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Forward-Looking Effects of Trade Liberalization between Japan and ASEAN Members: In the Framework of Ramsey-Cass-Koopmans Type Economic Growth*

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Abstract

This report clarifies the potential impact of trade liberalization between Japan and ASEAN members, using a *forward-looking*, multi-regional, multi-sectoral Applied General Equilibrium (AGE) model of global trade. We perform simulations with the model to evaluate several trade-liberalization programs under prospective consideration by the Japanese government, and offer some insights into the dynamic side of the impact. The simulation results revealed that: (i) trade liberalization between Japan and ASEAN4 has a tendency to cause trade diversion into the union followed by steady capital accumulation, while the case between China and ASEAN4 changes the trend of interregional investment flows through announcement effects that may significantly affect patterns of trade; (ii) the announcement effects and the subsequent changes in patterns of interregional investment, caused by trade liberalization between China and ASEAN4, are sufficiently large, but sensitive and may be easily affected by other policy changes such as those induce steady capital accumulation through removal of distortions in trade markets; (iii) Japan has a possibly important role in the Asian region in the linking of China and ASEAN4 through close and complementary relationships of Japanese and Chinese industries, particularly in the manufacturing sector, since the initial relationship between China and ASEAN4 is not very strong; and (iv) the benefit that ASEAN4 would receive from trade liberalization with Japan might be amplified by free trade between China and ASEAN4.

Keywords: applied general equilibrium; economic growth; trade liberalization; global trade.

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1 Introduction

Over the past decade, the global economy has become increasingly interdependent and international linkages have intensified with the launch of the World Trade Organization (WTO). Most of the members of the WTO are also involved in regional economic arrangements such as the Asia-Pacific Economic Cooperation (APEC), the European Union (EU), and the North American Free Trade Agreement (NAFTA), or bilateral Free Trade Agreements (FTAs), in the process of WTO negotiations. Because it often takes a long time to agree on a single guiding formula to be used by all members in making multilateral tariff cuts when the coverage of trade liberalization is wide, small-scale economic arrangements such as preferential trading cooperation are regarded as being consistent with and supportive of the formation of large-scale frameworks. Such small-scale economic arrangements that precede global trade liberalization are rapidly increasing numbers.

Along with this global economic situation, the Japanese government is examining the feasibility of several economic arrangements, such as respectively with Chile, Korea, Malaysia, Mexico, the Philippines, and Thailand. In particular, when Japan and Singapore signed an economic partnership arrangement in January 2002, Japanese Prime Minister Junichiro Koizumi emphasized the importance of forming a comprehensive economic partnership that would include an FTA, between Japan and ASEAN. In order to support the initiative, a group of professionals from Japan and ASEAN members started listing sensitive products and evaluating anticipated impact of liberalizing trade. The proposal prepared by the group was presented at a top-level meeting among the ASEAN+3 economies held in November, 2002. While many economists believe that increased economic integration among countries has tended to increase long-term growth rates, and that deepening openness and economic interdependence through free trade and international investment capital movement may be major factors in generating prosperity for the global economy, it may be important for policy makers to numerically estimate the anticipated impact of liberalizing trade and investment when countries launch into an economic partnership program.

In the field of trade-related negotiations, results from Applied General Equilibrium (AGE) analyses based on certain economic data sets may be informative, because the analytical models can quantify the impact of the policy changes in a highly complicated economic system and may yield concrete evaluations. Whalley (1985) is one of the earliest research papers that quantifies the merits of alternative actions in international trade policy. It analyzes the impact of various trade liberalization initiatives, using a numerical model of global trade. More recent studies have been presented by the Global Trade Analysis Project (GTAP, Hertel ed. (1997)), which continuously carries out comprehensive analyses on trade-related subjects and supplies consistent data that enable us to analyze trade-related policy changes and get information for decision making. However, since the models used in these analyses are essentially based on a static framework, the dynamic side of the impact that is important in the field of open-economy macroeconomics[1], for instance, how patterns of savings and

[1]Using a two-country model with capital accumulation and assuming pooling equilibrium, Buiter (1989) analyzes the impact of various fiscal policies on trade balance. Ono and Shibata (1992) examine the effect of home country supply-side shocks on the welfare levels of both

investment that lie behind growth effects translate into certain patterns of current account dynamics, have not been captured in the analyses. While adding capital accumulation process to a static model, to be a recursively dynamic or *backward-looking* model, may enable us to capture some of the positive aspects of growth, it is quite clear that a satisfactory welfare analysis requires the introduction of *forward-looking* intertemporal preferences of households (who decide on savings), as well as *forward-looking* intertemporal optimization of firms (who decide on investment)[2]. In this regard, this study offers some insights into the potential impact of trade liberalization, incorporating *forward-looking* decision making of economic agents.

When one analyzes impact of trade liberalization, three types of effects can be considered: (i) direct and basic effects of removing trade barriers; (ii) growth effects through capital accumulations; and (iii) effect of interregional capital movement through changes in capital prices. The first effects are the most basic ones, which are analyzed mainly in the static framework. When a group of countries settle free trade, import prices of products from liberalization partners initially fall, because of the removal of trade barriers. The falls in import prices expand the union member's demand for the products, and as a result, output prices of the products rise. This implies the improvements of terms-of-trade against outside the union, so that the union members may import more while they export less, and be better-off.

The second effects are the growth effects, which need the dynamic framework to be captured. Once a certain change occurs in patterns of global trade, the impact last long through changes in regional investment that would be accumulated as capital. If capital accumulations in union members are accelerated by trade liberalization, the members may expand productions comparative to the case that there is no policy change takes place, forever. We may not miss this kind of effects that continues for a long period.

The third ones are the effects that we would like to emphasize in this study, since *forward-looking* framework is needed. When one expects future prosperities of countries, those who are going to settle free trade several years later, what will she/he do? From the view point of an investor, one may invest to the companies in the countries involved in the liberalization program. The key factor in this kind of effects is capital price, which affects patterns of interregional capital flows. Note that this kind of impact may arise even before the implementation of the liberalization program, and affect the global trade patterns of real goods through current account dynamics.

The purpose of this study is to answer the following questions, using a

home and foreign countries. Some studies make efforts to extend the $2 \times 2 \times 2$ Hecksher-Ohlin model into dynamic frameworks. Fisher and Vousden (1997) analyze the growth effects of customs unions and free trade areas. Ono and Shibata (1991) incorporate intertemporally optimizing agents and analyze the effect of fiscal policy on each country's welfare. From the view point of economic growth, Islam (2001) clarifies, using a numerical multi-regional growth model, that patterns and trends in the global economy are consistent partially with the stylized facts of growth of national economies, and that optimal growth rates, optimal structure, and growth dynamics without and with convergence constraints appear to be the same.

[2]Francois *et al.* (1997) and Keuschnigg and Kohler (1997) address the importance of accumulated growth effects of trade-related policy changes. Devarajan and Go (1998) point out the contradiction of the assumption in recursively dynamic models that the same agent behaves rationally for one set of decisions (within-period decisions) but irrationally for another (intertemporal decisions).

forward-looking, multi-sectoral, multi-regional AGE model of global trade:

1. How does trade-liberalization program between Japan and ASEAN members affect regional welfare levels?

2. What are the dynamic profiles of potential impact?

We approach these questions simulating announced implementation of trade liberalization between Japan and ASEAN members, in comparison with the case of China and ASEAN countries. The model used in this paper solves for a set of inter- and intra-temporally consistent prices. Both savings and investment are the result of dynamic optimization based on future prices that are consistent with the achieved levels of savings and investment. Since the *forward-looking* model is calibrated on the assumption that the benchmark data are obtained from the global economy in a stationary state, we focus on the qualitative dynamic impact of policy changes. In the evaluation of policy options, we compare impact quantifying deviations from the values of variables given in the reference run.

In the following section, we introduce a simple enough model to grasp again the basic impact of changes in trade barriers that may aid us understanding the simulation results. In section 3, we outline the major assumptions and the structure of the forward-looking, multi-sectoral, multi-regional AGE model used in this study. In section 4, we perform four simulations with the model and interpret the results. Finally, section 5 concludes the paper.

2 Economic Intuition

Since the interpretation of simulation results requires reference to theoretical analysis, we revisit in this section some basic aspects of the effects of changes in trade barriers on the global economy, using a simple enough two-region model[3]. With this simplest model, we may analyze static impact of trade liberalization on the relationship between union members and non-members, and on the relationship within union members. In addition, an extension of the static analysis may shed light on recursively dynamic effects. Through this analysis, we are able to estimate the direction of impact of a certain policy changes, and also understand that the major source of the effects is pre-determined by the initial condition of economies, such as the shares in trade flows and the levels of trade barriers.

Focusing on cross hauling, the presence of regions both importing and exporting the same product at the same time, we make the following assumptions: (i) domestically produced and imported goods are imperfect substitutes (the Armington assumption); (ii) domestically produced goods sold on the domestic market are perfect substitutes for goods sold on the export market; (iii) the economies determine quantities of imports according to the endogenously determined output prices (perfect competition); (iv) instead of putting a balance of trade constraint, the foreign capital inflows/outflows to balance current account; and (v) aggregate production which is analogous to factor input is fixed[4].

[3]de Melo and Robinson (1989) analyze effects of other kind of environmental changes in the international market using an one-small-country model.

[4]If we assume that the output is produced by only one factor and the production function

The consumer in Region r maximizes her/his composite consumption subject to the budget constraint. The consumption aggregator function is assumed to be convex to the origin. The consumer's problem is:

$$\begin{aligned} \text{Max} \quad & C_r = C_r(TF_{rs}) \\ \text{s.t.} \quad & \sum_s (1+\tau_{rs}) PW_s TF_{rs} = PW_r \overline{Z_r} + \sum_s \tau_{rs} PW_s TF_{rs} + FS_r \end{aligned} \tag{1}$$

where:

C_r is composite consumption to be maximized in Region r,

TF_{rs} is trade flow from Region s to Region r,

$\overline{Z_r}$ is exogenously given output in Region r,

PW_r is price of output produced in Region r,

FS_r is foreign savings in Region r that represent foreign capital inflow/outflow,

τ_{rs} is protection rate in Region r levied on trade flow from Region s, and

$C_r(\cdot)$ shows the consumption aggregator function.

Note that, when $r = s$ in TF_{rs}, trade flow includes domestically produced goods and intra-regional trade. As a result, one can analyze effects of changes in protection rate, levied on the intra-regional trade, on both the union member and the region outside the union with this model.

Since the global total of the foreign savings, which is given by summing up FS_r with respect to r, becomes zero, we convert the consumer's budget constraint (1) to the following.

$$\sum_r \sum_s (1+\tau_{rs}) PW_s TF_{rs} = \sum_r \left(PW_r \overline{Z_r} + \sum_s \tau_{rs} PW_s TF_{rs} \right) \tag{2}$$

In this case, the reciprocal of the Lagrange multiplier λ on Equation (2) translates into the global average of protection-inclusive import prices[5], $(1+\tau_{sr})PW_r$, and Equation (2) can be dropped from the system of the model setting λ to unity as the numeraire[6]. Every price of output produced in Region r, PW_r, is determined relative to the numeraire.

The first order condition for the optimum and market clearing condition make the entire system of the simplest two-region model. Those are:

$$(1+\tau_{rs}) PW_s = \frac{\partial C_r}{\partial TF_{rs}} \tag{3}$$

and

$$\sum_s TF_{rs} = \overline{Z_s} \tag{4}$$

is linear function of the factor input, the aggregate production can be interpreted as factor endowment. Nothing changes in results from the analysis.

[5]The protection-inclusive import prices are simply defined as the output prices with protections.

[6]In the *forward-looking* framework, this equation defines the capital market equilibrium in every period.

Assuming the consumption aggregator function is of Cobb-Douglas type, for simplicity, the model solves six endogenous variables, TF_{11}, TF_{12}, TF_{21}, TF_{22}, PW_1, and PW_2. The solution of the model gives these endogenous variables described with share parameter α_{rs}[7] and the initial protection rate τ_{rs}.

