Unilateral and Regional Trade Liberalization: China's WTO Accession and FTA with ASEAN*

By

Mesut Saygili
Bank of Turkey

and

Kar-yiu Wong†
University of Washington

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† Corresponding author: Department of Economics, University of Washington, Seattle, WA 98195-3330, U. S. A.; fax number = 1-888-814-9988; e-mail address: karyiu@u.washington.edu.

1. Introduction

The post-war economy of the world is characterized by reduction of many of the government restrictions on the movements of goods and capital across countries. Through several rounds of multilateral trade negotiations, regional cooperation, and unilateral trade liberalization of many countries, the world had seen rapid dismantling of trade barriers and the resulting surge in international trade volumes, capital flows, and national income levels.

The rise of the Chinese economy after the decision of the government at the end of the seventies to liberalize many of its internal and external economic policies had created series of big shocks to the world economy. Because of the size of its economy and because of its impressive and nearly uninterrupted growth, China has affected other economies in many ways and generated a lot of discussion and concerns about the size and sign of some of these impacts. Therefore the rise of the economy and its liberalizing policies were met with mixed reactions from different countries and different individuals.

Recently two economic events concerning foreign trade liberalization of China had drawn particularly much attention of the government planners and economists of many countries. The first event is China's accession to the World Trade Organization (WTO) in November 2001.[1] In order to gain accession into this organization, China has promised to make changes in many of its trade and FDI policies. In particular, it agreed to greatly lower its tariffs, reduce its restriction on the inflow of capital into some of the sectors, and change many of its corporate taxes on foreign investors.

The second event is that China and ASEAN signed a framework free trade agreement in November 2002. They recently agreed to form a free trade area (FTA) in ten years.[2] By the agreement, China and ASEAN will remove nearly all the restrictions on the movement of goods between themselves. Japan and South Korea also expressed great interest in taking similar steps, i.e., forming free trade areas with ASEAN.

Based on the performance of the China economy in the past twenty-four years, it is widely expected that China's accession to the WTO and the establishment of China-ASEAN FTA will bring big changes to the economies of many other countries. These changes will probably benefit some countries and people, but will probably hurt the welfare of some countries and people.

Concerns about possible adverse impacts of these two events had been rising. For example, it has been worried that when China becomes a member of the WTO, trade liberalization will greatly improve the competitiveness of Chinese products in the world

[1] China formally became a member of the WTO on January 1, 2002.
[2] ASEAN decided back in 1992 to convert itself into a free trade area.

markets, and its economy will become much more attractive to foreign direct investment. It is further worried that the success of the Chinese trade performance could be at the expense of the AEASN economies. That is because ASEAN products could lose market shares in third countries such as the United States, and because China could attract foreign capital which was originally supposed to be sent to ASEAN.

To examine and analyze some of these worries, Wong (2004) investigates some of the features of trade between China and some of the ASEAN member nations.[3] He does not find evidence to support the worry that ASEAN products will lose out to Chinese products in other countries. Instead, he argues that the existence of significant intra-industry trade could bring good potential gains to all countries concerned. Wong (2003) builds a theoretical three-country model to analyze the impacts of trade liberalization by China on welfare of China, ASEAN and the rest of the world. He derives conditions under which the ASEAN could gain from China's accession to the WTO.

This paper is another attempt to investigate the impacts of trade liberalization by China. Contrary to the previous work of Wong, this paper examines not only China's accession to the WTO, but also the formation of a China-ASEAN FTA. How these two forms of trade liberalization by China may affect international trade, international capital movement, commodity and factor prices, and welfare will be analyzed.

This paper constructs a two-good, multi-variety, and three-country model. The countries are conveniently called China, ASEAN, and ROW (the rest of the world), while the two goods are manufacturing and agriculture. ROW in fact consists of eight countries/economies: the USA, Japan, Australia, Canada, France, Italy, Germany, and Hong Kong. We allow differentiation of products and the existence of internal economies of scale. Thus our model is suitable for analyzing both inter-industry trade and intra-industry trade among the countries. Another feature of the present model is that capital movement is allowed. We will investigate the impacts of trade liberalization on the movement of goods and capital movement.

We start with a theoretical model. The model is very extensive and capable of capturing many of the issues of interest. The cost of building such a model is that it is so complicated that analyzing the possible impacts of a shock, such as a reduction in tariff rates, is very difficult. Therefore in the second half of the paper, we solve the system numerically. We consider various cases and equilibria, depending on the assumed government policy parameters, which change after each stage of liberalization. We will investigate the features of the following cases:

(a) The benchmark. This is the case before China's accession to the WTO.

(b) Scenario 1: This is the case in which China is a member of the WTO but before the China-ASEAN FTA.

[3] Wong (2004) investigates the trade between China and the following five ASEAN members: Singapore, Thailand, Malaysia, Indonesia, and the Philippines.

(c) Scenario 2: This is the case in which China is a member of the WTO, and China and ASEAN forms an FTA. However, the China-ASEAN FTA does not include liberalization in capital movement.

The rest of the paper is organized as follows. Section 2 describes the three-country model. Section 3 presents the benchmark and some of the assumptions used in the simulation. Section 4 analyzes the case in which China is a member of the WTO. Sections 5 investigates scenario 2, with China and ASEAN forming an FTA (and also with China being a member of the WTO). The last section concludes.

2. A Three-Country Model

The model used in the present paper consists of two sectors with differentiated products, three (groups of) countries, and four factors (labor and three types of capital). The two sectors are manufacturing (m) and agriculture (a).[4] In each sector, there are a large number of monopolistically competitive firms, each of which employs labor and capital to produce a variety of the product. Free entry and exit ensures zero product of each firm in the long run.

The three countries or groups of countries/regions are China (c), ASEAN (a), and ROW (r). ASEAN, the Association of Southeast Asian Nations, is a group of countries, but in the present paper, they are combined together and treated as a country. ROW, or the rest of the world, consists of USA, Japan, Australia, Canada, UK, Italy, France, Germany, and Hong Kong. These eight countries/regions are the most important trading partners of China and ASEAN.

Labor is a homogeneous factor, which is perfectly mobile within a country but immobile between countries. Each country possesses a special type of capital. Capital may move between countries.

There have been many similar models of differentiated products and monopolistic competition in the literature, but the present one will allow us to consider inter-industry trade, intra-industry trade, and capital movement in a simple model.[5]

In country i, $i = c$, a, and r, there are n_i^m types of manufacturing goods and n_i^a types of agricultural goods produced by monopolistically competitive firms, where n_i^m and n_i^a are determined endogenously. Country i is endowed with $\overline{L}_i$ units of labor and

[4] Agriculture includes the service sector.
[5] See Wong (1995, Chapter 6) for a survey and some discussion about trade and capital movement under monopolistic competition. Amiti's model (Amiti, 1998) is close to ours but the present one considers four factors and allows international capital movement.

$\bar{K}_i$ units of capital of its own type. Both factors can move perfectly and costlessly within its own country, but only capital can move internationally.[6]

Trade in commodities and capital movements exist among the countries. Before the China-ASEAN free trade area (FTA) is formed, all countries have positive tariffs on the goods imported from other countries. For simplicity, it is assumed that no capital flows from China or ASEAN to the ROW. This assumption is justified by the fact that actual capital from China and ASEAN to the rest of the world is insignificant and it is used to simplify the analysis.

In order to allow for cross-hauling of capital between China and ASEAN, we take the Armington assumption for capital, and distinguish three different types of capital: capital from China, capital from ASEAN, and capital from the ROW. Firms in China and ASEAN require all three types of capital in their production while firms in the ROW use capital from the ROW only. This implies that capital moves between China and ASEAN, from ROW to China and ASEAN, but not from China and ASEAN to ROW.[7]

Currently, country *i* imposes a non-prohibitive tariff of *ad valorem* rate of t_{ij}^h on the goods in sector *h* imported from country *j*, and an income tax rate of τ_{ij} on the capital from country *j*, $i, j = c, a, r, \ i \neq j,$ and $h = m, a$. In equilibrium, the price of variety *s* of good *h* from country *j* in country *I*, q_{ij}^{hs}, is related to the corresponding price in country *j*, p_j^{hs}, by

$$q_{ij}^{hs} = p_j^{hs}(1+t_{ij}). \tag{1}$$

In other words, q_{ij}^{hs} is the price of variety *s* of good *h* from country *j* the consumers and producers in country *i* are facing. Similarly, if capital flows from country *i* to country *j*, in equilibrium, the rental rate of capital in country *I*, r_{ii}, is equal to the after-tax rental rate in country *j*, $r_{ji}(1-\tau_{ji})$, for $i = c, a, r, j = c, a,$ and $i \neq j$:

$$r_{ii} = r_{ji}(1-\tau_{ji}). \tag{2}$$

Goods shipped from country *j* to country *i* is subject to a per unit transport cost of $(1-g_{ji})$, where $0 < g_{ji} < 1$, meaning that if one unit of a good leaves country *j*, $(1-g_{ji})$ is used to pay for the transport cost so that only g_{ji} unit arrives.[8] Capital movement from one country to another is costless.

