RIETI Discussion Paper Series 07-E-053

Assessing the Economic Impacts of Free Trade Agreements: A Computable Equilibrium Model Approach

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Abstract

This paper presents assessments of the economic impacts of free trade agreements (FTAs) relating to Japan. The analysis relies on a simulation with a computable equilibrium model. The impacts of various combinations of FTAs are assessed to draw policy implications. This paper first reviews the theoretical framework, together with the specifications of the simulation model. Then, simulations in the various cases cover both Japan's bilateral FTAs and regional FTAs including Japan. The final section is a short summary of implications from the simulation work.

1. The Theoretical Framework and the Simulation Model Adopted

(1) Surveys on the Impacts of an FTA

Welfare Decomposition of Efficiency Improvement

A tariff reduction of an FTA has a wide variety of economic impacts on the member countries of the agreement, as well as the rest of the world. The effects encompass welfare, production, exports and imports in both real and nominal terms. On the effects on the welfare of the people, a survey by Baldwin and Venables (1995) demonstrated a comprehensive framework to decompose formally the impacts on the national welfare into six effects, based on an indirect utility function with respect to the consumption expenditure.[1] Assuming that all trade barriers give rise to rents only to domestic agents[2], one effect (trade cost effect) can be omitted from the six. Out of the remaining five effects, three effects (output effect, scale effect and variety effect) are only relevant in the models that allow for increasing returns to scale and imperfect competition.[3] These effects are important for analyzing the regional trade agreements between countries with similar industrial and trade structures, and where horizontal intra-industry trade is dominant, as between the United States and Canada and among the countries in the European Union. Because the percentage share of horizontal intra-industry trade in total bilateral trade within the East Asian region is still low, we may limit our analysis to the remaining two effects only, namely, trade volume effects and terms of trade effects. Such treatment is also due to a lack of necessary data for simulating welfare effects under the increasing returns to scale. The welfare decomposition of trade volume effect in formal expression is shown in Appendix 1.

Following the discussion above, the assumptions, mainly the constant returns to scale without significant product differentiation, enable us to limit the whole welfare change brought about by a tariff reduction under an FTA to only two effects: trade volume effect and terms of trade effect. The effects are in essence based on comparative statics, which merely takes the difference of the two statuses of variables in equilibrium. Some details of these two effects are as follows:

Trade Volume Effect: This is essentially the change in tariff revenues, brought about by the changes in imports. As such, the effects in terms of income are obtained as the weighted average of existing tariff rates, using changes in the import volumes, as the weights.[4] This effect is closely related to the seminal study by Viner (1950) in which he classified the effects

[1] The six effects consist of: trade volume effect, trade cost effect, terms of trade effect, output effect, scale effect and variety effect.

[2] In contrast, some trade barriers may be real trade costs incurred to the domestic agencies, or a quota under which foreigners capture the quota rents.

[3] The main reference on this theoretical application is Helpman and Krugman (1989).

[4] As Appendix 1 illustrates, the trade volume effects amount to tdm where t represents a vector of import tariffs and dm is the derivative of import vector. In the case of trade liberalization, the amount is approximately equal to the sum of two triangles of the dead-weight loss under tariff in the standard textbooks of trade theory, by means of the mean-value theorem.

of the Customs Union[5] (CU) into two types: the trade creation and trade diversion effects. The sum of the two effects corresponds to the trade volume effect, producing ambiguous results on welfare. The trade diversion effect means reduced imports from non-FTA members, while trade creation effect means the increase in the sum of increased imports from FTA/CU.[6] Trade diversion results from discriminatory tariff reduction that leads private agents to import from a supplier that is not the lowest cost source. Therefore, trade diversion reduces home welfare by raising the nation's cost of consuming such goods. If bilateral tariffs are reduced only on imports from countries that are already the lowest-cost supplier, trade diversion does not occur. FTAs/CUs are likely to be beneficial if the partners initially account for large shares of each other's imports, as would be the case if they were low-cost producers.

