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Country Size, Geographical Closeness and the Choice of Partner Countries in Forming Preferential Trade Agreements*

By

Masahiro Endoh

Abstract

This paper investigates the choice of partner countries in forming Preferential Trade Agreements (PTAs), analyzes two "syndromes" of regionalism, and shows the results of multi-country computer simulation. The following main conclusions are obtained. First, countries that are geographically close are likely to form PTAs. Secondly, the greater the economic size of the home country, the stronger its "syndromes" are and the smaller the geographical size of the PTA is. Thirdly, large countries prefer forming PTAs, while small countries prefer worldwide free trade, that means PTAs have a malign impact on multilateral trade negotiations.

Key Words

Preferential Trade Agreements, Free Trade Areas, Customs Unions.

1. Introduction

Two upsurges of "regionalism" exist in the post World War II period. The first upsurge of regionalism was stimulated by an attempt to form a common market in Europe in the 1950s, while the second, emerging in the late 1980s, was incarnated as various movements of regional economic organizations, such as the formation of the European Union (EU) and its enlargement to the north and east, the North American Free Trade Agreement (NAFTA), and the Mercosur customs union. In the 1990s, regionalism flourished to such an extent that it was considered a menace to "multilateralism" which promotes global free trade, based on the most-favored-nation (MFN) clause principle. That was established through the effort of the General Agreement on Tariff and Trade (GATT) or the World Trade Organization (WTO).

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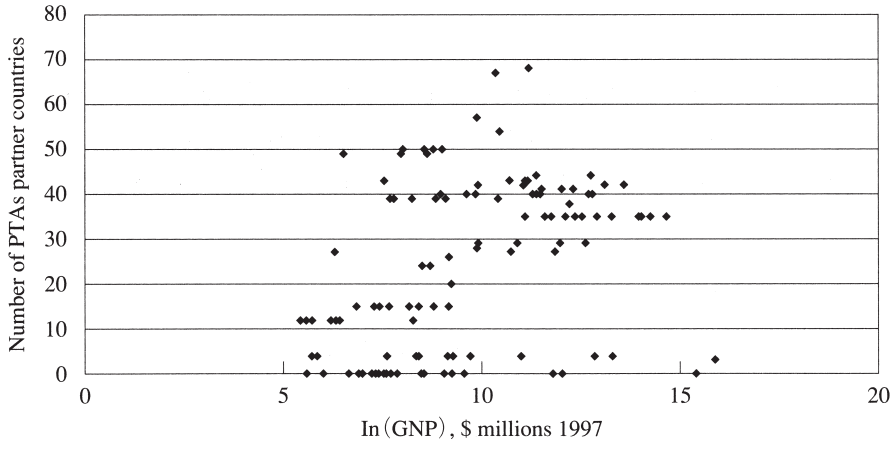
Figure 1: Countries' GNP and the number of their PTAs partner countries



In the context of international trade, "regionalism" is usually considered as the trend toward freeing regional trade by forming Preferential Trade Agreements (PTAs) such as Free Trade Areas (FTAs) or Customs Unions (CUs). In a FTA, member countries remove trade impediments among themselves but maintain their own commercial policies toward non-members. A CU goes a step further by establishing a common trade policy towards non-members. According to WTO, among the 134 members, excluding the European Communities (EC), 110 countries conclude PTAs with other countries, as of November 1999. Concerning the number of PTAs, out of the 198 PTAs reported to the GATT/WTO, 119 are presently in force. Moreover, it is interesting that all developed countries except Japan belong to PTAs[1]. Figure 1 shows the number of PTA partner countries belonging to WTO plotted against their gross national product (GNP)[2]. The ordinate indicates the number of PTA partners to each country, not the number of PTAs formed. For example, EC is a member of WTO and is composed of 15 countries. Each one of its member countries is considered to have concluded PTAs with the other 14 member countries, whereas any non-EC country concluding a PTA with EC counts it as concluding with 15 countries. The abscissa indicates the natural logarithm of each country's GNP in 1997. This figure shows the tendency, though it is not clear, that countries with medium size of GNP conclude PTAs with a large number of countries, compared to countries whose GNPs are both large and small.

To explain this tendency, it may be useful to employ the idea of two "syndromes" of regionalism, proposed by Bhagwati (1993) and Bhagwati and Panagariya (1996). PTAs are under pressure not to expand when the governments of member countries feel that "we already have a large market, so what do we stand to gain by going through the hassle of adding more members?" This is called "our market is large

[1]Information of PTAs presented in this paragraph is from WTO Website (http://www.wto.org/). Some of these 119 PTAs "in force" may be PTAs on paper only.

[2]The figure consists of 120 countries which are members of WTO as well as whose GNP data are available from the *World Bank Atlas 1999* (World Bank, 1999).

enough" syndrome (Bhagwati and Panagariya, 1996, p.48). Interest groups in member countries also line up against the expansion of member countries when it narrows down their profits --- profits that come from the diversion of trade away from efficient suppliers abroad. This problem is called "these are our markets" syndrome (Bhagwati, 1993, p.39). In this paper, it is proved that the enlargement of market size at a member country aggravates these two syndromes at that country.

The aims of this paper are (1) to analyze theoretically how and why these two syndromes of regionalism appear, (2) to investigate why medium-sized countries conclude PTAs with a large number of countries compared to large- and small-sized countries, as observed in Figure 1, and (3) to estimate whether PTAs accelerate or deter multilateral trade negotiations[3], by using the political-economy approach and computer simulation. The mathematical model takes into consideration a large number of countries with asymmetric market size and 'agents' such as interest groups or governments are introduced to examine the incentives of PTA formation and the expansion of partner countries with political-economic point of view. The program of the computer simulation is written in order to observe the number of partner countries of PTAs as well as the effects of regional and multilateral trade liberalization on each country's welfare, world welfare and world trading systems.

The next section presents the basic multi-country model for analyzing the effects of trade liberalization in the manner of PTAs as well as MTN. In Section 3, the incentive to conclude PTAs with neighboring countries is explained from the basic model. Section 4 shows the determination of partner countries and the phenomena of two syndromes of regionalism. Section 5 presents the main results of the computer simulations concerning regional and multilateral trade liberalization. Conclusions and implications will be presented in Section 6.

2. The Model

The model presented here is the extension of Venables (1987), Yi (1996) and Krishna (1998), including transportation cost. The support-for-government function, or the government policy objective, is a simplified version of Grossman and Helpman (1995a, 1995b).

The world consists of $2l+1$ ($l \geq 2$) countries, which are located along a circle at equal distances. Let L be the set of countries. Each country imposes an import tariff t, the rate of which is given[4], on its import goods. M_j is the set of countries which can supply goods to the market of country j without tariffs, in other words, country j plus countries on which country j lifts import tariffs. If country j ($j \in L$) lifts tariffs on m_j ($0 \leq m_j \leq 2l$) countries, it means M_j has m_j+1 elements. $M_j \subseteq L$, of course. The tariff which country j imposes on goods from country i ($i \in L$), t_j^i, is therefore,

[3]The theoretical challenges for addressing implications of regionalism for multilateralism are well surveyed by Panagariya (2000).

