Dynamic Impacts of Trade Liberalization on Foreign Direct Investment*

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Abstract

This study presents a simple prototype of an Applied General Equilibrium (AGE) model of global trade that incorporates the forward-looking decision-making on investment made by Multi-National Enterprises (MNEs) for maximization of total profit of group companies. The model can be used to clarify changes in the patterns of Foreign Direct Investment (FDI) in a general equilibrium framework in which labor wages are endogenously determined. In the study, we perform simulations to examine questions on liberalizing trade between Japan and ASEAN members where the trend of FDI is important. The simulation results revealed that: (1) trade liberalization between Japan and ASEAN 4 increases FDI to the partner country/region, and the MNEs established outside the union change the destinations of FDI from the members to other non-members; (2) increases in FDI to the partner countries/regions do not reduce domestic production volumes in Japan and ASEAN 4; (3) excess production of Japanese companies in ASEAN 4 lowers the cost of intermediate inputs, and resultant depreciation of output prices of goods enables households in every country/region except China to consume more; and (4) since the product of Japanese companies operating in ASEAN 4 is a kind of rivalry with Chinese tradable for other countries/regions, the excess supply of the product of Japanese companies in ASEAN 4 partially eliminates the Chinese product from the market, and makes China be worse off.

Keywords: applied general equilibrium model; trade liberalization; foreign direct investment; multi-national enterprise; optimal growth model.

JEL Classification Numbers: C68, D58, F15, F21, F22, F23, F41.

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1 Introduction

In the field of trade-related policy analysis, thousands of Applied General Equilibrium (AGE) models have been utilized to provide information for decision-makings, estimating potential economic impacts and evaluating policy options. Whalley (1985) is one of the earliest researches that quantifies the merits of alternative actions in international trade policy, and analyzes the effects of various trade liberalization initiatives using a numerical model of global trade. Recently, the Global Trade Analysis Project (GTAP, Hertel ed. (1997)) carries out a comprehensive analysis on trade-related subjects, and supplies a series of consistent macroeconomic data set for empirical applications.

On the other hand, most of such models simply define the foreign savings for each region, which are determined by the interregional capital market equilibrium condition, so that we cannot capture the patterns of Foreign Direct Investment (FDI) clearly with the models. Since peoplefs interests are often directed to the anticipated impacts on FDI when a group of countries/regions starts to examine the feasibility of policy changes, such as trade liberalization, inclusion of FDI in an analytical model is one of the important challenges for model builders. Petri (1997) and Lee and van der Mensbrugghe (2001) use AGE models that include aggregate FDI outflow/inflow. Since their models are essentially based on the static framework, fixed fractions of capital stock are assumed to be allocated abroad.

The purpose of this study is to present a simple prototype of an AGE model of global trade that incorporates the "forward-looking" decision-making on investment made by Multi-National Enterprises (MNEs) for maximization of total profit of group companies. Since the investment plans of firms are essentially forward-looking, a perfect foresight intertemporal model enables us to examine not only changes in the patterns of FDI, but also the dynamic gains from trade. In the study, we simulate announced implementation of trade liberalization between Japan and ASEAN countries, and clarify its impacts on the production volumes of MNEs that reflect changes in the FDI pattern.

In the following section, the major assumptions of the analysis and the basic structure of the model are outlined. In Section 3, we present the steps of benchmark data construction, and conditions needed to be satisfied in the benchmark data, which are derived from the characteristic part of the model. In Section 4, we perform a simulation with the model and interpret the results. Section 5 summarizes the major findings in the analysis.

2 The Model

2.1 Nature of the Model

In this section, we present the major assumptions of this study.

Multi-Regional Growth Model The framework is that of a dynamic multi-regional growth model, which is based on the Ramsey-Cass-Koopmans type optimal growth theory. The global economy is divided into five countries/regions, Japan, China, NIEs, ASEAN 4, and the Rest of the World. NIEs and ASEAN 4 respectively consist of Korea, Taiwan, Hong-Kong, and Singapore, and Indone-

sia, Malaysia, the Philippines, and Thailand[1]. Production sectors are redefined as sub-sectors that consist of activities/products of MNEs. MNEs are assumed to be established in every country/region, and operate subsidiary companies outside their home countries. As a result, there are five MNEs in the global economy and five "redefined" sectors in each country/region.

Economic growth is led by the exogenous growth of labor input and Total Factor Productivity (TFP). In order to obtain stationary state as the base case, the economic growth rate should be equal among countries/regions. It is unrealistic to assume identical economic growth rates in each country/region, but, we assume the growth rates to be zero in order to focus on the dynamic impacts of policy changes[2].

Perfect Competition Since the model is essentially based on the Ramsey-Cass-Koopmans type growth model and its solution can be regarded as the result of perfect competition[3]. This is one straightforward implication from the model. Since perfect competition is hardly realizable in actual economies, the simulation results should be read as giving only a potential picture of a hypothetical economy under conditions of perfect competition, on the basis of which we can abstract fundamental determinants of economic growth.

