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ABSTRACT

FTA bilateral and regional negotiations in Asia have developed quickly in the past decade moving Asia ever closer to an economic union. Unlike Europe with the EU and the 1997 treaty of Rome and the 1993 NAFTA in North American, Asian economic integration does not involve a comprehensive trade treaty, but an accelerating process of building one bilateral agreement on another. For countries in Asia there is negotiation of a China-Japan-Korea agreement, a China-India agreement, a Trans-Pacific Partnership (TPP) agreement, and a Regional Comprehensive Economic Partnership (RCEP). This paper uses a fifteen-country global general equilibrium model with trade costs to numerically calculate Debreu distance measures between the present situation and potential full Asia integration in the form of a trade bloc. Our results reveal that these large Asia economies can be close to full integration if they act timely in agreements through negotiation. All Asia countries will gain from Asia trade bloc arrangements except when the Asia FTA can only eliminate tariffs. These countries' gain will increase as bilateral non-tariff elimination deepens. Larger countries will gain more than small countries. Asia FTA, Asia Union and RCEP will benefit member countries more than ASEAN+3. Global free trade will benefit all countries the most.

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1. Introduction

In Asia formal FTA arrangements have developed more slowly than in North American and Europe. Until now, there is no fully comprehensive FTA in Asia, but instead a number of lesser arrangements. At present, some important negotiations are in progress, including the Regional Comprehensive Economic Partnership (RCEP), the Trans-Pacific Partnership (TPP), the ASEAN Plus Three (APT), an China-Japan-South Korea FTA, and others. In the future, Asia may thus probably move to some form of comprehensive trade bloc. Under these circumstances, it is helpful to numerically explore how close Asia is already to being a trade bloc as well as what will be the effects of potential Asian blocs like arrangements on individual economies.

Here we utilize the Debreu (1951, Econometrica) coefficient as a measure of closeness to being a formal trading bloc. Little research has used this measure in application, and there are only a few papers in which this measure plays a role in the theoretical structure, including Raa (2008), Ahlheim *et al* (1988), Anderson and Neary (1996), Brown and Srinivasan (2007). Riezman, Whalley and Zhang (2006) also construct distance measures to estimate distance of economies from free trade, but do not use Debreu's distance coefficient.

Computational general equilibrium methodology has been widely used to explore free trade agreement (FTA) effects. The Hicks (1943) welfare variation measures are the most common index used for analyzing FTA effects. This paper thus injects the Debreu distance into exploring FTA effects.

Literature on Asia trade blocs is sparse and mostly analytical, such as Shiino (2012), Fukunaga and Isono (2013), Williams (2012), Lewis (2011), Ezell and Atkinson (2011), and Stubbs (2002). Some earlier research numerically explores the effects of regional free trade agreements (see the survey by Lloyd and MacLaren (2004)), but few papers try to capture the potential effects of recent FTA developments in Asia. Petri *et al* (2011), Itakura and Lee (2012), Kawai and Wignaraja (2008) are the exceptions. Our paper departs from these in using a Debreu distance indicator to explore the closeness of Asia trade arrangements to being formal trade blocs. We also use Hicks (1943) compensation and equivalent variation measures to compare these results in sensitivity analysis.

Our global general equilibrium model has 15 countries, which are China, the US, the EU, Japan, South Korea, Canada, Mexico, India, AN (Australia and New Zealand), CP (Chile and Peru), BMSV (Brunei, Malaysia, Singapore and Vietnam), CILMPT (Cambodia, Indonesia, Laos, Myanmar, Philippine, and Thailand), ODDC (other developed countries), ODC (other developing countries), and the Rest of World (ROW). Each country produces two goods (Manufaturing goods and non-Manufacturing goods) with two factors of production (Capital and Labour). The model uses an exogenous trade imbalance structure and includes trade costs as trade barriers. We use a trade cost calculation method that recognizes limitations of data by utilizing an estimation method that follows Wong (2012) and Novy (2008).

Our calculation results show that the distances of present situation to Asia FTA, Asia Union, RCEP are nearly the same, but the distance to ASEAN+3 is nearer, which means ASEAN+3 will benefit involved countries less than other Asia FTAs. Distances to global free trade are farther than all regional Asia FTAs, which means that the global free trade agreement will gain all countries more than regional free trade arrangements. All countries in Asia trade bloc will gain from FTA arrangements when tariff and non-tariff can both been eliminated. But if the FTA arrangements can only remove tariff, some of big countries will be hurt. All countries' gain will increase when non-tariff barriers remove more. In the meanwhile, large countries will gain less than small countries.

2. Asia FTAs and Their Developments

Asia has not formed comprehensive free trade agreement, but multicounty Asian FTAs have been the subject of discussion particularly after the 2008 global financial crisis. These include ASEAN+3, ASEAN+6 and RCEP (Regional Comprehensive Economic Partnership). A comprehensive Asia FTA may come into being in the future, and result in a formal Asian bloc like NAFTA (North America Free Trade Agreement) and EU (Europe Union), but for now, Asian trade integration rests on the accommodation of overlapping sub Asian FTAs rather than blocs in Europe and North American, which reflect the design of an overachieving arrangement in the absence of prior agreements.

In contrast to Africa, the Americas and Western Europe, before 1992 Asia had no regional or bilateral free trade agreements (FTAs). In January 1993, the ASEAN Free Trade Area (AFTA) came into force over the last decade; Asia has seen a rapid increase in FTAs. According to the Asian Development Bank (ADB) FTA statistics as of 2013, there are 257 FTAs in the Asia Pacific Area (compared with just 50 in 2000), with 132 concluded, 75 under negotiation and 50 proposed. Within these, 189 are bilateral, and 68 are plurilateral. The leading countries involved in Asia FTAs are Singapore (37), India (34), Korea (32), China (27), Pakistan (27), Thailand (26), Japan (26) and Malaysia (26)[1].

Among Asia FTAs, larger agreements such as ASEAN act as a hub. For example: ASEAN's own FTA is complemented by FTAs between ASEAN and other economies

[1] See Asia Development Bank "Asia Regional Integration Center" statistics, http://aric.adb.org/fta.

(China, India, Japan, Korea); FTAs between individual ASEAN countries and other countries and comprehensive economic partnership agreements for East Asia. In Asia area, there are about 30 major FTAs in effect[2] (see Table 1).

Table 1: Major FTAs In Effect In the Asia Region

FTAs	Date In Effect
Laos-Thailand	June, 1991
AFTA (ASEAN)	January, 1992
Japan-Singapore	November, 2002
ASEAN-China	January, 2004
Thailand-India	September, 2004
Singapore-India	August, 2005
Singapore-South Korea	March, 2006
Japan-Malaysia	July, 2006
ASEAN-South Korea	June, 2007
Japan-Thailand	November, 2007
Japan-Indonesia	July, 2008
Japan-Brunei	July, 2008
ASEAN-Japan	December, 2008
Japan-Philippine	December, 2008
Singapore-China	January, 2009
Japan-Vietnam	October, 2009
ASEAN-India	January, 2010
South Korea-India	January, 2010
Malaysia-India	July, 2011
Japan-India	August, 2011

Source: Shiino (2012).

Among FTAs still under negotiation in Asia region, the most prominent arrangements are ASEAN Plus Three (APT) and the Regional Comprehensive Economic Partnership (RCEP). The proposed Trans-Pacific Partnership (TPP) also involves the Asia Pacific region, although we do not include it in the analysis of this paper since it exclusively includes non-Asian countries.

The ASEAN Free Trade Area (AFTA) is a trade agreement involving the Association of Southeast Asian Nations signed in January 1992 in Singapore. When the AFTA was originally signed, ASEAN had six members, namely Brunei, Indonesia, Malaysia, Philippines, Singapore and Thailand. Vietnam jointed in 1995, Laos and

[2] See K. Shiino, "Overview of Free Trade Agreements in Asia", BRC Research Report No.9, 2012, IDE-JETRO.

Myanmar in 1997 and Cambodia in 1999. AFTA now comprises ten countries of ASEAN.

ASEAN Plus Three (APT) coordinates cooperation between ASEAN and the three East Asian nations of China, Japan, and South Korea. The APT is the latest example of East Asian regional cooperation. It reflects earlier proposals for an Asian Free Trade Bloc, such as Korea's call for an Asian Common Market in 1970 and Japan's 1988 suggestion for an Asian Network. The first APT's leaders meeting was held in 1996, until now it has 13 summits; the latest one in October 2010.

The Regional Comprehensive Economic Partnership (RCEP) members include the 10 ASEAN countries and prospective 6 FTA partners: Australia, China, India, Japan, Korea and New Zealand. The RCEP negotiation aims to conclude by the end of 2015 and cover more than 3 billion people. The area has a combined GDP of about $17 trillion, and accounts for about 40% of world trade.

The idea of such a new trade treaty was first mooted at the 19th ASEAN Summit in November 2011, when leaders of the ten ASEAN member states adopted general principles for broadening and deepening ASEAN's engagement with its FTA Partners, and signaled ASEAN's commitment to play a central role in the emerging regional economic architecture.

RCEP's first round ministerial meeting was held in Brunei in August 2013, and the second round of RCEP negotiations was conducted on September 23-27 2013 in Brisbane, Australia. The 16 economic ministers of Asean+6 have agreed to finalize the Regional Comprehensive Economic Partnership by 2015, when the ASEAN

Economic Community takes full effect[3].

The aim of this paper is to numerically calculate how close Asia is already surrogate trade bloc, prior to the conclusion of a RCEP negotiation. FTA development in Asia area has received considerable attention. But the Asian area includes a lot of large countries and still does not have a high standard FTA. In the meanwhile, Asia countries all seem eager to form a FTA to promote regional integration after the global financial crisis in 2008. The issue of an Asia trade bloc may well become the most important FTA development in the near future and how close the Asian economies are already towards this goal is a key element in the debate.

[3] See P. Pratruangkrai, "Economic ministers agree to establish ASEAN+6 FTA by 2015", The Nation website, 2013-8-23.