[4]Previous papers concerning the stability of PTAs, Riezman (1985), Kennan and Riezman (1990), Bond and Syropoulos (1996), Yi (1996) and Bagwell and Staiger (1999), among others, consider the import tariffs adjustable to optimal rates. Here, however, the rate of tariff t is treated as given, therefore the choice for each countries is to impose t or 0 on its imports, because of the clarity of analyses.

$$t_j^i = \begin{cases} t & if \quad i \notin M_j \\ 0 & if \quad i \in M_j \end{cases}$$

There are three kinds of goods produced in each country: numeraire good produced and distributed competitively, transport service good produced and distributed also competitively, and an imperfect competition good. They are all produced under constant returns to scale with no fixed costs, and one unit of good requires one unit of labor as input. Numeraire good and transport service good are freely traded and priced one per one unit at world market. Therefore, the wage per one unit of labor is also one. These assumptions make marginal costs of three kinds of goods to be constant at one. If there exits Z_j units of labor in country j, the labor income of country j is Z_j. The numeraire good and the transport service good are transferred across countries to settle the balance of trade. The transport service good is the good that is required for the transportation of the imperfect competition good across borders. The required amount of the transport service good is assumed to be proportional to its distance. If transportation of one unit of the imperfect competition good from one country to its neighboring country requires g units of transport service goods, it requires $2g$ to the next country, and lg to the country furthest away, since $2l+1$ countries are located along the circle at equal distances. Domestic transportation requires no cost[5].

Regarding the imperfect competition good, each country possesses one firm, which produces this good[6]. The market structure is one of imperfect competition, with oligopolistic firms producing goods that are perfect substitutes for each other. Each firm, with recognition that markets in different countries are assumed to be segmented, decides the quantity of export to each country, taking tariffs and transportation costs into account. The equilibrium concept is that of Cournot-Nash. The quantity supplied by a firm in country i, firm i, to country j's market is described as q_j^i. Hereafter the imperfect competition good will mainly be referred to as "good".

Aggregate utility in country j, U_j, is assumed to take the form,

$$U_j(K_j, Q_j) = K_j + (A_j Q_j - Q_j^2/2), \tag{1}$$

where K_j denotes the consumption of the numeraire good in country j and $Q_j = \Sigma_i q_j^i$ denotes the total sales of the imperfect competition good in country j. From equation (1), the price of imperfect competition good in country j, P_j, is deduced as follows:

$$P_j = A_j - Q_j. \tag{2}$$

Each firm regards each country as a separate market and therefore chooses its optimal quantity for each country separately. Under the Cournot assumption, firms are assumed to be maximizing profits by taking other firms' outputs as given, with all firms choosing their quantities simultaneously. Firm i decides the quantity of export to country j, q_j^i, by solving the following problem:

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[5]Frankel, Stein and Wei (1995) also introduce transportation costs into their multi-country model. They, however, consider only two degrees of transportation cost: transport within a continent and transport between continents. They assume transportation costs to be iceberg type, which is different from this paper's assumption.

[6]It makes little effect on the point of argument if plural firms are admitted to exist in one country, as Krishna (1998). If the number of firms is assumed to be decided endogenously in order to reduce excess revenue to zero, like Venables (1987), the results may change largely.

$$\max_{q_j^i} \pi_j^i = q_j^i[A_j - Q_j - (1 + t_j^i + d_j^i g)] \tag{3}$$

where d_j^i denotes the distance between country i and country j, in terms of the distance normalized to one between neighboring countries. $0 \leq d_j^i \leq l$, since $2l+1$ countries are located along the circle at equal distances. Solving equation (3) and arranging it yields

$$\begin{aligned} q_j^i &= \left[\frac{A_j - 1 + \Sigma_k t_j^k + \Sigma_k d_j^k g}{2(l+1)} - t_j^i - d_j^i g\right] \\ &= \left[\frac{A_j - 1 + (2l - m_j)t + l(l+1)g}{2(l+1)} - t_j^i - d_j^i g\right]. \end{aligned} \tag{4}$$

From equation (3) and (4), the profit of firm i gained by supplying the good at the amount of q_j^i to country j's market, π_j^i, is

$$\pi_j^i = [q_j^i]^2.$$

The profit of a firm becomes the income of this firm's owner. Let the total profits of country i's firm from each country's market be $\prod^i = \sum_j \pi_j^i$.

Each country makes a decision about its trade policy in order to maximize the value of its government policy objectives. Here it is assumed that the objective of a government is to gain political support from domestic voters. The political-support function in country j, or the government policy objective of country j, W_j, takes form as

$$W_j = \prod^j + (1 - \alpha)(Z_j + T_j + S_j), \quad 0 \leq \alpha \leq 1, \tag{5}$$

where $\prod^j$ is the total firm profit, or the total income of firm-owner group, Z_j is the labor income, $T_j = \Sigma_i t_j^i q_j^i$ is the tariff revenue, $S_j = U_j - (K_j + P_j Q_j) = Q_j^2/2$ is the total consumer surplus which is equal to aggregate utility minus total purchase cost. The effect trade policy can be described as a change of the value of equation (5). Among the factors of this equation, the value of labor income Z_j is given. α denotes the ability of the firm-owner group to make government apply trade policy to its advantage. For example, α has a large value when a pressure group made up of firm owners of the imperfect competition good industry heavily influences the political decision making of the government. If $\alpha = 1$, the government only considers the welfare of the firm-owner group. On the other hand, if $\alpha = 0$ the government applies trade policy to maximize the economy-wide welfare.

In this model, there is a need to divide the effect PTAs have on the firm owner's income into that of Bilateral Trade Agreements (BTAs), concluded between two countries, and that of Regional Trade Agreements (RTAs), concluded among more than three countries, though they have the same effect on the tariff revenue and the total consumer surplus. BTA is defined as a free trade agreement between two countries where any import tariff amongst each other is abolished. Even if one country concludes BTAs with some countries, these partner countries of BTAs still conduct trade with each other including tariffs. On the other hand, RTA is a free trade agreement among three or more countries. If one country concludes RTA with some other country, these partner countries also conduct trade with each other without tariffs, which makes competition in the market of partner countries severer and reduces the profit of this country's firm compared to the case of BTAs.

In order to simplify and clarify the discussion, one country is chosen from $2l+1$

countries to analyze the effect of forming PTAs from this country's point of view. Let the country chosen as the subject of this analysis be country 0. Countries are indexed as $-l, -l+1, -l+2, \cdots\cdots, -2, -1, 0, 1, 2, \cdots\cdots, l-2, l-1, l$, in order along the circle, from one country that is located furthest from country 0, through country 0, to another country that is also located furthest away from country 0. Two countries exist that are located at the same distance from country 0, which lie on the circle, to the right and left of country 0. These two countries that are situated at a distance n from country 0, are named country -n and country n.

It is assumed that all countries except country 0 are identical, that is, $A_i=A$ for all i except i=0, and that no country concludes PTAs in the beginning. In this situation, country 0 chooses with which partner countries to conclude PTAs. Since this model has two countries that are situated at the same distance from country 0 and are therefore indifferent from country 0's point of view, it is also assumed that country 0 decides whether to conclude PTAs with both two countries or not. Therefore, the number of partner countries of the PTAs concluded with country 0 is described as $m_0=2n_0(0\leq n_0 \leq l)$. Here $q_j^i>0$ is assumed for every i and j, in order to make the decision of forming PTAs meaningful. This section analyzes the import and export of country 0, and that country 0's exports to the countries furthest away are always positive, $q_{-l}^0>0$ and $q_l^0>0$, requires A to be so large as holding this condition.

$$A-1>2lt+l(l+1)g, \tag{6}$$

Similarly, the fact that country 0's imports from the countries furthest away are always positive, $q_0^{-l}>0$ and $q_0^l>0$, requires A_0 to be

$$A_0-1>2lt+l(l+1)g.^{7} \tag{7}$$

3. Geographical Closeness of Partner Countries

In this section, the geographical closeness of partner countries of PTAs is examined, by distinguishing the effect BTAs and RTAs have on the political-support function. In equation (5), the value of labor income is constant, so only firm profit, tariff revenue and total consumer surplus are examined.