2.1 Static Effects of Trade Liberalization on the Relationship between Union Members and Non-Members

Firstly, define the following three representative variables with the parameters and the initial protection rates for simplicity:

$$A \equiv \alpha_{11}\alpha_{22} - \alpha_{12}\alpha_{21} \ (> 0) \tag{5}$$

$$X \equiv \frac{\left(\frac{\alpha_{11}}{1+\tau_{11}}\right)^{\frac{\alpha_{11}}{A}} \left(\frac{\alpha_{12}}{1+\tau_{12}}\right)^{\frac{\alpha_{12}}{A}}}{\left(\frac{\alpha_{21}}{1+\tau_{21}}\right)^{\frac{\alpha_{11}}{A}} \left(\frac{\alpha_{22}}{1+\tau_{22}}\right)^{\frac{\alpha_{12}}{A}}} > 0 \tag{6}$$

$$Y \equiv \frac{\left(\frac{\alpha_{11}}{1+\tau_{11}}\right)^{\frac{\alpha_{21}}{A}} \left(\frac{\alpha_{12}}{1+\tau_{12}}\right)^{\frac{\alpha_{22}}{A}}}{\left(\frac{\alpha_{21}}{1+\tau_{21}}\right)^{\frac{\alpha_{21}}{A}} \left(\frac{\alpha_{22}}{1+\tau_{22}}\right)^{\frac{\alpha_{22}}{A}}} > 0 \tag{7}$$

Normally, A is positive, since the shares of domestically produced goods plus intra-regional imports, such as α_{11} and α_{22}, are greater than those of interregional imports, such as α_{12} and α_{21}, in the total demand of a region. Therefore, for convenience, we assume positive A in the argument made in the rest of this section.

Let us assume countries included in Region 1 liberalize trade with the other countries included in the same region. This can be expressed as the reduction of protection rate, τ_{11}, when we focus on the relationship between union members and non-members.

Assuming positive A, we obtain: $\frac{\partial PW_1}{\partial \tau_{11}} < 0$; and $\frac{\partial PW_2}{\partial \tau_{11}} > 0$. This implies that, when the rate of protection levied on the intra-regional trade is reduced, output price of the product of the region where settle free trade rises, and output price of the region outside the union drops. As a result, terms-of-trade of the union member improves against non-members, and the region included in the union may import more from non-members, exporting the same amount before the policy change.

If we look at the impact on flow quantities of trade and consumption, it seems more complicated. Differentiating quantity variables in the model with respect to τ_{11}, we obtain: $\frac{\partial TF_{11}}{\partial \tau_{11}} \gtreqless 0$; $\frac{\partial TF_{12}}{\partial \tau_{11}} \gtreqless 0$; $\frac{\partial TF_{21}}{\partial \tau_{11}} \lesseqgtr 0$; $\frac{\partial TF_{22}}{\partial \tau_{11}} \lesseqgtr 0$; $\frac{\partial C_1}{\partial \tau_{11}} \gtreqless 0$; and $\frac{\partial C_2}{\partial \tau_{11}} \lesseqgtr 0$; when $X \lesseqgtr Y$. These show that the direction of changes are the same in the group of TF_{11}, TF_{12}, and C_1, and opposite in the group of TF_{21}, TF_{22}, and C_2. When the case that X is greater than Y, trade flows among union member and into the union from the outside increases when τ_{11} becomes smaller, and as a result, consumption level of the coalition member becomes

[7]The Cobb-Douglas type consumption aggregator is assumed to be linearly homogeneous that the summation of α_{rs} with respect to s is unity.

higher. Contrary, reduction of τ_{11} lessen the trade flows from the members to non-members and intra-regional trade outside the union. Consumption outside the union may decrease. This implies that trade-diversion to the union members occurs.

2.2 Static Effects of Trade Liberalization on the Relationship among Union Members

Let us assume a country/region liberalize trade reducing protection against another country/region. This can be expressed as the reduction of protection rate, τ_{12} or τ_{21}, in the model.

As in the previous case, we obtain: $\frac{\partial PW_1}{\partial \tau_{12}} < 0$; and $\frac{\partial PW_2}{\partial \tau_{12}} > 0$, assuming positive A. In the framework with the Armington assumption, cutting protection raises output price of the home country/region, and pulls down the price of the foreign output.

In turn, if we look at the impact on trade flows and consumption, we obtain: $\frac{\partial TF_{11}}{\partial \tau_{12}} \gtreqless 0$; $\frac{\partial TF_{12}}{\partial \tau_{12}} \gtreqless 0$; $\frac{\partial TF_{21}}{\partial \tau_{12}} \lesseqgtr 0$; $\frac{\partial TF_{22}}{\partial \tau_{12}} \lesseqgtr 0$; $\frac{\partial C_1}{\partial \tau_{12}} \gtreqless 0$; and $\frac{\partial C_2}{\partial \tau_{12}} \lesseqgtr 0$; when $X \lesseqgtr Y$. These show that liberalizing trade has similar effects on the foreign country/region to on the non-members in the previous case.

When the case that both home and foreign countries/regions settle free trade, opposite impact on trade flows and consumption is to be cancelled out, and direction of the total effect is determined depending on the initial condition of both economies. Output price of a country/region that has smaller share of domestically produced goods and intra-regional imports may have a tendency to be more sensitive and higher than that of another country/region that has larger share of domestically produced goods and intra-regional imports.

2.3 Recursively Dynamic Effects

Regarding the impact of the reduction of τ_{rs} on consumption as that on final demand, we may extend the analysis to recursively dynamic effects. Assuming monotonic increasing relation in final demand and investment[8], investment in Region r increases when the level of C_r becomes high. The increase of investment accelerates capital accumulation in Region r, and as a result, the production volume of the region becomes larger in the next period. This can be expressed as the increase of the output $\overline{Z_r}$.

If we consider the case that the volume of $\overline{Z_1}$ changes, we obtain: $\frac{\partial TF_{11}}{\partial \overline{Z_1}} \lesseqgtr 0$; $\frac{\partial TF_{12}}{\partial \overline{Z_1}} \lesseqgtr 0$; $\frac{\partial TF_{21}}{\partial \overline{Z_1}} \gtreqless 0$; $\frac{\partial TF_{22}}{\partial \overline{Z_1}} \gtreqless 0$; $\frac{\partial C_1}{\partial \overline{Z_1}} \lesseqgtr 0$; and $\frac{\partial C_2}{\partial \overline{Z_1}} \gtreqless 0$; when $X \lesseqgtr Y$. These show that when the case that X is greater than Y, effects of reduction in a particular protection rate may be amplified through the growth effects in the subsequent periods, while the changes in the volumes of output do not affect prices in the framework with Cobb-Douglas type consumption aggregator. Note that, if we assume Constant Elasticity of Substitution (CES) function with greater elasticity than unity, the gains from trade may also be magnified.

[8]This corresponds to the cases that split savings from household's income using constant saving rate.

3 The Model

In this section, we outline the major assumptions and the structure of the forward-looking, multi-sectoral, multi-regional AGE model used in this study. We also present the basic structure of Benchmark Data and the parameterization of the model.

3.1 Major Assumptions

First, let us show the nature of the model used in this study.

Multi-Sectoral, Multi-Regional Growth Model The framework is that of a dynamic multi-sectoral, multi-regional growth model, which is based on the Ramsey-Cass-Koopmans type of optimal growth theory. The global economy is divided into five countries/regions: (i) Japan; (ii) China; (iii) the Asian NIEs (Hong-Kong, Korea, Singapore, and Taiwan); (iv) ASEAN4 (Indonesia, Malaysia, the Philippines, and Thailand); and (v) the Rest of the World (ROW). While only four countries are included as the ASEAN members, because the model is planned to be extended to include Foreign Direct Investment (FDI) in the future[9], the other members are included in ROW. Industries are aggregated into three sectors: primary industries, manufacturing, and services[10]. Economic growth is led by the exogenous growth of labor input and Total Factor Productivity (TFP). In order to obtain a steady growth path as the base case, the economic growth rate should be equal among regions. While it is unrealistic to assume identical economic growth rates for each region, we assume the growth rates to be zero in order to focus on the qualitative dynamic impact of policy changes.

Perfect Competition The model is essentially based on the neo-classical growth theory, and its solution can be regarded as the result of perfect competition[11]. This is one straight-forward implication from the model. Since perfect competition is hardly realizable in actual economies, the simulation results may be interpreted 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. When one assumes monopolistic or oligopolistic scale economies in the model, the impact of policy changes may be amplified. In this regard, it can be said that results from the simulations with the model used in this study depict sorts of lower-bound estimates.

Primary Factors The labor force is assumed to be immobile beyond the regional boundaries. In contrast, investment capital flows across countries/regions

[9] Available data that captures interregional FDI flows and stocks are limited to those four countries out of the ASEAN members.

[10] The main purpose of this sector disaggregation is to capture the spillover effects through intermediate transactions. Sector specific growth patterns, such as those Roe and Saracoglu (2004) emphasize the importance, are not considered in this study.

[11] 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 that are often based on imperfect and biased information, we concentrate on an analysis assuming perfectly competitive markets.

(foreign capital inflow/outflow), and its flow is determined so as to balance each country/region's current accounts. It is assumed that the representative consumers in every country/region receives factor income from domestic firms, and that they then invest a fraction of their income through the interregional capital market. In addition to these, note that full employment of labor is assumed and plays an important role in performing simulations. Itakura *et al.* (2003) suggest that the investment capital may flood into particular regions in the wake of trade-related policy changes with the models assuming full employment. Since interregional investment capital movements affect welfare levels much in the general equilibrium framework, the simulation results may present extreme pictures.

Exchange Rates Exchange rates for the currencies of individual countries/regions do not enter into the equations in the model. 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 presented in neo-classical 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 changes, and the price level is determined by the money stock alone once real-side behavior is determined. Since the model used in this report is a real-side trade model, the issue of the determination of exchange rates does not arise.

Dynamic Consistency The agents' intertemporal behavior is assumed to be rational, so that the entire system of prices over time is internally consistent. This is because the model calculates variables of all the periods at the same time. Consumption and investment are determined on the basis not of what happened in the past, but of the assumed future conditions of technology, preference, and policy change. Changes in the future exogenous variables can affect present endogenous variables.

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), following Devarajan and Go (1998).

3.2 Basic Structure

In turn, we present the basic structure of the model used in this report, focusing on the dynamic side of the model. The model is an extension of a typical static global trade model, such as that presented by Hertel ed. (1997), with forward-looking properties, such as those introduced by Devarajan and Go (1998). In the following, subscripts r and t denote countries and time period, respectively.

Enterprise There is one competitive enterprise in each sector for every country/region, which produces one kind of product. Production and factor inputs are all determined endogenously so that resources are optimally used from the viewpoint of a maximization of net income. Factor substitutability is assumed among labor, capital, and intermediate input. Note that we assume that nested factor inputs in the production and technologies in all sectors exhibit constant returns to scale. Given the initial capital stock, interregional rate of return and prices of primary factors, composite intermediate good, composite investment good, and output, the dynamic decision problem of the enterprise is to choose a time path of investment that will maximize the value of the firm, defined as the discounted sum of temporal net cash flow yielded in every period. Investment comprises raw capital, and is equipped to form the capital stock of each country/region. Since this is a long-term model, inventory is included in investment.

An enterprise's optimization problem can be expressed as follows:

$$\text{Max} \qquad VF_{jr} = \sum_{t=1}^{\infty} \left(\prod_{v=1}^{t} \frac{1}{1+RI_v} \right) R_{jrt}$$

$$\text{s.t.} \qquad K_{jrt} \leqq A_{jrt-1} + (1-\delta_{jr}) K_{jrt-1} \qquad \perp PK_{jrt} \tag{8}$$

$$Y_{jrt} \leqq \text{CD}(K_{jrt}, L_{jrt}) \qquad \perp PY_{jrt} \tag{9}$$

$$Z_{jrt} \leqq \text{CES}(Y_{jrt}, QH_{jrt}) \qquad \perp PZ_{jrt} \tag{10}$$

$$\lim_{t\to\infty} \left(\prod_{v=1}^{t} \frac{1}{1+RI_v} \right) PK_{jrt} K_{jrt} = 0 \tag{11}$$

where:

VF_{jr} is the value of the j-th firm in Region r,

Z_{jrt} is j-th gross output in Region r,

Y_{jrt} is j-th value-added in Region r,

K_{jrt} is j-th capital stock in Region r,

L_{jrt} is j-th labor input in Region r,

QH_{jrt} is j-th composite intermediate input in Region r,

A_{jrt} is raw capital installed to be j-th capital in Region r,

PK_{jrt} is price of j-th capital in Region r,

PY_{jrt} is price of j-th value-added in Region r,

PZ_{jrt} is price of j-th output in Region r,

RI_t is interregional rate of return,

R_{jrt} is current net cash flow (the subtraction of costs and investment from sales) of j-th enterprise in Region r,

δ_{jr} is physical depreciation rate for j-th capital in Region r,

$\text{CD}(\cdot)$ shows the function is of Cobb-Douglas type,

CES$(\cdot)$ shows the function is of CES type, and

$\perp$ shows the counterpart relation between an inequality and a positive variable.