3. Debreu's Coefficient and Distance Measures

To measure the remaining distance for the Asian closeness to a comprehensive FTA we use a calibrated numerical general equilibrium model in which we incorporate a modified form of Debreu the resource utilization coefficient of inefficiency.

3.1 The Debreu Coefficient of Resource Utilization

Debreu (1951) proposes a measure of the inefficiency of the allocation of resources in an economy by calculating how much less resources could attain the same level of satisfaction to consumers. The ratio of how much less resources can show the inefficiency level of the allocation and we take this as the measure of distance between a multi-country equilibrium under a potential Asian trade arrangements and what a comprehensive agreement would permit.

To exposit the Debreu measure, consider an economy which comprises m consumers with preference relationships $\succsim_i$ and observed consumption vectors $X_i^0 \in R^l$ (i=1,…, m) , where l is the number of commodities. $Y \subset R^l$ is the set of possible input vectors (net quantities of commodities consumed by the whole production sector), including the observed one y^0. A combination of consumption vectors and an input vector is feasible if the total sum (the economy-wide net consumption), does not exceed the vector of utilizable physical resources, $Z^0 \in R^l$. Z^0 is assumed to be at least equal to the sum of the observed consumption and input vectors, ensuring the feasibility of the latter.

The set of net consumption vectors that are at least as good as the observed ones is

$$\mathrm{B} = \left\{ \sum X_i \mid X_i \geq_i X_i^0, i = 1, \cdots, m \right\} + Y \tag{1}$$

where B stands for the 'better' set. The minimal resources required to attain the same levels of satisfaction that come with X_i^0 belong to $B^{\min}$, the South-western edge or subset of elements z that are minimal with respect to $\geq$. Assume that preferences are convex and continuous, and that production possibilities form a convex and closed set, then a supporting price vector $p(z) > 0$ exists such that $Z' \in B$ and which implies

$$p(z)z' \geq p(z)z \quad (2)$$

Where $p > 0$ implies all components are positive.

The Debreu coefficient of resource utilization is defined by

$$\rho = \max_z \left\{ p(z)z / p(z)z^0 \mid z \in B^{\min} \right\} \quad (3)$$

and the coefficient ρ measures the distance from the set of minimally required physical resources, $z \in B^{\min}$, to the utilizable physical resources, z^0, in the metric of the supporting prices. Debreu shows that the distance or the max in equation (2) is attained by

$$z = \rho z^0 \in B^{\min} \quad (4)$$

In words, the Debreu coefficient of resource utilization is the smallest fraction of the actually available resources that would permit the achievement of the levels of satisfaction that come with X_i^0. Coefficient ρ is a number between zero and one, the latter indicating full efficiency[4] (Raa, 2008).

3.2 Debreu Distance Measures Used in Simulation

In this paper we use the Debreu's distance coefficient to calculate the distance from present trade agreement in Asia to an Asia trade bloc. Distance in our paper is measured by the shrinkage in the endowment of Asia such that a full trade bloc scenario could be attained.

We use a numerical global general equilibrium model to calculate the distance for

[4] See: Raa, T.T. "Debreu's coefficient of Resource Utilization, the Solow Residual, and TFP: the Connection by Leontief Preferences". Journal of Productivity Analysis, 30, pp.191-199.

present FTAs to a possible comprehensive Asian trade bloc. We compute two kinds of distance, one is individual country distance, and the other is whole Asia bloc distance.

If we assume an N country world, each countries denoted as i (1, …, m). In the base case (present status), a global general equilibrium has a consumption set $(C_1^*,\cdots,C_N^*)$, utility set $(U_1^*,\cdots,U_N^*)$, endowment set $(E_1^*,\cdots,E_N^*)$, and factor demand set $(K_1^*,\cdots,K_N^*)$. Under an Asia bloc scenario, the global general equilibrium has a consumption set denoted as $(C_1,\cdots,C_N)$, utility set $(U_1,\cdots,U_N)$, endowment set $(E_1,\cdots,E_N)$, and factor demand set $(K_1,\cdots,K_N)$.

For the distance we know to an Asia bloc, we denote the distance measure as λ. Under the Debreu's resource utilization concept, we define as

$$\begin{aligned} & min \ \ \lambda \\ & s.t. \ \ (1) GE, \\ & \quad (2) \forall i, \ \ K_i \le \lambda E_i, \ \ (i \in country \ \ in \ \ the \ \ bloc) \\ & \quad (3) \forall i, \ \ U_i \ge U_i^*, \ \ (i \in country \ \ in \ \ the \ \ bloc) \end{aligned} \tag{5}$$

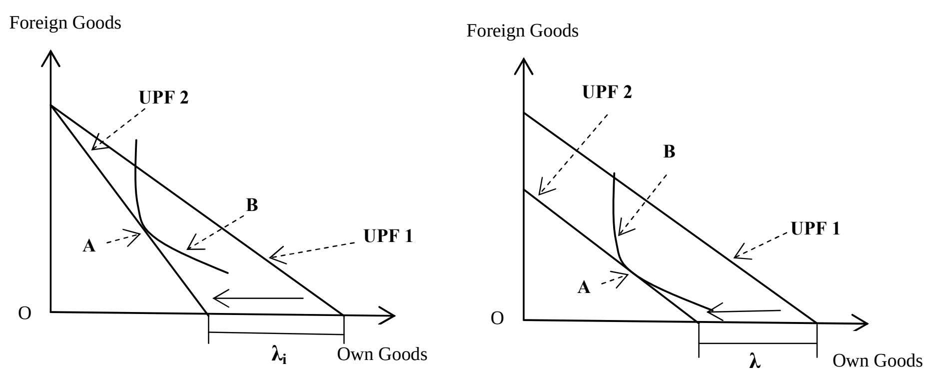
where λ is the distance of the present situation to that under an Asia bloc. The utility of all countries in the bloc will be not less than in their base case situation. Figure 1(II) shows this concept of distance a single country. In the base case, the equilibrium consumption point is B; in the Asia bloc scenario, the utility possibility frontier is UPF 1. If we keep the utility in the new scenario as not less than in base case, the utility possibility frontier can shrink to UPF 2, and λ is the ratio between UPF 1 and UPF 2.

For the distance of an individual country to Asia bloc, we can again denote the distance measure as λ_i, and define as

$$
\begin{aligned}
& min \ \ \lambda_i \\
& s.t. \ \ (1) GE, \\
& \quad (2) K_i \le \lambda_i E_i, \\
& \quad (3) U_i \ge U_i^*
\end{aligned}
\tag{6}
$$

where λ_i is the distance of country i from the present RTA situation to an Asia RTA bloc. It shows the minimum endowment ratio that keeps the utility of country i in the bloc not less than in the base case. Figure 1(I) shows the distance measured for individual countries. We keep the foreign country's consumption fixed, and own country consumption moves from point B to point A in utility space, and the own country's utility possibility frontier changes from UPF 1 to UPF 2, the ratio λ_i is the distance measure for country i.

Figure 1: Debreu Distance Measure Relative to Full Asia FTA



(I) Individual Country (II) Whole

If the distance measure is larger than 1, it implies that the trade bloc arrangement cannot improve welfare of the whole trade bloc of countries and not for individual countries, which means the trade bloc has negative effects. If the distance measure is smaller than 1, it implies that the trade bloc arrangement decreases welfares for the whole trade bloc and for individual countries. The nearer the distance measure to 1, then the distance between present situation and an Asia trade bloc is nearer. A small distance value means the trade bloc effects are significant and the present situation to trade bloc is large.

We thus use a revised Debreu distance indicator, which equals

$$\begin{cases} D = (1-\lambda)\times 100 \\ D_i = (1-\lambda_i)\times 100 \end{cases} \tag{7}$$

where D or D_i are separately the Debreu distance indicators for the whole FTA groups and individual countries. When D or D_i are positive, it means that FTA arrangements have positive effects for the whole group or individual countries and they can keep their original welfare level by decreasing D or D_i percent of their endowment; When D or D_i are negative, this means FTA arrangements have negative effects for the whole group and for individual countries. If they want to keep their original welfare level they must increase D or D_i percent of their endowment.

4. Model Structure and Trade Cost Calculation

We use a global general equilibrium model with an exogenous trade imbalance and trade barriers based on trade costs to calculate Debreu distance measures to assess how far close is already to a surrogate trade bloc.

4.1 An Exogenous Trade Imbalance GE Model with Trade Costs

Our single period global general equilibrium model has fifteen countries and each country produces two goods with two factors. These fifteen countries are China, the US, the EU, Japan, Korea, Canada, Mexico, India, AN (Australia and New Zealand), CP (Chile and Peru), BMSV (Brunei, Malaysia, Singapore, and Vietnam), CILMPT (Cambodia, Indonesia, Laos, Myanmar, Philippine, and Thailand), ODDC (other developed countries, including Switzerland, Norway, Israel, and Iceland), ODC (other developing countries, including Brazil, Russian, Egypt, Argentina, and South Africa), and ROW (the rest of the world). The two goods are manufactured goods and non-manufactured goods. We use agricultural and service sectors as producers of non-manufactured goods and assume these cannot be traded between countries. The two factors in each country are labor and capital, which are treated as intersectorally mobile but internationally immobile. We include trade imbalances in the model, with the trade imbalance for each country assumed to be fixed and exogenously determined.