At the beginning, country 0 concludes PTAs with all countries located within a distance of $\overline{n}(1\leq\overline{n}<l)$ and imports goods from these $2\overline{n}$ countries without tariffs. Here assume that country 0 replaces its partner countries: country 0 newly concludes a PTA with country n_{out} or country $-n_{out}$ which are located at a distance of $n_{out}(\overline{n}<n_{out})$ from country 0, and cancels the PTA with country n_{in} or country $-n_{in}$ located at a distance of $n_{in}(n_{in}\leq\overline{n})$.

3.1. Firm Profit

First examined is the effect of this replacement on the total profit of country 0's firm. In the case of BTAs, the difference between its profit before replacing country n_{in} (or $-n_{in}$) with country n_{out} (or $-n_{out}$), $\widehat{\Pi}^0$, and after the replacement, $\widetilde{\Pi}^0$, is calculated as

[7]Equations (6) and (7) are brought from the condition that the volume of trade between country 0 and country $-l$ or country l is always positive even if all countries except country $-l$ and l conclude PTAs with country 0.

$$\widehat{\Pi}^0-\breve{\Pi}^0=2(\Lambda(1)-\Lambda(0)+t)(n_{out}-n_{in})g \\ =\frac{2l+1}{l+1}(n_{out}-n_{in})tg>0, \tag{8}$$

where $\Lambda(k)=[A-1+(2l-k)t+l(l+1)g]/2(l+1)$. k in $\Lambda(k)$ denotes the number of countries which can export to a country without tariff. It is assumed that no country forms PTAs in the beginning, as noted above. Therefore the country that concludes a BTA with country 0 has $\Lambda(1)$ (country 0 is the only country that can export to this country without tariff) and the country that does not conclude a BTA with country 0 has $\Lambda(0)$ (country cannot export to this country without tariff). Equation (8) has a positive value, since $n_{in}<n_{out}$. This shows that the replacement of partner countries of BTAs decreases the profit of country 0's firm.

The case of RTA can be considered as similar. The RTA member countries conduct trade amongst each other without tariff. Therefore $\Lambda(1)$ becomes $\Lambda(2\overline{n})$ to all partner countries of the RTA. Then, equation (8) changes to

$$\widehat{\Pi}^0-\breve{\Pi}^0=\frac{2(l+1-\overline{n})}{l+1}(n_{out}-n_{in})tg>0. \tag{9}$$

The result is the same as that in the case of BTAs. These considerations bring the following proposition.

Proposition 1-1

With the number of partner countries of the PTAs given, the total profit of a country's firm increases as it forms PTAs with geographically near countries.

3.2. Tariff Revenue

Then, consider the effect of partner countries' replacement on tariff revenue of country 0. Tariff revenue and total consumer surplus (examined at 3.3.) are affected by the number of countries from which country 0 imports without tariffs, and not by the characteristics of PTAs (BTAs or RTA). Therefore, there is no need to distinguish BTAs from RTA when considering the effect of partner replacement on tariff revenue and total consumer surplus.

In the case of tariff revenue, the difference between tariff revenue of country 0 before replacing country n_{in} (or $-n_{in}$) with country n_{out} (or $-n_{out}$), $\widehat{T}_0$, and that after the replacement, $\breve{T}_0$, is calculated as below,

$$\widehat{T}_0-\breve{T}_0=-t(n_{out}-n_{in})g<0. \tag{10}$$

Equation (10) has a negative value, since $n_{in}<n_{out}$. This shows that the exchange of a geographically near country for a far country as PTAs partners increases country 0's tariff revenue, because country 0 imports more goods from the geographically near countries than from far countries. Therefore, the replacement of PTA partner countries has the opposite effect on the firm profit and the tariff revenue.

Proposition 1-2

With the number of partner countries of the PTAs given, the tariff revenue of a country increases as it forms PTAs with geographically far countries.

3.3. Total Consumer Surplus

In the case of total consumer surplus, the total volume of supplied good in country 0 does not change before and after replacing countries, therefore the total consumer

surplus of country 0 does not change[8].

3.4. Political-Support Function

Finally, combine the effects on firm profit and tariff revenue, and consider the geographical characteristic of partner countries of PTAs that country 0's government prefers in order to increase domestic political support. $\widehat{W}_0$ and $\breve{W}_0$ denote, respectively, political support to country 0's government before and after the replacement of member countries. In the case of BTAs, it is obtained from equations (5), (8) and (10) that

$$\begin{aligned}\widehat{W}_0-\breve{W}_0&=(\widehat{\Pi}^0-\breve{\Pi}^0)+(1-\alpha)(\widehat{T}_0-\breve{T}_0)\\&=\left(\alpha+\frac{l}{l+1}\right)(n_{out}-n_{in})tg>0.\end{aligned} \tag{11}$$

Equation (11) is always positive. Similarly, in the case of RTA, equations (5), (9) and (10) bring

$$\widehat{W}_0-\breve{W}_0=\left[(1+\alpha)-\frac{2\overline{n}}{l+1}\right](n_{out}-n_{in})tg. \tag{12}$$

Whether equation (12) is positive or negative depends on α, l and $\overline{n}$. The different results between BTAs and RTA stems from the characteristics of equations (8), (9) and (10): the values of equations (8) and (10) are independent of $\overline{n}$, while $\overline{n}$ affects the value of equation (9). Consider the replacement of a near country for a far country as RTA partners. From equation (9), if l increases and/or $\overline{n}$ decreases, the loss of the firm's profits increase, while from equation (10), neither l nor $\overline{n}$ affect total tariff revenue. Equation (12) shows that the more l and the less $\overline{n}$, the more the likelihood of forming RTA with near countries. When $2\overline{n}\leq l$, that is when the number of partner countries is less than half the number of countries in the world, the government of country 0 always prefers near countries regardless of the value of α. These considerations bring the following proposition.

Proposition 1-3

With the number of partner countries of the PTAs given, in the case of BTAs government always prefers concluding them with geographically near countries regardless of the value of α, *and* $\overline{n}$, *while RTA depends on these three values. The more and the less* $\overline{n}$, *the more likely that the government prefers concluding RTA with near countries. When* $2\overline{n}\leq l$, *government always prefers near countries regardless of the value of* α.

4. Incentive to PTAs and the Number of Partner Countries

In the previous section geographical closeness of partner countries is considered with the number of partner countries of the PTAs given. The next question is whether the government has an incentive to conclude PTAs and, if so, how many countries it wants to conclude PTAs with.

At the beginning, country 0 concludes PTAs with $m_0=2n$ countries that are

[8]To see this, let $\widehat{Q}_0$ and $\breve{Q}_0$ be the total supply to country 0's market before and after the replacement of member countries, and calculate $\widehat{Q}_0-\breve{Q}_0=0$.

located within distance $\overline{n}$ from country 0. Now assume that country 0 enlarges BTA partner countries to $m_0=2(n+1)$ countries that are located within distance $\overline{n+1}$ from country 0. This assumption may seem contradictory to proposition 1-3 in the case of RTA. However, since government prefers near countries when $\overline{n}$ is small, and in order to avoid the sudden change of partners from near countries to far ones when equation (12) becomes negative as $\overline{n}$ increases, it is assumed in this section that government concludes RTA with geographically near countries.