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[6] The assumption of perfect and costless factor movements within a country is consistent with similar assumptions for this type of models. Because of this assumption, the present model is not suitable for analyzing price disparities among different regions in the same country.

[7] The assumption of no capital from China and ASEAN to ROW simplifies the analysis and is consistent with the fact that ROW receives insignificant amount of capital from China and ASEAN.

[8] For simplicity, we assume the same transport cost is needed for both types of goods shipped from country *j* to country *i*.

2.1 Preferences and Technologies

We first describe the preferences and technology in China, as the other two countries have similar features. There are a large number of households with identical and homothetic preferences. The aggregate utility of the country can be represented by

$$U_c = (D_c^m)^{\theta_c} (D_c^a)^{1-\theta_c}, \tag{3}$$

where D_i^h is a sub-utility defined as

$$D_c^h = \left[\sum_{s=1}^{n_c^h} (c_c^{hs})^{\xi_c^h} + \sum_{s=1}^{n_a^h} (c_{ca}^{hs})^{\xi_c^h} + \sum_{s=1}^{n_r^h} (c_{cr}^{hs})^{\xi_c^h} \right]^{1/\xi_c^h}, \tag{4}$$

where c_{ci}^{hs} is China's consumption of type *s* of good *h* from country *i*, *i* = *a*, *r*. Note that $\sigma_c^h = (1-\xi_c^h)/1$ is the elasticity of substitution of sector *h* in China. Because of the presence of transport costs, China actually imports m_{ci}^{hs} units of type *s* of good *h* from country *i*, but of each unit $(1-g_{ci})$ is spent on the transport costs and only g_{ci} arrives for consumption. Thus

$$c_{ci}^{hs} = m_{ci}^{hs} g_{ci}. \tag{5}$$

Let us now turn to the production side of the Chinese economy. Firms use labor and effective capital, $\tilde{K}$, to produce each type of the goods. Technologies are identical for all firms in all countries. To produce type *s* of good *j*, a firm uses the production function given by

$$\alpha_c^h + \beta_c^h X_c^{hs} = \min\left(\frac{1}{\gamma_c^h} L_c^{hs}, \frac{1}{\delta_c^h} \tilde{K}_c^{hs} \right), \tag{6}$$

where L_c^{hs} and $\tilde{K}_c^{hs}$ are the labor and effective capital inputs, respectively, and α_c^h, β_c^h, γ_c^h, and δ_c^h are positive parameters. Equation (6) shows that there is no factor substitution between labor and effective capital in the production process. The left-hand side of the function indicates the presence of economies of scale. Another feature of the production function is that all firms in each sector face the production function given by (6). The effective capital used by the firm producing variety *s* of good *h* in China, $\tilde{K}_c^{hs}$, is an index determined by a combination of the amounts of capital from different countries, and is given by

$$\tilde{K}_c^{hs} = (K_{cc}^{hs})^{\phi_c} (K_{ca}^{hs})^{\mu_c} (K_{cr}^{hs})^{1-\phi_c-\mu_c}. \tag{7}$$

The way the effective capital is defined is based on the Armington assumption (Armington, 1969) that capitals from different countries are not the same, and that all three different types of capital are essential in the production process (except in ROW).

The effective capital of sector *h* for variety *s* of ASEAN can be defined in a similar way as

$$\tilde{K}_a^{hs} = (K_{ac}^{hs})^{\phi_a} (K_{aa}^{hs})^{\mu_a} (K_{ar}^{hs})^{1-\phi_a-\mu_a}. \tag{8}$$

We assume that there is no capital movement from China and ASEAN to ROW. Thus the effective capital of sector *h* of ROW can be defined as

$$\tilde{K}_r^{hs} = K_{rr}^{hs}. \tag{9}$$

Note that in terms of preferences and technologies, all the varieties in the same sector are symmetric. This implies that firms will choose to produce the same output of each variety and the consumers will choose to consume the same quantity of each variety of the same good. Thus for an equilibrium, we can define $c_i^h = c_i^{hs}$, $m_{ij}^h = m_{ij}^{hs}$, $X_i^h = X_i^{hs}$, $p_i^h = p_i^{hs}$, and $q_{ij}^h = q_{ij}^{hs}$, for $i, j = c, a, r$; $h = m, a$, and all varieties *s*.

2.2 Utility and Profit Maximization

The national income of China is equal to

$$Y_c = w_c \bar{L}_c + r_c \bar{K}_c + T_c, \tag{10}$$

where T_c is international transfer China receives. In the present model, it is equal to the total tax revenue the government receives through tariffs and income taxes on capital from other countries, i.e.,

$$T_c = \sum_j [t_{cj}^m p_j^m n_j^m m_{cj}^m + t_{cj}^a p_j^a n_j^a m_{cj}^a + \tau_{cj} r_{cj} K_{cj}], \tag{11}$$

where p_j^h is the market price of good *h* in country *j*, and r_{ij} is the rental rate of the capital from country *j* in country *i*.[9] The tax rates and the tax revenue will be taken as given by all households. The tax revenue is distributed in a lump-sum way to all households.

A representative household will choose an optimal basket of goods for consumption, taking the prices and income as given, to maximize its utility. The representative household will have an income equal to the national income, and with homothetic and identical preferences among households, the consumption of the representative household is the same as that of the economy. The maximization problem can be conceptually broken down in two stages. In the first stage, the economy chooses the two sub-utility indices to maximize the utility function as given by (3), taking the national income in (10) as given. In the second stage, the economy will choose the optimal consumption basket of each type of goods in order to maximize the corresponding sub-utility index as given by (4).

[9] Note that when some of the capital flows to ASEAN, in equilibrium the domestic rental rate is equal to the after-tax rental rate of China capital in ASEAN.

In the first stage, the first-order conditions give

$$\theta_c Y_c = n_c^m p_c^m c_c^m + n_a^m q_{ca}^m m_{ca}^m + n_r^m q_{cr}^m m_{cr}^m \tag{12}$$

$$(1-\theta_c) Y_c = n_c^a p_c^a c_c^a + n_a^a q_{ca}^a m_{ca}^a + n_r^a q_{cr}^a m_{cr}^a, \tag{13}$$

where the symmetry between the varieties of the same product in each country has been used. The right-hand sides of equations (12) and (13) represent the expenditures on the two groups of goods, manufacturing and agriculture.

In stage 2, the representative household will maximize the sub-utility of each group of goods by choosing the right basket of that group of goods, taking either equation (12) or (13) as given. The first-order conditions yield

$$m_{ca}^h = c_c^h \left(\frac{p_c^h}{q_{ca}^h} \right)^{\sigma_c^h} g_{ca}^{\sigma_c^h - 1} \tag{14}$$

$$m_{cr}^h = c_c^h \left(\frac{p_c^h}{q_{cr}^h} \right)^{\sigma_c^h} g_{cr}^{\sigma_c^h - 1}, \tag{15}$$

where $h = m, a$. Substitute equations (14) and (15) into equations (12) and (13) to get the consumption demands for the goods:

$$c_c^h = \frac{\zeta_c^h Y_c}{\tilde{p}_c^h} \tag{16}$$

$$m_{ci}^h = \frac{\zeta_c^h}{\tilde{p}_c^h} \left(\frac{p_c^h}{q_{ci}^h} \right)^{\sigma_c^h} g_{ci}^{\sigma_c^h - 1}, \tag{17}$$

where $i = a, r$, $h = m, a$, $\zeta_c^m = \theta_c$, $\zeta_c^a = 1 - \theta_c$, and

$$\tilde{p}_c^h = p_c^h \left[n_c^h + n_a^h (p_c^h g_{ca} / q_{ca}^h)^{\sigma_c^h - 1} + n_r^h (p_c^h g_{cr} / q_{cr}^h)^{\sigma_c^h - 1} \right]. \tag{18}$$

Variable $\tilde{p}_c^h / n_c^h$ can be interpreted as the effective price of a variety of the local good h in China. By equations (16) and (17), the consumption demands are functions of commodity prices and the number of varieties of each good, with some exogenous variables given.

We now turn to the maximization problem of a representative firm. The problem can also be solved in two hypothetic stages. In the first stage, the firm chooses the optimal inputs of labor and effective capital, taking all factor prices as given. In the second stage, the firms choose different types of capital to produce the optimal effective capital.