Factor Mobility The labor force is assumed to be immobile beyond the regional boundary. On the other hand, investment capital flows across countries/regions (foreign capital inflow/outflow), and is determined so as to balance each country/region's current account. It is assumed that the representative consumers in each country/region receive factor income from domestic firms, and that they then invest a fraction of their income through the interregional capital market. FDI flow is regarded as a part of this interregional capital movement.

Exchange Rates Exchange rates between the currencies of individual countries/regions do not enter the model since the model is a pure-barter general equilibrium type. In a monetized extension of the model, an explicit function of demand for money in each country/region is specified and a particular regional money stock determines the monetary equilibrium. Such a specification, however, will reveal the classical dichotomy between real and monetary phenomena, as often appealed to in a standard macroeconomic theory. This dichotomy implies that behavior on the real side of the economy is independent of monetary conditions and that the monetary side alone determines the price of money in terms of goods. Relative commodity prices therefore remain unchanged if the money stock is to change, and the price level is determined by the money stock alone once real-side behavior is determined. Since the model used in this report

[1]Other ASEAN members are included in the Rest of the World, because of the fact that data sources are limited.

[2]Lau *et al* (2002) present an idea to handle different regional growth rates in the base run with forward-looking models.

[3]Because of the difficulties in parameterizing the model, neither imperfect competition nor biased information is incorporated in this study. While Yeldan and Roe (1994) point out the importance of modeling non-competitive or missing market structures and heavily politicized, regulated managerial practices which are often based on imperfect and biased information, we concentrate on an analysis assuming perfectly competitive markets.

is real-side trade model, the issue of the determination of exchange rates does not arise.

Nominal Variables based on Dual Variables As exchange rates, the model does not have nominal variables so that dual variables are interpreted to indicate relative prices. Thus future nominal variables can be calculated, given the assumption of an overall rate of inflation.

Dynamic Consistency The agents' intertemporal behavior is assumed to be rational, so that the entire system of prices across sectors and over time is internally consistent. This is because the model calculates variables of all periods at the same time. Consumption and investment are determined on the basis not of what happened in the past, but of assumed changes in the future exogenous variables. Therefore, one can analyze announcement effects of future policy changes.

Discrete Time Formulation For the purpose of numerical implementation, the intertemporal problem is formulated in discrete time. Discounting in discrete time requires a dating convention. In order to keep the derivation and calibration simple, all transactions are assumed to take place at the end of the period (while decisions are made or planned at the beginning of the period).

2.2 Structure of the Model

In this section, we outline the basic structure of the model used in this report.

Multi-National Enterprise There is one competitive MNE established in each economy, which produces one kind of product. The MNEs have their local subsidiary companies in every foreign country/region, and maximizes the total value of the entire group of companies[4]. Factor substitutability is assumed between locally-hired labor, capital, and intermediate inputs. Investment by each parent or local subsidiary composes raw capital, and is equipped to form the capital stock of each company in the group. Note that a fraction of the raw capital used in the local subsidiaries is directly imported from the home country along with FDI flow. In the ordinary AGE models, all of the imported commodities are assumed to be sold at the import good market, and there is no distinction between commodities supplied for intermediate input, final consumption, and capital formation. While there are possible cases that local subsidiaries of MNEs purchase capital good at the local import good market, one of the profiles of FDI is characterized by the direct imports of capital good from the home country. In the model, we assume the volumes of such direct imports of capital good are technically determined by MNE, related to FDI. Finally, inventory investment is included in investment.

Household The representative consumer in each country/region maximizes her/his discounted utility of the temporal sequence of aggregated consumption.

[4]While the objective function is different, the sufficient optimal conditions are the same as those given in an ordinary model.

The utility function is homogenous and additively separable with constant elasticity of marginal utility. The utility is discounted by the consumer's positive and constant rate of time preference. Since the financial claims are perfect substitutes ex-ante, we cannot uniquely determine the individual consumer's optimal portfolio shares. However, a condition of interregional security market equilibrium defines the foreign saving for each region endogenously. The model treats capital flows as equal to the balance of trade, adjusted for debt-service payment, and the stream of debt-service payment arising from an increase in foreign saving is incorporated into the household's decision-makings. Without uncertainty and with efficient capital markets, financial assets among countries/regions earn the same anticipated rate of return.

Interregional Trade Products of MNEs in every country/region are not treated as homogeneous across countries but as imperfect substitutes for each other. This assumption is called the Armington assumption (Armington (1969)) and is necessary to accommodate cross-hauling; that is, the phenomenon of a country both importing and exporting the same product at the same time. Aggregated economic data tend to account for such cross-hauling.

Equilibrium Conditions To arrive at a solution, both the intertemporal and within-period general equilibrium conditions have to be satisfied simultaneously. At every point in time, the usual general equilibrium conditions require that: (i) material balance in the demand and supply of all commodities produced by MNEs in the economy holds; (ii) the demand for total labor equals its supply; (iii) government revenue is allocated between public expenditure and saving; and (iv) global-wide total of savings equals total investment[5].

