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# How Far is Asia Already Surrogate Trade Bloc?

## Abstract

This paper is the first exploration to numerically calculate the Debreu (1951) coefficient, and to introduce Debreu distance indicator in free trade agreement (FTA) effect measures. In the meanwhile, FTA negotiations in Asia developed very fast in the past decade which made it important to evaluate how far Asia has already surrogate trade bloc. This paper uses a fifteen-country global general equilibrium model with trade cost to numerically calculate Debreu distance between present situation and potential Asia trade blocs, so as to evaluate these Asia FTA effects. Our calculation results reveal that all Asia involved countries will gain from Asia trade bloc arrangements unless these FTAs can only eliminate tariffs. These countries' gain will increase as non-tariff elimination deeps. 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 gain all countries the most.

**Keywords**: Asia Trade Bloc; Debreu Distance Coefficient; Trade Cost; RCEP

**JEL Classification**: D61; F15; D58

# 1. Introduction

Debreu (1951, Econometrica) coefficient measure is an important resource utilization calculation method, and is universally cited in literatures. But nearly no researches have ever numerically used this measurement in application until now, only very few articles in which this measurement played a mere tangential role, including Raa (2008), Ahlheim *et al* (1988), Anderson and Neary (1996), Brown and Srinivasan (2007). Riezman, Whalley and Zhang (2006) uses distance measures to estimate free trade effects but is not Debreu's coefficient distance. This paper will be the first to numerically calculate Debreu coefficient.

Computational general equilibrium methodology has been widely used in exploring free trade agreement (FTA) effects. Within them, Hicks (1943) welfare variation measures are common index for surveying FTA influence, but Debreu coefficient has never been used. This paper injects the Debreu distance indicator into exploring FTA effects by the first time.

Asia's FTA develops slower than north American and Europe. Until now, there is no comprehensive FTAs in Asia area. But in the past decade, FTA arrangements and negotiations grow very fast in Asia. Especially after global financial crisis in 2008, Asia becomes the most active place in FTA negotiations and developments. At present, some important negotiations are in progression, including Regional Comprehensive Economic Partnership (RCEP), Trans-Pacific Partnership (TPP), ASEAN Plus Three (APT), China-Japan-South Korea FTA, and etc. In the future, Asia may form some comprehensive trade blocs. Under these circumstances, it will be very important in policy side to numerically explore how far Asia is already surrogate trade bloc as well as what will be the effects of potential Asia blocs.

Present literatures in Asia trade bloc are rare and mostly analytical, such as Shiino (2012), Fukunaga and Isono (2013), Williams (2012), Lewis (2011), Ezell and Atkinson (2011), Stubbs (2002). Some of earlier researches have numerically explored the effects of regional free trade agreements (see the survey by Lloyd and MacLaren (2004)), but few numerical methods have been used to capture potential effects of recent FTA developments in Asia region except Petri *et al* (2011), Itakura and Lee (2012), Kawai and Wignaraja (2008). Our paper uses Debreu distance indicator to explore the effects of potential Asia trade blocs.

On the potential Asia FTA effects, we focus on how far Asia has already surrogate trade bloc by using Debreu coefficient to estimate the distance of present situation to potential Asia surrogate trade bloc, and also use Hicks (1943) welfare variation measures to compare these results in sensitivity analysis.

The possible innovations for this paper have three points. The first is calculating Debreu (1951) coefficient numerically for the first time. The second is introducing Debreu distance indictor into FTA effects measure which is completely new. The third is using trade cost in exploring FTA effects, which is valuable for exploring non-tariff barrier effects, this treatment is only found in Li and Whalley (2013).

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 (Manufatory goods and non-Manufactory goods) with two factors (Capital and Labour). The model use exogenous trade imbalance structure and include trade cost in it. We use a trade cost calculation method that recognizes limitations of data by using an estimation treatment that follows Wong (2012) and Novy (2008).

Our calculation results show that 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. Comparing these different Asia trade blocs, 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. These results indicate that Asia trade bloc negotiations should mainly aim to eliminate non-tariff barriers.

## 2. Asia FTAs and Their Developments

Asia has not formed a most counties involved high-standard free trade agreement until now, but this proposal has never stopped talking. Asia FTAs have developed fast after the 2008 global financial crisis, like ASEAN+3, ASEAN+6 and RCEP (Regional Comprehensive Economic Partnership). Asia FTA may come to agreement in the near future, and form an Asia bloc like NAFTA (North America Free Trade Agreement) and EU (Europe Union).

Before 1992, Asia had no regional or bilateral free trade agreements (FTAs), in contrast to Africa, the Americas and Western Europe. In January 1993, the ASEAN Free Trade Area (AFTA) came into force. Over the past decade, Asia has formed a large number of FTAs. According to Asian Development Bank (ADB) FTA statistics for Asia Pacific area, as of 2013, there are 257 FTAs totally (compared with just 50 in 2000), including 132 concluded, 75 under negotiation and 50 proposed. Within them, 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].

In Asia FTAs, ASEAN is acting as a hub. For example: ASEAN's own FTA; FTAs between ASEAN and other economies like China, India, Japan, Korea; FTAs between individual ASEAN countries and other countries; Comprehensive Economic Partnership for East Asia and so on. In Asia area, there are about 30 FTAs in effect[2] (see Table 1).

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

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

**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).

In the presently negotiating FTAs in Asia region, most prominent arrangements are ASEAN Plus Three (APT) and Regional Comprehensive Economic Partnership (RCEP). TPP is related to Asia Pacific region, we do not talk about it in this paper.

ASEAN Free Trade Area is a trade bloc agreement by the Association of Southeast Asian Nations supporting local manufacturing in all ASEAN countries. The AFTA agreement was signed on 20 January 1992 in Singapore. When the AFTA agreement was originally signed, ASEAN had six members, namely Brunei, Indonesia, Malaysia, Philippines, Singapore and Thailand. Vietnam jointed in 1995, Laos and Myanmar in 1997 and Cambodia in 1999. AFTA now comprised the ten countries of ASEAN. All the four latecomers were required to sign the AFTA agreement in order to join ASEAN, but were given longer time frames in which to meet AFTA's tariff reduction obligations (Wikipedia, 2013).