Terms of Trade Effect: Changes in the trade by Japan and other East Asian countries will probably induce changes in their border prices with consequent effects on welfare through the change of their terms of trade. If imports of the FTA members from the rest of the world decrease, then the terms of trade of the members of the FTA are likely to improve, and vice versa. The terms of trade effects are supposed to have ambiguous results in general, because an FTA may or may not bring expansion of intra-regional trade and contraction of external trade. It is necessary to test the effects by means of economic models by taking into account the complex structure of complementarities in trade and other factors.

Location Effects and Regional Disparity

Researchers have identified many of the effects of an FTA other than the static efficiency improvement. An important one is the location effect. There is a concern that regional integration may be associated with increased inequality between the regions. In a perfectly competitive environment, regional integration reduces intra-FTA factor price differences, as was proven in the "factor price equalization theorem". As long as the countries' endowments lie inside the same cone of diversification, integration will equalize factor prices, *in the long run*. For example, China and Japan have much different endowments, but the virtual integration of the countries will eventually increase the internationally traded goods and factors, which will increase the size of the cones of diversification. Actually, wages in China have been increasing rapidly, while those in Japan have declined.

Economic geography, recently drawing the attention of some economists, often assumes imperfect competition and scale economies, which sometimes imply reverse outcomes. Scale economies and economies of agglomeration mean that firms will not locate some productive capacity in every country or region. The decision of the firm depends on the balance between production costs and trade costs. This balance changes as trade barriers are reduced, and it is possible that industry will be drawn into high-wage locations, increasing inter-regional wage difference. Regional disparity has been a top concern of the Chinese government. The coastal region enjoyed high rates of growth, compared to the inland regions,

[5] The Customs Union sets the common tariffs to the non-member countries, as well as abolishes the substantially all the tariffs between the members.

[6] According to Kowlczyk (1992), there are many other definitions of trade creation and diversion.

which have lagged behind. In Japan, disparity among both people and regions has become a serious political issue. Relocation of production processes and reduction of employment have long taken place in several regions of Japan. Concern about regional disparity sometimes materializes as political pressure to resist FTAs. The location effects are something new to trade theory, and we still need to accumulate literature and empirical data.

Other Dynamic Effects of an FTA on Economic Growth and Welfare

In addition to the effects above, researchers have identified the effects on economic growth of trade liberalization under an FTA. The tariff reduction may provide an incentive: (i) to mobilize inputs and to improve their quality; (ii) to increase the efficiency of management through the increased pressure of competition (the "competition enhancing" effect); and (iii) to enhance technological innovation. Most of these effects are hypothetical, and empirical studies on the growth function have tested them by the panel data estimates. In addition, the economy of agglomeration, brought about the freer movement of production resources, may accelerate economic growth. At present, an economic model simulation may not be able to capture these effects.

FTAs, especially the type of the economic partnership agreement (EPA) concluded by Japan, include many other liberalization and cooperation clauses in the agreements, such as liberalization in foreign direct investment, reduction of non-tariff barriers, protection of intellectual property rights, and industrial standardization. These apparently bring about many economic effects, some of which may be more significant than the tariff reduction. Some existing studies have tried to assess service sector liberalization and other trade cost reduction measures in FTAs/EPAs. Most of them rely on more or less arbitrary assumptions. Our study takes a model simulation approach and, as a result, is limited to the assessment of tariff reduction.

(2) Framework of the Adopted Simulation Model

Computable Equilibrium Models and their Advantage

In spite of the huge stock of theoretical literature, it is not empirically possible to construct a simulation model to assess quantitatively all the wide-ranging effects of an FTA under the present model technology and availability of required data. The following analysis adopts a simulation of a computable general equilibrium (CGE) model for assessing FTAs. A standard CGE model consists of equations of market demand and supply, market clearance conditions, as well as input-output relations, with a foundation in the microeconomic general equilibrium theory. The CGE model in its international version has its theoretical foundation in neo-classical trade theory. The pattern of comparative advantage explains the causes of and gains from trade on the basis of the relative differences between economies in factor endowments and production functions. By specializing in products that suit local conditions, and trading these for other goods that are produced with comparatively greater efficiency in other economies, each economy will have a higher real income and welfare than in the absence of trade. This is the basic motivation behind trade and explains its pattern in the world economy.