The intertemporal conditions ensure that future prices and quantities are fully anticipated and factored into the behavior of investment and consumption. They also guarantee that the path towards a new stationary state is unique. A sufficient condition is that the discount rate and the rate of time preference are positive and greater than the balanced-growth rate by the terminal period. To solve a growth model that has an infinite horizon, we follow the usual procedure of imposing stationary state conditions at some future terminal period. On the investment side, the required condition is that investment is equal to the physical depreciation rate plus given exogenous growth rate times capital stock. On the other hand, current account is in equilibrium that debt-service payment/receipt is equal to the net exports/imports. Since the stream of debt-service payment is incorporated into the household's decision-makings, as we noted in the part of household's optimization, this condition functions like the so-called No Ponzi-Game condition for the consumer's dynamics. As long as the transversality conditions are satisfied, the sums of various infinite series pertaining to the investment equation and the consumption function will be finite and well defined.

Software The model is formulated as a Mixed Complementarity Problem (MCP) and solved by "PATH-C" of the General Algebraic Modeling System

[5]This condition can be dropped because of the Walras' law. We include the inequality that reflects the condition (iv) in order to indicate interregional rate of return as its counterpart variable.

(GAMS)[6]. MCP is a set of Kuhn-Tucker conditions derived from certain optimization problems, and is a powerful tool when a model includes inequalities which are not always binding[7].

Choice of Terminal Period As variables of different time-periods are interdependent, the computational burden is much larger than that for models that calculate solutions period by period. Extension of the calculation horizon increases calculation difficulty more than proportionally, and expansion of models with respect to the number of sectors or countries/regions is more difficult. Moreover, inclusion of FDI tends to account for wide range values in certain variables, which make scaling of the variables difficult. Because of these difficulties and a limited amount of computational resources, we set the terminal period at 15[8].

3 Benchmark Data Construction

In the following sections, we outline the steps of modification to fit the basic macroeconomic data set into the form that is consistent with the model, and present the conditions needed to be satisfied in the benchmark data.

3.1 Steps of Benchmark Data Construction

In order to build an AGE model of global trade, we prepared the GTAP version 5 database, and aggregated the data into the particular group of countries/regions that we are going to focus on in our analysis. In addition to those I-O tables and trade flow data, we used *Statistics of World Foreign Direct Investment* compiled by the Institute for International Trade and Investment (ITI) to obtain FDI flows and stocks by country/region of origin and by country/region of destination. Using those data, we divide every economy into sub-sectors that consist of activities/products of MNEs. Since the sub-sectors cannot be categorized in the ordinary industry/commodity categories presented by GTAP database, such as agriculture, manufacturing, and services, we start with aggregating the ordinary sectors into one, and then, disaggregate into MNEs using the proportion given by the FDI flow or stock data.

The next task is to split interregional flows of capital good, which are directly imported from the home countries of MNEs to local subsidiaries along with FDI, from the ordinary trade flows. As we noted before, we assume the volumes of the direct imports of capital good are technically determined by MNE. Since it is difficult to identify or rationally parameterize such technical coefficients from the macroeconomic data, the author builder assumes the parameter. This distinction of imported capital good yields several conditions on the benchmark data, so that the data set is readjusted to keep consistency with the model.

[6]Brook, Kendrick, and Meeraus (1992).

[7]In our case, the local content constraint is included as a sort of policy. When a subsidiary of MNE invests, a fraction of the capital formation should be made by the locally produced capital good.

[8]The qualitative changes are not affected by the choice of terminal period. See Devarajan and Go (1998).

3.2 Conditions on the Benchmark Data

Suppose the proportion of the direct imports of capital good from the home country of MNE j is technically given as ν_{ij}^{H}, and suffices i, j, r, s, are respectively denote country/region. i is the commodity number, which produced by MNE i, j is the home country/region number of MNEs, and r and s are the country/region number where the parent or local subsidiaries of MNEs are located. The following problem characterizes the cost minimization of a local subsidiary of a MNE j located in country/region $r(j \neq r)$ to select the optimal component shares of each kind of capital good.

$$\text{Min.} \quad \sum_{i}\{(1+\tau_{ijr}^{DF})PD_{ir}DF_{ijr} + (1+\tau_{ijr}^{MF})PM_{ir}MF_{ijr} + \nu_{ij}^{H}(1+\tau_{ijr}^{M})PW_{ij}F_{ijr}\}$$

$$\text{s.t.} \quad (1-\nu_{ij}^{H})F_{ijr} = f(DF_{ijr}, MF_{ijr}) \qquad \perp PF_{ijr} \tag{1}$$

$$\nu_{r}^{L}F_{ijr} \leqq DF_{ijr} \qquad \perp RLC_{ijr} \tag{2}$$

$$QF_{jr} = g(F_{ijr}) \qquad \perp PQF_{jr} \tag{3}$$

where:

