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THE ECONOMIC EFFECTS OF ASIA-PACIFIC ECONOMIC COOPERATION (APEC) AND ASIA-BASED FREE TRADE AREA (AF-11): A COMPUTATIONAL GENERAL EQUILIBRIUM APPROACH

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has been accepted towards fulfillment of the requirements for

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THE ECONOMIC EFFECTS OF ASIA-PACIFIC ECONOMIC COOPERATION (APEC) AND ASIA-BASED FREE TRADE AREA (AF-11) : A COMPUTATIONAL GENERAL EQUILIBRIUM APPROACH

By

Inkyo Cheong

A DISSERTATION

Submitted to
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1995

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ABSTRACT

THE ECONOMIC EFFECTS OF ASIA-PACIFIC ECONOMIC COOPERATION (APEC) AND ASIA-BASED FREE TRADE AREA (AF-11) : A COMPUTATIONAL GENERAL EQUILIBRIUM APPROACH

By

Inkyo Cheong

The possibilty of a free trade area in the Asia-Pacific region has been discussed at several international conferences, such as the Pacific Economic Cooperation Conference and the Asia Pacific Economic Conference. The trends of the world economy are likely to strengthen economic cooperation in the area.

Even though many authors suggest that trade liberalization in the Asia-Pacific area would accelerate development, there is very little empirical evidence about the adjustment process which would follow the formation of such a free trade area (FTA). Thus, I intend to study the possibilities of Asia-Pacific free trade (APEC) and Asia-based free trade area (AF-11 FTA). I will perform simulations with a computational general equilibrium (CGE) model, in order to look at welfare changes under different combinations of member countries with APEC and AF-11. Since perfectly-competitive CGE models tend to underestimate the welfare effects of a FTA, I build a CGE model with increasing returns to scale and firm-level product differentiation. If a group of countries in the Pacific Rim can improve welfare by forming a FTA, this group will be a possible candidate for a new FTA in the Pacific Rim.

The main results can be summarized as follows: (1) The groupings of regions seem to be important for a formation of a free-trade area in the Pacific-Rim region. From

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our simulations, the highest probable regional cooperation scenario will be a FTA of Australia/New Zealand, China/Hong Kong, the Asian newly-industrialized countries, and the ASEAN nations except Thailand. (2) The introduction of imperfect competition into the model projects large discrepancies between the simulations from the perfectly-competitive CGE model and the model with an imperfectly-competitive component. (3) The results of the simulations are very robust with respect to the choices of parameters.

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TABLE OF CONTENTS

Table 1

Table 2

Table 3

Table 4

Table 5

Table 6

Table 7

Table 8

Table 9

Table 10

Table 11

Table 12

Table 13

Table 14

Table 15

LIST OF TABLES

Figure 1

Figure 2

Figure 3

Figure 4

LIST OF FIGURES

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CHAPTER I

INTRODUCTION

In recent years, economic integration and cooperation in the Pacific Rim have attracted widespread attention. Drobnick (1992) says that the trends of the world economy are likely to strengthen economic cooperation in the Asia-Pacific region. The completion of a single market in Europe and the open door policy of China may hasten the establishment of greater Pacific-rim economic integration and cooperation. The issues raised have been explored at a number of conferences. These include the Pacific Economic Cooperation Conference (26th International General Meeting, Seoul, Korea, May, 1993), and the Asia-Pacific Economic Cooperation Conference (APEC).

APEC was established in 1989 as an informal grouping of 12 Asia-Pacific countries, to better manage the effects of growing interdependence in the Pacific region and sustain economic growth. Currently, APEC has 18 member countries, as shown in Table 1. Foreign and economic ministers met for the first time to discuss APEC, in Canberra, Australia, in November, 1989. Remarkable progress was made at the third meeting, at Seoul, Korea, in 1991, and a permanent secretariat was established, at Singapore in September, 1992. After that, APEC has grown from an informal discussion group to a formalized organization, providing an institution for discussion on a broad range o

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range of economic issues. The United States chaired the 5th APEC ministerial meeting in Seattle, Washington, November 17-19, 1993, and President Clinton hosted a historic APEC national leaders' meeting at Blake Island, near Seattle, on November 19-20, 1993. It was important, in the sense that APEC's ministerial meeting was upgraded to include an economic and political leaders' meeting for Asia-Pacific economic cooperation, in addition to the ministerial meeting. The attendees at the Blake Island meeting issued a 'vision statement' on their "common goals for the Asia-Pacific region leading up to the 21st century: expand their economic dialogue; advance global and regional trade liberalization; deepen business sector participation in APEC ; establish cooperation in education and on development of small and medium size enterprises, ..."[1]

The 2nd economic leaders' meeting was held in Bogor, Indonesia, on November 15, 1994, following the APEC ministerial meeting, at Jakarta on November 11-12. The Bogor meeting produced a blueprint for APEC's trade liberalization agenda. APEC leaders agreed to remove trade and investment barriers in the next quarter century. The leaders' declaration highlights the fact that APEC nations support free and open trade and investment in the Asia-Pacific region by 2010 for industrialized economies, and by 2020 for developing economies. Even though the accord is not a legal commitment, it can be an important milestone for the region, as it pursues the free-trade goal.

The literature contains a great deal of discussion of economic integration in the Pacific region. For example, English (1989) predicted that the possible form of economic

[1] Quoted from "Focus on Asia-Pacific Economic Cooperation: APEC Economic Leader' Meeting Initiatives" October 28, 1994, Bureau of Public Affairs, U.S. Department of State.

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cooperation in the Pacific basin "would be a Pacific Free Trade Association involving the five most developed countries of the region (Australia, Canada, Japan, New Zealand and the United States) accompanied by varieties of unilateral or collective agreement of association with Korea, ASEAN, China, and perhaps Taiwan and the South Pacific Islands." Koo (1990) writes that "Korea has been and will continue to be very supportive of Asia-Pacific cooperation," explaining why APEC brings potential benefits to Korea and the regional economy.

The Pacific-rim region is an important trade partner for the United States. U.S. trade with the Pacific region ($344 billion) was greater than that with Western Europe ($228 billion) in 1992. Three million jobs were created from U.S. exports to the Asia-Pacific region during the period of 1989 to 1993.[2] For the sustained creation of jobs in the U.S., it is suggested that the U.S. should hurry to open the fast-growing economies of APEC.

The establishment of the European Community (EC) and the North American Free Trade Area (NAFTA) will inevitably direct some trade inward. Mexico's decision to join NAFTA will push Asian developing countries into an unfavorable competitive position, and these countries will reduce their market share in North America. Cox and Harris (1992) showed that the rest of world was expected to lose market share by 3 percent and 1.26 percent in the U.S. and Canada, respectively, as a result of the U.S. - Canada FTA (CAFTA) agreement. There has been an increase in the market shares of Pacific developing countries in North America in the 1970's and 1980's. Thus, Pacific

[2] Refer to Business Week, "It's Time To Open All Asia's Markets," November 14, 1994.

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Rim countries are likely to suffer from trade diversion as a result of NAFTA. This may accelerate the desire of Pacific-rim countries to form a free trade area (FTA). Under NAFTA, these market losses are expected to be bigger than under CAFTA, since Mexico is a developing country, taking the markets of North America, to which Asian developing countries have exported labor-intensive products before NAFTA.

Even though all countries in the region have common goals, such as welfare improvements and the creation of jobs by forming a new free trade area, the possibility of success for a FTA can be questioned. There exists a disagreement about the effects of Japan's participation in the Pacific-rim FTA. Lee and Roland-Holst (1994) emphasize the positive role of Japan, since Japan's purchasing power would increase employment in the member countries. Moreover, since the Korean War, Japan's industry and trade policies have been manipulated through a mixture of tariff and non-tariff barriers. Even though Japanese tariffs can be explicitly reduced, American firms face problems in penetrating the Japan market, due to Japan's subtle application of non-tariff barriers (NTBs),[3] which avoid violating GATT regulations. Even though reductions of some NTBs were negotiated in the Tokyo Round of multilateral trade agreements, Japan's intangible trade barriers have provoked the most foreign complaints. Choo (1992) expects Japan to increase its trade surpluses as a result of the market opening of Korea and Taiwan, while his calculations indicate that the United States would not collect big gains, and U.S.-Japan trade deficits would not be reduced.

[3] For Japan's NTBs to trade in manufactures, see Christelow (1990). Among the NTBs that have been practiced by the Japanese are product standards, testing procedures, distribution systems, and government procurement procedures.

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[6] See table 2.

Asia-Pacific countries have highly diverse regional, cultural, and political characteristics. Therefore, it is expected to be difficult that all Asia-Pacific countries agree to form a single free trade area. The United States International Trade Commission (USITC, 1989) reports that the U.S. has no formal diplomatic relations with Taiwan, and there is no official mechanism for the U.S. to enter into negotiations with Taiwan, while anti-American atmosphere may be a serious problem, in U.S.'s negotiating FTA issues with Korea. USITC writes that ". . .the majority of U.S. and foreign . . . did not think such an agreement (U.S.-ASEAN FTA) was workable," and " . . . an (U.S. -) FTA ASEAN is not feasible because it would be too difficult to administer."[4] On the other hand, the Association of South-East Asian Nations (ASEAN)[5] was already established, and thus, ASEAN can be a basis for the formation of a new free trade area, accepting some other countries in the region, and adding them to ASEAN. ASEAN may be compared with the Asian Newly Industrializing Economies (NIEs, which are Hong Kong, Korea, Singapore, and Taiwan) in several points.

Pearson (1994) reports that the ASEAN countries have recently started to produce labor-intensive manufactured products and natural-resource-based manufactured products. The Asian NIEs have exported more capital-intensive and technology-intensive products than ASEAN, with the exception of Singapore.[6] China was found to settle in between ASEAN and the NIEs. In addition, ASEAN is endowed with rich natural

[4] Quoted from USITC (1989), pp. 3-3 and 3-7, respectively.
[5] ASEAN was formed in 1967. The original members were Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Brunei joined ASEAN in 1984. ASEAN established the ASEAN Free Trade Area in January, 1993, and they decided to eliminate trade barriers in 10 years in September, 1994.
[6] See table 2.3 in p. 43, Pearson (1994).

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Yang (1994) suggests the regional cooperation of the nine countries in East Asia: four NIEs, four ASEAN (Indonesia, Malaysia, Philippines, Thailand), and China. He states that "greater cooperation among the industrializing countries/areas of the region can be an addition to, rather than a substitute for, ASEAN." Yang's reasoning is based on the mutual complementarity among nine countries, as well as the high growth of intraregional trade among these countries , "as a condition of success." Another complementarity can be found between Australia and New Zealand and the NIE economies. Australia and New Zealand have been major suppliers of intermediate goods to the NIEs (for example, ore, wool, and coal). The NIEs have exported manufactured goods to Australia and New Zealand, and Australia and New Zealand have exported high-technology products to Asian nations. Australia and New Zealand are economically-advanced countries with high-technology industry and high per capita income. Their industrial structure does not seem to compete with ASEAN nations, since Australia and New Zealand produce highly-capital-intensive manufactured goods, compared to ASEAN nations. Thus, one FTA in the Pacific-rim region would be the Asia-based FTA of 11 nations including Australia and New Zealand (AF-11). Kreinin and Plummer (1994) predict that Australia and New Zealand should endeavor to form closer economic links with their Asia-Pacific neighbors, as a result of the formation of NAFTA.

Even though many authors suggest that trade liberalization in Asia-Pacific area would accelerate development, there is very little empirical evidence about the adjustm

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The general equilibrium framework is most appropriate for analyzing the welfare effects of the formation of a free trade area. Firstly, a new FTA will imply more competition between industries for demand. More competitiveness may induce producers to lower the prices of their products, and general equilibrium models allow us to measure the possible welfare change, while providing more accurate welfare evaluations than the triangular calculations of partial equilibrium. Secondly, the general equilibrium approach allows factor prices to vary and thus, relative price changes in intermediate inputs and primary inputs will presumably affect the firm's ratio of average to variable costs. That is, the material components of variable costs will be optimized, based on new factor prices in each equilibrium. On the other hand, partial equilibrium analyses assume constant factor prices. However, it is generally believed that prices will be changed with the changes of economic environment. To illustrate this point, we may note two papers that analyze the effects of the FTA of Canada and U.S. using partial equilibrium methods (Dauphin (1978), and Magun *et al.*,(1987)). The approach these papers employed is as follows : Firstly, they simulate the macroeconomic impacts of the unilateral and bilateral removal of tariffs and some NTBs, and then determine the amounts of factor price changes

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changes and the import and export prices. Next, these price changes are entered as exogenous changes in the model, and a solution is obtained for changes in the variables of interest. Thus, their solutions do not reflect the full effects of the new FTA.

International trade modelers have widely used computational general equilibrium models for analyzing such issues as trade liberalization and fiscal reform, since CGE models allow us to track the resulting resource allocation movements between economic sectors. In particular, trade liberalization has increasingly been analyzed in a general equilibrium context.

However, in the early computational general equilibrium models that were used to address the issues of trade liberalization and economic integration, welfare effects were estimated to be very small.[7] These results pushed economic modelers to pay more attention to possible model misspecification. Their concern was centered on scale economies, since constant-returns-to-scale technology does not capture an important source of welfare gains from trade arising from the presence of economies of scale and imperfect competition. This concern is reinforced by the increasing empirical evidence that countries with similar factor endowments have large volumes of trade. And there has been a growing literature which has explored the issues of international trade and industrial organization.

Harris (1984) showed the possibility of increasing the estimated welfare effects of trade liberalization, by including scale economies and imperfect competition in the model. The assumptions of perfect competition and constant-returns-to-scale technology

[7] For a review of these early studies of trade liberalization, see Harris (1984).

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were regarded as the main sources for the modest welfare effects of trade liberalization in the earlier CGE modeling about trade liberalization. Under perfect competition with free entry and exit, individual firms were operating at the minimum of their average cost functions before trade barriers were reduced, and, thus, the formation of a new free-trade area does not bring a large welfare improvement. Welfare gains will be underestimated if trade liberalization enlarges the size of the market and lets domestic firms compete with foreign competitors. The adoption of scale economies will play an important role in the determination of the trade patterns and welfare effects of a FTA as long as average costs decline as their outputs increases, since fewer resources will be needed per unit of production of goods. The literature on international trade under increasing returns to scale includes Cox and Harris (1985, 1986, and 1992), de Melo and Robinson (1989), Dixit and Norman (1988), Harris (1984), Helpman (1981), Helpman and Razin (1983), Hunter, Markusen, and Rutherford (1992), Markusen and Wigle (1989), and Mercenier and Schmitt (1992).

Theoretical models with Chamberlinian monopolistic competition have been explored in Brown (1991), Dixit and Norman (1988), Helpman (1981), Helpman and Razin (1983), Krugman (1981, 1991), Markusen and Svensson (1986), Markusen and Wigle (1989), and Nguyen and Wigle (1992). Initially, firms are assumed to operate at the long-run equilibrium, earning zero profits. Now, trade liberalization would allow foreign competitors to sell their products, which would force domestic prices to decrease. Lower prices would increase the quantity of goods demanded. But there would exist barriers for new firms to enter the industry, because of fixed costs. With higher demand

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and the same number of firms in the industry, the firms might make positive profits. This is not an equilibrium. In the new long-run equilibrium allowing for free entry and exit, firms produce more and take advantage of scale economies.

The basic model I am using for the perfectly-competitive CGE part of this paper is the "Global Trade Analysis Project (GTAP),"[8] which is designed to simulate the effects of policy changes in a computational general equilibrium international trade model. It is a static, Walrasian general equilibrium model that endogenously determines quantities and prices, solved using the Johansen (1960) simulation approach.[9] A Johansen simulation will be carried out by solving the linearized equations of the model. Linearization of a non-linear model may give good approximations to the true simulation results, which can be obtained from a multi-step simulation (for example, by using Euler's method or Gragg's method).

Unfortunately, GTAP assumes that all sectors are perfectly competitive in all regions. As noted above, perfect competition tends to underestimate the welfare effects of trade liberalization. Following Harris (1984), and Cox and Harris (1985, 1986, and 1992), we will replace perfect competition with imperfect competition, and incorporate monopolistic competition. The GTAP model will be modified into a simple version, in order to introduce monopolistic competition. The details about the modifications of GTAP will be given in chapter 2. Then, the demand structure will be modified, so that product differentiation at the firm level is used to replace GTAP's product differentiation at the

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[8] See Hertel, *et al.* (1993).

[9] Johansen (1960) approximated his model by a system of linear equations in changes of the variables. This linear system was then solved by matrix manipulation, giving the approximate effects on the k endogenous variables of changes in the $(l - k)$ exogenous variables.

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national level. Section 2.3 describes the demand structure for consumers. We also incorporate firm-level product differentiation. A detailed description of the production technology in our model is given in section 2.4. Following Cox and Harris (1992) and Mercenier and Schmitt (1992), we will divide production sectors between perfectly-competitive sectors and monopolistically-competitive ones. The latter sectors will have increasing-returns-to-scale technology, with fixed costs.

We use the GTAP data base, which includes matrices describing bilateral trade, transport, and protection. These matrices link the 24 country / regional economic data bases, covering the whole world. Each regional data base is derived from each country's input-output tables. The disaggregated GTAP data base consists of 37 sectors and 24 regions. International trade data in GTAP is based on United Nations D series trade statistics. Export subsidy and protection data are obtained from the original country submissions to the GATT for the Uruguay Round. Lists of disaggregated sectors and mappings of commodities for our study are given in Table 2. Since we study the economic effects of FTA under APEC and AF-11, the GTAP data base will be aggregated into 13 regions, as shown in Table 1.

Our study will be centered on comparing the welfare effects of FTA under APEC and AF-11. Table 1 contains the member countries of APEC and the countries/regions in the GTAP data base. In the third column, the country (region) mappings for our study are given. We will aggregate the GTAP data base into a 13-region data base, for the simulations of APEC and AF-11 FTA. Each FTA will be simulated with the original GTAP model and with our modified GTAP model, in order to study the sensitivities of the el

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the welfare changes to different model specifications. Industry sectors are aggregated, based on similarities of the sizes of scale economies and sectoral characteristics. All GTAP sectors in each region will be aggregated into five sectors. Two sectors (RPR and TME)[10] will be assumed to have scale economies.[11] The five production sectors in each region will consist of one service sector, one agricultural sector, and three manufacturing sectors, as in Table 2.

In Table 3a, we list the benchmark values of exports of goods and services between 13 regions in our model in millions of 1992 U.S. dollars. The numbers are the total values of exported goods and services from source regions (row) to destination regions (column). If the source region is equal to the destination region, then the numbers are the total values of domestic uses of domestically produced goods and services. It is shown that there are small volumes of trade between Canada/Mexico and NIEs/ASEAN nations. Relatively high volumes of goods are traded between NIE nations and ASEAN countries. In Table 3b, we list the benchmark values of exports (excluding domestic uses of domestically-produced goods and services) of goods and services for 13 regions in our model in millions of 1992 U.S. dollars. Regional shares of world trade is also provided in the bottom in Table 3.

[10] RPR is a production sector for resources, plastic and refinery, and TME stands for transportation vehicles, machinery and equipment. See Table 2 for details.
[11] See Prattern (1988) for the magnitudes of scale economies for sectors.

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CHAPTER II

THE DESCRIPTION OF THE MODEL

2.1. Computational General Equilibrium (CGE) Modeling

CGE models have been used extensively to capture the essential features of an economic situation. A CGE model is a simplified computer representation of one or more economies. Each economy has consumers, producers, and governments. The CGE model provides a framework in which widely different policies can be examined. Once the basic model has been specified and implemented with actual data, various policies can be studied with minor modifications.

The consumers in the model supply factors of production and, in return, they collect income from production sectors. They purchase goods from producers. They pay taxes to government and save the rest of income after the expenditure for final consumption. The consumer solves a utility-maximization problem, with the budget constraint :

$$\text{Maximize } u\left(d_r^1, d_r^2, \ldots, d_r^N, S_r\right) \quad \text{subject to} \quad Y_r = \Sigma_{i=1}^{N} p_r^i * d_r^i + S_r, \text{ where} \tag{1}$$

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$d_r^1, d_r^2, \ldots, d_r^N$ stand for consumption demand for aggregated good 1, 2, ... N in region r, respectively, and p_r^i is the composite price index of good i in region r, inclusive of consumer taxes, which will be described in section 2.7. Y_r and S_r are income and savings in region r, respectively. The consumer in each region will solve the maximization problem.

Region r's aggregate demand for good i, d_r^i, is an aggregation of domestically-produced good i and an aggregation of imported good i from other regions in the model. The next problem is to divide the aggregated consumption of good i into domestic goods and imports. At this stage, the "Armington" assumption[12] has been a basic tool for explaining product differentiation to match CGE models to data on trade flows, for example, GTAP, and Cox and Harris (1985, 1986). If goods of the same good category were modeled as homogeneous, countries would specialize in the production of a small number of goods, and cross-hauling of the same good will not be observed in real trade data.

The approach of product differentiation by country of origin has several advantages over alternatives. First, the Armington specification helps multi-regional CGE models to converge into equilibrium fast and easily, since firms determine sourcing of inputs independently of the prices of domestic goods, due to separability.[13] Second, it can account for cross-hauling, where each region imports and exports the goods of the

[12] Armington (1969) suggested that products are differentiated by the country of origin.
[13] See the section for "Behavioral Equations" in Hertel and Tsigas (1994).

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same product category. International trade data show a large amount of cross-hauling even at a very high level of disaggregation. This can be explained with Armington's view that the goods of the same product category are regarded as different goods, if the places of production of the goods are different. One example is that a car made in U.S. is considered to be a different good from a German-produced automobile. Third, the Armington specification needs one more set of elasticities of substitution. Then, modelers can assign different values to the elasticities of substitution for domestically-produced goods and imports, depending on the researcher's purpose. Armington's assumption will be represented as follows.

$$d_r^i = \left[h_r^{i\;\sigma_d - 1/\sigma_d} + m_{cr}^{i\;\sigma_d - 1/\sigma_d} \right]^{\sigma_d/\sigma_d - 1}, \tag{2}$$

where σ_d is the elasticity of substitution between domestically-produced goods and imports, h_r^i is region r's consumption demand for domestic (home country) good i, and m_{cr}^i stands for demand for imported good i for consumption in region r. The subscript c indicates final consumption. In eq. (2), the consumer's preference for domestic goods or imports will depend on the elasticity, σ_d, which will be assigned exogenously by researchers.

One way of aggregating imports is to use a C.E.S. function, such as

$$m_{cr}^i = \left[\sum_{s \in REG} m_{csr}^{i\;\sigma_m - 1/\sigma_m} \right]^{\sigma_m/\sigma_m - 1}, \tag{3}$$

where *REG* is the set of all regions in the model. σ_m is the elasticity of substitution between imported goods. m_{csr}^{i} is region *r*'s consumption of good *i* from region *s*. With this equation, the sources of aggregate consumption of good *i* will be identified, and will be matched to the data. Similarly, a C.E.S. function will be defined for the composite price index in the following equation:

$$p_{cr}^{i} = \left[p_{cr}^{di\ 1-\sigma} + p_{cr}^{mi\ 1-\sigma} \right]^{1/1-\sigma}, \tag{4}$$

whose notations are similar to the aggregated consumption demand, except for replacing *C* with *P* to denote a composite price index. The superscripts *d* and *m* for prices are used to represent the prices of domestically-produced and imported goods. The same elasticity as in eq. (2) should be used for eq. (4), but subscripts for the elasticity were omitted for simplicity. Then, the conditional demand equation for the domestic goods will be

$$h_r^i = d_r^i * \left(\frac{p_{cr}^i}{p_{cr}^{di}} \right)^{\sigma} . \tag{5}$$

The demand equation for aggregated imports is

$$m_r^i = d_r^i * \left(\frac{p_{cr}^i}{p_{cr}^{mi}} \right)^{\sigma} . \tag{6}$$

The composite price index for aggregated imported commodity *i* in region *r*, p_{cr}^{mi}, will be calculated with the C.E.S. equation :

$$p_{cr}^{mi} = \left[\sum_{s \in REG} p_{csr}^{mi\ 1-\sigma} \right]^{1/1-\sigma}, \tag{7}$$

where p_{csr}^{mi} is the consumer's price for imported good i from region s in region r. Subscripts for the elasticity were restrained. The equation for imported goods by source will be

$$m_{csr}^{i} = m_{cr}^{i} * \left(\frac{p_{cr}^{mi}}{p_{csr}^{mi}} \right)^{\sigma}. \tag{8}$$

But the Armington assumption bears criticism : (1) The Armington assumption implies that products are differentiated by country of origin, and this differentiation is exogenous to the model. Today, the world economy tends to be unified, and thus, foreign/domestic distinctions have been blurred. (2) The Armington approach was found to underestimate the effects of trade liberalization in Norman (1990). Norman concludes that the "Armington" approach is "a poor substitute for explicit incorporation of oligopolistic interaction and product differentiation at the firm level."

Another approach is based on theoretical work by Dixit and Stiglitz (1977). Their idea is to assume that products are differentiated not by the origin of country but by the producing firm. Consumers purchase goods, considering the brand names of products. For example, a BMW is regarded as a different car than a Mercedes-Benz. Firm-level product differentiation is necessarily linked to imperfect competition, while the Armington assumption does not necessarily require imperfect competition.

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In a dynamic model, consumers save so that they can enjoy future consumption. In fact, saving elasticity could be positive, negative, or zero. Thus, the economic agent will divide his life-time income between current consumption and future consumption. However, in static CGE models, savings will be represented as purchase of investment (capital) goods.

Producers will minimize the total cost of production, and this will result in the optimal combination of intermediate goods and value added. The general form of the production function is

$$q_r^i = \text{MIN}\left(z_r^{1i}, z_r^{2i}, \ldots, z_r^{mi}, VA_r^i \right), \tag{9}$$

where z_r^{ji} is the demand for aggregate intermediate good *j* used in the production of good *i* in region *r*, and VA_r^i is the value added employed for the production sector *i* in region *r*.

Like the aggregated consumption demand, the aggregation formula for the intermediate goods and value added will be necessary, and the conditional demand for intermediate goods will be an aggregation of domestically-produced goods and imports. Researchers have used a C.E.S. aggregation for intermediate goods, as follows :

$$z_r^{ji} = \left[d_{fr}^{ji\;\sigma_z - 1/\sigma_z} + m_{fr}^{ji\;\sigma_z - 1/\sigma_z} \right]^{\sigma_z/\sigma_z - 1}, \tag{10}$$

where d_{fr}^{ji} and m_{fr}^{ji} are production sector *i*'s demand for domestically-produced good *j* and an aggregation of imported good *j* for intermediate inputs. The subscript *f* is used for produc

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producer's intermediate demand, and σ_z is the elasticity of substitution for the producer between the imported intermediate good and the domestic intermediate good.

