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A FREE TRADE AREA OF CORE ASIA PACIFIC ECONOMIC COOPERATION NATIONS (CAN): A COMPUTATIONAL GENERAL EQUILIBRIUM APPROACH

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I. INTRODUCTION

One of characteristics of current world economy is the establishment of free trade arrangement. European Community (EC) and the North American Free Trade Area (NAFTA) were already established, and the Association of southeast Asia nations (ASEAN) and Asia Pacific Economic Cooperation (APEC) are under discussion. APEC has 18 member countries.[1] President Clinton hosted a historic APEC national leaders' meeting at Blake Island, near Seattle, on November 19-20, 1993. Currently, national leaders meet every year, in order to pave roads for the free trade area (FTA) in the Asia-Pacific region. The Bogor meeting of November, 1994, produced a blue print for the future of APEC. That is, national leaders agreed to a schedule of eliminating tariffs and non-tariff barriers in the Asia-Pacific region by 2010 for industrialized economies, and by 2020 for developing economies. APEC leaders met at Osaka, and they announced the Action Agenda of eight principles November 19, 1995, in order to implement the Bogor Declaration.

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 in the Pacific-rim region can be questioned. The biggest obstacle to the formation of the APEC will be losing nations. Cheong (1995) predicts that Canada, Mexico, and Thailand will experience net losses with the formation of APEC. United States International Trade Commission (1989) rep-

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[1] Members of APEC are Australia, Brunei, Canada, Chile, China, Hong Kong, Indonesia, Japan, Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Philippines, Singapore, Taiwan, Thailand, and U. S.

orts that a FTA "negotiations with so many diverse economies at once would not be workable", even though the Pacific-rim region as a whole offers a large market and huge potential benefits resulting from the establishment of a FTA. This paper proposes a formation of subregional FTA in the APEC region, prior to the full APEC. This idea is similar to the experience of the EC. EC started with relatively small number of European nations, and this year, it has grown with 15 member nations, by accepting Austria, Finland, and Sweden, in 1995. Thus, the paper will study the welfare effects of a FTA, which has member nations of four NIEs, three ASEAN Indonesia, Malaysia, The Philippiness), China, Australia and New Zealand, Japan, and U.S.A. We call these nations as Core APEC Nations (CAN).

In this paper, computational general equilibrium (CGE) model will be used, in order to look at welfare changes of the subregional FTA in the APEC. The model is designed to study which country collects gains or loses from the formation of a free trade area. It is designed to study the nature and extent of their economic interdependence with respect to taxes, tariffs and non-tariff barriers (NTB). The formation of a FTA implies that there is no tariffs and non-tariff barriers within the region. This is performed by giving shocks, which is necessary, in order to eliminate tariffs and NTBs.

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.

II. THE CGE MODEL

CGE model is a computer representation of a national economy or a group of economies that is complex enough to capture the main channels working between economic agents (variables), yet simple enough to tract relationships between concerned variables. 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.

CGE models are widely used 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. After Harris (1984), CGE modelers began exploring the issues of international trade and industrial organization. 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.

Following Cox and Harris (1992) and Mercenier and Schmitt (1992), production sectors are divided into perfectly-competitive sectors and monopolistically-competitive ones. Assuming a commodity sector as perfectly competitive may be wrong. For example, some authors, such as Alaouze *et al* (1978) and Kolstad and Burris (1986), showed that agricultural markets are imperfectly competitive, while this paper assumes that agricultural sector is perfectly competitive. Even though any production sector can exhibit scale economies, this paper assigns two sectors out of five production sectors to be imperfectly competitive, based on the sizes of scale economies, studied by Prattern (1988). Perfectly-competitive (*PCM*) sectors are agriculture (AGR), light manufacturing (LMF), and service (SVC), and the rest two sectors are imperfectly competitive (IMC). One *IMC* sector is chemicals, plastic, resources, and resource refinery (aggregated as RPR in this paper). The other *IMC* sector is transportation and machinery equipment (TME).

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. Perfectly Competitive CGE models tends to underestimate the welfare effects of trade liberalization, as pointed out by Harris (1984). 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. Our model with increasing returns to scale is based on the CGE model structures in Cox and Harris (1992), Dixit and Norman (1988), Harris (1984), Hunter, Markusen, and Rutherford (1992), and Mercenier (1995).

The CGE model[2] in this paper has a firm-level product differentiation, based on theoretical work by Dixit and Stiglitz (1977). That is, 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 reg-

[2] Detailed description about the CGE model used in this paper is given in Cheong (1995).

arded as a different car than a Mercedes-Benz. Firm-level product differentiation is necessarily linked to imperfect competition.

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.