DF_{ijr} is i-th locally produced capital good used by MNE j in region r,

MF_{ijr} is i-th imported capital good used by MNE j in region r,

F_{ijr} is i-th composite capital good used by MNE j in region r,

QF_{jr} is raw capital used by MNE j in region r,

PD_{ir} is price of i-th commodity sold at domestic good market in region r,

PM_{ir} is price of i-th commodity sold at local import good market in region r,

PW_{ij} is output price of i-th commodity in region j,

PF_{ijr} is price of i-th composite capital good used by MNE j in region r,

PQF_{jr} is price raw capital used by MNE j in region r,

RLC_{ijr} is rent yielded by the local content constraint,

τ_{ijr}^{DF} is commodity tax rate on locally produced capital good,

τ_{ijr}^{MF} is commodity tax rate on imported capital good,

τ_{ijr}^{M} is rate of import tariff, interregional shipping cost, etc. on trade flow,

ν_{ij}^{H} is technical share of direct imports of capital good,

ν_{r}^{L} is statutory local content rate,

$f(\cdot)$ shows composite capital good aggregator, and

$g(\cdot)$ shows raw capital aggregator.

Equation (1) shows that new capital is formed with locally produced and imported capital goods, which are supplied through the local markets, and the capital good directly imported from the home country/region of MNE along with FDI. Note that any commodity tax except import tariff is not levied on the directly imported capital good.

Equation (2) is the local content constraint. When a subsidiary of MNE j in country/region r invests, a fraction of the capital formation should be made by the locally produced capital good. Assuming Equation (2) holds and there is no rent yielded in the benchmark data, the optimal conditions for the problem are as follows.

$$(1+\tau_{ijr}^{DF})PD_{ir} = PF_{ijr}\frac{\partial f}{\partial DF_{ijr}} \qquad \perp DF_{ijr} \tag{4}$$

$$(1+\tau_{ijr}^{MF})PM_{ir} = PF_{ijr}\frac{\partial f}{\partial MF_{ijr}} \qquad \perp MF_{ijr} \tag{5}$$

$$\nu_{ij}^{H}(1+\tau_{ijr}^{M})PW_{ij} + (1-\nu_{ij}^{H})PF_{ijr} = PQF_{jr}\frac{\partial g}{\partial F_{ijr}} \qquad \perp F_{ijr} \tag{6}$$

In the framework that does not include FDI, Equation (6) becomes:

$$PF_{ijr} = PQF_{jr}\frac{\partial g}{\partial F_{ijr}} \qquad \perp F_{ijr}. \tag{7}$$

Since PF_{ijr}, PQF_{jr}, F_{ijr}, and QF_{jr} should not take different values with the models, which include and does not include FDI, in the base case equilibrium[9], the following condition can be derived using Equations (6) and (7).

$$(1+\tau_{ijr}^{M})PW_{ij} = PF_{ijr} \tag{8}$$

At the same time, the market equilibrium condition for imported commodity i in country/region r holds.

$$\begin{aligned}\sum_j MH_{ijr} + MC_{ir} + MG_{ir} + \sum_j MF_{ijr} \\ = \sum_j \{TF_{ijr} - \nu_{ij}^{H}F_{ijr}(j \neq r)\} \qquad \perp PM_{ir}.\end{aligned} \tag{9}$$

where:

MH_{ijr} is i-th imported commodity used for intermediate input by MNE j in region r,

MC_{ir} is i-th imported commodity for private consumption in region r,

MG_{ir} is i-th imported commodity for government consumption in region r, and

[9]Using the same benchmark data, both models should solve the same values for the aggregated variables in the base run. The base case values of macroeconomic variables must be independent from the assumption. While differences in assumption affect the way of determination of values, the final destination must be the same.

TF_{isr} is trade flow of i-th commodity from region j to region r.

Equation (9) implies that the same price PM_{ir} is applied to both TF_{ijr} and $\nu_{ij}^{H} F_{ijr}$ when j is not equal to r. Therefore, the following relation should be satisfied for $j \neq r$.

$$\begin{aligned} PF_{ijr}F_{ijr} =& (1+\tau_{ijr}^{DF})PD_{ir}DF_{ijr} \\ &+ (1+\tau_{ijr}^{MF})PM_{ir}MF_{ijr} + \nu_{ij}^{H} PM_{ir}F_{ijr} \end{aligned} \tag{10}$$

Recall the objective function in the cost minimization problem for a local subsidiary of a MNE j located in country/region $r(j \neq r)$. Using Equation (8), it can be modified to:

$$\begin{aligned} \sum_i PF_{ijr}F_{ijr} =& \sum_i \{(1+\tau_{ijr}^{DF})PD_{ir}DF_{ijr} \\ &+ (1+\tau_{ijr}^{MF})PM_{ir}MF_{ijr} + \nu_{ij}^{H} PF_{ir}F_{ijr}\}. \end{aligned} \tag{11}$$

Comparing Equation (10) with (11), we obtain:

$$PM_{ir} = PF_{ijr}. \tag{12}$$

This is another condition that the benchmark data should satisfy, in addition to Equation (8). Putting Equations (8) and (12) together, finally we obtain the following condition.

$$(1+\tau_{ijr}^{M})PW_{ij} = PM_{ir} = PF_{ijr} \tag{13}$$

When the model is parameterized, the initial values of quantity variables are obtained setting all the tax-exclusive output prices to unity ($PW_{ij} = 1$). After that, relations between tax-inclusive data and quantity variables determine initial values of other prices, such as PM_{ir} and PF_{ijr}. In this process, Equation (13) is easily violated, and some adjustments are needed to construct the benchmark data, in addition to balancing the Social Accounting Matrices (SAM).