Aggregated intermediate demand for imported good *j* will be defined similarly to aggregated consumption for the imported good, as

$$m_{fr}^{ji} = \left[\sum_{s \in REG} m_{fsr}^{ji\;\sigma_m - 1/\sigma_m} \right]^{\sigma_m/\sigma_m - 1}, \tag{11}$$

where m_{fsr}^{ji} is production sector *i*'s demand for imported good *j* from region *s* in region *r*. σ_m is defined at eq. (3).[14]

As in the consumer's case, C.E.S. equations will be specified for aggregating the import prices from all sources, p_{fsr}^{mji}, and for the producer's price, p_{fr}^{ji}, aggregated over domestically-produced goods, p_{fr}^{dji}, and aggregated imports, p_{fr}^{mji}, where the notations for the prices for firms are the same as those for intermediate demand for producers. With the composite price index, producers will choose the optimal amounts of aggregated intermediate demand for domestically-produced goods and imported goods, respectively, as follows :

$$d_{fr}^{ji} = z_r^{ji} * \left(\frac{p_{fr}^{ji}}{p_{fr}^{dji}} \right)^{\sigma}. \tag{12}$$

[14] In our CGE modeling with the Armington assumption, the same values of the elasticity of substitution for imports will be used for final consumption and intermediate goods, due to the lack of data.

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$$m_{fr}^{ji} = z_r^{ji} * \left(\frac{p_{fr}^{ji}}{p_{fr}^{mji}} \right)^{\sigma} . \tag{13}$$

Then, the amounts of domestic goods and imports will be chosen, according to eqs. (12) and (13), respectively. The sources of imports for imported intermediates will be identified with the following equation:

$$m_{fsr}^{ji} = m_{fr}^{ji} * \left(\frac{p_{fr}^{mji}}{p_{fsr}^{mji}} \right)^{\sigma} . \tag{14}$$

The same procedure applies for final consumption: From the utility maximization problem, the optimal amount of each good consumed will be decided. Equations (5) and (6) determine the division of aggregated consumption of each good into domestically-produced goods and imports, with substitution between sources of goods depending on the elasticity of substitution. The sources of imports will be traced with eq. (7).

For the perfectly-competitive sectors, price will be simply equal to average total costs, which implies that there will be zero pure profits, while if the model is modeled as imperfectly competitive, then an extra equation will be necessary to assign some part of value added to be fixed costs.[15] And with fixed costs, firms will mark up their prices over their marginal costs. Value added will be a C.E.S. aggregation of labor and capital. Firms will employ labor and capital, according to the elasticity of substitution between primary production factors.

[15] Detailed descriptions for imperfectly-competitive models will be given, in sections 2.3, 2.4, and 2.5.

To close the model, we need market-clearing conditions : Primary production factors should be fully employed. The output of each production sector in each region should be equal to the sum of exports and domestic use for final consumption and intermediate use, and imports in each region should be equal to the sum of final consumption and intermediate use. Numerical expressions for market-clearing conditions will be provided in section 2.6.

If we solve all equations for consumers and producers simultaneously, satisfying the market-clearing conditions, we have an equilibrium which replicates observed data. Then, the policy changes can be simulated by changing the relevant policy parameters and recalculating a new equilibrium. With this procedure, we can predict the effects of policy changes, such as the effects of a bilateral reduction of tariffs on regional income.[16]

CGE models use the elasticities of substitution, given by macroeconomic and econometric studies. CGE analysts calibrate the parameters of the CGE model, so that the benchmark equilibrium reproduces the transactions observed in the data. And they will do the sensitivity test with a different set of parameters. Therefore, the numerical results of the models should be interpreted in the light of their chosen parameters and data. For the base-line case, we take the elasticity of substitution from the GTAP data base, but we calibrate the elasticity for different sets of parameters, as explained in section 3.1.

[16] Taxes and tariffs will be discussed in section 2.7.

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2.2. The Overall Description of the Model

This paper presents a CGE world trade model with imperfect competition and increasing-returns-to-scale technology, in order to study the welfare effects of the economic integration proposals for the Pacific-rim region. The basic framework of the model originates with the 1994 version of GTAP. The standard version of the GTAP model assumes perfect competition in all regions and all sectors, with constant returns to scale. We simplify the GTAP model in the following ways:

(1) Removing the consumption structure of the government in each region. This reduces the number of variables. Instead, government consumption will be regarded as a part of private consumption of final goods. Reducing the numbers of variables is important, since our model will be solved, by inverting matrix of variables. All tax and tariff revenues are assumed to be rebated to the household. This means that taxes will not have any income effects, as shown in Ballard (1990). Total demand for each commodity in each region will be the sum of private consumption and the intermediate demand for production sectors in each region.

(2) Eliminating re-exports via Hong Kong,[17] in order to reduce computational and analytical difficulties. If re-exports are included in the model, then we will need one more dimension of the variables of domestic uses of domestically-produced goods, which increases the number of columns of matrix. The GTAP data base contains the trade data

[17] An example of re-export will be Hong Kong's re-exports of agricultural products to USA, who exported the same products to Hong Kong. The GTAP data base will be modified to add the trades of re-exports to domestic consumption of domestically-produced goods.

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for re-exports. But in the model, re-exports will be counted as a part of domestic consumption of domestically-produced goods.

(3) The transportation sector is defined to be a world service sector in the GTAP model. But in our model, we eliminate it to reduce the complexity of the model.

(4) The GTAP model assumes that the agricultural sector has 3 primary production factors (land, labor, and capital), while other manufacturing sectors have only labor and capital. Our paper is much more concerned with manufacturing sectors than with agricultural sectors. Thus, we remove land from the primary production factors for the agricultural sector. The cost of land used will be added into capital. Section 3.2 has the description of the relevant modification of the GTAP data base, suitable for the model.

The model used here is a static, Walrasian general equilibrium model that endogenously determines quantities and prices, solved by using a descendant of the Johansen (1960) simulation approach. It is a multi-sector and multi-region model, which allows for the analysis of the effects of policy changes on regional welfare, production and demand per agent and per region, equilibrium prices, rates of return to factors of production, etc. Two initial assumptions are: (1) there are no pure profits in any economic activity (producing, importing, exporting, transporting, etc.), and (2) all sectors in all countries will be assumed to be in equilibrium.

Three sectors are assumed to be perfectly competitive, and the rest of the sectors are to be imperfectly competitive. This is a general case adopted by CGE analysts, such as Cox and Harris (1985), Mercenier and Schmitt (1992), and Brown, Deardorff, and

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Stern (1992). We will add the following components into the simplified version of the GTAP model :

(1) Imperfect competition. Some of the perfectly-competitive sectors of the GTAP model will be replaced with imperfect competition. Monopolistically-competitive sectors will be characterized by free entry and exit. As a result, their net profits will be driven to zero.

(2) Increasing returns to scale. Since we want to study the welfare effects of scale economies, the imperfectly-competitive sectors are assumed to have fixed costs, such that average total costs decline as output per firm increases.

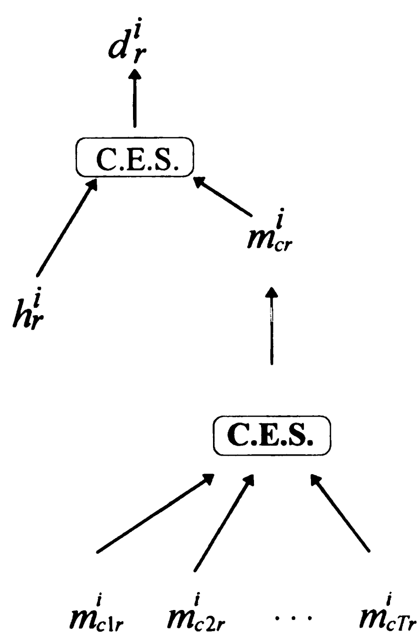
(3) Firm level product differentiation. The firm level product differentiation adopted here will be similar to that of Mercenier and Schmitt. In their model, perfectly-competitive sectors are modeled as having the "Armington" specification, by assuming that domestically-produced goods and imports are imperfect substitutes. But our model will assume no "Armington" assumption even for perfectly-competitive sectors, since re-exports were removed in our model. This distinguishes our model from that of Mercenier and Schmitt.

2.3. Consumer Preferences

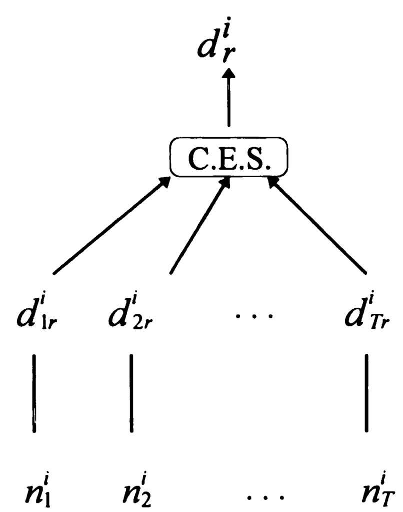
The major difference between GTAP and our model is that we replace the "Armington" assumption with firm-level product differentiation. Figure 1 describes the

Figure 1. "Armington" Assumption and Firm-Level Product Differentiation

"Armington" Specification



Firm-Level Product Differentiation



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different specifications of product differentiation in the demand structure for the household in each region. In the GTAP model, economic agents divide their consumption of composite commodities into domestically-produced goods and imports at the highest nest of the utility function. Then, the sources of imports will be identified by the bottom nest of the utility function. This is shown at the left-hand side of Figure 1. In this section, we describe the imperfectly-competitive model, since a perfectly-competitive model, such as the GTAP model, was described in section 2.1.

With firm-level product differentiation, consumers select commodities directly, without a middle procedure of dividing the composite commodity between domestic goods and imports, as with the "Armington" assumption. That is, economic agents are assumed to differentiate commodities at the firm level, which is shown at the right-hand side of Figure 1. Thus, consumers look at the brand name of the commodity, rather than its country of origin. At the right side of Figure 1, if the destination region is equal to the source region, the commodity is meant to be domestically produced.

Otherwise, it will be an imported commodity. The notations for Figure 1 are given in section 2.1, and subscript T denotes the number of regions in the model.

Our demand structure is shown in Figure 2, whose notations are the same as in section 2.1. The superscript N is the total number of commodities. A Cobb-Douglas (C-D) formulation is specified for the top nest, and each region has one representative consumer, whose welfare level represents the welfare level for the region. The household's utility level will depend on the consumed amounts of the composite goods.

Figure 2 shows two levels of consumer decision making: The first stage of the C-D nests will determine the expenditure shares for each of the composite commodities. At the second stage, the brand name (or firm) for each commodity will be identified.[18]

Mathematically, consumer preferences at the top nest will be defined as a C-D utility function of composite demand for all final commodities (both imported and domestic), assuming constant expenditure shares (δ_r^s) :

$$u_r = \prod_{i=1}^{N} {d_r^i}^{\delta_r^i} * {S_r}^{\delta_r^s}, \text{ where } \sum_{i=1}^{N} \delta_r^i + \delta_r^s = 1.^{19} \tag{15}$$

In equation (15), savings will be treated as one of the consumed commodities. Equation (15) shows that regional utility will be the product of consumed commodity aggregates and savings, weighted by the expenditure shares.

The second level of the utility function determines the optimal composition of the consumption aggregates in terms of regional origin. For the perfectly-competitive sectors, we have :

$$d_r^i = \Psi \left\{ \sum_{s=1}^{T} {d_{sr}^i}^{\sigma_c - 1/\sigma_c} \right\}^{\sigma_c/\sigma_c - 1}, \tag{16}$$

where σ_c is the elasticity of substitution between traded commodities for consumers, and Ψ is a scale parameter with positive value. The imperfectly-competitive sectors will

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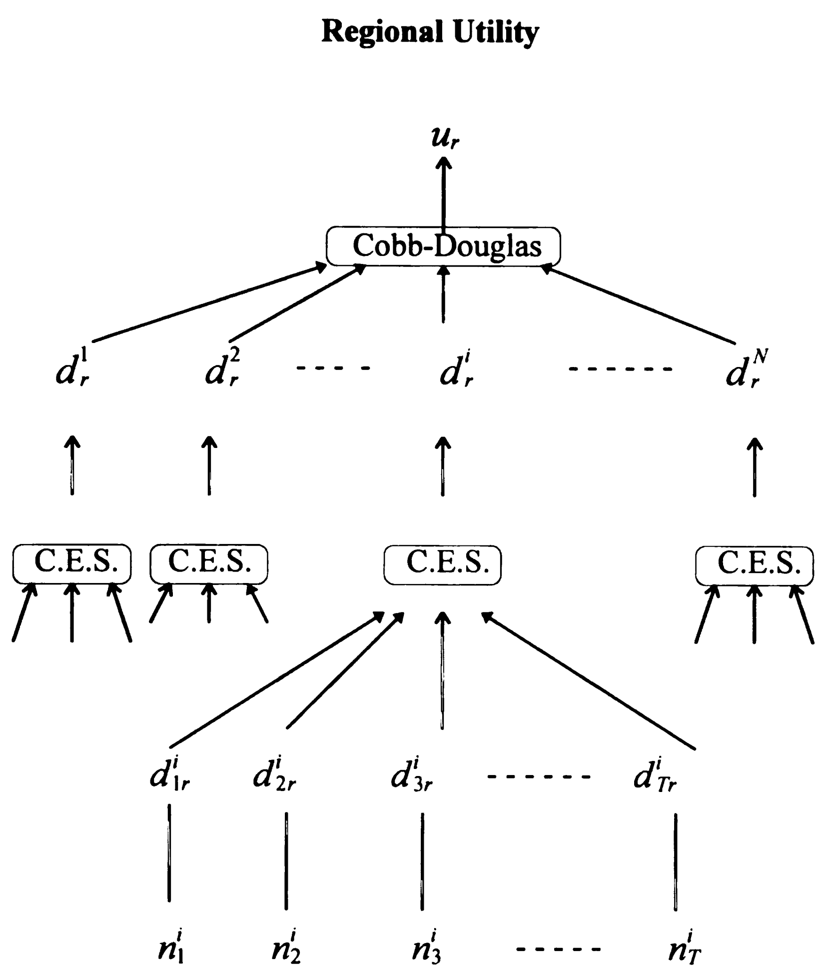
[18] Each firm is assumed to produce only one brand of product.

[19] We add savings to the utility function, in order to keep as many properties of the GTAP model as possible. More importantly, keeping the data for savings in our model minimizes the modification of the data base, without changing the basic structure of the data.

Figure 2. The Structure of Household Demand



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have additional components : The number of firms operating in region s's production sector i, n^i_s, and region r's market share for good i from region s, φ^i_{sr}.[20]

$$d^i_r = \Psi \left\{ \sum_{s=1}^{T} n^i_s * \varphi^i_{sr} * d^i_{sr}{}^{\sigma_c - 1/\sigma_c} \right\}^{\sigma_c/\sigma_c - 1} . \tag{17}$$

The top nest (eq. (15)) transforms composite commodity consumption into the regional utility level. The second level nest (eq. (16)) will identify the sources of composite consumption. For this transformation, we need the composite price index of aggregated good i in region r, p^i_{cr}. This price index will be aggregated with a C.E.S. formulation:

$$p^i_{cr} = \left[\sum_{s=1}^{T} p^i_{csr}{}^{1-\sigma} \right]^{1/1-\sigma} , \tag{18}$$

where p^i_{csr} is the consumer price for good i from region s in region r. A similar equation will be defined for savings (capital good).

$$p^{sav}_r = \left[\sum_{s=1}^{T} p^{sav}_{sr}{}^{1-\sigma} \right]^{1/1-\sigma} , \tag{19}$$

where p^{sav}_{sr} is region r's price of capital goods from region s.

[20] This is a typical method of adding firm-level product differentiation into CGE model, used by trade modelers, such as Brown (1992), Mercenier (1994), Mercenier/Schmitt (1992), and Nguyen/Wigle (1992).

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The household's demand can be summarized as follows: consumer prices are aggregated into the composite price index through eq. (18), which is the basis for deriving the conditional demands for composite commodities, in eq. (17). The information about the consumption of the composite goods will calculate the regional utility level, via eq. (15), weighted with the expenditure shares for composite commodities, which are aggregated over all sources. The change of utility will be used to compute the regional equivalent variation (*EV*) as in GTAP:

$$EV_r = Y_0 * \left\{ \frac{u_r^n - u_r^o}{u_r^o} \right\},[21] \tag{20}$$

where Y_0 is the regional income level before the policy, and u_r^n and u_r^o denote the utility level after policy and before policy, respectively.

2.4. Production Sector

In our model, some of the production sectors are assumed to be perfectly competitive (*PCM*) and the rest are imperfectly competitive (*IMC*). One *IMC* sector is chemicals, plastic, resources, and resource refinery (aggregated as RPR in this paper).

[21] In a non-linear CGE model, *EV* is defined as $(v_b - v_r) \cdot p_b$, where *V* is the indirect utility level, and *P* is the price level. The subscripts *b* and *r* imply base case and revised case, respectively. A linear CGE model cannot calculate *EV* with this formula, since the utility variable in eq. (20) is the level of utility, and this variable is the percentage change of the price level in the linearized version. But eq. (20) gives the EV for linear modeling.

The other *IMC* sector is transportation and machinery equipment (TME). This classification is based on the size of scale economies, studied by Prattern. In the *PCM* sectors, the producer's price is equal to marginal costs. It is assumed that the perfectly-competitive firms operate with constant-returns-to-scale technologies in production. All firms (including both *PCM* and *IMC* firms) use capital, labor, and intermediate goods as their inputs for production.

Firms employ labor and capital as primary production factors. Both labor and capital are assumed to be perfectly mobile within the region, but immobile between regions. The *IMC* firms have fixed costs, in addition to the variable inputs, and thus, their technology exhibits increasing returns to scale. Fixed costs will be composed of labor and capital, i.e., parts of the labor and capital employed will be regarded as fixed costs.[22] The *IMC* sectors are characterized by free entry and exit. No net profits will exist in the *IMC* model. Thus, we can think of these firms as monopolistically competitive. According to Krugman (1979, 1980), a Chamberlin approach was suggested to be useful here, in that the equilibrium of the model is unique. Each firm can ignore the effects of its strategic actions on other firms' behavior, eliminating the indeterminacies of oligopoly. That is, if the numbers of firms are large in a monopolistic competition model, firms will be hardly affected by one firm's price change. In addition to the determinacy of the model, Charmberlin models can be easily modified to reflect firm-level product differentiation.

[22] Details about fixed costs will be given in the section for market-clearing conditions.

Each industry in the imperfectly-competitive sectors has *N* firms per region, whose numbers are exogenously given for the initial equilibrium. More description about the number of firms will be given in the section 3.1. The variable for the number of firms will be endogenously determined as the new equilibrium is calculated, because of free entry and exit. Each firm in an industry has the same technology and the same pricing rule. And each industry is assumed to produce *N* varieties of commodities. That is, each firm is assumed to produce exactly one variety. If a new free trade area were to be formed in the Pacific-rim region, the demand for each variety would increase, since price would go down due to the elimination of tariffs, as long as the traded commodities are normal goods. Responding to the increased demand, firms increase their production, which decreases the average total costs in the imperfectly-competitive industries. Then, they will move downward along the curve for their average total costs, exploiting scale economies. On the other hand, the number of firms should be interpreted with caution. If the number of firms decreases, then existing firms can exploit scale economies. But the reduction of the variety of goods entails a welfare loss, as shown in the functions of household's utility and the aggregation of commodities (eqs. (15) and (17) respectively).

Figure 3 shows the production structure for the imperfectly-competitive sectors. Commodities at the firm level will be aggregated into a composite commodity with a C.E.S. formulation. Primary production factors will be aggregated into [23]fixed value added and variable value added, once again using a C.E.S. equation. In addition, the top

[23] The shares of *IMPC* sectors in regional output are very wide by region. Taiwan/Singapore have the highest share of 35%. Korea and Malaysia take the second highest shares (28%). Philippines and Thailand have the lowest (13%-14%). The U.S. and Japan are in the middle (21%-24%).

of the production structure in the *IMC* sectors will combine variable value added and composite intermediate goods, using a fixed-coefficient (Leontief) technology. Solid arrow lines and dotted arrow lines indicate intermediate goods and endowment factors, respectively.

Figure 3 summarizes how this model is different from the GTAP model. First, our model extends the GTAP model to have imperfect competition, by incorporating fixed costs. Second, for the intermediate goods, firm-level product differentiation is specified, as in consumer's demand structure, to replace the "Armington" assumption. Third, primary production factors are modified to have fixed costs in the imperfectly-competitive sectors. *K* and *L* in the Figure 3 are capital and labor, respectively. VA^{f}_{ri} (VA^{v}_{ri}) is fixed (variable) value added for the production sector *i* in region *r*. z^{ji}_{sr} is the conditional demand of the production sector *i* in region *r* for intermediate good *j* from region *s*.

The demand equations for producers will be similar to those for consumers, except at the top nest of production. The top nest has a fixed-coefficient technology, such that

$$q^{i}_{r} = VA^{v}_{ri}, \text{ and}$$

$$q^{i}_{r} = z^{ji}_{r}, \textit{ for } i = 1,2, \ldots\ldots, N. \tag{21}$$

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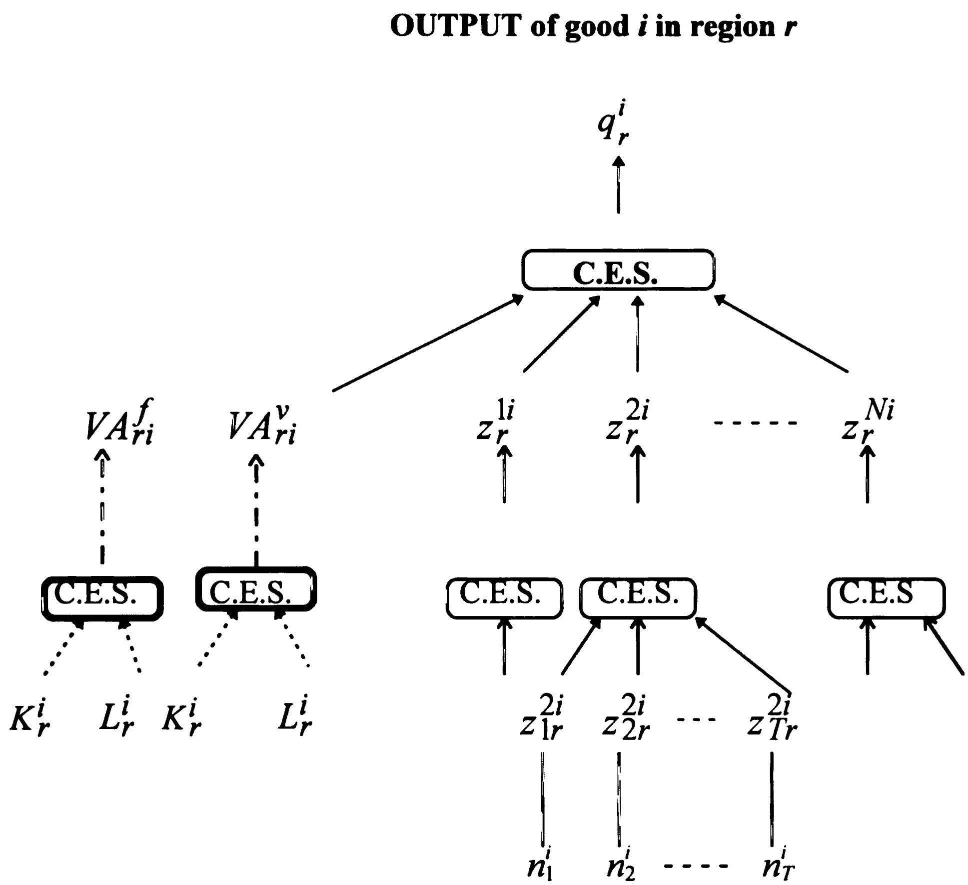
Figure 3. The Production Side for the Imperfectly-Competitive Sectors



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Composite intermediate goods will be defined as follows :

$$z_r^{ji} = \Phi\left\{\sum_{s=1}^{T} z_{sr}^{ji\;\sigma-1/\sigma}\right\}^{\sigma/\sigma-1},$$

for perfectly-competitive sectors, and

$$z_r^{ji} = \Phi\left\{\sum_{s=1}^{T} n_s^i * \xi_{sr}^{ji} * z_{sr}^{ji\;\sigma-1/\sigma}\right\}^{\sigma/\sigma-1}, \tag{22}$$

for imperfectly-competitive sectors. Φ is a scale parameter, and ξ_{sr}^{ji} is firm i's share in region r for good j from region s.

The composite prices will be

$$p_{fr}^{i} = \left[\sum_{s=1}^{T} p_{fsr}^{ji\;1-\sigma}\right]^{1/1-\sigma}, \tag{23}$$

where p_{fsr}^{ji} is firm i's price in region r for intermediate good j from region s.

Total variable costs, C_{ri}^{TV}, will be the sum of variable value added and intermediate demand multiplied by producer's costs for the intermediate demand from all sources.

$$C_{ri}^{TV} = \sum_{s=1}^{T}\sum_{j=1}^{N} p_{fsr}^{ji} * z_{sr}^{ji} + VA_{ri}^{v}. \tag{24}$$

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Eq. (24) represents the cost-minimizing input demands for a given output, q^i_r, and it can be written as follows :

$$c^{AV}_{ri} * q^i_r = \sum_{s=1}^{T}\sum_{j=1}^{N} p^{ji}_{fsr} * z^{ji}_{sr} + VA^{v}_{ri}, \tag{25}$$

where c^{AV}_{ri} is variable costs per unit for producing q^i_r.

The total costs of producing good *i* in region *r*, C^T_{ri}, will be the sum of fixed value added and total variable costs.

$$C^T_{ri} = VA^f_{ri} + C^{TV}_{ri}. \tag{26}$$

Total costs is the product of average total costs, c^{AT}_{ri}, times output, q^i_r, and rewriting eq. (26), using eq. (25),

$$c^{AT}_{ri} * q^i_r = VA^f_{ri} + c^{TV}_{ri} = VA^f_{ri} + c^{AV}_{ri} * q^i_r. \tag{27}$$

Dividing eq. (27) by q^i_r, it becomes

$$c^{AT}_{ri} = c^{AV}_{ri} + \frac{VA^f_{ri}}{q^i_r}. \tag{28}$$

Equation (28) demonstrates the scale economies, since average total costs will decline for the imperfectly-competitive sectors as output increases, given constant fixed value added and constant average variable costs in the short term.

