



Preferential trade agreements between asymmetric countries: Free trade areas (with rules of origin) vs. customs unions[☆]

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ABSTRACT

This paper examines differences in welfare implications between a free trade area (FTA) and a customs union (CU) for member countries differing in their market sizes. In a stylized three-country model of trade under oligopoly, we take into account the conditions that FTA members set external tariffs to induce their exporting firms to comply with rules of origin (ROO) within the trade bloc. This approach rules out trade deflection and regime switches in forming an effective FTA. The key findings are as follows: (i) Unless the difference in market size is too large and ROO are too restrictive, an FTA can be welfare-improving to countries with market size differential. (ii) The formation of a preferential trade agreement (either an FTA or a CU) is more likely to emerge between countries of similar market size. However, forming a CU allows for a greater degree of market size asymmetry than forming an FTA. (iii) Compared to the pre-PTA equilibrium, the greater reductions in external tariffs under an FTA than under a CU remain valid even for the case with market size asymmetry and preferential ROO. As such, a non-member country is relatively better off under an FTA. (iv) World welfare is higher under an FTA than under a CU when the market size asymmetry is moderate and ROO are less restrictive.

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1. Introduction

Since its first free trade agreement (FTA) with Singapore in 2002, Japan as a major economic power in the world economy has signed FTAs with smaller partners such as Malaysia, Chile, Thailand, Indonesia, Brunei, and Philippines. In reviewing different types of regional trade agreements in the 1990s, [Urata \(2002, 2005\)](#) remarked that if Japan were not actively engage in FTAs, it would not be treated as a worthwhile FTA partner by other countries and could suffer the consequences of being excluded from other FTAs. In analyzing what effects the free trade agreement between Japan and Singapore has on the two partners, [Hertel et al. \(2001\)](#) found that the FTA increased merchandise trade and GDP. The authors estimated that the overall gains from the FTA would exceed \$US 9 billion annually and that Japan would

benefit most from these gains. A recent contribution by [Takahashi and Urata \(2010\)](#) used a questionnaire survey to calculate the utilization rates of FTAs by Japanese firms. The authors found that the utilization rates were rather low: 32.9% for the Japan–Mexico FTA, 12.2% for the Japan–Malaysia FTA, and 23.7% for the Japan–Chile FTA. The authors further identified factors contributing to the surprisingly low utilization rates as follows: (i) the amount of foreign trade between Japan and each of these FTA partner countries is limited, (ii) the approval of the certificate of origin required to use the FTA is difficult, (iii) firms have limited knowledge of FTAs, and (iv) the difference between the Most-Favored-Nation tariff rate and the FTA tariff rate is small. Factor (i) is directly related to economic integration between asymmetric countries differing in their market sizes. Factor (ii) is about potential trade costs associated with preferential provisions such as rules of origin. Factor (iv) is concerned with the magnitude of tariff reductions under an FTA. These important results compel one to look into the theory concerning the economic effects of forming an FTA between countries that differ in their market sizes when there involve changes in trade costs resulting from tariff reductions and the preferential rules of origin.

Will an economy with a fairly large market have an economic incentive to form preferential trade agreements (PTAs) with smaller partners? Under what conditions will PTAs be welfare-improving for both big and small partners? The last two

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decades have witnessed an unprecedented proliferation of trade agreements, which typically take the forms of a “free trade area” (FTA) and a “customs union” (CU). An interesting observation is that countries forming an FTA or a CU are generally different in the sizes of their product markets (World Bank, 2005). In an FTA, member countries collectively eliminate barriers on certain goods traded among them, regardless of whether their market sizes are large or small. But FTA members individually set their own external tariffs toward non-members. This constitutes a significant difference between an FTA and a CU, the latter of which requires member countries to set a common external tariff on imports entering into the union (Krueger, 1993; Krishna and Krueger, 1995; Panagariya, 2000).

There are other distinctive aspects of an FTA. To prevent re-exportation or trade deflection from a low-tariff country to a high-tariff country, FTA members sign in preferential rules of origin (ROO) under which products cannot get duty-free access to a partner’s market unless ROO are met (Grossman and Helpman, 1995; Richardson, 1995).² Several different criteria may be adopted. These include ROO based on regional input restrictions, a change in tariff heading, particular processes that should be performed within an FTA, and a substantial transformation of a product.³ Despite their differences in criteria, there involve “ROO-induced trade costs” in producing final goods eligible for preferential treatment under an FTA. ROO not only generate production inefficiency,⁴ they may also cause final-good markets within an FTA to be segmented. These are not the overwhelming factors that make the formation of an FTA unattractive, however. Unlike a CU, an FTA allows member countries to maintain a separate and independent external trade policy. In a CU, there are no preferential ROO provisions and arbitrage activities are relatively costless such that the prices of similar products tend to be uniform across members’ markets. That is, there is internal market integration in a CU. Nevertheless, CU members individually do not have the flexibility in setting their external trade policies.

The objective of this theoretical paper is to examine differences in economic effects and welfare implications between an FTA and a CU when member countries differ in their market sizes. We pay particular attention to the effectiveness and efficiency of an FTA in terms of preferential ROO. Based on a stylized three-country model of trade under oligopoly, we wish to answer a set of questions which appear not to have been adequately examined in the trade literature on FTAs with ROO. Under imperfect competition in product markets, will the formation of an FTA with ROO or a CU be more likely to emerge between countries dissimilar in their market sizes? In other words, how will market size asymmetry affect their economic incentives of forming a PTA (either a FTA or a CU)? Which type of PTAs would allow for a greater degree of market size asymmetry between member countries? What effects preferential ROO have on the welfare of forming an FTA between asymmetric countries? Will

forming a CU be preferred to forming an FTA with ROO, viewed from the welfare perspectives of asymmetric members, a non-member country, and the world as a whole? Our paper is an attempt in the direction of the recent contribution by Krishna (2006), who called for more studies on the economics of ROO in FTAs where product markets are characterized by imperfect competition.

For forming an effective FTA, intra-bloc firms are required to comply with ROO to be eligible for preferential treatment in exports. In analyzing firm behavior in an FTA, Ju and Krishna (2002, 2005) showed the possibilities of trade regime switches because exporting firms may choose not to comply with ROO when the resulting trade costs exceed the external tariff rates. In the present paper, we consider the conditions that external tariffs set by FTA members effectively induce their exporting firms to comply with ROO. This approach rules out trade deflection and regime switches, on the one hand, and helps identify the economic determinants of establishing an effective and welfare-improving FTA with ROO, on the other. This paper is in line with the finding of Krishna and Panagariya (2002) that ROO are required to support the welfare-enhancing FTAs. As for forming a CU, member countries set a common external tariff with respect to non-members. One concern is whether member countries under an FTA with ROO or under a CU set high external tariffs to protect their own firms, which make non-member countries worse off. Article XXIV of the GATT/WTO aims to prevent non-member countries from being hurt by higher tariffs charged by member countries of a trade bloc. We take into account this GATT requirement when determining optimal external tariffs for member countries.

The present study complements the contribution by Mukunoki (2004) in terms of welfare comparisons between an FTA and a CU. The model of Mukunoki does not allow for ROO and their effects on production costs of final goods for trade within an FTA. The author adopts an oligopoly model of product differentiation and shows that an FTA entails endogenous change from segmented to integrated markets for internally produced goods. In our analysis, we take into account the complying decisions of intra-bloc exporters under ROO and look at issues on the effectiveness and efficiency of an FTA. In examining the formation of an FTA, we consider the circumstances that ROO-induced trade costs do not lead to internal market integration. Second, our analysis allows for market size asymmetry between potentially participating members. Despite the absence of internal market integration under an FTA, non-member countries are better off due to relatively lower external tariffs in an FTA than in a CU. However, a non-member country may be negatively affected by a CU when market size asymmetry between CU members is “significantly small.” As such, the external tariff requirement under Article XXIV of the GATT/WTO may be violated.⁵ We show that, under plausible conditions, welfare gains to asymmetric member countries are higher in a CU than in an FTA. Not surprisingly, forming a welfare-improving CU allows for a greater degree of market size asymmetry than forming a welfare-improving FTA. Nevertheless, world welfare can be higher under an FTA than under a CU when market size symmetry is moderate and ROO are less restrictive. From the perspective of world welfare, this finding is consistent with the observation that there are more FTAs than CUs (World Bank, 2005).

² Grossman and Helpman (1995) examined, among other things, the effects of FTA with ROO that prevent re-exportation from a lower tariff member to a higher tariff member. Richardson (1995) showed explicitly that there is no Nash equilibrium in setting external tariffs, because all members of an FTA compete to set the lowest tariff with respect to non-members.

³ See, e.g., Thoenig and Verdier (2004), Cadot et al. (2006), and Krishna (2006). The North American Free Trade Agreement (NAFTA), the European Union, and the ASEAN Free Trade Area agreement (AFTA), for example, all contain certain criteria of the ROO provisions which provide preferential treatment for member countries.

⁴ See Krishna and Krueger (1995) and Krishna (2006). There are contributions that examine non-preferential ROO content requirements. Falvey and Reed (1998) analyze the cases of non-preferential ROO and indicate that ROO may be used strategically as policy instruments. This is due to the potential arbitrariness in categorizing the geographical sources of goods produced not in a single location. Falvey and Reed (2002) further showed that producers may modify their production processes and input mix in response to ROO content requirements.

⁵ Bagwell and Staiger (1997b, 1999), Yi (2000) and Bond et al. (2004) showed that tariff reductions under FTAs are large enough to make the equilibrium external tariffs of member countries below their pre-PTA levels. As such, the optimal external tariffs benefits both members and nonmembers. We show that these findings continue to hold under FTA with ROO, provided that ROO are not too restrictive. We show that non-member countries are worse off under a CU, despite that the union’s common external tariff is consistent with Article XXIV of the GATT/WTO. This is consistent with the findings of Kennan and Riezman (1990), Yi (2000), Bagwell and Staiger (1997a), Syropoulos (1999) and Kose and Riezman (2000).

This paper is also closely related to two recent contributions on preferential trade agreements. One is [Das and Ghosh \(2006\)](#). The authors developed a model of an asymmetric world economy in which there are at least four countries. The authors showed, among other results, that the formation of an FTA is more likely to emerge between similar countries as an equilibrium phenomenon. In our study, we take into account various effects associated with ROO in forming an effective FTA. We analyze differences in welfare implications between an FTA and a CU when exporters inside the FTA obey ROO. This allows us to deal with the problem of trade deflection in an asymmetric global economy where FTA countries set different external tariffs. The other related contribution is [Duttgupta and Panagariya \(2007\)](#). The authors showed that ROO are not always harmful as they could make a previously infeasible FTA feasible. As noted by the authors, external tariffs in their analysis are assumed to remain at their pre-FTA levels. In our analysis, external tariffs are endogenously and independently set by FTA members. We find that when ROO are not too restrictive, an FTA with preferential provisions can be welfare-improving to member countries differing in their market sizes.

The remainder of the paper is organized as follows. Section 2 presents a simple framework of trade under international oligopoly. In Section 3, we first discuss the benchmark case with no preferential trade agreements of any form. We then examine conditions under which two asymmetric countries may form an FTA, subject to the constraints that exporting firms inside the FTA meet ROO. In Section 4, we derive conditions under which two asymmetric countries form a CU and jointly set their common external tariff. In Section 5, we analyze differences in welfare implications and economic effects between an FTA with ROO and a CU. Section 6 contains concluding remarks.

2. The analytical framework

2.1. A simple three-country model

Consider a simple world economy that is composed of three countries, denoted as A , B , and C .⁶ Countries A and B are located in the same region but are asymmetric with respect to the sizes of their product markets. In the absence of trading agreements, A and B engage in a two-way trade in final goods, with each country imposing a specific tariff on imports from the other ([Brander and Spencer, 1984](#)). Countries A and B consider forming a preferential trading agreement (either an FTA or a CU), while country C represents the rest of the world.

In the three-country framework, each country has a single firm called by its own country's name and produces a homogeneous final good q . Firms A and B do not export their final goods to country C , but firm C exports its final good to countries A and B . Denote q_{ik} as country i 's consumption of the final good produced by firm k , where $i = A, B$ and $k = A, B, C$.

We assume that country i 's aggregate utility function is $U_i = \alpha_i Q_i - (1/2)Q_i^2 + Y_i$, where α_i is a positive parameter, $Q_i = (q_{iA} + q_{iB} + q_{iC})$ represents the final-good consumption in country i , and Y_i is the consumption of a competitively produced numeraire good which is freely traded. The utility function implies that country i 's demand for final good is $p_i = \alpha_i - Q_i$, where p_i is the final-good price in the country and α_i represents its market size.

The asymmetry of the two potential member countries is captured by their different market sizes. Specifically, we assume that

$\alpha_B = \theta \alpha_A$, where $\theta (> 1)$ measures the degree of market size asymmetry between the small country, A , and the big country, B .