Behavioral Parameters Some of the behavioral parameters used in this analysis, such as the substitution elasticity for the CES aggregators in the production function, are calculated average of the values provided by GTAP database. Other parameters are calibrated from the benchmark data to reproduce the initial equilibrium in a stationary state, and then make the global economy to achieve balanced steady growth. This steady growth path is regarded as the reference run, which is used to scale the impacts of policies simulated. The behavioral parameters determine simulation results, while the formulation of the model also dominates the results in AGE analyses. No individual component can be considered more important than the others. For some simulations, it is the accounting identities that determine results, whereas the behavioral parameters may play a relatively small role. For other simulations, the specification of certain elasticity is of paramount importance.

4 Simulations

We now report on the result of a simulation in this dynamic framework, focusing on the impacts on the production volumes of MNEs in each country/region that reflect changes in the FDI pattern. The experiment treat the case that Japan and ASEAN 4 liberalize trade in the fifth period, and we examine announced effects of the policy changes that are fully anticipated four periods ahead. In the simulations, trade barriers against another member country/region of the union are partially removed forever, after the policy change. Considering the difficulty in solving the model, and the fact that the trade barriers removed totally at once is rare, we set the cutting rate of the barriers to 50 percent. In the figures, R01 to R05 respectively denote Japan, China, NIEs, ASEAN 4, and the Rest of the World.

4.1 Effects on Production

We begin with the impacts of permanent 50 percent removal of trade barriers, levied on interregional trade between Japan and ASEAN 4, on production volumes of MNEs in every country/region. The production volumes fully reflect the levels of capital accumulation, so that we can observe the changes in the FDI pattern. Figures 1 to 5 respectively show the effects on every parent and local subsidiary company of MNEs operating in Japan, China, NIEs, ASEAN 4, and the Rest of the World. The country/region number in the figures represents the home country of each company, and the values show the deviations from the base run on the steady growth path.

It is clear that the production volumes of Japanese and ASEAN MNEs increase the partner country/region. This is because, after the policy implementation in the fifth period, the prices of imported capital good from their home country/region become lower because of the removal of trade barriers, and FDI volumes become larger. These increases in FDI start when the trade liberalization is announced, expecting increases in trade with, and investment in the union members in the post-policy period.

An important point is that such expansions in production may increase the employment and raise the labor input cost in the union member. It may affect the responses of the group companies operating outside the union. It is appeared that Japanese and ASEAN MNEs also expand production in non-member countries/regions, especially in China, before the policy implementation. Since the trade barriers are not removed actually, input costs remain relatively higher so that the capital accumulations are moderate, and the MNEs also increase production in the comparatively low-cost countries/regions. After the policy implementation, the MNEs change the destinations of FDI from outside the union to the partner country/region and concentrate to accumulate capital in the union members.

The raises in input costs also affect MNEs established in the non-member countries/regions. The group companies of the MNE established in the Rest of the World , such as American and European MNEs, expand production in China and NIEs throughout the simulation period. It may be said that the trade liberalization stimulate FDI between non-members.

When a group of countries/regions starts to examine the feasibility of trade liberalization, one may feel concern for the case that increases in FDI to the part-