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With monopolistic competition, net profits should be zero, since the model assumes free entry and exit. The zero-profit condition requires that average total costs be equal to the price that producers receive from selling a unit of their product, p^i_{sr} for the imperfectly-competitive sectors.

$$p^i_{sr} = c^{AT}_{ri}. \tag{29}$$

The fixed value added of *IMC* sector *i* in region *r*, VA^f_{ri}, will be calculated from the relation of average variable costs, c^{AV}_{ri} and average total costs, c^{AT}_{ri}. The ratio of variable costs to total costs, θ^i_r, can be written as the ratio of average variable costs to average total costs.

$$\theta^i_r = \frac{c^{AV}_{ri} * q^i_r}{c^{AT}_{ri} * q^i_r} = \frac{c^{AV}_{ri}}{c^{AT}_{ri}}. \tag{30}$$

Using the zero-profit condition for *IMC* sectors, eq. (29), the variable cost ratio will be just the ratio of average costs to supply prices.

$$\theta^i_r = \frac{c^{AV}_{ri}}{p^i_{sr}}. \tag{31}$$

The ratio of marginal costs to supply prices is the inverse of the *IMC* firm's markup rate, which will be discussed in section 2.4. The Lerner formula says that the optimal markup rate, M^i_r, is the ratio of total perceived demand elasticity to total perceived demand elasticity minus one. Then, the variable cost share equation will be written as the following :

$$\theta_r^i = \frac{c_{ri}^{AV}}{p_{sr}^i} = \frac{1}{M_r^i} = \left\{\frac{E_r^i}{E_r^i-1}\right\}^{-1} = \frac{E_r^i-1}{E_r^i} = 1-\frac{1}{E_r^i}. \tag{32}$$

Substituting eqs. (25) and (27) into eq. (32),

$$\theta_r^i = \frac{c_{ri}^{AV}}{c_{ri}^{AT}} = \frac{c_{ri}^{AV}*q_r^i}{c_{ri}^{AT}*q_r^i} = \frac{\sum_{s=1}^{T}\sum_{j=1}^{N} p_{sr}^{ji}*z_{sr}^{ji}+VA_{ri}^{v}}{\sum_{s=1}^{T}\sum_{j=1}^{N} p_{sr}^{ji}*z_{sr}^{ji}+VA_{ri}^{v}+VA_{ri}^{f}} = \frac{V_r^i-VA_{ri}^f}{V_r^i}, \tag{33}$$

where $V_r^i = \sum_{s=1}^{T}\sum_{j=1}^{N} p_{sr}^{ji}*z_{sr}^{ji}+VA_{ri}^{v}+VA_{ri}^{f}$, which says that the total costs of producing IMC good *i* in region *r* will be the total revenue of *IMC* firms, V_r^i. Substituting eq. (32) into eq. (33), and rewriting eq. (33) becomes

$$VA_{ri}^f = \{1-\theta_r^i\}*V_r^i = \left\{1-\left(1-\frac{1}{E_r^i}\right)\right\}*V_r^i = \frac{1}{E_r^i}*V_r^i. \tag{34}$$

That is, fixed value added will be the product of the inverse of the total perceived demand elasticity and the total revenue of *IMC* firms. Currently, engineering information for fixed costs is not available at levels of aggregation that are sufficiently high to be used in nationwide CGE modeling. The eq. (34) will be used to calibrate fixed value added for the *IMC* model in this paper. As the total perceived demand elasticity goes up, fixed value added will be lower, given the market value of firm's output. Since fixed value added is a part of total value added, the share of fixed value added to total value added cannot be greater than one. During simulations, this point will be observed carefully, and the elasticity of substitution will be calibrated, such that the fixed share is less than one, as shown the section 3.1.

This model does not need extra equations, such as equations (30) - (34), for the *PCM* sectors, since there will be no fixed factors, and average total costs will be the same as marginal costs. Therefore, the *PCM* firms will have constant-returns-to-scale technology.

As shown in Figure 3, the fixed value added and variable value added will be aggregated in a C.E.S. formulation, in the same way that GTAP specifies the primary factors for the competitive sector. But we add fixed primary production factors, and thus, the pricing rule will be modified to reflect that. We assume that primary factor markets are perfectly competitive, such that the price of primary factors (labor and capital) is the same for competitive and imperfectly competitive sectors.

2.5. Total Perceived Demand Elasticities

The pricing rule for the monopolistically-competitive firms can be specified with either the Lerner formula or the Eastman-Stykolt hypothesis (ESH).

The ESH was used by Cox and Harris (1985, 1986, and 1992), and Nguyen and Wigle (1992). The ESH assumes that the firm sets its price equal to the price of the import-competing good, inclusive of the domestic tariff, such that domestic price = the world price of import * (1 + tariff). This is a less-aggressive pricing policy. This pricing rule has been supported in Canadian industrial organization studies.[24]

ESH is a collusive price-setting rule, in the sense that the prices that domestic firms set would be world prices plus domestic tariffs of the imports, without the large shifts of demands into imports, since the price of the domestic good is closely linked to the price of imported good. The Lerner rule is collusive and non-aggressive, since monopolistically-competitive firms establish a market niche for their product and mark up their prices over the marginal costs of their products, in order to maximize their profits, rather than increase their market shares, by setting prices lower than those of competing goods.

The Lerner optimal markup rule is based on a microeconomic foundation. On the other hand, the ESH has no theoretic basis. A serious problem can be raised with the ESH pricing rule. When the ESH rule is used as the pricing rule for monopolistic firms, the welfare effects of FTA may be overestimated,[25] because of the direct linkages between tariff cuts and domestic prices. Thus, our model will use the monopolistic pricing rule of Lerner, in order to provide a conservative evaluation of the benefits of new FTA.

The Lerner formula for the optimal pricing rule for a monopolistically-competitive firm is given in eq. (35).

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[24] See Cox and Harris (1986), p. 382 and Karikari (1988) for evidence supporting ESH.

[25] Harris / Cox was criticized by Nguyen and Wigle (1992) for overestimating the welfare effects of Canada-U.S.A. FTA. See also Sobarzo (1991).

$$\frac{p^i_{sr}-c^M_{ri}}{p^i_{sr}} = \frac{1}{E^i_r}, \tag{35}$$

where c^M_{ri} is marginal cost of producing good i in region r, and E^i_r is the value of the perceived total demand elasticity and its value will be greater than one, since the supply price will be greater than or equal to marginal costs.

Defining the markup rate as $M^i_r = \frac{p^i_{sr}}{c^M_{ri}}$, eq. (35) will be transformed to the following equation.

$$M^i_r = \frac{E^i_r}{E^i_r-1}, \tag{36}$$

where the markup rate is greater than one, since the total demand elasticity is greater than one. From eq. (36), we can see that markup rate will go down if the perceived demand elasticity increases. Then, lower welfare gains are expected, since the model will quickly approach the competitive position, yielding small efficiency gains. Another reason that lower welfare gains may be generated by higher elasticities can be seen in eq. (34) : If the perceived total demand elasticity increases, the fixed value added will be lower. Smaller fixed value added will be related to smaller welfare gains from removing tariffs and non-tariff barriers, which was discussed in the section for the production side. Firms will set a markup above marginal cost which is inversely related to the absolute value of the elasticity of the firm's total perceived demand elasticity. That is, if a firm faces a more elastic demand curve, then the firm will have low markup rates, and thus will lower its supply price. Combined with the increasing returns to scale and the zero-profit condition, lower markup will bring smaller changes of welfare with a formation of a FTA.

The perceived total demand elasticity will be derived from the perceived demand elasticity, η_{sr}^{i}, weighted with market shares, Φ_{sr}^{i}, as shown below :

$$E_r^i = \sum_{s=1}^{T} \Phi_{sr}^{i} * \eta_{sr}^{i}. \tag{37}$$

As tariffs are removed, region *s*'s market share for good *i* in region *r*, Φ_{sr}^{i}, increases, as long as region *r* and *s* are members of the new FTA, due to trade creation effects of FTA. Eq. (37) implies that, as market shares increase with the new FTA, a firm's total perceived demand elasticity will be increased. Then, markup rates will be decreased from eq. (36). That is, the sale share, Φ_{sr}^{i}, will be negatively related to the markup rate. Total perceived demand elasticities calculated from eq. (37) will be used for the calculation of optimal prices for producers in eq. (35), and fixed value added in eq. (34). Increasing total perceived demand elasticities imply that markets for goods are changing to be more competitive. Thus, producer's prices move closer to marginal costs, as shown in eq. (35), and fixed costs become smaller, such that new firms can be established with lower burden of fixed costs.

The *IMC* firms will increase their sales as trade barriers are removed, and decreasing average total costs will reinforce this, since unit average costs will decrease when output increases. More sales will increase the total perceived elasticity in eq. (37), and then, the markup rate in eq. (36) will decrease. Then, producers will lower the price of their products, and consumers enjoy the lower price, which will increase real income and regional utility.

The perceived demand elasticity, η^{i}_{sr}, can be defined in several ways, depending on the *IMC* firm's expectations about rival firm's behavior. In recent CGE modeling for imperfectly-competitive models, the Cournot conjecture has been used widely, for example, Norman (1990) and Harrison, Rutherford and Tarr (1995). But we add the Bertrand conjecture to our model. The first approach is to assume that a rival firm's quantity will be fixed, but rivals adjust their prices to clear the markets for differentiated products. The second approach is to assume that firms will change their output, while leaving their prices unchanged. In this paper, simulations will be performed under both of the two approaches discussed here. The derivations for the perceived demand elasticities will be to differentiate the conditional demand with respect to price.[26] Under the Bertrand conjecture, if we set the changes of other prices to zero (except the price concerned), we will have the following equation :

$$\eta^{Bi}_{sr} = \sigma - \{\sigma - 1\} * \left\{ \frac{\Phi^{i}_{sr}}{N^{i}_{s}} \right\}, \tag{38}$$

where σ is the elasticity of substitution, N^{i}_{s} is the number of firms in the imperfectly-competitive sector *i* in region *s*, and the superscript *B* in the perceived demand elasticity represents Bertrand. Alternatively, the Cournot perceived demand elasticity will be

[26] Detailed derivations for the elasticity of substitution are given at Hertel (1992).

derived, if the changes of other demands are set equal to zero, except for the demand concerned. The Cournot perceived demand elasticity will be

$$\eta_{sr}^{Ci} = \frac{\sigma}{1+\{\sigma-1\}^{*}\Phi_{sr}^{i}/N_{s}^{i}}, \tag{39}$$

where C is used to denote Cournot.

It can be said that perceived demand elasticities will increase, as the elasticities increase, when the market shares and the number of imperfectly-competitive firms remain constant, from eqs. (38) and (39). As the number of *IMC* firms increases, the demand elasticity will go up in eqs. (38) and (39).[27]

Hertel (1992) showed that the Cournot perceived elasticity will be lower than the alternative perceived elasticity, and the associated markup will be larger, with the same elasticity of substitution. Thus, it is expected that the effect of welfare may be overestimated, if *IMC* firms are assumed to operate under the Cournot conjecture. This overestimation may lead to incorrect results. If we take a conservative position in evaluating the welfare effects of a new FTA, the Bertrand perceived elasticity will be recommended for IMC firm's conjecture. This point will be studied in chapter IV, by performing simulations under the two conjectures.

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[27] The fact that the numbers of *IMC* firms increase implies that more varieties of goods are available. Following Spence-Dixit-Stiglitz's "love of variety" preference, consumption per variety will be smaller, in order to maximize utility, given budget constraint. On the other hand, demand elasticity will increase if the number of firms increases, as explained above. That is, consumption will be negatively related to the demand elasticity. This was assumed in Krugman's simple model (1979, and footnote 3 in 1980). But this assumption is not required, since eqs. (32) and (33) have a negative relationship between consumption and demand elasticity.

2.6. Market-Clearing Conditions

The primary production factors are labor (L) and capital (K), each of which is perfectly mobile within each region, and immobile between regions. The immobility assumption rules out migration and international capital flows in a static model like this paper. The market-clearing conditions for the factors for each region are :

$$L_r = \sum_{j \in PCM} L_{rj}^{v} + \sum_{h \in IMC} N_r^h * L_{rh}^{v} + \sum_{h \in IMC} N_r^h * L_{rh}^{f}$$

$$K_r = \sum_{j \in PCM} K_{rj}^{v} + \sum_{h \in IMC} N_r^h * K_{rh}^{v} + \sum_{h \in IMC} N_r^h * K_{rh}^{f}, \tag{40}$$

where L_r (K_r) denotes the total supply of labor (capital) in region r. L_{rj}^{v} (K_{rj}^{v}) is labor (capital) per firm for competitive sector j in region r,[28] L_{rh}^{v} (K_{rh}^{v}) is variable labor (capital) per firm for the imperfectly-competitive sectors, and L_{rh}^{f} (K_{rh}^{f}) is fixed labor (capital) per firm for the imperfectly-competitive sectors. N_r^h is the number of *IMC* firms in production sector h in region r. Equation (40) shows how the endowments in each region are allocated between perfectly-competitive and imperfectly-competitive sectors. As new firms are established, additional variable inputs and fixed inputs are required for the imperfectly-competitive firms.

For each region in the model, the domestically-produced commodities, q_r^i, should be equal to the sum of region r's sales of commodity i, such that

[28] Since *PCM* sectors have no fixed factors, the percentage changes of primary factors for perfectly-competitive sectors are represented with only variable primary production factors.

$$q_r^i = \sum_{s=1}^{T} s_{sr}^i , \tag{41}$$

where s_{sr}^i is region s's sale of commodity i to region r. Total imports of each commodity should satisfy both the final demand for that good by private households and the intermediate demand by production sectors. Imports (or the use of domestic goods) by source will be equal to the sum of all the domestic demands for the imported good in each region. The equilibrium condition for imports by source will be

$$s_{sr}^i = d_{sr}^i + \sum_{i=1}^{N} z_{sr}^{ji}\,[29]. \tag{42}$$

The market-clearing conditions apply for perfectly-competitive sectors and imperfectly-competitive firms. If $r = s$, eq. (41) will be applicable to domestic sales of domestically-produced commodities. The rest of domestic output will be exported and the market for good i produced by region r will be cleared according to eqs. (41) and (42).

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[29] s_{sr}^i is region s's exports of good i to region r. But this can also be interpreted as region r's imports of good i from region s.

2.7. Price Linkages

The last part of this chapter describes how prices are connected, as transactions of goods proceed. The price-linkage system in the GTAP model should be modified, so that the modified GTAP data are compatible with the model in this paper. First, the supplier's price will be equal to marginal costs, c_{ri}^{M}, for the competitive sectors, and the sum of marginal costs and markups for imperfectly-competitive sectors, such that

$$p_r^i = c_{ri}^M,$$

for the competitive sectors, and

$$p_r^i = c_{ri}^M * M_r^i,$$

for the imperfectly-competitive sectors. (43)

As explained in section 2.2, our model uses a simplified version of GTAP to add imperfect competition into the model. One of the simplifications is the omission of the world transportation sector, which links the F.O.B. and C.I.F. prices. Without this linkage, F.O.B. prices will be interpreted to be equal to C.I.F. prices. Thus, we introduce world prices of good *i* from region *r*, p_{wr}^{i} for F.O.B. prices. The world price will be the supplier price, p_{sr}^{i}, divided by export taxes.

$$p_{wr}^i = \frac{p_{sr}^i}{T_{xsr}^i}, \tag{44}$$

where T_{xsr}^{i} is export taxes on the exported good *i* of region *s* to region *r*, and all tax rates in this paper should be interpreted as (1 + tax rate).

The next equation links domestic and world prices :

$$p_{msr}^{i} = p_{wr}^{i} * T_{msr}^{i}, \tag{45}$$

where p_{msr}^{i} denotes region *r*'s domestic market price for imported good *i* from region *s*, and T_{msr}^{i} is region *r*'s import tariff on imported good *i* from region *s*. With the modification of the data, which will be described in section 3.1, T_{msr}^{i} will be zero for a single country, if $r = s$, since there is no re-export in our model. But if several regions are aggregated into one region, for example, the rest of world (ROW) in Table 1, T_{msr}^{i} may have positive values, even if $r = s$.

The consumer's price will be the product of the imported price of good *i*, p_{msr}^{i}, and the consumption tax on imported good *i* of region *s* to region *r*, T_{csr}^{i}:

$$p_{csr}^{i} = p_{msr}^{i} * T_{csr}^{i}. \tag{46}$$

The gross-of-tax price of commodity *i* equals the market price of imported commodity *i* plus the consumption tax, when region *r* differs from region *s*. If $r = s$, T_{csr}^{i} is the output tax on a domestically-produced commodity. Similarly, the firm's prices for intermediate goods will be defined to include the tax on intermediate goods, T_{fsr}^{ji} :

$$p_{fsr}^{ji} = p_{msr}^{i} * T_{fsr}^{ji}, \tag{47}$$

where p_{fsr}^{ji} is the after-tax price of good *j* from region *s* for production sector *i* in region *r*. As for the consumer's price, if $r = s$, p_{fsr}^{ji} is the firm's intermediate price for domestically-produced goods, including the tax on the use of domestically-produced goods as intermediate goods.

CHAPTER III

DATA, PARAMETERS, AND SIMULATIONS

3.1. The Modification of the GTAP Data and Parameters

The GTAP data base draws heavily from the SALTER-III data base.[30] In particular, the GTAP data base uses regional input-output matrices taken from the SALTER-III data base, and international trade and protection data were incorporated into the GTAP data base. The 1994 version of the GTAP data base used in this paper comprises 26 disaggregated regions and 37 disaggregated sectors.

The data in the GTAP can be grouped into two categories : Data for domestically-produced goods, and data for internationally-traded goods. Our model does not classify the geographical origins of products, that is, whether the good concerned is produced domestically or imported, since products are differentiated at the firm level. The original GTAP data base was designed for competitive models. Thus, it is necessary to modify the data base suitable for our model in this paper.

[30] See Jomini, *et al.* (1991).

We can summarize how the data base was modified and aggregated to be adapted to the model : First, re-export through Hong Kong will just be added to domestic uses of domestically-produced commodities. Second, some of the coefficients in the modified GTAP data base will be modified to be workable under the model, using the GTAP data aggregation program. For example, the GTAP data base does not have the sources of imported goods for final consumption and intermediate use, which are needed under the *IMC* model in this paper to account for the firm-level product differentiation. The sources of imports will be identified by modifying the aggregation program and running it with the SALTER-III data base. Third, the data for the domestic consumption of domestically-produced commodities will be added into the consumption components with the same origin and destination, and the data for domestically-produced production factors will be treated similarly. Fourth, we drop land for agriculture as a primary production factor, but the data for land will be added into the data for capital.

The preference and technology parameters in GTAP data base are taken from the SALTER data set. These parameters can be aggregated, according to the aggregation of the data base. For a comparison between the GTAP model and our model, simulations will be performed under both the GTAP model and the model with imperfect competition. We will use the original GTAP data base and parameters for the simulation of the GTAP model. We will take the elasticities of substitution for imports from the GTAP parameter set for the perfectly-competitive sectors in our model. For the imperfectly-competitive sectors, a calibration procedure will be required. This procedure is described below. In addition, information about the number of firms will be needed for the *IMC* sectors. We will follow Nguyen and Wigle (1992), by assigning some positive numbers, for example, 100, to each of the imperfectly-competitive sectors,[31] and conducting a sensitivity test by assigning different numbers, for example, 25, 50, 200 and 1000.

Table 4 summarizes the values of the elasticities of substitution used by other trade CGE modelers, and those taken for this paper. For easy comparison and the adjustment of differences for aggregated commodities, elasticities are given for 11 production sectors. We have a wide range of the parameters used by modelers. Mercenier and Schmitt used 2 - 4 for the elasticities for competitive sectors, while values of 5 - 10 were used for imperfectly-competitive sectors. But Brown and Stern (1989b) used a high elasticity of 15. This high elasticity was required by Brown and Stern, in order for the fixed value-added shares to be lower than one. As described above, GTAP has two sets of elasticities for traded commodities. The numbers on the left side of the GTAP parameter column are Armington elasticities (AE), which are used for dividing aggregated commodities into domestically-produced goods and imported goods. The right side contains the elasticities for imported commodities (EM). Only EM elasticities will be used in order to identify the sources of aggregated imports. Simulations using the GTAP model will be performed with the GTAP parameters. These numbers are moderate, compared to those in Mercenier/Schmitt and Brown/Stern. For the model with product differentiation at the firm level, we will use the elasticity of substitution for

[31] One hundred firms per *IMC* industry may seem to be too many firms. But this can be a reasonable number of firms, since our model has high degree of aggregation, which is five sector per economy and two of them are *IMC* sectors. Nguyen and Wigle have a similar degree of aggregation and use 100 firms as the initial equilibrium number of firms per *IMC* sector.

imported goods for the base case. It is reasonable to compare results simulated from two models with the same elasticities.

For the competitive sectors, there is no strict restriction on choosing the values of elasticities. Our model will take the elasticities for competitive sectors from the GTAP database. But the elasticities for the imperfectly-competitive sectors must be calibrated, such that the fixed value-added shares be less than one. Since the numerical results of the models will be interpreted in light of their chosen parameters and data, sensitivity tests should be conducted to check how robust the results are to the different choices of parameters.

We will perform sensitivity tests with different sets of elasticities of substitution, in order to study the effects of the different magnitudes of the elasticities on the variables concerned, such as regional utility level and income. Alternative sets of elasticities will be taken from the calibrations of different fixed value-added shares. Sections 2.4 and 2.5 deal with the relationship between elasticities and fixed value added. As the elasticities of substitution get larger, fixed value-added shares will be decreased. *99%* in the second column of the elasticities for this paper implies that the elasticities are calibrated, so that the fixed value-added ratios to the total value added are maintained below *99%*.[32] Even though we set the fixed value-added ratios below *99%*, only a few of the 26 *IMC* sectors (2 *IMC* sectors * 13 regions in this model) will have fixed value-added shares near the *99%* ratio, and the other sectors will have shares far below *90%*. This happens, because

[32] Note that the elasticities of substitution in the EM column are higher than *99%* elasticities. Thus, we can use these elasticities for *IMC* sectors in this paper.

common elasticities will be used for all the regions, and the fixed value-added shares will depend on market shares and the number of firms, in addition to the elasticities of substitution. Later, we will study how the welfare effects change when changing the elasticities of substitution, and compare it with the results for our base-case parameters. The same calibration will be done for the *59%* ratio.

Another sensitivity test will be done by assigning different numbers for the *IMC* sectors, to determine how sensitive our results are to varying parameter values. Initially, it was assumed that each *IMC* production sector have 100 monopolistically-competitive firms. Alternative numbers for *IMC* sectors will be 25, 50, 200, and 1000 to each *IMC* sector per region. Simulations will be conducted with these alternative numbers of firms, and compared to assess the robustness of model.

3.2. The Simulation Method

Current CGE models can be grouped into the linearization school and the levels school.[33] The levels approach is descended from the work of Scarf (1973). This approach solves non-linear general equilibrium problems, by furnishing subroutines of explicit algebraic formulas for indicating the levels of variables.

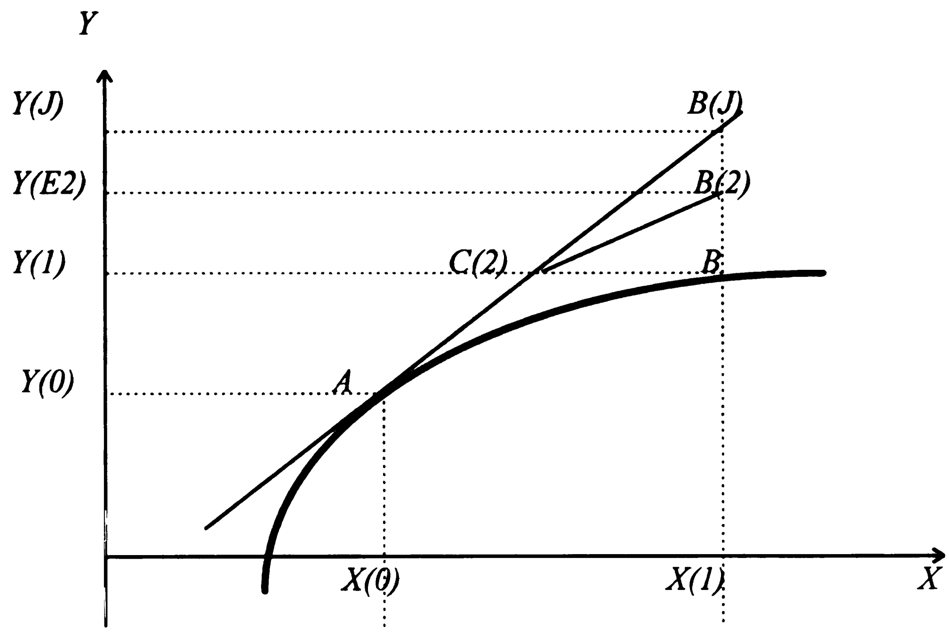
The linearization school solves the problem by inverting the matrix of linearized equations. This is the Norwegian/Australian approach to CGE modeling, which builds on

[33] See Hertel, Horridge, and Pearson (1993) for the grouping of the CGE models.

the Johansen (1960) approach, a method of solving systems of linearized equations by inverting a single matrix. The original Johansen approach did not involve updating, so that there could be substantial approximation errors for large perturbations. These linearization errors are likely to be significantly diminished by adopting a multi-step solution procedure and updating method (enhanced solution method) of Euler or Gragg. Utilizing the Johansen approach with an updating procedure, the Impact Project in Australia made a notable contribution to CGE modeling. Hertel *et al.* (1993) demonstrate that the linearized and non-linear schools of CGE modeling can be reconciled. They report reasonably similar simulation results from both linearized and non-linear approaches, as long as the data base is updated in the linearized case. All variables in the model used here are denoted in terms of proportional changes, which can be used to update coefficients read from the data source file. The linearization of the equations produces the relationships of percentage changes of variables, coefficients, and parameters. The initial data base will be systematically updated, and the updated data bases will be saved for the next-stage simulations, in order to provide more accurate solutions. With a relevant shock, coefficients will be updated as long as the iterative solution process continues.