ASEAN Plus Three (APT) is a forum that functions as a coordinator of cooperation between ASEAN and the three East Asia nations of China, Japan, and South Korea. Government leaders, ministers, and senior officials from the 10 members of the ASEAN and the three Northeast Asian states consult on an increasing range of issues. The APT is the latest development of East Asian regional cooperation. In the past, proposals, such as Korea's call for an Asian Common Market in 1970 and Japan's 1988 suggestion for an Asian Network have been made to bring closer regional cooperation. The first APT's leaders meetings were held in 1996 and 1997, until now it has held 13 summits; the latest one was conducted in October 2010 (Wikipedia, 2013).

Regional Comprehensive Economic Partnership (RCEP) is actually the ASEAN Plus Six free trade agreement, members include 10 ASEAN countries and its 6 FTA partners, Australia, China, India, Japan, Korea and New Zealand. RCEP aims to be concluded by the end of 2015 includes more than 3 billion people, 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 the RCEP framework setting out the 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[3].

The 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[4].

It is said that the significant progress made through ASEAN's FTAs with its six FTA partners has put the countries in a position to bring their economic partnership to a higher level by negotiating a comprehensive, high-quality agreement. If completed, the RCEP would be the largest regional trading arrangement to date.

TPP is a very important FTA arrangement in Asia-Pacific region, but it is not a pure Asia country trade bloc, so we do not analyze it in this paper. For the FTAs development in Asia area, they have received abroad attention. In the meanwhile, Asia area includes a lot of large countries and does not has high standard FTA until now, they have development potential. In the meanwhile, Asia countries are all eager to form a FTA to promote regional integration after global financial crisis in 2008. Therefore the Asia trade bloc will become the most important FTA development in the near future. This paper is to numerically calculate how far Asia is already surrogating trade bloc, which is an important topic in policy and reality side.

# 3. Debreu's Coefficient and Distance Measure

## 3.1 The Debreu Coefficient of Resource Utilization

Debreu (1951) measures the inefficiency of the allocation of resources in an economy by calculating how much less resources could attain the same level of satisfaction to the consumers. The ratio of how much less resources can show the inefficiency level of the allocation.

Consider an economy 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 during ), including the observed one $y^0$. A combination of consumption

3 See Wikipedia website "Regional Comprehensive Economic Partnership", http://en.wikipedia.org/wiki.

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

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, $Z^0 \in R^l$. For example, if the last commodity, $l$, represents labor, and this is the only nonproduced commodity, then $z^0 = Ne_t$, where N is the labor force and $e_l$ the $l-th$ unit vector. Vector $Z^0$ 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

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

Where B stands for '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 $\geq$. By convention, this vector inequality holds if it holds for all components. Assume that preferences are convex and continuous, and that production possibilities form a convex and closed set, then the separating hyperplane theorem yields a supporting price vector $p(z) > 0$ such that $Z' \in B$ such that implies

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

Where $p > 0$ means that all components are positive. The prices are positive because of the min-superscript in $z \in B^{\min}$ and the fact that $z$ is the only point in common to B and $\{z' \mid z' \leq z\}$; hence, $p$ may be chosen such that $pz' < pz$ for $z' \leq z$ (except $z' = z$). This argument requires no monotonicity and Debreu (1951) does not assume it indeed. An example is an exchange economy ($Y = \{0\}$) with one consumer and two commodities of which the quantities are nonnegative. Let $X \geq X'$ if $(2 - X_l)^2 \leq (2 - X_l^{'})^2$. Let $X^0 = z^0 = (3 \;\; 1)$, then

$$B^{\min} = \left\{ X \mid X \geq X^0 \right\}^{\min} = \left\{ X \mid 1 \leq X_l \leq 3 \right\} = \left\{ (1 \;\; 0) \right\} \qquad (3)$$

In this point, any positive price vector renders $B = \left\{ X \mid 1 \leq X_l \leq 3 \right\}$ more expensive.

The Debreu coefficient of resource utilization is defined by

$$\rho = \max_z \left\{ p(z)z / p(z)z^0 \mid z \in B^{\min} \right\} \qquad (4)$$

Coefficient $\rho$ 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 (which indicate welfare indeed). Debreu (1951) shows that the distance or the max in equation (2) is attained by

$$z = \rho z^0 \in B^{\min} \tag{5}$$

In other 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 $\rho$ is a number between zero and one, the latter indicating full efficiency. In Modern terminology, this result means that $\rho$ is the input-distance function, determined by the program[5] (Raa, 2008)

$$\rho = \min_r \left\{ r \mid \sum X_i + y \le rz^0, X_i \ge_i X_i^0, y \in Y \right\} \tag{6}$$

### 3.2 Debreu Distance Measures Used in Simulation

This paper uses Debreu's distance coefficient to calculate the distance to Asia trade bloc. Distance in our paper shows how much less endowment in Asia bloc scenario could attain the same welfare (utility) as present situation.

We use a numerical global general equilibrium model to calculate distances of present status to possible Asia blocs so that to show the effects of these trade blocs. Asia bloc is a several countries formed free trade agreement area, so we have two kinds of distances, one is individual country distance, and the other is whole Asia bloc countries distance.

Assume an $N$ country general equilibrium world, each country denotes as $i$ (1, …, m), in the base case (present status), the global general equilibrium has 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 the Asia bloc scenario, the global general equilibrium has 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 of whole Asia bloc countries, we denote the Debreu distance as $\lambda$. Under the Debreu's resource utilization concept, we have

[5] 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.

$$\begin{aligned} & \min \ \lambda \\ & s.t. \ (1) GE, \\ & \quad (2) K_i \le \lambda E_i, \\ & \quad (3) U_i \ge U_i^* \end{aligned} \tag{7}$$

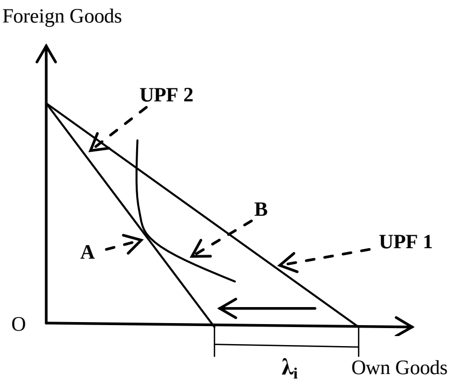
where $\lambda$ is the distance of present situation to Asia bloc, it should make the utility of all countries in the bloc not less than their base case situation. Figure 1(II) shows the concept of distance for whole country. In the base case, the equilibrium consumption point is B; in the Asia bloc scenario, the utility possibility frontier is UPF 1. If we keep the utility in the new scenario not less than in base case, the utility possibility frontier can shrink to UPF 2, and then $\lambda$ is the ratio between UPF 1 and UPF 2.

