to dominate the MFN tariff's change, but both tariff changes are not as large as the trade cost reduction. This indicates that country i, under the MFN, increases imports from country k more than under the FTA formation. On the other hand, the trade structure between members is affected from two aspects: the change in the trade costs between country i and k, and between country j and k. When the imports from the non-member country (country k) increase with the reduction in trade costs between countries i and k, this leads consumers in country i to substitute imports from country k for those from country j in both regimes. In addition, the consumers in country j are induced by an increase in trade costs between country j and k to substitute imports from country k for those

from country i, which brings about an increase in exports of manufacturing firms in country i.

From the changes of trade structure caused by the reduction in trade costs between country i and k, we explain the effects on FTA benefits in respect of gross utility effects (ΔU_i), third-country effects ($\Delta IM_{ki}(\boldsymbol{\tau}_i)$), and trade cost effects ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$). As trade costs decrease between country i and k, the gross utility effects (ΔU_i) is negative on the FTA benefits since country i under the MFN can achieve unbiased consumption relative to the FTA. Considering the third-market effects ($\Delta IM_{ki}(\boldsymbol{\tau}_i)$), an increase in country i's import value from country k caused by their trade costs declining is larger under the MFN than under an FTA. Thus, in this case, the third-country effects ($\Delta IM_{ki}(\boldsymbol{\tau}_i)$) work to enhance the FTA. Next, we consider the trade cost effect ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$). The large γ induces the large increase in external tariff as e declines and, thus, country i under the MFN can save payments for trade costs more than when country i forms the FTA with country j. Consequently, a reduction in trade costs generating the substitution effects increases payments of trade costs under the FTA relative to the MFN and, thus, does not improve the FTA benefit in this case.

In order to show the intuition about the direct trade surplus effects ($\Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j)$), we need to focus on the effects on trade structure between members yielded by the trade costs faced by each member countries via trading with the non-member country. Based on the shift of trade structure as mentioned above, a reduction in e causes the two opposing effects to country i's trade surplus with country j. Hence, it is unclear whether the direct trade surplus effects ($\Delta NE_{ij}(\boldsymbol{\tau}_i, \boldsymbol{\tau}_j)$) work on the FTA benefit because of the change in trade costs denoted by e in this case.

In the previous two cases, the FTA benefits are improved with reduced trade costs, even if there are ambiguous or negative effects. However, the change in e has ambiguous effects on the FTA benefits in the case that we focus on the trade costs faced by the members when they trade with the non-member country. This is because trade costs are not affected between the member countries. Keeping trade costs between the members constant, the trade cost effect ($\tau_{ji}\left[q_{ji}^{FTA}(\boldsymbol{\tau}_i) - q_{ji}^{MFN}(\boldsymbol{\tau}_i)\right]/3$) is affected by the substitution effects only indirectly and works to mitigate the benefit of forming the FTA relative to the case of reducing the trade costs between the members.

Totally, we summarize these discussions in each case as Proposition 6

Proposition 6 (Asymmetric trade costs and welfare) *As compared with the symmetric equilibrium, the FTA benefit for member countries is amplified by the introduction in trade costs if it is like ensuring the lower trade costs*

between member countries rather than any other trade costs. Otherwise, the FTA formation could not have an advantage relative to the symmetric case.

5 Conclusion

In this study, we construct a simple intra-industrial trade model in the presence of international trade costs, and reveal the relationship between trade costs and tariffs, determined according to three scenarios: tariff discrimination, the MFN principle, and the FTA. Many economists state that FTA formation has beneficial effects for member countries as well as non-member countries owing to tariff complementarity effects. In contrast to previous literature, the present analysis shows that tariff complementarity effects are likely to disappear with higher trade costs between countries forming the FTA. Furthermore, welfare analysis sheds light on the negative aspects of an FTA, which may lower FTA members' welfare when each trade cost between countries is significantly large. Despite trade expansion by the FTA formation, it also increases the payment of trade costs, which leads to a decrease in national welfare. Thus, higher trade costs, especially between member countries, bring about welfare worsening under the FTA for its members.

In the closing, we suggest the possibility of trade costs being the factor that can influence conservative results, so that we are required to implement further analysis on FTAs in the presence of trade costs. For example, there is a puzzle in this field whether an FTA yields "building blocks" or "stumbling blocks" (Bhagwati, 1993). To approach this issue, our model should be extended to incorporate an endogenous decision about FTA formation, analyzing the relationship between the structure of trade costs and the incentive to conclude the FTA.

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