Equation (11) is the transversality condition, which places a limit on borrowing and ensures that the maximand is bounded.

Following Uzawa (1969), we assume the relation between quantity of investment and installable new capital, respectively per unit of capital stock, is given as:

$$\frac{A_{jrt}}{K_{jrt}} = f\left(\frac{QF_{jrt}}{K_{jrt}}\right) \tag{12}$$

where:

QF_{jrt} denotes composite investment good used by j-th enterprise in Region r.

The adjustment cost function $f(\cdot)$ satisfies: $f(0) = 0$; $f'(0) = 1$; $f' > 0$; and $f'' < 0$, and Equation (12) shows that adjustment cost is needed to set up investment goods to be installed as capital, and the cost of one unit of investment declines when capital accumulation proceeds. This implies that rapid capital accumulation needs more capital installation cost, and as a result, desired levels of capital stock are attained gradually with instantaneous changes in the rate of return.

First order conditions derived from this enterprise's optimization problem formulates the investment side of the dynamics in the model. Using the conditions, we obtain the following relation for interior solutions:

$$\begin{aligned}\frac{1}{1+RI_{t+1}} PK_{jrt+1}K_{jrt+1} \\ = PK_{jrt}K_{jrt} - \left\{1 - f'\left(\frac{QF_{jrt}}{K_{jrt}}\right)\right\} PQF_{rt}QF_{jrt} \\ - (PY_{jrt}Y_{jrt} - PL_{jrt}L_{jrt} - PQF_{rt}QF_{jrt})\end{aligned} \tag{13}$$

where:

PL_{rt} is price of labor in Region r, and

PQF_{rt} is composite price of investment good in Region r.

The second term of the right hand side is the adjustment cost for capital installation, and the third term is net cash flow payable to owners of capital as dividend. Equation (13) shows that future rise of capital price affects in the direction of increasing investment considering the adjustment cost, through retaining operating surplus inside the enterprise.

Household Given the interregional rate of return, composite price of consumption good, and regional wealth, the representative consumer in each country/region chooses a time path of savings that will maximize her/his discounted utility of the temporal sequence of aggregated consumption. 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, since the goods are imperfect substitutes, interregional capital market equilibrium conditions define the foreign borrowings/lending for each region endogenously. The model treats capital flows as equal to the balance of trade, adjusted for debt-service payment/receipt, and the stream of debt-service payment/receipt arising from an increase in foreign borrowings/lending is incorporated into the household's decision making. Without uncertainty and with efficient capital markets, financial assets among countries/regions earn the same anticipated rate of return.

A household's optimization problem can be expressed as follows:

$$\begin{aligned} \text{Max} \quad & U_r = \sum_{t=1}^{\infty} \overline{L_{rt}} \left(\frac{1}{1+\rho_r} \right)^t \frac{1}{1-\sigma_r} \left(\frac{QC_{rt}}{\overline{L_{rt}}} \right)^{1-\sigma_r} \\ \text{s.t.} \quad & \sum_{t=1}^{\infty} \left(\prod_{v=1}^{t} \frac{1}{1+RI_v} \right) PQC_{rt} QC_{rt} \leqq W_r \qquad \perp \lambda_r^H \end{aligned} \tag{14}$$

where:

U_r is utility level in Region r,

$\overline{L_{rt}}$ is exogenous labor supply in Region r,

QC_{rt} is composite consumption in Region r,

PQC_{rt} is composite price of consumption good in Region r,

λ_r^H is the marginal utility of wealth in Region r,

W_r is regional wealth (the discounted sum of current net factor income and foreign debt/asset) in Region r,

ρ_r is subjective discounted rate in Region r, and

σ_r is inverse of the elasticity of intertemporal substitution in Region r.

Similar to the enterprise's investment, first order conditions derived from the above optimization problem formulates the consumption side of the dynamics in the model. When we ignore the regional growth of labor for simplicity, we obtain the following relation for interior solutions:

$$\frac{QC_{rt+1}}{QC_{rt}} = \left\{ \left(\frac{1+RI_{t+1}}{1+\rho_r} \right) \frac{PQC_{rt}}{PQC_{rt+1}} \right\}^{1/\sigma_r} \tag{15}$$

Equation (15) implies that higher rate of return makes future consumption cheaper, so that future consumption increases. The rate of return RI_t is determined by the opportunity cost of savings, which in this study is the cost of foreign borrowings.

Interregional Trade The product of the firm in every country/region is not treated as homogeneous across countries but as imperfect substitute for that of another. By way of example, American and Japanese cars are not treated as a single homogeneous product (cars), but as differentiated products between

which there is a specific elasticity of substitution due to demand. This assumption is called the Armington assumption (Armington (1969)) and is necessary to accommodate cross hauling (the phenomenon of a country both importing and exporting the same product at the same time). This is inconsistent with the traditional Hecksher-Ohlin trade model, which is based on the premise of homogeneous products. The model adopts a transaction system similar to the GTAP model, presented by Hertel ed. (1997), to note the interregional trade.

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 goods in the economy holds; (ii) the demand for total labor equals its supply; (iii) government's tax revenue is allocated between public expenditure and saving; and (iv) global-wide total of savings equals total investment[12].

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 time horizon, we follow the usual procedure of imposing stationary state conditions at some future terminal period. The converting procedure used in this study will be shown later. On the investment side, the required condition is that investment is equal to the physical depreciation rate plus exogenously given post-terminal growth rate times capital stock. At the same time, current account is in equilibrium that debt-service payment/receipt is equal to the net exports/imports[13]. Since the stream of debt-service payment/receipt is incorporated into the household's decision making, as noted in the part of the household's utility maximization, this condition functions like the so-called No Ponzi-Game condition for the consumer's dynamics. As long as the terminal conditions are satisfied, the sums of various infinite series pertaining to the investment equation and the consumption function will be finite and well defined.

Conversion of the Infinite Time Horizon Model to a Computable Format with a Certain Terminal Period Since we know the value of the j-th firm in Region r at every time period t is equivalent to the value of capital $PK_{jrt}K_{jrt}$, the previously appeared VF_{jr} can be divided into two terms:

$$\begin{aligned} VF_{jr} = &\sum_{t=1}^{T}\left(\prod_{v=1}^{t}\frac{1}{1+RI_v}\right)R_{jrt} \\ &+\left(\prod_{t=1}^{T}\frac{1}{1+RI_t}\right)(1+\gamma_r)PKT_{jr}K_{jrT} \end{aligned} \tag{16}$$

[12]This condition can be dropped because of the Walras' law. The counterpart variable of the condition (iv) is interregional rate of return. Every agent in every country/region faces this identical rate of return in the model.

[13]Following Ono and Shibata (1992), exports and imports do not balance in a stationary state in this study.

where:

PKT_{jr} is price of j-th capital in Region r at the time period $t = T$, and

γ_r is post-terminal balanced growth rate in Region r.

The second term of the right hand side of Equation (16) is the present value of the j-th firm in Region r at the time period $t = T$, which must be zero when $T \to \infty$ as the transversality condition. This value of capital is returned to the household at the end of the time period $t = T$, and finance the series of final consumption after the time period $t = T + 1$ as the non-human wealth along with the human wealth.

Introducing a stationary state condition instead of the transversality condition, the previously shown enterprise's optimization problem can be converted to a problem, which maximizes Equation (16) as the objective function subject to Inequalities (8), (9), (10), and (17):

$$(\gamma_r + \delta_{jr})K_{jrT} \leqq A_{jrT} \qquad \perp PKT_{jr} \tag{17}$$

Let us ignore the several kinds of income taxes, and government and foreign savings to make discussions simple. Then, the regional wealth W_r in the household's budget constraint (14) can be expressed by both non-human and human wealths as follows:

$$W_r = VF_{jr} + \sum_{t=1}^{\infty} \left(\prod_{v=1}^{t} \frac{1}{1 + RI_v} \right) \sum_j PL_{rt} L_{jrt} \tag{18}$$

Note that the transversality condition for the household's maximization problem is implicitly included in the above Equation (18).

Assuming that the series of consumption in the post-terminal period is financed by the value of capital, which is returned from enterprises at the end of the time period $t = T$, and human wealth earned in the post-terminal period, the budget constraint for the household's final consumption (14) can be converted to:

$$\begin{aligned} \sum_{t=1}^{T} \left(\prod_{v=1}^{t} \frac{1}{1 + RI_v} \right) PQC_{rt} QC_{rt} \\ \leqq \sum_{t=1}^{T} \left(\prod_{v=1}^{t} \frac{1}{1 + RI_v} \right) \sum_j (R_{jrt} + PL_{rt} L_{jrt}) \end{aligned} \tag{19}$$

Other optimal conditions derived from the previously shown household's utility maximiztion problem are not affected by this conversion.

Choice of the Terminal Period As variables of different time-periods are interdependent, the computation burden is much larger than that for models that calculate solutions period by period (recursively dynamic or *backward-looking* models). Moreover, extensions of the calculation horizon increase calculation difficulty more than proportionally, and expansions of models with respect to the number of sectors or regions are more difficult. Because of these difficulties and a limited amount of computational resources, we set the terminal period at $T = 50$[14].

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

Software The model is formulated as a Mixed Complementarity Problem (MCP) and solved by "PATHC" of the General Algebraic Modeling System (GAMS)[15]. MCP is a set of Kuhn-Tucker conditions derived from certain optimization problems.

3.3 Overview of the Benchmark Data

The source of data for the model is the GTAP version 5 database. A fixed proportion of services output is supplied for interregional shipping services. Countries/regions and industries are aggregated into five and three, as noted in the previous section. Assuming that the data is obtained from an economy in a stationary state, parameters and exogenous variables are calibrated from the data. In this section, we document the GTAP version 5 database that forms the basis for our analysis.

Basic System of the GTAP Data The GTAP database is a set of regional input-output tables and sectoral trade flows that connect sectoral exports and imports that appear in the input-output tables, plus several kinds of estimated elasticity. The target year is 1997. There are four sheets of trade-flow data, which are respectively presented at wholesale prices, F.O.B. prices, C.I.F. prices, and protection-inclusive market prices. The differences among these four sheets consist of *ad valorem* equivalent domestic transportation margins and export subsidies, international shipping margins, and import tariffs, import quotas, antidumping duties and non-tariff barriers. Note that we collectively handle the latter four (import tariffs, import quotas, antidumping duties, and non-tariff barriers), as a single item to be removed in the simulations performed in this report.

Service Trade Service trade includes trade in factor services (interest, profits, and dividends) as well as trade in non-factor services (business, insurance, and financial services). In the GTAP framework, we have data only on non-factor services trade, which are in turn broken down into shipping and non-shipping service components. In the model, a fixed fraction of output is supplied for interregional shipping services. Since the GTAP database does not fully include estimated trade barriers, which might exist in service trade, our simulations do not reflect reforms in the service sector. Francois (2001) estimates *ad valorem* equivalent distortions in trade in services, and incorporates mark-ups by monopolistic firms. One point is that this kind of modifications may vastly magnify the anticipated impact of trade liberalization. While the real service sector may remain restrictive, it is not included in this study because of difficulties in measuring the distortions or mark-ups: therefore, the simulation results in this study may be regarded as lower-bound estimates.

Behavioral Parameters Some of the behavioral parameters used in this analysis, such as the set of substitution elasticity for the CES aggregators, are weighted average of the values provided by GTAP database. The substitution elasticity for the commodities from different countries/regions are on the assumption of so-called *Rule of Two*. Other parameters are calibrated from the

[15] Brook *et al.* (1992).

benchmark data to reproduce the initial equilibrium in a stationary state[16], 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 impact of policies simulated. As shown in Section 2, the behavioral parameters rule the 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 results of four simulations, categorized into two types, performed in this *forward-looking* framework. The two categories distinguish simulation scenarios according to whether the primary industries are included or not included in the trade-liberalization program. This is because some groups are feeling concern for the case that liberalizing trade in primary industries, especially in agriculture, reduce domestic production volumes of the sector when they face a more competitive trade market.