To analyze the firm's maximization problem, note that the cost of capital for the production of type *s* of good *h* is given by

$$R_c^h = r_{cc}K_{cc}^h + r_{ca}K_{ca}^h + r_{cu}K_{cr}^h, \tag{19}$$

where $h = m, a$, and the symmetry among the varieties of each good has been used. In the second stage, a firm will choose optimal inputs of capital by minimizing the cost of capital as given by (19), taking the effective capital, $\tilde{K}_c^h$, its dependent on different types of capital as given by (7), and the rental rates of capital as given. The different types of cost-minimizing capital for the production of each type of good *h* are given by

$$\tilde{K}_{cc}^h = \left(\frac{r_{cc}}{\phi_c}\right)^{\phi_c - 1}\left(\frac{r_{ca}}{\mu_c}\right)^{\mu_c}\left(\frac{r_{cr}}{1-\phi_c-\mu_c}\right)^{1-\phi_c-\mu_c}\tilde{K}_c^h \tag{20}$$

$$\tilde{K}_{ca}^h = \left(\frac{r_{cc}}{\phi_c}\right)^{\phi_c}\left(\frac{r_{ca}}{\mu_c}\right)^{\mu_c - 1}\left(\frac{r_{cr}}{1-\phi_c-\mu_c}\right)^{1-\phi_c-\mu_c}\tilde{K}_c^h \tag{21}$$

$$\tilde{K}_{cu}^h = \left(\frac{r_{cc}}{\phi_c}\right)^{\phi_c}\left(\frac{r_{ca}}{\mu_c}\right)^{\mu_c}\left(\frac{r_{cr}}{1-\phi_c-\mu_c}\right)^{-(\phi_c+\mu_c)}\tilde{K}_c^h. \tag{22}$$

Equations (20) to (22) are combined to give the cost-minimizing cost of capital in sector *h*:

$$R_c^h = R_c^h(r_{cc}, r_{ca}, r_{cr}, \tilde{K}_c^h) = \tilde{r}_c\tilde{K}_c^h, \tag{23}$$

where

$$\tilde{r}_c = \left(\frac{r_{cc}}{\phi_c}\right)^{\phi_c}\left(\frac{r_{ca}}{\mu_c}\right)^{\mu_c}\left(\frac{r_{cr}}{1-\phi_c-\mu_c}\right)^{1-\phi_c-\mu_c}, \tag{24}$$

which can be interpreted as the rental rate of the effective capital.

In the first stage of profit maximization, the firm producing each type of good *h* maximizes the following profit function, taking factor prices and the production function (6) as given, by choosing the labor and effective capital inputs:

$$\pi_c^h = p_c^h X_c^h - w_c L_c^h - \tilde{r}_c\tilde{K}_c^h. \tag{25}$$

Substitute the production function in (6) into (25) to give

$$\pi_c^h = p_c^h X_c^h - (w_c\gamma_c^h + \tilde{r}_c\delta_c^h)(\alpha_c^h + \beta_c^h X_c^h). \tag{26}$$

The first-order condition of the profit-maximizing problem thus gives

$$p_c^h = \left(\gamma_c^h w_c + \delta_c^h\tilde{r}_c\right)\beta_c^h\sigma_c/(\sigma_c - 1). \tag{27}$$

Equation (27) gives the relations between commodity prices and factor prices.

Free entry and exit under monopolistic competition implies that firms earn zero profit in the long run. Setting $\pi_c^h = 0$ and rearranging terms, we have

$$X_c^h = \frac{(w_c\gamma_c^h + \tilde{r}_c\delta_c^h)(\alpha_c^h + \beta_c^h X_c^{hs})}{p_c^h}. \tag{28}$$

Making use of the price in (27) and the effective capital in (23), equation (28) reduces to

$$X_c^h = \frac{\alpha_c^h(\sigma_c^h - 1)}{\beta_c^h}. \tag{29}$$

Equation (29) shows that the equilibrium output of each type of good depends only on the values of the relevant parameters. The equation applies to ASEAN and the ROW as well.

Equation (29) has a very useful implication: Because the production of each variety depends only on the relevant parameters but not on government policies, and because of the link between the output and inputs as given by the production function, the corresponding amounts of labor and effective capital employed by each firm will be independent of the policies of the governments. The labor and effective capital employment of each sector will then be determined by the number of varieties of the sector.

2.3 Market Equilibrium

The equilibrium of the labor market in country i, $i = c, a, r$, is

$$\bar{L}_i = \sigma_i(\alpha_i^m n_i^m \gamma_i^m + \alpha_i^a n_i^a \gamma_i^a). \tag{30}$$

The right-hand side of equation (30) is the total demand for labor, where the symmetry between all types of goods in the same sector has been used. The equilibrium of the China capital market is described by the following equation:

$$\bar{K}_c = n_c^a \tilde{K}_{cc}^a + n_c^m \tilde{K}_{cc}^m + n_a^a \tilde{K}_{ac}^a + n_a^m \tilde{K}_{ac}^m. \tag{31}$$

In equation (31), the left-hand side equals the given endowed capital while the right-hand side represents the demand for China capital in the two sectors of China and ASEAN.[10] Similarly, the equilibrium of the capital market in ASEAN is described by

$$\bar{K}_a = n_c^a \tilde{K}_{ca}^a + n_c^m \tilde{K}_{ca}^m + n_a^a \tilde{K}_{aa}^a + n_a^m \tilde{K}_{aa}^m, \tag{32}$$

while that of the ROW capital market is

$$\bar{K}_r = n_r^a \tilde{K}_r^a + n_r^m \tilde{K}_r^m + n_c^a \tilde{K}_{cr}^a + n_c^m \tilde{K}_{cr}^m + n_a^a \tilde{K}_{ar}^a + n_a^m \tilde{K}_{ar}^m. \tag{33}$$

The equilibrium of the market of type s of good h in China is given by

$$X_c^h = c_c^h + m_{ac}^h + m_{rc}^h. \tag{34}$$

[10] Recall that firms in ROW does not use the capital from China or ASEAN.

Similar equations for ASEAN and ROW can be stated.[11]

3. Simulation and the Benchmark

3.1 Solving the System

The present three-country model can be described by following reduced-form equations:

$$X_c^h = c_c^h + m_{ac}^h + m_{rc}^h \tag{35}$$

$$X_a^h = c_a^h + m_{ca}^h + m_{ra}^h \tag{36}$$

$$X_r^h = c_r^h + m_{cr}^h + m_{ar}^h \tag{37}$$

$$\overline{K}_c = n_c^a \tilde{K}_{cc}^a + n_c^m \tilde{K}_{cc}^m + n_a^a \tilde{K}_{ac}^a + n_a^m \tilde{K}_{ac}^m \tag{38}$$

$$\overline{K}_a = n_c^a \tilde{K}_{ca}^a + n_c^m \tilde{K}_{ca}^m + n_a^a \tilde{K}_{aa}^a + n_a^m \tilde{K}_{aa}^m \tag{39}$$

$$\overline{L}_i = \sigma_i(\alpha_i^m n_i^m \gamma_i^m + \alpha_i^a n_i^a \gamma^a). \tag{40}$$

Each of (35) to (37) in fact contains two equations, and (40) contains three equations. Together with (38) and (39), there are eleven equations. Note also that the equilibrium condition for the ROW capital market is regarded as redundant and thus not included in the system of equations because of Walras' Law. All the demands can be expressed as functions of factor prices, commodity prices, and tax rates, when given the exogenous variables and policy parameters, but commodity prices can in turn be expressed in terms of factor prices. Therefore equations (35) to (40) can all be expressed in terms of factor prices and the numbers of varieties. There are three wage rates and seven rental rates in the three countries. Equation (2), four of them, can be used to provide the links among the rental rates, and can be used to eliminate four rental rates. There are six unknown numbers of varieties in the countries. Thus there are twelve unknowns left, but one of them is chosen as the numeraire (having a value of one). When given the exogenous variables and policy parameters, the eleven equations are then solved for the eleven unknown variables. Once these variables are known, other endogenous variables can be solved using the equations described in the previous section.

The present paper considers three sets of policy parameters and the corresponding three-country equilibria. A change in the policy parameters is due to (a) China's accession to the WTO in January 2002; (b) the formation of a free trade area between China and ASEAN. Thus this paper focuses on the equilibria in the following situations:

1. The benchmark: pre-WTO and pre-FTA
2. Scenario 1: after China's WTO accession

[11] The equilibrium condition of the capital market of ROW can be regarded as redundant because of Walras' Law.

3. Scenario 2: after China's WTO accession and ASEAN-China FTA

The benchmark is the one before China's accession to the WTO and before the China-ASEAN FTA. China's accession to the WTO leads to unilateral trade liberalization (scenario 1). It involves a reduction of the tariffs on goods from other countries and a change in its corporate tax policies. The formation of the China-ASEAN implies a mutual reduction of the tariffs (down to zero) by these countries on the goods from other member countries of the FTA (scenario 2). We will solve for the equilibrium of the system under each of these situations. A comparison between the benchmark and scenario 1 shows the impacts of unilateral trade liberalization while a comparison between scenario 1 and scenario 2 will show the effects of regional trade liberalization on the member countries and non-member countries.

To solve for a equilibrium, we use actual observed data as much as possible. The tariff rates and corporate tax rates in which of the situation are based on the announced policies of the countries. Some figures, such as factor endowments and national income, come from government publications or are the estimates done by others. The preference and technology parameters, including transport costs, are our estimates or assumptions. More details about the data sources, the assumptions, and the values of the parameters are given in Tables 1 and 2.

Table 1a presents the endowments of the countries. The labor endowment, or the effective labor, of a country depends on the quantity of physical labor and human capital. We use the approach suggested in Duffy and Papageorgieu (2000) to define the effective labor of a country, with human capital in different countries carefully considered. The table shows that China has the most number of workers, but ROW has the most effective labor, mainly because ROW has a substantial amount of human capital. ROW also has the most amount of physical capital. The capital-labor ratio is the highest in ROW but the lowest in China.