In the framework, tariffs cause distortions in the markets that impede trade, and bring about losses of trade and welfare to the economies. Tariff elimination under an FTA is therefore understood as the removal of economic distortions. Tariff cuts lower import costs that lead to pushing down the import prices in the domestic markets under a competitive environment. The lower import prices stimulate imports in the short run. Cheaper imports, in turn, lead to lower production costs for other domestic industries. Relocation of labor and capital to other, more efficient sectors takes place from the formerly protected sectors, in the medium to long run. Improved competitiveness of the export industries, led by the relocation of resources and cheaper production costs, eventually increases the exports of the economy. After the adjustment process is completed, the nation may take more benefits from the trade, and production of the economy shifts toward sectors with comparative advantage. The static improvement of welfare through this efficiency gain is measured as trade volume effects, as indicated in the sub-section above. The model also measures the terms of trade effects on welfare.

The CGE models have an apparent advantage of having multi-sector and multi-country structure. They can identify a likely impact of an FTA on some sectors of some countries, as well as on a country and/or the world as a whole. This merit favorably distinguishes the CGE model from other macroeconomic models in the context of policy analysis. Another advantage of the CGE models is their concrete microeconomic foundation, which enables the modelers to rigorously assess the welfare changes.

"Accumulation Effect" Measured by a CGE Model

The CGE models are inherently designed to undertake comparative statics, skipping the intermediate process of market adjustment. On the effect of trade liberalization, the standard models can only measure the simple efficiency gains of recovering the dead weight loss. That notwithstanding, the model builders have tried to enable the models to assess the dynamic effects of trade liberalization, in addition to measure the efficiency gain / loss from external shocks. For example, recent models can incorporate a capital accumulation mechanism, which is induced by trade liberalization. This is the "accumulation effect" introduced in Baldwin (1992).[7] The mechanism, which is incorporated into the CGE model, is as follows: increased incomes caused by enhanced efficiency of the economy lead to increased savings, and the increased savings induce an increase in investment, and such an increase continues until the increased capital stock requires a larger amount of capital depreciation to balance the net investment. As such, the model measures the accumulation effects as medium-term transient, rather than the increase in long-term growth rates. Appendix 2 provides a detailed explanation on the specification. Our study adopts the specification because of its greater reality.

The accumulation effect of the Baldwin specification is measured by comparing one set of variables to another, both on the long-run growth paths. Therefore, the model does not trace and identify the dynamic path in the transition period. However, the order and sequence of the choice of FTA partners, which reflect the transitional path, significantly matters in the

[7] Baldwin (1992) termed the same effects "dynamic gains."

context of policy. Moreover, the Baldwin specification has a semi-linear nature, which precludes the path-dependency of the final results. But the political consideration often requires the assessment of the difference of the final outcomes, brought about by the sequence of the possible FTAs. As such, "real" dynamic models are desired for the policy analysis. In this paper, several cases of combination of the FTAs concerning Japan are simulated to illustrate the transition as a compromise. In addition, our study uses a Dynamic GTAP, which is a dynamic recursive CGE model.

The Global Trade Analysis Project Model

Our study uses the Global Trade Analysis Project (GTAP) model version 6.2, and its database version 6.0, provided by Purdue University. The original database consists of 87 regions and 57 industrial sectors, which are aggregated for the study into 24 regions and 25 sectors. Appendix 3 summarizes the aggregation with abbreviation. The GTAP model provides the Baldwin accumulation specification as a standard option.