As in [Ishikawa et al. \(2007\)](#), we focus our analysis on how the formation of a PTA affects the final-good markets by assuming that input market in each country is competitive. We further assume that, without preferential ROO of any form, the average and marginal costs of producing the final good for all firms are constant. For expositional simplicity, these costs are normalized to zero. This allows us to pay special attention to different types of trade costs that firms may incur in the presence of ROO.

2.2. Different trade costs under alternative regimes

In the subsequent analysis, we use a "trade cost approach" to capture costs of exporting for a firm under different trade regimes. Denote c_{ik} as the extra cost that firm k incurs in producing one unit of its final good in country i . When serving its own domestic market, the extra cost is zero ($c_{ii} = 0$) for an inside firm regardless of whether or not there is an FTA or a CU.

Prior to forming a PTA, firm j ($j = A, B, j \neq i$) is required to pay tariffs for each unit of its final good exported to country i . To firm j , its trade cost c_{ij} is equal to the tariff rate charged by country i . After an FTA is established, a firm that exports its final good within the trade bloc incurs an extra cost if it chooses to comply with ROO. In this case, c_{ij} represents an ROO-induced trade cost (i.e., $c_{ij} > 0$).⁷ Under a CU, member countries trade with each other without ROO or artificial barriers. In this case, the trade cost c_{ij} to firm j is zero.

As for firm C that serves the final-good markets in A and B , this outside firm is required to pay tariffs. The trade cost c_{iC} to firm C is taken to be a specific tariff, the amount of which depends on whether there is an FTA, a CU, or without any form of a trade agreement.

We consider a two-stage game. In the first stage, governments of countries A and B decide on whether or not to form an FTA or CU and thereafter determine their external tariffs. In the second stage, firms choose their output levels and compete in the final-good markets in the region. We use backward induction to solve for the sub-game perfect Nash equilibrium of the alternative trade regimes. We begin with the second stage at which firms make their production decisions. Unless otherwise noted, detailed proofs and the deviations of model results are to be found in [Appendix A](#).

3. Pre-FTA and post-FTA (cases without market integration)

Product markets in big and small countries are segmented prior to the formation of a PTA. This is due to differential specific tariffs on imports under a two-way trade, along with the usual assumptions of linear demands and constant marginal costs of production. For the case in which the two asymmetric countries establish an FTA, inside firms are required to comply with ROO to qualify for preferential treatment for their intra-bloc exports. As such, product markets in the two countries remain segmented due to the ROO-induced trade costs. For the pre-PTA and FTA regimes without internal market integration, firm k ($k = A, B, C$) sells q_{ik} units of final good to country i ($i = A, B$). Depending on the amounts of trade costs c_{ik} in different situations discussed earlier, the total profit of firm k is:

$$\Pi_k = \sum_{i=A,B} (p_i - c_{ik})q_{ik}. \quad (1)$$

⁶ Although model setting and assumptions may differ, the use of a three-country model to analyze issues on FTA with ROO can be found in several recent studies such as [Anson et al. \(2005\)](#), [Ju and Krishna \(2005\)](#), and [Ishikawa et al. \(2007\)](#).

⁷ In Section 3, we will discuss in more details the increase in costs resulting from complying with preferential ROO requirements.

We assume that each firm employs a Cournot strategy in its production decision, taking as given the quantities of final goods produced by all other firms. Based on Eq. (1), we calculate the quantity of the final good exported to country $i (=A, B)$ by firm $k (=A, B, C)$ as

$$q_{ik} = \frac{(\alpha_i + c_{ij} + c_{iC})}{4} - c_{ik}. \tag{2}$$

Total consumption, $Q_i = (q_{iA} + q_{iB} + q_{iC})$, of the final good and its price in country i are:

$$Q_i = \frac{(3\alpha_i - c_{ij} - c_{iC})}{4}; \quad p_i = \frac{(\alpha_i + c_{ij} + c_{iC})}{4}. \tag{3}$$

The conditions for positive quantities for q_{ik} and Q_i are when the market size α_i is large enough (i.e., $\alpha_i > 4c_{ik} - c_{ij} - c_{iC}$ and $\alpha_i > [(c_{ij} + c_{iC})/3]$). These conditions are assumed to hold.

We then calculate consumer surplus and producer surplus for country i :

$$S_i = \frac{(3\alpha_i - c_{ij} - c_{iC})^2}{32}; \quad \Pi_i = \frac{(\alpha_i + c_{ij} + c_{iC})^2 + (\alpha_j - 3c_{ji} + c_{jC})^2}{16}; \tag{4}$$

where $j = A, B$ and $j \neq i$. Denoting t_{ij} and t_{iC} as the tariff rates that country i charges on imports from country j and country C , we calculate total tariff revenue for country i to be

$$R_i = t_{ij}q_{ij} + t_{iC}q_{iC} = \frac{t_{ij}(\alpha_i - 3c_{ij} + c_{iC}) + t_{iC}(\alpha_i + c_{ij} - 3c_{iC})}{4}. \tag{5}$$

Each potential member country's social welfare, which is taken as the sum of consumer surplus, producer surplus, and tariff revenue, is $W_i = S_i + \Pi_i + R_i$. That is,

$$W_i = \frac{(3\alpha_i - c_{ij} - c_{iC})^2}{32} + \frac{(\alpha_i + c_{ij} + c_{iC})^2 + (\alpha_j - 3c_{ji} + c_{jC})^2}{16} + \frac{t_{ij}(\alpha_i - 3c_{ij} + c_{iC}) + t_{iC}(\alpha_i + c_{ij} - 3c_{iC})}{4}. \tag{6}$$

We proceed to discuss the equilibrium outcomes for pre-PTA and post-FTA.

3.1. Pre-PTA equilibrium

In the absence of any trade agreements, country $i (=A, B)$ charges a uniform tariff on all imports of the final good from countries $j (=A, B, j \neq i)$ and C . Denoting \bar{t}_i as country i 's pre-PTA tariff rate, we have trade cost for each unit of the final good as the specific tariff:

$$c_{iC} = c_{ij} = t_{iC} = t_{ij} = \bar{t}_i. \tag{7}$$

Substituting the above conditions into W_i in Eq. (6), using the first-order condition that $dW_i/d\bar{t}_i = 0$, we derive the pre-PTA optimal tariff rate:⁸

$$\bar{t}_i = \frac{3}{10}\alpha_i. \tag{8}$$

The pre-PTA tariff of a country is positively related to its market size. This indicates that, other things being equal, the big country (with a larger domestic market) sets a higher tariff rate than the small country (with a smaller domestic market). Before forming a PTA, the big country has a higher level of trade protectionism than the small country.

Using Eqs. (7) and (8), we calculate the equilibrium quantities, price, and total consumptions of the final good in country i :

$$\bar{q}_{ii} = \frac{2}{5}\alpha_i; \quad \bar{q}_{ij} = \frac{1}{10}\alpha_i; \quad \bar{q}_{iC} = \frac{1}{10}\alpha_i; \quad \bar{p}_i = \frac{2}{5}\alpha_i; \quad \bar{Q}_i = \frac{3}{5}\alpha_i. \tag{9}$$

Substituting the equations in (9) back into Eqs. (4)–(6), we have the equilibrium values of consumer surplus, producer surplus, tariff revenue, and social welfare for country i :

$$\bar{S}_i = \frac{9}{50}\alpha_i^2; \quad \bar{\Pi}_i = \frac{4}{25}\alpha_i^2 + \frac{1}{100}\alpha_j^2; \quad \bar{R}_i = \frac{3}{50}\alpha_i^2; \tag{10}$$

$$\bar{W}_i = \frac{2}{5}\alpha_i^2 + \frac{1}{100}\alpha_j^2.$$

Throughout the analysis, we use the pre-PTA equilibrium as the benchmark to evaluate alternative trade regimes.

3.2. An effective FTA with preferential ROO

Under an FTA, member countries do not charge tariffs on imports from their partners such that $t_{ij} = 0$, for $i, j = A, B$, and $i \neq j$. But the FTA members maintain independence in setting different external tariffs (t_{iC}) on their respective imports. Denoting the tariff rates as t_i^{FTA} for $i = A, B$, we have the trade costs for firms from country C such that $t_{iC} = t_i^{FTA}$. The differential external tariffs may cause a re-exportation of the final good from a lower-tariff member to a higher-tariff member within the trade bloc. To avoid trade deflection, the FTA countries agree that final products cannot get duty-free access to trading partners unless their productions meet preferential ROO requirements.⁹

Under preferential ROO, the unit cost of exporting final good within a trade bloc unambiguously increases for inside firms if they want to enjoy duty-free treatments for their exports. We use $\delta (> 0)$ to represent the ROO-induced trade cost, that is, $c_{ij} = \delta$. Under an FTA, intra-bloc final-good exporters may or may not choose to comply with ROO (Ju and Krishna, 2005). Whether such an inside firm decides to meet ROO depends crucially on external tariffs set by FTA members and the ROO-induced trade cost. For each unit of final good exported to country i by firm j , if

$$t_i^{FTA} > \delta \tag{11}$$

it is to the benefit of the firm to comply with ROO. Otherwise, the firm exports its final good by simply paying the specific tariff. In this case, ROO are not met and an inside firm is then treated as an “outside firm.” For forming an effective FTA, we consider the case that each member country sets its external tariff rate above δ . Eq. (11) thus defines the ROO-complying condition.

For firm C producing outside of the FTA, it pays the specific tariff t_i^{FTA} on its exports to country i . In this case, firm C 's trade cost is $c_{iC} = t_i^{FTA}$. Given that $c_{ij} = \delta$ for FTA members under the ROO-complying condition, positive quantities for the final good as shown in Eq. (2) requires that

$$\alpha_i + \delta - 3t_i^{FTA} > 0 \quad \text{and} \quad \alpha_i - 3\delta + t_i^{FTA} > 0. \tag{12}$$

⁸ It is easy to verify that the second-order condition for welfare maximization is satisfied.

⁹ There are different criteria for ROO in terms of (i) regional content requirements, (ii) a change in tariff heading, (iii) particular processes that should be performed within an FTA; and (iv) a substantial transformation of a product. See, e.g., Thoenig and Verdier (2004), Cadot et al. (2006), and Krishna (2006). The North American Free Trade Agreement (NAFTA), the European Union (EU), and the ASEAN Free Trade Area agreement (AFTA) all contain ROO provisions which provide preferential treatment for member countries.

We assume these conditions hold. We then calculate welfare for country i under FTA by substituting $t_{ij} = 0$, $c_{iC} = t_{iC} = t_i^{FTA}$, and $c_{ij} = \delta$ into Eq. (6) to obtain

$$W_i^{FTA} = \frac{1}{32}[-21(t_i^{FTA})^2 + (14\delta + 6\alpha_i)(t_i^{FTA}) + 3\delta^2 + 11\alpha_i^2 - 2\delta\alpha_i] + \left(\frac{\alpha_j + t_j^{FTA} - 3\delta}{4}\right)^2. \tag{13}$$

We assume that each potential member is willing to sign in preferential ROO as long as doing so is welfare-improving. Country i decides to join an effective FTA with ROO when its FTA welfare in (13) is greater than the pre-PTA welfare in Eq. (10). That is,

$$W_i^{FTA} > \bar{W}_i. \tag{14}$$

Eq. (14) defines the welfare-improving condition for forming an effective FTA.

The next step is to determine the degree of market size asymmetry (θ) and the range of the ROO-induced trade cost (δ) that guarantee welfare gains from forming an FTA for each member. Also, we wish to determine the optimal external tariff for each member. The problem facing an FTA member is to choose t_i^{FTA} that maximizes W_i^{FTA} in (13), subject to the ROO-complying condition in (11), the welfare-improving condition in (14), and the positive quantity constraints in (12).

For the big country, B , its solution to the constrained welfare-optimization problem exists when the following conditions are satisfied (see Appendix A.1):

$$1 < \theta < 1.2928 \text{ and } 0 < \delta < \hat{\delta},$$

$$\text{where } \hat{\delta} = \alpha_A \left(\frac{24}{77} - \sqrt{\frac{27}{385}\theta^2 - \frac{5949}{296450}} \right). \tag{15}$$

For the small country, A , its solution to the constrained welfare-optimization problem also exists under the same set of conditions in (15). This indicates that, when the degree of market size asymmetry is not too large ($1 < \theta < 1.2928$) and the ROO-induced trade cost is sufficiently small ($0 < \delta < \hat{\delta}$), forming an FTA is welfare-improving to both the big and small countries. But when the market size asymmetry is too large ($\theta \geq 1.2928$), an FTA with ROO is welfare-deteriorating to at least one country (especially the big country, B). Furthermore, investigation of Eq. (15) reveals that, for $1 < \theta < 1.2928$, the critical value of $\hat{\delta}$ is inversely associated with θ .