A single representative consumer will make final consumption decisions in each region. Consumer's final demand decision is represented by a two-level utility function. The higher level of a Cobb-Douglas utility function combines consumption goods (both imported and domestic) and savings, S_r, assuming constant expenditure shares (δ^s_r). The lower nest of the utility function determines the optimal composition of the consumption aggregates in terms of regional origin. For the perfectly-competitive sectors, we have :

$$d^i_r = \Psi \left\{ \sum_{s=1}^{T} d^i_{sr}{}^{\frac{\sigma_c - 1}{\sigma_c}} \right\}^{\sigma_c / \sigma_c - 1} \tag{1}$$

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 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}.

$$d^i_r = \Psi \left\{ \sum_{s=1}^{T} n^i_s * \varphi^i_{sr} * d^i_{sr}{}^{\frac{\sigma_c - 1}{\sigma_c}} \right\}^{\sigma_c / \sigma_c - 1} \tag{1'}$$

This formulation of preferences will catch firm-level product differentiation. Corresponding this demand systems, the composite price index of aggregated good i in region r will be defined in a C.E.S. form.

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. The *IMC* sectors are characterized by free entry and exit. No net profits will exist in the *IMC* model, which can be regarded 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. Theoretical models with Chamberlinian monopolistic competition have been explored in Brown (1991), Dixit and Norman (1988), and Nguyen and Wigle (1992).

Initially, an exogenous numbers of *IMC* firms are given for each industry, due to the lack of information at a substantially-high level of aggregation, and 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, as a result of the trade creation effect from the formation of the free trade area. 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 decrease, then existing firms can exploit scale economies. But the reduction of the diversity of goods worsens the welfare.

The production technology for producers is as follows: The top nest has a fixed-coefficient technology with variable value added and composite intermediate goods.

Composite intermediate goods, z_r^{ji}, will be defined as follows:

$$z_r^{ji} = \Phi \left\{ \sum_{s=1}^{T} z_{sr}^{ji\,\frac{\sigma-1}{\sigma}} \right\}^{\sigma/\sigma-1} \tag{2}$$

for perfectly-competitive sectors, and

$$z_r^{ji} = \Phi \left\{ \sum_{s=1}^{T} n_s^i * \xi_{sr}^{ji} * z_{sr}^{ji\,\frac{\sigma-1}{\sigma}} \right\}^{\sigma/\sigma-1} , \tag{2'}$$

for imperfectly-competitive sectors. z_{sr}^{ji} is the conditional demand for aggregate intermediate good j from region s used in the production of good i in region r, Φ is a scale parameter, and ξ_{sr}^{ji} is firm i's share in region r for good j from region s. The formulation of conditional demand in eq. (2′) will catch firm-level product differentiation, following Dixit-Stiglitz approach. The composite prices will be defined, with a similar form as in consumer's composite price.

The perceived total demand elasticity is denoted with the perceived demand elasticity of substitution, weighted with market shares. The perceived demand elasticity can be defined in several ways, depending on the *IMC* firm's expectations about rival firm's behavior. 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. If we set the changes of other prices to zero (except the price concerned), then, we will have Bertrand elasticity. Alternatively, the Cournot perceived demand elasticity will be derived, if the changes of other demands are set equal to zero, except for the demand concerned.

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 interpretation of simulations.

Ⅲ. SIMULATIONS AND RESULTS

For the simulations of the model, we use the Global Trade Analysis Project (GTAP) data base, which 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 fully disaggregated GTAP data base consists of 37 sectors and 24 regions for 1992. We will aggregate the data base into a 13-region data base, for the simulation done in this paper. 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.

The preference and technology parameters are taken from the SALTER data set. These parameters can be reaggregated, matching the aggregation of the data base. The elasticities of substitution are 4.72 (agriculture), 5.82 (light industries), 4.81 (chemical products and resources), 6.91 (machinery and vehicle), and 3.92 (services).[3] A sensitivity test will be done by assigning different numbers for the *IMC* sectors, to determine how sensitive our results are to varying values for the elasticities of substitution. 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-

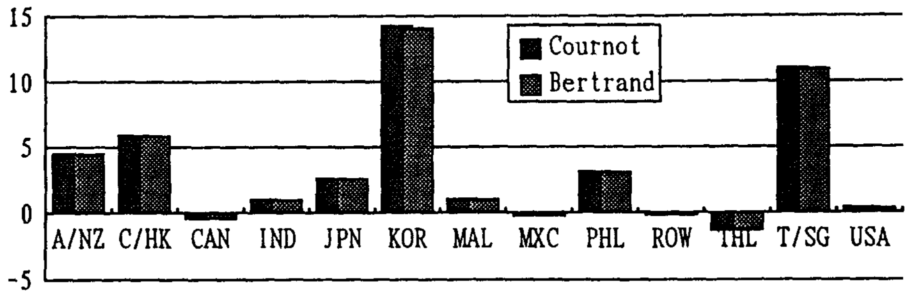
[3] See Cheong (1995) for detailed description about parameters.

competitive sectors.[4] Initially, it was assumed that each *IMC* production sector have 100 monopolistically-competitive firms. Alternative numbers for *IMC* sectors will be 25 and 1000 for a sensitivity test. Simulations will be conducted, with these alternative numbers of firms, and simulation results will be compared to check the robustness of model.