One of the specific features of the GTAP model is the Armington structure, which sets the fixed elasticity of substitution between imported and domestic goods due to changes in the relative price of those two goods [8] (see Armington [1969]). The incomplete substitutability between the imported and domestic goods, because of the international product discrimination, implies the finite elasticity. The Armington structure significantly simplifies the model.

The Plan for Simulations in this Paper

The rest of this paper plans to make CGE model simulations on the effects of tariff reduction and elimination under the possible FTAs. The static model with the Baldwin accumulation specification is employed to assess Japan's three existing FTAs.

2. The Simulations of Japan's Existing and Future Bilateral FTAs

Trade and Tariff Structures of the Three Countries of Japan's Existing FTAs

As of now, Japan has three FTAs[9]; with Singapore (effective November 2002), Mexico (effective April 2005) and Malaysia (effective July 2006). There have been FTA negotiations with several countries/region, including the Philippines, Thailand, Korea, Indonesia, Chile and the Association of Southeast Asian Nations (ASEAN) as a whole.

As for Japan's imports, the sector shares of the amounts of import and tariff rates in Japan are summarized in Table 1. Japan imported from Singapore and Malaysia mainly the products of mining and manufactures, and almost no amounts of agriculture, forestry and

[8] This elasticity is known as Armington elasticity.

[9] The Japanese government has tried to make its EPAs standard bilateral agreements that include all the typical components of an FTA, as well as additional agreements on economic cooperation and liberalization measures.

fisheries. The imports from Mexico included about 10 percent of livestock, and six percent of crops.

Table 1: Sector Shares of Imports and Tariffs of Japan (percent)

	Singapore		Mexico		Malaysia	
	Import Share	Tariff Rates	Import Share	Tariff Rates	Import Share	Tariff Rates
GRN	0.0	0.0	0.0	0.0	0.0	967.1
CROP	0.1	1.6	6.1	3.0	0.5	0.2
LSK	0.0	119.2	9.3	62.7	0.0	9.0
FRS	0.0	1.0	0.2	0.0	0.0	0.0
FSH	0.1	3.4	2.8	3.9	0.4	3.2
MNG	23.1	0.0	17.2	3.1	33.7	0.0
FDP	4.6	20.8	1.8	8.5	2.8	3.7
TEX	0.0	8.6	0.2	6.1	0.5	4.1
WAP	0.1	15.4	1.3	11.8	0.5	6.6
CHM	11.3	1.8	3.0	0.2	7.5	0.2
MET	6.4	0.4	7.1	0.0	3.2	0.0
MVH	0.1	0.0	10.3	0.0	0.3	0.0
OTN	0.1	0.0	0.0	0.0	0.0	0.0
ELE	24.2	0.0	10.6	0.0	25.7	0.0
OME	28.9	0.1	22.5	0.0	11.3	0.0
OMF	0.8	0.5	7.6	0.4	13.5	2.6
Total	100.0		100.0		100.0	

1. See Appendix 3 for the abbreviation of sectors.
2. Import shares are made from the Customs Statistics of Japan, 2006.
3. Tariff rates are taken from the GTAP database, based on the 2001 data.

Japan's import tariffs before the FTAs, which may have reflected the most favored nation (MFN) treatments, had very similar structures across the three countries. The import tariff rates of agriculture and FDP (processed food) are higher[10], while those of mining and manufacturing are lower. Among manufacturing, TEX (textiles) and WAP (apparel) have comparatively higher tariffs, and many of the other manufacturing sectors have zero or minimal tariffs. Tariff elimination under Japan's FTAs would bring about almost no change in the effective tariffs in most of manufacturing sectors, except for FDP, TEX and WAP. These, together with agriculture, are the key sectors for the FTAs.

The sector shares of Japan's bilateral exports and the tariff rates of the three FTA partners are summarized in Table 2. Japan exported virtually no products of agriculture, forestry, and fisheries. The main export items are all manufacturing goods. Among them,

[10] As the GTAP tariff rates are the effective tariff rates, calculated from the sector-base tariff revenue divided by the import amounts, the imports of GRN (grain), almost all the imports which were quantitatively restricted without tariff payments have entries of zero percent in Singapore and Malaysia. The similar backgrounds apply to the different tariff rates in LSK (livestock).