The findings of the above analyses permit us to establish

Proposition 1. Forming an FTA with ROO is welfare-improving to participating countries when their market size asymmetry is not too large and the preferential ROO are not too restrictive. The critical value of the ROO-induced trade cost, $\hat{\delta}$, that makes FTA formation to be welfare-improving is higher (lower) when the market size asymmetry is smaller (greater).

The economic implications of Proposition 1 are straightforward. Other things being equal, the likelihood of forming an effective FTA with ROO between two asymmetric countries is higher (lower) when the difference in market size is smaller (greater).

Assuming that the conditions for forming an FTA in (15) hold, we use the welfare function in (13) to solve for the optimal tariff rate set by member country i

$$t_i^{FTA} = \frac{1}{7}\alpha_i + \frac{1}{3}\delta. \tag{16}$$

For an exogenous increase in δ , other things being equal, the FTA members must raise tariffs in order to induce their firms to comply with ROO.

A comparison between Eqs. (8) and (16) reveals that

$$t_i^{FTA} < \bar{t}_i. \tag{17}$$

This result is consistent with the requirement under Article XXIV of GATT/WTO that an external tariff should not be set above the pre-PTA level to avoid a negative welfare impact on a non-member country.

Substituting the members' external tariffs from Eq. (16) into Eqs. (2)–(6), taking into account the trade cost conditions that $t_{ij} = 0$, $c_{ij} = \delta$ and $t_{iC} = c_{iC} = t_i^{FTA}$, we obtain equilibrium outputs, prices, consumptions, consumer surplus, producer surplus, tariff revenue, and social welfare:

$$q_{ii}^{FTA} = \frac{2}{7}\alpha_i + \frac{1}{3}\delta; \quad q_{ij}^{FTA} = \frac{2}{7}\alpha_i - \frac{2}{3}\delta; \quad q_{iC}^{FTA} = \frac{1}{7}\alpha_i; \tag{18a}$$

$$p_i^{FTA} = \frac{2}{7}\alpha_i + \frac{1}{3}\delta; \quad Q_i^{FTA} = \frac{5}{7}\alpha_i - \frac{1}{3}\delta; \tag{18b}$$

$$S_i^{FTA} = \frac{1}{2}\left(\frac{5}{7}\alpha_i - \frac{1}{3}\delta\right)^2; \quad \Pi_i^{FTA} = \left(\frac{2}{7}\alpha_i + \frac{1}{3}\delta\right)^2 + \left(\frac{2}{7}\alpha_j - \frac{2}{3}\delta\right)^2; \tag{18c}$$

$$R_i^{FTA} = \frac{1}{7}\left(\frac{1}{7}\alpha_i + \frac{1}{3}\delta\right)\alpha_i; \quad W_i^{FTA} = \frac{11}{18}\delta^2 - \frac{8}{21}\alpha_j\delta + \frac{5}{14}\alpha_i^2 + \frac{4}{49}\alpha_j^2. \tag{18d}$$

To compare alternative trade regimes, our next step is to analyze the scenario in which the big and small countries form a CU.

4. A customs union

In a CU where member countries trade with each other duty-free, they collectively set a common external tariff with respect to non-members. Also, firms producing within the CU are not subject to preferential ROO. Denoting the common external tariff rate as t^{CU} , we have from the trade cost conditions that $c_{ij} = 0$ ($i, j = A, B, i \neq j$) and $c_{iC} = t^{CU} (> 0)$. Because of free trade, the final good q may be resold between member countries A and B until their prices are identical, $p_i^{CU} = p^{CU}$. In order to discuss how and to what degree the formation of a CU depends on the market integration, we first examine the case when market are segmented. We then analyze the case that market is integrated.

4.1. A customs union without internal market integration

In order to analyze what effects market integration has on forming a CU, we first examine the case when markets remain to be segmented after a CU is formed. In this case, we use \tilde{t}^{CU} to denote the common external tariff rate. Substituting the trade cost conditions $c_{ij} = 0$ ($i, j = A, B, i \neq j$) and $c_{iC} = \tilde{t}^{CU}$ into Eq. (6), we have for country i its post-CU welfare without market integration as:

$$\tilde{W}_i^{CU} = -\frac{19}{32}(\tilde{t}^{CU})^2 + \left(\frac{3}{16}\alpha_i + \frac{1}{8}\alpha_j\right)\tilde{t}^{CU} + \frac{11}{32}\alpha_i^2 + \frac{1}{16}\alpha_j^2. \tag{18}$$

It is plausible to assume that two potential member countries choose to establish a CU when each country's welfare, \tilde{W}_i^{CU} , exceeds its pre-PTA welfare, \bar{W}_i . That is, $\tilde{W}_i^{CU} > \bar{W}_i$, which defines the welfare-improving conditions for CU members.

As mentioned earlier, Article XXIV of the GATT/WTO requires that the CU external tariff be no greater than the pre-PTA tariff to avoid a negative welfare effect on non-members. In this case, we impose the constraint that $\tilde{t}^{CU} \leq \bar{t}_i$. Note that since the pre-PTA tariff is $\bar{t}_i = (3/10)\alpha_i$ (see Eq. (9)), where $\alpha_A < \alpha_B$, we have $\bar{t}_A < \bar{t}_B$. The GATT/WTO policy then implies that a common external tariff rate should be no greater than \bar{t}_A , that is, $\tilde{t}^{CU} \leq \bar{t}_A$.

In setting a common external tariff, the CU member countries jointly maximize the sum of their social welfare, $(\tilde{W}_A^{CU} + \tilde{W}_B^{CU})$, subject to the above welfare-improving conditions, $\tilde{W}_i^{CU} > \bar{W}_i$, and the GATT/WTO condition, $\tilde{t}^{CU} \leq \bar{t}_A$. Considering these constraints together, we have two possibilities in terms of solving for the common external tariff.

Case 1: When $1 < \theta < 1.28$, there is an *interior* solution. Solving for the CU common external tariff yields

$$\tilde{t}^{CU} = \frac{5(1 + \theta)}{38} \alpha_A. \tag{19}$$

Substituting the trade cost conditions that $c_{ij} = 0$ ($i, j = A, B, i \neq j$) and $c_{iC} = \tilde{t}^{CU}$, where \tilde{t}^{CU} is given by (19), into Eqs. (2)–(6), we obtain the equilibrium outputs, prices, total consumptions, consumer surplus, producer surplus, tariff revenue, and social welfare:

$$\tilde{q}_{ii}^{CU} = \tilde{q}_{ij}^{CU} = \frac{43}{152} \alpha_i + \frac{5}{152} \alpha_j; \quad \tilde{q}_{iC}^{CU} = \frac{23}{152} \alpha_i - \frac{15}{152} \alpha_j; \tag{20a}$$

$$\tilde{Q}_i^{CU} = \frac{109}{152} \alpha_i - 5 \alpha_j; \quad \tilde{p}_i = \frac{43}{152} \alpha_i + \frac{5}{152} \alpha_j; \tag{20b}$$

$$\tilde{S}_i^{CU} = \frac{1}{2} \left(\frac{109}{152} \alpha_i - \frac{5}{152} \alpha_j \right)^2; \quad \tilde{\Pi}_i^{CU} = \frac{937(\alpha_i^2 + \alpha_j^2) + 430 \alpha_i \alpha_j}{11552}; \tag{20c}$$

$$\tilde{R}_i^{CU} = \frac{5(\alpha_i + \alpha_j)(23\alpha_i - 15\alpha_j)}{5776}; \quad \tilde{W}_i^{CU} = \frac{871\alpha_i^2 + 50\alpha_i\alpha_j + 167\alpha_j^2}{2432}. \tag{20d}$$

Case 2: When $1.28 \leq \theta < 1.4487$, there is a *corner* solution. Solving for the CU common external tariff yields

$$\tilde{t}^{CU} = \bar{t}_A = \frac{3}{10} \alpha_A. \tag{21}$$

Substituting the trade cost conditions that $c_{ij} = 0$ and $c_{iC} = \tilde{t}^{CU}$, where the CU external tariff by (21), into Eqs. (2)–(6) yields

$$\tilde{q}_{ii}^{CU} = \tilde{q}_{ij}^{CU} = \frac{1}{4} \alpha_i + \frac{3}{40} \alpha_A; \quad \tilde{q}_{iC}^{CU} = \frac{1}{4} \alpha_i - \frac{9}{40} \alpha_A;$$

We further calculate total consumption of the final good, its market price, consumer surplus, producer surplus, tariff revenue and social welfare:

$$\tilde{Q}_i^{CU} = \frac{3}{4} \alpha_i - \frac{3}{40} \alpha_A; \quad \tilde{p}_i^{CU} = \frac{1}{4} \alpha_i + \frac{3}{40} \alpha_A; \tag{22a}$$

$$\begin{aligned} \tilde{S}_i^{CU} &= \left(\frac{3}{4} \alpha_i - \frac{3}{40} \alpha_A \right)^2; \quad \Pi_i^{CU} \\ &= \left(\frac{1}{4} \alpha_i + \frac{3}{40} \alpha_A \right)^2 + \left(\frac{1}{4} \alpha_j + \frac{3}{40} \alpha_A \right)^2; \end{aligned} \tag{22b}$$

$$\tilde{R}_i^{CU} = \frac{3}{10} \left(\frac{1}{4} \alpha_i - \frac{9}{40} \alpha_A \right) \alpha_A; \tag{22c}$$

$$\begin{aligned} \tilde{W}_i^{CU} &= \left(\frac{3}{4} \alpha_i - \frac{3}{40} \alpha_A \right)^2 + \left(\frac{1}{4} \alpha_i + \frac{3}{40} \alpha_A \right)^2 + \left(\frac{1}{4} \alpha_j + \frac{3}{40} \alpha_A \right)^2 \\ &+ \frac{3}{10} \left(\frac{1}{4} \alpha_i - \frac{9}{40} \alpha_A \right) \alpha_A. \end{aligned} \tag{22d}$$

For the two cases in which $1 < \theta < 1.28$ and $1.28 \leq \theta < 1.4487$, there is a welfare improvement for each CU member without requiring a transfer of welfare. If a transfer of welfare between the FTA members is allowed, the range of market size asymmetry θ that makes each member welfare-improving becomes as wide as

$1 < \theta < 24.819$. When θ is such that $1.4487 \leq \theta < 24.819$, the overall welfare of CU member countries is increased. However, the member country with a big domestic market gets hurt if welfare transfer is not allowed.

We proceed to examine the case with internal market integration in a CU.¹⁰

4.2. A customs union with internal market integration

Inside and outside firms treat the two markets in countries A and B as an integrated one under a CU. As such, the total quantity of final good sold by firm k ($= A, B, C$) to the single CU market is q_k^{CU} , where $q_k^{CU} = q_{Ak}^{CU} + q_{Bk}^{CU}$. Depending on the amounts of trade costs c_{ik} in different situations discussed earlier, profits of inside firm i and outside firm C are given, respectively, as

$$\Pi_i^{CU} = p^{CU} q_i^{CU}; \tag{23a}$$

$$\Pi_C^{CU} = (p^{CU} - t^{CU}) q_C^{CU}. \tag{23b}$$

All firms independently determine their profit-maximizing levels of the final good, q_k^{CU} , subject to the uniform-price condition, $p_A^{CU} = p_B^{CU} = p^{CU}$. We calculate the equilibrium outputs as follows:

$$q_i^{CU} = \frac{1}{4}(1 + \theta) + \frac{1}{2} t^{CU}; \quad q_C^{CU} = \frac{1}{2}(1 + \theta) \alpha_A - \frac{3}{2} t^{CU}. \tag{24}$$

The equilibrium price and consumption of the final good in each CU member are:

$$p^{CU} = \frac{1}{8}(1 + \theta) \alpha_A + \frac{t^{CU}}{4}; \quad Q_i^{CU} = \frac{1}{8}(7\alpha_i - 2t^{CU} - \alpha_j). \tag{25}$$

We then calculate consumer surplus and firm profit of each member country as follows:

$$S_i^{CU} = \frac{1}{128}(7\alpha_i - 2t^{CU} - \alpha_j)^2; \quad \Pi_i^{CU} = \frac{1}{32} [(1 + \theta) \alpha_A + 2t^{CU}]^2. \tag{26}$$

Due to internal market integration, we cannot determine tariff revenue collected by each CU member. Given a common external tariff t^{CU} on imports from country C, total tariff revenue collected by the CU is:

$$R_{AB}^{CU} = R_A^{CU} + R_B^{CU} = t^{CU} q_C^{CU} = \frac{1}{4}(1 + \theta) t^{CU} + \frac{1}{2} (t^{CU})^2. \tag{27}$$

Based on Eqs. (24)–(27), we calculate welfare for each CU member as

$$\begin{aligned} W_i^{CU} &= S_i^{CU} + \Pi_i^{CU} + R_i^{CU} = \frac{(7\alpha_i - 2t^{CU} - \alpha_j)^2}{128} \\ &+ \frac{(\alpha_i + \alpha_j + 2t^{CU})^2}{32} + R_i^{CU}, \end{aligned} \tag{28}$$

noting that R_i^{CU} depends on how the total tariff revenue, R_{AB}^{CU} , is distributed between the members.