For the distance of individual country to Asia bloc, we denote the Debreu distance as $\lambda_i$, and then we have

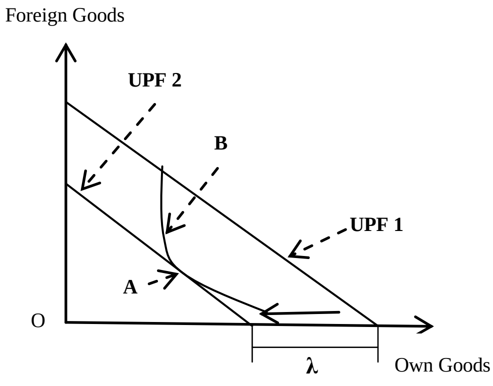
$$\begin{aligned} & \min \ \lambda_i \\ & s.t. \ (1) GE, \\ & \quad (2) K_i \le \lambda_i E_i, \\ & \quad (3) U_i \ge U_i^* \end{aligned} \tag{8}$$

where $\lambda_i$ is the distance of country $i$ from the present situation to Asia bloc, it shows the minimum endowment shrink ratio that make the utility of country $i$ in the bloc not less than in base case. Figure 1(I) shows the distance for individual countries. Keep the foreign country's consumption fixed, own country consumption can switch from point B to point A in utility indifference curve, and then own country's utility possibility frontier can change from UPF 1 to UPF 2, the shrink ratio $\lambda_i$ is the distance for own country.

**Figure 1: Debreu Distance**




(I) Individual Country




(II) Whole

According to above definition, if distance value is larger than 1, it says that the trade bloc arrangement cannot improve welfares of the whole trade bloc countries or individual countries, which means trade bloc has negative effects. If distance value is smaller than 1, it says that the trade bloc arrangement decrease welfares of the whole trade bloc countries or individual countries. In the meanwhile, the nearer of distance value to 1, then the distance between present situation and Asia trade bloc is nearer. Small distance value means the trade bloc effects are significant and the present situation to trade bloc is far.

We use Debreu distance to measure the effects of Asia bloc for Debreu coefficient is an important indicator for the level of resource utilization. Until now seldom literatures had used this measurement to numerically evaluate resource utilization level, our paper is the first numerical application of Debreu coefficient.

# 4. Model Structure and Trade Cost Calculation

We use a global general equilibrium model with trade imbalance and trade costs to calculate Debreu distance to show how far Asia is already surrogate trade bloc. We use trade cost to comprehensively explore trade barriers which are important but has been widely ignored in present literatures (they mainly use tariff).

## 4.1 Exogenous Trade Imbalance GE Model with Trade Cost

Our global general equilibrium model has fifteen countries and each country produce 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 manufacturing goods and non-manufacturing goods, we will use agricultural sector and service sector to denote non-manufacturing goods and assume them cannot be traded between countries. The two factors in each country are labor and capital, which are intersectorally mobile but internationally immobile. We include trade and trade imbalance in the model, trade imbalance for each country is 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

$$Q_i^l = \phi_i^l [\delta_i^l (L_i^l)^{\frac{\sigma_i^l - 1}{\sigma_i^l}} + (1-\delta_i^l)(K_i^l)^{\frac{\sigma_i^l - 1}{\sigma_i^l}}]^{\frac{\sigma_i^l}{\sigma_i^l - 1}}, \qquad i = country, l = goods \tag{9}$$

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 $l$, $\phi_i^l$ is the scale parameter, $\delta_i^l$ is the distribution parameter and $\sigma_i^l$ is the elasticity of factor substitution. First order conditions for cost minimization imply the factor input demand equations,

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

$$L_i^l = \frac{Q_i^l}{\phi_i^l}[\delta_i^l + (1-\delta_i^l)[\frac{\delta_i^l w_i^K}{(1-\delta_i^l)w_i^L}]^{(1-\sigma_i^l)}]^{\frac{\sigma_i^l}{1-\sigma_i^l}} \tag{11}$$

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

$$U_i(X_i^M, X_i^{NM}) = [\alpha_{i1}^{\frac{1}{\sigma_i}}(X_i^M)^{\frac{\sigma_i-1}{\sigma_i}} + \alpha_{i2}^{\frac{1}{\sigma_i}}(X_i^{NM})^{\frac{\sigma_i-1}{\sigma_i}}]^{\frac{\sigma_i}{\sigma_i-1}}, \quad i = country \tag{12}$$

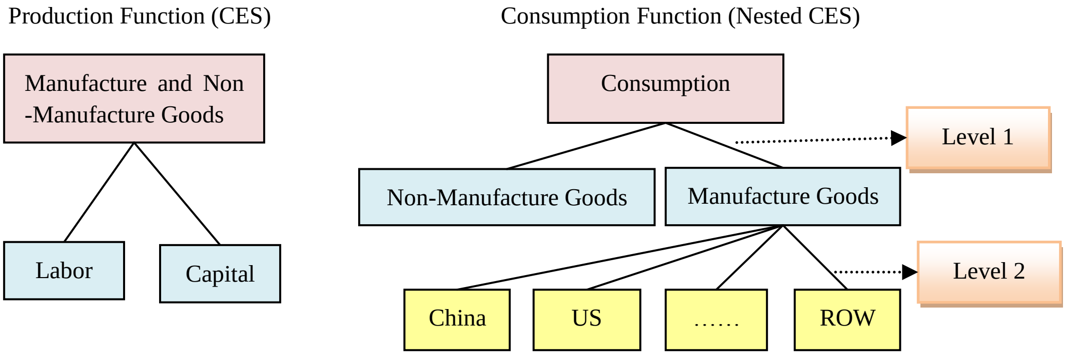
Where $X_i^{NM}$ denotes the consumption of non-manufacturing goods in country $i$, $X_i^M$ denotes the consumption of composite Armington manufacturing goods in country $i$. Additionally $\alpha_{i1}$ and $\alpha_{i2}$ are share parameters and $\sigma_i$ is the top level elasticity of substitution in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