ELE (electronic equipment), OME (other manufactured equipment), MET (metal products), MVH (motor vehicles) lead Japan's exports. ELE invariably takes the top share.

Table 2: Sector Shares of Imports and Tariffs of Japan's FTA Partners

(percent)

	Singapore		Mexico		Malaysia	
	Import Share	Tariff Rates	Import Share	Tariff Rates	Import Share	Tariff Rates
GRN	0.0	0.0	0.0	0.0	0.0	0.0
CROP	0.0	0.0	0.0	5.5	0.0	1.3
LSK	0.1	0.0	0.0	22.7	0.0	8.8
FRS	0.0	0.0	0.0	0.0	0.0	0.0
FSH	0.1	0.0	0.0	17.0	0.0	0.1
MNG	1.7	0.0	0.0	12.9	0.3	0.1
FDP	0.3	1.3	0.0	20.5	0.1	10.3
TEX	0.4	0.0	0.2	18.2	0.7	10.5
WAP	0.1	0.0	0.0	30.8	0.1	15.0
CHM	8.5	0.0	3.5	14.8	10.0	7.7
MET	13.2	0.0	11.6	14.1	19.8	12.0
MVH	6.9	0.0	31.5	16.7	10.0	45.4
OTN	5.7	0.0	0.0	25.9	0.6	14.8
ELE	35.9	0.0	37.4	7.9	36.4	0.1
OME	25.4	0.0	14.8	12.9	19.8	3.8
OMF	1.8	0.0	0.9	18.1	2.0	11.2
Total	100.0		100.0		100.0	

1. See Appendix 3 for sector abbreviations.
2. Import shares are derived from the Customs Statistics of Japan in 2006.
3. Tariff rates are taken from the GTAP database, based on the 2001 data.

The import tariffs of the three countries from Japan sharply contrast each other. Singapore has virtually no import tariff. Mexico levies comparatively high tariff rates, particularly on WAP (apparel) and OTN (other transport equipment). The import tariff of Malaysia is particularly high in MVH (motor vehicles), but the tariff rates of the other sectors are lower than Mexico. Protection of the automobile industry is a common policy in developing countries in Asia, as well as in Mexico.

Details of the Simulations and Technical Assumptions

The simulation is implemented by applying external shocks to the model, and measures the impacts from the changes of the values of model variables. In this study, the external shocks are the reduction and elimination of the import tariff rates agreed upon in the existing FTAs. Four technical points deserve note.

1. The GTAP database reflects the effective tariff rates in 2001. The FTA partners may have changed the tariff rates between the year 2001 and the time of enforcement of the FTA. The simulation should measure the impacts of changes of the tariff rates

between the periods of agreed upon and implemented points. In this study, the possible changes after 2001 are ignored, because no major multilateral or regional initiatives to liberalize trade took place for that period, except for the tariff reduction committed to in China's WTO accession, which is taken into account in the related simulations.

2. The targeted tariff rate specified by the FTAs may be lower than, equal to, or even higher than the existing concession rate, because the existing rates may be the concession rates of the MNF treatment made after the WTO agreement, which is lower than the FTA concession rates.[11] Our observation on the import shares and existing and target tariff rates of the items implies that the tariff reduction under the existing FTAs may bring about virtually no tariff reduction in agriculture, fisheries, forestry, and food-related manufacturing (FDP) in Japan, compared to the MFN concession rates. In contrast, assuming zero tariff rates of Japan under FTAs provides a good estimate for mining and manufacturing.

3. The existing FTAs often allowed for grace periods and scheduling in the reduction of tariff rates of specific items, often over the subsequent 10 years. In this study, the transition periods are ignored, and the simulation shocks simply assume the total change of target rates. The three FTA partners are committed to eliminate most of the tariffs by the end of the transition period, except for Mexico's LSK (livestock), FSH (fishery), FDP (processed food), and WAP (apparel), for which tariff rates will be reduced, but not to zero.