In the case in which trade liberalization is implemented for all of the sectors (let us call this as "Case A" in the simulations), we consider three scenarios[17]: (i) trade liberalization between Japan and ASEAN4 that takes place in the fifth period; (ii) trade liberalization between China and ASEAN4 that is imposed in the fifth period; (iii) sequential implementation of (i) and (ii) whereby China (initiating free trade in the fifth period) precedes Japan (liberalizing trade in the ninth period). The third scenario considers the present situation that China is going ahead of Japan in preparing to conclude agreements on economic partnerships with ASEAN members[18].

In turn, we consider one additional scenario, which corresponds to (i), trade liberalization between Japan and ASEAN4 that takes place in the fifth period in Case A, and in which trade liberalization is implemented for the manufacturing and service sectors (Case B). The reason is that there is only a small difference between Cases A and B in other combinations of policies.

In these experiments, we examine announced effects of the policy changes that are fully anticipated four or eight periods ahead, and trade barriers against the other member countries/regions of the union are removed forever after lib-

[16]A detailed calibration procedure in a forward-looking model is clearly presented by Devarajan and Go (1998).

[17]In the simulations, Singapore, who is grouped in the Asian NIEs in this analysis, is not included in trade-liberalization programs. This is because, as mentioned before, the model used in this study is designed to be comparable with an extended model that incorporates FDI, which is now under construction. Since we make a great point of analyzing qualitative dynamic impact of liberalizing trade in this study, we prioritized comparing results from several *forward-looking* models, which have identical aggregation level but are different in the choice of assumptions over simulating plausible policy changes.

[18]There is no special reason in our choice of the period when policy changes occur. To highlight the impact of two trade-liberalization programs, assuming sequential implementation makes things clear rather than assuming simultaneous one. It is difficult to split effects of a policy change from those of another in simulating several policy implementations in the same period.

eralizing trade. Note that, in the figures, the deviations in values of variables from the base case are shown.

4.1 Existing Trade Barriers

First of all, we identify the trade barriers to be removed in the simulations. Table 1 shows the *ad valorem* equivalent protection rates for 1997 levied on sectoral trade flows from the source countries/regions (appearing in the top row) to the destination (appearing in the left column). The values of protection are obtained by subtracting the trade flows at C.I.F. prices from those at protection-inclusive market prices. Specifically, these margins include import tariffs, import quotas, antidumping duties, and non-tariff barriers. Note that we collectively handle them in the simulations as the trade barriers to be removed.

		Japan	China	NIEs	ASEAN4	ROW
Japan	Primary	0.000	13.900	11.360	2.191	12.742
	Manuf.	-1.086	8.477	4.933	8.974	9.239
	Services	0.000	-0.001	-0.007	-0.002	-0.004
China	Primary	9.492	0.003	9.757	4.778	17.767
	Manuf.	15.632	0.001	16.489	19.150	14.111
	Services	-0.019	0.000	-0.010	-0.016	-0.014
NIEs	Primary	10.121	49.825	9.744	3.753	11.586
	Manuf.	4.224	3.568	1.968	1.685	4.188
	Services	0.027	0.018	0.101	0.136	0.083
ASEAN4	Primary	12.038	14.794	36.071	6.613	6.043
	Manuf.	11.116	11.771	8.388	9.998	7.812
	Services	0.000	0.000	0.000	0.000	0.000
ROW	Primary	8.379	9.751	12.881	9.111	4.588
	Manuf.	5.651	8.907	6.744	7.687	4.586
	Services	0.147	0.131	0.395	0.164	0.166

Table 1: *Ad Valorem* Equivalent Protection Rates (%, 1997)

4.2 Dynamic Effects

In this subsection, we focus on the dynamic impact of the four scenarios of trade-liberalization programs in the Asian region. In a static framework, output prices of the commodities produced in countries/regions involved in a union tend to rise relative to the global average of output prices, as seen in Section 2. The high prices of products of union members in comparison with those of non-members improve the terms-of-trade, and enable the members to be better off. Under the condition of low price distortion and resulting more efficient intra- and interregional resource allocation, trade diversion may occur, and as a result, economic volumes of union members may enlarge in the global economy through expansions of production among the members. Such growth effect amplifies the static impact through capital accumulations in a dynamic framework.

In the framework of *forward-looking* dynamics, capital price becomes one key factor. Changes in capital prices triggered by the future static shock will

lead movements into patterns of interregional investment flow in the period before the policy change, following the movements in interregional trade in goods. The effects of the movements in interregional investment are crucial for the global economic situation. When a policy change, such as trade liberalization, is announced to be implemented in a certain future period, the expected static impact and subsequent growth effects raise the capital prices[19] among the union members relative to those among the non-members. Thus, the effects of future trade liberalization appear in the periods before policy changes through the movements in interregional investment flows, and the existence of price distortions characterizes the impact before and after policy implementation. In the pre-implementation period, changes in capital prices affect the allocation of interregional investment, and at the same time, affect the real markets through changes of output prices.

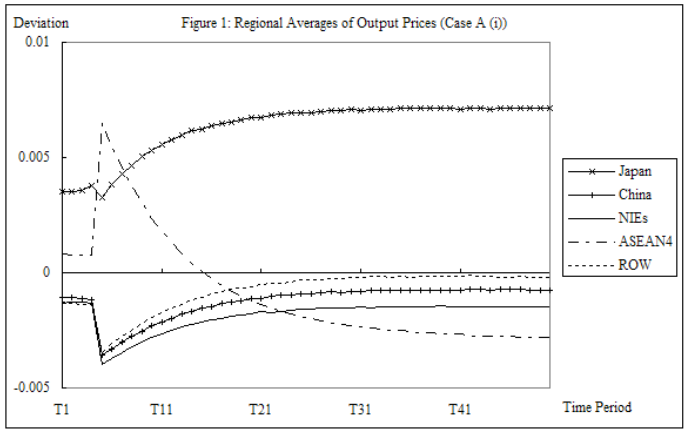
4.2.1 Case A (i): Trade Liberalization between Japan and ASEAN4

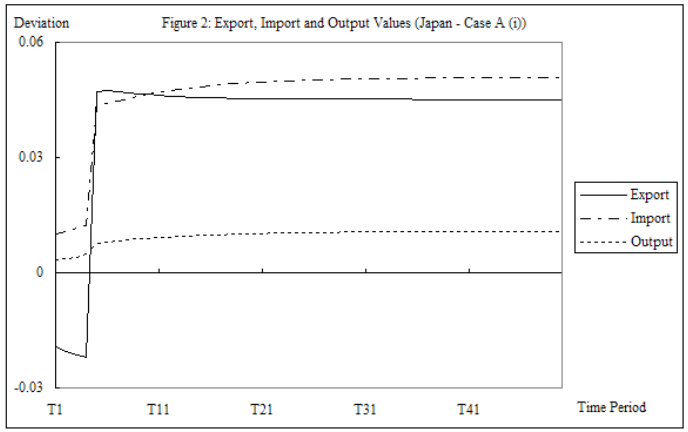
We start with simulating trade liberalization between Japan and ASEAN4 that takes place four periods ahead. In this case, the basic impact confirms our economic intuition obtained in the previous section. Since the values of A, X, and Y, given in Equations (5) to (7), are respectively 0.92, 63.14, and 0.05, when we consider the relationship between union members and non-members, output prices of Japan and ASEAN4 rise relative to the global average of output prices. According to these improvements of terms-of-trade, both trade flow between Japan and ASEAN4, as well as inflow to the free-trade area from China, the Asian NIEs, and ROW increase. In contrast, trade outside the union, and trade outflows from Japan and ASEAN4 to other countries/regions are respectively reduced. Trade diversion to Japan and ASEAN4 occurs.

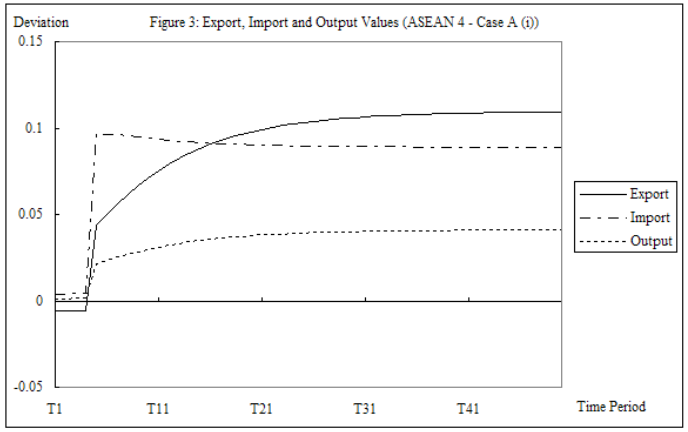
Figure 1 shows the dynamic impact of trade liberalization between Japan and ASEAN4 on regional averages of output prices relative to the global average. The values are deviations from the base case that there is no policy change takes place, and the values above/below the zero level can be regarded as improvements/aggravations of terms-of-trade, so that the corresponding countries/regions may import more/less while exporting less/more. The previously mentioned basic impact of liberalizing trade are appearing just after the fifth period, when Japan and ASEAN4 settle free trade, that output prices of Japanese and ASEAN4 products rise. The basic improvements/aggravations of terms-of-trade affect capital prices to rise/fall in the period before the policy implementation, and yields announcement effects that change patterns of interregional investment flow. If the country/region who is involved in a trade liberalization program accumulates sufficient capital, capital price in the country/region may fall in the post-implementation period. If capital stock is not sufficiently accumulated within a certain period, because of the existence of adjustment cost for capital installment, capital price may remain high. In the former case, capital formation in the country/region is financed mainly by domestic investment through growth effects, and the share of interregional investment forwarded to the country/region decreases.

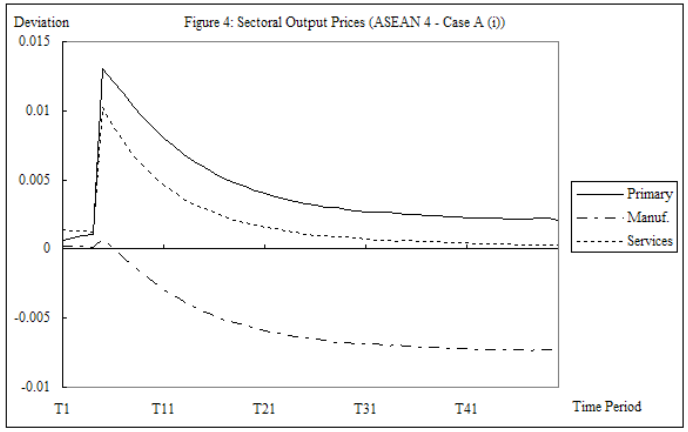
The following points can be observed if we look on Figures 2 and 3, which show export, import, and output values of Japan and ASEAN4, respectively,

[19]Capital prices may be translated into stock prices. Capital price times interregional rate of return in the model forms dividend and earnings retained in an enterprise to be invested.