This can be explained by comparing the original Johansen method with Euler's method. As shown in Figure 4, Johansen's method is to calculate the direction of change (dy / dx) at the initial point *A*, and to move from origin *A* to estimated point *B(J)* along the tangent line to the curve at *A*, while changing x from *X(0)* to *X(1)*. But point *B* is the point to reach. Therefore, {*Y(J)* - *Y(1)*} will be the approximation error associated with

Figure 4. Illustration of Euler Method



Source: Harrison, Jill, and Ken Pearson (1993), GEMPACK Documentation, p.2-24.

the Johansen method. One way of achieving a more accurate solution may be to divide the interval, $\{X(1) - X(0)\}$, into two pieces. First, move to point A, and, then, recalculate the slope and move along the line $\{C(2), B(2)\}$, starting at $C(2)$. The estimation error will be $\{Y(E2) - Y(1)\}$, which is smaller than the Johansen error, $\{Y(J) - Y(1)\}$. Euler's method is to calculate the derivatives, (dy / dx), at each sub-interval, to move that direction each time of the calculation of the derivative for a short distance. The above figure explains a two-stage Euler's method. If the distance, $\{X(1) - X(0)\}$, is divided into N times, and if the direction in which to move is recalculated N times, we will have an N-stage Euler's method. If N is sufficiently large, the solution can be close to the true solution $Y(1)$. That is, performing the Johansen method multiple times will bring accurate solutions.

The most important advantage of the linearized modeling is that it becomes simpler to formulate and modify models. Furthermore, benchmarking is also easy with the linearization method. In order to benchmark the data base to the linearized model, it is simply necessary to check that the model data base satisfies accounting identities, whereas non-linear CGE modeling requires that the calibration procedure correctly represent the systems of equations that are used in the later simulations.

Therefore, we will solve the model in this paper, taking the linearization approach. The model will be written with GEMPACK (General Equilibrium Modeling PACKage), which is a suite of general-purpose economic modeling software. A recent version of GEMPACK can solve the non-linear problem, but it takes more computer time than the linearized version, with the same results. To save computer time, the non-linear equations will be linearized. In the linearized version, the variables should be interpreted as the percentage changes of the levels variables.

CHAPTER IV

INTERPRETATION OF RESULTS

This section reports on the results of FTA simulations with the CGE model. In the first case, we will discuss the welfare effects of APEC, obtained from the simulation of the perfectly-competitive GTAP model. Next, we will present the simulation results taken from our model with firm-level product differentiation, under both conjectures on rival firms' behavior, described in the section for the production side. Then, we will report the results with different sets of parameters for the sensitivity tests.

It was assumed that a FTA is created by removing all nominal tariffs existing between all member regions. To study the economic welfare changes of Asia Pacific Economic Cooperation and AF-11 FTA, we will compare the change of welfare after establishing new FTA. It will be interpreted that the member countries of a new FTA will be willing to create a free trade area, if welfare is improved in all of the member countries after a FTA simulation.

Formation of a new FTA gives different welfare consequences to the regions involved in the FTA, depending on the net effect of trade creation and trade diversion. Trade creation means that a country will begin to import from the other member countries the goods which were previously produced domestically at higher costs. This happens, due to the elimination of tariffs. This improves welfare, because of enhanced production efficiency. That is, the resources that were previously used for the good will be transferred to other sectors, thus raising the efficiency of production by using resources more efficiently. On the other hand, some countries may experience welfare losses due to trade diversion, which means that a country switches the source of imports from a more efficient producer outside the FTA to a less efficient producer in the FTA. For example, assume that, before NAFTA, the U.S. imports microwave ovens at lowest prices after import tariffs from Korea, which was the most efficient producer in the world. After NAFTA, U.S. imports the goods from Mexico, since Mexican producers can supply the goods with lower prices than Korean firms, because of the elimination of tariffs within NAFTA.

The production efficiency gain will be enhanced with the introduction of imperfect competition into the competitive GTAP model, since the elimination of import tariffs will provide *IMC* firms with a larger market for their products. With a larger market, they will lower their markup, and they can produce goods at lower costs with the higher level of outputs.

In addition to welfare changes, the model produces measures of the changes of regional income, the overall price indices, and firm outputs for selected scenarios.

But our main concern is to look at the welfare changes that result from eliminating tariffs and NTBs in the region. Each model will have ten possible scenarios of grouping regions for a new FTA. Each of the ten scenarios will be simulated under all the combinations of two alternative firm's conjectures (Bertrand and Cournot), three different sets of elasticities (GTAP parameters, *99%*, and *59%*), and five different numbers of firms (100, 25, 50, 200, 1000). Our base case for our *IMC* model will be the simulation with GTAP parameters and 100 firms operating in each *IMC* sector.

Possible groupings of regions for new FTAs in the Asia-Pacific region will be :

(1) APEC : All regions in the Pacific-Rim are assumed to participate in Asia-Pacific FTA, which was discussed in Seattle, Washington, November 1993, and Bogor, Indonesia, November 1994. In our data aggregation, all the regions except ROW will be APEC members.

(2) APEC - Canada

(3) APEC - Mexico

(4) APEC - Thailand

Groupings from scenarios (2) - (4) will be the cases in which only one country withdraws from the full size APEC. Canada and Mexico are chosen for exclusion from the FTA in simulations (2) and (3) because they are members of the North America FTA, so that they have access to the U.S. market. If a new FTA is formed with the U.S., Canada and Mexico will compete with other new nations in the North American market. Thailand is chosen because it is a traditional agricultural country and its economy's international trade is low relative to its GNP, which only leaves a small amount of room for improving its welfare with lower tariffs and non-tariff barriers.

(5) APEC - CM : Canada and Mexico will not participate in the APEC.

(6) APEC - CMT : Canada, Mexico and Thailand will not involve in the APEC.

An Asia-based FTA (AF-11) will be comprised of four Asian NIE economies (Hong Kong, Korea, Singapore, and Taiwan), four ASEAN economies (Indonesia, Malaysia, Philippine, and Thailand), China, and two Oceanic countries (Australia and New Zealand).

(7) AF-11 + Japan : Japan joins AF-11.

(8) AF-11 + U.S. : U.S. joins the AF-11.

(9) AF-11 : The formation of the full APEC in the area may be too extensive. In this case, only AF-11 members are assumed to participate to form a new FTA.

(10) AF-11 - Thailand : Thailand withdraws from the AF-11.

These scenarios are designed to study the consequences of removing import barriers within regions involved in each scenario, scrutinizing carefully what happens to welfare for the possible member regions. The scenarios are ordered according to the number of countries involved in new FTA (i.e. APEC has the most countries, and AF-11-Thailand has the fewest).

The model is solved using a computer with 75 Megahertz Pentium processor and 32 Megabytes of memory. With the high capacity of memory, the model can be solved in around 26 minutes for one scenario of a new FTA in the Asia-Pacific region.

4.1. The Simulation of GTAP model

Table 5 reports the welfare effects, taken from the simulations of the perfectly-competitive GTAP, with GTAP parameters. Note that it is not necessary to specify the number of firms here, since the GTAP is assumed to have perfect competition for all of the production sectors. The first five groupings are in the top of the table, and next five groupings are in the bottom. The first column displays the welfare effects under the full APEC. Welfare is measured by percentage changes in the utility of the representative consumer. It is found that four countries will suffer a deterioration of their welfare as a result of APEC. Two ASEAN countries and two NAFTA countries seem not to be positive to the new APEC, which implies that the formation of APEC is not likely, if we are guided by the results of the competitive GTAP model.

Canada's withdrawal from APEC will worsen its welfare, while no significant effects occur to the other countries. Canada will have negative benefit changes in 9 cases out of 10 groupings, which implies that Canada will be reluctant to form a new FTA in the Pacific basin, from the economic point of view. Mexico has similar results as Canada's withdrawal. An interesting aspect for Mexico is that Mexico will have a possibility of improving its welfare with the variations of AF-11. As shown in Table 3a, Canada and Mexico have traded with Asian nations, except Japan, which implies that they are not likely to collect gains from a new FTA. And these two countries export large portions of their total exports into the U.S. They may lose the North American market, when joining the APEC. The GTAP model also simulates this assertion (The column of APEC in Table 5 has negative welfare changes for Canada and Mexico).

Evidently, Thailand is a loser for all 10 groupings of countries within the GTAP model. Thailand is a traditional agricultural country, and Thailand's exports are highly concentrated to a few countries, such as U.S., Japan, and Taiwan, with low levels of trade with Asian neighbors, such as Indonesia, Philippines, and Korea.[34] Under APEC and AF-11, Thailand loses 5 % of its welfare. It is expected that Thailand will minimize its welfare losses, if it does not involve in the APEC. Reading two columns of APEC - CM and APEC - CMT, APEC does not seem to be supported in the perfectly-competitive GTAP model, since Malaysia worsens its welfare, in addition to three nations' objection to APEC.

Japan improves its welfare when it joins AF-11, while the U.S. will worsen. On the contrary, it is expected that U.S. benefits, when U.S. joins the AF-11. Japan and U.S. trade substantial volumes of goods with Asian nations. Under the competitive GTAP model, it is inferred that U.S. and Japan compete for the Asia market. Under AF-11+Japan, the U.S. is estimated to export less manufactured goods to Korea, Malaysia, Philippines, and Thailand, while Japan will increase its LMF and RPR commodities to these Asian nations. Especially, Korea imports more RPR (77%) and LMF (91%). On the contrary, under AF-11+U.S.A., the opposite case happens. Only Taiwan/Singapore remain stable in trade values under two free trade scenarios. It is noticeable that

[34] Thailand's biggest trade partner among APEC member nations is Japan, (The total value of Thailand's trade with Japan is U.S. $ 18730 million). The U.S. and Taiwan/Singapore are the second and third trade partners, respectively. Trade between Thailand and other nations in the possible APEC is less than U.S. $ 3 billion.

Australia/New Zealand face a substantial decline in their economic well-being, from a 2.39 % gain under AF-11 + Japan to a 0.06 % gain under AF-11 + U.S. It can be guessed from this point that Australia/New Zealand compete with the U.S. in the Asia market, especially for agriculture and food products. When AF-11 opens free trade with the U.S., there will be decreased exports of agricultural products from Australia/New Zealand to Korea and Taiwan/Singapore by 75%. Under AF-11+Japan, Australia/New Zealand is expected to export more agricultural products to Japan by four times.

The formation of AF-11 is anticipated to have trouble within its member nations, since Thailand has negative welfare changes, regardless of the grouping of regions. The column of AF-11 - Thailand shows that all countries in AF-11 are winners, if they form a FTA of AF-11 without Thailand.

It is still expected that either Japan or the U.S. will join the AF-11 without Thailand, but not both Japan and the U.S., since Malaysia will not be better off, as shown in the column of APEC - CMT.

From Table 5, we see that Korea is expected to collect the highest gains, ranging from 6.6 % to 8.9 %, throughout all of the ten scenarios. Following Korea, Taiwan/Singapore seems to be the second biggest winner. These nations have high ratios of total values of exports and imports to gross domestic output, especially with U.S., Japan, and ASEAN nations.[35] Under APEC, the light manufacturing sector (LMF) in Korea and Taiwan/Singapore are simulated to increase their exports to Japan by factors of nearly three and nearly two, respectively. Similar trade patterns are found for the U.S.

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[35] See Sakong (1993).

Resource-rich ASEAN nations export resources and intermediate goods to the two NIE nations, and import manufactured goods from the NIEs.

Japan and Australia/New Zealand have wide ranges of welfare changes, depending on the combinations of nations for a FTA. Japan experiences positive welfare gains when it participates in any form of free trade area, while losing welfare, otherwise. This means that Japanese firms are taking big trade creation with FTA. Under APEC, Japan is expected to increase its exports of manufactured commodities by 22-24% (RPR and TME sectors) and 55% (LMF). Other nations than these countries are expected to be affected by less than 1% of welfare. For example, the U.S. is anticipated to have negligible welfare changes, ranging from - 0.0309% to 0.067%. This can be explained with that the U.S. has a big domestic market in its territory, that is, 94.4% of the goods made in America are sold in the U.S. market for domestic uses.

Table 6 reports equivalent variations simulated from 10 scenarios of APEC and AF-11. The equivalent variations are measured in U.S. $ million. Equivalent variations are directly related to the percentage changes of regional utility and the initial GNP levels, as shown in eq. (14). Thailand loses by more than 5 and 4 billion US dollars under the full-size APEC and AF-11, respectively. The welfare of the rest of world (ROW) declines by U.S. $31 billion under the APEC scenario. This is due to the trade diversion under a FTA in the region. Korea experiences the highest welfare improvement, of $23 billion, under AF-11 + U.S. It can be inferred that Korea would prefer to become involved in a free trade agreement with the U.S., since Korea collects a relatively lower welfare gain under AF-11 + Japan than AF-11 + U.S. Japan collects the highest gain of $83 billion, if the full-size APEC is realized. This means that Japanese firms could enjoy the highest degree of trade creation effects under the largest FTA (which is APEC) in the Pacific-rim region. We can see that Japan and the U.S. compete in the Pacific-rim region, by noting that Japan and the U.S. each experience welfare declines, under the scenario in which one of them is not involved in the new FTA, and the other does participate, such as AF-11 + Japan and AF-11 + U.S.

Tables (7) and (8) present the changes of income and prices, respectively, obtained from the simulation of the GTAP model. Some countries, such as Australia/New Zealand and Taiwan/Singapore, are expected to have positive changes of the general price level with the elimination of tariffs in the APEC region. This happens because of the increases in the demand for goods and services. Canada and Thailand have large declines of prices with a FTA in the Pacific-rim region. For example, Australia/New Zealand and Taiwan/Singapore have positive changes of final consumption for services under full-size APEC, while composite price of services will go up in the nations. On the other hand, Canada and Thailand are expected to have the opposite results.

4.2. Imperfectly-Competitive Model

The model with imperfect competition and scale economies will be simulated with base case parameters of GTAP elasticities and the assumption of 100 firms operating in each of *IMC* sectors. Tables 9 and 10 summarize the changes of welfare from 10 groupings for new FTAs under Cournot and Bertrand, respectively.

The results from GTAP and the *IMC* models differ significantly. First, it should be noted that welfare changes under *IMC* model are significantly larger than under the competitive model, as reported in Table 5. For example, some regions are expected to have two-digit welfare gains : Korea improves welfare by at least 13% under all of ten of the scenarios of the *IMC* model. Taiwan/Singapore gains by more than 11% of welfare under 7 scenarios out of 10 groupings of countries / regions. (The GTAP model gives 9% at most.) Significantly bigger welfare gains were obtained from the *IMC* model in most cases.[36] The *IMC* model is defined to have a fixed factor, and the removal of protection will result in the firm producing at lower unit cost with higher levels of outputs. And more competition will drive firms to lower markups over marginal costs. Thus, the scale economies and efficiency gains will be realized.

Second, the smaller economies such as Korea and Taiwan/Singapore, are affected more, when we move from GTAP to the *IMC* model. On the other hand, large economies (U.S. and Japan) are affected relatively less, even though their welfare changes are

[36] Under AF-11 and some of its variations, the differences between the welfare changes with the PCM model and the welfare changes with the IMC model are small for Canada, Indonesia, and the U.S.

increased a little under the *IMC* model, relative to the welfare changes of the GTAP model. This is explained by the fact that bigger countries have already exploited scale economies relatively more,[37] even without the policy change.

Third, China/Hong Kong, and Australia/New Zealand are to collect substantially higher welfare gains for the new FTA, even though Korea and Taiwan/Singapore are still the biggest winners. Under the GTAP model, those regions have moderately low welfare gains. Relatively, Japan and the U.S. are estimated to remain at the similar levels of welfare under both GTAP and the *IMC* models.

Fourth, Malaysia will change to be a strong supporter of the formation of a FTA at any level. Under the GTAP model, Malaysia experiences welfare losses with any scenarios of APEC, but positive gains at all variations of AF-11. The *IMC* model predicts positive welfare gains for all of 10 scenarios.

Fifth, all of ASEAN and the NIEs except Thailand prefer to establish a FTA with the U.S. rather than with Japan, under the competitive GTAP model, since they will experience higher benefits under AF-11 + U.S. than AF-11 + Japan, if they are supposed to have free trade with only one of Japan and the U.S. This also applies to the predictions from the *IMC* model, except China/Hong Kong. China/Hong Kong will have higher welfare gains under AF-11 + Japan than AF-11 + U.S. This can be explained with one of common aspects of these economies, that is, most countries in the region export more to the U.S. than to Japan, but they import more from Japan than from the U.S. Thus more trade creation effects will be realized, when these nations are involved in a FTA with the

[37] See p. 13 in Brown and Stern (1989a), for the smaller level of scale economies in the U.S.

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U.S. China is different, because of higher trade dependence with Japan rather than the U.S. According to Table 3a, the total value of imports and exports between China and Japan was U.S. $ 58089.3 million, and that of trade between China and the U.S. was U.S. $ 56376.5 million. But other nations, such as Korea and Taiwan/Singapore, have higher trade with the U.S. than Japan.

Sixth, Indonesia experiences relatively variable welfare changes under each of the APEC scenarios and AF-11 scenarios of the GTAP model, while the *IMC* model predicts relatively stable welfare changes. But the Philippines is expected to have relatively stable welfare changes under both GTAP and the *IMC* model.

From the results of both GTAP and the *IMC* model, we can conclude that the full-size APEC is not likely to be established in the Pacific-Rim area. But the *IMC* model predicts a higher possibility for establishing the APEC, since only Mexico and Thailand seem to experience welfare losses under the *IMC* model. The GTAP model suggests that Canada and Malaysia, in addition to Mexico and Thailand, would not want to get involved in the FTA. Thailand's welfare losses are lower, when she does not participate in the APEC and AF-11, than with alternative choices. This is learned by comparing numbers in the columns of APEC and APEC - Thailand, and the columns of AF-11 and AF-11 - Thailand. The opposite case happens to Canada. That is, Canada is expected to be better off (minimize welfare losses), if Canada participates in the APEC. From Table 5, Canada's welfare loss is 1.43% under APEC-Canada, while their welfare loss will be decreased to 0.6% under the full-size APEC. Canada under *IMC* model collects even positive welfare gains. AF-11 seems not to be realized under either the GTAP or the *IMC* models. l

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models, because of Thailand's losses for the scenario. But both models show that *AF-11 - Thailand is an economically-desirable scenario for a new FTA in the Pacific basin*, since all member nations under AF-11-Thailand are estimated to have positive welfare gains under the GTAP and *IMC* model.

Under the *IMC* model, a candidate for a wide-range FTA in the area will be APEC-CMT, which contains both Japan and the U.S. But it is not likely that the regions in the AF-11 could agree to open their markets with only one of Japan and U.S., since Asian NIEs prefer to establish a FTA with U.S., but Australia/New Zealand and China/Hong Kong want a FTA with Japan rather than the U.S.[38] The competitive model does not support the FTA grouping of APEC - CMT, but it seems to be possible that AF-11 regions excluding Thailand might agree to eliminate import tariffs with either Japan or the U.S.

Table 10 presents the changes of welfare from the simulations of the imperfectly-competitive model with our base-case parameters and the Bertrand conjecture. In the previous section, it was described that the perceived demand elasticity of the Bertrand firms is larger than that of the Cournot firms. As a result, Cournot firms will have higher markup than Bertrand firms. Therefore, generally, the economic efficiency gains from trade liberalization will be larger under Cournot approach than the alternative approach. This will be clear, by comparing Table 9 and Table 10.[39] All of the discussions above

[38] Compare utility changes under AF-11+Japan and AF-11+USA in Table 9. Taiwan/Singapore are expected to have 12.4% under a FTA with the U.S. but their welfare declines to 6.13% when only Japan joins AF-11. On the contrary, Australia/New Zealand are estimated to increase welfare by almost three times, when they establish a FTA with Japan (6.87%) rather than the U.S. (2.39%).

[39] There exist two exceptions for the scenario of AF-11, but they are not substantial.

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Table 12.

about Table 9 apply also to Table 10. Our *IMC* model does not show substantial differences of the changes of welfare under Cournot and Bertrand conjectures, simulated with GTAP parameters and the assumption of 100 firms actively operating in the *IMC* sectors of each region.

Most regions in our model are expected to have decreasing markup rates under the full-size APEC. But the reductions are very moderate, in the ranges of -.003% to -0.32%. The markup rates of Taiwan/Singapore are not affected at all, while ROW has positive markup rates.

Tables 11 and 12 summarize the estimated income changes with the simulations of 10 FTA scenarios, under our base-case parameters and two alternative conjectures. Combining the income changes of Tables 11 and 12 with the welfare changes in Tables 9 and 10, it can be seen that the percentage changes of income are positive, if those of welfare are positive.[40] Different patterns can be found for regions in the model. For example, Taiwan/Singapore has higher income changes than welfare changes by 3-4 percentage points, in the ten groupings of FTA in the area. China/Hong Kong has a similar pattern. On the contrary, in Korea and Indonesia, the percentage changes of utility are higher than those of income, for 9 out of 10 groupings. This is due to price reductions in these countries, as shown in Tables 13 and 14. The previous page had the discussion about the relative sizes of welfare changes under imperfectly-competitive firms' alternative conjectures: Cournot and Bertrand. The estimated income changes are

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[40] One component of AF-11 scenario has a opposite direction for U.S. under the Bertrand conjecture in Table 12. But this is negligible.

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larger, when employing the Cournot assumption than the Bertrand assumption, with the exception of Australia/New Zealand in the AF-11 scenario.

The estimated changes of consumer price indices are reported for the base case under the Cournot conjecture (Table 13) and the Bertrand conjecture (Table 14). One of the main effects of eliminating import tariffs is the price reduction for imports from the member countries. As described in the section on price linkages, section 2.7, the price of imports will be just the world price, if no tariffs are charged. Then, the prices of imports for consumers and producers will be lowered, and firms will be able to reduce their production costs, because of lower costs for intermediate goods. Lower costs will be linked to a lower supplier's price. Therefore, overall consumer price indices will decline. This is found in some countries, for example, Indonesia, Japan, Korea, Mexico, and Thailand.

In spite of this import price reduction, with the removal of tariffs, some countries, such as Australia/New Zealand, China/Hong Kong, and Taiwan/Singapore, experience increases of their consumer price indices. This can be explained by the competition among firms for hiring labor and capital. With a formation of a new FTA, domestic firms of these regions will increase output and (or) new firms will enter the production sector, thus employing more labor and capital. If labor is demanded more in an economy, then the wage rate will be increased, which will induce substitution between labor and capital. This affects the production costs for their products. In a general equilibrium model, the cost increase will be spread over the whole economy. The rise in the wage increases domestic income, since national income consists of the sum of the returns to the production factors and tax/tariff revenues. As shown in Tables 11 and 12, countries with positive price changes have relatively higher income increases, as in Australia/New Zealand. On the other hand, the rise in income will increase demands, and thus increase prices.

Tables 15 - 18 contain the percentage changes of the numbers of *IMC* firms. Tables 15 and 17 report the changes of the numbers of resources, plastic, and refinery (RPR) firms under the Cournot conjecture and base-line parameters. Tables 16 and 18 are under the Bertrand conjecture with base-case parameters. There is no pattern of changes, but it can be said that if the numbers of firms decrease, then the *IMC* sector can exploit scale economies, but the economies sacrifice the diversity of goods.

Tables 19 - 28 are presented for conducting sensitivity tests for chosen parameters of the elasticities of substitution and the number of firms. First, the elasticities of substitution are altered to produce a *59%* fixed value-added share, shown in Table 4, while we leave the number of firms unchanged. The *59%* elasticities are larger than the GTAP elasticities. Each table reports the changes of welfare for 10 FTA scenarios under Cournot (Table 19) and Bertrand (Table 20). Both tables predict the same directions of welfare changes, with no exception. In most cases, the welfare changes are estimated to be lower in the simulations with *59%* elasticities than those with the GTAP elasticities, because of the higher elasticities of substitution for the *59%* fixed value-added share. The next test will be to assume lower elasticities of substitution, while still keeping constant the number of firms. We find a set of elasticities, such that the common elasticities assign the fixed value-added share to be less than *99%*, which is the highest share.

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share, since the fixed value-added share cannot be larger than one. That is, we assume lower elasticities of substitution than GTAP. It is simulated, similar to that of the *59%* case, as reported in Tables 21 and 22. It is found that the patterns of welfare changes are the same as in Tables 19 and 20 for Cournot and Bertrand conjectures, respectively. The only differences are lower changes of welfare, as expected. Thus, it can be concluded that our results are robust to the choices of the elasticities of substitution.

Another question may be raised for the number of firms. The first test is to change the number of firms from 100 (central case) to 25, keeping the GTAP elasticities. The simulation results under alternative conjectures are reported in Tables 23 and 24. Other simulations were performed for 50 firms, in order to study how robust the model is with respect to the number of firms (reported in Tables 25 and 26). The welfare changes move in the same direction and are of about the same magnitude as in the simulations of 100 firms. As expected, the welfare changes are larger in the simulations with 25 firms than in those with 100 firms, since lowering the numbers of firms in the model reduces the perceived demand elasticities. And the simulations with Cournot give higher welfare changes than Bertrand. It is also confirmed that the results with 25 firms are not substantially different from those with 50 firms, by comparing Tables 23/24 and 25/26. Increasing the numbers of *IMC* firms from 100, to 200 and to 1,000,[41] presents the same patterns of welfare changes as the simulations of 50 firms and 100 firms. Tables 27 and 28 report the simulation results of 200 firms under Cournot and Bertrand, respectively. It is confirmed again that the *IMC* model used in this paper is stable for the parameters.

[41] Simulations with 1,000 firms are not reported in this paper.

Simulations are performed for three different numbers of firms with *59%* and *99%* elasticities, and we have similar results, as described above.

Tables 29-38 summarize the percentage changes of sectoral output. The first five tables (Tables 29-33) are estimated production output changes by sectors and regions in the model, obtained from the simulation of the competitive GTAP model. The output changes for the *IMC* model are reported in Tables 34-38. Generally, the output changes in the *IMC* model are larger than in the GTAP model.

CHAPTER V

CONCLUSION

The main results of the paper can be summarized as follows :

(1) The groupings of regions seem to be important for a formation of free trade area in the Pacific-Rim region, which contain countries with diverse backgrounds.

(2) The introduction of imperfect competition into the model projects large discrepancies between the simulations from the GTAP model and the *IMC* model.

(3) No substantial differences are raised from alternative assumptions about the firm's expectations regarding on rival firm's behavior.