4.1. Firm Profit

First, consider the relation between the number of partner countries that country 0 concludes PTAs with and the profit of country 0's firm. In the case of BTAs, the profit of country 0's firm in the case of BTAs, $\prod^0(BTAs)$, when country 0 concludes BTAs with $m_0=2n$ countries, is

$$\begin{aligned}(13)\qquad \prod^0(BTAs)=&\Lambda_0(2n)^2+2n\Lambda(1)[\Lambda(1)-(n+1)g]\\&+2(l-n)\Lambda(0)[\Lambda(0)-2t-(l+n+1)g]\\&+2(l-n)t^2+\frac{1}{3}l(l+1)(2l+1)g^2+2(l+n+1)(l-n)tg.\end{aligned}$$

Here, the enlargement of BTA partner countries to $m_0=2(n+1)$ countries changes the profit of country 0's firm. The degree of change, $\Delta\prod^0(BTAs)|_{m_0=2n}$, caused by this enlargement, is

$$\begin{aligned}(14)\qquad \Delta\prod^0(BTAs)|_{m_0=2n}=&\frac{t}{2(l+1)^2}[2(2l+1)(A-1)-2(A_0-1)\\&+4(l+1)(l^2-2l-1-2ln-n)g+(4l^2-8l-1+4n)t].\end{aligned}$$

With conditions (6) and (7), $\Delta\prod^0(BTAs)>0$ if $n=0$ and $A\geq A_0$. It shows that if the market size of country 0 is smaller than that of other countries, the total profit of country 0's firm increases by the conclusion of BTAs with other countries. Moreover,

$$(15)\qquad \Delta\prod^0(BTAs)|_{m_0=2n}-\Delta\prod^0(BTAs)|_{m_0=2(n+1)}=\frac{2t[(2l+1)(l+1)g-t]}{(l+1)^2}.$$

Equation (15) is positive if $(2l+1)(l+1)g>t$. That is, $\Delta\prod^0(BTAs)$ decreases as the number of BTA partner countries increase. Here it is assumed that t and g have values that make (15) always positive (this assumption is not unreal). The number of partner countries that maximize the profit of country 0's firm, i.e. the optimum number of partner countries for country 0's firm-owner group, is denoted by $2n^*(BTAs)$. $n^*(BTAs)$ is the number that makes equation (14) zero, and is derived as

$$(16)\qquad n^*(BTAs)=\frac{2(2l+1)(A-1)-2(A_0-1)+4l(l^2-l-3)g+(4l^2-8l-1)t}{4[(2l+1)(l+1)g-t]}.$$[9]

There exists a possibility that $n^*(BTAs)\geq l$, i.e. $n^*(BTAs)$ has a corner solution l, if A_0 is fairly small compared with A. However, the larger the market size of country 0 is compared with that of other countries, i.e. the larger A_0 is compared with A, the less the number of $n^*(BTAs)$ there will exist. From equation (16), $\partial n^*(BTAs)/\partial g<0$

[9] $n^*(BTAs)$ should be an integer since it denotes number of countries. There is, however, a possibility that $n^*(BTAs)$ in equation (16) is not an integral number. In the following, the analysis is carried out without assuming $n^*(BTAs)$ as an integer. Of course, conclusions in the text rarely change even if $n^*(BTAs)$ is assumed to be an integer.

and $\partial n^*(BTAs)/\partial t>0$ can be derived, implying the more g and the less t, the less $n^*(BTAs)$. This means the optimum number of partner countries decreases as the transportation cost increases or the rate of tariff decreases.

In the case of RTA, the profit of country 0's firm in this case, $\prod^0(RTA)$, is

$$\begin{aligned}(17)\qquad \prod^0(RTA)=&\Lambda_0(2n)^2+2n\Lambda(2n)[\Lambda(2n)-(n+1)g]\\&+2(l-n)\Lambda(0)[\Lambda(0)-2t-(l+n+1)g]\\&+2(l-n)t^2+\frac{1}{3}l(l+1)(2l+1)g^2+2(l+n+1)(l-n)tg.\end{aligned}$$

Here, as in the case of BTAs, the enlargement of RTA partner countries to $m_0=2(n+1)$ countries that are located within a distance of $\overline{n+1}$ from country 0 changes the profit of country 0's firm. The degree of change, $\Delta\prod^0(RTA)|_{m_0=2n}$, is calculated as below;

$$\begin{aligned}(18)\qquad \Delta\prod^0(RTA)|_{m_0=2n}=&\frac{t}{(l+1)^2}[2(l-2n)(A-1)-(A_0-1)\\&+(l+1)(2l^2-5l+6n^2-8ln+6n)g+(2l^2-6l+1+6n^2-8ln+8n)t].\end{aligned}$$

With conditions (6) and (7), equation (18) means $\Delta\prod^0(RTA)>0$ if $n=0$ and $A\geq A_0$. As in the case of BTAs, this shows that, if the market size of country 0 is smaller than that of other countries, the total profit of country 0's firm increases by the conclusion of RTA with other countries.

The difference of the firm's profit between the case of BTAs and RTA is,

$$\begin{aligned}(19)\qquad &\prod^0(BTAs)-\prod^0(RTA)\\&=\frac{nt(2n-1)[2(A-1)+2(l+1)(l-n-1)g+(4l-2n-1)t]}{2(l+1)^2}\geq 0.\end{aligned}$$

Equation (19) equals zero if $n=0$, and is positive if $n>0$. This means that the profit of country 0's firm in the case of BTAs is always no less than that of the RTA case. Moreover,

$$\begin{aligned}(20)\qquad &[\prod^0(BTAs)-\prod^0(RTA)]|_{m_0=2(n+1)}-[\prod^0(BTAs)-\prod^0(RTA)]|_{m_0=2n}\\&=\frac{t[2(4n+1)\{(A-1)+2lt+l(l+1)g\}-3(2n+1)^2t-4(l+1)(3n+1)(n+1)g]}{2(l+1)^2}>0.\end{aligned}$$

Equation (20) is always positive with condition (6). This means that the difference of a firm's profit between the case of BTAs and RTA becomes larger as n increases. Therefore, $n^*(BTAs)\geq n^*(RTA)$, where $2n^*(RTA)$ is the number of partner countries that maximize the profit of country 0's firm, or the optimum number of partner countries for country 0's firm-owner group, in the case of RTA[10]. Equation (20) assures the property that, similar to $n^*(BTAs)$, the larger A_0 is compared with A, the less the $n^*(RTA)$[11].

These considerations bring the following proposition.

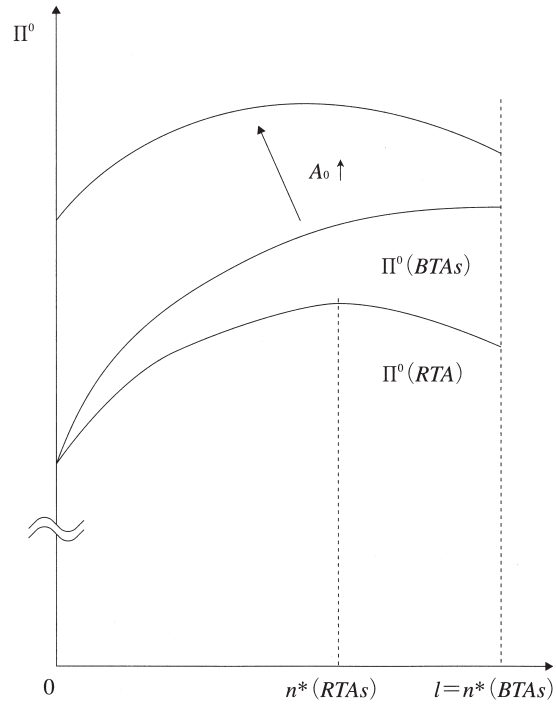
Proposition 2-1

If market size of a country is smaller than that of other countries, the total profit of this country's firm increases by the conclusion of PTAs with other countries. The

[10]There is a possibility that $n^*(BTAs)=n^*(RTA)$ only if $n^*(RTA)$ has a corner solution l.