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

$$X_i^M = [\sum_j \beta_{ij}^{\frac{1}{\sigma_i'}} x_{ij}^{M\frac{\sigma_i'-1}{\sigma_i'}}]^{\frac{\sigma_i'}{\sigma_i'-1}}, \quad j = country \tag{13}$$

Where $x_{ij}^M$ is the consumption of manufactory goods from country $j$ in country $i$. If $i = j$ this denotes that this country consumes its domestically produced tradable goods. $\beta_{ij}$ is the share parameter for country $j's$ manufactory goods consumed in country $i$. $\sigma_i'$ is the elasticity of substitution in level 2 preferences in country $i$.

**Fig. 2 Structure of Production and Consumption Functions**




Source: Compiled by authors.

The utility optimization problem above yields

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

$$X_i^{NM} = \frac{\alpha_{i2} E_i}{(pc_i^{NM})^{\sigma}[\alpha_{i1}(P_i^M)^{1-\sigma} + \alpha_{i2}(pc_i^{NM})^{1-\sigma}]} \tag{15}$$

Where $P_i^M$ and $pc_i^{NM}$ are separately 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, they enter the second level preferences and come from different countries, the country specific demands are

$$x_{ij}^M = \frac{\beta_{ij}(X_i^M P_i^M)}{(pc_{ij}^M)^{\sigma_i'}[\sum_j \beta_{ij}(pc_{ij}^M)^{(1-\sigma_i')}]} \tag{16}$$

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 manufactory goods is

$$P_i^M = [\sum_{j=1}^{15} \beta_{ij}(pc_{ij}^M)^{(1-\sigma_i')}]^{\frac{1}{1-\sigma_i'}} \tag{17}$$

Then, the total consumption expenditure of country $i$ is

$$E_i = P_i^M X_i^N + pc_i^{NM} X_i^{NM} \tag{18}$$

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

$$Q_i^M = \sum_j x_{ji}^M \tag{19}$$

$$\sum_l K_i^l = \overline{K_i} \quad , \qquad \sum_l L_i^l = \overline{L_i} \tag{20}$$

The non-manufacturing goods market clearing condition will give later in the paper. A zero profit condition must also be satisfied in each industry in each country, such that

$$p_i^l Q_i^l = w_i^K K_i^l + w_i^L L_i^l \qquad = l \;, M \tag{21}$$

We introduce trade cost for trade between countries. Trade costs include not only import tariffs but also other non-tariff barriers such as transportation costs, language barriers, institutional barriers and etc. We divide trade costs into two parts in our model; import tariff 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 of consumption prices and production prices in country $i$ for country $j's$ exports.

$$pc_{ij}^M = (1 + t_i + N_{ij}) p_j^M \tag{22}$$

Import tariffs will generate revenues $R_i$, which are given by

$$R_i = \sum_{j, i \neq j} p_j^M x_{ij}^M t_i \tag{23}$$

For non-tariff trade costs, they are different from the import tariff: they cannot collect revenue, and importers need to use actual resources to cover the costs involved. In the numerical model, we assume that the resource costs involved in overcoming all other non-tariff barriers 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 the barrier. We thus 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 thus given by

$$w_i^K \overline{K_i} + w_i^L \overline{L_i} + R_i = I_i \tag{24}$$

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

$$Q_i^{NM} = \frac{NR_i}{p_i^{NM}} + X_i^{NM} \tag{25}$$

where

$$NR_i = \sum_{j,i \neq j} p_j^M x_{ij}^M N_{ij} \tag{26}$$

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

We assume an exogenously determined fix trade imbalance, denoted as $S_i$, which will bigger than 0 when in trade surplus and less than 0 when in trade deficit. Trade equilibrium will influence individual country's budget constraint. In the equilibrium, we have

$$I_i = E_i + S_i \tag{27}$$

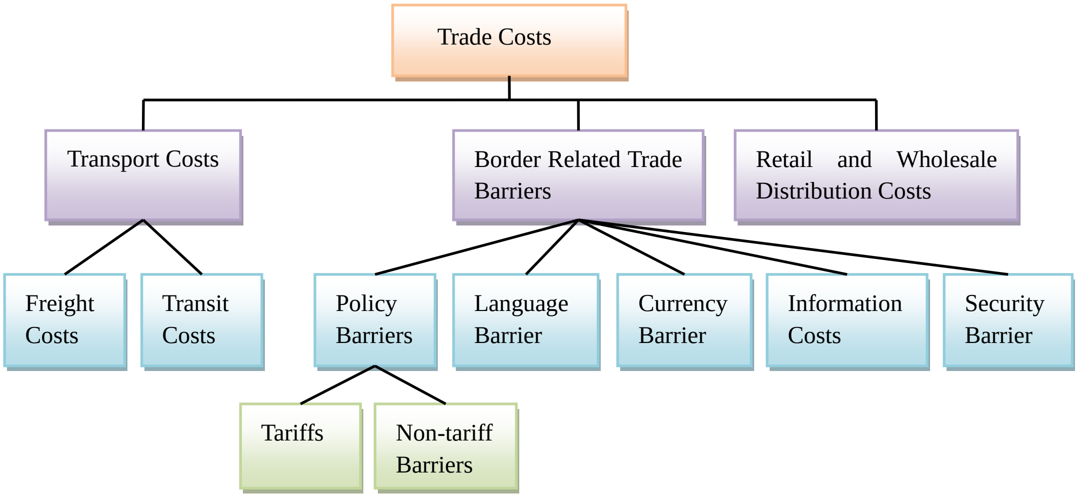
## 4.2 Trade Cost Calculation Methodology

A broad definition of trade costs includes policy barriers (Tariffs and Non-tariff barriers), 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 papers have argued that this measure is consistent with the gravity equation and robust across a variety of trade models (Novy, 2008; Wong, 2012).