(4) The *IMC* model in this paper is very robust in the choices of parameters.

Both GTAP and the *IMC* models predict no formation of a free-trade area for the entire Asia-Pacific region. The GTAP model is more pessimistic about APEC than is the *IMC* model, since more countries are losers in the GTAP simulations. On the contrary, the *IMC* model points out the possibilities of a variation of APEC, by excluding a couple of countries. For example, a small-size APEC may be formed by excluding Canada, Mexico, and Thailand. An Asia-based FTA, AF-11, is demonstrated as a candidate for an alternative free-trade area under imperfectly-competitive CGE modeling, at the expense of Thailand, since the *IMC* model gives smaller losses to Thailand than does the GTAP model. Negative welfare changes for Thailand seem to come from her industry structure. Thailand's trade dependence (measured by the ratio of the total value of exports and imports to the gross domestic products) is the lowest among the AF-11 regions.[42] Thus, they have a small mechanism for improving welfare, with the introduction of scale economies, and firm-level product differentiation.

Another point to notice is that the *IMC* model simulates substantially larger welfare changes than the GTAP model. This makes big winners of the NIE countries, for example, Korea, Taiwan/Singapore, and China/Hong Kong. These economies will be active supporters of a FTA in the region under the *IMC* model. In simulations with imperfect competition, the specifications of a firm's conjecture on its rival's behavior do not seem to be important in evaluating the welfare changes in our model. In most cases, the Cournot assumption presents larger values for the welfare changes, but the differences are negligible. In our model, the GTAP elasticities are used as a central case, and the sensitivity tests confirm the stability of the model with respect to the parameters. A similar conclusion was reached from sensitivity tests with respect to the number of firms.

A couple of qualifications should be pointed out. First, in this model, the complete elimination of import tariffs and non-tariff barriers means the formation of free trade area. But the welfare changes should be interpreted as an upper bound for the economic benefits that the model predicts, because NTBs are not likely to be removed completely, taking various forms of security regulations and government procurement practices. Second, the benefits of scale economies cannot be fully captured by a static

[42] See Shibusawa *et al.* (1992), for detailed description.

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CGE model, since the regional economies will be growing with a new FTA. Thus, a dynamic modeling is suggested, for full estimation of the welfare effects under a new FTA in the Pacific basin.

Table 1. Members of APEC and Aggregation Mappings of Regions

Members of APEC	Regions in GTAP	Mappings of regions in our study
Australia (1989)*	Australia	Australand (ANZ)
Brunei (1989)		Rest of World (ROW)
Canada (1889)	Canada	Canada (CND)
Chile (1994)		Rest of World (ROW)
China (1991)	China	China (CHK)
Hong Kong (1991)	Hong Kong	China (CHK)
Indonesia (1989)	Indonesia	Indonesia (IND)
Japan (1989)	Japan	Japan (JPN)
Korea (1989)	Korea	Korea (KOR)
Malaysia (1989)	Malaysia	Malaysia (MLS)
Mexico (1993)	Mexico	Mexico (MXC)
New Zealand (1989)	New Zealand	Australand (ANZ)
Papua New Guinea (1993)		Rest of World (ROW)
Philippines (1989)	Philippines	Philippines (PHL)
Singapore (1989)	Singapore	Singapore (TSP)
Taiwan (1991)	Taiwan	Taiwan (TSP)
Thailand (1989)	Thailand	Thailand (THL)
United States (1989)	United States	United States (U.S.A.)
	Argentina	Rest of World (ROW)
	Brazil	Rest of World (ROW)
	EEurope and Soviet#	Rest of World (ROW)
	EEC	Rest of World (ROW)
	MEast and NAfrica&	Rest of World (ROW)
	Other Latin America	Rest of World (ROW)
	Other Regions%	Rest of World (ROW)
	South Asia	Rest of World (ROW)
	SS Africa@	Rest of World (ROW)

*. The numbers after the countries in the APEC column indicate the years in which they joined the APEC.
#. EEurope and Soviet : Eastern Europe and Former Soviet Union
&. MEast and NAfrica : Middle East and North Africa
%. Other Regions : Regions not elsewhere classified
@. SS Africa : Sub-Saharan Africa

Table 2. Lists of Industries / Commodities and Mappings in Our Study

Listings of Industries in GTAP	Mappings of Industries in This Paper
Paddy Rice	Agriculture (AGR)
Wheat	Agriculture (AGR)
Grains (except rice and wheat)	Agriculture (AGR)
Non-grain Crops	Agriculture (AGR)
Wool	Agriculture (AGR)
Other Livestock	Agriculture (AGR)
Forestry	Agriculture (AGR)
Fishery	Agriculture (AGR)
Coal	Resource, Chemical, and Refinery (RPR)
Oil	Resource, Chemical, and Refinery (RPR)
Gas	Resource, Chemical, and Refinery (RPR)
Other Minerals	Resource, Chemical, and Refinery (RPR)
Processed Rice	Light Manufacturing (LMF)
Meat Product	Light Manufacturing (LMF)
Milk Products	Light Manufacturing (LMF)
Other Food Products	Light Manufacturing (LMF)
Beverages and Tobacco	Light Manufacturing (LMF)
Textile	Light Manufacturing (LMF)
Wearing Apparel	Light Manufacturing (LMF)
Leather, etc.	Light Manufacturing (LMF)
Lumber and Wood	Light Manufacturing (LMF)
Pulp, Paper, etc.	Light Manufacturing (LMF)
Petroleum and Coal Products	Resource, Chemical, and Refinery (RPR)
Chemicals, Rubber, and Plastics	Resource, Chemical, and Refinery (RPR)
Non-Metallic Mineral products	Resource, Chemical, and Refinery (RPR)
Primary Ferrous Metals	Resource, Chemical, and Refinery (RPR)
Non-ferrous Metals	Resource, Chemical, and Refinery (RPR)
Fabricated Metal Products	Transportation, Machinery, and Equipment (TME)
Transport Industries	Transportation, Machinery, and Equipment (TME)
Machinery and Equipment	Transportation, Machinery, and Equipment (TME)
Other Manufacturing	Light Manufacturing (LMF)
Electricity, Water and Gas	Services (SVS)
Construction	Services (SVS)
Trade and Transport	Services (SVS)
Other Services (private)	Services (SVS)
Other Services (government)	Services (SVS)
Ownership of Dwellings	Services (SVS)

Table 3a The Matrix of Regional Exports (U.S. $ million)

Source\Destination	Astral/NZeal	China/HK	Canada	Indonesia	Japan	Korea	Malaysia
Astralia/NZealand	537969	3569.03	784.889	1652.21	17874.7	3712.23	1215.74
China/Hong Kong	3706.4	1.01E+06	2844.13	1297.21	20976.9	5567.54	1558.87
Canada	923.93	2861.38	959712	463.771	8760.17	1850.56	278.756
Indonesia	1054.16	2706.8	282.268	188613	13213	2331.53711	496.969025
Japan	9275.45	37112.4	8909.02	6585.65	6.55E+06	21358.5	8589.32
Korea	1701.56	8946.52	1861.29	2088.31	15581.9	571107	1221.73
Malaysia	790.91	2374.72	435.93	648.49	7216.59	1630.69	83768.8
Mexico	107.83	387.28	2409.62	85.11	2459.61	257.1	11.864
Philippines	164.38	696.48	227.32	100.54	3370.02	405.313	173.931
ROW	16866.2	38678.7	19998.7	9384.21	112618	27374	6217.39
Thailand	650.08	2855.25	470.44	380.20	7519.96	711.38	862.705
Taiwan/Singapore	4439.58	24616.8	2588.71	3269.84	19460	4409.85	10261.2
USA	14332.5	21534.7	81040.9	4289.01	75880.1	20845.6	5013.89

Source\Destination	Mexico	Philippines	ROW	Thailand	Taiwan/Sing	USA
Astralia/NZealand	295.303	586.356	17665.7	887.789	3877.67	5453.69
China/Hong Kong	1233.91	1030.7	51788.4	2017.26	7549.55	34841.8
Canada	1096.27	221.113	21324.3	380.585	1319.91	103615
Indonesia	108.17	202.31	7335.14	373.82	4463.18	4459.33
Japan	4406.93	3456.36	127620	11210.1	39250	103244
Korea	945.49	813.66	33670.2	1790.99	6346.63	19091.9
Malaysia	166.255	389.247	9798.83	1402.82	11334	8107.88
Mexico	472546	10.846	10548.6	70.779	141.98	38431
Philippines	37.899	81582.8	3034.9	237.493	683.584	4509.97
ROW	13462.3	4583.76	1.81E+07	11358.6	32305.9	201742
Thailand	137.463	114.713	12049.3	165685	3415.49	7885.96
Taiwan/Singapore	311.818	1653.97	47897.4	6077.78	475198	40618.5
USA	42577.2	2834.29	257457	5005.85	29164.4	9.49E+06

Table 3b The Regional Exports (U.S. $ million)

Total Values of Regional Exports

Aust/NZ	China/HK	Canada	Indonesia	Japan	Korea	Malaysia
62441.8	203697	143096	37026.7	381018	94060.2	44296.4
Mexico	Philippines	ROW	Thailand	Taiwan/SP	USA	World
54922.3	13641.9	1400700	37053	173783	559976	3205710

Shares of World Trade

Aust/NZ	China/HK	Canada	Indonesia	Japan	Korea	Malaysia
1.95	6.35	4.46	1.16	11.89	2.93	1.38
Mexico	Philippines	ROW	Thailand	Taiwan/SP	USA	World
1.71	0.43	43.69	1.16	5.42	17.47	100

* Total of Shares may not be one, due to rounding errors.

Table 4 Parameters for the Elasticity of Substitution

	Mercenier-Schmitt	Brown-Stern	GTAP Parameter		Model with Firm-Level Product		
			(AE)	*(EM)*	*(EM)*	*(99%)*	*(59%)*
Agriculture	2	15	2.48	4.72	4.72	4.72	4.72
Forestry, Fishery	2	15	2.48	4.72	4.72	4.72	4.72
Processed Food	4	15	2.53	5.82	5.82	5.82	5.82
Lumber	4	15	2.53	5.82	5.82	5.82	5.82
Paper Product	4	15	2.53	5.82	5.82	5.82	5.82
Textile. Leather	4	15	2.53	5.82	5.82	5.82	5.82
Chemical	5	15	2.32	4.81	4.81	4.40	7.30
Resource	5	15	2.32	4.81	4.81	4.40	7.70
Machinery	10	15	3.42	6.91	6.91	5.10	8.10
Vehicle	10	15	3.43	6.91	6.91	5.10	8.10
Service	2	15	1.94	3.92	3.92	3.92	3.92

AE : The elasticity of substitution for Armington specification in GTAP.

EM : The elasticity of substitution between imported goods in GTAP.

Table 5 Welfare Changes [GTAP Model, GTAP Parameter]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	1.09524	1.15251	1.09464	1.09273	1.15233
China/Hong Kong	0.834849	0.808756	0.832409	0.863859	0.805972
Canada	-0.60126	-1.43455	-0.57617	-0.61575	-1.39339
Indonesia	0.631411	0.65044	0.632843	0.560754	0.652738
Japan	2.667	2.55356	2.66271	2.5577	2.54889
Korea	7.45897	7.35196	7.39872	6.78335	7.29244
Malaysia	-0.80981	-0.77479	-0.80853	-1.55657	-0.77011
Mexico	-0.81881	-0.80155	-1.01526	-0.8348	-0.924
Philippines	0.654334	0.632357	0.669579	0.653426	6.49E-01
ROW	-0.34027	-0.32276	-0.32913	-0.32716	-0.31176
Thailand	-4.98103	-4.96538	-4.98248	-2.69211	-4.97238
Taiwan/Singapore	4.12822	4.11727	4.15572	3.83373	4.14618
USA	0.0466	0.0562	0.02.7	0.0447	0.0333
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	1.15005	2.38917	0.0631	0.379166	0.295108
China/Hong Kong	0.833804	1.09651	1.78369	1.21916	1.16231
Canada	-1.39381	-0.09.79	0.504199	-0.0124	-0.0226
Indonesia	0.581256	0.935309	1.79841	1.61535	1.47456
Japan	2.4382	0.404067	-0.4201	-0.24419	-0.20901
Korea	6.62229	6.64	8.94003	8.15	7.14
Malaysia	-1.52679	0.841509	1.74271	2.05252	0.807879
Mexico	-0.934	0.0432	0.738054	0.0415	0.0292
Philippines	0.647602	0.781469	1.2795	0.410352	0.248741
ROW	-0.29885	-0.138	-0.0846	-0.0464	-0.0444
Thailand	-2.5800	-4.0800	-4.16084	-4.1600	-0.460
Taiwan/Singapore	3.84577	2.07807	6.38234	3.04665	2.1897
USA	0.0309	-0.159	0.0685	-0.0312	-0.0279

Table 6 Equivalent Variation [GTAP Model, GTAP Parameter] (U.S. $ million)

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	3214.33	3381.45	3.21E+03	3207	3380.94
China/Hong Kong	3868.25	3747.83	3856.99	4002.09	3734.99
Canada	-3177.07	-7610	-3044.12	-3250	-7390
Indonesia	751.786	774.373	753.485	667.896	777.1
Japan	83351.4	79850.5	83219.1	79978	79706.4
Korea	19518.2	19248.4	19366.2	17808	19098.1
Malaysia	-500.481	-478.752	-499.684	-965.626	-475.85
Mexico	-2414.12	-2360	-2996.28	-2460	-2730
Philippines	319.063	308.383	326.473	318.629	316.47
ROW	-31895.3	-30300	-30800	-30700	-29200
Thailand	-5061.13	-5044.81	-5062.63	-2703.27	-5050
Taiwan/Singapore	9723.47	9698.19	9786.92	9042.72	9764.97
USA	2450	2960	1420	2350	1750
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	3374.29	6967.13	186.062	1116.79	869.597
China/Hong Kong	3863.42	5073.93	8225.96	5638.18	5376.75
Canada	-7394.44	-516	2649.51	-65.5	-119
Indonesia	692.248	1111.96	2128.92	1913.97	1748.37
Japan	76286.4	12770.3	-13331.5	-7742.48	-6625.74
Korea	17398.8	17400	23230.3	21300	18700
Malaysia	-947.009	515.841	1063.43	1250.61	495.334
Mexico	-2760	127	2159.14	122	85.9
Philippines	315.802	380.832	621.974	200.345	121.554
ROW	-28007.4	-12900	-7920	-4340	-4150
Thailand	-2590	-4130	-4209.72	-4200	-456
Taiwan/Singapore	9070.65	4943.69	14871.3	7213.61	5206.38
USA	1624.93	-8340	3600	-1640	-1470

Table 7 Changes of Income [GTAP Model, GTAP Parameter]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	3.17905	3.38667	3.15	3.09299	3.35331
Chind/Hong Kong	0.669072	0.715333	0.655933	0.748983	0.701557
Canada	-2.73135	-5.25	-2.69884	-2.82	-5.17
Indonesia	-0.0497	0.0112	-0.0451	-0.23953	0.0176
Japan	4.14662	4.12974	4.12142	3.78829	4.10207
Korea	5.97049	5.81834	5.86138	4.92166	5.70996
Malaysia	-2.16798	-2.09749	-2.17878	-3.22788	-2.10401
Mexico	-3.04003	-2.99	-4.57188	-3.16	-4.28
Philippines	1.49538	1.48895	1.51391	1.48863	1.51044
ROW	-2.25	-2.19	-2.21	-2.25	-2.16
Thailand	-9.07509	-9.01221	-9.0756	-5.93647	-9.01
Taiwan/Singapore	4.48203	4.49909	4.50853	3.8428	4.52701
USA	-0.899	-0.974	-1.05	-0.998	-1.15
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	3.2676	8.22548	0.4429	1.52026	1.1356
China/Hong Kong	0.778462	4.23593	3.91775	3.38319	3.32699
Canada	-5.22092	-0.852	1.68222	-0.283	-0.351
Indonesia	-0.17425	1.73504	2.48541	2.63958	2.2866
Japan	3.74118	0.630101	-1.16252	-0.71106	-0.64475
Korea	4.66715	6.0600	9.45771	8.2200	6.5600
Malaysia	-3.17875	0.807745	2.25645	2.88128	1.01787
Mexico	-4.3800	-0.473	3.23177	-0.128	-0.215
Philippines	1.50064	4.36056	4.12017	2.2759	1.88826
ROW	-2.16143	-0.816	-0.353	-0.272	-0.318
Thailand	-5.7200	-6.1200	-6.62989	-6.2700	-1.0300
Taiwan/Singapore	3.8769	4.06948	8.87062	5.79031	4.06819
USA	-1.2443	-1.3000	0.628	-0.432	-0.474

Table 8 Changes of Prices [GTAP Model, GTAP Parameter]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	2.35579	2.55914	2.18972	2.27046	2.5259
China/Hong Kong	-0.0114	0.10888	-0.0946	0.0942	0.0956
Canada	-2.70323	-5.05577	-2.73064	-2.78846	-4.9834
Indonesia	-1.03374	-0.955815	-1.16018	-1.2191	-0.94722
Japan	2.84788	2.95425	2.84345	2.50441	2.92627
Korea	-3.04401	-3.10439	-2.93212	-3.62438	-3.17473
Malaysia	-2.85483	-2.7705	-2.88612	-3.7657	-2.78242
Mexico	-3.1311	-3.07538	-4.30981	-3.24799	-4.0209
Philippines	0.0629	0.0898	-0.0846	0.113568	0.103014
ROW	-2.16399	-2.1134	-2.14989	-2.17501	-2.07976
Thailand	-10.7719	-10.6824	-10.8352	-5.3235	-10.6603
Taiwan/Singapore	1.2506	1.28816	1.27038	0.649284	1.30329
USA	-1.03443	-1.08953	-1.22584	-1.13394	-1.25178
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	2.4408	7.31129	0.101917	1.27365	0.917786
China/Hong Kong	0.198451	4.42095	3.30823	3.20935	3.22783
Canada	-5.03483	-0.87691	1.54749	-0.30651	-0.37207
Indonesia	-1.13479	1.24453	1.51025	2.12237	1.78646
Japan	2.5804	0.510181	-1.07637	-0.66623	-0.60456
Korea	-3.75757	-1.60677	0.555099	0.43887	-0.57564
Malaysia	-3.7066	0.243335	1.57904	2.35856	0.726593
Mexico	-4.11777	-0.50196	3.03958	-0.14684	-0.23146
Philippines	0.151037	3.82214	3.14269	2.19128	1.97532
ROW	-2.09097	-0.78196	-0.33497	-0.26443	-0.31166
Thailand	-5.1364	-7.12167	-6.60611	-5.50071	-0.97011
Taiwan/Singapore	0.692304	3.70734	5.31636	5.4598	3.82169
USA	-1.35177	-1.24732	0.615293	-0.43206	-0.4733

Table 9 Changes of Welfare [IMC Model, GTAP Parameter, Cournot, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	4.49704	4.58664	4.47381	4.42688	4.56348
China/Hong Kong	6.00049	5.89338	5.96754	6.05201	5.85961
Canada	0.48985	-0.42194	0.489341	0.480036	-0.41796
Indonesia	1.19394	1.15865	1.16547	1.04842	1.13022
Japan	2.90069	2.71142	2.88436	2.7909	2.69439
Korea	16.337	16.0624	16.1474	14.7306	15.8729
Malaysia	2.40131	2.37156	2.3588	1.1242	2.33357
Mexico	-0.51397	-0.50714	-0.29923	-0.52548	-0.224
Philippines	3.10027	3.05301	3.10062	3.15258	3.05278
ROW	-0.221	-0.206	-0.21934	-0.22426	-0.204
Thailand	-2.21026	-2.23822	-2.24935	-1.37144	-2.28225
Taiwan/Singapore	11.758	11.678	11.7543	11.1248	11.6758
USA	0.375239	0.392132	0.348812	0.368267	0.36312

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.49444	6.86767	2.39464	2.37631	2.24773
China/Hong Kong	5.91097	7.03539	5.52615	4.65433	4.82647
Canada	-0.42102	-0.0710	0.796	-0.0300	-0.0367
Indonesia	0.98347	1.33381	1.45237	1.04307	0.891183
Japan	2.58461	-0.16399	-0.41048	-0.34913	-0.33053
Korea	14.2511	14.7	16.5083	15.3	13.2
Malaysia	1.04371	3.06232	3.51007	3.05214	1.33268
Mexico	-0.237	-0.0451	1.1500	-0.0262	-0.0405
Philippines	3.10549	3.56301	3.17485	2.4757	2.62295
ROW	-0.20717	-0.0743	-0.0768	-0.0616	-0.0693
Thailand	-1.3300	-1.2300	-2.45463	-2.5100	-0.112
Taiwan/Singapore	11.0369	6.12743	12.3932	5.75311	4.67124
USA	0.35635	-0.0859	0.0926	-0.0497	-0.0534

Table 10 Changes of Welfare [IMC Model, GTAP Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	4.45665	4.54726	4.4335	4.38805	4.52418
China/Hong Kong	5.91205	5.80821	5.87994	5.96533	5.77515
Canada	0.440224	-0.433144	0.440479	0.430651	-0.42891
Indonesia	1.1625	1.12758	1.13412	1.01792	1.09925
Japan	2.84955	2.65995	2.83306	2.74106	2.64286
Korea	16.1327	15.8621	15.9446	14.5357	15.6742
Malaysia	2.3363	2.30736	2.29391	1.06659	2.26944
Mexico	-0.54283	-0.535109	-0.30469	-0.55413	-0.230
Philippines	3.04707	3.00158	3.048	3.10028	3.00189
ROW	-0.206	-0.191541	-0.20474	-0.20965	-0.190
Thailand	-2.27469	-2.30127	-2.31325	-1.38569	-2.34477
Taiwan/Singapore	11.6667	11.5882	11.663	11.0402	11.586
USA	0.331201	0.349994	0.305912	0.324593	0.322042

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.45679	6.84718	2.37777	2.38286	2.25664
China/Hong Kong	5.82828	6.96043	5.46217	4.60672	4.78141
Canada	-0.43196	-0.0709	0.779773	-0.0306	-0.0374
Indonesia	0.953465	1.30837	1.43432	1.02863	0.877646
Japan	2.53439	-0.17977	-0.4019	-0.34674	-0.32858
Korea	14.0617	14.5736	16.3499	15.2215	13.1303
Malaysia	0.987032	3.01742	3.47505	3.03381	1.31947
Mexico	-0.243	-0.0444	1.13946	-0.0275	-0.0419
Philippines	3.05553	3.52636	3.14338	2.45163	2.59947
ROW	-0.19436	-0.0724	-0.0749	-0.0618	-0.0697
Thailand	-1.34447	-1.2861	-2.49456	-2.53592	-0.119
Taiwan/Singapore	10.9539	6.07891	12.3223	5.73574	4.65529
USA	0.315646	-0.0849	0.0790	-0.0490	-0.0529

Table 11 Changes of Income [IMC Model, GTAP Parameter, Cournot, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	10.622	10.8876	10.5448	10.4239	10.8101
China/Hong Kong	9.30647	9.20752	9.23246	9.34472	9.13227
Canada	0.542054	-1.37711	0.529442	0.508991	-1.37837
Indonesia	0.646982	0.604268	0.591209	0.395444	0.548593
Japan	2.79636	2.66742	2.75206	2.56054	2.62114
Korea	15.133	14.7489	14.889	13.5481	14.505
Malaysia	2.25921	2.23801	2.19762	0.717248	2.18182
Mexico	-1.22599	-1.1999	-1.14279	-1.2638	-0.936
Philippines	5.73075	5.69635	5.70819	5.87801	5.6700
ROW	-0.80206	-0.75337	-0.80703	-0.83138	-0.75762
Thailand	-5.12095	-5.13485	-5.18164	-2.50306	-5.18878
Taiwan/Singapore	15.4846	15.3943	15.4554	14.4033	15.3669
USA	0.370991	0.405099	0.284526	0.331727	0.310904
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	10.6149	17.36	5.74622	6.17023	5.821
China/Hong Kong	9.17121	12.5419	9.5494	8.74934	9.03124
Canada	-1.4036	-0.305	1.87141	-0.219	-0.239
Indonesia	0.295364	1.86499	1.08791	1.02651	0.769277
Japan	2.38629	-0.85396	-0.82119	-0.66597	-0.637
Korea	12.9014	15.2924	15.5236	15.595	13.3394
Malaysia	0.624632	3.51331	3.9	3.63244	1.5200
Mexico	-0.986	-0.313	3.05386	-0.269	-0.309
Philippines	5.82121	9.65264	6.28838	6.18466	6.66172
ROW	-0.787	-0.183	-0.268	-0.199	-0.231
Thailand	-2.43033	-2.39443	-4.73061	-4.13152	-0.170
Taiwan/Singapore	14.277	10.2559	16.4192	9.41615	7.61408
USA	0.272372	-0.408	0.0162	-0.315	-0.333

Table 12 Changes of Income [IMC Model, GTAP Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	10.5496	10.817	10.4725	10.3548	10.7396
China/Hong Kong	9.18027	9.0867	9.10746	9.22161	9.01255
Canada	0.438899	-1.40142	0.428078	0.406331	-1.40208
Indonesia	0.599181	0.556904	0.543439	0.34915	0.501241
Japan	2.69758	2.56776	2.65297	2.46415	2.52133
Korea	14.858	14.4796	14.6159	13.2834	14.2376
Malaysia	2.18827	2.16785	2.12675	0.655244	2.11167
Mexico	-1.29595	-1.26746	-1.15939	-1.33342	-0.952
Philippines	5.62726	5.59629	5.6058	5.7763	5.5700
ROW	-0.75495	-0.70959	-0.76198	-0.78608	-0.71584
Thailand	-5.20533	-5.21757	-5.26542	-2.51875	-5.27097
Taiwan/Singapore	15.3534	15.2655	15.3242	14.2823	15.2381
USA	0.258281	0.297009	0.174727	0.219797	0.20547

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	10.5477	17.3281	5.72631	6.19974	5.85552
China/Hong Kong	9.0547	12.4397	9.46605	8.69574	8.98218
Canada	-1.42736	-0.303	1.83636	-0.220	-0.241
Indonesia	0.249566	1.82807	1.06199	1.00818	0.752493
Japan	2.28888	-0.88495	-0.80518	-0.66117	-0.633
Korea	12.6444	15.1	15.3158	15.50	13.2
Malaysia	0.563496	3.46487	3.86255	3.61462	1.5100
Mexico	-1.0000	-0.310	3.02642	-0.273	-0.313
Philippines	5.72399	9.59013	6.23382	6.14978	6.6286
ROW	-0.74698	-0.176	-0.263	-0.200	-0.232
Thailand	-2.4500	-2.4600	-4.78083	-4.1700	-0.177
Taiwan/Singapore	14.1584	10.1934	16.3263	9.40288	7.60181
USA	0.167747	-0.404	-0.0202	-0.313	-0.332