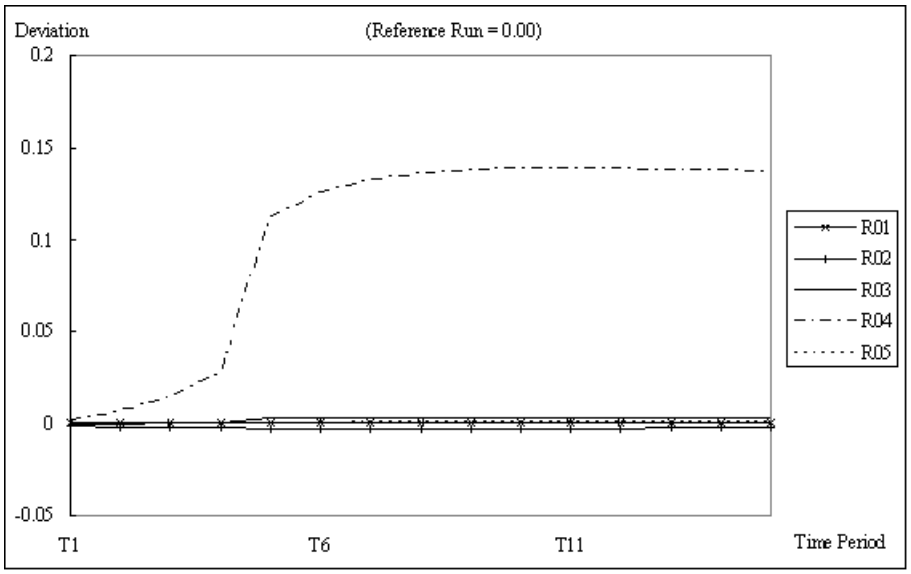

Figure 1: Effects on Production in Japan

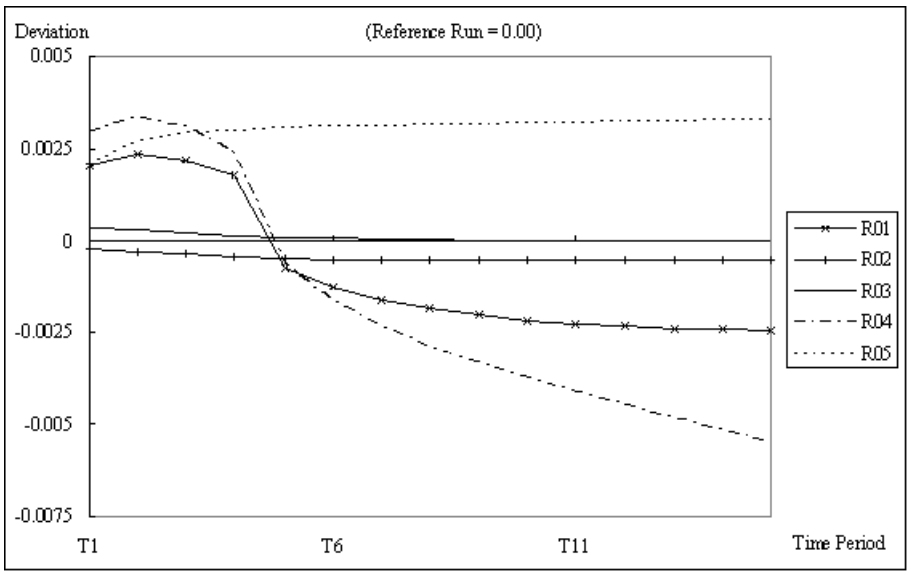

Figure 2: Effects on Production in China

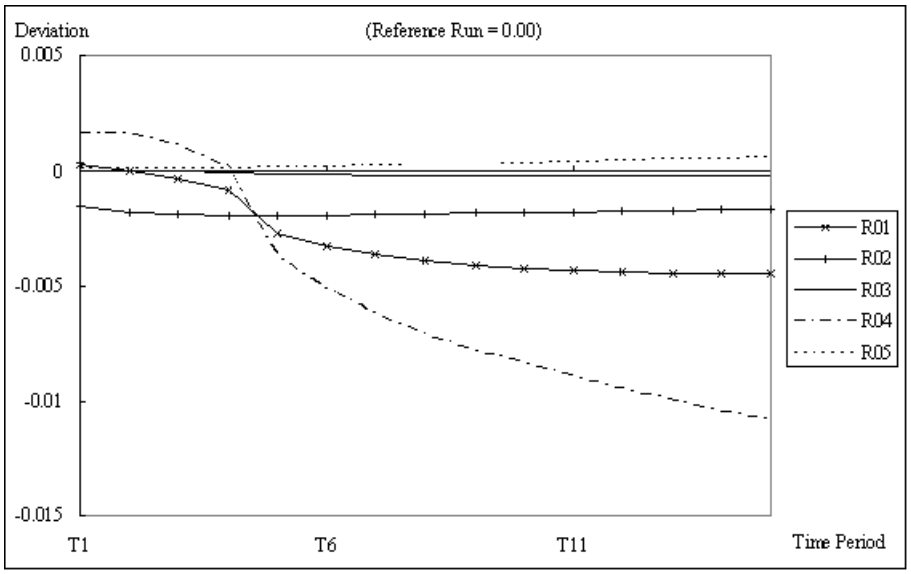

Figure 3: Effects on Production in NIEs

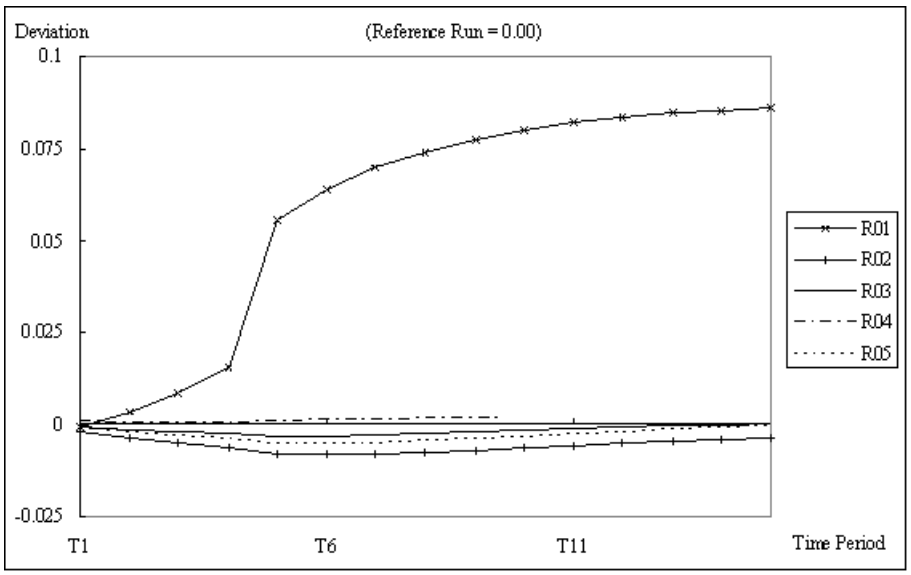

Figure 4: Effects on Production in ASEAN 4

ner countries/regions reduce domestic production volumes. In our experiment, it may be an imaginary fear because Japanese and ASEAN MNEs operating in their home countries/regions will not reduce the volumes of production. It is shown in Figures 1 and 4.

4.2 Welfare Impacts

The effects of the 50 percent trade liberalization between Japan and ASEAN 4 on the regional welfare are measured based on the idea of Hicksian Equivalent Variations (EV). EV are the amount of money equivalent to the changes which have already taken place at the initial period; in other words, the income changes that move the agent to her/his post-change welfare levels. In our dynamic framework, we calculate the discounted sum of temporal EV obtained in each period to grasp the accumulated growth effects that policy changes potentially have. The welfare gains in millions 1997 U.S. dollars from the trade liberalization and the percentage welfare changes from the reference run are reported in Table 1.

	Gains (U.S. mil. $)	Changes (%)
R01	6228.361	0.00100
R02	-11381	-0.03268
R03	405.2096	0.00064
R04	16356.27	0.06485
R05	20752.85	0.00135

Table 1: Welfare Impacts

It is interesting that the results are different from the orthodox proposition that all of the countries/region that settle free trade are better off while countries/region outside the union tend to be worse off. In spite of the fact that the protections are still imposed on imports from non-member countries/region and the unions raise relative level of those retained protection, excess production of Japanese companies in ASEAN 4 seems to lower the cost of intermediate inputs used in all over the world except China. Through the intermediate inputs, depreciation of output prices of goods produced in every country/region occurs. As a result, households in every country/region except China may consume more.

In turn, why is China worse off? One reason for this is because the product of Japanese companies operating in ASEAN 4 is a kind of rivalry with Chinese tradable for other countries/regions, so that the excess supply of the product of Japanese companies in ASEAN 4 to the market makes its price comparatively lower than the Chinese made intermediates, and partially eliminates the Chinese product from the market. Reduced Chinese production decreases portfolio investment directed to China. Figure 6 depicts the changes in the regional consumption. China decreases consumption throughout the simulation period, and their increased private saving outflows from the country.

5 Concluding Remarks

The purpose of this study is to present a simple prototype of an Applied General Equilibrium (AGE) model of global trade that incorporates the "forward-