[11]$n^*(RTA)$ has the same characteristics as $n^*(BTAs)$: that the more g and the less t, the less $n^*(RTA)$. This can be derived by calculating $n^*(RTA)$ from equation (18) and differentiating it by g and t.

Figure 2: Firm profit, the number of partner countries, and "these are our markets" syndrome



optimum number of partner countries for this country's firm-owner group in the case of BTAs is larger than that of the RTA. Moreover, this optimum number of partner countries decreases as this country's market size increases.

Figure 2 shows an example of the relation between $\prod^0$ and n in the case of both BTAs and RTA. This illustration is in a situation where $n^*(BTAs)=l$. $\prod_0(RTA)$ is located under $\prod^0(BTAs)$ from equation (19), and $n^*(RTA)$ is less than $n^*(BTAs)$ from equation (20). The theoretical outcome $n^*(BTAs) \geq n^*(RTA)$ means, in other words, that RTA causes "these are our markets" syndrome to the firm-owner group stronger than BTAs. This phenomenon can be explained from the difference of $\Lambda(k)$ in the partner countries. In the case of BTAs, each partner country imposes tariffs on imports from all countries except country 0, which means $\Lambda(1)$. Therefore the profit of country 0's firm gained from exporting to a partner country is fixed regardless of the number of partner countries $m_0=2n$. On the other hand, RTA makes all partner countries remove their tariffs amongst each other, and as a consequence $\Lambda(k)$ becomes $\Lambda(2n)$, where Λ decreases as n increases. This means that the profit of country 0's firm gained by exporting to a partner country decreases as the number of partner countries increases, since the expansion of RTA intensifies market competition in existing partner countries.

Figure 2 also shows the shift of $\prod^0(BTAs)$ caused by the augmentation of A_0. As the market size of country 0, A_0, increases, both $\prod^0(BTAs)$ and $\prod^0(RTA)$ increase, while both $n^*(BTAs)$ and $n^*(RTA)$ decrease. Thus, when the market size of one

country increases, "these are our markets" syndrome brought on by the home firm-owner group intensifies, and the optimal regional area of PTA partner countries diminishes. This phenomenon can be explained as follows. When other conditions are fixed and A_0 increases, not only does the revenue of country 0's firm gained from the domestic market increase, but the revenue of other countries' firms gained from country 0's market also increase. Yet the revenue of country 0's firm gained from other countries' markets do not change. Therefore, by canceling PTAs with some existing partner countries and imposing tariffs on imports from them, even though country 0's firm will suffer the loss of profit caused by decreasing export, this firm can gain profit from the home market whose market competition will ease by canceling PTAs with some countries. The firm-owner group in country 0 will then demand from its government to cancel some of the PTAs in order to maximize its net gain, i.e. the gain from supplying more good to the home market minus the loss caused by diminishing export to the PTAs-canceled market. This explanation supports the familiar story that the management of certain industries in one country, witnessing augmentation of foreign firms' revenues by exporting more goods to the home market due to its enlargement, often strengthens a sense of "here is our market", and tries to deprive foreign firms of part of their rents by imposing tariffs on import from them.

4.2. Tariff Revenue and Total Consumer Surplus

Second examined is the relation between the number of partner countries and tariff revenue plus total consumer surplus in country 0. It is already obtained in the previous sections that one does not need to distinguish BTAs from RTA when examining these two values and that labor income Z_0 is independent from n. Therefore, only the effect of the number of partner countries on T_0+S_0 is considered. When country 0 concludes PTAs with $m_0=2n$ countries that are located within the distance of $\overline{n}$ from country 0, the values of T_0 and S_0 are, respectively,

$$T_0=(l-n)[2\Lambda_0(2n)-2t-(l+n+1)g]t. \tag{21}$$

$$S_0=[(2l+1)\Lambda_0(2n)-2(l-n)t-l(l+1)g]^2/2. \tag{22}$$

The enlargement of PTAs partners to $m_0=2(n+1)$ countries that are located within a distance of $\overline{n+1}$ from country 0 changes both tariff revenue and total consumer surplus. The relations of T_0 and S_0 with n are depicted in Figure 3. The degree of change, $\Delta(T_0+S_0)|_{m_0=2n}$, brought by this enlargement, is calculated as

$$\begin{aligned}\Delta(T_0+S_0)|_{m_0=2n}=\frac{-t}{2(l+1)^2}[&(A_0-1)+\{4l^2-2l-9-(8l+10)n\}t\\&+(l+1)\{2l^2-l-4-4(l+1)n\}g].\end{aligned} \tag{23}$$

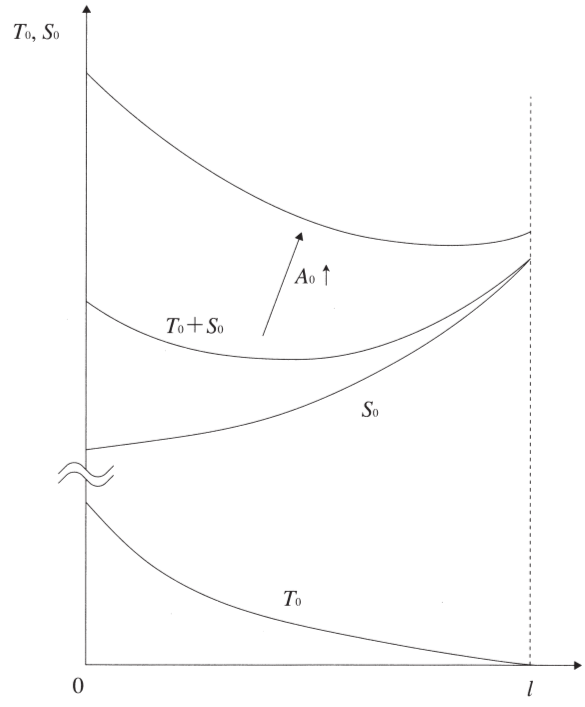
With equation (7), $\Delta(T_0+S_0)<0$ if $n=0$. Moreover,

$$\Delta(T_0+S_0)|_{m_0=2n}-\Delta(T_0+S_0)|_{m_0=2(n+1)}=-\left(\frac{(4l+5)t}{(l+1)^2}+2g\right)t<0. \tag{24}$$

Equation (24) is always negative, that is, as the number of partner countries, $m_0=2n$, increases, $\Delta(T_0+S_0)$ increases. It is clear that the maximization of T_0+S_0 has a corner solution: $n=0$ or $n=l$. Compare T_0+S_0 in the cases $n=0$ and $n=l$ then

$$(T_0+S_0)|_{m_0=0}-(T_0+S_0)|_{m_0=2l}=\frac{[(A_0-1)-(l+1)(l+2)g-(3l+4)t]lt}{2(l+1)^2}. \tag{25}$$

Figure 3: Tariff revenue, consumer surplus, and the number of partner countries



If equation (25) is positive (negative), T_0+S_0 has a maximum value at $n=0$ ($n=l$). As A_0 increases, equation (25) may become positive. Figure 3 also shows one example of the relation between n and T_0+S_0, as well as the shift of T_0+S_0 caused by the augmentation of A_0. From these considerations, the following can be stated.

Proposition 2-2

A country's tariff revenue plus total consumer surplus is maximized either when PTAs are concluded with all other countries or when PTAs are not concluded at all. The latter possibility increases as the size of this country's domestic market increases.