On the production side of the model, we assume CES technology for production of each good in each country

$$Q_i^l = \phi_i^l [\delta_i^l (L_i^l)^{\frac{\sigma_i^l - 1}{\sigma_i^l}} + (1-\delta_i^l)(K_i^l)^{\frac{\sigma_i^l - 1}{\sigma_i^l}}]^{\frac{\sigma_i^l}{\sigma_i^l - 1}}, \qquad i = country, l = goods \tag{8}$$

where Q_i^l is the output of the lth industry (including tradable goods and non-tradable goods) in country i, L_i^l and K_i^l are the labor and capital inputs in sector l, ϕ_i^l is the scale parameter, δ_i^l is the distribution parameter and σ_i^l is the elasticity of factor substitution. First order conditions imply the factor input demand equations,

$$K_i^l = \frac{Q_i^l}{\phi_i^l}[\delta_i^l [\frac{(1-\delta_i^l) w_i^L}{\delta_i^l w_i^K}]^{(1-\sigma_i^l)} + (1-\delta_i^l)]^{\frac{\sigma_i^l}{1-\sigma_i^l}} \tag{9}$$

$$L_i^l = \frac{Q_i^l}{\phi_i^l}[\delta_i^l + (1-\delta_i^l)[\frac{\delta_i^l w_i^K}{(1-\delta_i^l) w_i^L}]^{(1-\sigma_i^l)}]^{\frac{\sigma_i^l}{1-\sigma_i^l}} \tag{10}$$

where w_i^K and w_i^L are the prices of capital and labor in country i.

On the consumption side, we use the Armington assumption of product heterogeneity across countries, and use a nested CES utility function for each country

$$U_i(X_i^M, X_i^{NM}) = [\alpha_{i1}^{\frac{1}{\sigma_i}} (X_i^M)^{\frac{\sigma_i - 1}{\sigma_i}} + \alpha_{i2}^{\frac{1}{\sigma_i}} (X_i^{NM})^{\frac{\sigma_i - 1}{\sigma_i}}]^{\frac{\sigma_i}{\sigma_i - 1}}, \quad i = country \tag{11}$$

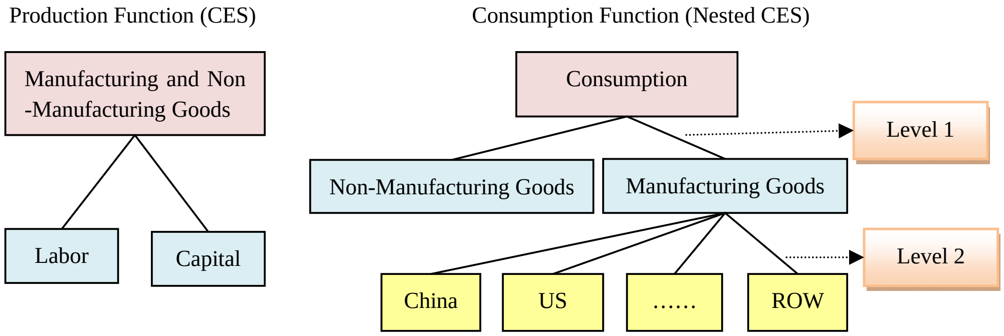
where X_i^{NM} denotes the consumption of non-manufacturing goods in country i, X_i^M denotes the consumption of composite Armington manufacturing goods in country i. Additionally α_{i1} and α_{i2} are share parameters and σ_i is the top level elasticity of substitution in consumption.

The composite of manufactoring goods is defined as another reflecting the country from which goods come. We assume this level 2 composite consumption is also of CES form and represented as,

$$X_i^M = [\sum_j \beta_{ij}^{\frac{1}{\sigma_i'}} x_{ij}^{M \frac{\sigma_i'-1}{\sigma_i'}}]^{\frac{\sigma_i'}{\sigma_i'-1}}, \quad j = country \tag{12}$$

where x_{ij}^M is the consumption of manufactory goods from country j in country i. If $i = j$ this implies that this country consumes its domestically produced tradable goods. β_{ij} is the share parameter for country $j's$ manufactoring goods consumed in country i. σ_i' is the elasticity of substitution in level 2 preferences in country i.

Fig. 2 Nesting Structure of Production and Consumption Functions



Source: Compiled by authors.

The utility optimization problem above yields

$$X_i^M = \frac{\alpha_{i1} E_i}{(P_i^M)^\sigma [\alpha_{i1}(P_i^M)^{1-\sigma} + \alpha_{i2}(pc_i^{NM})^{1-\sigma}]} \tag{13}$$

$$X_i^{NM} = \frac{\alpha_{i2} E_i}{(pc_i^{NM})^\sigma [\alpha_{i1}(P_i^M)^{1-\sigma} + \alpha_{i2}(pc_i^{NM})^{1-\sigma}]} \tag{14}$$

where P_i^M and pc_i^{NM} are the separate consumption prices of composite manufacturing goods and non-manufacturing goods in country i. E_i is the total consumption expenditure of country i. For the composite manufacturing goods which enter the second level preferences and come from different countries, the country specific demands are

$$x_{ij}^{M} = \frac{\beta_{ij}(X_i^M P_i^M)}{(pc_{ij}^M)^{\sigma_i^{'}}[\sum_j \beta_{ij}(pc_{ij}^M)^{(1-\sigma_i^{'})}]} \tag{15}$$

where pc_{ij}^M is the consumption price in country i of manufacturing goods produced in country j, $X_i^M P_i^M$ is the total expenditure on manufacturing goods in country i. The consumption price for the composite of manufacturing goods is

$$P_i^M = [\sum_{j=1}^{15} \beta_{ij}(pc_{ij}^M)^{(1-\sigma_i^{'})}]^{\frac{1}{1-\sigma_i^{'}}} \tag{16}$$

and the total consumption expenditure of country i is

$$E_i = P_i^M X_i^N + pc_i^{NM} X_i^{NM} \tag{17}$$

Equilibrium in the model characterized by market clearing prices for goods and factors in each country such that

$$Q_i^M = \sum_j x_{ji}^M \tag{18}$$

$$\sum_l K_i^l = \overline{K_i} \quad , \quad \sum_l L_i^l = \overline{L_i} \tag{19}$$

Later we discuss the non-manufacturing goods market clearing condition. A zero profit condition must also be satisfied in each industry in each country, such that

$$p_i^l Q_i^l = w_i^K K_i^l + w_i^L L_i^l \qquad l = M, NM \tag{20}$$

We introduce trade costs for pairwise trade between countries (Anderson and Wincoop, 2003). Trade costs include not only import tariffs but also other non-tariff barriers such as transportation costs, language barriers, and institutional barriers. We divide trade costs into two parts in our model; import tariffs and non-tariff trade costs. We denote the import tariff in country i as t_i, and non-tariff trade costs as N_{ij} (ad volume tariff-equivalent non-tariff trade costs for country i imported from country j). This yields the following relation between consumption prices and production prices in country i for country $j's$ exports.

$$pc_{ij}^{M} = (1 + t_i + N_{ij})\, p_j^{M} \tag{21}$$

We assume that trade costs are covered by importing country. Import tariffs generate revenues R_i, which are given by

$$R_i = \sum_{j, i \neq j} p_j^{M} x_{ij}^{M} t_i \tag{22}$$

Non-tariff trade barriers generate no revenue, and importers need to use real resources to cover the costs involved. In the model, we assume that these resource costs are denominated in terms of domestic non-manufacturing goods. We incorporate this resource using feature through use of non-manufacturing goods equal in value terms to the cost of barriers. We assume reduced non-tariff trade costs (including transportation cost) will thus occur under trade liberalization as an increase in non-manufacturing goods consumption NR_i by the representative consumer in importing countries. The representative consumer's income in country i is given by

$$w_i^{K} \overline{K_i} + w_i^{L} \overline{L_i} + R_i = I_i \tag{23}$$

and the demand-supply equality involving non-manufacturing goods becomes

$$Q_i^{NM} = \frac{NR_i}{p_i^{NM}} + X_i^{NM} \tag{24}$$

where

$$NR_i = \sum_{j,i\neq j} p_j^M x_{ij}^M N_{ij} \tag{25}$$

The Asia bloc thus reduces both import tariffs and non-tariff trade costs between member countries which will influence trade in the whole world.

We assume an exogenously determined fixed trade imbalance, denoted as S_i, which will be positive when in trade surplus and negative when in trade deficit. Trade equilibrium will influence individual country's budget constraint. In the equilibrium, we have

$$I_i = E_i + S_i \tag{26}$$

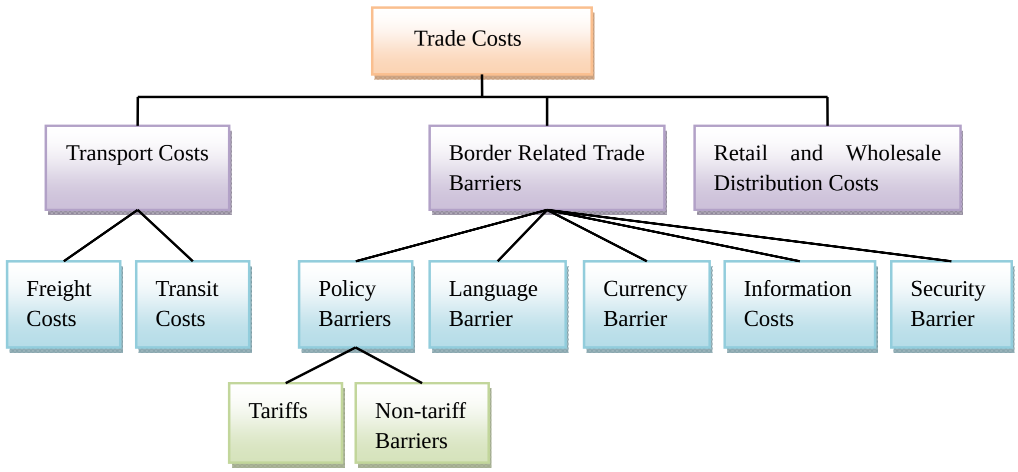
which means that one country's total income equals its total consumption expenditure plus its surplus (trade imbalance), if one country has trade surplus then its income will more than consumption expenditure, but if one country has trade deficit than its income will be less than consumption expenditure.

4.2 Trade Cost Calculation Methodology

Trade costs capture not only policy barriers (Tariffs and Non-tariff barriers) but also transportation costs (freight and time costs) as well as communication and other information costs, enforcement costs, foreign exchange costs, legal and regulatory costs and local distribution costs. Figure 3 reports the structure of representative trade costs used by Anderson and Wincoop (2004) to illustrate conceptually what is involved.