The gravity equation is one of the most robust empirical relationships in economics which relates trade between two countries to their economic size, bilateral trade barriers, costs of production in exporter countries, and how remote the importer is from the rest of the world (Wong, 2012). Some recent studies have provided the micro foundations for the gravity equation, for example Anderson and Wincoop (2003), Eaton and Kortum (2002) and Chaney (2008).

**Fig. 3 Representative Trade Costs**




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

The measure of trade barriers 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 $\tau_{ir}$ and a fixed cost of exporting $F_{ir}$. The variable trade barrier $\tau_{ir}$ 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:

$$X_{ir} = \frac{Y_i \times Y_r}{Y} \left(\frac{w_r \tau_{ir}}{\theta_i}\right)^{-\gamma} F_{ir}^{-(\frac{\gamma}{\sigma-1}-1)} \qquad (28)$$

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, $\tau_{ir}$ is variable trade costs and $F_{ir}$ is the fixed cost of exporting. The Pareto parameter $\gamma$ governs the distribution of firm productivities. $\sigma$ is the elasticity of substitution in preferences. $\theta_i$ 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 can 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:

$$\frac{X_{ir}X_{ri}}{X_{ii}X_{rr}} = (\frac{\tau_{ri}\tau_{ir}}{\tau_{ii}\tau_{rr}})^{-\gamma}(\frac{F_{ri}F_{ir}}{F_{ii}F_{rr}})^{-(\frac{\gamma}{\sigma-1}-1)} \tag{29}$$

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 ( $F_{ri} = F$ ), the fixed costs drop out of this measure and the measured trade costs would simply be interpreted as variable trade costs, as in models without fixed export costs such as Eaton and Kortum (2002), Anderson and Wincoop (2003).

For simplicity of exposition, 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

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

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

$$t_{ir} = (\frac{X_{ii}X_{rr}}{X_{ir}X_{ri}})^{\frac{1}{2\gamma}} = (\tau_{ir}\tau_{ri})^{\frac{1}{2}}(F_{ri}F_{ir})^{\frac{1}{2}(\frac{1}{\sigma-1}-\frac{1}{\gamma})} \tag{31}$$

Data for this equation is 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

$$\bar{t}_{ir} = t_{ir} - 1 = (\frac{X_{ii}X_{rr}}{X_{ir}X_{ri}})^{\frac{1}{2\gamma}} - 1 \tag{32}$$

Using the trade costs equation above, we can calculate actual trade costs between countries 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)),

$$X_{ii} = y_i - X_i \tag{33}$$

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

$$X_i \equiv \sum_{r,i\neq r} X_{ir} \tag{34}$$

# 5. Data and Parameters Calibration

We use 2011 as our base year in building a benchmark general equilibrium dataset for use in calibration and simulation following the method set out in Shoven and Whalley (1992). There are fifteen countries in our model, country groups' 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 manufacture goods, and primary and tertiary industries (agriculture, extractive industries, and services) yield non-manufacture 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 values for mutual consistency for calibration purposes.

All data except the EU are from 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 ratio to yield capital and labor input in production. The EU data are from EU statistics, the currency unit is Euro, we use annual average exchange rate to change them into US dollar currency unit. These data are listed in Table 2.

**Table 2: 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 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. Trade data are listed in Table 3.

Trade cost between countries is calculated with the methodology discussed in Part 4. In calculating trade cost, trade data is 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 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 $\gamma$ to be 8.3 as in Eaton and Kortum (2002). Trade costs between countries in our general equilibrium model are shown in Table 4.

Trade cost has 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 rate to denote these values. We calculate non-tariff barriers by using trade costs minus import tariffs. Import tariffs data are listed in Table 5.

**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 will do the sensitivity analysis to these elasticities.

With these data, we calibrate the model parameters. When used in model solution these will 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.

**Table 3: 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 |
| | 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 |
| **Exporter** | 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.

**Table 4: 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) 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 see group countries as a whole to calculate trade costs.

Source: Calculated by authors.

# 6. Simulation Results

We use our 15-country global general equilibrium model to numerically calculate Debreu distances of present status to Asia trade bloc, we calculate distances for individual country that involves in the trade bloc and also distances for whole trade bloc countries. From these distances, we show how far is Asia already surrogate trade bloc, and analyze the effects of different Asia trade bloc arrangements.

Main large countries in the Asia region include China, Japan, Korea, India, and ASEAN; they are near each other in geography. Therefore, typical Asia bloc should include these four countries and one country group. In the meanwhile, Asia trade bloc may have two different types. One is like NAFTA, all member countries do not have tariff between each other but each has different tariff level for outside countries, we call this type as Asia FTA; the other is like EU, all member countries do not have tariff between each other and they also have 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, they may develop to Asia FTA, and so we take account of these two trade blocs either. 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 cost in our global general equilibrium model, it includes tariff and non-tariff barriers. We assume that all these Asia FTA arrangements will remove whole tariff and partial non-tariff, for non-tariff removal, we set five different assumptions, which are 100% non-tariff barrier remaining, 80% non-tariff barrier remaining, 60% non-tariff barrier remaining, 40% non-tariff remaining, and 20% non-tariff remaining. We separately calculate Debreu distances under this five different situations.

For the distance value, it shows how much less resources under Asia trade bloc scenario could attain the same level of utility satisfaction as under present reality scenario. So the distance is the shrink ratio of total endowment.

## 6.1 Distances to 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 in our numerical general equilibrium model, they are BMSV and CILMPT. We calculate distances of present situation to the Asia FTA. Table 6, Fig.4 and Fig.5 list all the results.

We find that nearly all the results are less than 1 except the whole and China under only tariff elimination case. This reveals that almost all countries will gain from Asia FTA, but if Asia FTA just remove tariff between countries and has no effect to non-tariff removal, China and the Asia trade bloc as a whole will be hurt. As the non-tariff barriers remove more, the distance value becomes smaller, which means that all individual countries will gain more from Asia FTA if non-tariff barriers can eliminate more. For individual countries, BMSV will gain the most, then CILMPT, India, Korea, Japan, and the least is China. We can say that China is nearest to Asia

FTA.