Table 1b presents the tariff rates imposed by the countries in different situations. We allow the possibility that each country imposes different tariff rates on different goods from the same country. When China joins the WTO (from the benchmark to scenario 1), it reduces its tariff on manufacturing products from 11.3 percent to 9.1 percent, and that on agricultural products from 19.2 percent to 15.8 percent. ASEAN and ROW maintain the same tariff policies as before. When China and ASEAN form an FTA, with China's membership of the WTO (from scenario 1 to scenario 2) they remove the tariffs on the goods from each other.

The corporate tax rates of the countries are given in Table 1c. As China joins the WTO, due to harmonization of the tax systems, China actually raises its effective tax rates from 15 percent to 33 percent.

Tables 2a to 2c present the assumed transport costs, preference parameters, and technology parameters of the countries used in the simulation. These parameters are used in all simulation exercises below.

3.2 The Benchmark

To have a better understanding of the present model, we first present and analyze the benchmark. This is the situation before China becomes a member of the WTO and before China and FTA form a free trade area.

We substitute the values of the parameters described in Tables 1 and 2, including the post-WTO policy parameters, into the system of equations described in (35) to (40), and solve the system of equations using *Mathematica*. The results of the eleven unknown factor prices and number of varieties of the two goods in the three countries are used to determine other endogenous variables.

Our analysis will focus on the trade and FDI relations among the countries and their welfare. Table 3a presents the flow of goods between any two pairs of countries. The export and import of each of the two types of goods of each country are presented in each of the three panels. Panel (i) shows that China is a significant exporter (in a gross term and a net term) of manufacturing, most of which goes to ROW. China also exports agriculture, but the table shows that China imports much more agriculture than its export. As a result, China is a net exporter of manufacturing but a net importer of agriculture. Most of China's foreign trade is with ROW. Another interesting feature is that while China has a trade surplus with ROW, it does have a small trade deficit with ASEAN.

ASEAN has smaller trade volumes with other countries. It has a trade surplus of 54.0 with other countries but a trade deficit in agriculture. It has about the same sizes of export to China and to ROW, but it imports more manufacturing from China and more agriculture from ROW. As a result, ASEAN has a trade deficit in manufacturing with China but a trade deficit in agriculture with ROW.

ROW is a big trading partner for China and ASEAN. Because of its size, it has much bigger volumes of trade. It is a net importer of manufacturing from the other two countries, but a net exporter of agriculture. This model captures the fact that ROW runs a big trade deficit in terms of manufacturing and is a big exporter of agriculture.

Table 3b shows the capital flows among the three countries. In panel (i), one can see that China is a big recipient of foreign capital, mostly from ROW, both in manufacturing and in agriculture sectors. China and ASEAN have mutual flows of capital, even in the same industry. However, the outflow of capital from China is insignificant. So between China and ASEAN, capital flows mainly from ASEAN to China. Panel (ii) shows a similar picture for ASEAN: big recipient of capital from ROW. ASEAN sends considerable amounts of capital (manufacturing and agriculture) to China, but none to ROW. On the whole ASEAN is an important destination country for FDI from ROW.

ROW is for sure the most important source of FDI. Recall that the present model assumes that no capital flow from other countries to ROW. Because of its size, ROW naturally is a major source of FDI for China and ASEAN.

In addition to the directions of movements of goods and capital, the possibility of intra-industry flows is equally important. Table 3c presents the indices of intra-industry trade and capital flows. For each sector, the index of intra-industry trade or capital flows between two countries, I_i, is defined as

$$I_i = 1 - \frac{|E_i - M_i|}{E_i + M_i}, \tag{41}$$

where E_i is the export of sector *i* or capital inflow of one of the countries and M_i is the import of sector *i* or capital outflow, $i = m, a$. To show the overall degree of intra-industry trade and capital flow, the aggregate index of intra-industry trade or capital flow between two countries can be defined as

$$AI = \frac{\left(\sum_i E_i + \sum_i M_i\right) - \sum_i |E_i - M_i|}{\left(\sum_i E_i + \sum_i M_i\right) - \left(\sum_i E_i - \sum_i M_i\right)}. \tag{42}$$

Note that the formula given in (42) includes an adjustment for the existence of trade imbalance.

The indices of intra-industry trade and capital flows for different pairs of countries in the benchmark are presented in Table 3c. In terms of trade, China and ASEAN have a high degree of intra-industry trade in both manufacturing and agriculture sectors. This phenomenon is probably because of similar factor endowments of China and ASEAN. Trade between China and ROW is more of in inter-industry nature. The degree of intra-industry trade in manufacturing between ASEAN and ROW is also small, but the index for trade in agriculture between ASEAN and ROW is very high. The last row of Table 3c represents the aggregate indices of intra-industry trade, and it shows that China and ASEAN have a high degree of intra-industry trade. The latter point is an important one, which has not received much attention in the literature.

The last column of Table 3c presents the indices of intra-industry capital flow between China and ASEAN.[12] The table shows that the degree of intra-industry capital flow between China and ASEAN in either sector is positive but very small. That is because China receives considerable amount of capital from ASEAN but is not a major source of FDI. Note that because it is assumed that ROW receives no capital from China or ASEAN, the indices of intra-industry capital flows between ROW and China or ASEAN is zero.

[12] The present paper explains the co-existence of intra-industry trade and intra-industry capital flows by assuming monopolistic competition and regarding capital from different countries as different types of capital. Chan and Wong (2004) provide an alternative approach to intra-industry trade and intra-industry capital flows by focusing on the competition between oligopolistic firms.

4. Scenario 1: China's WTO Accession

In this section, we try to measure the impacts of China's WTO accession on foreign trade, capital movement, and welfare. As China becomes a new member country of the WTO, it is committed to liberalizing its trade and FDI policies. Three major policy changes made by China can be summarized as follows: (a) China reduces its tariff rate on imported manufacturing from 11.3 percent to 9.1 percent and that on agriculture from 19.2 percent to 15.8 percent; (b) China opens some domestic sectors to foreign direct investment; and (c) For the purpose of accounting harmonization, China eliminates certain advantages granted to foreign firms, resulting in an increase in the effective taxes on foreign capital from 15 percent to 33 percent in China. The changes in China's trade and FDI policies are summarized by Tables 1b and 1c. Note that all other countries do not have any obligation to have corresponding changes in their trade and FDI policies.

In order to find the impacts of this unilateral trade liberalization by China, we solve the equilibrium represented by equations (35) to (40), using the new policy parameters given in Table 1b. The values of the endogenous variables in the system of equations are then used to determine all other endogenous variables of the model.

Tables 4a and 4b present the changes in the flows of commodities and capital among the three countries. Table 4a indicates that China's unilateral trade liberalization does lead to a substantial increase in its imports. In particular, there is an increase in China's import of manufacturing and agriculture from ASEAN and ROW. The increase in import from ROW is even more significant—an increase by 55 percent. Such an increase in import causes a drop in domestic production of these products, causing a shift of the resources from the import competing sectors to the exportable sectors. As a result, China experiences a simultaneous rise in export of both manufacturing and agriculture. The jump in the export of agriculture is even more impressive than that of manufacturing: 28 percent versus 7 percent.

Not surprisingly, ASEAN benefits, at least in terms of trade with China, as a result of China's unilateral trade liberalization: Its exports of manufacturing and agriculture to China jump by 27 percent and 18 percent, respectively. At the same time, its imports from China also rise, especially in agriculture. On the whole, ASEAN sees a substantial increase in trade with China as the latter joins the WTO.

ROW also experiences an expansion of trade as China becomes a member of the WTO, especially in terms of export of manufacturing to China. The main reason probably is that there is a bigger gap between China's capital-labor ratio and ROW's capital-labor ratio than between China's ratio and ASEAN's ratio. In other words, ROW, being the most capital-abundant country (group of countries), will be able to significantly improve its export, especially its export of manufacturing, to China.

More interesting is that China's unilateral action encourages flows of commodities in all directions. This suggests that a country's trade liberalization could lead to not only a more efficient allocation of its domestic resources, but also a more efficient allocation of resources in the rest of the world. As a result, world's volume of trade increases.

One lesson suggested by our results is that while it is true that China's WTO accession could improve the competitiveness of China's products in the rest of the world, other countries could expect to export more to China. After all, China is not only a producer but also a consumer.

The impacts of China's WTO accession on international capital movements are presented in Table 4b. As noted above, this policy includes changes in China's corporate taxation policy; i.e., China raises its effective tax rate on foreign investment income from 15 percent to 33 percent. Such a policy obviously has negative impacts on FDI in China, as confirmed by Table 4b: the flows of foreign capital in both sectors to China drop substantially. There is an increase in the outflow of capital from both sectors in China. An interesting point is that while the percentage increase in the amount of capital outflow from China is huge, the absolute amount is in fact negligible because the amount of capital outflow was small to begin with.

Probably the more important result of China's WTO accession is that ROW increases significantly its investment in the ASEAN while lowering its investment in China. This investment diversion effect is contrary to what some people have been worrying about. The reason for this result is that China actually tries to take back the incentives it provided to foreign investors before its accession to the WTO. Thus instead of losing foreign investment, as some people have suggested, ASEAN actually gains more investment from ROW.