We calculate trade costs following the approaches in Novy (2008) and Wong (2012). Their method is to take the ratio of bilateral trade flows over local trade, scaled to some parameter values, and then use a measure that capture all barriers. Some have argued that this measure is consistent with the gravity equation and robust across a variety of trade models (Novy, 2008; Wong, 2012).

Fig. 3 Representative Trade Costs



Source: Anderson and Wincoop (2004) and De (2006).

The measure of trade barrier used here is based on the gravity equation derived from Chaney's (2008) model of heterogeneous firms with bilateral fixed costs of exporting. Trade barriers can take two forms in the model, a variable trade barrier τ_{ir} and a fixed cost of exporting F_{ir}. The variable trade barrier τ_{ir} is an iceberg cost. In order to deliver one unit of good to i from r, $\tau_{ir} > 1$ unit of good has to be delivered. The gravity equation supported by this model is:

$$X_{ir} = \frac{Y_i \times Y_r}{Y} \left(\frac{w_r \tau_{ir}}{\theta_i}\right)^{-\gamma} F_{ir}^{-(\frac{\gamma}{\sigma - 1} - 1)} \tag{27}$$

Where X_{ir} is import of country i from country r. Y_i, Y_r and Y are the economic sizes of both countries and the total world, w_r is labor costs, τ_{ir} is variable trade costs and F_{ir} is the fixed cost of exporting. The Pareto parameter γ governs the distribution of firm productivities. σ is the elasticity of substitution in preferences. θ_i is a remoteness measure for the importing country which captures trade diversion effects. The mechanism is that the further away i is from the rest of the world, the more likely that r could export more to i due to less competition from third party countries in the importer country. This has a similar interpretation to the multilateral resistance term in Anderson and Wincoop (2003).

We relate data on trade flows to unobservable trade barriers by taking ratios of bilateral trade flows of two regions over local purchases of each of two countries:

$$\frac{X_{ir}X_{ri}}{X_{ii}X_{rr}}=(\frac{\tau_{ri}\tau_{ir}}{\tau_{ii}\tau_{rr}})^{-\gamma}(\frac{F_{ri}F_{ir}}{F_{ii}F_{rr}})^{-(\frac{\gamma}{\sigma-1}-1)} \tag{28}$$

This equation reveals the relationship between observable trade data and unobservable trade barriers and eliminates the need to worry about the omission of unspecified or unobserved trade barriers. If the fixed costs of exporting are not bilaterally differentiated ($F_{ri}=F_r$) or are constant across locations ($F_{ri}=F$), fixed costs drop out of this measure and measured trade costs are interpreted as variable trade costs, as in models without fixed export costs such as Eaton and Kortum (2002), Anderson and Wincoop (2003).

For simplicity, we normalize own trade costs to 1, i.e. $\tau_{ii}=1$ and $F_{ii}=1$. Defining the geometric average of trade costs between the country pair i and r as

$$t_{ir}=(\frac{X_{ir}X_{ri}}{X_{ii}X_{rr}})^{-\frac{1}{2\gamma}} \tag{29}$$

We then get a measure of the average bilateral trade barrier between country i and r:

$$t_{ir}=(\frac{X_{ii}X_{rr}}{X_{ir}X_{ri}})^{\frac{1}{2\gamma}}=(\tau_{ir}\tau_{ri})^{\frac{1}{2}}(F_{ri}F_{ir})^{\frac{1}{2}(\frac{1}{\sigma-1}-\frac{1}{\gamma})} \tag{30}$$

Data for this equation are relatively easy to obtain, and so we have a comprehensive measure of trade barriers, and the ad valorem tariff-equivalent bilateral average trade cost between country i and r can be written as

$$\bar{t}_{ir} = t_{ir} - 1 = \left(\frac{X_{ii} X_{rr}}{X_{ir} X_{ri}}\right)^{\frac{1}{2\gamma}} - 1 \tag{31}$$

Using the trade costs equation above, we can calculate actual trade costs between bilateral country pairs in our general equilibrium model. In the calculation, X_{ir} and X_{ri} are separately exports and imports between countries i and r. Due to market clearing, intranational trade X_{ii} or X_{rr} can be rewritten as total income minus total exports (see equation (8) in Anderson and Wincoop(2003)),

$$X_{ii} = y_i - X_i \tag{32}$$

Where X_i is the total exports, defined as the sum of all exports from country i, which is

$$X_i \equiv \sum_{r, i \neq r} X_{ir} \tag{33}$$

In the trade cost calculation, all trade data are from the UN Comtrade database. For y_i, GDP data are not suitable because they are based on value added, whereas the trade data are reported as gross shipments. In addition, GDP data include services that are not covered by the trade data (Novy, 2008). It is hard to get this income data according to such a definition, so here we use GDP data minus total service value added. We get GDP data from the World Bank database, and the service share of GDP data from World Development Indicators (WDI) of World Bank database, we then calculate results for GDP minus services. We take the value of γ to be 8.3 as in Eaton and Kortum (2002). We only use trade cost data for 2011 in our numerical general equilibrium model, calculation results are shown in Table 2.

Table 2: Ad Valorem Tariff-Equivalent Trade Costs Between Countries in 2011 (Unit: %)

Country	US	EU	China	Japan	Korea	Canada	Mexico	India	AN	CP	BMSV	CILMPT	ODDC	ODC	ROW
US	0	0.253	0.265	0.344	0.293	0.151	0.142	0.854	0.225	0.411	0.468	0.714	0.236	0.678	0.632
EU	0.254	0	0.268	0.423	0.319	0.408	0.391	0.728	0.262	0.484	0.462	0.746	0.358	0.672	0.649
China	0.265	0.268	0	0.252	0.171	0.427	0.412	0.733	0.175	0.414	0.335	0.489	0.359	0.493	0.436
Japan	0.344	0.423	0.252	0	0.247	0.515	0.541	1.029	0.267	0.597	0.334	0.591	0.414	0.701	0.538
Korea	0.293	0.319	0.171	0.247	0	0.461	0.383	0.791	0.177	0.439	0.264	0.491	0.341	0.539	0.439
Canada	0.151	0.408	0.427	0.515	0.461	0	0.312	1.194	0.424	0.55	0.793	0.983	0.369	0.987	0.888
Mexico	0.142	0.391	0.412	0.541	0.383	0.312	0	1.188	0.433	0.486	0.739	1.058	0.354	0.971	0.956
India	0.854	0.728	0.733	1.029	0.791	1.194	1.188	0	1.144	1.219	1.001	1.602	1.157	1.139	0.625
AN	0.225	0.262	0.175	0.267	0.177	0.424	0.433	1.144	0	0.741	0.217	0.718	0.358	0.749	0.638
CP	0.411	0.484	0.414	0.597	0.439	0.55	0.486	1.219	0.741	0	0.976	1.094	0.593	0.926	0.987
BMSV	0.368	0.362	0.295	0.304	0.264	0.593	0.639	0.701	0.217	0.976	0	0.335	0.612	0.712	0.316
CILMPT	0.714	0.746	0.489	0.591	0.491	0.983	1.058	1.602	0.718	1.094	0.535	0	0.917	0.931	0.439
ODDC	0.236	0.358	0.359	0.414	0.341	0.369	0.354	1.157	0.358	0.593	0.612	0.917	0	0.524	0.553
ODC	0.678	0.672	0.493	0.701	0.539	0.987	0.971	1.139	0.749	0.926	0.712	0.931	0.524	0	0.751
ROW	0.632	0.649	0.436	0.538	0.439	0.888	0.956	0.625	0.638	0.987	0.516	0.439	0.553	0.751	0

Notes: (1) (1) BMSV denotes Brunei+Malaysia+Singapore+Vietnam, AN denotes Australia+New Zealand, CP denotes Chile+Peru, CILMPT denotes Cambodia+Indonesia+Laos+Malaysia+Philippine+Thailand. (2) We see group countries as a whole to calculate trade costs.

Source: Calculated by authors.

5. Data and Parameters Calibration

We use 2011 as our base year in building a global benchmark general equilibrium dataset for use in calibration and simulation following the methods set out in Shoven and Whalley (1992). There are fifteen countries in our model, and country group data is obtained by adding individual country data together. ROW data is obtained from total world values minus values for the other fourteen countries. For the two goods, we assume secondary industry (manufacturing) reflects manufactured goods, and primary and tertiary industries (agriculture, extractive industries, and services) yield non-manufactured goods. For the two factor inputs, capital and labor, we use total labor income (wage) to denote labor values for inputs by sector. All data are in billion US dollars. We adjust some of the data for mutual consistency for calibration purposes.

All data except for the EU are from the World Bank database (World Development Indicate). We use agriculture and service share of GDP data and GDP data to yield production data of manufacturing goods and non-manufacturing goods, and use capital/GDP ratios to yield capital and labor input in production. The EU data are from EU statistics, the currency unit is Euro, and we use annual average exchange rates to change them into US dollar currency units. These data are listed in Table 3.

Trade data between each pair of countries are from the UN Comtrade database. We use individual country total export and import values to indirectly yield exports to and imports from the ROW, and add individual country trade data to yield country group's trade data. Using production and trade data, we can then calculate each country's consumption values. The trade data we use are listed in Table 4.