4. The simulation model specifies the Baldwin dynamic closure, as illustrated in the previous section in this paper. The simulation under the specification generally produces larger amounts of impacts in terms of welfare and product.

Table 3 below summarizes the expected percentage changes in the import tariff rates under the FTAs, as the shocks to the simulation. Japan will cut the tariffs on TEX and WAP rather significantly, by 5 to 15 percentage points, but will make virtually no change in tariffs for the other sectors, except for minor reductions in CHM, MET and OMF. Singapore, because of the virtually zero rates of existing tariffs, will not change any tariffs, except for a minor reduction in FDP. Mexico and Malaysia were committed to abolishing all tariffs by the end of the FTA schedules.

Table 3: Shocks to the Import Tariff under Japan's FTAs

(percent changes)

[11] To compare the FTA target rates and the existing concession rates, we classified the import items of Japan on the HS two-digit basis into the following for categories: (i) excluded (the FTA does not change the existing tariff rate); (ii) minimal (the FTA reduces the tariff rates of less than three tariff lines [on the six-digit basis] within the two-digit item); (iii) most (the FTA reduces the tariff rates of more than or equal to three tariff lines [on the six-digit basis] within the two-digit item); and (iv) all (the FTA eliminates all the tariff lines [on the six-digit basis] within the two-digit item).

	JSEPA		JMxEPA		JMsEPA	
	Japan	Singapore	Japan	Mexico	Japan	Malaysia
GRN	0.0	0.0	0.0	0.0	0.0	0.0
CROP	0.0	0.0	0.0	-5.5	0.0	-1.3
LSK	0.0	0.0	0.0	-11.3	0.0	-8.8
FRS	0.0	0.0	0.0	0.0	0.0	0.0
FSH	0.0	0.0	0.0	-8.5	0.0	-0.1
MNG	0.0	0.0	0.0	-12.9	0.0	-0.1
FDP	0.0	-1.3	0.0	-13.6	0.0	-10.3
TEX	-8.6	0.0	-6.1	-18.2	-4.1	-10.5
WAP	-15.4	0.0	-11.8	-20.5	-6.6	-15.0
CHM	-1.8	0.0	-0.2	-14.8	-0.2	-7.7
MET	-0.4	0.0	0.0	-14.1	0.0	-12.0
MVH	0.0	0.0	0.0	-11.1	0.0	-45.4
OTN	0.0	0.0	0.0	-25.9	0.0	-14.8
ELE	0.0	0.0	0.0	-7.9	0.0	-0.1
OME	-0.1	0.0	0.0	-12.9	0.0	-3.8
OMF	-0.5	0.0	-0.4	-18.1	-2.6	-11.2

1. See Appendix 3 for sector abbreviations.

Macroeconomic Impacts

The macroeconomic impacts of the simulations of the CGE models are usually summarized in the changes in the real gross domestic product (GDP) and equivalence of variation (EV). Both reflect the efficiency improvement. The EV measures the income-based welfare improvement, theoretically explained in Appendix 1. The measure means the recovery of the dead-weight loss. Table 4 shows the simulation results.

Table 4: Macroeconomic Impact of Japan's FTAs
(GDP in percent change, EV in US$ million)