We now examine how intra-industry trade and capital flows may be affected. Table 4c presents the relevant indices, which are computed using equations (41) and (42). In order to show the degrees of impacts, the table also gives the percentage changes from the corresponding values in the benchmark. One interesting phenomenon is that all the indices go up, meaning that the intra-industry trade and capital flows between any pair of countries are enhanced. While intra-industry trade between China and ASEAN, and that between ASEAN and ROW increase moderately, that between China and ROW receives much bigger impacts. In general, intra-industry trade in manufacturing is much greater than that in agriculture, not surprisingly.

Table 4c also shows the indices of intra-industry capital flows. The degree of intra-industry capital flows between China and ASEAN is small, since capital flows mostly from ASEAN and China. China is still not yet an important source of FDI. Although the indices of intra-industry capital flows between China and ROW are small, they show substantial percentage increases.

The welfare impacts of China's WTO accession are given in Table 5a, which presents the values of GNP (including tax revenues) at domestic prices and welfare of the countries in different scenarios.[13] Welfare of each country is the utility of the representative household defined by equation (3). The table shows that China's WTO accession leads to small changes in the countries' welfare; In particular, it benefits ASEAN but hurts China, while the utility of ROW remains about the same as before.

Perhaps the more interesting result is that China may be hurt by its accession to the WTO. Two questions immediately arise: How could this happen? What are the implications, if any?

To identify the factors of a drop in welfare in the present model is not easy because the endogenous variables in general are inter-related. However, we can still find out the intuition behind this result. First, we note from Table 5a that after becoming a member of the WTO, China's national income increases by 12.8 percent. This means that the gain in income from efficient resource allocation could cover the negative impact of a loss in tariff and corporate tax revenues. Second, Table 5b shows that China's WTO accession leads to jumps in the prices of all commodities. What is more, agricultural products get much more expensive than the manufacturing products do. For China, that is a bad news in terms of welfare because China is a net importer of agricultural products. Thus China experiences a deterioration in its terms of trade. Table 5c shows the numbers of varieties of the products produced by the countries. The last column gives the total number of varieties, which is an approximate indication of what the consumers enjoy.[14] The table shows that the consumers in the countries are facing a slightly smaller number of varieties, and this tends to hurt them.

What Table 5a to 5c suggest is that China could be hurt by a deterioration of its terms of trade, despite a rise in its national income, as it joins the WTO. This result seems to be striking, since China chooses to be a member of this international organization voluntarily. While the present result is only suggestive and more analysis will be needed for a more definitive conclusion, we do note that the present policy involves both economic and political consideration for China. The present model can at best examine the economic impacts of the policy, however. So to examine the rationality of the present policy, one needs to investigate any possible political impacts.

Lastly, let us examine the impacts of the policy on income distribution in various countries. Table 5d gives the domestic wage-rental ratio of the countries, i.e., w_i / r_{ii}, for $i = c$, a, and r.[15] All these ratios increase as China becomes a new member of the WTO, implying that workers relatively to capitalists benefit. The intuition behind this result is

[13] The GNP of a country is defined in equation (10) while the welfare is defined by equation (3).
[14] The total is the sum of all the varieties of both products. However, the sum of varieties is not an exact indication of what the consumers enjoy because with trade restrictions and/or transport costs, consumers do not treat domestic varieties and foreign varieties equally.
[15] This ratio, the ratio of domestic wage rate to local rental rate of capital at domestic price, is a comparison of the income levels of workers and capital owners. Recall that the assumption of perfect and costless factor mobility within a country implies one price of each factor.

that as China raises the effective tax rates on foreign investment, the international movement of all types of capital among the countries will substantially improve the productivity of the workers.

5. Scenario 2: China-ASEAN FTA

We now turn to the next scenario: China and ASEAN form a free trade area (FTA). The economic integration requires that both countries remove tariffs on goods from each other, while the tariffs on the goods from non-member countries remain unchanged. The corporate tax rates imposed by the member countries are assumed to stay as before. The new tariff and tax rates of the countries assumed in this scenario are listed in Tables 1b and 1c. Using these new policy parameters but keeping other exogenous variable parameters unchanged, the system of equations (35) to (40) is again solved for the eleven unknowns. Other endogenous variables are then determined.

We first examine the impacts of this FTA on the flows of commodities and capital in the world. Table 6a presents the new trade volumes of the countries after the formation of this FTA. It is clear from the table that the China-ASEAN FTA has a huge impact on their mutual trade, apparently at the expense of their trade with ROW. For example, China's exports of manufacturing and agriculture to ASEAN increase by 28 percent and 81 percent, respectively, while China's corresponding imports from ASEAN rise by 41 percent and 79 percent, respectively. These jumps come mainly from their trade with ROW. The table shows that ROW's trade with China and ASEAN drop substantially. For example, its total exports to China and ASEAN of manufacturing and agriculture decrease by 5 and 4 percent, respectively, while its imports of manufacturing and agriculture from the two countries drop slightly, by zero and 8 percent, respectively.

Such trade diversion is not surprising, as the reduction of trade restrictions tends to encourage trade between the two countries. However, the substantial increase in the intra-regional trade implies that much trade between China and ASEAN has been created. As a result, China's total exports and imports all expand, and so do the total exports of ASEAN.

The impacts of the FTA on capital movement are much less as compared with those on trade. For example, China will expect a drop in the FDI in the manufacturing and agriculture sectors from ASEAN by about 3 percent. Note that China remains to be a huge recipient of FDI.

Another way to see how the countries get more inter-dependent as a result of the China-ASEAN FTA is to examine how intra-industry trade and capital may be affected. Table 6c presents the new indices of intra-industry trade and capital movement. For example, the indices of intra-industry trade between China and ASEAN in

manufacturing and agriculture both increase.[16] This shows that the FTA will encourage intra-industry trade between China and ASEAN. The degree of intra-industry trade between China and ROW goes up slightly, but that between ASEAN and ROW falls, both in terms of manufacturing, agriculture, and the aggregate. The degree of intra-industry capital movement between China and ASEAN also rises, although it is small to begin with.[17]

Table 5a presents the welfare impacts of the China-ASEAN FTA. It shows that the welfare levels of China and ROW drop slightly, while ASEAN turns out to be a big winner: China's welfare falls by 0.2 percent, ROW's by 0.4 percent, while ASEAN's goes up by 3.5 percent. To examine why the welfare of the countries change in such ways, we first examine the national income levels of the countries. The interesting thing is that all three countries get a higher national income level after the FTA, and the increase in ASEAN's national income is more substantial, 4.9 percent.

Table 5b shows the terms of trade of the countries. While all domestic prices of the commodities increase, those of manufacturing and agriculture in ASEAN rise significantly. As a result, both China and ROW experience deterioration in their terms of trade, i.e., the goods from ASEAN become more expensive to China and ROW. This turns out to be a significant negative factor for their welfare.

Table 5c presents the changes in the numbers of varieties in the countries. It is shown that the numbers remain fairly constant, especially the total number of varieties of the two goods. In the present exercise, we discover that the terms-of-trade effect is significant for the changes in welfare of countries.

Lastly, let us examine the impacts of the regional integration on income distribution in the three countries. Table 5d gives the wage-rental ratio, w_i / r_{ii} of country *i*, after the formation of the China-ASEAN FTA, which can be compared with the previous values. The table shows that the FTA raises the wage-rental ratios of the countries. In other words, workers in all countries can benefit relatively to the capitalists from such regional trade liberalization. One possible explanation for the change in the wage-rental ratio is that both unilateral and regional trade liberalization allow capital to be used more efficiently, thereby substantially improving the productivity of the workers.

[16] The aggregate index of intra-industry trade between China and ASEAN drops slightly. Note that because of the adjustment for trade balance, the aggregate index is not a weighted average of the indices of intra-industry trade of the sectors.

[17] Again, intra-industry capital movement between either China or ASEAN and ROW is zero because of zero capital movement from China or ASEAN to ROW.

6. Concluding Remarks

Trade liberalization is one main feature of the post-war world trade. Sometimes countries choose to liberalize trade and capital movement unilaterally, expecting to get sufficient rewards in return. Multilateral trade liberalization happens when a large group of countries remove trade restrictions simultaneously. In addition to multilateralism, some countries form preferential trading clubs (such as free trade areas), imposing lower tariffs on the goods flowing within the club but keeping different tariffs on goods from non-member countries. Asia is relatively a late comer in terms of forming free trade areas (FTAs), but since the ASEAN decided to convert itself into an FTA in 1992, many countries in Asia had caught the fever of FTAs and are negotiating with other countries to expand their list of FTA partners. These several channels of trade liberalization have brought unavoidable impacts to many countries.

The present paper constructs a two-differentiated-product, three-country, four-factor model to investigate the effects of unilateral and regional trade liberalization. Using observed or assumed values of the countries' factor endowments, preference parameters, and technology parameters, this paper simulates several equilibria, based on the trade policies of the countries. The equilibria provide a convenient way of performing several comparative-static exercises in order to investigate how unilateral and regional trade liberalization may affect trade, capital movement, income distribution, and welfare among the three countries in the present model.