Table 3: Base Year Data Used For Calibration and Simulation (2011 Data)

Country	GDP	T-G	NT-G	Balance	Capital		Labor	
					T-G	NT-G	T-G	NT-G
USA	14991.3	2998.3	11993	-788.2	959.5	1289.2	2038.8	10703.8
EU	17589.8	4397.5	13192.3	-413.1	1945.5	1220.7	2452	11971.6
China	7318.5	3366.5	3952	155	1387.6	2125.3	1978.9	1826.7
Japan	5867.2	1642.8	4224.4	-32.2	516.3	657.1	1126.5	3567.3
Korea	1116.2	680.9	435.3	30.8	204.5	119.2	476.4	316.1
Canada	1736.1	590.3	1145.8	-0.2	309.6	89.7	280.7	1056.1
Mexico	1153.3	415.2	738.1	-1.2	207.6	80.7	207.6	657.4
India	1872.8	561.8	1311	-160.9	201.3	454.2	360.5	856.8
AN	1539.1	314.2	1224.9	46.7	81.3	321.4	232.9	903.5
CP	425.5	164.9	260.6	14.4	96.2	10.1	68.7	250.5
BMSV	667.6	462	205.6	-204.3	84.9	90.5	377.1	115.1
CILMPT	1489.8	694.2	795.6	5.9	304.7	139.9	389.5	655.7
ODDC	1407.4	539.1	868.3	90	163.6	374.6	375.5	493.7
ODC	5459.7	2841.5	2618.2	212.9	1582.5	1200.4	1259	1417.8
ROW	7262.5	4128.3	3134.2	1044.4	1992.3	1777.2	2136	1357

Note: (1) Units for production, capital, labor, inside money and endowments are all billion US$, and labor here denotes factor income (wage). (2) AN denotes Australia+New Zealand, CP denotes Chile+Peru, BMSV denotes Brunei+Malaysia+Singapore+Vietnam, CILMPT denotes Cambodia+Indonesia+Laos+Myanmar+Philippine+Thailand. (3) ODDC denotes other developed countries, including Switzerland, Norway, Israel, Iceland; ODC denotes other developing countries including Brazil, Russia, Egypt, Argentina, and South Africa. (4) T-G denotes tradable goods production; NT-G denotes non-tradable goods production. (5) We add countries together to generate AN, CP, BMSV values. (6) We use world values minus all individual countries to generate ROW values.

Sources: EU data from EU statistics, and the currency unit is Euro, we use annual average exchange rate to change them into US dollar currency unit; Other countries' data are all calculated from WDI of World Bank database.

Trade costs have two parts, import tariffs and all other non-tariff barriers. We obtain each country's import tariff data from WTO Statistics Database. For ROW, we use world average tariff rates to denote these values. Import tariffs data are listed in Table 5. We then can get non-tariff barriers by using trade costs minus import tariffs.

Table 5: Import Tariffs for Countries in 2011 (Unit: %)

Country	USA	EU	China	Japan	Korea	Canada	Mexico	India
Tariff	3.5	5.3	9.6	5.3	12.1	4.5	8.3	12.6
Country	AN	CP	BMSV	CILMPT	ODDC	ODC	ROW	/
Tariff	2.4	4.9	4.8	8.1	6.9	12.2	7.8	/

Notes: (1) Import tariffs here are simple average MFN applied tariff rates. (2) We use the average individual country's import tariff to get country groups' import tariff. (3) AN denotes Australia+New Zealand, CP denotes Chile+Peru, BMSV denotes Brunei+Malaysia+Singapore+Vietnam, CILMPT denotes Cambodia+Indonesia+Laos+Myanmar+Philippine+Thailand. (4) We use import tariff of the world to denote the tariff for the ROW.

Source: WTO Statistics Database.

There are no available estimates of elasticities for individual countries on the demand and production sides of the model. Many of the estimates of domestic and import goods substitution elasticity are around 2 (Betina *et al*, 2006), so we set all these elasticities in our model to 2 (Whalley and Wang, 2010). We perform sensitivity analysis around these elasticities.

With these data, we calibrate the model parameters. When used in model solution these regenerate the benchmark data as an equilibrium for the model. Then, using these parameters we can form a numerical global general equilibrium system, and can use this system to calculate Debreu distance measures for Asia trade arrangements.

Table 4: Trade between Countries in 2011 (Unit: Billion USD)

Countries		Importer														
		USA	EU	China	Japan	Korea	Canada	Mexico	India	AN	CP	BMSV	CILMPT	ODDC	ODC	ROW
Exporter	USA	0	256.7	103.9	66.2	43.5	280.7	174.9	22.6	31	24.2	54	26.1	33	69.3	359.5
	EU	329.3	0	172	61.8	41	37.4	30.1	51.1	43.3	13.2	56.5	29.9	254.9	242.4	571.3
	China	417.3	406.7	0	148.3	82.9	25.3	52.2	55.5	37.6	15.5	90.1	69	28.2	111.3	358.5
	Japan	132.4	93.9	194.6	0	66.2	8.9	10.2	11.2	19.7	3.2	58.3	63	10.1	30.4	121.1
	Korea	58.6	50.3	162.7	39.8	0	4.9	16.5	12.3	9.3	3.8	41.9	28.1	5.1	27.1	94.8
	Canada	319.1	31.5	22.2	13	6.6	0	9.6	2.3	2.3	1.5	2.4	2.9	5.2	7.3	24.5
	Mexico	275	22.6	6	4	2.3	10.6	0	2.2	2	3.9	2.2	0.4	1.1	9.1	8.2
	India	32.9	54.8	16.7	5.6	4.5	1.9	1.3	0	2.4	1	22.9	10.2	4.2	15.2	127.9
	AN	13.7	20.6	87.7	59.8	27.8	2.1	1.5	14.1	0	16.4	27.9	16.2	0.8	5.5	12.9
	CP	16.2	24.1	28.5	12.1	6.9	5.7	2.3	2.2	5.3	0	5.1	1.3	0.2	1.7	15.4
	BMSV	56.8	73.5	69.6	52.1	24.5	3.3	4.8	4.9	38	16.7	0	50.8	1.9	4.3	1
	CILMPT	54.4	56.3	79.1	68.5	25.2	5	4.7	15.5	17	1.6	71.2	0	2.1	5.7	48.1
	ODDC	83.5	287	16.1	12.6	5.3	7.4	1.9	6.8	4.1	0.6	1.9	3.1	0	10.6	26.4
	ODC	56	382.3	98.2	32.6	21.8	6.6	6.1	14.7	2.4	4.7	4.3	4.7	7.6	0	339.5
	ROW	488.6	587	686.1	279	165.9	50.8	34.7	247	45.9	6.3	167.8	142.8	22.9	228.7	0

Notes: (1) AN denotes Australia+New Zealand, CP denotes Chile+Peru, BMSV denotes Brunei+Malaysia+Singapore+Vietnam, CILMPT denotes Cambodia+Indonesia+Laos+Myanmar+Philippine+Thailand. (2) We get trade data of AN, CP, and BMSV by adding separate country's trade data together, and these do not include inner trade between these group countries. (3)We get the ROW trade data by deducting from each country's total export, total import and total world trade value.

Sources: United Nations (UN) Comtrade database and WTO Statistics.

6. Simulation Results

We use our 15-country global general equilibrium model to numerically calculate Debreu distances of present arrangements from various forms of an Asia trade bloc. We calculate distances for individual countries that are involved in the trade bloc and also distances for whole trade bloc of countries. From these distances, we can assess how close Asia is already to a surrogate trade bloc, and analyze the effects of different Asia trade bloc arrangements.

The main large countries in the Asia region include China, Japan, Korea, India, and ASEAN; and they are near each other in geography. Therefore, a typical Asia bloc should include these four countries and one country group. In the meanwhile, an Asia trade bloc may have two different types. One is like NAFTA, and in this all member countries do not have tariffs between each other but each has different tariff levels for outside countries. We call this type as an Asia FTA. The other is like the EU, all member countries do not have tariff between each other but they also have the same tariff level to outside countries. We call this type as Asia Union. ASEAN Plus Three (APT) and RCEP are presently important FTA arrangement negotiations and they may develop to an Asia FTA, we also take account of these two trade blocs. We are also interested in the distance to global free trade. Therefore, the paper will analyze five different scenarios: Asia FTA, Asia Union, ASEAN Plus Three, RCEP, and global free trade.

We use trade costs in our global general equilibrium model, to include both tariff and non-tariff barriers. We assume that all these Asia FTA arrangements will remove the whole of tariffs and partial non-tariff barriers. For non-tariff barrier removal, we use five different assumptions, which are 0% non-tariff barrier elimination (tariff only), 20% non-tariff barrier elimination, 40% non-tariff barrier elimination, 60% non-tariff barrier elimination, and 80% non-tariff barrier elimination. We separately calculate Debreu distances under this five different alternatives.

For the distance value, it shows how much less resources under Asia trade bloc scenario are needed to attain the same level of utility satisfaction as under the present scenario. The distance indicator is the shrinkage percent for the total endowment. If the distance indicator is negative, this means an increased percent ratio of total endowment are needed to keep the original welfare level, so that FTA arrangements have negative effects.

6.1 Distance Measures to An Asia FTA

Asia FTA is the scenario that China, Japan, South Korea, India, and ASEAN form a trade bloc. ASEAN has 10 countries; we separate them into two country groups of BMSV and CILMPT in our numerical general equilibrium model. We calculate distances for the present situation to an Asia FTA. Table 6, Figure 4 and Figure 5 list these results.

We find that nearly all the results are positive except the whole and China under only tariff elimination case. This reveals that almost all FTA member countries will gain. But if Asia FTA only remove tariff between countries and has no effect to non-tariff removal, China will be hurt. The reason is that China's import tariff is comparatively high, and Asian countries are not China's main trade partner, under such circumstance, when only tariffs removed between members, trade condition effects will make China lose.

Table 6: Distance Measures for the Present Situation to Asia FTA (%)

Country/Trade Cost	Tariff Only	T+20%NT	T+40%NT	T+60%NT	T+80%NT
China	-0.1	0.4	0.7	1.2	1.7
Japan	0.3	0.7	1.2	1.7	2.2
Korea	1.2	2.4	3.8	5.3	6.9
India	3.7	4.7	5.8	7.1	8.8
BMSV	3.5	8.2	13.5	18.9	24.5
CILMPT	0.2	3.0	5.8	9.1	13.1
WHOLE	**-0.1**	**0.3**	**0.7**	**1.1**	**1.6**

Note: (1) Tariff only denotes all tariff removed between FTA member countries, T+20% NT denotes all tariff and 20% non-tariff removed between FTA member countries, others are the same for T+40% NT, T+60% NT and T+80% NT.