In setting a common external tariff, the CU members jointly maximize the sum of their social welfare, $(W_A^{CU} + W_B^{CU})$, subject to the welfare-improving conditions that

$$W_i^{CU} > \bar{W}_i \tag{29}$$

and the GATT/WTO policy that

$$t^{CU} \leq \bar{t}_A. \tag{30}$$

¹⁰ See, e.g., [Ishikawa et al. \(2007\)](#) for an analysis of internal market integration when firms engage in Bertrand price competition.

Making use of Eqs. (27) and (28), we calculate overall welfare (W_{AB}^{CU}) as

$$W_{AB}^{CU} = W_A^{CU} + W_B^{CU} = -\frac{19}{16}(t^{CU})^2 + \frac{5}{16}(1 + \theta)\alpha_A t^{CU} + \left[\frac{29}{64}(1 + \theta^2) - \frac{3}{32}\theta\right]\alpha_A^2. \tag{31}$$

The solution to the constrained welfare-maximization problem exists and the equilibrium quantity of the final good consumption in the small country A is positive, $Q_A^{CU} > 0$,¹¹ provided that market size asymmetry satisfies the following: $1 < \theta < 6.4$. Considering the constrained conditions in (29) and (30), we have two possibilities in terms of solving for the common external tariff.

Case 1: When $1 < \theta < 1.28$, there is an interior solution. In this case, the CU optimal external tariff is calculated as

$$t^{CU} = \frac{5(1 + \theta)}{38}\alpha_A. \tag{32}$$

Substituting t^{CU} from (32) into Eqs. (24)–(28) yields the equilibrium outputs, market price, consumer surplus, producer surplus, each member’s welfare, and the total tariff revenue:

$$q_i^{CU} = \frac{6}{19}(1 + \theta)\alpha_A; \quad q_C^{CU} = \frac{1}{19}(1 + \theta)\alpha_A; \tag{33a}$$

$$Q_i^{CU} = \frac{16}{19}\alpha_i - \frac{3}{19}\alpha_j; \quad p^{CU} = \frac{3(1 + \theta)\alpha_A}{19}; \tag{33b}$$

$$S_i^{CU} = \frac{1}{2}\left(\frac{16}{19}\alpha_i - \frac{3}{19}\alpha_j\right)^2; \quad \Pi_i^{CU} = \frac{18(1 + \theta)^2\alpha_A^2}{361}; \tag{33c}$$

$$W_i^{CU} = \frac{1}{2}\left(\frac{16}{19}\alpha_i - \frac{3}{19}\alpha_j\right)^2 + \frac{18}{361}(1 + \theta)^2\alpha_A^2 + R_i^{CU}. \tag{33d}$$

$$R_{AB}^{CU} = \frac{5}{722}(1 + \theta)^2\alpha_A^2. \tag{33e}$$

Case 2: When $1.28 \leq \theta < 1.8234$ or $3.5099 < \theta < 6.4$, there is a corner solution. For $1.8234 < \theta < 3.5099$, the solution remains to be a corner solution when the large country receives a sufficient amount of tariff revenue such that $R_B^{CU} > \hat{R}_B^{CU}$, where $\hat{R}_B^{CU} = (3/10)(-3\theta^2/64) + (\theta/4) - (3/10)\alpha_A^2$. This sufficient condition ensures that forming a CU is welfare-improving to the big country, i.e., $W_B^{CU} > W_B$. Solving for the common external tariff yields

$$t^{CU} = \bar{t}_A = \frac{3}{10}\alpha_A. \tag{34}$$

Substituting t^{CU} from Eq. (34) into the output equations in (24) yields

$$q_i^{CU} = \left(\frac{2}{5} + \frac{\theta}{4}\right)\alpha_A; \quad q_C^{CU} = \left(\frac{\theta}{4} - \frac{1}{5}\right)\alpha_A. \tag{35a}$$

We further calculate total consumption of the final good, market price, consumer surplus, producer surplus, social welfare for each member country, and total tariff revenue as follows:

$$Q_A^{CU} = \left(\frac{4}{5} - \frac{\theta}{8}\right)\alpha_A; \quad Q_B^{CU} = \left(\frac{7\theta}{8} - \frac{1}{5}\right)\alpha_A;$$

$$p^{CU} = \left(\frac{1}{5} + \frac{\theta}{8}\right)\alpha_A; \tag{35b}$$

¹¹ When $\theta \geq 6.4$, $Q_A^{CU} = 0$. This case is ruled out from the analysis.

$$S_A^{CU} = \frac{(5\theta - 32)^2}{3200}\alpha_A^2; \quad S_B^{CU} = \frac{(35\theta - 8)^2}{3200}\alpha_A^2; \tag{35c}$$

$$\Pi_i^{CU} = \left(\frac{1}{32}\theta^2 + \frac{1}{10}\theta + \frac{2}{25}\right)\alpha_A^2;$$

$$W_A^{CU} = \frac{(25\theta^2 + 256)}{640}\alpha_A^2 + R_A^{CU};$$

$$W_B^{CU} = \frac{(265\theta^2 - 48\theta + 64)}{640}\alpha_A^2 + R_B^{CU}; \tag{35d}$$

$$R_{AB}^{CU} = \frac{3}{10}\left(\frac{\theta}{4} - \frac{1}{5}\right)\alpha_A^2. \tag{35e}$$

For country A where its domestic market is relatively smaller, joining a CU is beneficial since its post-CU welfare exceeds its pre-PTA welfare. Interestingly, the result that $W_A^{CU} > \bar{W}_A$ holds even for $R_A^{CU} = 0$. But for country B where its domestic market is relatively larger, whether or not joining a CU is welfare-improving cannot be determined unambiguously. When market size asymmetry is “moderate” ($1.8234 < \theta < 3.5099$), there is a welfare gain to the big country provided that it receives a sufficiently large amount of the CU tariff revenue. That is, only when $R_B^{CU} > \hat{R}_B^{CU}$ will the big country be better off such that $W_B^{CU} > \bar{W}_B$. Thus, for a moderate degree of market size asymmetry, forming a CU is not Pareto welfare-improving to all members unless there is an appropriate distribution of tariff revenue between members.¹²

We thus have

Proposition 2. In the case of internal market integration, the formation of a CU between big and small countries is welfare-improving when their market size asymmetry is sufficiently low ($1 < \theta \leq 1.8234$) or sufficiently high ($3.5099 \leq \theta < 6.4$). When market size asymmetry is moderate ($1.8234 < \theta < 3.5099$) however, forming a CU is not always welfare-improving to the big country unless it receives a sufficient amount of the CU tariff revenue.

By comparing the equilibrium outcomes without the market integration of CU to those with it, we find that for $\theta > 1$, the market price of the final good in the big country decreases whereas that of the final good in the small country increases. We further find that market integration leads to lower consumer surplus in the big country and higher consumer surplus in the small country. Hence, it benefits consumers in the big country and hurts those in the small country. It is not a surprise that profits of firms in a CU are higher when there is no market integration, as compared to the case when there is market integration.

An interesting finding is that if a transfer of welfare between members is feasible, the range of θ which satisfies the welfare-improving condition to each member becomes much broader for the case without market integration. But if a transfer of welfare is not feasible, the converse of the conclusion is true. We also find that for $1 < \theta < 1.4487$, there is a welfare gain to each member of a CU, regardless of whether or not internal markets are integrated. The difference in total welfare between the cases with and

¹² As we focus our analysis on the incentive to form a CU, we assume that CU members maximize their joint welfare in determining a common external tariff without considering specific rules for the distribution of the tariff revenues. Syropoulos (1999) presented a systematic analysis concerning how rules for the distribution of tariff revenues affect CU members’ preferences over common external tariff levels. The rules include the following: (i) distribution of CU tariff revenues based on each member’s population, (ii) distribution based on each member’s consumption, and (iii) distribution based on each member’s ability in absorbing extra-union imports. The author shows that tariff preferences may be polarized when tariff revenues are distributed in proportion to members’ imports.

without market integration increases when the degree of market size asymmetry increases.

5. Differences in effects and implications between an FTA and a CU

As discussed in Section 3.2, relative to the pre-PTA equilibrium, there are welfare gains to both the big and small countries when their market size asymmetry is not too large ($1 < \theta < 1.2928$) and ROO are less restrictive ($0 < \delta < \hat{\delta}$). Further, Proposition 2 shows that there are welfare gains to the two asymmetric countries under a CU when their market size asymmetry is small ($1 < \theta < 6.4$) and the big country receives a sufficient amount of tariff revenue. In terms of differences in market size asymmetry in affecting the choice between a welfare-improving FTA and a welfare-improving CU, we have

Proposition 3. Other things being equal, forming a welfare-improving CU allows for a greater degree of market size asymmetry than forming a welfare-improving FTA (with ROO).

When market size asymmetry is not too large ($1 < \theta < 1.2928$), either forming an FTA with less restrictive ROO ($0 < \delta < \hat{\delta}$) or forming a CU is welfare-improving to each member. In what follows, when comparing welfare differences between the two alternative trade regimes, we assume that both the asymmetry condition and the ROO restrictions hold unless otherwise specified.

5.1. Effects on external tariffs

From \bar{t}_i in Eq. (8) and t_i^{FTA} in Eq. (15), we find that the ratio of the post-FTA tariff to the pre-PTA tariff for the big country is less than that for the small country. This implies that there is a greater tariff reduction by the big country than by the small country under an FTA.

Moreover, we find that, for given ROO-induced trade cost, t_i^{FTA}/\bar{t}_i decreases as the degree of market size asymmetry, θ , increases. Thus, there is a greater reduction in FTA tariffs for both member countries when the degree of market size asymmetry is larger.

Eq. (15) indicates that the FTA tariffs for both members are increasing functions of δ . Specifically, we have

$$\frac{t_i^{FTA}|_{\delta=0}}{\bar{t}_i} < \frac{t_i^{FTA}|_{0 < \delta < \hat{\delta}}}{\bar{t}_i} < \frac{t_i^{FTA}|_{\delta=\hat{\delta}}}{\bar{t}_i} < 1. \tag{36}$$

Fig. 1 illustrates for each country the upper and lower limits of the tariff ratio before and after the formation of an FTA.

For the case of forming a CU, although both members set a common external tariff t^{CU} (see Eqs. (32) and (34)), the ratios of the CU tariff to the pre-PTA tariff for the two countries are different due to their differences in the pre-PTA tariffs \bar{t}_i (see Eq. (9)). As can be seen from Fig. 1, this tariff ratio for the small country increases as θ increases until $\theta = 1.28$. For the big country, the external tariff reduction after forming a CU becomes relatively greater when θ is larger.

As illustrated in Fig. 1, the CU tariff is always higher than the upper limit of the FTA tariffs. We thus have

Proposition 4. Despite the presence of ROO-induced trade costs under an FTA between two asymmetric countries, tariff reductions by the FTA members remain relatively greater than tariff reductions under a CU. Furthermore, the big country lowers its external tariff by an amount greater than that by the small country, regardless of whether they form an FTA or a CU.

5.2. Comparing profits of inside firms within a PTA

In an FTA, there are fundamentally no trade barriers between member countries other than their preferential ROO. But the ROO-induced trade cost, δ , is at a level lower than the external tariff set by each member of an effective FTA. It is then interesting to see how ROO affect firms inside the big and small countries.

An inspection of Eq. (17) reveals that producer surplus in either the small or big country is a decreasing function of δ . That is, $\partial \Pi_i^{FTA} / \partial \delta < 0$ for $i=A, B$. Given that firms of the small and big countries are negatively affected by the opening of their domestic markets under free trade, each firm is better off with less trade. The higher the ROO-induced trade cost, δ , the lower the likelihood that the big and small countries will form a PTA. This explains why firms producing within an FTA may prefer high δ . It follows that

$$\Pi_A^{FTA}|_{\delta=\hat{\delta}} < \Pi_A^{FTA}|_{0 < \delta < \hat{\delta}} < \Pi_A^{FTA}|_{\delta=0} \tag{37a}$$

and

$$\Pi_B^{FTA}|_{\delta=\hat{\delta}} < \Pi_B^{FTA}|_{0 < \delta < \hat{\delta}} < \Pi_B^{FTA}|_{\delta=0}. \tag{37b}$$

Eqs. (37a) and (37b) indicate that, due to differences in market sizes, the small country firm prefers ROO to be less restrictive whereas the big country firm prefers ROO to be more restrictive.