**Table 6: The Distance of Present Situation to Asia FTA**

| Country/Trade Cost | 100% NT | 80% NT | 60% NT | 40% NT | 20% NT |
|---|---|---|---|---|---|
| China | 1.001 | 0.996 | 0.993 | 0.988 | 0.983 |
| Japan | 0.997 | 0.993 | 0.988 | 0.983 | 0.978 |
| Korea | 0.988 | 0.976 | 0.962 | 0.947 | 0.931 |
| India | 0.963 | 0.953 | 0.942 | 0.929 | 0.912 |
| BMSV | 0.965 | 0.918 | 0.865 | 0.811 | 0.755 |
| CILMPT | 0.998 | 0.970 | 0.942 | 0.909 | 0.869 |
| **WHOLE** | **1.001** | **0.997** | **0.993** | **0.989** | **0.984** |

Note: (1) 100% NT denotes all tariff removed between FTA member countries, 80% NT denotes all tariff and 20% non-tariff removed between FTA member countries, others are the same for 60% NT, 40% NT and 20% 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.

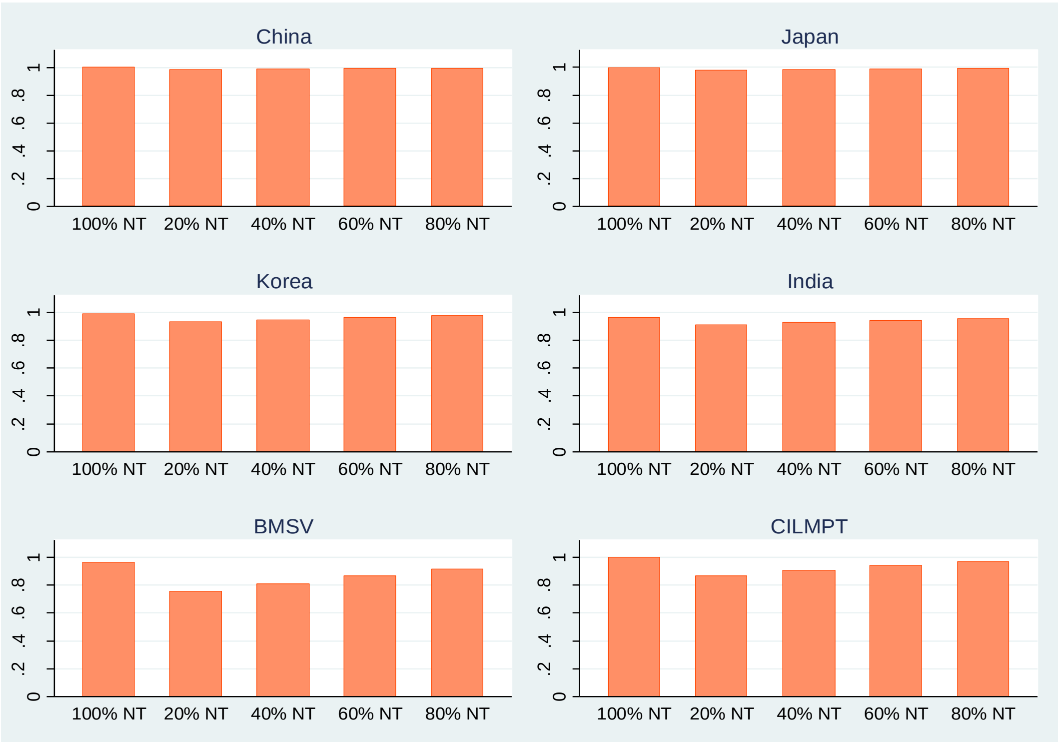



**Fig. 4 Distances of Individual Countries to Asia FTA**

Source: Calculated by Authors.

In the detailed values, we take 20% NT case as an example. The Asia FTA countries as a whole can user 98.4% of previous endowment to obtain utilities for each country in the trade bloc not less than their former level.

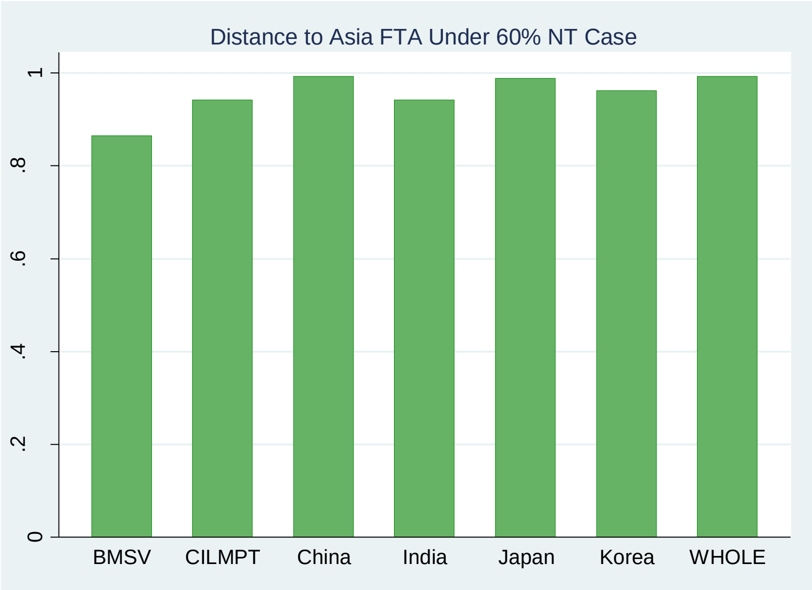



**Fig. 5 Distances to Asia FTA under 60% NT Case**

Source: Calculated by Authors.