Table 13 Changes of Prices [IMC Model, GTAP Parameter, Cournot, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	5.86329	6.0259	5.81294	5.74463	5.97524
China/Hong Kong	3.1200	3.13159	3.0800	3.1100	3.09
Canada	0.0522	-0.95923	0.0401	0.0290	-0.96446
Indonesia	-0.54076	-0.54825	-0.56793	-0.6466	-0.57536
Japan	-0.10119	-0.0424	-0.12838	-0.22379	-0.0709
Korea	-1.08271	-1.17872	-1.12989	-1.06408	-1.22618
Malaysia	-0.13881	-0.13048	-0.15751	-0.40254	-0.14832
Mexico	-0.71568	-0.69626	-0.84603	-0.74221	-0.71294
Philippines	2.5600	2.5700	2.54	2.65654	2.5519
ROW	-0.5822	-0.54865	-0.58883	-0.60833	-0.55478
Thailand	-2.9805	-2.96624	-3.00389	-1.14757	-2.97778
Taiwan/Singapore	3.32794	3.32061	3.30526	2.94483	3.29816
USA	-0.00416	0.0130	-0.0640	-0.0363	-0.0520
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	5.85835	9.83963	3.27349	3.70597	3.49472
China/Hong Kong	3.081	5.16466	3.8169	3.91802	4.02024
Canada	-0.98675	-0.23408	1.06737	-0.18915	-0.20269
Indonesia	-0.68178	0.525102	-0.35907	-0.0160	-0.12041
Japan	-0.19281	-0.69014	-0.41236	-0.31789	-0.30763
Korea	-1.21283	0.486538	-0.89962	0.236	0.125
Malaysia	-0.4148	0.437581	0.376898	0.563107	0.186485
Mexico	-0.75098	-0.26849	1.88248	-0.24307	-0.26881
Philippines	2.64751	5.92698	3.03618	3.65951	3.9917
ROW	-0.58087	-0.108	-0.19123	-0.13772	-0.16148
Thailand	-1.11522	-1.17724	-2.33718	-1.6700	-0.0587
Taiwan/Singapore	2.91213	3.89073	3.57316	3.46437	2.81175
USA	-0.0836	-0.32287	-0.0764	-0.26571	-0.28015

Table 14 Changes of Prices [IMC Model, GTAP Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	5.83193	5.99524	5.78155	5.71475	5.94455
China/Hong Kong	3.0800	3.09474	3.0400	3.0700	3.0600
Canada	-0.00151	-0.97246	-0.0126	-0.0244	-0.97734
Indonesia	-0.55736	-0.56477	-0.58459	-0.66268	-0.59197
Japan	-0.14769	-0.0895	-0.17505	-0.26933	-0.1181
Korea	-1.15025	-1.24498	-1.19717	-1.13156	-1.29221
Malaysia	-0.14673	-0.1384	-0.16548	-0.40907	-0.1563
Mexico	-0.75748	-0.73651	-0.85722	-0.78391	-0.72388
Philippines	2.5100	2.5300	2.4900	2.60746	2.50396
ROW	-0.55023	-0.5189	-0.55824	-0.57749	-0.52635
Thailand	-3.00609	-2.99148	-3.02942	-1.15031	-3.003
Taiwan/Singapore	3.28902	3.28236	3.26631	2.90856	3.25989
USA	-0.0728	-0.0530	-0.13092	-0.1046	-0.11636

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	5.82917	9.82737	3.26876	3.72589	3.51721
China/Hong Kong	3.04563	5.13646	3.79544	3.90847	4.01236
Canada	-0.99969	-0.23259	1.04836	-0.18993	-0.20343
Indonesia	-0.69785	0.512934	-0.36731	-0.0204	-0.12422
Japan	-0.23904	-0.70514	-0.40482	-0.31542	-0.3055
Korea	-1.27875	0.432258	-0.94744	0.206	0.0969
Malaysia	-0.42139	0.431674	0.372654	0.561751	0.186022
Mexico	-0.76216	-0.26568	1.86545	-0.24515	-0.2709
Philippines	2.60043	5.90109	3.01262	3.64754	3.98068
ROW	-0.55355	-0.103	-0.18815	-0.13796	-0.16203
Thailand	-1.1185	-1.19456	-2.35137	-1.6800	-0.0588
Taiwan/Singapore	2.87654	3.8755	3.54985	3.46528	2.81253
USA	-0.14761	-0.31918	-0.0991	-0.26456	-0.2791

Table 15 Percentage Changes of Number of RPR Firms

[IMC Model, GTAP Parameter, Cournot, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	-7.46371	-7.6529	-7.41925	-7.58895	-7.60875
China/Hong Kong	-3.66832	-3.8993	-3.62715	-3.63564	-3.85867
Canada	-8.3103	-8.17659	-8.24457	-8.87171	-8.11076
Indonesia	7.73532	7.96033	7.72998	7.60413	7.94839
Japan	-1.48124	1.85829	-1.51882	-1.56496	1.85005
Korea	-6.39995	-3.87069	-6.17353	-6.44752	-3.47313
Malaysia	1.42824	1.49626	1.48049	1.35684	1.5481
Mexico	19.3115	19.7162	19.1267	20.1892	19.5276
Philippines	1.5228	1.59856	1.51633	1.41028	1.59288
ROW	7.8881	8.187	7.94342	8.08009	8.23581
Thailand	-2.2145	-1.9748	-2.12145	-2.42588	-1.88211
Taiwan/Singapore	-26.149	-25.5485	-25.9272	-24.5793	-25.337
USA	0.577603	0.61402	0.636845	0.705954	0.663703

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	-7.73861	-12.9023	-1.3796	-1.23539	-1.2995
China/Hong Kong	-3.83499	-9.11724	11.4736	17.4202	17.1838
Canada	-8.67627	-12.5493	-7.12144	-7.31364	-8.30967
Indonesia	7.81057	2.10213	10.9561	11.4286	10.3984
Japan	1.82586	0.267275	0.181898	0.117225	0.0851
Korea	-3.42252	-0.61958	1.92269	-0.46436	-0.42983
Malaysia	1.4747	-2.68669	-0.50829	-1.17519	-1.32273
Mexico	20.4021	18.9386	24.6701	26.3781	26.1798
Philippines	1.4761	2.29254	0.444121	0.328443	0.296126
ROW	8.42139	2.56333	-1.20173	-0.92893	-0.72454
Thailand	-2.09672	-2.83922	-1.11373	-1.64678	-1.62453
Taiwan/Singapore	-23.7215	-29.0331	-22.5088	-23.5375	-21.6409
USA	0.782346	-3.31977	-1.38762	-2.06734	-1.92218

Table 16 Percentage Changes of Number of TME Firms

[IMC Model, GTAP Parameter, Cournot, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	3.6767	3.91054	3.8800	7.65267	4.08089
China/Hong Kong	-0.75045	-0.66464	0.801038	-0.8563	0.700012
Canada	3.97186	3.6500	-7.12081	3.9700	-5.9300
Indonesia	-2.69078	-2.75774	-2.70388	-3.91476	-2.77136
Japan	55.8728	54.9527	56.0795	50.7781	55.1222
Korea	0.289584	0.28326	0.289566	0.299561	0.283666
Malaysia	-0.55759	-0.49744	-0.47949	-0.45786	-0.42289
Mexico	-13.8366	-0.138	-13.6809	5.1700	-0.136
Philippines	35.1282	34.9845	35.3172	-2.43594	35.1348
ROW	-4.56957	-4.5200	-4.5600	-4.2200	-4.5100
Thailand	-6.86018	-6.46876	-6.74771	-6.37257	-6.3700
Taiwan/Singapore	-0.54868	-0.87065	-0.58629	-0.63629	-0.9016
USA	-9.1600	-9.8100	-9.0400	-9.1700	-9.7300

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	8.10214	-2.57847	3.50086	-0.77071	0.287075
China/Hong Kong	0.714323	0.172296	-1.83051	0.129047	0.138494
Canada	-5.88688	-0.0670	2.25191	0.204	0.251
Indonesia	-3.99827	-7.79629	-3.44375	-4.47136	-6.42673
Japan	50.0317	29.7844	43.5472	21.429	8.51267
Korea	0.292912	0.0929	0.134052	0.0297	0.0293
Malaysia	-0.32537	-0.95074	-0.60895	-0.55423	-0.48979
Mexico	5.0100	-17.6	-9.43693	-9.2900	0.531
Philippines	-2.25917	16.4474	21.4682	10.6952	-3.61105
ROW	-4.16167	-0.479	-4.2900	0.162	0.725
Thailand	-5.8700	-1.9200	-0.32886	5.8100	3.1300
Taiwan/Singapore	-0.99204	0.193704	0.302447	0.0855	0.0723
USA	-9.75206	-1.2100	-0.401	-0.678	-0.572

Table 17 Percentage Changes of Number of RPR Firms

[IMC Model, GTAP Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	-7.49132	-7.68439	-7.4478	-7.6212	-7.64115
China/Hong Kong	-3.75798	-3.99047	-3.71724	-3.73084	-3.95009
Canada	-8.36953	-8.23857	-8.30482	-8.93824	-8.17367
Indonesia	7.36004	7.57987	7.35369	7.22641	7.5674
Japan	-1.38569	1.8621	-1.42611	-1.47193	1.85225
Korea	-6.20843	-3.82752	-5.98288	-6.25789	-3.42849
Malaysia	1.56771	1.63159	1.61822	1.48961	1.68176
Mexico	19.5844	19.9878	19.3994	20.4634	19.7989
Philippines	1.60248	1.67806	1.59531	1.48417	1.67156
ROW	8.20173	8.50305	8.25779	8.38811	8.5523
Thailand	-2.28825	-2.04851	-2.19494	-2.49389	-1.95556
Taiwan/Singapore	-26.1911	-25.5916	-25.9687	-24.6111	-25.3793
USA	0.696655	0.729277	0.754516	0.815932	0.777649
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	-7.77571	-12.9701	-1.41785	-1.30671	-1.37703
China/Hong Kong	-3.93187	-9.25997	11.1951	16.9746	16.7231
Canada	-8.74652	-12.6516	-7.18551	-7.38597	-8.38972
Indonesia	7.42703	1.67397	10.5208	10.9598	9.92849
Japan	1.82677	0.281578	0.220871	0.132008	0.0986
Korea	-3.37808	-0.60314	1.99135	-0.45643	-0.422
Malaysia	1.60153	-2.5633	-0.38373	-1.06758	-1.22315
Mexico	20.6747	19.1964	24.8861	26.5503	26.35
Philippines	1.54891	2.34986	0.460614	0.348121	0.314827
ROW	8.7323	2.6621	-1.22117	-0.94278	-0.73762
Thailand	-2.16438	-2.89875	-1.17768	-1.70253	-1.67378
Taiwan/Singapore	-23.7531	-29.1039	-22.588	-23.6281	-21.7229
USA	0.887148	-3.21977	-1.28666	-1.98809	-1.85246

Table 18 Percentage Changes of Number of TME Firms

[IMC Model, GTAP Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	3.78892	4.01959	3.99219	7.75596	4.19041
China/Hong Kong	-0.67361	-0.591881	0.806922	-0.78208	0.703732
Canada	4.18854	3.8629	-7.0703	4.18679	-5.8778
Indonesia	-2.61453	-2.68383	-2.629	-3.84349	-2.69874
Japan	55.7447	54.8184	55.9516	50.6576	54.9885
Korea	0.281174	0.275567	0.281398	0.291046	0.276148
Malaysia	-0.58005	-0.517265	-0.49872	-0.47764	-0.43946
Mexico	-13.709	-13.6437	-13.5543	5.26795	-13.4922
Philippines	35.2507	35.1004	35.4392	-2.40058	35.2506
ROW	-4.59376	-4.5437	-4.58794	-4.24558	-4.53996
Thailand	-6.99285	-6.60477	-6.88044	-6.50026	-6.50442
Taiwan/Singapore	-0.46611	-0.79722	-0.50779	-0.55681	-0.83224
USA	-8.78724	-9.44516	-8.66814	-8.80287	-9.37486
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	8.20237	-2.48532	3.5477	-0.72107	0.320732
China/Hong Kong	0.717515	0.179088	-1.81117	0.138704	0.147623
Canada	-5.83273	-0.0575	2.32648	0.215312	0.263004
Indonesia	-3.9308	-7.7388	-3.36632	-4.39711	-6.36248
Japan	49.9057	29.6965	43.4164	21.3436	8.43157
Korea	0.285273	0.101215	0.142341	0.0406	0.0395
Malaysia	-0.33925	-0.94928	-0.60841	-0.55773	-0.49177
Mexico	5.10552	-17.5001	-9.31729	-9.18535	0.599072
Philippines	-2.22468	16.5287	21.5023	10.7267	-3.60318
ROW	-4.19358	-0.48514	-4.33442	0.137111	0.699784
Thailand	-6.00144	-2.02644	-0.48927	5.69341	3.02682
Taiwan/Singapore	-0.92581	0.203267	0.342111	0.0944	0.0803
USA	-9.39818	-1.19921	-0.27478	-0.67933	-0.57366

Table 19 Changes of Welfare [IMC Model, 59% Parameter, Cournot, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	3.9938	4.07993	3.97231	3.92193	4.05845
China/Hong Kong	5.0287	4.9245	4.99831	5.05153	4.89312
Canada	0.350274	-0.49384	0.348636	0.334991	-0.48809
Indonesia	1.34924	1.3204	1.32152	1.19604	1.29269
Japan	3.1891	3.01439	3.17581	3.08491	3.00032
Korea	15.1395	14.89	14.9605	13.6021	14.7115
Malaysia	2.06251	2.03423	2.02529	0.820514	2.00094
Mexico	-0.58445	-0.58085	-0.38304	-0.60468	-0.308
Philippines	2.91358	2.85723	2.91213	2.91475	2.85505
ROW	-0.270	-0.253	-0.26692	-0.27084	-0.250
Thailand	-2.38877	-2.4214	-2.43189	-1.60337	-2.46966
Taiwan/Singapore	10.5783	10.5088	10.5754	9.99281	10.5074
USA	0.29109	0.293921	0.263678	0.280214	0.26369
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	3.98746	6.2681	2.03851	2.01063	1.87185
China/Hong Kong	4.91555	5.96779	4.72372	3.83047	3.93933
Canada	-0.49416	-0.0966	0.827918	-0.0358	-0.0447
Indonesia	1.13793	1.34427	1.55392	1.14517	0.970471
Japan	2.89577	0.00788	-0.42149	-0.34637	-0.32517
Korea	13.1601	13.6559	15.4212	14.3281	12.3098
Malaysia	0.744224	2.58935	3.24544	2.79559	1.02285
Mexico	-0.323	-0.0562	1.13769	-0.0211	-0.0361
Philippines	2.85624	3.26004	2.98029	2.1899	2.22573
ROW	-0.25185	-0.102	-0.0845	-0.0682	-0.0761
Thailand	-1.56274	-1.64478	-2.90837	-3.26115	-0.261
Taiwan/Singapore	9.91592	5.53141	11.4126	5.35884	4.30098
USA	0.252896	-0.113	0.103	-0.0569	-0.0604

Table 20 Changes of Welfare [IMC Model, *59%* Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	3.94945	4.03737	3.92793	3.87991	4.01588
China/Hong Kong	4.9345	4.83525	4.9053	4.95965	4.80503
Canada	0.279449	-0.50419	0.278661	0.264453	-0.4983
Indonesia	1.30611	1.27723	1.2784	1.15414	1.24953
Japan	3.12322	2.94769	3.10973	3.021	2.93353
Korea	14.8983	14.6535	14.7211	13.3723	14.4767
Malaysia	1.97933	1.95178	1.94208	0.749601	1.91839
Mexico	-0.62737	-0.62251	-0.38621	-0.64713	-0.311
Philippines	2.84179	2.78813	2.8411	2.84477	2.78668
ROW	-0.243	-0.228	-0.241	-0.24506	-0.227
Thailand	-2.4742	-2.50512	-2.51656	-1.60277	-2.55258
Taiwan/Singapore	10.4864	10.419	10.4834	9.90974	10.4173
USA	0.234488	0.240228	0.208606	0.224157	0.211417
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	3.94727	6.25444	2.02101	2.0319	1.89663
China/Hong Kong	4.82994	5.88334	4.65724	3.7872	3.89966
Canada	-0.50453	-0.0937	0.805661	-0.0356	-0.0446
Indonesia	1.09605	1.30663	1.5283	1.1225	0.949317
Japan	2.83095	-0.0138	-0.40641	-0.34114	-0.32089
Korea	12.9366	13.5	15.2314	14.2	12.2
Malaysia	0.674053	2.52459	3.19835	2.76777	1.0061
Mexico	-0.327	-0.0530	1.1243	-0.0221	-0.0373
Philippines	2.78979	3.20859	2.93503	2.15415	2.19201
ROW	-0.22944	-0.0962	-0.0792	-0.0670	-0.0754
Thailand	-1.5600	-1.7200	-2.96538	-3.3000	-0.262
Taiwan/Singapore	9.83469	5.48057	11.3376	5.34857	4.29264
USA	0.201217	-0.109	0.0848	-0.0550	-0.0587

Table 21 Changes of Welfare with IMC Model [99% Parameter, Cournot, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	4.7741	4.86428	4.74947	4.70404	4.83981
China/Hong Kong	6.57324	6.46797	6.54115	6.63899	6.43516
Canada	0.721841	-0.23017	0.720614	0.716495	-0.23045
Indonesia	1.1651	1.12652	1.13721	1.02585	1.09883
Japan	2.40514	2.19367	2.38249	2.28027	2.17072
Korea	17.4349	17.139	17.2388	15.7536	16.943
Malaysia	2.89234	2.86251	2.84597	1.53546	2.82113
Mexico	-0.39428	-0.37855	-0.10395	-0.40116	-0.0374
Philippines	3.15863	3.12222	3.16055	3.25094	3.1200
ROW	-0.11447	-0.10062	-0.1146	-0.11916	-0.10047
Thailand	-2.30564	-2.32528	-2.34494	-1.09271	-2.36908
Taiwan/Singapore	12.5009	12.4065	12.4946	11.8378	12.4019
USA	0.550143	0.578771	0.523607	0.544539	0.550352

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.771	7.20459	2.63343	2.62068	2.5026
China/Hong Kong	6.50102	7.51939	5.87937	4.98267	5.18723
Canada	-0.23098	-0.0231	0.769106	-0.0114	-0.0162
Indonesia	0.958418	1.28935	1.37925	0.942405	0.802315
Japan	2.04618	-0.3013	-0.34006	-0.30812	-0.296
Korea	15.2436	15.8228	17.4248	16.1793	14.019
Malaysia	1.45134	3.50037	3.7747	3.30141	1.5600
Mexico	-0.0476	-0.0120	1.12273	-0.0195	-0.0320
Philippines	3.2169	3.64534	3.23381	2.61729	2.85883
ROW	-0.10519	-0.0193	-0.0452	-0.0383	-0.0451
Thailand	-1.04913	-1.15129	-2.01788	-1.71834	-0.0110
Taiwan/Singapore	11.7328	6.49761	12.7807	5.79199	4.77999
USA	0.545084	-0.0352	0.0987	-0.0280	-0.0327

Table 22 Changes of Welfare [IMC Model, 99% Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	4.73724	4.82854	4.71272	4.66862	4.8042
China/Hong Kong	6.48292	6.38042	6.45148	6.55034	6.34827
Canada	0.683115	-0.2415	0.682568	0.678044	-0.24144
Indonesia	1.13712	1.09903	1.10934	0.998675	1.07145
Japan	2.36736	2.16E+00	2.34449	2.24E+00	2.13E+00
Korea	17.2668	16.975	17.0723	15.5946	16.7805
Malaysia	2.83075	2.80191	2.78E+00	1.48E+00	2.76E+00
Mexico	-0.41817	-0.40154	-0.10986	-0.42481	-4.31E-02
Philippines	3.11417	3.07948	3.11661	3.20727	3.08154
ROW	-1.09E-01	-9.60E-02	-1.10E-01	-1.14E-01	-9.63E-02
Thailand	-2.36E+00	-2.3804	-2.40E+00	-1.11E+00	-2.42E+00
Taiwan/Singapore	12.419	12.3262	12.4128	11.7613	12.3217
USA	0.517632	0.548439	0.492221	0.512428	0.5211
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.73683	7.18659	2.61267	2.61748	2.50131
China/Hong Kong	6.41583	7.44373	5.81188	4.92809	5.1347
Canada	-0.24186	-2.49E-02	0.756514	-1.28E-02	-1.75E-02
Indonesia	0.931889	1.26831	1.36376	0.92984	0.790506
Japan	2.00884	-0.31425	-0.3354	-0.3069	-0.2955
Korea	15.09	15.6947	17.2999	16.0924	13.9439
Malaysia	1.39728	3.45786	3.74146	3.2803	1.54687
Mexico	-5.32E-02	-1.28E-02	1.11476	-2.10E-02	-3.35E-02
Philippines	3.17547	3.61235	3.20641	2.59478	2.83661
ROW	-0.10139	-1.97E-02	-4.56E-02	-3.93E-02	-4.62E-02
Thailand	-1.06803	-1.19705	-2.05079	-1.74386	-2.00E-02
Taiwan/Singapore	11.6581	6.45211	12.7196	5.76751	4.75926
USA	0.51625	-3.64E-02	8.77E-02	-2.86E-02	-3.33E-02

Table 23 Changes of Welfare [IMC Model, GTAP Parameter, Cournot, 25]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	4.63431	4.7197	4.61085	4.5581	4.69631
China/Hong Kong	6.32551	6.20679	6.28992	6.36944	6.17044
Canada	0.661265	-0.38115	0.658022	0.650424	-0.37811
Indonesia	1.30838	1.27185	1.27967	1.15958	1.24324
Japan	3.08253	2.89391	3.06646	2.96816	2.87688
Korea	17.0573	16.7683	16.8621	15.4163	16.5732
Malaysia	2.62565	2.59297	2.58284	1.32252	2.55484
Mexico	-0.41269	-0.4091	-0.28078	-0.4252	-0.206
Philippines	3.28701	3.23317	3.28537	3.33556	3.2300
ROW	-0.26593	-0.24669	-0.26189	-0.2669	-0.24253
Thailand	-1.9818	-2.01493	-2.02298	-1.31273	-2.06098
Taiwan/Singapore	12.0652	11.979	12.0615	11.4092	11.9768
USA	0.529494	0.53869	0.498751	0.520907	0.505651
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.62118	6.92265	2.45784	2.35767	2.22067
China/Hong Kong	6.21384	7.30096	5.76116	4.82905	4.98973
Canada	-0.38131	-0.0708	0.849626	-0.0284	-0.0350
Indonesia	1.0931	1.42037	1.51496	1.09286	0.937589
Japan	2.76256	-0.10603	-0.43817	-0.35732	-0.337
Korea	14.9169	15.2755	17.0542	15.6712	13.5218
Malaysia	1.23866	3.21473	3.62724	3.11441	1.3800
Mexico	-0.219	-0.0463	1.18266	-0.0220	-0.0361
Philippines	3.27975	3.69116	3.28464	2.56029	2.70445
ROW	-0.24364	-0.0806	-0.0828	-0.060	-0.0687
Thailand	-1.27151	-1.04974	-2.31565	-2.40117	-0.0867
Taiwan/Singapore	11.3147	6.29197	12.6229	5.81047	4.72447
USA	0.497229	-0.0886	0.141	-0.0523	-0.0556

Table 24 Changes of Welfare [IMC Model, GTAP Parameter, Bertrand, 25]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	4.483	4.57275	4.46E+00	4.41323	4.54963
China/Hong Kong	5.97516	5.86904	5.9425	6.02709	5.83547
Canada	0.47197	-0.427	0.471742	0.462	-0.423
Indonesia	1.18326	1.14813	1.15482	1.038	1.11974
Japan	2.88161	2.69221	2.86521	2.77214	2.67517
Korea	16.2676	15.994	16.0784	14.6637	15.8049
Malaysia	2.37981	2.3503	2.33735	1.10469	2.31233
Mexico	-0.523	-0.516	-0.30163	-0.535	-0.227
Philippines	3.08384	3.03698	3.08439	3.13629	3.03691
ROW	-0.21502	-0.200	-0.214	-0.219	-0.198
Thailand	-2.2294	-2.25708	-2.26841	-1.3756	-2.3000
Taiwan/Singapore	11.7271	11.6475	11.7234	11.096	11.6452
USA	0.358	0.375	0.332	0.351	0.346
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.48103	6.85903	2.39113	2.38037	2.25251
China/Hong Kong	5.88719	7.01514	5.5098	4.64374	4.81661
Canada	-0.42564	-0.0711	0.789926	-0.0302	-0.0369
Indonesia	0.973251	1.32548	1.44652	1.03894	0.887287
Japan	2.56573	-0.16923	-0.40707	-0.34825	-0.32977
Korea	14.1856	14.7	16.4542	15.3	13.2
Malaysia	1.02444	3.04956	3.49968	3.049	1.33012
Mexico	-0.239	-0.0450	1.14592	-0.0268	-0.0411
Philippines	3.08975	3.5534	3.16656	2.47022	2.61754
ROW	-0.20202	-0.0737	-0.0761	-0.0617	-0.0694
Thailand	-1.3300	-1.2500	-2.466	-2.5100	-11.3
Taiwan/Singapore	11.0084	6.11309	12.3704	5.7512	4.66853
USA	0.3396	-0.0855	0.0877	-0.0493	-0.0531

Table 25 Changes of Welfare [IMC Model, GTAP Parameter, Cournot, 50]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	4.54043	4.62864	4.51709	4.46819	4.60538
China/Hong Kong	6.10111	5.99013	6.06732	6.15023	5.95555
Canada	0.547833	-0.40849	0.546404	0.537675	-0.40481
Indonesia	1.23183	1.19614	1.20329	1.08519	1.16764
Japan	2.96141	2.77247	2.9452	2.85002	2.75548
Korea	16.5714	16.2921	16.38	14.9538	16.1008
Malaysia	2.47546	2.44476	2.43286	1.18955	2.40673
Mexico	-0.47984	-0.47407	-0.29294	-0.49167	-0.218
Philippines	3.16096	3.1115	3.16066	3.21199	3.1100
ROW	-0.23762	-0.22095	-0.23514	-0.24007	-0.2183
Thailand	-2.13693	-2.16655	-2.17672	-1.35452	-2.21128
Taiwan/Singapore	11.8558	11.7738	11.8521	11.215	11.7716
USA	0.426898	0.441268	0.399055	0.419411	0.410946