Fig. 2(a) and (b) illustrates for each country the ratio of firm profit (or producer surplus) before and after forming an FTA or a CU. We find that the final-good producers in both the big and small countries are better off under a CU than under an FTA since

$$\frac{\Pi_i^{CU}}{\bar{\Pi}_i} > \frac{\Pi_i^{FTA}|_{\delta=\hat{\delta}}}{\bar{\Pi}_i}. \tag{38}$$

Note that despite market size asymmetry between member countries, firms producing inside a trade block are taken to be identical in our analysis. We find that the relative profits are increasing functions of the market size differential θ for the small country, but are decreasing functions of θ for the big country. These findings, which are illustrated in Fig. 2(a) and (b), can be intuitively explained as follows. After the establishment of a PTA (an FTA or a CU), trading partners share their markets. The firm located in country A with a smaller market benefits from tariff-free in country B with a larger market. When the market size differential θ is greater, firm A finds it more profitable from accessing to the larger market. After forming a PTA, the firm located in country B can enjoy tariff-free access to the country with a smaller market. But the loss to firm B in its domestic country, resulting from the free access of firm A, may outweigh its gain from entering into the smaller market. This is especially true when the degree of market size asymmetry is significantly large.

As presented in Fig. 2(b), forming an FTA makes the final-good producers in country B worse off. But as illustrated in Fig. 2(a), the effect on the final-good producers in country A cannot be determined unambiguously, however. It depends on the degree of market size asymmetry, as well as the ROO-induced trade cost. We show in Appendix A.2 the following two possibilities:

- (a) $\Pi_A^{FTA} < \bar{\Pi}_A$ when (i) $1 < \theta < 1.0460$ or (ii) $1.0460 < \theta < 1.1155$ and $0 < \delta < \hat{\delta}$;
- (b) $\Pi_A^{FTA} > \bar{\Pi}_A$ when (i) $1.1155 \leq \theta < 6.4$ or (ii) $1.0460 < \theta < 1.1155$ and $\hat{\delta} < \delta < \bar{\delta}$.

It comes as not a surprise that the formation of a CU makes the final-good producers in the small country better off. The effect on the final-good producers in the larger country cannot be determined unambiguously, however. It depends on the degree of market size asymmetry. We show in Appendix A.3 the following two possibilities:

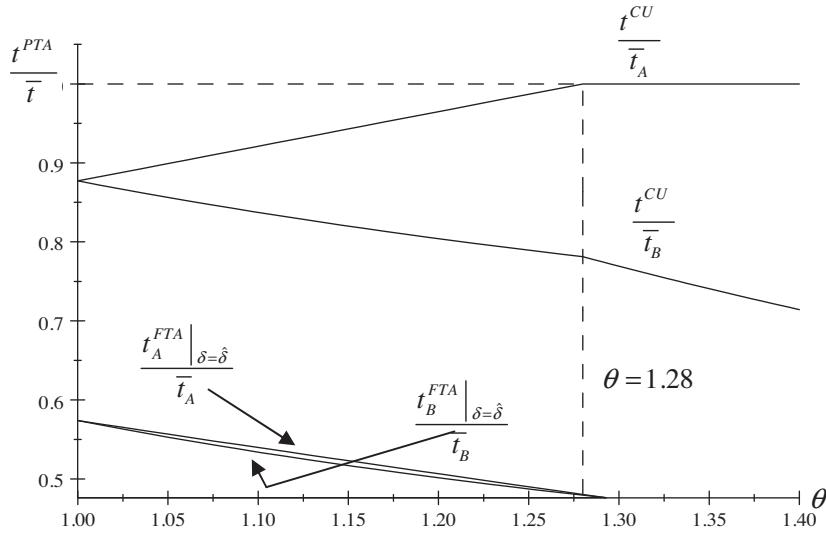


Fig. 1. Tariff reductions under the formation of a PTA.

- (a) $\Pi_B^{CU} > \bar{\Pi}_B$ when $1 < \theta < 1.2056$;
- (b) $\Pi_B^{CU} < \bar{\Pi}_B$ when $1.2056 < \theta < 6.4$.

We summarize the above findings in the following proposition:

Proposition 5. In two asymmetric countries that form a PTA (FTA or CU), intra-bloc firms make more profits under a CU than under an FTA. The big country producer is hurt by an FTA but may be better off in a CU when the degree of market size asymmetry is sufficiently low. The small country producer is better off under a CU but may be hurt by an FTA.

5.3. Effects on a non-member country

In our simple model of trade under oligopoly, the non-member country exports the final good to the region where two asymmetric countries may form an FTA or a CU. Making uses of Eqs. (1)

and (23b), we calculate profits of the outside firm under the three alternative trade regimes:

$$\bar{\Pi}_C = \frac{1}{100}(1 + \theta^2)\alpha_A^2; \tag{39a}$$

$$\Pi_C^{FTA} = \frac{1}{49}(1 + \theta^2)\alpha_A^2 > 0 \quad \text{when } 1 < \theta < 1.2928 \text{ and } 0 < \delta < \hat{\delta}; \tag{39b}$$

$$\Pi_C^{CU} = \begin{cases} \frac{1}{722}(1 + \theta)^2\alpha_A^2 & \text{when } 1 < \theta < 1.28; \\ \frac{(5\theta - 4)^2}{800}\alpha_A^2 & \text{when } 1.28 \leq \theta < 6.4. \end{cases} \tag{39c}$$

It is straightforward to verify the following results:

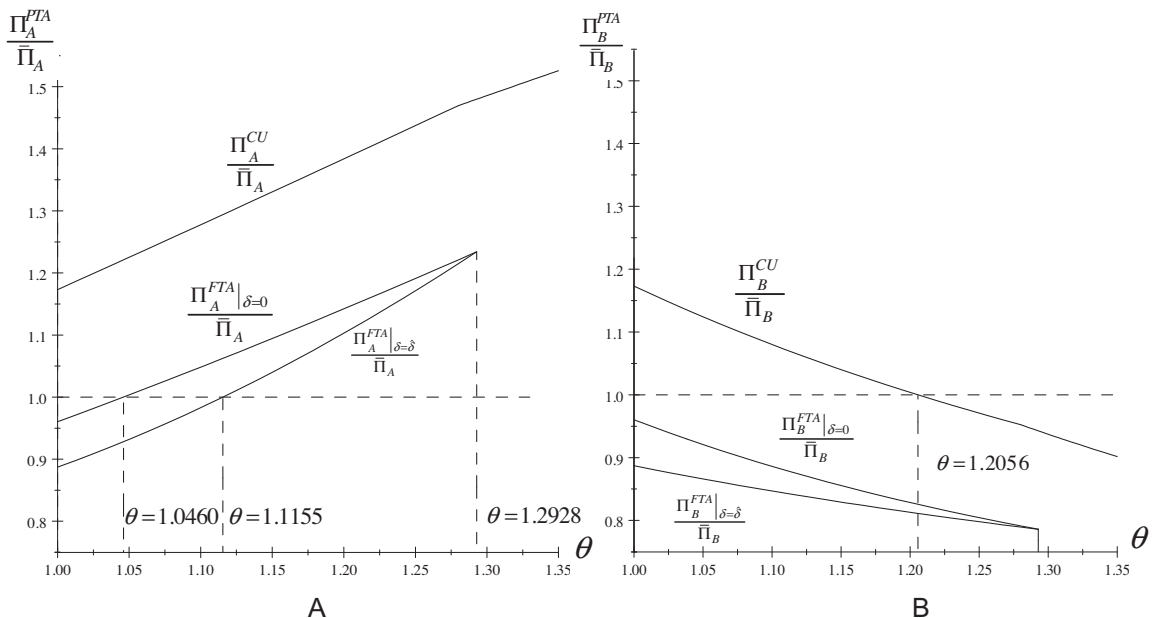


Fig. 2. (a) Producer surplus of country A. (b) Producer surplus of country B.

- (a) $\Pi_C^{FTA} > \Pi_C^{CU}$ and $\Pi_C^{FTA} > \bar{\Pi}_C$ when $1 < \theta < 1.2928$ and $0 < \delta < \hat{\delta}$;
- (b) $\Pi_C^{CU} < \bar{\Pi}_C$ for $1 < \theta < 2.1322$, but $\Pi_C^{CU} > \bar{\Pi}_C$ for $2.1322 \leq \theta < 6.4$.

We thus have

Proposition 6. For the two trade regimes we consider, a non-member country finds it most beneficial when the big and small countries form an FTA. Nevertheless, the non-member country may be negatively affected by a CU when market size asymmetry between the CU members is small.

Forming a PTA has two opposing effects on a non-member country. One effect is positive in that FTA countries unambiguously reduce their external tariffs. The other effect is negative since the non-member country is hurt by the fact that its outside firm's trade costs remain to be higher than those for the inside firms. Proposition 6 indicates that, the positive effect may outweigh the negative effects under a CU when its member countries are similar in their market sizes.

5.4. Effect on consumers in a member country

We know from the previous analysis that the final-good consumption of a member country in an FTA decreases as the ROO-induced trade cost δ increases (see Q_i^{FTA} in Eq. (17)). As a result, we have

$$Q_i^{FTA}|_{\delta=\hat{\delta}} < Q_i^{FTA}|_{0<\delta<\hat{\delta}} < Q_i^{FTA}|_{\delta=0}. \tag{40}$$

Fig. 3(a) and (b) illustrates for the big and small countries the lower and upper limits of the final-good consumption in an FTA, as compared to their pre-FTA consumption levels. We find that this consumption ratio is strictly greater than one. This indicates that, due to tariff reductions and lower trade costs between member countries, each member country's total consumption of the final good increases after forming an FTA. This implies that the FTA formation results in a fall in the market price of the final good, causing consumer surplus in each member country to increase.

Fig. 3(a) and (b) also illustrates for each country the ratio of the final-good consumption after forming a CU, relative to the pre-PTA level. For the big country, this ratio increases as the degree of market size asymmetry increases. Note that this consumption ratio is strictly greater than 1, which means that the final-good consumption increases after forming a CU. For the small country, however, its consumption decreases as the degree of market size asymmetry increases. We show in Appendix A.4 that the consumption ratio for the small country is greater than 1 when $1 < \theta < 1.6$, but is less than 1 when $\theta > 1.6$. These results can be explained as follows. The internal market integration of member countries a CU lowers the final good price in the big country but raises the final good price in the small country when the market size asymmetry is significantly large. As a result, consumers in the big country are better off whereas consumers in the small country are worse off.

If market size asymmetry is not too large ($1 < \theta < 1.2928$), the final-good consumption in the small country is relatively higher under an FTA than under a CU (or without a PTA). This suggests that the small country consumers prefer an FTA over a CU.

For the big county, the relationship in the final-good consumption between the FTA and the CU cannot be determined unambiguously. As shown in Appendix A.5, the levels of the final-good consumption depend crucially on θ and δ . When (i) $1 < \theta < 1.0317$ or (ii) $1.0317 < \theta < 1.2353$ and $((9/19) - (51/133)\theta)\alpha_A < \delta < \hat{\delta}$, the big country consumers are better off under an FTA since $Q_B^{FTA} > Q_B^{CU}$. But when (i) $1.0317 < \theta < 1.2353$

and $0 < \delta < ((9/19) - (51/133)\theta)\alpha_A$ or (ii) $1.2353 < \theta < 1.2929$, the big country consumers are better off under a CU since $Q_B^{CU} > Q_B^{FTA}$.

We summarize the findings of the analyses in the following proposition:

Proposition 7. Forming a welfare-improving FTA with ROO makes consumers in each member country better off. If the degree of market size asymmetry between two member countries is large, the big country consumers are better off under a CU than under an FTA. Although the small country consumers are better off under an FTA than under a CU, they may be worse off in a CU when the market size asymmetry is sufficiently large.

5.5. Effects on welfare of each member country in a trade bloc

We show in the previous section (see Proposition 2) that for each member country, there is a welfare improvement under a CU when $1 < \theta < 6.4$. We now discuss this welfare effect of forming CU in more detail.

For the small country, its producer surplus under a CU is always greater than its pre-PTA producer surplus (see Proposition 5). The small country's consumer surplus decreases as market size asymmetry increases and is greater its pre-PTA level when $1 < \theta < 1.6$. For $\theta > 1.6$, the increase in producer surplus after forming a CU outweighs the decrease in consumer surplus and tariff revenue. This explains why for the small country, social welfare under a CU is unambiguously higher.

But for the big country, the welfare effect of forming a CU cannot be determined unambiguously. Under a CU, producer surplus decreases as market size asymmetry increases and is less than 1 when θ is significantly large. The big country's consumer surplus increases as θ increases. When market size asymmetry is not too large ($1 < \theta \leq 1.8234$) or is large enough ($3.5099 \leq \theta < 6.4$), the increase in consumer surplus outweighs the loss in both producer surplus and tariff revenue. When market size asymmetry is "moderate" ($1.8234 < \theta < 3.5099$) the increase in consumer surplus is more than offset by the decrease in producer surplus. We find that for the big country to improve its social welfare through forming a CU, it needs to collect a sufficient amount of tariff revenues on imports from outside of the trade bloc.