### 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 shows all distance calculation results.

We find the results are nearly the same as Asia FTA, when Asia Union only eliminate tariffs, China and the whole 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 remove the more gaining of member countries. Comparatively, ASEAN countries gain the most, and then do 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 | 100% NT | 80% NT | 60% NT | 40% NT | 20% NT |
|---|---|---|---|---|---|
| | | | **China Tariff Level** | | |
| China | 1.001 | 0.996 | 0.993 | 0.988 | 0.983 |
| Japan | 0.995 | 0.99 | 0.986 | 0.981 | 0.976 |
| Korea | 0.989 | 0.973 | 0.962 | 0.947 | 0.931 |
| India | 0.965 | 0.953 | 0.944 | 0.93 | 0.912 |
| BMSV | 0.965 | 0.903 | 0.864 | 0.811 | 0.756 |
| CILMPT | 0.993 | 0.961 | 0.939 | 0.906 | 0.867 |
| **WHOLE** | **1.001** | **0.996** | **0.993** | **0.988** | **0.983** |
| | | | **Japan Tariff Level** | | |
| China | 1.005 | 1.001 | 0.997 | 0.992 | 0.987 |
| Japan | 0.998 | 0.993 | 0.99 | 0.985 | 0.979 |
| Korea | 0.998 | 0.982 | 0.971 | 0.956 | 0.94 |

| | | | | | |
|---|---|---|---|---|---|
| India | 0.971 | 0.959 | 0.95 | 0.936 | 0.918 |
| BMSV | 0.978 | 0.915 | 0.876 | 0.822 | 0.765 |
| CILMPT | 0.999 | 0.967 | 0.945 | 0.912 | 0.873 |
| **WHOLE** | **1.005** | **1.000** | **0.997** | **0.992** | **0.987** |
| | | | **India Tariff Level** | | |
| China | 0.998 | 0.993 | 0.990 | 0.985 | 0.980 |
| Japan | 0.993 | 0.989 | 0.984 | 0.979 | 0.974 |
| Korea | 0.984 | 0.967 | 0.957 | 0.942 | 0.926 |
| India | 0.961 | 0.948 | 0.940 | 0.926 | 0.909 |
| BMSV | 0.956 | 0.895 | 0.857 | 0.804 | 0.750 |
| CILMPT | 0.989 | 0.957 | 0.936 | 0.903 | 0.864 |
| **WHOLE** | **0.998** | **0.994** | **0.990** | **0.986** | **0.981** |

Note: (1) 100% NT denotes all tariff removed between FTA member countries, 80% NT denotes all tariff and 20% non-tariff removed between FTA member countries, others are the same for 60% NT, 40% NT and 20% 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.

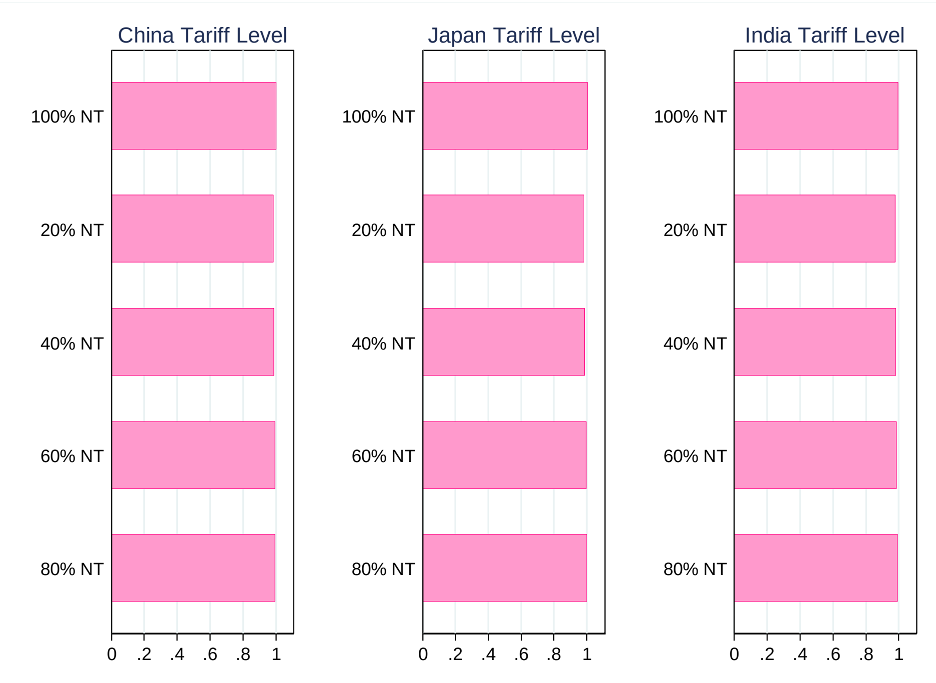



**Fig. 6 Distances of Whole to Asia Union under Different Country Tariff Level**

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 outside tariff value, most countries will gain less than in Asia FTA scenario.

### 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 shows the distance calculation results.

The same as in Asia FTA and Asia Union scenarios, all member countries will gain in all situations except China and the whole trade bloc countries 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.

**Table 8: The Distance of Present Situation to ASEAN+3**

| Country/Trade Cost | 100% NT | 80% NT | 60% NT | 40% NT | 20% NT |
|---|---|---|---|---|---|
| China | 1.002 | 0.999 | 0.995 | 0.992 | 0.988 |
| Japan | 0.997 | 0.993 | 0.989 | 0.985 | 0.98 |
| Korea | 0.99 | 0.979 | 0.967 | 0.955 | 0.942 |
| BMSV | 0.97 | 0.926 | 0.881 | 0.833 | 0.784 |
| CILMPT | 0.996 | 0.975 | 0.952 | 0.926 | 0.896 |
| **WHOLE** | **1.002** | **0.999** | **0.996** | **0.992** | **0.989** |

Note: (1) 100% NT denotes all tariff removed between FTA member countries, 80% NT denotes all tariff and 20% non-tariff removed between FTA member countries, others are the same for 60% NT, 40% NT and 20% 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 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 use 98.9% 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 shows all distance calculation results.