The present model has two major features: the presence of international capital movements and the existence of differentiated products. The former feature is used to capture the rising importance of international capital movements and their roles in welfare and income distribution. The latter feature is used to bring out the importance of increasing returns and trade between China and ASEAN. What is more, this feature allows us to examine the effects of trade liberalization on intra-industry trade, which, we argue, is an important factor of the welfare of the countries.

One important objective of the exercises in the present paper is to analyze whether China's WTO accession and China-ASEAN FTA could hurt some neighboring countries. The results obtained in the present project do not support the concerns that neighboring countries may be hurt by a more open Chinese economy. For example, we showed that neighboring economies may be able to benefit from China's unilateral trade liberalization. This result relies heavily on the existence of economies of scale and intra-industrial trade between China and ASEAN. Other countries, like Japan and the United States, may not have to worry about detrimental effects, either. (Table 5a)

One result seems to be very interesting: China may experience a drop in its welfare when it liberalizes trade as a condition for its accession to the WTO, or when it forms an FTA with ASEAN. We provided some reasons to explain why this is possible. Although we noted that this result is only preliminary, and although more research

should be done to draw any definitive conclusions, this result does suggest that China may be expecting more impacts than economic ones when it liberalizes its foreign trade.

While we have tried our best to rely on observed data to guess the values of some of the parameters, it is no doubt that the results obtained in the present paper are at best good guess of the impacts of trade liberalization. Further work should be done, including the construction of a more complicated model.

Basic Data and Assumptions

Table 1a: Endowments of the Countries (1996-2000 Average)

	China	ASEAN	ROW[6]
Labor, E_i [1]	754	255	363
Human Capital, H_i [2]	5.21	5.07	10.33
Effective Labor Coefficient, χ_i	0.18	0.19	0.68
Effective Labor, $L_i = H_i^{\chi_i} E_i$ [3]	1014	347	1497
Physical Capital, K_i	674	464	5107
K_i / L_i [5]	0.66	1.34	3.1

Notes and Sources:

(1) These are the labor force figures of the countries in 2002. For Malaysia (2001), Vietnam (2000), Cambodia (2000), the labor force figures are based on the corresponding figures in the years indicated and the assumption that the growth rates of the labor force were the same as their population growth rates. Brunei and Laos did not have any labor force figures. These countries labor force for year 2002 are estimated from their population figure by assuming that they have the same labor participation rate as the remaining ASEAN countries. Data for the ASEAN countries and China are from the Asian Development Bank Website (www.adb.org/statistics). Population data for Brunei, USA, France and Canada are taken from World Bank Website (http://www.worldbank.org/data/countrydata/countrydata.html). However, the labor force data for all ROW countries is taken from International Labor Organization website (http://laborsta.ilo.org/). Figures are in millions of labor units.

(2) Human capital (average number of years of education) figures are for the year 1987 and they are taken from Chris Papagerogieou's Website http://www.bus.lsu.edu/economics/faculty/cpapageorgiou/personal/welcome.html). This data set was used in Duffy and Papagergieou (2000). Figures are in terms of average number of years of education units.

(3) Duffy and Papageorgieu (2000) provided estimates of χ_i for 82 countries. Following the paper, χ_i estimate for low K/L countries is used for China. Their data samples include some ASEAN countries in both low and low-middle K/L groups. We used the average of those for the whole ASEAN countries. High K/L countries' χ_i estimate is used for the all ROW countries except Japan. The parameter estimate for Japan is zero.

(4) Effective labor is the combination of population and human capital. Following Duffe and Papageorgieu (2002) effective capital is defined as $L_i = H_i^{\chi_i} E_i$. Figures are in millions of effective labor units.

(5) Capital stock estimates for a group of countries are given in Duffy and Papagergieou (2000) for years up to 1987

(http://www.bus.lsu.edu/economics/faculty/cpapageorgiou/personal/welcome.html). The figures are extended to year 2000 by using World Penn Tables real USD investment data (http://pwt.econ.upenn.edu/php_site/pwt61_form.php). Capital is assumed to depreciate by 6% every year following the method described in Duffy and Papageorgieu (2000). There are few data regarding capital stock of the ASEAN economies available. The capital stock for the whole ASEAN is estimated by assuming that the K/L ratio of the countries with no data (Brunei, Vietnam, Cambodia, Laos, and Myanmar) are the same as the average K/L ratio of the ones with data (Indonesia, Malaysia, Singapore, Thailand, and Philippines). Figures are in ten billion USD units.

(6) ROW includes the USA, Japan, Australia, Canada, UK, Italy, France, Germany, and Hong Kong.

Table 1b: Tariffs of the Countries in Different Scenarios

(i) benchmark

percent

	China		ASEAN		ROW	
country *j*	t^m_{cj}	t^a_{cj}	t^m_{aj}	t^a_{aj}	t^m_{rj}	t^a_{rj}
China	--	--	7.8	11.4	3.6	5.5
ASEAN	11.3	19.2	--	--	3.6	5.5
ROW	11.3	19.2	7.8	11.4	--	--

(ii) post WTO

percent

	China		ASEAN		ROW	
country *j*	t^m_{cj}	t^a_{cj}	t^m_{aj}	t^a_{aj}	t^m_{rj}	t^a_{rj}
China	--	--	7.8	11.4	3.6	5.5
ASEAN	9.1	15.8	--	--	3.6	5.5
ROW	9.1	15.8	7.8	11.4	--	--

(iii) post FTA

percent

	China		ASEAN		ROW	
country *j*	t^m_{cj}	t^a_{cj}	t^m_{aj}	t^a_{aj}	t^m_{rj}	t^a_{rj}
China	--	--	0	0	3.6	5.5
ASEAN	0	0	--	--	3.6	5.5
ROW	9.1	15.8	7.8	11.4	--	--

Notes and Sources:

(1) Benchmark tariffs for agriculture and non-agriculture products were taken from WTO website for year 2002 except for Malaysia (2001), Thailand (2001), Brunei (2001) and Philippines (2003) (http://stat.wto.org/)). The parameter for ASEAN is the GDP weighted average of individual member countries. ASEAN countries' GDPs are taken from the Asian Development Bank website for the year 2002 (http://www.adb.org/statistics). The ASEAN figure does not include Myanmar and Laos due to lack of data.

(2) Post WTO data represent maximum tariff commitment of China in both Agriculture and others.

(3) ROW includes the USA, Japan, Australia, Canada, France, Italy, Germany, and Hong Kong. Figures for ROW are GDP weighted averages of individual figures.

Table 1c: Corporate Taxes of the Countries in Different Scenarios

(i) benchmark

percent

country k	China[1] τ_{ck}	ASEAN[2] τ_{ak}	ROW[3] τ_{rk}
China	--	28.7	38.3
ASEAN	15	--	38.3
ROW	15	28.7	--

(ii) post WTO

percent

country k	China[1] τ_{ck}	ASEAN[2] τ_{ak}	ROW[3] τ_{rk}
China	--	28.7	38.3
ASEAN	33	--	38.3
ROW	33	28.7	--

(iii) post FTA

percent

country k	China[1] τ_{ck}	ASEAN[2] τ_{ak}	ROW[3] τ_{rk}
China	--	28.7	38.3
ASEAN	33	--	38.3
ROW	33	28.7	--

Notes and Sources:

(1) Following the reports by Price Waterhouse Cooper http://www.pwccn.com/home/eng/index.html) instead of statutory rate, preferential corporate tax rates for the special zones are used. However, the same reports also claim that preferential treatments of the foreign companies will end due to WTO harmonization.

(2) GDP weighted average of six ASEAN members (Indonesia, Malaysia, Singapore, Thailand, Vietnam, and Philippines).

(3) ROW includes the USA, Japan, Australia, Canada, France, Italy, Germany, and Hong Kong. Figures for ROW are GDP weighted averages of individual figures.

(4) Corporate Tax rates are taken from the KPMG Website (http://www.kpmg.co.uk/pubs/taxrates_04.pdf) for year 2004.

Table 2a: Transportation Costs[1]

country j	China[2] g_{cj}	ASEAN[3] g_{aj}	ROW[4] g_{rj}
China	--	0.90	0.87
ASEAN	0.90	--	0.83
ROW	0.85	0.83	--

Notes and Sources:

(1) Variable g_{ij} is defined in such a way that it represents the fraction of a good left for consumption after paying for the transportation cost. So the transportation cost is $1-g_{ij}$.

(2) Transportation costs between countries are computed by using distance between capital cities as a proxy (http://www.wcrl.ars.usda.gov/cec/java/lat-long.htm). Following Frankel (1997), estimation of transportation cost between China and USA is 16%. Transportation costs between ASEAN economies, USA and China are calculated by applying the formula

$$TCost(i,j) = 0.05 + \frac{Distance(i,j)}{Distance(\text{China, USA})} * 0.11.$$

This formula assumes that transportation cost consists of two componenets: a fixed cost and a part that is a function of distance. If the distance between two countries is the same as the distance between China and USA, the formula gives 16% transportation costs. If the distance is greater, then the transportation cost increases less than proportionately due to the fixed cost term. Note also that Jakarta, Indonesia is chosen as a representative of the all ASEAN economies due to its size in terms of population and GDP. Considering that ASEAN economies are very localized compared to the countries/economies of ROW, this assumption did not change the result very much.