	JSEPA		LMxEPA		JMsEPA	
	GDP	EV	GDP	EV	GDP	EV
AUS	0.00	-1	0.00	2	-0.01	-32
NZL	0.00	0	0.00	0	0.00	0
CHN	0.00	-5	0.00	-71	0.00	-69
HKG	0.00	0	0.00	-15	0.02	25
JPN	0.00	-2	0.02	1286	0.02	1017
KOR	0.00	-1	-0.01	-61	-0.01	-63
TWN	0.00	-1	-0.02	-69	-0.01	-67
IDN	0.00	-1	-0.01	-18	-0.03	-47
MYS	0.00	-2	-0.03	-39	1.41	862
PHL	0.00	-1	-0.06	-43	-0.04	-24
SGP	0.02	26	-0.02	-18	-0.01	-26
THA	0.00	-1	-0.05	-55	-0.04	-53
VNM	0.00	-1	0.00	0	0.00	1
XSE	0.00	0	0.01	6	0.01	8
IND	0.00	-1	0.00	12	0.00	0
XSA	0.00	0	0.00	-5	0.01	6
CAN	0.00	-1	0.01	50	0.00	11
USA	0.00	-11	0.00	-408	0.00	139
MEX	0.00	-2	0.60	2837	0.01	57
PER	0.00	0	0.01	7	0.01	5
CHL	0.00	0	0.00	0	0.00	1
EU15	0.00	-12	0.00	206	0.00	139
RUS	0.00	-1	0.00	21	0.00	1
ROW	0.00	-6	0.00	55	0.00	58
World		-25		3680		1948

1. See Appendix 3 for region abbreviations.
2. Author's simulation, using GTAP database and GEMPACK.

Three major points characterize the simulation result. First, the FTA members, Japan and its FTA partners, tend to gain GDP and EV, and many of the other regions lose them. This results from the trade diversion effect. The non-member regions will have the FTA members import their products less, and they will be induced to produce less the goods of the sectors with comparative advantage. The trade diversion effect should also take place among the FTA members, but the trade creation effect outweighs the trade diversion effects. Second, Mexico and Malaysia will gain a larger percentage of GDP, but Japan and Singapore will gain little. Theoretically, the countries that reduce the tariffs more will generally gain more. Mexico and Malaysia will reduce tariffs by greater percentage, but the tariff reduction of Singapore and Japan will be smaller. The existing tariff rates of Singapore are virtually zero. Japan will maintain the high tariff in agriculture and only reduced the existing tariff rates in limited sectors, i.e. TEX and WAP. Third, the EV in the world generally adds up to positive numbers. The FTAs will increase the welfare in the world, albeit in small amounts.

Impacts on Sectors

The CGE model simulation can assess the impacts on the sectors in each economy. The impacts on sector production would interest more the domestic groups than the macroeconomic impacts would. Generally, the sectors protected by high tariff rates will lose their production more when the tariffs are reduced under an FTA. While the trade liberalization brings about efficiency gains to increase in income and production across the sectors, the income gains and resulting demand increase will not generally offset the decrease of the production of the losing sectors. Table 5 illustrates the impacts on the production of the sectors.

Table 5: Impacts on the Industry Sectors of Japan's FTAs

(percents)

	JSEPA		JMxEPA		JMsEPA		Total
	Japan	Singapore	Japan	Mexico	Japan	Malaysia	Japan
GRN	0.0	0.0	-0.1	0.1	-0.1	-0.5	-0.2
CROP	0.0	0.0	-0.1	0.0	0.0	-0.3	-0.1
LSK	0.0	0.1	-0.1	0.4	-0.1	-0.4	-0.2
FRS	0.0	0.0	-0.1	0.5	0.0	2.2	-0.1
FSH	0.0	0.0	0.0	0.3	0.0	0.3	0.0
MNG	0.0	0.0	-0.1	0.1	0.0	0.3	-0.1
FDP	0.0	0.0	0.0	0.4	0.0	0.3	0.0
TEX	0.0	0.8	-0.3	0.5	-0.1	3.6	-0.4
WAP	0.0	4.7	-0.1	0.5	-0.1	3.7	-0.3
CHM	0.0	0.0	0.0	0.4	0.1	0.7	0.1
MET	0.0	0.0	0.2	0.4	0.4	0.0	0.5
MVH	0.0	-0.1	-0.1	0.9	0.3	3.8	0.2
OTN	0.0	-0.1	-0.4	0.5	-0.1	1.7	-0.5
ELE	0.0	0.0	0.0	2.0	-0.4	2.4	-0.3
OME	0.0	0.0	0.2	1.1	-0.1	2.9	0.1
OMF	0.0	0.0	0.0	0.5	0.0	3.6	0.0
EGW	0.0	0.0	0.0	0.5	0.1	1.2	0.1
CNS	0.0	0.0	0.0	0.9	0.0	2.2	0.1
TRD	0.0	0.0	0.0	0.7	0.0	0.8	0.0
TRS	0.0	0.0	0.0	0.6	0.0	1.3	0.0
CMN	0.0	0.0	0.0	0.5	0.0	0.7	0.0
FIN	0.0	0.0	0.0	0.5	0.0	1.3	0.0
PRS	0.0	0.0	0.0	0.6	0.0	1.2	0.0
OFS	0.0	0.0	0.0	0.3	0.0	0.3	0.0
DWE	0.0	0.0	0.0	0.8	0.0	1.0	0.1