Recall that after forming a CU, the total amount of tariff revenue is given by Eqs. (33e) and (35e). Note that one member country's tariff revenue is maximized when the other one's is zero. We know that each CU member's welfare is an increasing function of its tariff revenue (see Eqs. (33d) and (35d)). Thus,

$$\frac{W_i^{CU}|_{R_i^{CU}=0}}{W_i} \leq \frac{W_i^{CU}|_{R_i^{CU}}}{W_i} \leq \frac{W_i^{CU}|_{R_j^{CU}=0}}{W_i}. \tag{41}$$

We also know that for $1 < \theta < 1.2928$, the FTA welfare is a decreasing function of the ROO-induced trade cost, δ , where $0 < \delta < \hat{\delta}$ (see Eq. (15)). It follows that

$$\frac{W_i^{FTA}|_{\delta=\hat{\delta}}}{W_i} < \frac{W_i^{FTA}|_{0<\delta<\hat{\delta}}}{W_i} < \frac{W_i^{FTA}|_{\delta=0}}{W_i}. \tag{42}$$

Eq. (42) implies that the members of FTA will set a minimal degree of δ if they can choose it freely. It is necessary to discuss how to determine the lowest level of δ , denoted as $\underline{\delta}$, that prevents tariff-circumvention. The reason is that an outside firm can set up its plant in a member country of FTA via FDI to enjoy duty-free treatment within the FTA. We show in Appendix A-X the detailed derivation

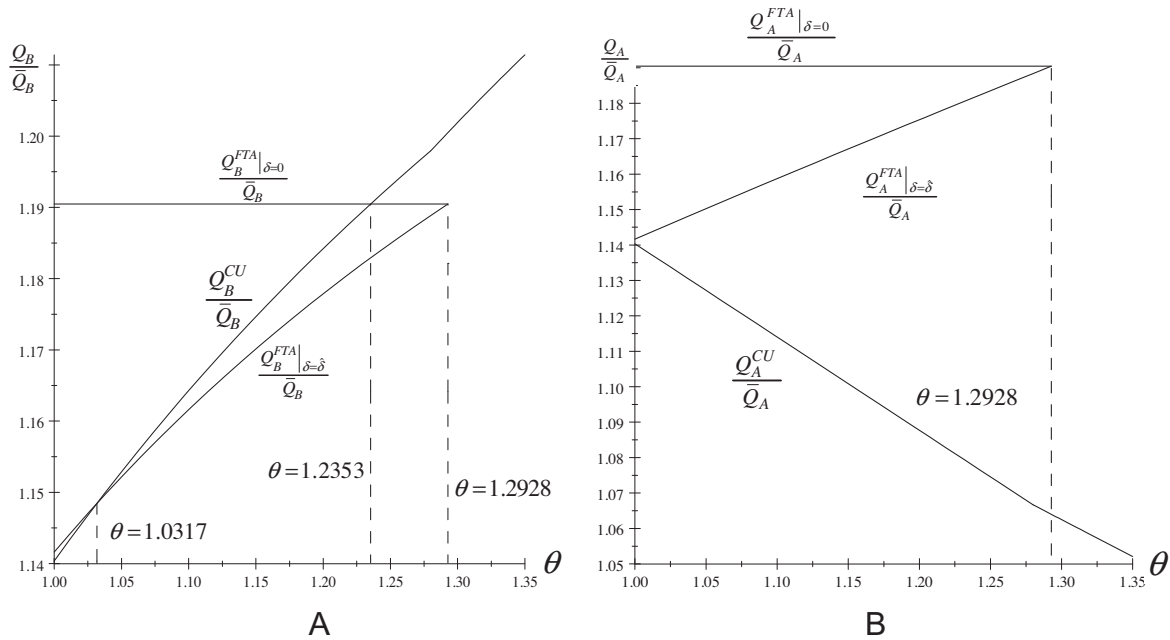


Fig. 3. (a) Total consumption in country B. (b) Total consumption in country A.

of δ that prevents an outside firm’s FDI induced by the FTA. We find that δ decreases in the level of the fixed cost for FDI.¹³

Fig. 4(a) and (b) illustrates the ratios of post-PTA welfare for each member country to its pre-PTA levels. For the big country, the lower limit of the welfare ratio under an FTA is equal to one. The big country prefers a CU over an FTA if $1.0807 < \theta < 1.2928$. For $1 < \theta < 1.0807$, CU formation is a preferred choice to the big country only when its tariff revenue (R_B^{CU}) is significantly large. For an acceptable value of δ , we see from Fig. 4(b) that there is a greater welfare gain to the small country under a CU than under an FTA, provided that its tariff revenue is also significantly large.

But we cannot tell whether both the big and small countries prefer a CU over an FTA at the same time. It depends crucially on the distribution of tariff revenue to the two countries. With internal market integration, we only know the overall tariff revenue collected by the CU (see Eqs. (33e) and (35e)) but not the amount to each individual member. It is interesting to identify the conditions under which both countries are better off under a CU than under an FTA.

This analysis leads to the following proposition:

Proposition 8. Whether there will be a greater welfare improvement for two asymmetric countries under a CU than under an FTA cannot be determined unambiguously. But if each participating country is able to collect a sufficient amount of tariff revenue, forming a CU is a preferred choice over forming an FTA.

Proof. See Appendix A.7. ■

Proposition 8 implies that the distribution of tariff revenue plays a role in affecting a member country’s welfare when there is internal market integration in a CU.

Note that due to the market integration, the distribution of tariff revenue under CU between the two members is undetermined, and manipulating the distribution of tariff revenue works as a “transfer” among members. This means that we can arrange the distribution

of tariff revenue so that all member countries become better off if one member of CU becomes worse off without tariff revenue (i.e., the case under $1.8234 \leq \theta \leq 3.5099$). Such arrangement is always feasible since $\hat{R}_B^{CU} < R_{AB}^{CU}$.

5.6. Effects on global welfare

Finally, we examine differences between an FTA and a CU in terms of their effects on the overall welfare of the three-country world. In our setting, global welfare is defined as the sum of social welfare in the two member countries and producer surplus in the non-member country. Denoting global welfare for the pre-PTA, FTA, and CU cases as \bar{W}_G , W_G^{FTA} , and W_G^{CU} , we have

$$\bar{W}_G = \bar{W}_A + \bar{W}_B + \bar{\Pi}_C \text{ and } W_G^m = W_A^m + W_B^m + \Pi_C^m, \tag{43}$$

where $m = \text{FTA, CU}$.

We first calculate the pre-PTA level of global welfare by substituting \bar{W}_i and $\bar{\Pi}_i$ in (9) into \bar{W}_G in Eq. (43) to obtain

$$\bar{W}_G = \bar{W}_A + \bar{W}_B + \bar{\Pi}_C = \frac{21}{50}(1 + \theta^2)\alpha_A^2. \tag{44}$$

We then calculate the FTA level of global welfare by substituting W_i^{FTA} and Π_i^{FTA} in (17) into W_G^{FTA} in Eq. (43) to obtain

$$\begin{aligned} W_G^{FTA} &= W_A^{FTA} + W_B^{FTA} + \Pi_C^{FTA} \\ &= \left\{ \frac{11}{9} \left[\frac{\delta}{\alpha_A} - \frac{12}{77}(1 + \theta) \right]^2 + \frac{463}{1078}\theta^2 - \frac{32}{539}\theta + \frac{463}{1078} \right\} \alpha_A^2. \end{aligned} \tag{45}$$

For the case in which market size asymmetry is not too large ($1 < \theta < 1.2928$), the FTA level of global welfare decreases as δ increases for $0 < \delta < \hat{\delta}$. That is,

$$W_G^{FTA}|_{\delta=\hat{\delta}} < W_G^{FTA}|_{0 < \delta < \hat{\delta}} < W_G^{FTA}|_{\delta=0}. \tag{46}$$

We use Fig. 5 to illustrate the lower and upper limits of global welfare under an FTA. For $0 < \delta < \hat{\delta}$, the post-FTA global welfare increases with the degree of market size asymmetry, θ . Even though the big country welfare decreases, when θ is critically larger, the

¹³ The calculation of $\hat{\delta}$ that prevents tariff-circumvention was due to an anonymous reviewer’s insightful suggestion. The reviewer also suggested that we link $\hat{\delta}$ to the level of the fixed cost for FDI.

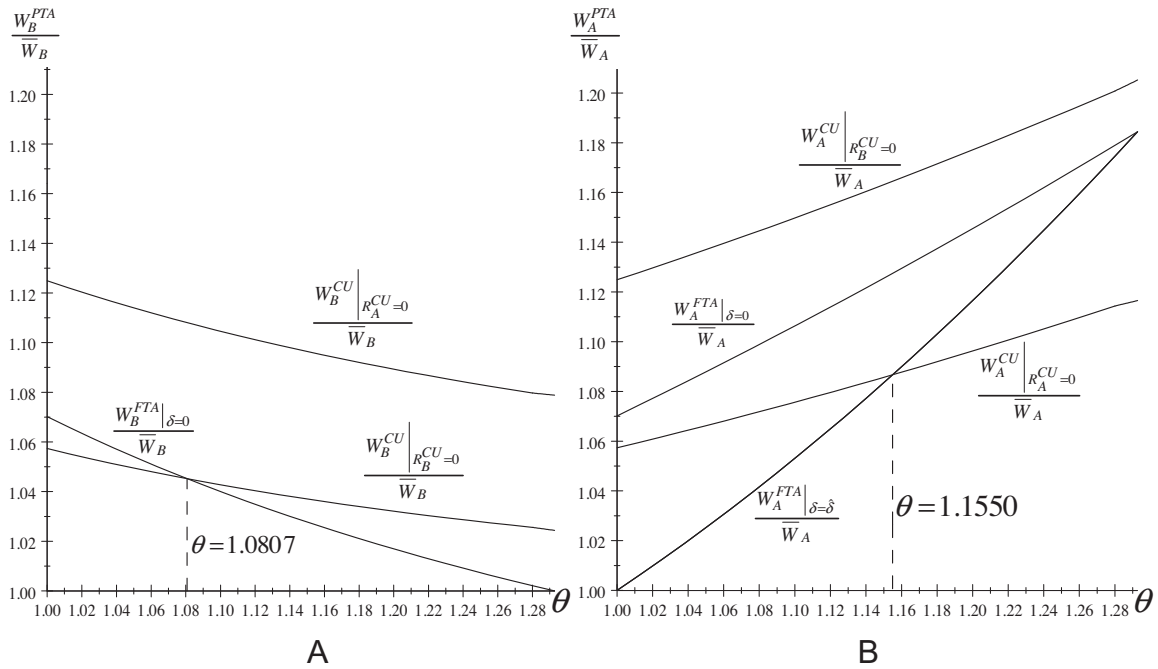


Fig. 4. (a) Social welfare of country B. (b) Social welfare of country A.

increase in the sum of the small country's welfare and the non-member country's producer surplus outweighs the decrease in the big country's welfare.

Next, we calculate the CU level of global welfare by substituting Eqs. (33d) and (35d) into W_G^{CU} in Eq. (43) to obtain

$$W_G^{CU} = W_A^{CU} + W_B^{CU} + \Pi_C^{CU} = \begin{cases} \frac{343\theta^2 - 360\theta + 343}{722} \alpha_A^2 & \text{when } 1 < \theta < 1.28, \\ \frac{775\theta^2 - 80\theta + 736}{1600} \alpha_A^2 & \text{when } 1.28 \leq \theta < 6.4. \end{cases} \quad (47)$$

As illustrated in Fig. 5, global welfare increases with the degree of market size asymmetry under a CU. Even though the big country welfare decreases, when the value of θ is larger, the increase in the sum of the small country welfare and the non-member country

producer surplus outweighs the decrease in the big country welfare.