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.53432	6.88453	2.41281	2.36667	2.2352
China/Hong Kong	6.00433	7.11756	5.59767	4.70583	4.87421
Canada	-0.40791	-0.0712	0.814024	-0.0294	-0.0361
Indonesia	1.01972	1.36251	1.47323	1.05962	0.90652
Japan	2.64413	-0.14432	-0.42016	-0.35189	-0.333
Korea	14.4679	14.9	16.6868	15.4	13.3
Malaysia	1.10794	3.11179	3.54834	3.07154	1.3500
Mexico	-0.231	-0.0457	1.16105	-0.0247	-0.0390
Philippines	3.16198	3.60366	3.21007	2.50222	2.6483
ROW	-0.22087	-0.0767	-0.0790	-0.0617	-0.0690
Thailand	-1.3100	-1.1700	-2.41043	-2.4700	-0.105
Taiwan/Singapore	11.125	6.17942	12.466	5.7691	4.68594
USA	0.403643	-0.0870	0.109	-0.0506	-0.0542

Table 26 Changes of Welfare [IMC Model, GTAP Parameter, Bertrand, 50]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	4.4653	4.55563	4.44211	4.44211	4.53254
China/Hong Kong	5.93272	5.82813	5.90041	5.90041	5.79491
Canada	0.450664	-0.43103	0.450766	0.450766	-0.42685
Indonesia	1.16933	1.13435	1.14093	1.14093	1.10598
Japan	2.85999	2.67047	2.84355	2.84355	2.6534
Korea	16.177	15.9053	15.9885	15.9885	15.717
Malaysia	2.35064	2.32151	2.30822	2.30822	2.28357
Mexico	-0.53632	-0.52883	-0.30369	-0.30369	-0.229
Philippines	3.05915	3.01321	3.05994	3.05994	3.0100
ROW	-0.209	-0.194	-0.20768	-0.20768	-0.193
Thailand	-2.2598	-2.28675	-2.29851	-2.29851	-2.3304
Taiwan/Singapore	11.6866	11.6077	11.6828	11.6828	11.6054
USA	0.339896	0.358165	0.314329	0.314329	0.329956

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.46472	6.85109	2.38214	2.38205	2.25528
China/Hong Kong	5.84761	6.97834	5.47781	4.61889	4.79298
Canada	-0.42991	-0.0710	0.783117	-0.0305	-0.0372
Indonesia	0.95997	1.31402	1.43834	1.03204	0.880836
Japan	2.54461	-0.17633	-0.4036	-0.34723	-0.329
Korea	14.1023	14.6	16.3842	15.2	13.2
Malaysia	0.999358	3.02803	3.48319	3.03882	1.3200
Mexico	-0.242	-0.0446	1.14158	-0.0273	-0.0416
Philippines	3.06678	3.53524	3.15101	2.45778	2.60543
ROW	-0.19689	-0.0728	-0.0753	-0.0618	-0.0696
Thailand	-1.3400	-1.2700	-2.48516	-2.5300	-0.117
Taiwan/Singapore	10.9718	6.09016	12.3382	5.74083	4.65964
USA	0.32347	-0.0851	0.0818	-0.0491	-0.0529

Table 27 Changes of Welfare [IMC Model, GTAP Parameter, Cournot, 200]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	4.47107	4.56128	4.44786	4.40186	4.5382
China/Hong Kong	5.94275	5.83763	5.91032	5.99537	5.80437
Canada	0.459873	-0.42857	0.459822	0.45021	-0.42443
Indonesia	1.17472	1.13965	1.14631	1.02977	1.11129
Japan	2.86998	2.68054	2.85356	2.76098	2.66347
Korea	16.2095	15.9375	16.0209	14.6092	15.749
Malaysia	2.36082	2.33157	2.31839	1.08831	2.29364
Mexico	-0.53163	-0.52424	-0.3024	-0.54301	-0.228
Philippines	3.06662	3.02048	3.06735	3.11949	3.02057
ROW	-0.212	-0.197	-0.21082	-0.21573	-0.196
Thailand	-2.25148	-2.27857	-2.29025	-1.38095	-2.32227
Taiwan/Singapore	11.6992	11.6201	11.6956	11.0702	11.618
USA	0.348942	0.367023	0.323223	0.342196	0.338675
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.47019	6.85395	2.38272	2.3786	2.2514
China/Hong Kong	5.85679	6.98566	5.48336	4.62139	4.79502
Canada	-0.42749	-0.0710	0.786069	-0.0304	-0.0371
Indonesia	0.96512	1.31788	1.44117	1.03395	0.882588
Japan	2.55448	-0.17335	-0.40541	-0.34769	-0.32935
Korea	14.1332	14.6	16.4093	15.3	13.2
Malaysia	1.00842	3.03334	3.4876	3.0395	1.32324
Mexico	-0.240	-0.0447	1.14349	-0.0270	-0.0413
Philippines	3.07386	3.53894	3.15438	2.45959	2.60714
ROW	-0.19973	-0.0732	-0.0757	-0.0617	-0.0695
Thailand	-1.3400	-1.2700	-2.48061	-2.5300	-0.117
Taiwan/Singapore	10.9833	6.09563	12.3468	5.73999	4.65932
USA	0.332141	-0.0853	0.0844	-0.0493	-0.0531

Table 28 Changes of Welfare [IMC Model, GTAP Parameter, Bertrand, 200]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	4.45238	4.54313	4.42919	4.38396	4.52006
China/Hong Kong	5.90188	5.79834	5.86981	5.95535	5.76543
Canada	0.435056	-0.43418	0.435394	0.425516	-0.42991
Indonesia	1.15912	1.12424	1.13075	1.01465	1.09592
Japan	2.84441	2.65478	2.82792	2.73608	2.63766
Korea	16.1109	15.8407	15.9229	14.515	15.653
Malaysia	2.32919	2.30034	2.28681	1.06038	2.26243
Mexico	-0.54605	-0.53822	-0.30518	-0.55732	-0.230
Philippines	3.04108	2.99582	3.04209	3.09444	2.9962
ROW	-0.204	-0.190	-0.20329	-0.20819	-0.189
Thailand	-2.28206	-2.30848	-2.32054	-1.38727	-2.35192
Taiwan/Singapore	11.6568	11.5785	11.6531	11.0311	11.5763
USA	0.326927	0.345967	0.301764	0.320367	0.318141
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.45284	6.84519	2.38E+00	2.38328	2.25733
China/Hong Kong	5.81879	6.95152	5.45444	4.60073	4.77567
Canada	-0.43297	-0.0709	0.778115	-0.0307	-0.0374
Indonesia	0.950248	1.30556	1.43231	1.02694	0.876066
Japan	2.52936	-0.18145	-0.40106	-0.3465	-0.32839
Korea	14.0416	14.6	16.3329	15.2	13.1
Malaysia	0.980927	3.01214	3.47101	3.03132	1.31773
Mexico	-0.243	-0.0443	1.13839	-0.0277	-0.042
Philippines	3.04998	3.52194	3.13958	2.44858	2.59653
ROW	-0.1931	-0.0721	-0.0747	-0.0618	-0.0697
Thailand	-1.3500	-1.2900	-2.49922	-2.5400	-0.120
Taiwan/Singapore	10.945	6.07331	12.3144	5.73317	4.65309
USA	0.312	-0.0848	0.0775	-0.0490	-0.0528

Table 29 Changes of Output for SVC [GTAP Model, GTAP Parameter]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	-0.33686	-0.373581	-0.329	-0.36119	-0.38183
China/Hong Kong	2.74206	3.55505	2.73512	2.79639	3.62995
Canada	16.2521	16.0	15.8183	16.9	16.0
Indonesia	-4.06855	-4.12704	-3.86368	-4.32542	-4.09312
Japan	-19.1936	-19.2751	-18.973	-19.4688	-19.2847
Korea	0.233569	0.214023	0.240664	0.182538	0.208123
Malaysia	-0.74569	-0.844963	-0.72551	-0.89626	-0.86944
Mexico	2.68883	2.8600	2.61183	3.2500	2.9100
Philippines	-5.1262	-5.5466	-5.14682	-5.40556	-5.59394
ROW	-2.71373	-2.6700	-2.6200	-3.3200	-2.6600
Thailand	4.61753	4.98571	4.75687	4.29128	4.9200
Taiwan/Singapore	0.510555	0.467829	0.526061	0.399006	0.454932
USA	0.0163	0.647	0.00523	-0.0102	0.619
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	-0.40562	-0.863	-0.18334	-0.294	-0.287
China/Hong Kong	3.69078	20.295	-0.344	1.5300	1.57868
Canada	16.6253	9.8200	1.64769	-1.1800	-0.616
Indonesia	-4.35816	-7.82266	3.2000	2.75467	2.54942
Japan	-19.5669	-21.1095	-5.9800	-0.853	-1.6600
Korea	0.158237	0.130	0.110	0.0841	0.0610
Malaysia	-1.01736	-2.5700	-1.05371	-1.4900	-1.64905
Mexico	3.4600	9.2600	1.9300	3.0100	3.8300
Philippines	-5.86793	-12.3569	-3.76656	-6.58494	-7.0700
ROW	-3.27425	-6.3900	-2.5800	-2.7200	-3.5700
Thailand	4.5900	9.53E-01	7.22482	9.4500	8.6200
Taiwan/Singapore	0.345887	0.283137	0.240	0.183826	0.133418
USA	0.589732	0.192	0.171	0.137	0.118

Table 30 Changes of Output for AGR [GTAP Model, GTAP Parameter]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	19.5364	-1.1456	19.7681	19.729	-0.81265
China/Hong Kong	-6.01974	-2.07647	-5.99794	-5.7623	-2.146
Canada	2.36976	3.63556	2.2769	2.30297	3.55603
Indonesia	-4.18768	-6.11586	-4.08203	-4.36205	-5.84099
Japan	0.343389	0.314652	0.333639	0.268363	0.305978
Korea	0.789275	0.742453	0.768332	0.747767	0.722011
Malaysia	-5.69663	-5.61488	-5.57535	-5.67133	-5.49007
Mexico	0.715796	0.539262	0.606487	1.15251	0.42845
Philippines	-1.13454	-1.11318	-1.14955	-1.27605	-1.1299
ROW	49.6055	50.37	49.4309	49.8035	50.1689
Thailand	0.621038	0.569067	0.603406	0.48535	0.553378
Taiwan/Singapore	0.618868	0.545874	0.611423	0.601461	0.539131
USA	-41.3389	-39.0085	-41.3293	-41.2724	-39.0061
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	-0.70766	-1.696	-1.49283	-0.48239	-0.44185
China/Hong Kong	-1.93738	-1.62481	-3.90972	-1.15796	-1.08986
Canada	3.53511	0.348507	1.36896	0.351149	0.334115
Indonesia	-5.92299	1.16731	3.44546	0.351426	0.409748
Japan	0.232637	0.190432	0.161114	0.123638	0.0897
Korea	0.682024	0.0615	0.662626	0.300782	0.289106
Malaysia	-5.46489	-1.29416	-4.23559	-2.42532	-2.40291
Mexico	0.867537	-4.21383	2.06392	-2.90743	-2.5178
Philippines	-1.27515	-2.20526	-3.85239	-3.19862	-3.26063
ROW	50.3584	50.6803	57.2288	61.084	60.0743
Thailand	0.420737	0.344408	0.291384	0.223606	0.162289
Taiwan/Singapore	0.52197	0.120037	0.206785	0.124613	0.100321
USA	-38.9199	-12.0868	-0.10402	-0.18545	-0.27577

Table 31 Changes of Output for LMN [GTAP Model, GTAP Parameter]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	1.7496	1.33021	1.7775	1.89983	1.33427
China/Hong Kong	1.52408	1.5252	1.47712	1.44844	1.51891
Canada	5.34324	5.44091	5.31115	5.38637	5.47915
Indonesia	0.461691	0.423054	0.475712	0.360818	0.411391
Japan	0.260927	0.22566	0.403673	0.240873	0.217234
Korea	-38.5787	-38.2208	-39.4608	-38.1008	-38.081
Malaysia	69.3196	68.5623	69.8226	67.3997	68.2676
Mexico	0.705719	0.854787	0.541806	0.571859	0.912488
Philippines	-19.6915	-19.3075	-20.1583	-18.1943	-19.1919
ROW	0.603919	0.55338	0.622261	0.471972	0.538124
Thailand	0.736246	0.662173	0.719643	0.897164	0.636546
Taiwan/Singapore	-10.3279	-10.2453	-10.2236	-10.476	-10.1876
USA	2.76923	2.68795	2.41627	1.08016	2.59143

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	1.48202	0.0754	-1.09901	-0.780	-0.737
China/Hong Kong	1.43843	1.57308	0.386	0.284	0.275783
Canada	5.52051	1.70013	-0.73181	-0.37148	-0.23044
Indonesia	0.312783	0.256039	0.217	0.166232	0.120649
Japan	0.200562	-0.26173	-0.0305	0.0155	0.0448
Korea	-37.6266	-28.1	-35.7	-32.0	-31.3
Malaysia	66.3554	60.792	67.0416	60.627	58.308
Mexico	0.764022	0.70737	0.266	1.0300	0.82348
Philippines	-17.6884	-18.4872	-17.8247	-16.8872	-15.4628
ROW	0.409139	0.334914	0.283352	0.2.7	0.157816
Thailand	0.80042	-0.49647	-0.2227	-0.73114	-0.45946
Taiwan/Singapore	-10.3254	-2.2811	-5.7500	-2.16677	-1.43402
USA	0.877731	1.59728	1.94439	1.14604	-0.38595

Table 32 Changes of Output for RPR [GTAP Model, GTAP Parameter]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	5.3714	5.36921	5.41352	4.63021	5.39554
China/Hong Kong	3.20963	3.47029	3.33731	5.09765	3.53087
Canada	0.554151	0.507777	0.570982	0.433077	0.493778
Indonesia	-0.29299	-0.350149	0.562569	-0.31583	0.479939
Japan	3.74107	4.0284	0.738075	3.84729	0.813606
Korea	-1.344	-1.32976	-1.10391	-1.19546	-1.08896
Malaysia	0.412845	0.470897	1.86819	0.311538	1.70578
Mexico	-2.04835	-2.13235	-10.0413	-2.11253	-8.86107
Philippines	0.368094	0.33729	0.379275	0.287671	0.327992
ROW	-0.38595	-0.479465	-0.38979	-0.47959	-0.52063
Thailand	0.940556	1.25329	0.823698	1.86163	1.33883
Taiwan/Singapore	-7.09504	-7.26292	-6.96556	-7.4332	-7.26901
USA	5.26142	5.24887	5.35173	4.29928	5.24183
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	4.62902	0.652	1.433	0.435	-0.283
China/Hong Kong	5.4455	3.62587	6.5200	5.1200	4.98211
Canada	0.375423	0.307314	0.260002	0.199523	0.14481
Indonesia	0.453309	0.166792	-0.139	0.121083	0.10518
Japan	0.859059	-0.52385	2.3400	-0.314	-0.307
Korea	-1.01508	-0.546	-0.512	-0.475	-0.455
Malaysia	1.75	-0.0454	-1.80108	0.0879	0.107543
Mexico	-8.91658	0.501207	2.2400	0.129	0.212012
Philippines	0.249374	0.204133	0.172706	0.132533	0.0962
ROW	-0.61196	-1.72398	-1.12921	-1.1400	-1.171
Thailand	2.25463	8.17759	2.08082	4.76015	6.2377
Taiwan/Singapore	-7.60336	-13.8943	-5.9000	-9.34032	-9.80557
USA	4.26831	3.34537	4.11491	4.79195	3.46195

Table 33 Changes of Output for TME [GTAP Model, GTAP Parameter]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	36.5368	36.519	36.9808	3.26E+01	36.656
China/Hong Kong	0.37954	0.347778	0.391068	0.296616	0.33819
Canada	0.372519	0.348127	0.35852	0.345713	0.332675
Indonesia	-1.30285	-1.31216	-1.30022	-1.29137	-1.26808
Japan	-1.64154	-1.59313	-1.64085	-1.58908	-1.57536
Korea	0.0970	0.140428	0.0886	0.137593	0.130282
Malaysia	-0.24831	-0.15672	-0.12385	-0.15436	-0.0712
Mexico	0.311779	0.285688	0.321249	0.24366	0.277812
Philippines	-1.26299	-1.31871	-1.21846	1.33951	-1.34468
ROW	-4.85256	-4.43295	-5.03753	-5.45988	-4.18837
Thailand	2.28434	2.10086	2.20918	-2.63816	1.99375
Taiwan/Singapore	-5.90118	-5.89821	-5.7675	5.79241	-5.8515
USA	30.5	30.545	30.5	-0.681	30.4384
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	32.7	35.7	37.0334	27.4	16.5
China/Hong Kong	0.257128	0.210481	0.178	0.137	0.0992
Canada	0.306406	0.164522	0.217797	0.121401	0.102463
Indonesia	-1.25398	-0.44442	-0.691	-0.33222	-0.30611
Japan	-1.52263	-0.75084	-1.0400	-0.620	-0.569
Korea	0.16921	0.0866	0.207	0.135	0.138
Malaysia	0.0181	-0.247	-0.31592	-0.202	-0.12991
Mexico	0.211222	0.172903	0.146	0.112	0.0815
Philippines	1.24522	-2.26933	-1.60787	-1.78782	0.322
ROW	-5.14848	8.3065	-0.87621	4.8800	-0.46645
Thailand	-2.51173	-3.08537	1.28748	-1.83053	-1.4700
Taiwan/Singapore	5.5856	-7.66869	-4.3200	-3.41751	1.55722
USA	-0.55259	24.9735	23.8628	18.2267	0.0188

Table 34 Changes of Output for SVC [IMC Model, GTAP Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	-3.08854	-3.15319	-3.0900	-3.1000	-3.15499
China/Hong Kong	6.69113	8.0903	6.69931	6.52541	8.09745
Canada	24.6078	24.4	24.5493	25.1	24.3
Indonesia	8.15101	7.88411	8.18839	7.92583	7.92124
Japan	16.5371	16.2324	16.5722	16.5215	16.2678
Korea	0.270	0.257242	0.251	0.185505	0.239457
Malaysia	-1.3265	-1.41033	-1.34211	-1.53039	-1.4300
Mexico	-0.48495	-0.285	-0.443	0.182	-0.242
Philippines	-4.59948	-5.09035	-4.71299	-5.09531	-5.20333
ROW	13.0414	13.1	13.1	12.4	13.1
Thailand	41.1251	41.2182	41.0729	41.0027	41.2
Taiwan/Singapore	0.270155	0.257242	0.251281	0.185505	0.239457
USA	-0.369	0.453	-0.375	-0.387	0.437
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	-3.1700	-4.5800	-2.67792	-2.9200	-2.9200
China/Hong Kong	7.95016	40.0834	-0.856	1.1200	0.865
Canada	24.8332	19.5	11.9445	9.7800	10.2
Indonesia	7.69135	2.07422	13.7	12.9759	12.7917
Japan	16.2422	10.405	32.1	37.7	37.3
Korea	0.155263	-0.275	0.0761	-0.0750	-0.177
Malaysia	-1.6300	-3.8800	-1.66482	-2.3900	-2.74263
Mexico	0.431	8.4200	-2.0000	0.404	1.8200
Philippines	-5.70782	-12.7558	-2.17304	-6.09343	-7.1600
ROW	12.452	8.0400	13.7	12.7	11.6
Thailand	41.0	34.7	43.4129	43.0	41.8
Taiwan/Singapore	0.155263	-0.27533	0.0761	-0.0750	-0.17665
USA	0.41707	0.0581	0.00340	0.0629	0.0433

Table 35 Changes of Output for AGR [IMC Model, GTAP Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	45.4249	0.846709	45.3	45.5726	0.766894
China/Hong Kong	-10.5355	-1.50551	-10.5421	-10.3744	-1.64948
Canada	0.862635	1.5200	0.807221	0.770	1.5100
Indonesia	-2.44688	-4.23072	-2.27793	-2.50086	-3.83234
Japan	0.270155	0.257242	0.251281	0.185505	0.239457
Korea	0.915126	0.887169	0.898189	0.904711	0.870591
Malaysia	-7.63292	-7.56813	-7.54496	-7.73021	-7.48131
Mexico	2.87157	2.6600	2.69568	3.2500	2.4800
Philippines	3.32543	3.36562	3.36378	3.18899	3.40359
ROW	27.7738	28.1	27.5	28.5	27.9
Thailand	0.270155	0.257242	0.251281	0.185505	2.39E-01
Taiwan/Singapore	1.07155	1.0192	1.06531	1.05208	1.01355
USA	-71.7	-69.3	-71.7	-71.7	-69.2

	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	0.787741	2.66794	2.34148	2.7341	2.80035
China/Hong Kong	-1.55872	-1.05557	-2.84189	-1.1029	-1.00931
Canada	1.49433	0.241	0.702079	0.120	0.0901
Indonesia	-3.77475	-0.59612	2.72249	-0.44867	-0.41182
Japan	0.155263	-0.27533	0.0761	-0.0750	-0.177
Korea	0.860074	-0.451	0.698002	-0.0792	-0.108
Malaysia	-7.57422	2.90739	-6.05965	0.400	0.56538
Mexico	2.8600	-7.4700	3.94372	-6.9300	-6.7100
Philippines	3.26482	-0.83091	1.01292	0.159	-0.0427
ROW	28.5666	27.4	30.7	30.9	30.5
Thailand	0.155	-0.275	0.0761	-0.0750	-0.177
Taiwan/Singapore	0.994244	0.421033	0.314077	0.206665	0.168201
USA	-69.1977	-19.4	1.8400	1.9300	1.7800

Table 36 Changes of Output for LMN [IMC Model, GTAP Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	6.68999	5.47986	6.6500	6.74034	5.45258
China/Hong Kong	4.16506	4.10649	4.15105	3.99067	4.09227
Canada	10.2292	10.4	10.2841	10.4	10.5
Indonesia	0.270155	0.257242	0.251281	0.185505	0.239457
Japan	3.6338	3.62654	3.62144	3.42541	3.61432
Korea	-86.4097	-86.1432	-86.0426	-82.7839	-85.7759
Malaysia	135.54	134.205	134.664	129.706	133.344
Mexico	20.6427	20.5	20.5747	19.4	20.4
Philippines	-10.4939	-10.0201	-10.3179	-9.09315	-9.85745
ROW	0.270155	0.257	0.251	0.186	0.239
Thailand	1.13274	1.08728	1.12824	1.51434	1.0800
Taiwan/Singapore	-10.5162	-10.458	-10.5633	-11.2264	-10.4965
USA	-1.9000	-2.0800	-2.1500	-6.5800	-2.2900
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	5.51239	-1.79239	-2.02561	-1.43097	-1.3421
China/Hong Kong	3.913	2.49114	0.127518	0.0546	0.0594
Canada	10.6192	2.9000	-1.39869	-1.1000	-0.875
Indonesia	0.155263	-0.27533	0.0761	-0.0750	-0.177
Japan	3.40424	2.17171	3.33558	2.34246	2.18677
Korea	-82.1123	-67.6	-85.3	-69.9	-64.9
Malaysia	127.43	121.308	131.383	117.031	108.154
Mexico	19.1	18.1	19.3508	17.0	15.4
Philippines	-8.428	-14.8004	-8.7773	-11.7241	-10.4638
ROW	0.155263	-0.275	0.0761	-0.0750	-0.177
Thailand	1.4600	-0.987	-0.0986	-0.965	-0.608
Taiwan/Singapore	-11.1908	2.20385	-4.46939	1.2465	2.72111
USA	-7.041	-0.0660	-1.6900	-0.401	-5.1100

Table 37 Changes of Output for RPR [IMC Model, GTAP Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	6.25714	6.26476	6.3200	5.47127	6.31726
China/Hong Kong	15.2081	15.4153	15.428	18.1983	15.6019
Canada	0.270155	0.257	0.251281	0.186	0.239
Indonesia	-0.36802	-0.38745	0.509902	-0.38934	0.461173
Japan	2.67324	2.91854	0.507001	2.72673	0.378784
Korea	-3.58833	-3.59664	-0.56799	-3.41913	-0.65686
Malaysia	1.18949	1.22219	0.503378	1.07778	0.452635
Mexico	7.64332	7.2300	-7.41584	7.6400	-6.1600
Philippines	0.270155	0.257242	0.251281	0.185505	0.239457
ROW	-1.67357	-1.7200	-1.6900	-1.8400	-1.7300
Thailand	7.46678	7.87705	7.53109	8.9937	7.9400
Taiwan/Singapore	-15.8328	-16.1374	-15.9224	-16.6055	-16.2206
USA	13.7	13.4	13.7	12.5	13.3
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	5.51104	1.62107	3.12137	1.9300	0.948647
China/Hong Kong	18.6256	8.12231	13.3243	7.16325	6.46991
Canada	0.155263	-0.275	0.0761	-0.0750	-0.177
Indonesia	0.438045	0.0896	-0.4425	0.104	0.0822
Japan	0.411471	-0.13957	2.99185	-0.16793	-0.1389
Korea	-0.60175	-0.460	-0.36161	-0.584	-0.527
Malaysia	0.466306	0.15132	-1.01898	0.119381	0.125126
Mexico	-6.1100	-0.0739	3.51424	0.196	0.238
Philippines	0.155263	-0.27533	0.0761	-0.0750	-0.17665
ROW	-1.89913	-3.8400	-2.0700	-2.7000	-3.0200
Thailand	9.4700	22.20	8.49137	16.2	19.2
Taiwan/Singapore	-16.9968	-26.8726	-13.4702	-20.0036	-21.4509
USA	12.111	9.1800	10.7	8.0400	6.4000

Table 38 Changes of Output for TME [IMC Model,

GTAP Parameter, Bertrand, 100]

	APEC	APEC-Canada	APEC-Mexico	APEC-Thailand	APEC-CM
Astralia/NZealand	93.6858	92.1304	93.9	87.6	92.347
China/Hong Kong	0.270155	0.257242	0.251281	0.185505	0.239457
Canada	0.352864	0.343	0.343914	0.329	0.334
Indonesia	-0.69615	-0.70757	-0.70514	-0.70452	-0.71586
Japan	-1.72378	-1.69977	-1.72839	-1.65559	-1.70372
Korea	0.168	0.169604	0.170	0.183193	0.171974
Malaysia	-0.71201	-0.64052	-0.62515	-0.60381	-0.557
Mexico	0.270155	0.257	0.251	0.186	0.239
Philippines	-1.08645	-1.12909	-1.10217	1.63566	-1.14764
ROW	1.947	2.4600	2.2300	-3.5600	2.7400
Thailand	-8.04237	-8.27427	-8.34665	-3.82842	-8.5500
Taiwan/Singapore	-3.37086	-3.37829	-3.26216	3.75084	-3.28155
USA	63.4	63.1	63.5	-4.17	63.1
	APEC-CMT	AF-11+Japan	AF-11+USA	AF-11	AF-11-Thailand
Astralia/NZealand	86.3	63.8	70.6169	39.9	25.8
China/Hong Kong	0.155263	-0.27533	0.0761	-0.0750	-0.177
Canada	0.310301	0.159	0.221	0.148	0.123
Indonesia	-0.72224	0.325	-0.0354	0.208	0.233
Japan	-1.63472	-0.60556	-1.1200	-0.716	-0.619
Korea	0.186456	0.0332	0.0660	-0.00705	-0.00394
Malaysia	-0.451	-0.989	-0.66742	-0.594	-0.52382
Mexico	0.155	-0.275	0.0761	-0.0750	-0.177
Philippines	1.5762	-3.01989	-1.4200	-2.0500	0.510
ROW	-3.4171	29.4	7.7100	22.8	2.0400
Thailand	-3.7400	-16.9	-7.78639	-14.5	-2.6400
Taiwan/Singapore	3.64185	-7.42195	-1.1100	-2.0800	0.384446
USA	-3.9278	41.9	38.5	23.8	-3.6500

APPENDIX

! This is written for the model under the Cournot conjecture only !