4.3. Political-Support Function

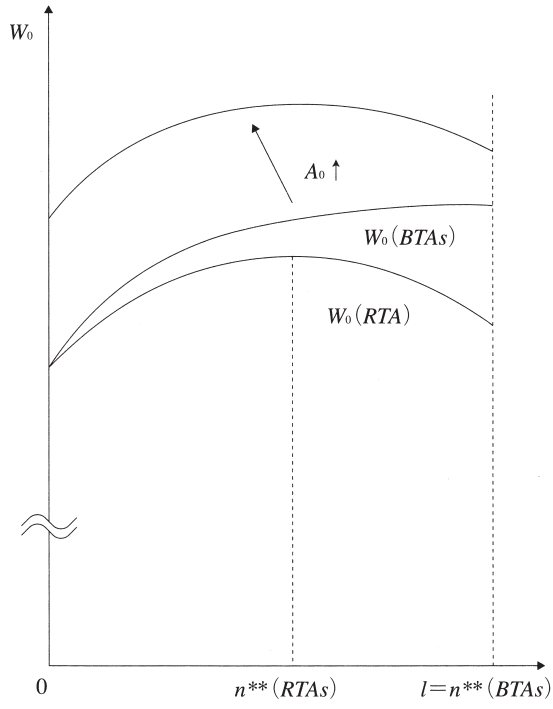
Finally, using the results mentioned above, consider the incentive of governments to conclude PTAs in order to maximize its domestic political support. The changes of political support before and after the enlargement of partners in the case of BTAs, $\Delta W_0(BTAs)|_{m_0=2n}$, and in the case of RTA, $\Delta W_0(RTA)|_{m_0=2n}$, are calculated respectively as below, using equations (5),

$$\Delta W_0(BTAs)|_{m_0=2n}=\Delta\prod{}^0(BTAs)|_{m_0=2n}+(1-\alpha)\Delta(T_0+S_0)|_{m_0=2n}, \tag{26}$$

$$\Delta W_0(RTA)|_{m_0=2n}=\Delta\prod{}^0(RTA)|_{m_0=2n}+(1-\alpha)\Delta(T_0+S_0)|_{m_0=2n}, \tag{27}$$

Substitute equations (14), (18) and (24) for (26) and (27), and it can be ascertained that $\Delta W_0(BTAs)>0$ and $\Delta W_0(RTA)>0$ if $n=0$ and $A\geq A_0$ at any α. This shows that, if the market size of country 0 is smaller than that of other countries, government 0 has an incentive to conclude PTAs with some countries.

Figure 4: Political support, the number of partner countries, and "our market is large enough" syndrome



Examples of $W_0(BTAs)$ and $W_0(RTA)$ are described in Figure 4. $n^{**}(BTAs)$ and n^{**} (RTA) are the points where $W_0(BTAs)$ and $W_0(RTA)$ have maximum values respectively. This figure also shows the shift of $W_0(BTAs)$ caused by the augmentation of A_0. As the market size of country 0, A_0, increases, both the curved lines $W_0(BTAs)$ and $W_0(RTA)$ shift upward and to the left, and the maximum point $n^{**}(BTAs)$ and $n^{**}(RTA)$ also move to the left[12]. These indicate that the phenomenon of "our market is large enough" syndrome is brought on by the government. With increasing domestic market size, this syndrome is intensified and the optimal regional area of PTAs partner countries diminishes. This phenomenon is similar to the case of "these are our markets" syndrome brought on by the firm-owner group. These considerations bring the following proposition.

Proposition 2-3

If the market size of a country is smaller than that of other countries, this country's government always prefers concluding PTAs with other countries in order to increase domestic political support. The optimum number of partner countries for this government in the case of BTAs is larger than that of the RTA. Moreover, this optimum number of partner countries decreases as this country's market size increases.

[12]The figure of the function W_0 in Figure 6 is similar to the result of Nordström (1995) that employs the differentiated products model.

5. Simulations

In this section, multi-country computer simulations are employed in order to clarify the propriety of the discussions and propositions developed in the previous section and to show the effects of forming PTAs on each country's welfare, world welfare, world trading system, comparing with the cases of worldwide free trade situation.

The mathematical analysis in the previous section examines the incentive of forming PTAs from only one chosen country's point of view, with all other countries treated as passive to this country's proposals. However, it is natural to consider that all countries can decide their trade policies for themselves. Therefore, in this computer simulation all countries are assumed to have the ability to decide with which countries they should conclude PTAs in order to increase political support from within their domains. Here it has to assume that the market size of each country is different from each other to avoid the possibility of countries having two or more indifferent countries as potential PTAs partners.

In each simulation, 20 countries are considered. Their market sizes are determined by the following equation:

$$A_i = \exp(c - d \cdot \ln i), \qquad i = 1, 2, \cdots, 19, 20 \tag{28}$$

where c and d are parameters. This means that A is modeled to be distributed exponentially, based on the fact that the distribution of the population or GNP of actual countries fits along with exponential distribution.

The values of parameters t and g are given as $t=8$ and $g=2$ throughout these analyses. This t can be interpreted as a remaining tariff after series of trade negotiations held by GATT/WTO and it is assumed that all 20 counties still put tariff $t=8$ on goods from all other countries. There are two combinations of values concerning c and d in equation (28): $(c, d)=(12, 2)$ and $(15, 3)$. When $(c, d)=(12, 2)$, the largest country's market size, $A_1=162{,}754.8$, is 400 (20^2) times that of the smallest country's market size, $A_{20}=406.9$. $A_{20}=406.9$ is the value that just satisfies the condition that all twenty countries trade with a positive quantity of trade under all circumstances, similar to condition (6) or (7). When (c, d) is (15, 3), this becomes 8,000 (20^3) times ($A_1=3{,}269{,}017.4$, $A_{20}=408.6$)[13]. As for α, it has five values: $\alpha=0$, 0.25, 0.5, 0.75, 1.

In the previous sections, the difference of BTAs and RTA is mentioned. However, in order to simplify the procedure of computer simulation and make it easy to grasp the implication of the results, only BTAs are used in the analyses. RTA can be considered as the accumulation of BTAs among countries. The procedure of the simulation in the case of bilateral trade liberalization is stated as below.

Step 1. *Randomly locate 20 countries along the circle at equal distances.*

[13]When these differences are shown by each country's GNP, compared with U.S.A., which has the largest GNP (7,783,092 millions $), Slovak Republic (19,801 millions $), Tunisia (19,433 millions $) and Ecuador (18,785 millions $) are 1/400 of it while Mongolia (998 millions $), Burundi (924 millions $) and Eritrea (852 millions $) are 1/8000. Depicted by using population, these differences are also demonstrated like. Compared with China, which has the largest population (1,227,177 thousands), Uruguay (3,266 thousands), Singapore (3,104 thousands) and Liberia (2,886 thousands) are 1/400 of it while Vanuatu (177 thousands), St. Lucia (159 thousands) and São Tomé and Principe (138 thousands) are 1/8000. These data are given as of 1997 by the World Bank, *World Bank Atlas* 1999.

Step 2. *Randomly select one country and give it an opportunity to decide whether (1) to conclude a new BTA, (2) to cancel an existing BTA, or (3) to do nothing.*

Step 3. *This country selects (1) or (2) depending on which one brings a larger increase in its government policy objective. Note that to select (1), it is necessary that this conclusion raise the partner country's government policy objective in order to acquire its support. If neither (1) nor (2) raises this country's government policy objective, then this country chooses (3) and does not change its commercial policy.*

Step 4. *Repeat Step 2 and Step 3 400 times.*

The location of 20 countries and the number of turns of decision-making are programmed to be allotted randomly to countries (Step 1 and 2) because they may affect the results of the simulation. This simulation is conducted 100 times and the results are taken from average values of these trials. One trial of simulation consists of Step 1 to Step 4, and each simulation reaches to a stable state after 400 times' repetition of Step 2 and 3[14].