Deviation
Figure 1: Regional Averages of Output Prices (Case A (i))
0.01
0.005
0
-0.005
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW


Deviation
Figure 2: Export, Import and Output Values (Japan - Case A (i))
0.06
0.03
0
-0.03
T1
T11
T21
T31
T41
Time Period
Export
Import
Output


Deviation
Figure 3: Export, Import and Output Values (ASEAN 4 - Case A (i))
0.15
0.1
0.05
0
-0.05
T1
T11
T21
T31
T41
Time Period
Export
Import
Output


Deviation
Figure 4: Sectoral Output Prices (ASEAN 4 - Case A (i))
0.015
0.01
0.005
0
-0.005
-0.01
T1
T11
T21
T31
T41
Time Period
Primary
Manuf.
Services

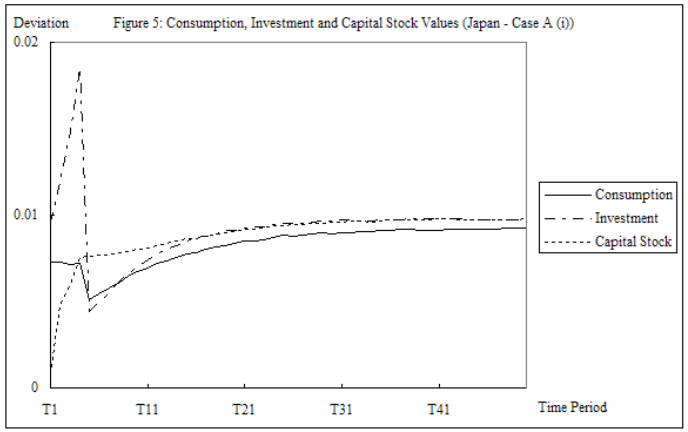
in addition to Figure 1. First, Japanese and ASEAN4 export volumes are reduced before liberalizing trade. This is because, the capital prices in Japan and ASEAN4 rise in comparison with those of the other countries/regions before the policy change, so the proportion of the interregional investment flow directed toward the region, particularly toward Japan, becomes larger. Consequently, Japan and ASEAN4 increase foreign savings by cutting exports and importing more, in the pre-implementation period. This increased foreign savings finances the expansion of investment in Japan and ASEAN4.

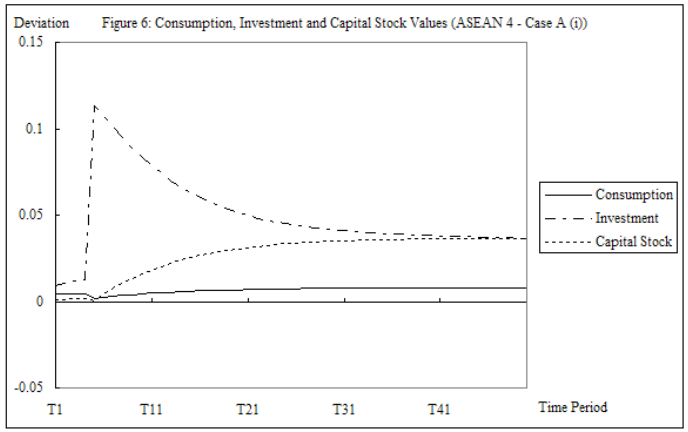
Second, there is a large difference in the time profile of output prices, between Japan and ASEAN4. The average output price of ASEAN4 products falls sharply after the policy change, and the price goes below the level in the base case after the 15th period. Consequently, impact on exports from ASEAN 4 exceeds that on imports after the 15th period.

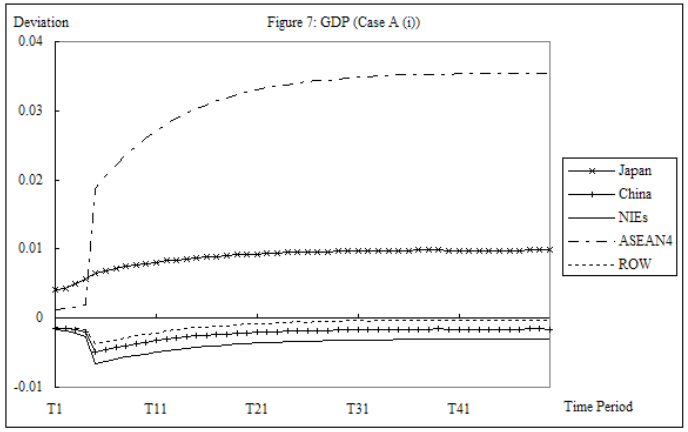
One interesting point on the fall of output price in ASEAN4 is that it comes from the manufacturing sector. Figure 4 shows effects on the sectoral output prices in ASEAN4. Output prices of manufactured products drop after the implementation of the policy. This indicates that liberalizing trade with Japan expands the volume of manufacturing sector in ASEAN4, concentrating resources from primary and service sectors, and resulting excess supply of the products lowers the output prices. While some important elements, such as interregional fragmentation and intra-group trade in Multi-National Enterprises (MNEs), are not modeled in this study, the close relationships among manufacturers operating in Japanese and ASEAN4 might be suggested with this result.

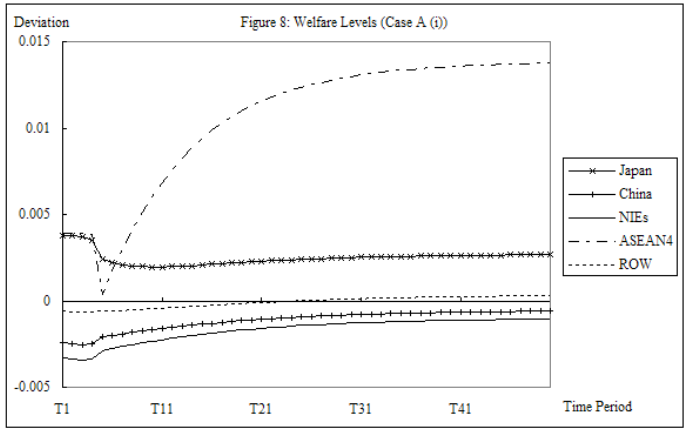
Another aspect for the difference in the time profile of output prices comes from the capital-investment side. Figures 5 and 6 show the effects on values of consumption, investment, and capital stock in Japan and ASEAN4. It is clear that the investment in Japan increases before liberalizing trade, and in the post-implementation period, it rapidly decreases to the new stationary state level. In contrast, the investment in ASEAN4 increases with the implementation of trade liberalization then gradually decreases to the new stationary state level higher than the base case. The deviation of investment in ASEAN4 is more than five times higher than that in Japan at the highest level. This implies that a large portion of interregional investment flows into ASEAN4 after the policy change is outflow from Japan. The rush of interregional investment to ASEAN4 enlarges the stock of foreign capital of ASEAN4, and a portion of the borrowings is repaid to the creditors within the simulation period. The terminal condition for the model used might affect this result. Since the capital in ASEAN4 is steadily accumulated, the foreign borrowings may easily be repaid, and the capital prices in ASEAN4 fall along with advances of capital accumulation. This is reflected to the gradual fall in output prices in ASEAN4 in the post-implementation period.

Figures 5 and 6 also show that the levels of investment in Japan and ASEAN4 toward the new stationary state are respectively one and three percent higher than the base case. It implies that investment in both countries/regions is continuously expanded by the trade liberalization. This is the result of growth effects, in addition to the improvement in terms-of-trade. If we look at GDP, the impact of trade liberalization between Japan and ASEAN4 is clearly illustrated. The effects on GDP are shown in Figure 7. Since the values in the figure shows the deviations from the base case, GDP levels in Japan and ASEAN4 are successively raised by one and more than three percent, respectively.


Deviation
Figure 5: Consumption, Investment and Capital Stock Values (Japan - Case A (i))
0.02
0.01
0
T1
T11
T21
T31
T41
Time Period
Consumption
Investment
Capital Stock


Deviation
Figure 6: Consumption, Investment and Capital Stock Values (ASEAN 4 - Case A (i))
0.15
0.1
0.05
0
-0.05
T1
T11
T21
T31
T41
Time Period
Consumption
Investment
Capital Stock


Deviation
Figure 7: GDP (Case A (i))
0.04
0.03
0.02
0.01
0
-0.01
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW


Deviation
Figure 8: Welfare Levels (Case A (i))
0.015
0.01
0.005
0
-0.005
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW

While GDP may be a major indicator that captures the economic condition, increases in income do not directly imply improvement in welfare levels. Even when income levels increase, welfare levels may worsen if commodity prices rise more than increases in income. In this regard, we also check the welfare levels, which are measured by the consumption quantities in each country/region.

Figure 8 shows the effects on consumption quantities of every country/region comparative to the case that no policy change takes place. Since the welfare levels reflect the story noted above, Japan and ASEAN4 are better-off in the new stationary state. Improvement in Japanese welfare is the result of the improvement in terms-of-trade, expansion of imports from ROW with cheap prices. On the other hand, ASEAN4 enjoys consumption of imports from ROW after the policy implementation, and also domestic products that finally become cheaper than the base case. After the 15th period, consumption level of ASEAN4 reaches 1 percent higher than that in the base case, and it continues forever. The trough in the fifth period is caused by the sharp rise in the prices of home products supplied for domestic consumption. Since the largest trade partner of Asian countries/regions is ROW, ROW recovers welfare level withdrawing interregional investment capital.

The levels of consumption also show the levels of saving. As seen, investment by ASEAN4 sharply increases in the fifth period, and there is a change in the patterns of interregional investment flows to be forwarded to ASEAN4. The consumption level of ASEAN4 shows that the saving rate in ASEAN4 is also raised to finance the expansion of investment within the region in the fifth period.

4.2.2 Case A (ii): Trade Liberalization between China and ASEAN4

The second simulation is trade liberalization between China and ASEAN4. As in the case between Japan and ASEAN4, trade liberalization is announced four periods before the implementation. In this case, the story seems to be totally different from the previous case. While the values of A, X, and Y are respectively 0.86, 83.09, and 0.08, when we consider the relationship between union members and non-members, price effects are dominant in the overall impact. The rise in output prices in China and ASEAN4 spills over to the global economy through intermediate use of imports. Consequently, the global average of output prices is three times higher than in the base case, relative to the interregional rate of return. This is because the initial relationship between China and ASEAN4 through trade is the weakest in the relationships among the five countries/regions modeled in this study. Table 2 shows the initial relationships among countries/regions with regard to both exports and imports. In the table, each country/region labeled at the top is the source, and in its column for the destinations listed at left.

It can easily be seen that the shares of China show the smallest values in both exports (4.26%) and imports (4.72%) of ASEAN4, and that those of ASEAN4 are similar in Chinese exports and imports (3.53% in exports and 3.92% in imports). Because of initial weaknesses in trade relationships, products with inflated prices are exported from both China and ASEAN4, and used as intermediate inputs in countries/regions all over the world. This causes a secondary price rise in commodities produced in Japan, Asian NIEs, and ROW, and amplifies the price effects several times larger than the initial impact. As

Panel A: Export Side

	Japan	China	NIEs	ASEAN4	ROW
Japan	0.00	17.04	8.38	13.91	5.93
China	8.66	0.00	12.52	3.53	1.85
NIEs	18.35	14.42	10.43	19.82	5.41
ASEAN4	10.12	4.26	10.95	5.90	2.76
ROW	62.87	64.28	57.71	56.85	84.05
Total	100.00	100.00	100.00	100.00	100.00

Panel B: Import Side

	Japan	China	NIEs	ASEAN4	ROW	Total
Japan	0.00	10.15	9.82	9.23	70.80	100.00
China	21.25	0.00	29.57	4.72	44.45	100.00
NIEs	18.48	7.10	10.12	10.88	53.43	100.00
ASEAN4	19.07	3.92	19.87	6.06	51.08	100.00
ROW	6.25	3.13	5.53	3.08	82.01	100.00

Table 2: Share of Trade Partner (%, 1997)

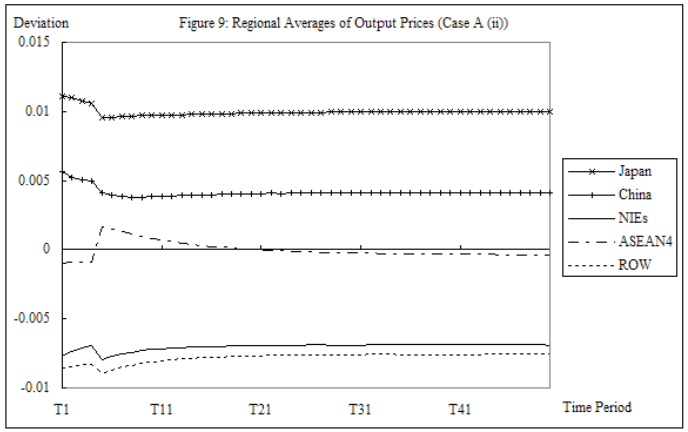
mentioned before, one cause of this phenomenon is because of the assumption of full employment. If one were to include the factor of redundant workers in Asian countries/regions, the price effects would be moderate.