! This appendix contains a part of the program used for the study in this paper !

! The non-linear equations in this dissertation were linearized, and

! linearized eqautions are written in this appendix !

! Some statements, such as "UPDATED" and "READ" are omitted !

! Quantities are specified, according to the order of index !

! after variables and coefficients !

! Variables and Coefficients are reogranized for readers to understand easily !

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FILE DSET # File with set specification #;

FILE DATA # The file containing all base data for the economy. # ;

FILE (TEXT)  PARM # The parameter file # ;

SET REG # Regions in the model #

    MAXIMUM SIZE 13 READ ELEMENTS FROM FILE DSET HEADER "REG";

SET NSAV_COMM # NON-SAVINGS COMMODITIES #

    MAXIMUM SIZE 10 READ ELEMENTS FROM FILE DSET HEADER "NSAV";

SET PROD_COMM # PRODUCED COMMODITIES #

    MAXIMUM SIZE 8 READ ELEMENTS FROM FILE DSET HEADER "PROD";

SET PCM_COMM # PERFECTLY COMPETITIVE COMMODITIES #
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    MAXIMUM SIZE 5 READ ELEMENTS FROM FILE  DSET HEADER "PCMP";
SET NIMC_TRAD # TRAD_COMM - IMC_COMM #
    MAXIMUM SIZE 4 READ ELEMENTS FROM FILE  DSET HEADER "NIMP";
SET TRAD_COMM # TRADED COMMODITIES #
    MAXIMUM SIZE 7 READ ELEMENTS FROM FILE  DSET HEADER "TRAD";
SET IMC_COMM # IMPERFECTLY COMPETITIVE COMMODITIES #
    MAXIMUM SIZE 4 READ ELEMENTS FROM FILE  DSET HEADER "IMPC";
SET ENDW_COMM # ENDOWMENT COMMODITIES #
    MAXIMUM SIZE 2 READ ELEMENTS FROM FILE  DSET HEADER "ENDW";
SET DEMD_COMM # DEMANDED COMMODITIES #
    MAXIMUM SIZE 9 READ ELEMENTS FROM FILE DSET HEADER "DEMD";
SET CGDS_COMM # CAPITAL GOODS COMMODITIES #
    MAXIMUM SIZE 1 READ ELEMENTS FROM FILE  DSET HEADER "CGDS";
SUBSET DEMD_COMM IS SUBSET OF NSAV_COMM ;
SUBSET PROD_COMM IS SUBSET OF NSAV_COMM ;
SUBSET PCM_COMM IS SUBSET OF PROD_COMM ;
SUBSET IMC_COMM IS SUBSET OF PROD_COMM ;
SUBSET TRAD_COMM IS SUBSET OF DEMD_COMM ;
SUBSET TRAD_COMM IS SUBSET OF PROD_COMM ;
SUBSET IMC_COMM IS SUBSET OF TRAD_COMM ;
SUBSET NIMC_TRAD IS SUBSET OF TRAD_COMM ;
SUBSET ENDW_COMM IS SUBSET OF DEMD_COMM ;
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SUBSET CGDS_COMM IS SUBSET OF NSAV_COMM ;

! Define Variables !

qvap (i,r : PCM_COMM, REG) : value-added in PCM_COMM industry i of region r

vqva (i,r :IMC_COMM, REG) : variable value-added in sector i of region r

fqva (i,r : IMC_COMM, REG) : fixed value-added in sector i of region r

qxs (i,r,s : TRAD_COMM, REG, REG) : exports of commodity i from r to region s

qfep (i,j,r : ENDW_COMM, PCM_COMM, REG) : IMC firm's demand for dowment i for use in j in region r

qfem (i,j,r : ENDW_COMM, IMC_COMM, REG) : PCM firm's demand for endowment i for use in j in region r

qf (i,j,r : TRAD_COMM, PROD_COMM, REG) : demand for traded composit commodity i for use in j in region r

qfsp (i,j,r,s : IMC_TRAD, PROD_COMM, REG, REG) : PCM firm's demand for commodity i from r for use in j in region s

qfsm (i,j,r,s : IMC_COMM, PROD_COMM, REG, REG) : IMC firm's demand for commodity i from r for use in j in region s

qc (i,r, : TRAD_COMM, REG) : household demand for composite commodity i in region r

qcsp (i,r,s : NIMC_TRAD, REG, REG) : hhld demand for NIMC_COMM commodity i from r in region s qcsm (i,r,s : IMC_COMM, REG, REG) : hhld demand for IMC_COMM commodity i

from r in region s

globalcgds : global supply of capital goods

qsave (r, : REG) : region r's demand for save :

walras_dem : demand in the ommitted market--global demand for save

walas_sup : supply in the omitted market --global supply of cgds composite

mkr (i,r, : IMC_COMM, REG) : markup in industry i of region r

ela (i,r : IMC_COMM, REG) : total perceived d. elast. facing producers of i in r

elas (i,r,s : IMC_COMM, REG, REG) : perceived d. el. facing sales of IMC_COMM i

from r into s

avc (i,r : IMC_COMM, REG) : average variable cost in the production of i in r

atc (i,r : IMC_COMM, REG) : average total cost for i in r

pvap (i,r : PCM_COMM, REG) : price of value-added in PCM_COMM industry i of

region r

pvam (i,r : IMC_COMM, REG) : price of value-added in IMC_COMM industry i of

region r

ps (i,r : NSAV_COMM, REG) : supply price of commodity i in region r

pm (i,r, : TRAD_COMM, REG) : market price for traded commodity i in region r

pfe (i,j,r : ENDW_COMM, PROD_COMM, REG) : demand price for endowment

commodity i in j of region r

pf (i,j,r : TRAD_COMM, PROD_COMM, REG) : composite price for traded comm i for

use in j in region r # ;

pfs (i,j,r,s : TRAD_COMM, PROD_COMM, REG, REG) : agents' price of commodity i from r for use in j in region s

pc (i,r : TRAD_COMM, REG) : household price for traded commodity i in region r

pcs (i,r,s : TRAD_COMM, REG, REG) : agents' price for commodity i from r in region s

pme (i,r : ENDW_COMM, REG) : domestic price for primary factor i in region r

pms (i,r,s : TRAD_COMM, REG, REG) : domestic price for good i supplied from r to region s

pw (i,r,s : TRAD_COMM, REG, REG) : world price of commodity i supplied from r to s

pcgds : price of capital goods supplied to savers

walaslack : slack variable associated with walras law -- normally endogenous

EV (r : REG) : Equivalent Variation

! This variable reduces the accuracies of solutions. Unless the calculation of EV(r) is necessary, this variable and relevant equation were removed from the file !

to (i,r : ENDW_COMM, REG) : income tax on endowment commodity i in region r

tf (i,j,r : ENDW_COMM, PROD_COMM, REG) : tax on primary factor i used by j in region r

tcs (i,r,s : TRAD_COMM, REG, REG) : tax on i purchased by hhlds in r from s

tfs (i,j,r,s : TRAD_COMM, PROD_COMM, REG, REG) : tax on i purchased by j in r from s

txs (i,r,s : TRAD_COMM, REG, REG) : combined tax in r on good i bound for region s

tms (i,r,s : TRAD_COMM, REG, REG) : import tax in s on good i imported from region r u (r : REG) : aggregate utility of household in region r y (r : REG) : household income in region r

gp (r : REG) : general price index for region r

qo (i,r : NSAV_COMM, REG) : industry output of commodity i in region r

n (i,r : IMC_COMM, REG) : number of firms active in sector i of region r

! Define Coefficients !

VOA (i,r : NSAV_COMM, REG) : value of commodity i output in region r

VXA (i,r,s : TRAD_COMM, REG, REG) : value of exports of commodity i from region r to s

VFA (i,j,r : DEMD_COMM, PROD_COMM, REG) : producer expenditure on i by industry j, region r valued at agent's prices

VCA (i,r : TRAD_COMM, REG) : household expenditure on commodity i in region r valued at agent's prices

VFAS (i,j,r,s : TRAD_COMM, PROD_COMM, REG, REG) : purchases of commodity i from r for use in j in region s

VCAS (i,r,s : TRAD_COMM, REG, REG) : household expenditure on i from r in s

VOM (i,r : ENDW_COMM, REG) : value at market prices of commodity i in region r

VFM (i,j,r : ENDW_COMM, PROD_COMM, REG) : producer expenditure on i in industry j, region r valued at domestic market prices

VFMS (i,j,r,s : TRAD_COMM, PROD_COMM, REG, REG) : purchases of commodity i from r for use in j in region s

VCMS (i,r,s : TRAD_COMM, REG., REG) : household expenditure on i from r in s

VIWS (i,r,s : TRAD_COMM, REG, REG) : imports of commodity i from region r to s valued cif (tradeables only)

SAVE (r: REG) : regional savings

INCOME(r : REG) : level of income in region r

INCOME(r) = sum(i,TRAD_COMM, VCA(i,r)) + SAVE(r)

VIMS (i,r,s : TRAD_COMM, REG, REG) : value of imports of commodity i from r in s at domestic market prices

VIMS(i,r,s) = sum(j,PROD_COMM, VFMS(i,j,r,s)) + VCMS(i,r,s)

VCGDS : value of world capital goods

VCGDS = sum(r,REG, sum(k,CGDS_COMM, VOA(k,r)))

VSAVE : The value of global savings

VSAVE = sum(r,REG, SAVE(r))

SALSHR (i,r,s : IMC_COMM, REG, REG) : The share of sales, by source, in total sales of i from r to s, at agent's prices

SALSHR(i,r,s) = VXA(i,r,s) / VOA(i,r)

VIMSHR (i,r,s : TRAD_COMM, REG, REG) : The share of demand by source in the composite demand for region s as a whole, at market prices

VIMSHR(i,r,s) = VIMS(i,r,s) / sum(k,REG, VIMS(i,k,s))

VA (i,r : PROD_COMM, REG) : Value-added in sector i of region r

VA(i,r) = sum(k,ENDW_COMM, VFA(k,i,r))

CASHRS (i,r,s : TRAD_COMM, REG, REG) : The share of demand by source in the commodity i evaluated at agents' prices

CASHRS(i,r,s) = VCAS(i,r,s) / sum(k,REG, VCAS(i,k,s))

FASHRS (i,j,r,s : TRAD_COMM, PROD_COMM, REG, REG) : The share of demand by source in the commodity j evaluated at agents' prices

FASHRS(i,j,r,s) = VFAS(i,j,r,s) / sum(k,REG, VFAS(i,j,k,s))

PELAS (i,r,s : IMC_COMM, REG, REG) : perceived demand elasticity

PELAS(i,r,s) = SIGMAS(i,r) / [1 + {{SIGMAS(i,r) - 1} VIMSHR(i,r,s) / N_L(i,r)}]

TELA (i,r : IMC_COMM, REG) : total demand elasticity

TELA(i,r) = sum(s,REG, SALSHR(i,r,s) * PELAS(i,r,s))

FVA (i,r : IMC_COMM, REG) : Fixed value-added in sector i of region r

FVA(i,r) = [1 / TELA(i,r)] * VOA(i,r)

VVA (i,r : IMC_COMM, REG) : Variable value-added in sector i of region r

VVA(i,r) = VA(i,r) - FVA(i,r)

SHR_FVA(i,r : IMC_COMM, REG) : Variable value-added in sector i of region r

SHR_FVA(i,r) = FVA(i,r) / VA(i,r)

VC (i,r : IMC_COMM, REG) : variable cost in the production of i in region r

VC(i,r) = VOA(i,r) - FVA(i,r)

SHRPELAS (i,r,s : IMC_COMM, REG, REG) : share of PELAS, weighted with SALSHR

SHRPELAS(i,r,s) = SALSHR(i,r,s) * PELAS(i,r,s) / TELA(i,r)

ESHR (i,j,r : ENDW_COMM, PROD_COMM, REG) : the share in sector j value-added of ENDW_COMM i

ESHR(i,j,r) = VFA(i,j,r)/VA(j,r)

ALPHA (i,r,s : IMC_COMM, REG, REG) : The multiplier in the perceived demand

ALPHA(i,r,s) = [1-SIGMAS(i,r)] ^ 2 * VIMSHR(i,r,s)

/ {(SIGMAS(i,r) -1) * VIMSHR(i,r,s) + N_L(i,r)}

! Define Parameters !

SIGMAS (i,r : TRAD_COMM, REG) : elasticity of substitution

ESUBVA(i : PROD_COMM) : elasticity of substitution between primary endowments

N_L (i,r : IMC_COMM, REG) : number of IMC_COMM firm i in region r

INC(r : REG) : = INCOME(r)

! Define Equations !

EQUATION (i,j,r : ENDW_COMM, PCM_COMM, REG) : calculate qfep(i,j,r)

qfep(i,j,r) = qvap(j,r) + ESUBVA(j) * [pvap(j,r) - pfe(i,j,r)]

EQUATION (i,j,r : ENDW_COMM, IMC_COMM, REG) : calculate qfem(i,j,r)

qfem(i,j,r) = {[VVA(j,r)/VA(j,r)] * vqva(j,r)}

+ {[FVA(j,r)/VA(j,r)] * fqva(j,r)} + ESUBVA(j) * [pvam(j,r) - pfe(i,j,r)]

EQUATION (j,r : PCM_COMM, REG) : calculate pvap

pvap(j,r) = sum(e,ENDW_COMM, ESHR(e,j,r) * pfe(e,j,r))

EQUATION (j,r : IMC_COMM, REG) : calculate pvam

pvam(j,r) = sum(e,ENDW_COMM, ESHR(e,j,r) * pfe(e,j,r))

EQUATION (j,r : IMC_COMM, REG) : top nest of IMC_COMM production function

vqva(j,r) = qo(j,r)

EQUATION (j,r : IMC_COMM, REG) : determination of fqva(j,r)

fqva(j,r) = n(j,r)

EQUATION (j,r : PCM_COMM, REG) : top nest of PCM_COMM production function

qvap(j,r) = qo(j,r)

EQUATION (i,j,r : TRAD_COMM, PCM_COMM, REG) : top nest of PCM_COMM production function

qf(i,j,r) = qo(j,r)

EQUATION (i,j,r : TRAD_COMM, IMC_COMM, REG) : top nest of IMC_COMM production function

qf(i,j,r) = qo(j,r)

EQUATION (i,j,r,s : NIMC_TRAD, PROD_COMM, REG, REG) : calculate qfsp(i,j,r,s)

qfsp(i,j,r,s) = qf(i,j,s) - SIGMAS(i,s) * [pfs(i,j,r,s) - pf(i,j,s)]

EQUATION (i,j,r,s : IMC_COMM, PROD_COMM, REG, REG) : calculate qfsm(i,j,r,s)

```
qfsm(i,j,r,s) = qf(i,j,s) - SIGMAS(i,s) * [pfs(i,j,r,s) - pf(i,j,s)]
    - sum(l,REG,FASHRS(i,j,l,s)*n(i,l))

EQUATION (i,j,r : TRAD_COMM, PROD_COMM, REG) : calculate pf(i,j,r)

    pf(i,j,r) = sum(c,REG, FASHRS(i,j,c,r) * pfs(i,j,c,r))

EQUATION (i,s : TRAD_COMM, REG) : calculate pm(i,s)

    pm(i,s) = [sum(f,REG, VIMSHR(i,f,s) * pms(i,f,s))]

EQUATION (j,r : IMC_COMM, REG) : calculate ps(j,r)

    ps(j,r) = avc(j,r) + mkr(j,r)

EQUATION (j,r : IMC_COMM, REG) : calculate avc(j,r)

    VC(j,r) * avc(j,r) = sum(i,TRAD_COMM, VFA(i,j,r) * pf(i,j,r))
    + VVA(j,r) * pvam(j,r)

EQUATION (j,r : IMC_COMM, REG) : calculate atc(j,r)

    VOA(j,r) * atc(j,r) = sum(i,TRAD_COMM, VFA(i,j,r) * pf(i,j,r))
    + VA(j,r) * pvam(j,r)

EQUATION (j,r : IMC_COMM, REG) : calculate IMC_COMM ps(j,r)

    VOA(j,r) * ps(j,r) = VOA(j,r) * atc(j,r) - FVA(j,r) * [qo(j,r) - n(j,r)]

EQUATION (j,r :PCM_COMM, REG) : calculate PCM_COMM ps(j,r)

    VOA(j,r) * ps(j,r) = sum(i,TRAD_COMM, VFA(i,j,r) * pf(i,j,r))
    + VA(j,r) * pvap(j,r)

EQUATION (i,r : TRAD_COMM, REG) : calculate qc(i,r)

    qc(i,r) = y(r) - pc(i,r)

EQUATION (r : REG) : calculate qsave(r)
```

qsave(r) =y(r) - pcgds

EQUATION (i,r : TRAD_COMM, REG) : calculate pc(i,r)

pc(i,r) = [sum(p,REG, CASHRS(i,p,r) * pcs(i,p,r))]

EQUATION (i,r,s : NIMC_TRAD, REG, REG) : calculate qcsp(i,r,s)

qcsp(i,r,s) = qc(i,s) - SIGMAS(i,s) * [pcs(i,r,s) - pc(i,s)]

EQUATION (i,r,s : IMC_COMM, REG, REG) : calculate qcsm(i,r,s)

qcsm(i,r,s) = qc(i,s) - SIGMAS(i,s)

* [pcs(i,r,s) - pc(i,s)] - sum(l,REG, CASHRS(i,l,s) * n(i,l))

EQUATION (r : REG) : calculate regional utility u(r)

INCOME(r) * u(r) = sum(i,TRAD_COMM,VCA(i,r) * qc(i,r)) +

SAVE(r)*qsave(r)

EQUATION (i,r,s : NIMC_TRAD, REG,REG) : calculate NIMC_COMM qxs(i,r,s)

qxs(i,r,s) = sum(k,PROD_COMM, [VFMS(i,k,r,s)/VIMS(i,r,s)] * qfsp(i,k,r,s))

+ [VCMS(i,r,s)/VIMS(i,r,s)]* qcsp(i,r,s)

EQUATION (i,r,s : IMC_COMM, REG, REG) : calculate IMC_COMM qxs(i,r,s)

qxs(i,r,s) = sum(k,PROD_COMM, [VFMS(i,k,r,s)/VIMS(i,r,s)] * qfsm(i,k,r,s)

+ [VCMS(i,r,s)/VIMS(i,r,s)]* qcsm(i,r,s)

EQUATION (i,r : ENDW_COMM, REG) : calculate ENDW_COMM qo(i,r)

VOM(i,r) * qo(i,r) = sum(j,PCM_COMM, VFM(i,j,r) * qfep(i,j,r)) +

sum(j,IMC_COMM, VFM(i,j,r) * qfem(i,j,r)

EQUATION : calculate pcgds

VCGDS * pcgds = sum(r,REG, sum(k,CGDS_COMM, VOA(k,r) * ps(k,r)))

```
EQUATION (r : REG) : calculate globalcgds

        globalcgds = sum(k,CGDS_COMM, qo(k,r))

EQUATION (i,r,s : TRAD_COMM, REG, REG) : calculate pms(i,r,s)

        pms(i,r,s) = tms(i,r,s) + pw(i,r,s)

EQUATION (i,r,s : TRAD_COMM, REG, REG) : calculate pw(i,r,s)

        pw(i,r,s) = ps(i,r) - txs(i,r,s)

EQUATION (i,r : ENDW_COMM, REG) : calculate pme(i,r)

        pme(i,r) =  ps(i,r) - to(i,r)

EQUATION (i,j,r : ENDW_COMM, PROD_COMM, REG) : calculate pfe(i,j,r)

        pfe(i,j,r) = tf(i,j,r) + pme(i,r)

EQUATION (i,r,s : TRAD_COMM, REG, REG) : calculate pcs(i,r,s)

        pcs(i,r,s) = tcs(i,r,s) + pms(i,r,s)

EQUATION (i,j,r,s : TRAD_COMM, PROD_COMM, REG, REG) : calculate pfs(i,j,r,s)

        pfs(i,j,r,s) = tfs(i,j,r,s) + pms(i,r,s)

EQUATION (i,r : TRAD_COMM, REG) : calculate qo(i,r)

        VOA(i,r) * qo(i,r) = sum(s,REG, VXA(i,r,s) * qxs(i,r,s))

EQUATION (i,r : IMC_COMM, REG) : calculate mkr(i,r)

        mkr(i,r) = {1 - TELA(i,r) / [TELA(i,r) -1]} * ela(i,r)

EQUATION : (i,r,s : IMC_COMM, REG, REG) : calculate elas(i,r,s)

        elas(i,r,s) = - ALPHA(i,r,s) * [pm(i,s) - pms(i,r,s)]

EQUATION (i,r : IMC_COMM, REG) : calculate ela(i,r)

        ela(i,r) = - qo(i,r) + sum(s,REG, SHRPELAS(i,r,s) * [elas(i,r,s) + qxs(i,r,s)])
```

EQUATION (r : REG) : calculate EV(i,r)

EV(r) - [INC(r) / 100] * u(r) = 0

EQUATION (r : REG) : calculate gp(i,r)

[sum(i,TRAD_COMM, VCA(i,r)) + SAVE(r)] * gp(r)

= sum(i,TRAD_COMM, VCA(i,r) * pc(i,r)) + SAVE(r) * pcgds

EQUATION (r : REG) : calculate regional income y(r)

y(r) = {1/INCOME(r)} * {sum(m,ENDW_COMM, VOA(m,r)

* (ps(m,r) + qo(m,r)))+ sum(m,IMC_COMM, VOA(m,r) * [ps(m,r) + qo(m,r)]

- sum(h,TRAD_COMM, VFA(h,m,r) * [pf(h,m,r) + qf(h,m,r)])- VA(m,r) *

[pvam(m,r) + {[VVA(m,r)/VA(m,r)] * vqva(m,r)} + {[FVA(m,r)/VA(m,r)] *

fqva(m,r)}]) + sum(m,PCM_COMM, VOA(m,r) * [ps(m,r) + qo(m,r)] -

sum(h,TRAD_COMM, VFA(h,m,r) * [pf(h,m,r) + qf(h,m,r)])- VA(m,r) *

[pvap(m,r) + qo(m,r)]) + sum(m,ENDW_COMM, (VOM(m,r) * (pme(m,r) +

qo(m,r))) - (VOA(m,r) * (ps(m,r) + qo(m,r)))) + sum(h,ENDW_COMM,

sum(m,PCM_COMM, (VFA(h,m,r) * (pfe(h,m,r) + qfep(h,m,r))) -(VFM(h,m,r) *

(pme(h,r) + qfep(h,m,r)))) + sum(m,IMC_COMM, (VFA(h,m,r) * (pfe(h,m,r) +

qfem(h,m,r))) - (VFM(h,m,r) * (pme(h,r) + qfem(h,m,r))))) +

sum(m,PROD_COMM, sum(h,NIMC_TRAD, sum(s,REG, (VFAS(h,m,s,r) *

(pfs(h,m,s,r) + qfsp(h,m,s,r))) - (VFMS(h,m,s,r) * (pms(h,s,r) + qfsp(h,m,s,r))))))

+ sum(m,PROD_COMM, sum(h,IMC_COMM, sum(s,REG,

(VFAS(h,m,s,r) * (pfs(h,m,s,r) !+ n(h,s)! + qfsm(h,m,s,r))) - (VFMS(h,m,s,r) *

(pms(h,s,r) + qfsm(h,m,s,r)))))) + sum(h,NIMC_TRAD, sum(s,REG, (VCAS(h,s,r) * (pcs(h,s,r) + qcsp(h,s,r))) - (VCMS(h,s,r) * (pms(h,s,r) + qcsp(h,s,r))))) + sum(h,IMC_COMM, sum(s,REG, (VCAS(h,s,r) * (pcs(h,s,r) + qcsm(h,s,r))) - (VCMS(h,s,r) * (pms(h,s,r) ! + n(h,s)! + qcsm(h,s,r))))) + sum(h,TRAD_COMM, sum(s,REG, (VIWS(h,r,s) * (pw(h,r,s) + qxs(h,r,s))) - (VXA(h,r,s) * (ps(h,r) + qxs(h,r,s))))) + sum(h,TRAD_COMM, sum(o,REG, (VIMS(h,o,r) * (pms(h,o,r) + qxs(h,o,r))) - (VIWS(h,o,r) * (pw(h,o,r) + qxs(h,o,r)))))}

EQUATION : check Walras law

VSAVE * walras_dem = sum(r,REG, SAVE(r) * qsave(r))

EQUATION : check Walras law

walras_sup = globalcgds

EQUATION : Walras law

walras_sup = walras_dem + walraslack

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