(2) CILMPT denotes countries group of Cambodia+Indonesia+Laos+Myanmar+Philippine+Thailand, BMSV denotes countries group of Brunei+Malaysia+Singapore+Vietnam, NT denotes non-tariff barrier.

Source: Calculated by authors.

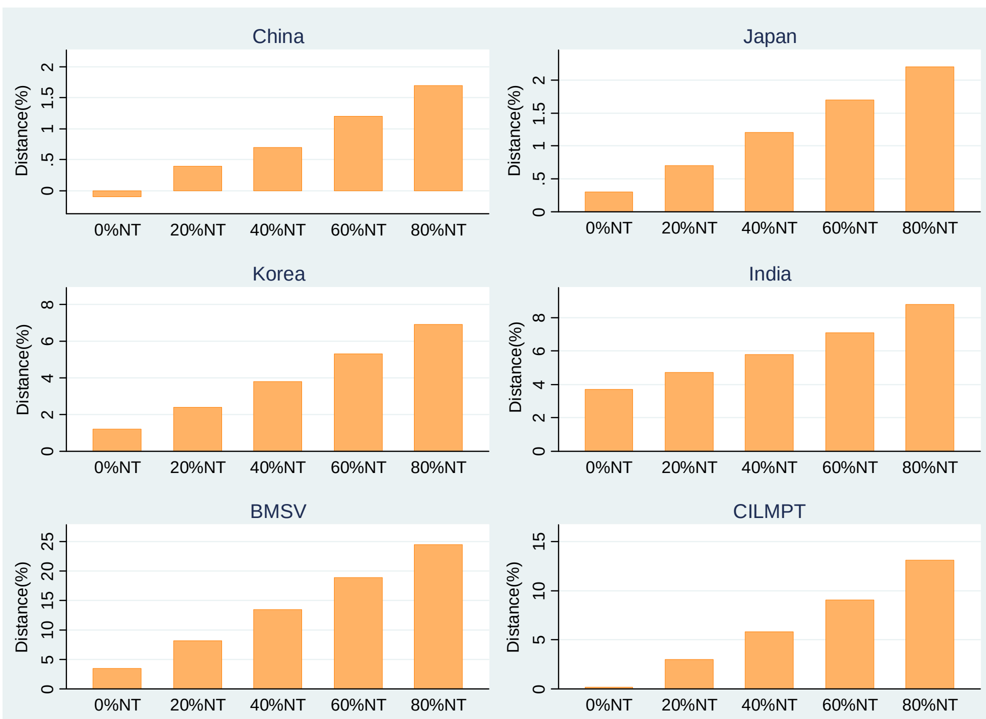


Fig. 4 Distances of Individual Countries to Asia FTA

Source: Calculated by Authors.

As the non-tariff barriers are removed more, the distance value becomes bigger, which means that all individual countries will gain more as non-tariff barriers eliminate more. For individual countries, BMSV will gain the most, then CILMPT, India, Korea, Japan, and the least is China. China's low benefit is also because of China's high import tariff and Asia counties are not China's main trade partner.

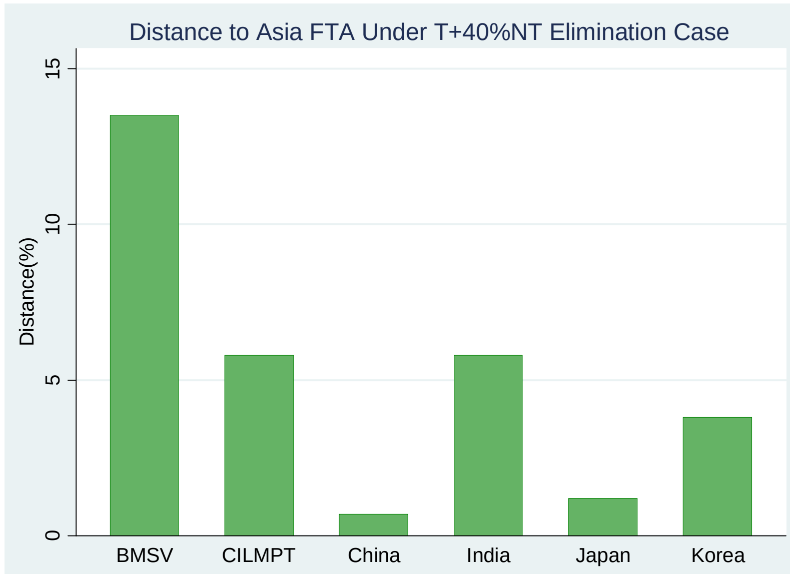


Fig. 5 Distances to Asia FTA under T+40%NT Case

Source: Calculated by Authors.

For the specific values, we take T+80%NT elimination case as an example. The Asia FTA countries as a whole can shrink 1.6% of their endowment to obtain utilities for each country in the trade bloc not less than their former level.

6.2 Distances to Asia Union

Asia Union is the scenario of China, Japan, South Korea, and ASEAN forming a free trade area and they have the same tariff level to outside countries in the meanwhile. The Asia Union's same outside tariff can choose different levels, we assume it to separately choose China tariff level, Japan tariff level and India tariff level. Table 7 and Figure 6 show all distance calculation results.

We find the results are nearly the same as Asia FTA, when Asia Union only eliminate tariffs, China will be hurt under China tariff level and Japan tariff level. All of other member countries in all other situations will gain from the Asia Union arrangement. In the meanwhile, the more non-tariffs are removed the more the gain of member countries. Comparatively, ASEAN countries gain the most, and then India, Korea, Japan and China. These show that comparatively larger countries gain less from FTAs.

Table 7: The Distance of Present Situation to Asia Union (%)

Country/Trade Cost	Tariff Only	T+20%NT	T+40%NT	T+60%NT	T+80%NT
			China Tariff Level		
China	-0.1	0.4	0.7	1.2	1.7
Japan	0.5	1.0	1.4	1.9	2.4
Korea	1.1	2.7	3.8	5.3	6.9
India	3.5	4.7	5.6	7.0	8.8
BMSV	3.5	9.7	13.6	18.9	24.4
CILMPT	0.7	3.9	6.1	9.4	13.3
WHOLE	**-0.1**	**0.4**	**0.7**	**1.2**	**1.7**
			Japan Tariff Level		
China	-0.5	-0.1	0.3	0.8	1.3
Japan	0.2	0.7	1.0	1.5	2.1
Korea	0.2	1.8	2.9	4.4	6.0
India	2.9	4.1	5.0	6.4	8.2
BMSV	2.2	8.5	12.4	17.8	23.5
CILMPT	0.1	3.3	5.5	8.8	12.7
WHOLE	**-0.5**	**-0.1**	**0.3**	**0.8**	**1.3**
			India Tariff Level		
China	0.2	0.7	1.0	1.5	2.0
Japan	0.7	1.1	1.6	2.1	2.6
Korea	1.6	3.3	4.3	5.8	7.4
India	3.9	5.2	6.0	7.4	9.1
BMSV	4.4	10.5	14.3	19.6	25.0
CILMPT	1.1	4.3	6.4	9.7	13.6
WHOLE	**0.2**	**0.6**	**1.0**	**1.4**	**1.9**

Note: (1) Tariff only denotes all tariff removed between FTA member countries, T+20% NT denotes all tariff and 20% non-tariff removed between FTA member countries, others are the same for T+40% NT, T+60% NT and T+80% NT.

(2) CILMPT denotes countries group of Cambodia+Indonesia+Laos+Myanmar+Philippine+Thailand, BMSV denotes countries group of Brunei+Malaysia+Singapore+Vietnam, NT denotes non-tariff barrier.

Source: Calculated by authors.

Compared with Asia FTA arrangement, we find that most countries will gain more in Asia Union than in Asia FTA under China tariff level case and India tariff level case. But if the Asia Union takes the Japan tariff level as their outside tariff value, most countries will gain less than in Asia FTA scenario.

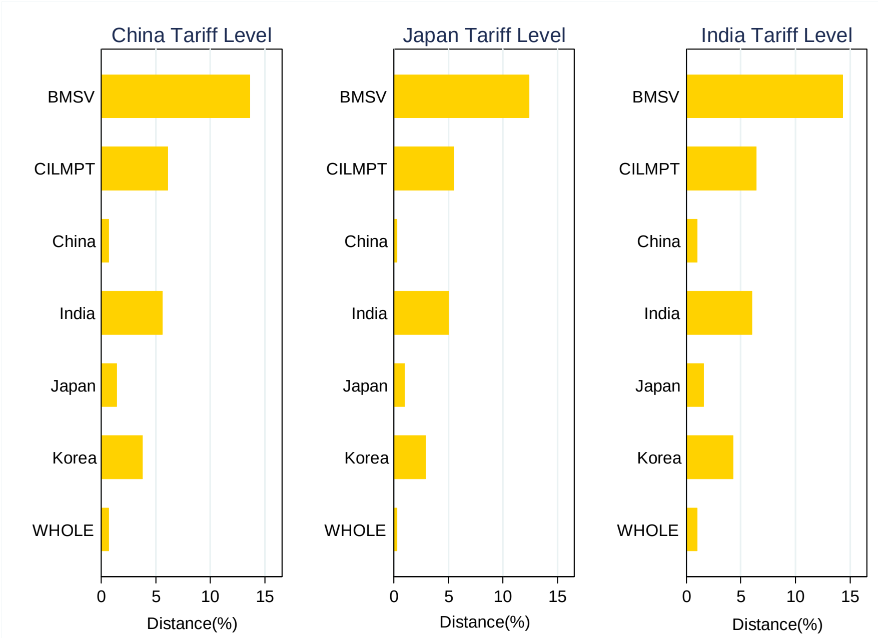


Fig. 6 Distances of Whole to Asia Union under T+40% NT Elimination Case

Source: Calculated by Authors.