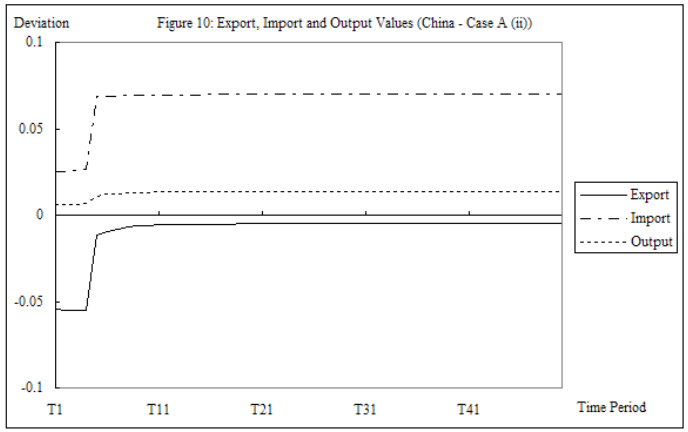
Taking a look on regional averages of output prices shown in Figure 9, which are relative to the global average, to see regional terms-of-trade, an interesting point can be observed. One may find that the average output price of Japanese products takes the highest values in the global market throughout the simulation period. This is caused because the Japanese intermediate use of imported materials from China and ASEAN4 occupies three times larger shares than that in ROW. According to the strong structural relationships among Japanese industries and producers in China and ASEAN4, Japan also improves terms-of-trade and becomes prosperous along with China and ASEAN4 liberalize trade.

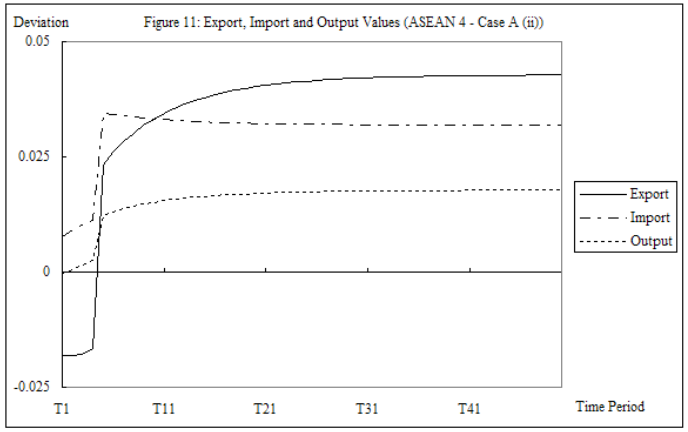
From the view point of interregional capital investment, the improvement of Japanese terms-of-trade raises capital price in Japan, as seen in the previous simulation. Since global investment mainly flows into both China and ASEAN4 during the pre-implementation period in this case, Japanese capital price remains high and is reflected to output prices in Japan.

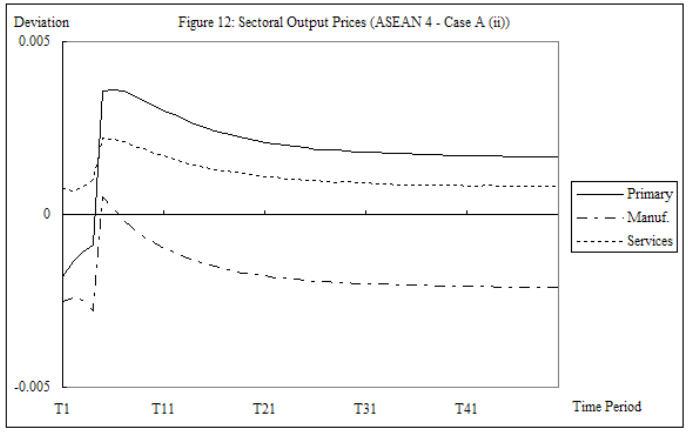
An important point here is that the announcement effects are much sensitive to some other policy changes that may affect people's future expectation, such as increases in consumption tax or pension fund burden that are under consideration in Japan, or possible free trade programs between the United States and Asian economies. It should be reminded that our experiments simulate some pure situations that do not include any other environmental change, which may take place all around the world. Inclusion of such policy changes in addition to the trade liberalization considered here may show different results.

The effects of trade liberalization between China and ASEAN4 that tales place in the fifth period on export, import, and output values of China and ASEAN4 are respectively shown in Figures 10 and 11. It is clear that exports of China do not exceed the volume in the base case while imports expand through-


Deviation
Figure 9: Regional Averages of Output Prices (Case A (ii))
0.015
0.01
0.005
0
-0.005
-0.01
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW


Deviation
Figure 10: Export, Import and Output Values (China - Case A (ii))
0.1
0.05
0
-0.05
-0.1
T1
T11
T21
T31
T41
Time Period
Export
Import
Output


Deviation
Figure 11: Export, Import and Output Values (ASEAN 4 - Case A (ii))
0.05
0.025
0
-0.025
T1
T11
T21
T31
T41
Time Period
Export
Import
Output


Deviation
Figure 12: Sectoral Output Prices (ASEAN 4 - Case A (ii))
0.005
0
-0.005
T1
T11
T21
T31
T41
Time Period
Primary
Manuf.
Services

out the simulation period, different from the Japanese response in the previous simulation. In contrast, the response of ASEAN4 to trade liberalization with China is similar to that in the case with Japan, that exports decrease before the policy change because of the increase of foreign capital inflow during the period, both imports and exports increase after settling free trade and effects on import values exceed those on export for a while because of the improved terms-of-trade. Then, trade balance becomes positive along with the drop of output prices, and ASEAN4 repays foreign borrowings.

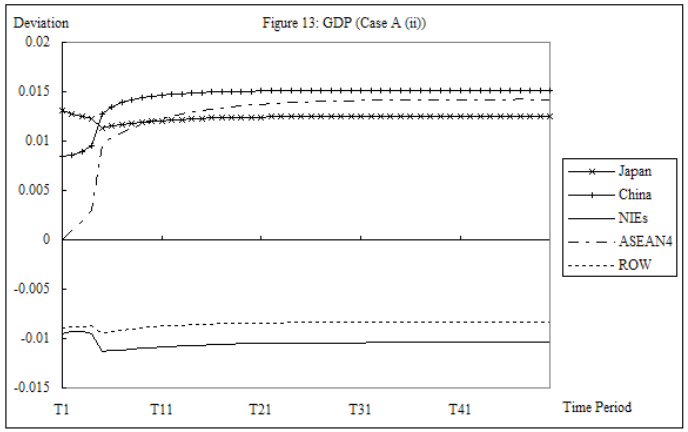
These results show that Japanese response crucially affects trade patterns in the Asian region, as well as there are two types of industrial relationships among Japan, China, and ASEAN4. Chinese and ASEAN4 products are respectively complementary to Japanese industries, while the relationship between China and ASEAN4 is competitive. Since it is not strange that investors expect Japan to be prosperous because its productions are complementary to the products from countries/regions that are going to settle free trade, capital prices in Japan rise even in the case of trade liberalization between China and ASEAN4, and even in the period just the policy change is announced. On the other hand, the competitive relationship curbs Chinese exports and keeps output price of Chinese products high, while the output price of manufactured products made in ASEAN4 falls as in the previous case. Figure 12 shows the sectoral output prices in ASEAN4. It is clear that the prices of manufactured goods are less that those in the base case.

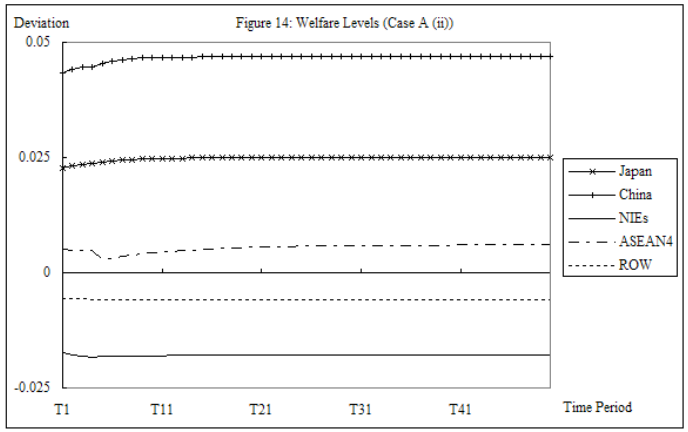
Then, let us go ahead to the macroeconomic impact. Figures 13 and 14 show the effects of trade liberalization between China and ASEAN4 on GDP and welfare levels, respectively. Since Japan, China, and ASEAN4 respectively have strong trade relationships with ROW, these countries/regions increase imports of cheap products from ROW and become better-off. The GDP volumes of Japan, China, and ASEAN4 become more than 1 percent larger than those in the base case. A point is that, if we look at welfare levels, improvement of ASEAN4 remains less than 1 percent, while Japan and China respectively have 2 and 5 percent higher levels than in the base case. These are the result of terms-of-trade effects, and show how large the influence of Japanese response to the policy change, on the global economy.

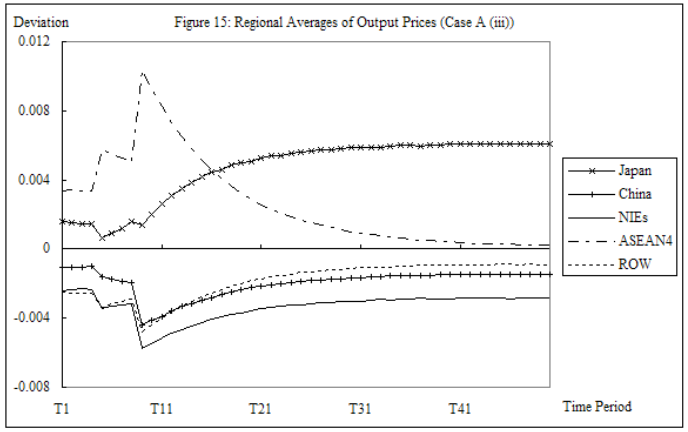
One more difference from Case A (i) is that welfare levels do not surge through the simulation period. This implies that the growth effects are not so strong. In this case, the initial impact of liberalizing trade between China and ASEAN4 itself might not be so large; however, Japan responds sensitively to the price increases in products made in China and ASEAN4, and this affects trade patterns in the global economy. This means that Japan may have an important role to play in linking with both China and ASEAN4, since the initial relationships with them are not so strong.

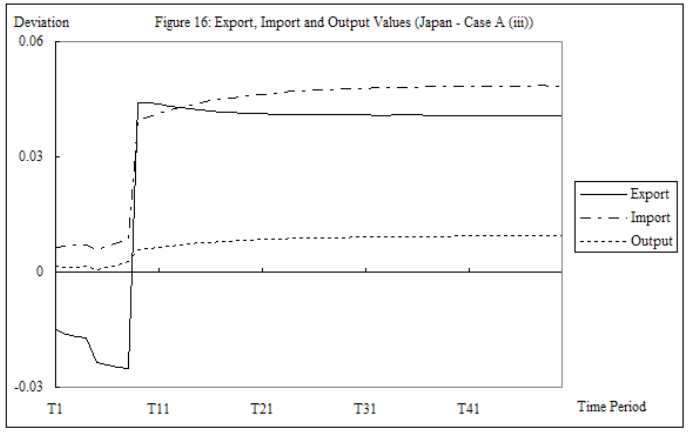
4.2.3 Case A (iii): Sequenced Implementation in Which China Precedes Japan in Liberalizing Trade with ASEAN4

Let us proceed to the third simulation, in which China gets a head start on Japan in liberalizing trade with ASEAN4. Both policy changes are assumed to occur in the fifth and ninth periods, respectively, and those are fully anticipated by all of the economic agents in the global economy. Figure 15 shows that the effects of sequenced implementation of two types of trade liberalization on


Deviation
Figure 13: GDP (Case A (ii))
0.02
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW


Deviation
Figure 14: Welfare Levels (Case A (ii))
0.05
0.025
0
-0.025
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW


Deviation
Figure 15: Regional Averages of Output Prices (Case A (iii))
0.012
0.008
0.004
0
-0.004
-0.008
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW


Deviation
Figure 16: Export, Import and Output Values (Japan - Case A (iii))
0.06
0.03
0
-0.03
T1
T11
T21
T31
T41
Time Period
Export
Import
Output

regional averages of output prices.

Two critical differences from the previous two scenarios can be observed. One is that average output price of goods made in ASEAN4 takes the highest values in the periods before the policy changes and reaches more than 1 percent higher than the base case when Japan and ASEAN4 settle free trade. In addition, the price in ASEAN4 remains higher than the base case in the new stationary state. The second difference is that Japanese output prices takes lower values in the pre-implementation period in comparison with the previous two cases. It is symmetrical response to ASEAN4.