The model in this paper can be solved with the levels approach software, for example, GAMS and FORTRAN, which requires 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 the Johansen (1960) approach. The most important advantage of the linearized modeling is that it becomes simpler to formulate and modify models. Therefore, we will solve the model in this paper, taking the linearization approach. The model will be written with GEMPACK (General Equilibrium Modeling PACKage). To save computer time, non-linear equations will be linearized. In the linearized version, the variables should be interpreted as the percentage changes of the levels variables.

Figure 1 shows the percentage changes of welfare of the FTA of core APEC nations under Cournot and Bertrand assumption.

[Figure 1] The Percentage Changes of Welfare of a FTA of CAN under Alternative Assumptions of Conjecture



Our simulation predicts positive welfare gains for all core nations in the Pacific-rim region. Korea and Taiwan/Singapore (T/SG) are predicted to collect high welfare gains. Substantial welfare gains for Korea and Taiwan/Singapore can be explained with high trade dependence (measured by the ratio of the total

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

value of exports and imports to the gross domestic products). Another reason may be the introduction of imperfect competition into the model. In a CGE model with imperfect competition, the formation of a FTA will force regional economies to exploit scale economies and to reap efficiency gains (rationalization), since firms will face more competition, and they will reduce their price (up to marginal costs).

Australia/New Zealand (A/NZ)and China/Hong Kong (C/HK) will experience around five percentage welfare gains, while ASEAN nations are estimated to have moderate welfare gains. Xingmei *et al* (1994) discuss about the sources of efficiency gain between Asian NIEs and China. China imports large quantities of capital and technology intensive products from NIEs but Chinese manufactured products are competing with the products in ASEAN nations. With a FTA, ASEAN nations seem not to increase their market shares substantially with a FTA concerned here.

Large economies of Japan and U.S. will have different results. Japan will benefit by positive two and half percentage welfare gains, but U.S. collects welfare gains of less than half percentage. This is due to Asia nations' higher trade share with Japan than U.S. Asia nations imports intermediate goods for their manufactured sectors (especially for sectors with scale economies) from the Japan. In a new FTA, the elimination of trade barriers will reduce the importing costs of their intermediate goods, and they can sell their products at lower prices. Then, the demand for their products increases, and their total average costs will go down along their long run average cost curve. Japan will have similar effects, realizing rationalization effects, due to higher demands for their products. U.S. has large domestic market and already exploited a scale economies within its domestic market.[5]

As expected, non-CAN nations, such as Canada, Mexico, and Thailand, are expected to suffer welfare losses. And the rest of world (ROW) will face welfare losses. Generally, welfare losses seem not to be substantially large. That means that trade diversion from the formation of CAN will not be large.

From Figure 1, the assumptions of conjectures seem to be insignificant. That is, two assumptions produce almost same simulation results, except Korea and Australia/New Zealand. As described above, the Cournot conjecture calculates lower perceived demand elasticity than the Bertrand with same data base, and associated markup rate in the imperfectly-competitive sectors will be higher than that of the alternative assumption. Therefore, the simulation results for welfare changes will be bigger with the Cournot assumption.

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[5] For reference, see Brown and Stern (1989).

[Figure 2] The Percentage Changes of Regional Income

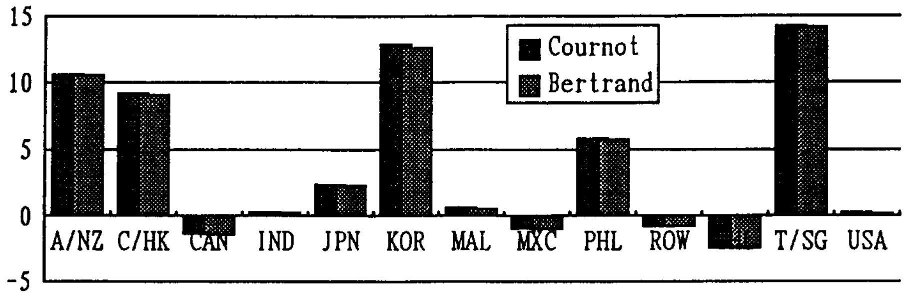
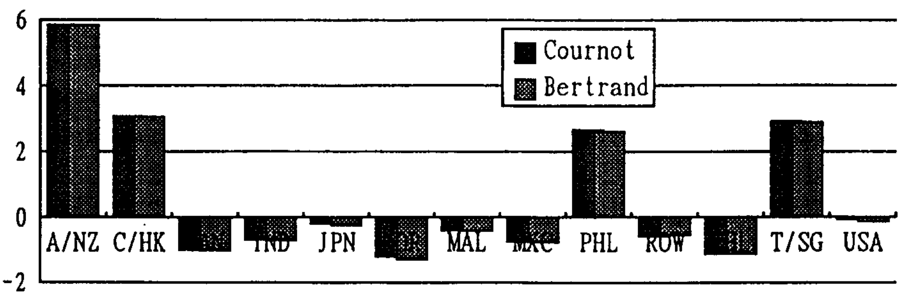