Table 1 summarizes the results of simulation in this case. It shows the number of countries from which each country eliminates tariffs on import goods, i.e. the number of "freed channels," and the ratio of changing each country's total surplus, or economy-wide welfare, compared to the initial situation, with the combination of parameter values and each country's market size (Ai). The maximum number of freed channels in each country is 19 (20 minus home country). The number of freed channels is equal to the number of BTAs each country concludes. The ratios of changing total surplus, i.e. the value of political-support function valued at $\alpha=0$, are shown in Table 1, although each government makes decisions through the simulation by using various values of α at the political-support function. This is because the author wishes to show the change of each country's domestic total surplus (consumer plus producer) and world total surplus, instead of its government policy objective, from an impartial and benevolent point of view.

All 100 trials bring similar results despite two kinds of randomness. Given the summation of each country's forming BTAs for example, its standard deviation in each simulation, shown in Table 1 at a row "World," are all fairly small. The standard deviation in each country's BTAs is also very small at some countries and is zero at all other countries, though its figures are left out from this table. The reasons are as follows. First, for the randomness of location (Step 1 of the simulation), large differentials between market sizes, calculated by equation (28), affect the determination of the results overwhelmingly compared with the transportation costs. Second, the randomness of turns of decision-making (Step 2 of the simulation) does not affect each country's choices of partner countries at all[15]. Therefore, it can be concluded that the results of this simulation are robust and stable. The results where $\alpha=0.25$ and $\alpha=0.75$ are not shown in this table because these results range evenly between $\alpha=0$ and $\alpha=0.5$, and $\alpha=0.5$ and $\alpha=1$.

Table 1 shows three features concerning each country's freed channels. First, in all

[14]The program used in this paper is available on request.

[15]This is because the simulation is programmed such that each country can cancel existing BTAs (Step 3.). If the procedure is rewritten to prohibit canceling of existing BTAs ("lock in" effect of regionalism), the randomness of turns of decision-making can affect the results of simulation.

Table 1: Results of simulations

Country No. (i)	$(c, d) = (12, 2)$							
	BTAs							Free Trade Worldwide
	Ai	$\alpha = 0$		$\alpha = 0.5$		$\alpha = 1$		
		No. of F. Ch.	Change of Surplus	No. of F. Ch.	Change of Surplus	No. of F. Ch.	Change of Surplus	Change of Surplus
1	162,754.8	2.	−0.0001%	2.12	−0.0001%	3.	−0.0001%	−0.0013%
2	40,688.7	6.	0.0129%	6.12	0.0126%	7.22	0.0117%	−0.0032%
3	18,083.9	9.	0.0601%	10.07	0.0593%	11.29	0.0555%	−0.0006%
4	10,172.2	11.5	0.0122%	12.79	0.0238%	15.28	0.1138%	0.0067%
5	6,510.2	15.7	0.0221%	16.44	0.0196%	16.8	0.0092%	0.0138%
6	4,521.0	17.96	0.0286%	17.79	0.0255%	17.57	0.0136%	0.0186%
7	3,321.5	18.	0.0322%	18.	0.0289%	17.93	0.0164%	0.0217%
8	2,543.0	17.	−0.0112%	17.12	−0.0091%	18.	0.0181%	0.0236%
9	2,009.3	17.	−0.0105%	17.	−0.0140%	17.22	−0.0169%	0.0248%
10	1,627.5	17.	−0.0100%	17.	−0.0135%	17.	−0.0268%	0.0257%
11	1,345.1	16.	−0.0306%	16.92	−0.0148%	17.	−0.0265%	0.0263%
12	1,130.2	16.	−0.0303%	16.15	−0.0307%	16.84	−0.0295%	0.0268%
13	963.0	16.	−0.0301%	16.	−0.0337%	16.35	−0.0397%	0.0271%
14	830.4	15.5	−0.0359%	15.9	−0.0347%	16.1	−0.0448%	0.0274%
15	723.4	15.	−0.0417%	15.54	−0.0388%	15.84	−0.0487%	0.0276%
16	635.8	15.	−0.0416%	15.22	−0.0425%	15.62	−0.0512%	0.0278%
17	563.2	14.85	−0.0426%	14.87	−0.0460%	15.32	−0.0541%	0.0279%
18	502.3	14.56	−0.0447%	14.7	−0.0472%	14.95	−0.0576%	0.0280%
19	450.8	14.23	−0.0472%	14.5	−0.0486%	14.6	−0.0604%	0.0281%
20	406.9	14.02	−0.0486%	14.17	−0.0507%	14.25	−0.0631%	0.0281%
World (s.d.)	-----	282.32 (2.167)	0.0002%	288.42 (2.761)	0.0002%	298.18 (3.226)	0.0002%	0.0006%

Country No. (i)	$(c, d) = (15, 3)$							
	BTAs							Free Trade Worldwide
	Ai	$\alpha=0$		$\alpha=0.5$		$\alpha=1$		
		No. of F. Ch.	Change of Surplus	No. of F. Ch.	Change of Surplus	No. of F. Ch.	Change of Surplus	Change of Surplus
1	3,269,017.4	1.	0.0000%	1.	0.0000%	1.	0.0000%	−0.0001%
2	408,627.2	3.	0.0024%	4.	0.0024%	4.	0.0023%	−0.0002%
3	121,074.7	5.	0.0005%	5.	0.0004%	6.	0.0004%	0.0005%
4	51,078.4	7.	0.0008%	7.43	0.0008%	8.	0.0007%	0.0009%
5	26,152.1	8.	−0.0003%	10.	0.0009%	10.8	0.0009%	0.0010%
6	15,134.3	10.53	−0.0002%	11.41	−0.0003%	12.42	−0.0003%	0.0011%
7	9,530.7	12.95	−0.0002%	13.65	−0.0003%	14.92	−0.0003%	0.0011%
8	6,384.8	14.45	−0.0006%	15.01	−0.0006%	16.3	−0.0003%	0.0011%
9	4,484.2	15.94	−0.0006%	15.77	−0.0006%	15.81	−0.0007%	0.0011%
10	3,269.0	15.	−0.0007%	15.43	−0.0007%	15.95	−0.0007%	0.0011%
11	2,456.1	15.	−0.0007%	15.	−0.0008%	15.	−0.0008%	0.0011%
12	1,891.8	14.	−0.0008%	15.	−0.0008%	15.	−0.0008%	0.0011%
13	1,487.9	14.	−0.0008%	14.	−0.0009%	14.8	−0.0008%	0.0011%
14	1,191.3	13.53	−0.0008%	14.	−0.0009%	14.	−0.0009%	0.0012%
15	968.6	13.	−0.0008%	13.41	−0.0009%	13.85	−0.0009%	0.0012%
16	798.1	12.81	−0.0008%	13.	−0.0009%	13.48	−0.0009%	0.0012%
17	665.4	12.14	−0.0009%	12.5	−0.0009%	12.96	−0.0009%	0.0012%
18	560.5	11.91	−0.0009%	12.11	−0.0009%	12.39	−0.0009%	0.0012%
19	476.6	11.37	−0.0009%	11.64	−0.0009%	12.06	−0.0010%	0.0012%
20	408.6	11.11	−0.0009%	11.18	−0.0009%	11.66	−0.0010%	0.0012%
World (s.d.)	-----	221.74 (2.185)	0.0000%	230.54 (2.431)	0.0000%	240.40 (2.800)	0.0000%	0.0000%