We find that there is an overall welfare improvement for the three-country world, regardless of whether the two asymmetric countries form an FTA or a CU. As for welfare comparison between the two trade regimes, we find conditions under which global welfare is higher under an FTA than under a CU. That is, $W_G^{FTA} > W_G^{CU}$ when (i) $1.2036 < \theta < 1.2928$ or (ii) when $1 < \theta < 1.2036$ and $0 < \delta < [(12/77)(\theta + 1) - 0.19309\sqrt{\theta^2 + (1850/8867)\theta + 1}] \alpha_A$. We thus have

Proposition 9. World welfare improves when the big and small countries form a PTA (either FTA or CU), other things being equal. World welfare is greater under an FTA than under a CU if either one of the following conditions is satisfied:

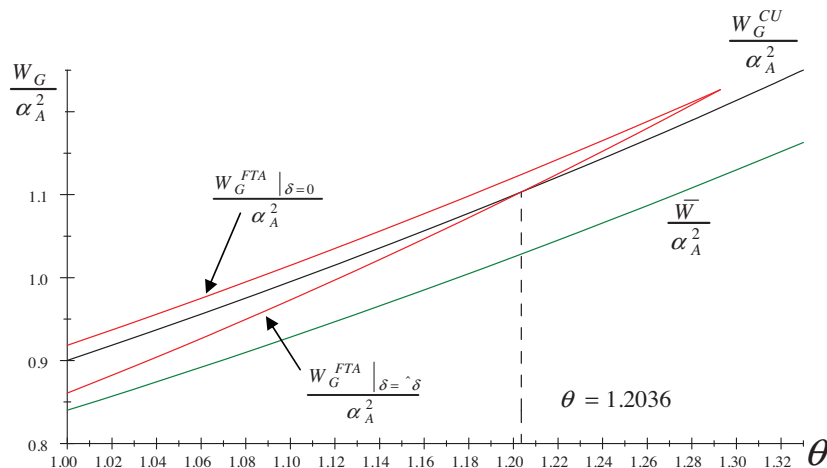


Fig. 5. Global welfare under the alternative trade regimes.

- (a) The market size asymmetry is “moderate”(i.e., $1.2036 < \theta < 1.2928$);
- (b) The ROO-induced trade cost is small.

It has been observed that FTAs are the prevalent types of preferential trading agreements (World Bank, 2005). From the perspective of world welfare, the finding in Proposition 9 may help explain conditions under which such an observation would emerge.

6. Concluding remarks

In this paper, we have presented a simple model of international oligopoly to analyze the conditions under which there are welfare gains from forming a PTA for countries differing in their market sizes. These conditions are shown to depend on the degree of market size symmetry between trade partners, the form of trade agreement as either an FTA or a CU, and preferential ROO in an FTA. Note that ROO are indispensable to the formation of an effective FTA. Without preferential ROO, products from non-member countries could enter an FTA partner with the lowest external tariff and then serve another FTA member where external tariff is higher. Preferential ROO may prevent trade deflection and ensure that each FTA member maintains

its independence in external trade policy. Nevertheless, ROO require that firms exporting within an FTA use a certain proportion of relatively expensive regional inputs to be eligible for duty-free treatment. As a consequence, ROO reduce efficiency in production for exports. Cautions should be taken in implementing preferential ROO as they involve the effectiveness and efficiency of an FTA.

We have also discussed differences in welfare implications between an FTA with ROO and a CU. In examining the welfare effect of an FTA, we incorporate into the analyses the decisions of intra-bloc exporters in complying with ROO. We find that the formation of an effective FTA with ROO is welfare-improving when market size differential between asymmetric members is not too large and ROO are less restrictive. Despite that the present study is theoretical in nature, it has interesting policy implications. Although ROO are indispensable in an FTA to prevent tariff-circumvention, policymakers and administrators should make efforts to lower trade costs associated with ROO. In the case of Japan in forming FTAs with other countries, the costs of obtaining the certificate of origin should be reduced. As indicated by Takahashi and Urata (2010), this can be done by minimizing the procedure and by offering assistance to exporting firms which do not have a large amount of human and financial resources. The authors further suggest that Japan as a major economic power should establish FTAs with countries (such as China, the U.S. and the E.U.) where markets are large and should obtain tariff reductions for products with high tariff rates. The economic reason is that such FTAs between countries similar in market sizes help increase the FTA utilization rate and benefit Japanese firms and economy.

We also find that the formation of PTA (either an FTA or a CU) is more likely to emerge between countries of similar in their market sizes, ceteris paribus. Remarkably, forming a welfare-improving CU allows for a greater degree of market size asymmetry than forming a welfare-improving FTA. Using the pre-PTA equilibrium tariffs as a reference base, we find that tariff reductions are relatively greater in an FTA than in a CU. This implies that a non-member country is relatively better off under an FTA than under a CU. For the case

in which market size asymmetry is moderate and ROO are not too restrictive, global welfare is higher under an FTA than under a CU.

It should be mentioned that several important factors are ignored, which point to the potentially interesting extensions of the analysis. A possible extension is to incorporate production differentiation into the oligopolistic model to analyze how the intensity of competition in the final-good markets affects welfare implications between an FTA with ROO and a CU. Our analysis also abstracts from the consideration of possible interactions between interest groups and government.¹⁴ Trade liberalization without preferential treatments may not always be politically feasible, once one looks at how active interest groups may have in lobbying government for protections. It might be interesting to see how the political feasibility of forming a regional trade agreement is affected by market size asymmetry between member countries.

Appendix A.

A.1. The constrained welfare maximization problem under an FTA

The mathematical model of choosing t_i^{FTA} to maximize W_i^{FTA} in Eq. (13), subject to the ROO-complying condition, the welfare-improving condition, and the production constraints is:

$$\begin{aligned} \max_{\{t_i^{FTA}\}} W_i^{FTA} &= \frac{1}{32} \left[-21(t_i^{FTA})^2 + (14\delta + 6\alpha_i)(t_i^{FTA}) + 3\delta^2 + 11\alpha_i^2 - 2\delta\alpha_i \right] + \left(\frac{\alpha_j + t_j^{FTA} - 3\delta}{4} \right)^2 \\ \text{subject to } t_i^{FTA} &> \delta, \alpha_i + \delta - 3t_i^{FTA} > 0, \alpha_i - 3\delta + t_i^{FTA} > 0, \text{ and } W_i^{FTA} > \bar{W}_i. \end{aligned}$$

For the big country, we solve this problem by the Kuhn–Tucker method and find that its optimal tariff exists only when the following conditions hold:

$$1 \leq \theta < 1.2928 \text{ and } 0 < \delta < \hat{\delta},$$

$$\text{where } \hat{\delta} = \alpha_A \left(\frac{24}{77} - \sqrt{\frac{27}{385}\theta^2 - \frac{5949}{296450}} \right).$$

The optimal tariff is $t_B^{FTA} = (1/7)\alpha_B + (1/3)\delta$.

For the small country, when $1 < \theta < 1.2928$ and $0 < \delta < \hat{\delta}$, the solution of maximizing W_B^{FTA} is $t_A^{FTA} = (1/7)\alpha_A + (1/3)\delta$. It is straightforward to prove that the ROO-complying condition, the welfare-improving condition, and the production constraints are all satisfied. Thus, when $1 < \theta < 1.2928$ and $0 < \delta < \hat{\delta}$, the optimal tariff set by the small country always exists and is equal to $t_A^{FTA} = (1/7)\alpha_A + (1/3)\delta$. Unlike the big country, which has its optimal tariff rate only when $1 < \theta < 1.2928$ and $0 < \delta < \hat{\delta}$, the conditions for the small country to have an optimal solution are weaker.

A.2. Profits of firms under an FTA

When $1 < \theta < 1.2928$ and $0 < \delta < \hat{\delta}$, the small country producer surplus under an FTA is:

$$\Pi_A^{FTA} = \left(\frac{2}{7}\alpha_A + \frac{1}{3}\delta \right)^2 + \left(\frac{2}{7}\theta\alpha_A - \frac{2}{3}\delta \right)^2.$$

¹⁴ Grossman and Helpman (1995) further examined the political viability of FTAs when two countries negotiate a free-trade agreement. Based on a political-economy framework, in which industrial interest groups attempt to influence their government, the authors show that an FTA can be an equilibrium outcome. For further contributions on FTA formation and interest group politics see, e.g., Krishna (1998), Maggi and Rodríguez-Clare (1998), Mitra (2002) and Ornelas (2005).

It is straightforward to prove that Π_A^{FTA} is an increasing function of δ ($0 < \delta < \hat{\delta}$), when $1 < \theta < 1.2928$. For θ such that $1 < \theta < 1.2928$, we have

$$\Pi_A^{FTA}|_{\delta=0} = \Pi_A^{FTA}|_{0 < \delta < \hat{\delta}} = \Pi_A^{FTA}|_{\delta=\hat{\delta}}$$

Before forming any form of a PTA, the small country producer surplus is:

$$\bar{\Pi}_A = \left(\frac{4}{25} + \frac{1}{100}\theta^2 \right) \alpha_A^2$$

It is easy to prove that when $1 < \theta < 1.0460$, $\Pi_A^{FTA}|_{\delta=\hat{\delta}} < \bar{\Pi}_A$. Since Π_A^{FTA} is an increasing function of δ for $0 < \delta < \hat{\delta}$, we have $\Pi_A^{FTA}|_{0 < \delta < \hat{\delta}} < \bar{\Pi}_A$ when $1 < \theta < 1.0460$. It is also easy to derive the result that $\Pi_A^{FTA}|_{\delta=0} > \bar{\Pi}_A$ when $1.1155 < \theta < 1.2928$. Given that $\Pi_A^{FTA}|_{0 < \delta < \hat{\delta}} > \Pi_A^{FTA}|_{0 < \delta < \hat{\delta}}$, we have

$$\Pi_A^{FTA}|_{0 < \delta < \hat{\delta}} > \bar{\Pi}_A \quad \text{when } 1.1155 < \theta < 1.2928.$$

It follows that $\Pi_A^{FTA}(\delta) = \bar{\Pi}_A$ is solvable when $1.0460 < \theta < 1.1155$. There are two possible solutions:

$$\tilde{\delta} = \left[\frac{6}{35}(2\theta - 1) - \frac{9}{10} \sqrt{-\frac{31}{2205}\theta^2 - \frac{64}{441}\theta + \frac{464}{2205}} \right] \alpha_A$$

and

$$\tilde{\delta}' = \left[\frac{6}{35}(2\theta - 1) + \frac{9}{10} \sqrt{-\frac{31}{2205}\theta^2 - \frac{64}{441}\theta + \frac{464}{2205}} \right] \alpha_A.$$

We find that

$$0 < \tilde{\delta} < \hat{\delta} < \tilde{\delta}' \quad \text{when } 1.0460 < \theta < 1.1155.$$

Given that Π_A^{FTA} increases with δ for $0 < \delta < \hat{\delta}$ and $1 < \theta < 1.2928$, we conclude that when $1.0460 < \theta < 1.1155$, the following results hold:

$$(i) \Pi_A^{FTA} < \bar{\Pi}_A \quad \text{if } 0 < \delta < \tilde{\delta} \quad \text{and} \quad (ii) \Pi_A^{FTA} > \bar{\Pi}_A \quad \text{if } \tilde{\delta} < \delta < \hat{\delta}.$$

A.3. Firm profits in the big country under a CU

When $1 < \theta < 1.64$, the CU level of optimal profit for the firm in the big country is:

$$\Pi_B^{CU} = \begin{cases} \frac{18}{361}(1 + \theta)^2 \alpha_A^2 & \text{if } 1 < \theta < 1.28; \\ \left(\frac{1}{32}\theta^2 + \frac{1}{10}\theta + \frac{2}{25} \right) \alpha_A^2 & \text{if } 1.28 \leq \theta < 6.4. \end{cases}$$

Without forming any type of a PTA, the optimal profit for the firm in the big country is:

$$\bar{\Pi}_B = \left(\frac{4}{25}\theta^2 + \frac{1}{100} \right) \alpha_A^2.$$

The difference between Π_B^{CU} and $\bar{\Pi}_B$ is:

$$\Pi_B^{CU} - \bar{\Pi}_B = \begin{cases} \frac{1}{36100}(-3976\theta^2 + 3600\theta + 1439)\alpha_A^2 & \text{when } 1 < \theta < 1.28; \\ \frac{1}{800}(-103\theta^2 + 80\theta + 56)\alpha_A^2 & \text{when } 1.28 \leq \theta < 6.4. \end{cases}$$

It is straightforward to prove that the profit differential, $\Pi_B^{CU} - \bar{\Pi}_B$, decreases as θ increases when $1 < \theta < 6.4$. By setting $\Pi_B^{CU} - \bar{\Pi}_B = 0$, we have the solution of $\theta = 1.2056$. Given that $(\Pi_B^{CU} - \bar{\Pi}_B)$

is a decreasing function of θ , there are two possibilities:

- (i) $\Pi_B^{CU} > \bar{\Pi}_B$ when $1 < \theta < 1.2056$;
- (ii) $\Pi_B^{CU} < \bar{\Pi}_B$ when $1.2056 < \theta < 6.4$.