(3) ROW includes the USA, Japan, Australia, Canada, France, Italy, Germany, and Hong Kong. Figures for ROW are GDP weighted averages of individual figures.

Table 2b: Preference Parameters

	China[1]	ASEAN[2]	ROW[3]
θ_i	0.53	0.27	0.27
ξ_i^m	5/6	5/6	5/6
σ_i^m	6	6	6
ξ_i^a	5/6	5/6	5/6
σ_i^a	6	6	6

Notes and Sources:

(1) Variable θ_i is calculated by using the share of industry and agriculture + services in total domestic expenditure. All the figures are for year 2003. Expenditure shares were taken from the *CIA Factbook Online* database (http://www.cia.gov/cia/publications/factbook/fields/2012.html). The parameter for ASEAN is the GDP weighted average of individual members. ASEAN member country GDPs are taken from Asian Development Bank website for year 2002 (except Myanmar fro 2001) (http://www.adb.org/statistics). ASEAN data excludes Brunei due to lack of data.

(2) $\sigma_i^h = 1/(1-\xi_i^h)$.

Table 2c: Technology Parameters

(i) Industry *m*

country *i*	China[1]	ASEAN[2]	ROW[3]
α_i^m	2	2	2
β_i^m	1	1	1
γ_i^m	0.20	0.30	0.48
δ_i^m	0.33	1.22	2.37
ϕ_i^m	0.90	0.914	1
μ_i^m	0.007	0.0002	0

(i) Industry *a*

country *i*	China[1]	ASEAN[2]	ROW[3]
α_i^a (1)	2	2	2
β_i^a (1)	1	1	1
γ_i^a (2)	0.80	0.70	0.52
δ_i^a (3)	0.17	0.41	1.51
ϕ_i^m	0.90	0.914	1
μ_i^m	0.007	0.00017	0

Notes and Sources:

(1) The values of α_i^h and β_i^h are taken from Amiti (1998).

(2) The values of parameters γ_i^h are obtained from the ratio of labor shares in the two industries and the ratio of production shares as follows:

$$\frac{L_i^a / L_i}{L_i^m / L_i} * \frac{n_i^m X_i^m / \left(n_i^a X_i^a + n_i^m X_i^m\right)}{n_i^a X_i^a / \left(n_i^a X_i^a + n_i^m X_i^m\right)} = \frac{\gamma_i^a}{\gamma_i^m}.$$

This ratio gives us the ratio of labor intensity parameter if α_i^j, β_i^j, δ_i^j and the prices of capital and labor intensive goods are the same in both industries. After calculating this ratio, individual parameters for γ_i^j are solved for each country and each industry by using the fact that $\gamma_i^a + \gamma_i^m = 1$.

(3) In order to estimate δ_i^j for these countries the distribution of the employment of effective capital need to be calculated. Unfortunately this data is not available and

we need to use some estimates. Sectoral distribution of FDI flows to ASEAN countries is available in the ASEAN secretariat website (http://www.aseansec.org) for the 1999-2003 period. For this period, the FDI shares of agriculture + services and industry are 48% and 52% respectively. The assumptions that parameters in the effective capital function are identical for different sectors ($\phi_i^a = \phi_i^m$ and $\mu_i^a = \mu_i^m$), free flow of capital within the country, and identical corporate income taxes on foreign direct investments on different sectors simplify the estimation. These assumptions help us conclude that a sector's share in total FDI will be equal to its share in total effective capital (including domestic capital). From the full employment condition, we can show that

$$\frac{1}{\gamma^j} L^j = \frac{1}{\delta^j} \bar{K}^j.$$

Rearranging this term gives $\delta^j = \frac{\gamma^j \bar{K}^j}{L^j}$. Given the values for these parameters, we could calculate this parameter. Due to lack of data, Chinese data are assumed to have the same distribution of FDI in different sectors. The same parameters for the USA are calculated by using the distribution of fixed capital stock data (2002) provided by US Department of Commerce (http://www.bea.doc.gov). In the calculations, the fixed capital stock is classified as "agriculture+services" and industry categories. The shares of these sectors in the total capita stock (excluding real estate) are computed.

(4) The total expenditure shares of domestic and foreign capital are calculated by using domestic and FDI stock estimates for the average in the 2000-2 period. The ratio of value of FDI stock to the domestic capital stock gives us the parameter for the foreign capital. In order to distinguish further the composition of FDI as Chinese (or ASEAN) and USA we calculate the share of Chinese direct investment in ASEAN in the total value of FDI in ASEAN. This figure is 0.2% for the 1995-2003 period. FDI and fixed capital investment figures are taken from the Asian Development Bank website (http://www.adb.org/statistics). Investment and FDI figures added successively in order to calculate the stock of capital. 6% depreciation rate is considered following Duffy and Papagiergeou (2000). Some FDI data from the ASEAN Secretariat website (http://www.aseansec.org/home.htm) is also used in order to find the share of Chinese FDI in the total FDI to ASEAN.

(5) ROW countries are the source of roughly 70% of the FDI to China and ASEAN. We assumed that all of the FDI flows are coming from these countries.

(6) Capital stock estimate for a group of countries is given in Duffy and Papagergieou (2000) up to year 1987 (http://www.bus.lsu.edu/economics/faculty/cpapageorgiou/personal/welcome.html). This data is extended to year 2000 by using World Penn Tables real USD investment data (http://pwt.econ.upenn.edu/php_site/pwt61_form.php). Capital is assumed to depreciate by 6% every year following the method described in Duffy and Papageorgieu (2000). There are few data regarding capital stock of the ASEAN economies. Capital stock for the whole ASEAN is estimated by assuming that the K/L ratios of the countries with no data (Brunei, Vietnam, Cambodia, Laos, and

Myanmar) are the same as the average K/L ratio of the ones with data (Indonesia, Malaysia, Singapore, Thailand, and Philippines). Figures are in ten billion USD units.

The Benchmark

Table 3a: Foreign Trade among the Countries in the Benchmark

(i) China

	export to		import from		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
ASEAN	251	175	170	268	81	–93	–12
ROW	1288	479	171	1082	1117	–602	514
Total	1538	654	340	1350	1198	–696	502

(ii) ASEAN

	export to		import from		balance		
	in M	in A	in M	in A	in M	in A	total
China	169.7	268.1	250.8	174.9	–81.0	93.2	12.2
ROW	167.9	296.2	32.9	436.3	135.0	–140.0	–5.1
Total	337.6	564.4	283.6	611.2	54.0	–46.9	7.1

(iii) ROW

	export to		import from		balance		
	in M	in A	in M	in A	in M	in A	total
China	170.7	1081.5	1287.5	479.1	–1116.8	602.4	–514.4
ASEAN	32.9	436.3	167.9	296.2	–135.0	140.0	5.1
Total	203.6	1517.8	1455.4	775.4	–1251.8	742.4	–509.4

Notes:
(1) M = manufacturing; A = agriculture.
(2) balance = export – import

Table 3b: Capital Flows in the Benchmark

(i) China

	capital outflow		capital inflow		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
ASEAN	0.00068	0.00615	19	6	19	6	25
ROW	0.0	0.0	355	112	355	112	467
Total	0.00068	0.00615	373	118	373	118	492

(ii) ASEAN

	capital outflow		capital inflow		balance		
	in M	in A	in M	in A	in M	in A	total
China	18.6	5.9	0.00631	0.00615	–18.6	–5.9	–24.5
ROW	0.0	0.0	21.4	20.8	21.4	20.8	42.2
Total	18.6	5.9	21.4	20.8	2.7	14.9	17.7

(iii) ROW

	capital outflow		capital inflow		balance		
	in M	in A	in M	in A	in M	in A	total
China	354.7	112.5	0.0	0.0	–354.7	–112.5	–467.2
ASEAN	21.4	20.8	0.0	0.0	–21.4	–20.8	–42.2
Total	376.0	133.3	0.0	0.0	–376.0	–133.3	–509.4

Notes:
(1) M = manufacturing; A = agriculture.
(2) balance = capital inflow – capital outflow.

Table 3c: Indices of Intra-industry Trade and Intra-industry Capital Flows

	intra-industry trade			i-i K flows
	C-A	C-R	A-R	C-A
manufacturing	0.8074	0.2341	0.3275	0.0007
agriculture	0.7897	0.6140	0.8088	0.0021
total	0.7872	0.5189	0.7015	0.0004

Notes:
(1) C-A = China-ASEAN; C-R = China-ROW; A-R = ASEAN-ROW;
(2) i-i K = intra-industry capital flow;
(3) For the formulas of the indices of intra-industry trade and intra-industry capital flow, see the text.