6.3 Distances to ASEAN+3

ASEAN Plus Three (APT) is the scenario of China, Japan and South Korea forming a free trade area. Although the present "ASEAN+3" is just a forum, but it is possible to form an FTA, so we include this scenario for analysis. Table 8 and Figure 7 show the distance calculation results.

Table 8: The Distance of Present Situation to ASEAN+3 (%)

Country/Trade Cost	Tariff Only	T+20%NT	T+40%NT	T+60%NT	T+80%NT
China	-0.2	0.1	0.5	0.8	1.2
Japan	0.3	0.7	1.1	1.5	2
Korea	1	2.1	3.3	4.5	5.8
BMSV	3	7.4	11.9	16.7	21.6
CILMPT	0.4	2.5	4.8	7.4	10.4
WHOLE	**-0.2**	**0.1**	**0.4**	**0.8**	**1.1**

Note: (1) Tariff only denotes all tariff removed between FTA member countries, T+20% NT denotes all tariff and 20% non-tariff removed between FTA member countries, others are the same for T+40% NT, T+60% NT and T+80% NT.

(2) CILMPT denotes countries group of Cambodia+Indonesia+Laos+Myanmar+Philippine+Thailand, BMSV denotes countries group of Brunei+Malaysia+Singapore+Vietnam, NT denotes non-tariff barrier.

Source: Calculated by authors.

The same as in Asia FTA and Asia Union scenarios, all member countries will gain in all situations except China under only tariff elimination scenario. All countries and the whole will gain more as non-tariff removes more. Comparatively, ASEAN countries will gain the most, and then do Korea, Japan and China.

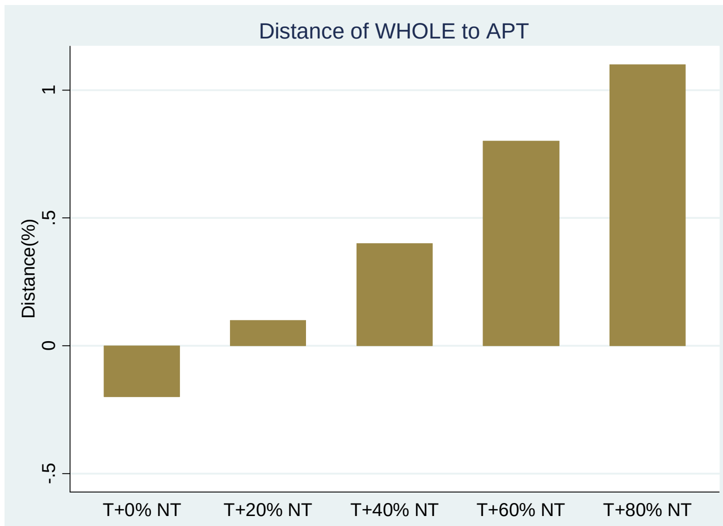


Fig. 7 Distances of Whole to ASEAN+3

Source: Calculated by Authors.

Compared with other Asia trade bloc arrangements, ASEAN Plus Three will benefit member countries less than Asia FTA and Asia Union. In specific distance values, the whole trade bloc countries can shrink 1.1% of their endowment to obtain utilities not less than their present level.

6.4 Distances to RCEP

RCEP involves countries of China, Japan, Korea, India, Australia and New Zealand. RCEP is aiming to reach an agreement by the end of 2015; it may become an important FTA in Asia. Table 9 and Figure 8 show all distance calculation results.

The effects are nearly the same as Asia FTA. When RCEP just eliminates tariff between member countries, China and the trade bloc as a whole will be hurt which means RCEP cannot benefit China and all countries in the bloc as a whole. Under all other situations, all countries will gain, so RCEP should negotiate mainly on non-tariff barriers. As non-tariff barriers remove more, all member countries will benefit more from it. Comparing distances of individual countries, China is the nearest country, and ASEAN is the most far country group, which means that China will gain the least and ASEAN the most.

Table 9: The Distance of Present Situation to RCEP (%)

Country/Trade Cost	Tariff Only	T+20%NT	T+40%NT	T+60%NT	T+80%NT
China	-0.2	0.2	0.6	1.1	1.7
Japan	0.2	0.7	1.1	1.7	2.3
Korea	0.9	2.2	3.6	5.1	6.7
India	3.6	4.6	5.7	7.1	8.9
AN	0.9	1.5	2.1	2.8	3.5
BMSV	3.4	8.9	14.4	20.2	26.1
CILMPT	0.4	3.1	6.3	9.9	14.1
WHOLE	**-0.2**	**0.2**	**0.6**	**1.1**	**1.6**

Note: (1) Tariff only denotes all tariff removed between FTA member countries, T+20% NT denotes all tariff and 20% non-tariff removed between FTA member countries, others are the same for T+40% NT, T+60% NT and T+80% NT.

(2) CILMPT denotes countries group of Cambodia+Indonesia+Laos+Myanmar+Philippine+Thailand, BMSV denotes countries group of Brunei+Malaysia+Singapore+Vietnam, AN denotes countries group of Australia+New Zealand, NT denotes non-tariff barrier.

Source: Calculated by authors.

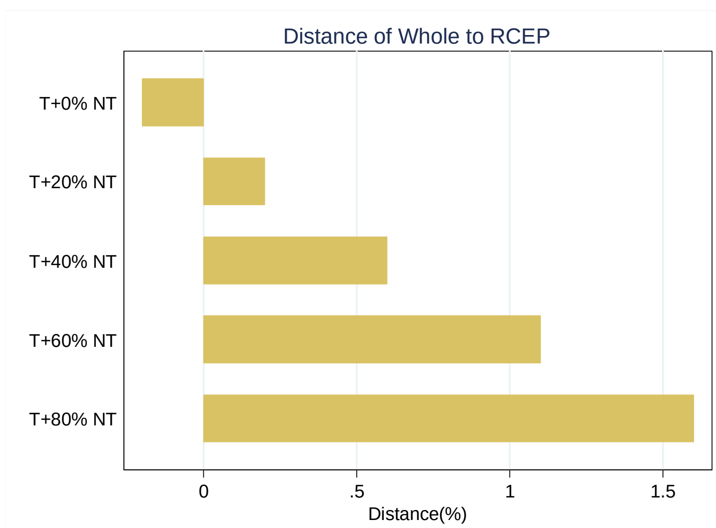


Fig. 8 Distances of Whole to RCEP

Source: Calculated by Authors.

Comparing the effects of RCEP with other FTA arrangements, its positive effects on member countries is nearly the same as Asia FTA and Asia Union, and the effects are stronger than ASEAN Plus Three (APT).

6.5 Distances to Global Free Trade

Distances to global free trade (GFT) is an interesting topic, and we can compare Asia trade bloc effects with global free trade effects. We calculate distances of each individual county in our model and distances of all countries as a whole. Table 10 and Figure 8 report all these results.

Table 10: The Distance of Present Situation to Global Free Trade (%)

Country/Trade Cost	Tariff Only	T+20%NT	T+40%NT	T+60%NT	T+80%NT
US	-0.1	0.8	1.7	2.8	3.9
EU	0	1.1	2.3	3.8	5.4
China	-0.5	0.9	2.4	3.9	5.6
Japan	0	1.0	2.1	3.4	4.8
Korea	0.2	3.4	6.6	10.1	13.6
Canada	0.1	1.8	3.7	5.8	8.3
Mexico	-0.4	1.4	3.4	5.6	8.2
India	2.6	6.0	9.9	14.4	19.9
AN	0.6	1.7	2.9	4.2	5.8
CP	0.4	5.0	10.2	16.1	22.8
BMSV	2.6	12.0	21.2	27.9	39.2
CILMPT	-0.3	4.0	8.9	14.5	20.9
ODDC	0.3	2.8	5.5	8.3	11.4
ODC	-0.4	2.1	4.9	8.2	12.0
ROW	1.4	7.6	14.2	21.3	29.0
WHOLE	-0.5	0.7	1.6	2.6	3.7

Note: (1) Tariff only denotes all tariff removed between FTA member countries, T+20% NT denotes all tariff and 20% non-tariff removed between FTA member countries, others are the same for T+40% NT, T+60% NT and T+80% NT.

(2) CILMPT denotes countries group of Cambodia+Indonesia+Laos+Myanmar+Philippine+Thailand, BMSV denotes countries group of Brunei+Malaysia+Singapore+Vietnam, AN denotes countries group of Australia+New Zealand, ODDC denotes other developed countries, ODC denotes other developing countries, NT denotes non-tariff barrier.

Source: Calculated by authors.

All countries in all situations except only tariff elimination case will gain from global free trade. When the global free trade is just tariff elimination, the US, the EU, China, Japan, Mexico, CILMPT and other developing countries (ODC) will lose, this may be caused by trade condition effects. This proves that global trade liberalization in the future should mainly focus on non-tariff elimination. Another implication of the results is that all countries will gain more as non-tariff barriers remove more.

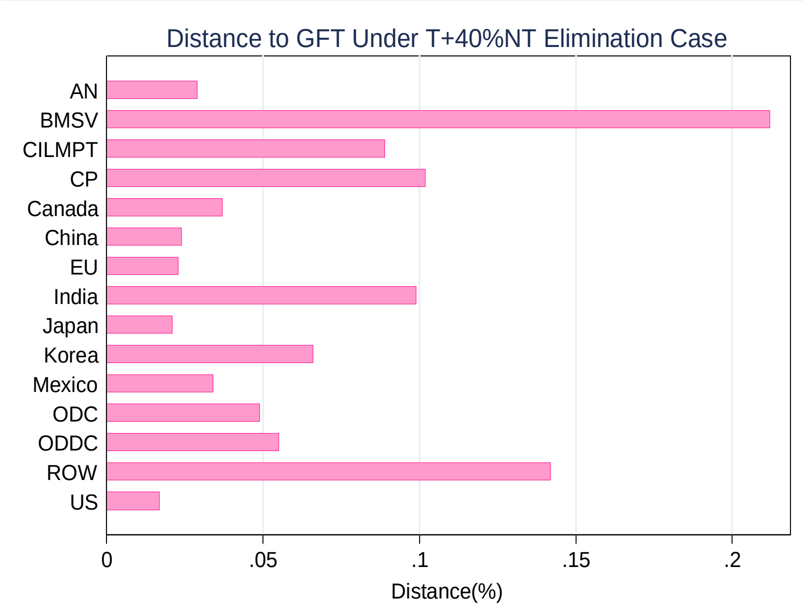


Fig. 8 Distances to Global Free Trade Under T+40%NT Elimination Case

Source: Calculated by Authors.