A.4. The proof that the consumption ratio for the small country is greater than 1 when $1 < \theta < 1.6$, but is less than 1 when $\theta > 1.6$

When $1 < \theta < 6.4$, the CU level of total consumption in the small country is:

$$Q_A^{CU} = \begin{cases} \left(\frac{16}{19} - \frac{3}{19}\theta \right) \alpha_A & \text{if } 1 < \theta < 1.28; \\ \left(\frac{4}{5} - \frac{1}{8}\theta \right) \alpha_A & \text{if } 1.28 \leq \theta < 6.4. \end{cases}$$

The pre-PTA level of total consumption in the small country is:

$$\bar{Q}_A = \frac{3}{5}\alpha_A.$$

When $1 < \theta < 6.4$, the ratio of total consumption under CU over total consumption under a FTA for the small country is:

$$\frac{Q_A^{CU}}{\bar{Q}_A} = \begin{cases} \frac{80}{57} - \frac{5}{19}\theta & \text{if } 1 < \theta < 1.28; \\ \frac{4}{3} - \frac{5}{24}\theta & \text{if } 1.28 \leq \theta < 6.4. \end{cases}$$

It follows that Q_A^{CU}/\bar{Q}_A is a decreasing function of θ ($1 < \theta < 6.4$) as shown in Fig. 3(b). By solving $Q_A^{CU}/\bar{Q}_A = 1$ we have $\theta = 1.6$. Given that Q_A^{CU}/\bar{Q}_A decreases with θ , when $1 < \theta < 6.4$, we have Q_A^{CU}/\bar{Q}_A being greater than 1 for $1 < \theta < 1.6$. But Q_A^{CU}/\bar{Q}_A is less than 1 for $1.6 < \theta < 6.4$.

A.5. The proof that the levels of the final-good consumption depend crucially on θ and δ

When $1 < \theta < 6.4$, the CU level of total consumption in the big country is:

$$Q_B^{CU} = \begin{cases} \left(\frac{16}{19}\theta - \frac{3}{19} \right) \alpha_A & \text{if } 1 < \theta < 1.28; \\ \left(\frac{7\theta}{8} - \frac{1}{5} \right) \alpha_A & \text{if } 1.28 \leq \theta < 6.4. \end{cases}$$

When $1 < \theta < 1.2928$ and $0 < \delta < \hat{\delta}$, the Pre-PTA level of total consumption in the big country is:

$$Q_B^{FTA} = \frac{5}{7}\theta\alpha_A - \frac{1}{3}\delta.$$

It is clear that for given θ , where $1 < \theta < 1.2928$, Q_B^{FTA} decreases with as δ increases. Thus, we have

$$Q_B^{FTA}|_{\delta=\hat{\delta}} < Q_B^{FTA}|_{0 < \delta < \hat{\delta}} < Q_B^{FTA}|_{\delta=0}.$$

It is easy to verify that when $1 \leq \theta < 1.0317$, $Q_B^{FTA}|_{\delta=\hat{\delta}} > Q_B^{CU}$. Since Π_B^{FTA} is a decreasing function of δ , we have $Q_B^{FTA}|_{0 < \delta < \hat{\delta}} > Q_B^{CU}$, when $1 < \theta < 1.0317$. It is also straightforward to show that $Q_B^{FTA}|_{\delta=0} < Q_B^{CU}$ when $1.2353 < \theta < 1.2929$. Given $Q_B^{FTA}|_{0 < \delta < \hat{\delta}} < \Pi_A^{FTA}|_{\delta=0}$, we have $Q_B^{FTA}|_{0 < \delta < \hat{\delta}} < Q_B^{CU}$, when $1.2353 < \theta < 1.2929$.

When $1.0317 < \theta < 1.2353$, the relationship between Q_B^{FTA} and Q_B^{CU} cannot be determined unambiguously. Solving $Q_B^{FTA}|_{0 < \delta < \hat{\delta}} = Q_B^{CU}$ gives $\delta = ((9/19) - (51/133)\theta)\alpha_A$. Thus when $1.0317 < \theta < 1.2353$ and $((9/19) - (51/133)\theta)\alpha_A < \delta < \hat{\delta}$, we have $Q_B^{FTA} > Q_B^{CU}$. But

when $1.0317 < \theta < 1.2353$ and $0 < \delta < ((9/19) - (51/133)\theta)\alpha_A$, we have $Q_B^{CU} > Q_B^{FTA}$.

A.6. The lowest level of the ROO-induced trade cost that prevents tariff-circumvention

The outside firm from country C may undertake foreign direct investment (FDI) in order to enjoy duty-free treatment within the FTA. We denote this case as FTA-FDI. It is then necessary to discuss how to determine the lowest level of δ , denoted as $\underline{\delta}$, that prevents such a tariff-circumvention.

Given that the market is bigger in country B, the outside firm chooses to locate its production plant there. Let the fixed cost of setting up the plant be denoted as ϕ . In this FTA-FDI case, we have the following trade cost conditions: $c_{ii} = 0$, $c_{AC} = c_{ij} = \delta$, and $c_{BC} = 0$.

The profit function of firm C is:

$$\Pi_C^{FTA-FDI} = (p_A^{FTA-FDI} - \delta)q_{AC}^{FTA-FDI} + (p_B^{FTA-FDI})q_{BC}^{FTA-FDI} - \phi,$$

where

$$p_A^{FTA-FDI} = \alpha_A - (q_{AA}^{FTA-FDI} + q_{AB}^{FTA-FDI} + q_{AC}^{FTA-FDI}) \quad \text{and}$$

$$p_B^{FTA-FDI} = \alpha_B - (q_{BB}^{FTA-FDI} + q_{BA}^{FTA-FDI} + q_{BC}^{FTA-FDI}).$$

The profit functions of firms A and B are:

$$\Pi_A^{FTA-FDI} = (p_A^{FTA-FDI})q_{AA}^{FTA-FDI} + (p_B^{FTA-FDI} - \delta)q_{BA}^{FTA-FDI},$$

$$\Pi_B^{FTA-FDI} = (p_A^{FTA-FDI} - \delta)q_{AB}^{FTA-FDI} + (p_B^{FTA-FDI})q_{BB}^{FTA-FDI}.$$

The FOCs for the firms are given as follows:

$$\alpha_A - (q_{AA}^{FTA-FDI} + q_{AB}^{FTA-FDI} + q_{AC}^{FTA-FDI}) - \delta - q_{AC}^{FTA-FDI} = 0,$$

$$\alpha_B - (q_{BB}^{FTA-FDI} + q_{BA}^{FTA-FDI} + q_{BC}^{FTA-FDI}) - q_{BC}^{FTA-FDI} = 0,$$

$$\alpha_A - (q_{AA}^{FTA-FDI} + q_{AB}^{FTA-FDI} + q_{AC}^{FTA-FDI}) - q_{AA}^{FTA-FDI} = 0,$$

$$\alpha_B - (q_{BB}^{FTA-FDI} + q_{BA}^{FTA-FDI} + q_{BC}^{FTA-FDI}) - \delta - q_{BA}^{FTA-FDI} = 0,$$

$$\alpha_A - (q_{AA}^{FTA-FDI} + q_{AB}^{FTA-FDI} + q_{AC}^{FTA-FDI}) - \delta - q_{AB}^{FTA-FDI} = 0,$$

$$\alpha_B - (q_{BB}^{FTA-FDI} + q_{BA}^{FTA-FDI} + q_{BC}^{FTA-FDI}) - q_{BB}^{FTA-FDI} = 0.$$

Solving the equilibrium levels of outputs by the firms yields

$$q_{AA}^{FTA-FDI} = \frac{\alpha_A + 2\delta}{4}, \quad q_{AC}^{FTA-FDI} = q_{AB}^{FTA-FDI} = \frac{\alpha_A - 2\delta}{4},$$

$$q_{BA}^{FTA-FDI} = \frac{\alpha_B - 3\delta}{4}, \quad q_{BB}^{FTA-FDI} = q_{BC}^{FTA-FDI} = \frac{\alpha_B + \delta}{4}.$$

We calculate the equilibrium profit for firm C in the FTA-FDI case as

$$\Pi_C^{FTA-FDI} = (q_{AC}^{FTA-FDI})^2 + (q_{BC}^{FTA-FDI})^2 - \phi$$

$$= \frac{5}{16}\delta^2 + \frac{1}{8}(\alpha_B - 2\alpha_A)\delta + \frac{1}{16}(\alpha_A^2 + \alpha_B^2) - \phi.$$

To prevent the outside firm from undertaking FDI within the FTA, the ROO-induced trade cost δ must be at a level that makes the FTA is unprofitable. That is, $\Pi_C^{FTA-FDI} - \Pi_C^{FTA} < 0$ where $\Pi_C^{FTA} = (1/49)(1 + \theta^2)\alpha_A^2$. Calculating the profit difference, we have t

$$\Pi_C^{FTA-FDI} - \Pi_C^{FTA} = \frac{5}{16}\delta^2 + \frac{1}{8}(\theta - 2)\delta\alpha$$

$$+ \frac{1}{16}(1 + \theta^2)\alpha^2 - \frac{1}{49}(1 + \theta^2)\alpha^2 - \phi.$$

Assuming that the set-up cost ϕ and the market size α satisfy the following simple relationship: $\phi = f\alpha^2$, where $f > 0$. Rewriting the above profit difference yields

$$\Pi_C^{FTA-FDI} - \Pi_C^{FTA} = \frac{5}{16}\delta^2 + \frac{1}{8}(\theta - 2)\alpha\delta + \left[\frac{33}{784}(1 + \theta^2) - f\right]\alpha^2 < 0.$$

When ϕ is large enough such that $\phi > ((29/980)\theta^2 + (1/20)\theta - (31/3920))\alpha^2$, we can find the range of the ROO-induced trade cost which makes $\Pi_C^{FTA-FDI}$ to be lower than Π_C^{FTA} . That is, we have $\Pi_C^{FTA-FDI} - \Pi_C^{FTA} < 0$ when $\underline{\delta} < \delta < \bar{\delta}$ where

$$\underline{\delta} = \frac{1}{5}\alpha \left(2 - \theta - \frac{\sqrt{31 - 116\theta^2 - 196\theta + 3920f}}{7} \right) \quad \text{and}$$

$$\bar{\delta} = \frac{1}{5}\alpha \left(2 - \theta + \frac{\sqrt{31 - 116\theta^2 - 196\theta + 3920f}}{7} \right).$$

Note that the lowest value of δ , $\underline{\delta}$, is decreasing in the level of the outside firm's fixed cost for FDI.

A.7. Proof of Proposition 6

With the formation of an FTA, the welfare of country i ($=A, B$) is:

$$W_i^{FTA} = \frac{1}{32}[-21(t_i^{FTA})^2 + (14\delta + 6\alpha_i)(t_i^{FTA}) + 3\delta^2 + 11\alpha_i^2 - 2\delta\alpha_i]$$

$$+ \left(\frac{\alpha_j + t_j^{FTA} - 3\delta}{4} \right)^2.$$

It is easy to verify that $\partial W_i^{FTA} / \partial t_i^{FTA} < 0$ when $0 < \delta < \hat{\delta}$. This implies that for any δ ($0 < \delta < \hat{\delta}$), we have

$$\max W_i^{FTA}(\delta) = W_i^{FTA}(\delta = 0) = \frac{5}{14}\alpha_i^2 + \frac{4}{49}\alpha_j^2.$$

With the formation of a CU, instead, the levels of welfare for the two countries are:

$$W_A^{CU} = \begin{cases} \frac{(45\theta^2 - 24\theta + 292)}{722}\alpha_A^2 + R_A^{CU} & \text{when } 1 < \theta < 1.28; \\ \frac{(25\theta^2 + 256)}{640}\alpha_A^2 + R_A^{CU} & \text{when } 1.28 \leq \theta < 6.4. \end{cases}$$

$$W_B^{CU} = \begin{cases} \frac{(45\theta^2 - 24\theta + 292)}{722}\alpha_A^2 + R_B^{CU} & \text{when } 1 < \theta < 1.28; \\ \frac{(265\theta^2 - 48\theta + 64)}{640}\alpha_A^2 + R_B^{CU} & \text{when } 1.28 \leq \theta < 6.4. \end{cases}$$

We compare W_i^{CU} and $\max W_i^{FTA}(\delta)$ for $1 < \theta < 1.2928$ and find that each member country has to collect a sufficient amount of tariff revenue to achieve a welfare improvement from forming a CU. That is, $W_i^{CU} > \max W_i^{FTA}(\delta)$ when $R_i^{CU} > \hat{R}_i^{CU}$, where

$$\hat{R}_A^{CU} = \begin{cases} \frac{683\theta^2 + 1176\theta - 1673}{35378}\alpha_A^2 & \text{if } 1 < \theta < 1.28; \\ \frac{1335\theta^2 - 1344}{31360}\alpha_A^2 & \text{if } 1.28 \leq \theta < 1.2928, \end{cases}$$

and

$$\hat{R}_B^{CU} = \begin{cases} \frac{-1673\theta^2 + 1176\theta + 683}{35378}\alpha_A & \text{if } 1 < \theta < 1.0807; \\ 0 & \text{if } 1.0807 \leq \theta < 1.2928. \end{cases}$$

Note that $(\hat{R}_A^{CU} + \hat{R}_B^{CU})$ is less than the total quantity of the final good imported to CU when $1 < \theta < 1.2928$.

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