China's WTO Accession

Table 4a: Foreign Trade among the Countries after China's WTO Accession

(i) China

	export to		import from		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
ASEAN	282 (12)	222 (27)	216 (27)	317 (18)	66	–95	–29
ROW	1371 (7)	615 (28)	265 (55)	1261 (17)	1106	–647	460
Total	1653 (7)	837 (28)	481 (41)	1579 (17)	1172	–742	431

(ii) ASEAN

	export to		import from		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
China	216 (27)	317 (18)	282 (12)	222 (27)	–66	95	29
ROW	185 (10)	342 (15)	47 (42)	491 (13)	138	–150	–12
Total	400 (19)	659 (17)	328 (16)	714 (17)	72	–55	17

(iii) ROW

	export to		import from		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
China	265 (55)	1261 (17)	1371 (7)	615 (28)	–1106	647	–460
ASEAN	47 (42)	491 (13)	185 (10)	342 (15)	–138	150	12
Total	311 (53)	1753 (16)	1556 (7)	956 (23)	–1244	796	–448

Notes:
(1) M = manufacturing; A = agriculture.
(2) balance = export – import
(3) Numbers in parentheses represent the percentage changes from the corresponding values in the benchmark.

Table 4b: Capital Flows among the Countries after China's WTO Accession

(i) China

	export to		import from		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
ASEAN	0.0067 (890)	0.0062 (0.5)	14 (–23)	5 (–21)	14	5	19
ROW	0	0	302 (–15)	99 (–12)	302	99	401
Total	0.0067 (890)	0.0062 (0.5)	316 (–15)	104 (–12)	316	104	420

(ii) ASEAN

	export to		import from		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
China	14 (–23)	5 (–21)	0.0067 (6)	0.0062 (0)	–14.3	–4.7	–18.9
ROW	0 (0)	0 (0)	24.7 (16)	22.8 (9)	24.7	22.8	47.5
Total	14 (–23)	5 (–21)	24.7 (16)	22.8 (9)	10.5	18.1	28.5

(iii) ROW

	export to		import from		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
China	302 (–15)	99 (–12)	0 (0)	0 (0)	–302	–99	–401
ASEAN	25 (16)	23 (9)	0 (0)	0 (0)	–25	–23	–47
Total	326 (13)	122 (9)	0 (0)	0 (0)	–326	–122	–448

Notes:
(1) M = manufacturing; A = agriculture;
(2) balance = capital inflow – capital outflow;
(3) Numbers in parentheses represent the percentage changes from the corresponding values in the benchmark.

Table 4c: Indices of Intra-industry Trade and Capital Movement after China's WTO Accession

	intra-industry trade			i-i K flows
	C-A	C-R	A-R	C-A
manufacturing	0.8674 (7)	0.3238 (38)	0.4028 (23)	0.0009 (39)
agriculture	0.8241 (4)	0.6553 (7)	0.8203 (1)	0.0026 (27)
total	0.8218 (4)	0.5763 (11)	0.7217 (3)	0.0007 (72)

Notes:
(1) C-A = China-ASEAN; C-R = China-ROW; A-R = ASEAN-ROW;
(2) i-i = intra-industry;
(3) For the formulas of the indices of intra-industry trade and intra-industry capital flow, see the text.
(4) Numbers in parentheses represent percentage changes in values from the corresponding ones before China's WTO accession.

Table 5a: Welfare Impacts of Various Policies

	China		ASEAN		ROW	
	GNP_c	U_c	GNP_a	U_a	GNP_r	U_r
benchmark	6668	2661	1448	682	7814	3945
post WTO	7520	2652	1676	687	8983	3944
change, %[1]	(12.8)	(–0.3)	(15.7)	(0.7)	(15.0)	(0.0)
post FTA	7553	2647	1758	711	8998	3930
change, %[2]	(0.4)	(–0.2)	(4.9)	(3.5)	(0.2)	(–0.4)

Notes:
(1) percentage changes from the corresponding ones in the benchmark
(2) percentage changes from the corresponding ones in the post-WTO case
(3) The welfare of each country is equal to the utility of the representative given by (3).

Table 5b: Terms of Trade

	China		ASEAN		ROW	
	p_c^m	p_c^a	p_a^m	p_a^a	p_r^m	p_r^a
benchmark	3.98	3.09	3.61	2.80	3.89	2.94
post WTO	4.43	3.53	4.05	3.26	4.34	3.43
change, %[1]	(11.3)	(14.5)	(12.3)	(16.6)	(11.6)	(16.6)
post FTA	4.44	3.56	4.20	3.43	4.34	3.43
change, %[2]	(0.2)	(0.8)	(3.6)	(5.2)	(0.1)	(0.2)

Notes:
(1) percentage changes from the corresponding ones in the benchmark
(2) percentage changes from the corresponding ones in the post-WTO case.

Table 5c: Number of Varieties under Various Policies

	China		ASEAN		ROW		
	n_c^m	n_c^a	n_a^m	n_a^a	n_r^m	n_r^a	**total**
benchmark	122.0	75.1	12.4	36.0	21.4	220.2	487.1
post WTO	119.1	75.9	13.0	35.7	26.6	215.3	485.6
change, %[1]	(-2.4)	(1.0)	(5.1)	(-0.7)	(24.5)	(-2.2)	(-0.3)
post FTA	119.1	75.9	13.1	35.7	8998	3930	3930
change, %[2]	(0.0)	(0.0)	(0.9)	(-0.1)	(-0.6)	(0.1)	(0.0)

Notes:
(1) percentage changes from the corresponding ones in the benchmark
(2) percentage changes from the corresponding ones in the post-WTO case.

Table 5d: Income Distribution under Various Policies

	China	ASEAN	ROW
benchmark	0.157	1.538	1.808
post WTO	0.175	1.659	2.589
post FTA	0.178	1.713	2.599

Notes:
(1) The numbers represent the domestic wage-rental ratios, i.e., w_i / r_{ii}, for $i = c$, a, and r.

China-ASEAN FTA

Table 6a: Foreign Trade among the Countries with the China-ASEAN FTA

(i) China

	export to		import from		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
ASEAN	360 (28)	403 (81)	303 (41)	567 (79)	57	–164	–107
ROW	1389 (1)	605 (–2)	258 (–2)	1198 (–5)	1131	38	1169
Total	1750 (6)	1008 (20)	562 (17)	1765 (12)	1188	–127	1062

(ii) ASEAN

	export to		import from		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
China	303 (41)	567 (79)	360 (28)	403 (81)	–57	164	107
ROW	160 (–14)	271(–21)	38 (–19)	481 (–2)	122	–210	–88
Total	463 (16)	838 (27)	398 (21)	884 (24)	64	–46	19

(iii) ROW

	export to		import from		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
China	258 (–2)	1198 (–5)	1389 (1)	605 (–2)	–1131	593	–538
ASEAN	38 (–19)	481 (–2)	160 (–14)	271 (–21)	–122	210	88
Total	296 (–5)	1679 (–4)	1549 (–0)	876 (–8)	–1253	803	–450

Notes:
(1) M = manufacturing; A = agriculture.
(2) balance = export – import
(3) Numbers in parentheses represent the percentage changes from the corresponding values in the post-WTO scenario.

Table 6b: Capital Flows among the Countries with the China-ASEAN FTA

(i) China

	capital outflow		capital inflow		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
ASEAN	0.0070 (4)	0.0063 (3)	14 (–3)	5 (–3)	14	5	19
ROW	0	0	302 (0)	99 (0)	302	99	401
Total	0.0070 (4)	0.0063 (03)	316 (0)	104 (0)	316	104	420

(ii) ASEAN

	capital outflow		capital inflow		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
China	14 (–3)	5 (–3)	0.0070 (4)	0.0063 (3)	–14	–5	–18
ROW	0 (0)	0 (0)	26 (4)	23 (3)	26	23	49
Total	14 (–3)	5 (–3)	26 (4)	23 (3)	12	19	31

(iii) ROW

	capital outflow		capital inflow		balance[2]		
	in M[1]	in A[1]	in M	in A	in M	in A	total
China	302 (–0)	99 (–0)	0 (0)	0 (0)	–302	–99	–401
ASEAN	26 (4)	23 (3)	0 (0)	0 (0)	–26	–23	–49
Total	327 (0)	122 (1)	0 (0)	0 (0)	–327	–122	–450

Notes:
(1) M = manufacturing; A = agriculture;
(2) balance = capital inflow – capital outflow;
(3) Numbers in parentheses represent the percentage changes from the corresponding values in the post-WTO scenario.

Table 6c: Indices of Intra-industry Trade and Capital Movement with the China-ASEAN FTA

	intra-industry trade			i-i K flows
	C-A	C-R	A-R	C-A
manufacturing	0.9137 (5)	0.3136 (–3)	0.3839 (–5)	0.0010 (7)
agriculture	0.8307 (1)	0.6711 (2)	0.7208 (–12)	0.0028 (7)
total	0.8113 (–1)	0.5929 (3)	0.5954 (–17)	0.0007 (6)

Notes:
(1) C-A = China-ASEAN; C-R = China-ROW; A-R = ASEAN-ROW;
(2) i-i K = intra-industry capital;
(3) For the formulas of the indices of intra-industry trade and intra-industry capital flow, see the text.
(4) Numbers in parentheses represent percentage changes in values from the corresponding ones in the post-WTO scenario.

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