Figure 2 reports the expected percentage changes of regional income and price, when a CAN FTA is established. Highest percentage changes of regional income is expected for Taiwan/Singapore and Korea. Next group will be Australia/New Zealand, China/Hong Kong, and the Philippines. Indonesia, Malaysia, and U.S. are simulated not to have substantial changes of regional income. The changes of prices in each region in Figure 3 are expected quiet differently to the changes of regional income in Figure 2. Australia and New Zealand will have highest price changes with the establishment of a CAN FTA. Australia/New Zealand will be followed by China/Hong Kong, The Philippines, and Taiwan/Singapore. Note that Korea, Japan, and U.S. will experience the decrease of prices, with the establishment of a FTA in the region.

[Figure 3] The Percentage Changes of Overall Price in each Region



Sensitivity tests are done as follows: Change the number of firms from 100 (central case) to 25 and 1000, in order to study how robust or fragile the model is with respect to the number of firms. The welfare changes move in the same di-

[Table 1] Summary of Simulation

	Utility (%)	Income (%)	Price (%)
	Cournot (Bertand)	Cournot (Bertand)	Cournot (Bertand)
Astralia/Nzealand	4.494(4.457)	10.615(10.548)	5.858(5.829)
China/Hong Kong	5.911(5.828)	9.171(9.055)	3.081(3.046)
Canada	−0.421(−0.432)	−1.404(−1.427)	−0.987(−1.000)
Indonesia	0.983(0.953)	0.295(0.250)	−0.682(−0.698)
Japan	2.585(2.534)	2.386(2.289)	−0.193(−0.239)
Korea	14.251(14.062)	12.901(12.644)	−1.213(−1.279)
Malaysia	1.044(0.987)	0.625(0.563)	−0.415(−0.421)
Mexico	−0.237(−0.243)	−0.986(−1.000)	−0.751(−0.762)
The Philippiness	3.105(3.056)	5.821(5.724)	2.648(2.600)
ROW	−0.207(−0.194)	−0.787(−0.747)	−0.581(−0.554)
Thailand	−1.330(−1.344)	−2.430(−2.450)	−1.115(−1.119)
Taiwan/Singapore	11.037(10.954)	14.277(14.158)	2.912(2.877)
USA	0.356(0.316)	0.272(0.168)	−0.084(−0.148)

rection and are of about the same magnitude as in the simulations of 100 firms, confirming the robustness of the model in this paper(not reported in this paper).

Table 1 contains the simulation results, shown in Figures 1-3. The second column of table 1 reports the percentage changes of welfare under alternative conjecture assumptions. Next column is about regional income changes, and price changes are in the fourth column. As explained above, no substantial differences are found under alternative conjecture assumptions.

Ⅳ. CONCLUSION

This paper is to study the welfare effects of the formation of a FTA of core APEC nations. That is, Canada, Mexico, and Thailand, among the APEC members, seem not to join a FTA for Asia-Pacific region. For the sustained development and growth in the region, the formation of a FTA will be needed, and then, the most probable solution would be a CAN FTA. As the FTA is established, and member nations are to grow with trade creation effects from the FTA, countries not included in the CAN FTA may join the club.

A point to notice is that the model simulates substantially large welfare changes, making big winners Asian NIE countries of Korea, Taiwan/Singapore, and China/Hong Kong. These economies will be active supporters of a FTA in the region under the model. If the full APEC FTA is realized, then, these nations are expected to benefit most among member nations. This paper proposes two stage formation of a FTA in the Pacific-rim region. The formation of a CAN FTA will be the first stage, and then remaining APEC countries will be induced to join the existing CAN FTA.

In simulations with imperfect competition, the specifications of a firm's conjecture on its rival firm'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.

A couple of qualifications should be pointed out. First, in this model, the formation of free trade area means the complete elimination of import tariffs and non-tariff barriers. Therefore, 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, nations practice their own industry policies, and therefore, the welfare of a formation of a FTA is likely to be affected by industrial and structural characteristics of each nation. But the CGE model in this paper ignores this fact. On the other hand, trade dependence is designed to work through the model, which gives high welfare changes for Asian NIEs from the formation of a CAN FTA. Third, the benefits of scale economies cannot be fully captured by a static 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.

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