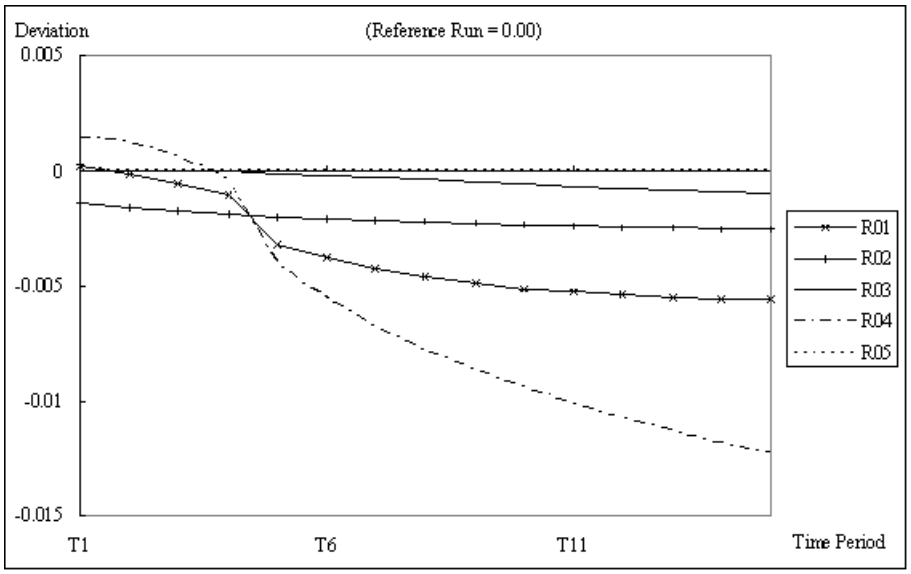

Figure 5: Effects on Production in the Rest of the World

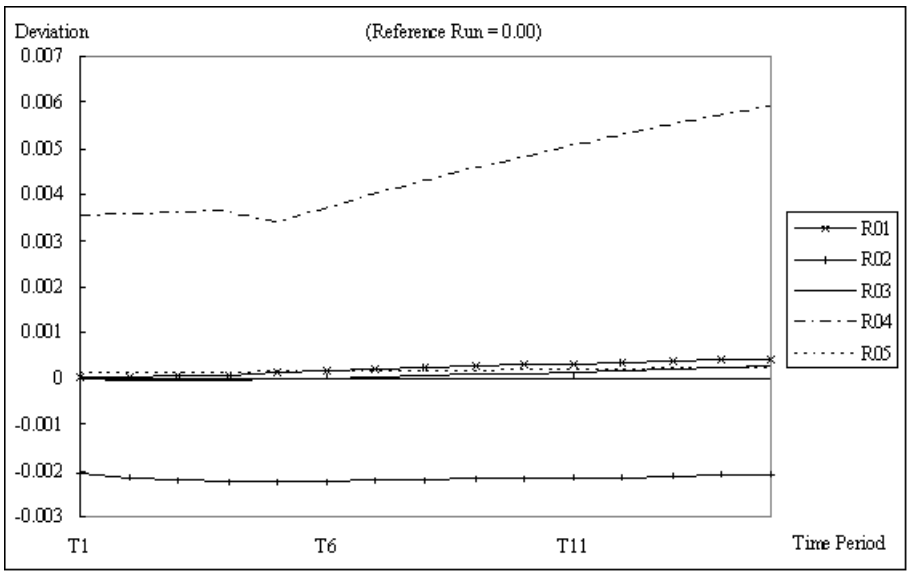

Figure 6: Effects on Consumption

looking" decision-making on investment made by Multi-National Enterprises (MNEs), and clarify the impacts of announced implementation of trade liberalization between Japan and ASEAN countries on the production volumes of MNEs that reflect changes in the FDI pattern. Since investment plans made by companies are essentially forward-looking, it is difficult to grasp the impacts of policy changes on FDI using a static or recursively dynamic model.

Simulations with the model revealed the response of MNEs to the trade liberalization. The key findings can be summarized as follows:

1. trade liberalization between Japan and ASEAN 4 increases FDI to the partner country/region, and the MNEs established outside the union change the destinations of FDI from the members to other non-members.

2. increases in FDI to the partner countries/regions do not reduce domestic production volumes in Japan and ASEAN 4.

3. excess production of Japanese companies in ASEAN 4 lowers the cost of intermediate inputs, and resultant depreciation of output prices of goods enables households in every country/region except China to consume more.

4. Since the product of Japanese companies operating in ASEAN 4 is a kind of rivalry with Chinese tradable for other countries/regions, the excess supply of the product of Japanese companies in ASEAN 4 partially eliminates the Chinese product from the market, and makes China be worse off.

There are several potentially important issues that are not taken into account in the present analytical framework. First, the model used in this study is too difficult to be solved with the GAMS system. Inclusion of FDI to a global trade model tends to account for wide range values in certain variables, so that it makes scaling of the variables difficult. Further modifications should be made on the model to perform a variety of simulations.

Second, the model includes only the several profiles of MNEs. Some of the most important characters, such as technological transfer along with FDI, should be included in the model.

Third, some previous studies point out that economies of scale are often observed in markets in which MNEs exist. We therefore feel that it is necessary to abandon the assumption of perfectly competitive markets in the future.

Finally, future investment plans of MNEs are often affected by the anticipated exchange rate. An extension of the model to include monetary market is therefore necessary to handle FDI.

References

Armington, P. S. (1969), "A Theory of Demand for Products Distinguished by Place of Production", International Monetary Fund Staff Papers.

Brooke, A., D. Kendrick, and A. Meeraus (1992), *GAMS: A User's Guide. Release 2.25.*, Scientific Press, San Francisco.

Devarajan, S., and D. S. Go (1998), "The Simplest Dynamic General Equilibrium Model of an Open Economy", *Journal of Policy Modeling*, 20(6), 677–714.

Institute for International Trade and Investment (2002), *Statistics of World Foreign Direct Investment*, Institute for International Trade and Investment, Tokyo.

Hertel, T. W. (ed.) (1997), *Global Trade Analysis*, Cambridge University Press, Cambridge.

Lau, M. I., A. Pahlke, and T. F. Rutherford (2002), "Approximating Infinite-Horizon Models in a Complementarity Format: A Primer in Dynamic General Equilibrium Analysis", *Journal of Economic Dynamics and Control*, (26), 577–609.

Lee, H., and D. van der Mensbrugghe (2001), "Interactions between Direct Investment and Trade in the Asia-Pacific Region", in *Forth Annual Conference on Global Economic Analysis*, Purdue University.

Petri, P. A. (1997), "Foreign Direct Investment in a Computable General Equilibrium Framework", in *Brandeis-Keio Conference on Making APEC Work: Economic Challenges and Policy Alternatives*, Keio University.

Whalley, J. (1985), *Trade Liberalization among Major World Trading Areas*, MIT Press, Cambridge.

Yeldan, A. E., and T. L. Roe (1994), "Environmental Policy under Alternative Market Structures: Lessons from Turkey as a NIC", in *Fifth International CGE Modeling Conference*, ed. by T. Nguyen, University of Waterloo.