One possible reason to these results is that ASEAN4, who settles free trade with two countries, hails foreign capital making investors to expect that the region supposed to enjoy positive impact of the policy changes. The amount corresponding to the increased foreign capital flow to ASEAN4 lessens foreign investment toward Japan in comparison with Case A (i).

Then, let us examine the effects on export, import, and output values of Japan, China, and ASEAN4, depicted in Figures 16 to 18. One may find that pattern of Chinese exports and productions differ from those which observed in Case A (ii). In this sequenced case, exports from China increase by more than three percent in the new stationary state level. Since Japan settle free trade with ASEAN4 in the ninth period, output prices of Chinese products remain low relative to the global average, making Chinese export volumes larger in the global market. This is an effect of Japanese trade liberalization with ASEAN4, which lower the Chinese output prices, and the positive effects help China to expand production, especially in the manufacturing sector, under the condition of Chinese liberalization with ASEAN4.

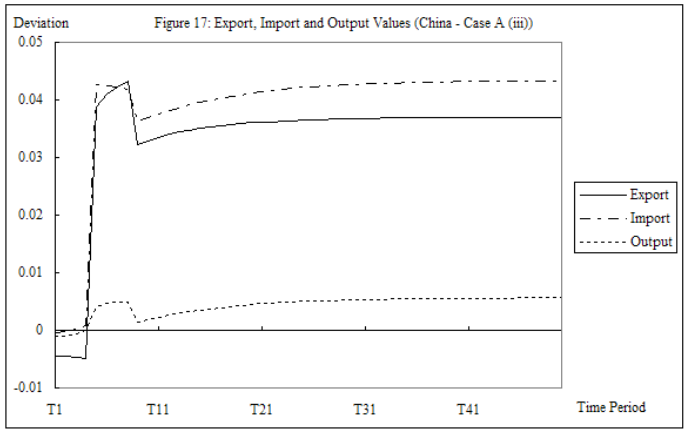
In turn, the impact on Japan is close to that seen in Case A (i). This is because the impact of liberalizing trade between Japan and ASEAN4 is much greater than those between China and ASEAN4, so that the effects observed in the previous simulation, Case A (ii), are concealed. It is not strange since people's future expectations, which affect patterns of interregional investment flow and regional capital prices, change sensitively to the policy change that has the largest impact. In this reason, announcement effects in this case become similar to those in Case A (i).

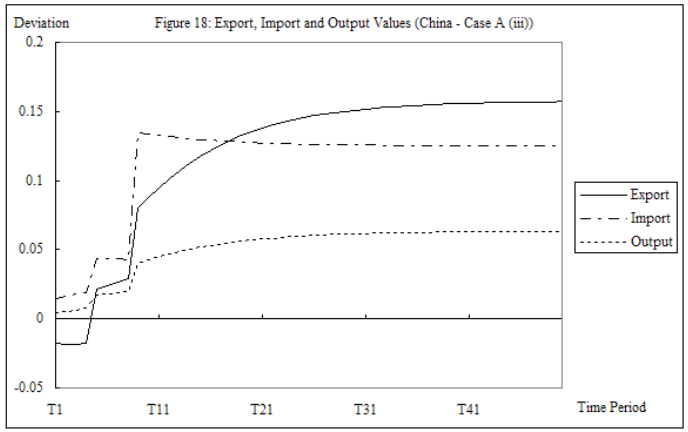
Figure 18, which shows the impact on export, import, and output values of ASEAN4 products, also supports this hypothesis. While the impact on ASEAN4 seems to be simple combination of Cases A (i) and (ii), the shocks when free trade with Japan starts are several times larger than the impact when trade liberalization with China takes place.

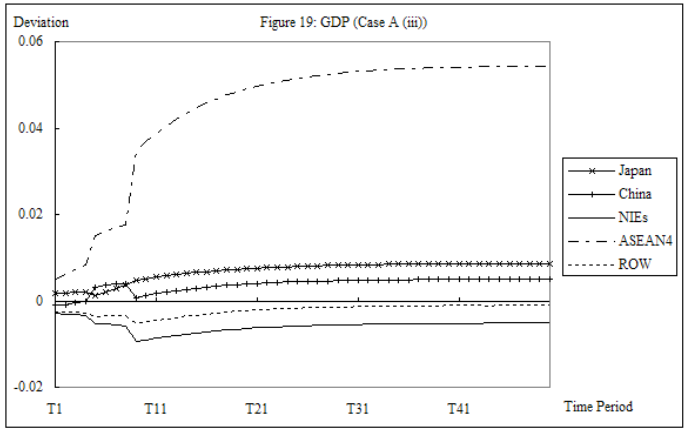
Finally, let us look at the impact on GDP and welfare levels. Both Figures 19 and 20 show that the benefit ASEAN4 would receive from trade liberalization between Japan and ASEAN4 is amplified by the precedent free trade between China and ASEAN4. This is because less distortion makes results in benefit for the countries/regions involved in plural coalitions.

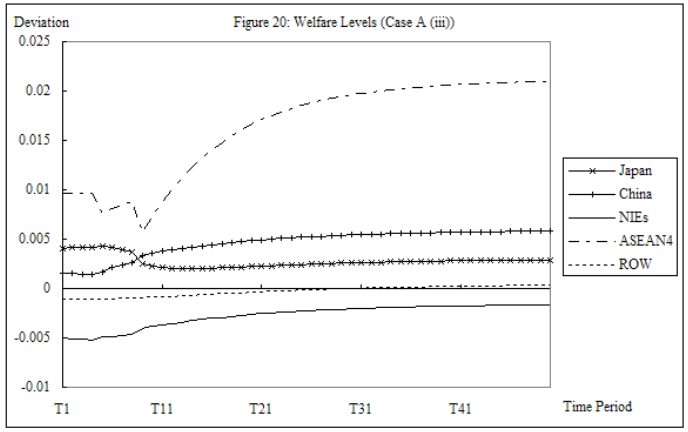
4.2.4 Case B (i): Trade Liberalization between Japan and ASEAN4 Excluding Primary Industries

The last simulation enables us to verify impact of excluding primary sectors from the liberalization program for Japan and ASEAN4. In comparison with Case A (i), one may find that the effects on the average output price in ROW


Deviation
Figure 17: Export, Import and Output Values (China - Case A (iii))
0.05
0.04
0.03
0.02
0.01
0
-0.01
T1
T11
T21
T31
T41
Time Period
Export
Import
Output


Deviation
Figure 18: Export, Import and Output Values (China - Case A (iii))
0.2
0.15
0.1
0.05
0
-0.05
T1
T11
T21
T31
T41
Time Period
Export
Import
Output


Deviation
Figure 19: GDP (Case A (iii))
0.06
0.04
0.02
0
-0.02
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW


Deviation
Figure 20: Welfare Levels (Case A (iii))
0.025
0.02
0.015
0.01
0.005
0
-0.005
-0.01
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW

becomes positive in the new stationary state, which is captured in Figure 21. On the other hand, price changes in Japan and ASEAN4 are rather moderate from the case of full liberalization. These come from the smaller inflow of foreign capital from ROW to Japan and ASEAN4, and consequent repayment of foreign borrowings by ASEAN4. It is shown in Figure 22, which depicts the impact on Japanese export, import, and output values, in which the export volume becomes larger and import is smaller.

If primary industries are not included in the liberalization program, Japanese imports of products of primary industries are smaller, and Japanese domestic production volume of this sector becomes slightly larger than in the case that includes this sector in the liberalization program. This implies that resource allocation for the sectors other than primary becomes smaller in Japan.

An interesting point is that the volume of Chinese manufacturing becomes smaller and the other sectors larger, while Japanese production of the primary sector becomes larger. These are shown in Figures 23 to 26, which depict the sectoral production quantities in Japan and China in both Cases A (i) and B (i). It is well explained if we assume that the manufacturing sectors in both China and ASEAN4 individually have close and complementary relationships with Japanese manufacturers, as mentioned in the previous simulation.

When resources allocated to the manufacturing sector are reduced in Japan, intermediate use of imported materials from ASEAN4 increase in order to maintain the sector's production volume, because these two countries/regions settle free trade, replacing Chinese made materials. Since China and ASEAN4 do not have so close relationship, their products may be rivalry rather than complementary. Therefore, Chinese manufacturing reduces the volume, and more resources are allocated to the primary and service sectors in the country.

Other variables, such as production volumes and output prices in the other countries/regions, are not sufficiently affected.

It is important to note that these consequences are obtained on the assumption that sectoral differences are characterized only by the values of parameters in production functions calibrated with the benchmark data. We did not made any other treatment, at this time, which characterizes differences among three sectors modeled in this analysis, such as scale economics, sector specific growth patterns, and market structures for the primary factors.

The GDP and welfare levels, which are captured in Figures 27 and 28, show overall impact of liberalizing trade between Japan and ASEAN4 except the primary products. As mentioned, the negative impact on the Asian NIEs and ROW are reduced from the case of full liberalization, so the deviation of GDP of ROW from the base case becomes positive in the new stationary state. In contrast, Japanese consumption decrease from Case A (i), because of the loss from distortions left in the primary sector, and it affects China to also reduce consumption. It is interesting that ASEAN4 is not affected so much.

4.3 Welfare Effects

In this subsection, we measure the effects of four cases of trade liberalization on the regional welfare, based on the idea of Hicksian Equivalent Variations (EV). EV are the amount of money equivalent to the changes that have already taken place in the base case. In other words, the income changes that move the agent to the post-change welfare levels. In our dynamic framework, we

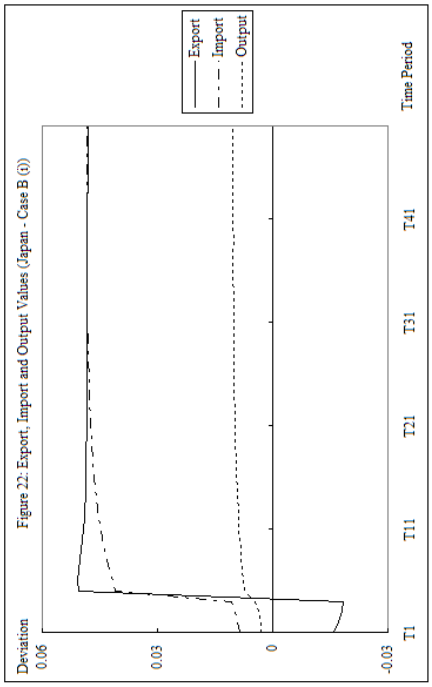


Figure 22: Export, Import and Output Values (Japan - Case B (i))
Deviation
0.06
0.03
0
-0.03
T1
T11
T21
T31
T41
Time Period
Export
Import
Output

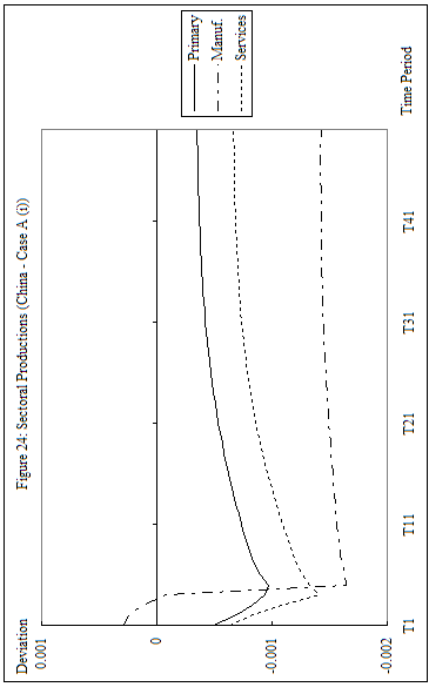


Figure 24: Sectoral Productions (China - Case A (i))
Deviation
0.001
0
-0.001
-0.002
T1
T11
T21
T31
T41
Time Period
Primary
Manuf.
Services