We compare the effects of global free trade with Asia trade bloc arrangements, and find that global free trade will benefit involved countries much more than Asia trade bloc, the distances of present situation to the global free trade are much longer than to the Asia trade bloc.

6.6 Sensitivity Analysis

We perform sensitivity analysis in this part with two methods. The first is changing the values of elasticities in the production and consumption to seperately equal 1.5, 2 and 2.5, and compare their different results to check the sensitivity to elasticities. We perform sensitivity analysis for the Whole country distance; the results are listed in Table 11. We can see that all results are nearly the same, and as elasticities increase, the positive effects of FTAs and global free trade will increase. This suggests that our simulation results are reliable.

Table 11: Sensitivity Analysis to Elasticities (%)

Country	Elasticities	Tariff Only	T+20% NT	T+40% NT	T+60% NT	T+80% NT
Asia FTA	E=1.5	-0.1	0.3	0.7	1.1	1.6
	E=2.0	-0.1	0.3	0.7	1.1	1.6
	E=2.5	-0.1	0.3	0.7	1.2	1.7
Asia Union (China Tariff Level)	E=1.5	-0.1	0.4	0.7	1.1	1.6
	E=2.0	-0.1	0.4	0.7	1.2	1.7
	E=2.5	-0.1	0.3	0.7	1.2	1.8
ASEAN+3	E=1.5	-0.2	0.1	0.4	0.7	1.1
	E=2.0	-0.2	0.1	0.4	0.8	1.1
	E=2.5	-0.2	0.1	0.5	0.8	1.2
RCEP	E=1.5	-0.2	0.2	0.6	1.1	1.6
	E=2.0	-0.2	0.2	0.6	1.1	1.6
	E=2.5	-0.1	0.3	0.7	1.2	1.7
Global Free Trade	E=1.5	-0.4	0.7	1.6	2.5	3.6
	E=2.0	-0.4	0.7	1.6	2.6	3.7
	E=2.5	-0.4	0.7	1.6	2.7	3.8

Source: Calculated by authors.

The second method is using Hicks (1943) welfare variation measures to calculate and show these Asia trade bloc effects to individual countries. We use equivalent variation (EV) and compensation variation (CV) to evaluate the effects of Asia trade blocs. Compensating variation refers to the amount of additional money an agent would need to reach its initial utility after a change in prices, or a change in product quality, or the introduction of new products. Compensating variation can be used to find the effect of a price change on an agent's net welfare. CV reflects new prices and the old utility level. Equivalent variation (EV) is a closely related measure that uses old prices and the new utility level. It measures the amount of money a consumer would pay to avoid a price change, before it happens. They have the following equations

$$\begin{cases} EV = e(p^0, v(p^1, m^1)) - e(p^0, v(p^0, m^0)) = e(p^0, v(p^1, m^1)) - m^0 \\ CV = e(p^1, v(p^1, m^1)) - e(p^1, v(p^0, m^0)) = m^1 - e(p^1, v(p^0, m^0)) \end{cases} \quad (34)$$

where 0 denotes former situation, 1 denotes the situation after change. With this calculation methodology, we choose the case of "T+40%NT" to do sensitivity analysis to further compare and check our simulation results. Table 12 and Table 13 report these results; Table 12 shows the absolute value of CV and EV, Table 13 shows the comparative CV and EV as share of GDP.

Table 12: Sensitivity Analysis with Hicks EV and CV Indicator (Billion US$)

Country	Asia FTA		Asia Union (China Tariff)		ASEAN+3		RCEP		Global Free Trade	
	EV	CV	EV	CV	EV	CV	EV	CV	EV	CV
USA	-21.41	-13.86	-21.61	-15.29	-23.51	-16.83	-22.20	-14.81	86.60	196.44
EU	-39.78	-24.64	-40.27	-26.17	-40.11	-25.48	-40.30	-25.23	99.06	298.90
China	14.69	40.07	14.90	42.19	7.84	25.94	11.54	35.87	48.19	123.29
Japan	18.91	50.69	35.88	61.86	17.91	46.42	18.03	49.34	32.01	92.07
Korea	25.18	31.04	22.78	30.99	23.06	27.17	24.06	29.15	34.78	49.29
Canada	-3.21	-0.97	-3.31	-1.20	-3.16	-1.02	-3.27	-1.10	25.42	47.02
Mexico	-2.98	-1.57	-3.08	-1.84	-2.81	-1.35	-2.94	-1.52	8.89	26.06
India	8.70	26.46	3.37	24.71	4.12	3.78	7.40	25.74	18.02	82.45
AN	-4.38	-4.27	-5.41	-6.00	-3.95	-3.75	14.90	26.81	18.43	34.30
CP	-2.06	-2.30	-2.16	-2.55	-1.95	-2.16	-2.32	-3.41	16.56	30.93
BMSV	47.18	56.78	49.28	56.94	43.90	51.34	50.82	61.09	72.13	88.17
CILMPT	27.04	58.73	29.60	61.57	25.13	48.85	29.24	63.32	41.16	89.23
ODDC	0.13	2.41	-0.20	1.94	0.73	3.11	0.30	2.62	38.36	57.73
ODC	-16.58	-5.98	-17.23	-7.08	-15.00	-3.88	-16.41	-6.07	47.37	179.72
ROW	-28.20	-13.91	-32.50	-20.86	-19.95	-1.75	-27.91	-14.30	435.51	699.90

Note: These results are calculated with the scenario of 60% NT case, which mean that all tariff and 40% non-tariff barriers removed.
Source: Calculated by authors.

Table 13: Sensitivity Analysis with Hicks EV and CV as Share of GDP (%)

Country	Asia FTA		Asia Union (China Tariff)		ASEAN+3		RCEP		Global Free Trade	
	EV	CV	EV	CV	EV	CV	EV	CV	EV	CV
USA	-0.150	-0.097	-0.152	-0.107	-0.165	-0.118	-0.156	-0.104	0.599	1.360
EU	-0.240	-0.149	-0.243	-0.158	-0.242	-0.154	-0.243	-0.152	0.590	1.780
China	0.213	0.582	0.216	0.612	0.114	0.377	0.167	0.520	0.691	1.768
Japan	0.341	0.913	0.646	1.113	0.323	0.836	0.325	0.888	0.570	1.640
Korea	2.497	3.078	2.263	3.078	2.287	2.695	2.383	2.887	3.372	4.779
Canada	-0.200	-0.060	-0.206	-0.074	-0.196	-0.063	-0.203	-0.068	1.551	2.870
Mexico	-0.282	-0.149	-0.292	-0.174	-0.266	-0.128	-0.278	-0.144	0.823	2.413
India	0.546	1.660	0.212	1.551	0.261	0.239	0.464	1.616	1.102	5.044
AN	-0.302	-0.294	-0.372	-0.413	-0.272	-0.258	1.025	1.844	1.253	2.333
CP	-0.574	-0.641	-0.600	-0.709	-0.543	-0.602	-0.644	-0.947	4.471	8.350
BMSV	9.166	11.031	9.551	11.035	8.584	10.040	9.855	11.846	13.264	16.212
CILMPT	2.107	4.577	2.307	4.799	1.957	3.803	2.276	4.931	3.147	6.822

ODDC	0.010	0.187	-0.015	0.150	0.057	0.241	0.023	0.203	2.914	4.384
ODC	-0.330	-0.119	-0.343	-0.141	-0.299	-0.077	-0.327	-0.121	0.936	3.549
ROW	-0.459	-0.227	-0.529	-0.340	-0.325	-0.029	-0.455	-0.233	6.918	11.118

Note: (1) These results are calculated with the scenario of 60% NT case, which mean that all tariff and 40% non-tariff barriers removed. (2) EV and CV values listed above are absolute EV and CV values as share of GDP, which are (CV*100/GDP) and (EV*100/GDP).

Source: Calculated by authors.

These results show that all Asia trade bloc member countries will gain, but most non-member countries will loss. Comparatively, small countries will gain more from FTA and large countries gain less. All CV results and EV results are nearly the same, and the Asia trade bloc effects to countries are the same with distance calculation results. These prove that our simulation results are reliable.

7. Conclusions

This paper numerically calculates the Debreu coefficient, and introduces Debreu distance measures into FTA effects measurement. We use a fifteen-country global general equilibrium model with exogenous trade imbalance and trade cost to explore the distance to potential Asia trade blocs. We use a Debreu coefficient distance indicator to evaluate how far Asia is already surrogate trade bloc, which indicator is new in literature and provide another angle to show FTA effects from endownment shrink ratio side. Although Debreu coefficient is an old notion, little research has calculated it numerically.

We have set six scenarios to calculate distances of present situation to Asia trade bloc and explore the potential effects. These six scenarios are: Asia FTA, Asia Union, ASEAN Plus Three, RCEP, global free trade and sensitivity analysis.

Our simulation results show that all trade bloc member countries will gain when the FTA arrangements will eliminate both tariff and non-tariff barriers. But when Asia trade bloc can only eliminate tariff, some of big countries may lose. As non-tariff barriers remove more, the gains of trade bloc member countries will increase. Compared with different country type, larger countries will generally benefit less and small countries will benefit more. For different Asia trade bloc arrangements, distances from present situation to Asia FTA, Asia Union and RCEP are nearly the same and larger than ASEAN Plus Three, which means the ASEAN Plus Three will benefit member countries less than other trade bloc arrangements. Distances to the global free trade are the largest.

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