**Table 9: The Distance of Present Situation to RCEP**

| Country/Trade Cost | 100% NT | 80% NT | 60% NT | 40% NT | 20% NT |
|---|---|---|---|---|---|
| China | 1.002 | 0.998 | 0.994 | 0.989 | 0.983 |
| Japan | 0.998 | 0.993 | 0.989 | 0.983 | 0.977 |
| Korea | 0.991 | 0.978 | 0.964 | 0.949 | 0.933 |
| India | 0.964 | 0.954 | 0.943 | 0.929 | 0.911 |
| AN | 0.991 | 0.985 | 0.979 | 0.972 | 0.965 |
| BMSV | 0.966 | 0.911 | 0.856 | 0.798 | 0.739 |
| CILMPT | 0.996 | 0.969 | 0.937 | 0.901 | 0.859 |
| **WHOLE** | **1.002** | **0.998** | **0.994** | **0.989** | **0.984** |

Note: (1) 100% NT denotes all tariff removed between FTA member countries, 80% NT denotes all tariff and 20% non-tariff removed between FTA member countries, others are the same for 60% NT, 40% NT and 20% 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.

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.

Comparing the effects of RCEP with other FTA arrangements, its positive effects to 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 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 reports all these results.

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 rule from the results is that all countries will gain more as non-tariff barriers remove more.

**Table 10: The Distance of Present Situation to Global Free Trade**

| Country/Trade Cost | 100% NT | 80% NT | 60% NT | 40% NT | 20% NT |
|---|---|---|---|---|---|
| US | 1.001 | 0.992 | 0.983 | 0.972 | 0.961 |
| EU | 1.000 | 0.989 | 0.977 | 0.962 | 0.946 |
| China | 1.005 | 0.991 | 0.976 | 0.961 | 0.944 |
| Japan | 1.000 | 0.990 | 0.979 | 0.966 | 0.952 |
| Korea | 0.998 | 0.966 | 0.934 | 0.899 | 0.864 |
| Canada | 0.999 | 0.982 | 0.963 | 0.942 | 0.917 |
| Mexico | 1.004 | 0.986 | 0.966 | 0.944 | 0.918 |
| India | 0.974 | 0.940 | 0.901 | 0.856 | 0.801 |
| AN | 0.994 | 0.983 | 0.971 | 0.958 | 0.942 |
| CP | 0.996 | 0.950 | 0.898 | 0.839 | 0.772 |
| BMSV | 0.974 | 0.88 | 0.788 | 0.721 | 0.608 |
| CILMPT | 1.003 | 0.96 | 0.911 | 0.855 | 0.791 |
| ODDC | 0.997 | 0.972 | 0.945 | 0.917 | 0.886 |
| ODC | 1.004 | 0.979 | 0.951 | 0.918 | 0.880 |
| ROW | 0.986 | 0.924 | 0.858 | 0.787 | 0.710 |
| **WHOLE** | **1.004** | **0.993** | **0.984** | **0.974** | **0.963** |

Note: (1) 100% NT denotes all tariff removed between FTA member countries, 80% NT denotes all tariff and 20% non-tariff removed between FTA member countries, others are the same for 60% NT, 40% NT and 20% 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.

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 just do sensitivity analysis for the Whole country distance; the results are listed in Table 11. We can see that all results have not changed much, and as elasticities increase, the positive effects of FTAs and global free trade will decrease. This proves that our simulation results are reliable, but in the meanwhile, the results are a little sensitive to elasticities.

**Table 11: Sensitivity Analysis to Elasticities**

| Country | Elasticities | 100% NT | 80% NT | 60% NT | 40% NT | 20% NT |
|---|---|---|---|---|---|---|
| Asia FTA | 1.5 | 0.994 | 0.990 | 0.986 | 0.982 | 0.977 |
| | 2 | 1.001 | 0.997 | 0.993 | 0.989 | 0.984 |
| | 2.5 | 1.015 | 1.004 | 1.000 | 0.995 | 0.990 |
| Asia Union (China Tariff Level) | 1.5 | 0.994 | 0.990 | 0.986 | 0.981 | 0.976 |
| | 2 | 1.001 | 0.996 | 0.993 | 0.988 | 0.983 |
| | 2.5 | 1.015 | 1.003 | 1.000 | 0.994 | 0.989 |
| ASEAN+3 | 1.5 | 0.995 | 0.992 | 0.989 | 0.985 | 0.982 |
| | 2 | 1.002 | 0.999 | 0.996 | 0.992 | 0.989 |
| | 2.5 | 1.016 | 1.006 | 1.003 | 0.999 | 0.996 |
| RCEP | 1.5 | 0.994 | 0.990 | 0.986 | 0.981 | 0.977 |
| | 2 | 1.002 | 0.998 | 0.994 | 0.989 | 0.984 |
| | 2.5 | 1.015 | 1.004 | 1.000 | 0.995 | 0.990 |
| Global Free Trade | 1.5 | 0.998 | 0.986 | 0.978 | 0.968 | 0.957 |
| | 2 | 1.004 | 0.993 | 0.984 | 0.974 | 0.963 |
| | 2.5 | 1.020 | 1.002 | 0.991 | 0.981 | 0.969 |

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[6]. They have the following equations

[6] See: Wikipedia "Compensating Variation", http://en.wikipedia.org/wiki/Compensating_variation.

$$\begin{cases} EV = e(p^0, v(p^1, m^1)) - e(p^0, v(p^0, m^0)) = e(p^0, v(p^1, m^1)) - m^0 \\ CV = e(p^1, v(p^1, m^1)) - e(p^1, v(p^0, m^0)) = m^1 - e(p^1, v(p^0, m^0)) \end{cases} \tag{35}$$

Where 0 denotes former situation, 1 denotes the situation after change. With this calculation methodology, we choose the case of "60% 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 calculate Debreu coefficient, and introduce Debreu distance into FTA effects measurement for the first time. 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 Debreu coefficient distance indicator to show and evaluate how far Asia is already surrogate trade bloc, which indicator is new in literature and provide another angel to show FTA effects from endownment shrink ratio side. Although Debreu coefficient is an old notion, but seldom researches had ever calculated it numerically, we are the first to calculate and use it in understanding reality.

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, 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 longer 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, which means that the global free trade will benefit all countries the most.

The simulation results have some policy implications. The first is that non-tariff barriers elimination will be the most import part to benefit potential Asia trade bloc countries, therefore, the present Asia FTA negotiations should focus on non-tariff barriers removal. The second is that the global free trade will benefit all countries but regional FTA can benefit only member countries, which proves that global free trade is the best choice from the point view of the world.

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