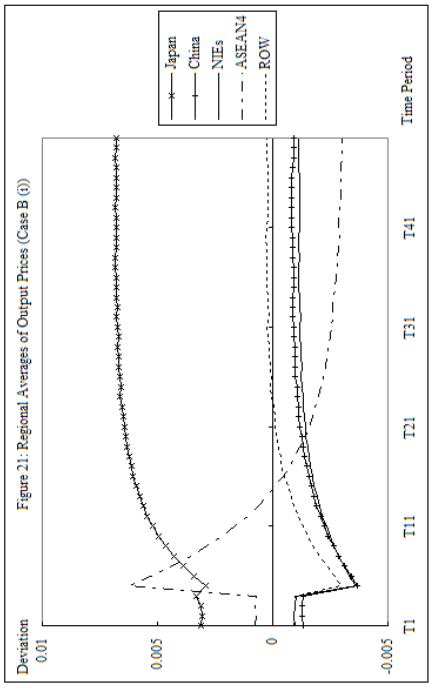


Figure 21: Regional Averages of Output Prices (Case B (i))
Deviation
0.01
0.005
0
-0.005
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW

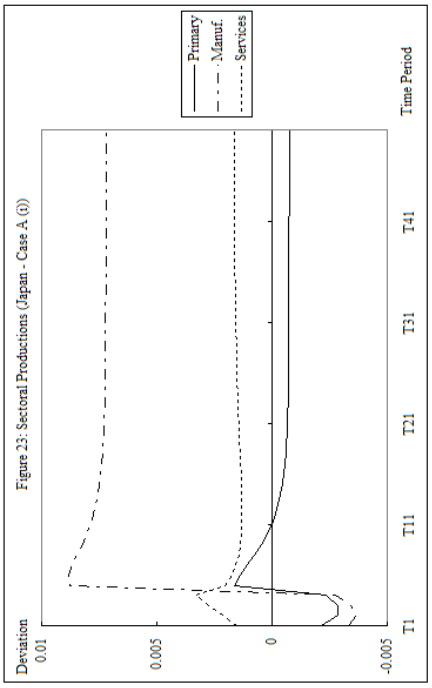
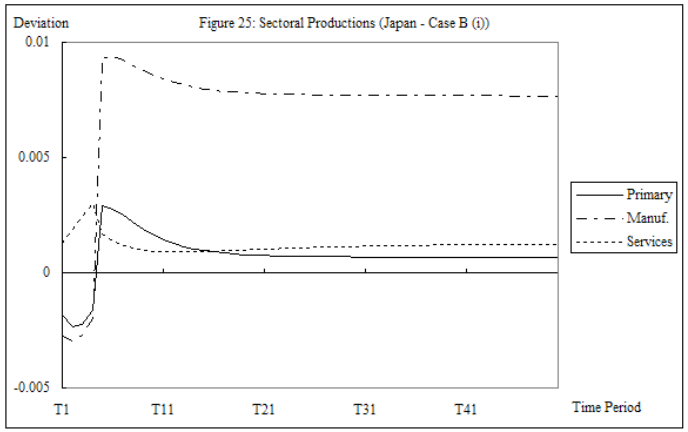
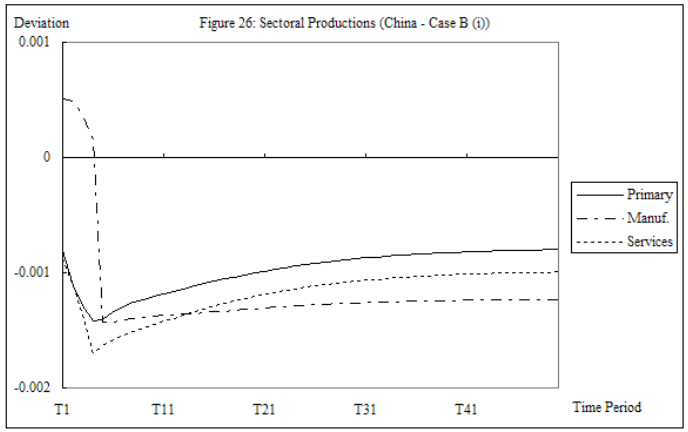
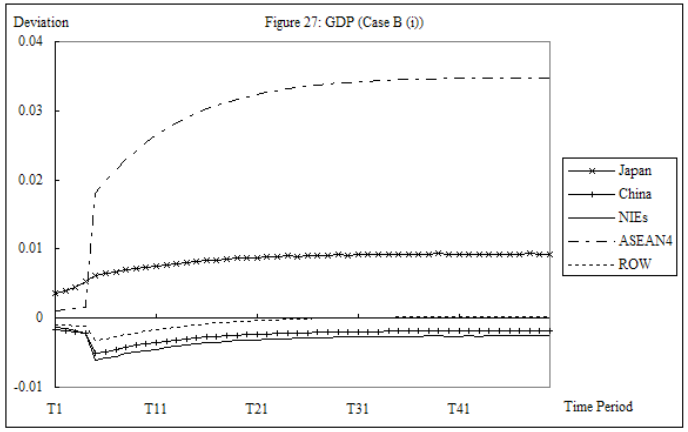
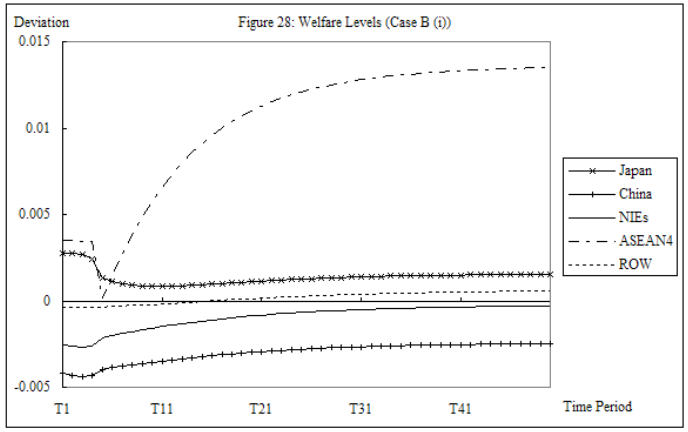


Figure 23: Sectoral Productions (Japan - Case A (i))
Deviation
0.01
0.005
0
-0.005
T1
T11
T21
T31
T41
Time Period
Primary
Manuf.
Services


Deviation
Figure 25: Sectoral Productions (Japan - Case B (i))
0.01
0.005
0
-0.005
T1
T11
T21
T31
T41
Time Period
Primary
Manuf.
Services


Deviation
Figure 26: Sectoral Productions (China - Case B (i))
0.001
0
-0.001
-0.002
T1
T11
T21
T31
T41
Time Period
Primary
Manuf.
Services


Deviation
Figure 27: GDP (Case B (i))
0.04
0.03
0.02
0.01
0
-0.01
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW


Deviation
Figure 28: Welfare Levels (Case B (i))
0.015
0.01
0.005
0
-0.005
T1
T11
T21
T31
T41
Time Period
Japan
China
NIEs
ASEAN4
ROW

calculate the discounted sum of temporal EV obtained in each period to find the accumulated growth effects that policy changes potentially have[20]. The welfare gains from trade liberalizations are reported in Table 3. Note that these welfare gains are closely related to the welfare levels shown in Figures 8, 14, 20, and 28 in the previous subsection, which are the *discounted* integral values of the images valued with the income in the base case. Since our EV are accumulated through 50 periods to capture the results from growth effects, it is important *not to directly compare* with the EV calculated in the other analyses based on static AGE models.

Panel A: Millions U.S. Dollars at 1997 Constant Prices

	Case A (i)	Case A (ii)	Case A (iii)	Case B (i)
Japan	168800.80	1658510.00	193797.70	94139.28
China	-15560.10	526476.10	46247.82	-36715.00
NIEs	-27887.00	-251987.00	-45111.20	-17200.50
ASEAN4	73534.28	41863.28	117621.80	71160.14
ROW	-67290.00	-1929980.00	-151189.00	18229.82
Total	131597.98	44882.38	161367.12	129613.74

Panel A: Percentage Changes

	Case A (i)	Case A (ii)	Case A (iii)	Case B (i)
Japan	0.013	0.122	0.014	0.007
China	-0.021	0.682	0.061	-0.049
NIEs	-0.020	-0.180	-0.032	-0.012
ASEAN4	0.134	0.076	0.214	0.130
ROW	-0.002	-0.059	-0.005	0.001
Total	0.104	0.641	0.252	0.076

Table 3: Welfare Gains

There are several points to be noted. First, the results from simulations with Case A (i) and (iii) confirm the orthodox proposition that all of the countries/regions that enter into free trade are better-off, while countries/regions outside the union tend to be worse-off. However, as we saw previously, announcement effects and resulting terms-of-trade shock push the Japanese welfare level in Case A (ii) to ten times larger than in Case A (i). Rather than Japanese welfare gains, a welfare loss of ROW reaches thirty times larger. In our framework, the interregional investment flow greatly affects the global trade patterns. One solution may be parting from the assumption of full employment to avoid interregional capital movement to be large and remains in the same position for a long period. Such movement is essentially sensitive, as mentioned, and easily affected by the other policy changes.

Second, while it also supports the results from straight-forward analyses, less distortion results in more benefit for the countries/regions involved in a union. If we look at Case A (iii), Japan and ASEAN4 receive the larger benefit than in Case A (i). Instead, the welfare losses of the countries/regions outside the union are also increased. From the view point of ASEAN4, while the welfare

[20]Since we calculate the discounted sum of entire changes caused by the policy changes, the values of regional EV become several times larger than the results obtained by static analyses.

gains from liberalizing trade with China are not large, the gains from free trade with Japan might be beneficial owing to growth effects.

Third, the welfare gains of Japan in Case B (i), when primary industries are excluded from the liberalization program, come to less than sixty percent of the gains in Case A (i), the case of full liberalization. In contrast, ROW recovers to get an overall gain in welfare in Case B (i). The increase in consumption in ROW in the latter half of the simulation period is larger.

5 Concluding Remarks

The purpose of this study was to clarify the potential impact of trade liberalization between Japan and ASEAN members, using a *forward-looking*, multi-regional, multi-sectoral AGE model of global trade. The model can be used to analyze questions where the response of intertemporal variables such as savings and investment are important, and the structure of the global economy is also relevant.

Simulations with the model revealed the response of the global economy to four types of trade-liberalization program. The key findings can be summarized as follows:

1. Trade liberalization between Japan and ASEAN4 has a tendency to cause trade diversion into the union followed by steady capital accumulation, while the case between China and ASEAN4 changes the trend of inter-regional investment flows through announcement effects that may significantly affect patterns of trade.

2. The announcement effects and the subsequent changes in patterns of interregional investment, caused by trade liberalization between China and ASEAN4, are sufficiently large, but sensitive and may be easily affected by other policy changes such as those induce steady capital accumulation through removal of distortions in trade markets.

3. Japan has a possibly important role in the Asian region in the linking of China and ASEAN4 through close and complementary relationships of Japanese and Chinese industries, particularly in the manufacturing sector, since the initial relationship between China and ASEAN4 is not very strong.

4. The benefit that ASEAN4 would receive from trade liberalization with Japan might be amplified by free trade between China and ASEAN4.

There are several potentially important issues that are not taken into account in the present analytical framework. First, the assumption that the global economy is on a balanced growth path at the initial point (used in order to calibrate the model) is unrealistic. Since the Asian economies are still in the process of development, it is appropriate to think that the global economy is on a dynamic adjustment path. While Lau *et al.* (2002) offer a procedure for allowing different regional growth rates in a stationary state, the econometric approach still has importance in projections.

Second, since trade liberalization may affect fiscal budgets by reducing revenues from import and export duties, it is important to shed light on the possible

negative impact that trade liberalization may have. Economic growth may be decelerated through the accumulation of public capital. The next issue of this study would include such activities of the public sector.

Third, impact on the trend of FDI cannot be captured clearly in this analysis. An effort to include decision making on investment by MNEs has been made, but several important profiles of FDI still remain that are difficult to model.

Fourth, the present analytical model seems to be too sensitive to changes in patterns of interregional investment. As Itakura *et al.* (2003) suggest, modeling without an assumption of full employment may be an important subject.

Fifth, it may also be important to include sector specific growth patterns. Roe and Saracoglu (2004) stress the importance to model higher TFP growth rate observed in agricultural sector compared to the others, along with sector specific factors, such as land.

Finally, it would be crucial from a political-economic standpoint to incorporate economies of scale. We therefore feel that it is also important to abandon the assumption of perfectly competitive markets in the future.

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