Table 2: Partner countries of BTAs at $(c, d)=(12, 2)$ and $\alpha = 0$

Country No.	No. of F. Ch.	Partner countries of BTAs																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	2.	–	○	○																	
2	6.	○	–	○	○	○	○	○													
3	9.	○	○	–	○	○	○	○	○	○	○										
4	11.5		○	○	–	○	○	○	○	○	○	○	○	○	50%						
5	15.7		○	○	○	–	○	○	○	○	○	○	○	○	○	○	○	85%	56%	23%	6%
6	17.96		○	○	○	○	–	○	○	○	○	○	○	○	○	○	○	○	○	○	96%
7	18.		○	○	○	○	○	–	○	○	○	○	○	○	○	○	○	○	○	○	○
8	17.			○	○	○	○	○	–	○	○	○	○	○	○	○	○	○	○	○	○
9	17.			○	○	○	○	○	○	–	○	○	○	○	○	○	○	○	○	○	○
10	17.			○	○	○	○	○	○	○	–	○	○	○	○	○	○	○	○	○	○
11	16.				○	○	○	○	○	○	○	–	○	○	○	○	○	○	○	○	○
12	16.				○	○	○	○	○	○	○	○	–	○	○	○	○	○	○	○	○
13	16.				○	○	○	○	○	○	○	○	○	–	○	○	○	○	○	○	○
14	15.5				50%	○	○	○	○	○	○	○	○	○	–	○	○	○	○	○	○
15	15.					○	○	○	○	○	○	○	○	○	○	–	○	○	○	○	○
16	15.					○	○	○	○	○	○	○	○	○	○	○	–	○	○	○	○
17	14.85					85%	○	○	○	○	○	○	○	○	○	○	○	–	○	○	○
18	14.56					56%	○	○	○	○	○	○	○	○	○	○	○	○	–	○	○
19	14.23					23%	○	○	○	○	○	○	○	○	○	○	○	○	○	–	○
20	14.02					6%	96%	○	○	○	○	○	○	○	○	○	○	○	○	○	–

○ means these two countries form bilateral trade agreement at all 100 trials.
**% means these two countries form bilateral trade agreement at ** times among 100 trials.

cases, the largest country (country 1) liberalizes its imports from, i.e. concludes BTAs with, the least number of countries. The number of freed channels increases as market size decreases and after its number peaks between country 7 and country 9, it declines as market size decreases. This result supports the discussion in the previous section where countries with large market sizes compared with others, strongly show the "our market is large enough" syndrome, thus forming less BTAs. The fact shown in Figure 1 that countries with medium size of GNP conclude BTAs with a large number of countries, compared to countries whose GNPs are both large and small is also similar to this result.

The distribution of the number of BTAs concluded by each country indicates that large countries form BTAs with only large countries and refuse to form BTAs with small countries. Table 2 shows with which countries they form BTAs in the case $(c, d)=(12, 2)$ and $\alpha=0$ as an example. Here, country 1 forms BTAs only with country 2 and 3, country 2 with country 1, 3−7, and country 4 signs BTAs always with country 2, 3, 5−13 and sometime accepts the offers to conclude BTA from country 14. On the other hand, country 7, the medium-sized country, form BTAs with all other countries except country 1.

Secondly, the larger the value of α each country form more BTAs, at both $(c, d)=$ (12, 2) and (15, 3). This is because, as the value of α increases, governments put less weight on the sum of tariff revenue and total consumer surplus, which is maximized for medium- to large-sized countries when it does not concludes BTAs with any country. And thirdly, the larger the difference of each country's market size, the less the number of freed channels, indicated from the comparison of the case $(c, d)=(12, 2)$ and (15, 3). This means that as some countries' market size increase compared with

others, they lose their intention of liberalizing imports and of concluding BTAs with other countries. This also verifies the discussion about the intensification of "our market is large enough" syndrome accompanying with the increase of domestic market size.

From the point of change in each country's total surplus, Table 1 shows two features. First, surpluses of all relatively small countries are decreased by forming BTAs, and the smaller the market size, the more decrease in its surplus. This is caused by discriminating methods of trade liberalization held by large countries that do not eliminate tariffs against small countries. On the other hand, the medium- to large-sized countries show an increase in surplus. The largest country 1 suffers a slight decrease in its surplus when $(c, d)=(12, 2)$, but the decrease enlarges if country 1 concludes more BTAs with other countries and liberalizes an access to its home market.

Secondly, the larger the value of α, the larger the ratio of decrease in regard to the total surpluses of small countries, at both $(c, d)=(12, 2)$ and $(15, 3)$. This is brought by the increase of BTAs concluded by large countries. As α increases, large countries lift only their import tariffs against medium-sized, not small-sized countries. This discriminating trade liberalization worsens the terms of trade for small countries and reduces the profit of the small countries' firm-owner gained from large countries. The changes of these ratios are fairly small at $(c, d)=(15, 3)$, for two reasons: the number of BTAs becomes small, and the market size of each country enlarges compared to the welfare effect of tariff policy produced with a given value of $t=8$.

Table 1 also shows each country's change of total surplus by completing free trade multilaterally, the calculation of this case is simply eliminate import tariff $t=8$ from all trade flows. The most striking point in this result is that relatively medium- to small-sized countries increase their surpluses, and the smaller one country's market size is, the greater the ratio of increase in its surplus, while large countries decrease their surpluses. This result is quite opposite to the case of PTA. The reason why this kind of contraposition occurs is that, worldwide free trade promotes exports from small countries to large countries rather than from large countries to small countries, which increases firm profit located in small countries and decreases big countries' firm profit.

It shows that smaller countries prefer worldwide trade liberalization, while larger countries prefer PTA-type trade liberalization. At the case $(c, d)=(12, 2)$ and $\alpha=0$, for example, the surpluses of larger countries 1-7 have larger increases by the formation of PTAs and these countries prefer forming PTAs than free trade worldwide. On the contrary, smaller countries 8-20 choose worldwide free trade. After all, PTAs become "stumbling block" of multilateral trade negotiations in this model.

6. Conclusion

This paper investigates the incentive of forming PTAs, the two "syndromes" of regionalism, and the effect of regionalism on multilateral trade negotiations, by employing the political-economy approach and computer simulation. In this paper, the market structure is that of imperfect competition, with oligopolistic firms producing goods that are perfect substitutes for each other. Twenty countries with asymmetric

market size are taken into consideration at the simulation to investigate with how many countries they form PTAs and to compare the effects of forming PTAs and worldwide free trade on each country's surplus.

The mathematical model shows some propositions about the conclusion of PTAs and its effects on member countries. First, concerning the geographical area of PTA partners, a tendency exists of forming PTAs with neighboring countries. Secondly, for all countries but extremely large ones, the total profit of domestic firms increases by the conclusion of PTAs with other countries. Thirdly, on the contrary, the conclusion of some PTAs may decrease a country's tariff revenue plus total consumer surplus. It is maximized either when PTAs are concluded with all other countries or when PTAs are not concluded at all. Fourthly, for all countries but extremely large ones, these governments prefer concluding some PTAs in order to increase domestic political support. Fifthly, the greater the economic size of the home country, the stronger its "syndromes" are and the smaller the number of optimal partner countries of PTAs is.

The simulation verifies some characteristics about forming PTAs, two "syndromes" of regionalism and the relation between regionalism and multilateralism. First, the largest country forms BTAs with the least numbers of countries because of the strengthening effect of the two syndromes. The number of BTAs increases as market size decreases and after its number peaks it declines as market size decreases since large countries refuse to conclude BTAs with small countries. This result can explain the tendency that medium-sized countries conclude PTAs with a large number of countries compared with large- and small-sized countries, as shown in Figure 1. Secondly, the more governments put weight on the intention of the firm-owner groups, countries form more BTAs. Thirdly, smaller countries prefer worldwide free trade, while larger countries prefer PTA-type trade liberalization. Once larger countries form BTAs they then lose their intention to liberalize trade further. This means that PTAs become "stumbling block" of multilateral trade negotiations based on WTO, the same result as Levy (1997), Krishna (1998) and Bagwell and Staiger (1999).

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