1. See Appendix 3 for region abbreviations.
2. Author's simulation, using GTAP database and GEMPACK.

The impacts on the production of the industrial sectors for Japan are generally small in terms of percentage, less than 0.5 percent throughout the sectors. Singapore will receive some positive impact only on the production of WAP. In contrast, many sectors in Mexico and Malaysia will face larger impacts in terms of percentage changes. For Mexico, all the

industrial sectors will be "the winners," and the largest gains in terms of percentage will go to ELE, OME and MVH. For Malaysia, GRN, CROP and LSK are "the losers", but the loss will be less than 0.5 percent. All the other sectors in Malaysia will increase the production, particularly some manufacturing, such as MVH, TEX, WAP and OMF. The difference of the percentage changes between Japan and its FTA partners should reflect the magnitude of the economies, as well as the scales of the tariff reductions. The column of total, adding the impacts of the three FTAs, in Table 5 indicates that Japan will receive comparatively small impacts in terms of percentage change in the production in the industrial sectors.

The GTAP database includes an input-output table which simply mixes the imported and domestically produced intermediates. In the model, all the exports from an FTA member to another can enjoy the tariff concession, even if the local contents of such exports are very low. In reality, however, the rules of origin (ROO) clauses in the FTAs may possibly block the concession to such exports.[12] ROOs may function as trade protection measures when a country establishes numerous overlapping FTAs. This issue is essential in the case of the regional FTAs which are expected to function to extend the regional production networks, but the bilateral FTAs also suffer from them. The effects from the efficiency improvement assessed by the GTAP model, therefore, should be possibly overestimated.

3. Simulations of the Future Scenarios of Japan's FTAs

The objective of this section is to assess the scenarios of Japan's future FTAs, making comparisons between these multiple scenarios. This section contains two groups of simulation works. The first group covers the static simulations on the effects of the FTAs relating to Japan. They are static in the sense that they measure the ultimate impacts of the FTAs without following their time paths. The second group covers the dynamic simulation by using the Dynamic GTAP model to assess Japan's FTAs.

Static Simulation

The first group undertakes simulations on:

(1) Japan's bilateral FTAs with possible future FTA partners. Such potential FTA partners and their combinations may include: (i) the remaining ASEAN 8 countries (ASEAN10 except for Singapore and Malaysia); (ii) China and Korea; (iii) ASEAN10 countries plus China and Korea; and (iv) ASEAN 10 countries plus China, Korea, Australia, New Zealand and India. The simulations assess only the effects of the combinations of Japan's bilateral FTAs, not the effects brought about by the regional FTAs which assume the FTAs between the counterparts of Japan.

[12] Preferential trade agreements, including FTAs, require ROOs to enable a given trade good to be identified as originating in the area covered by the agreement, and thus subject to exemption from customs duties. ROOs exist to prevent imports from countries outside the scope of the agreement from taking advantage of the concessions of FTAs. Such imports are knows as trade deflection.

(2) Regional FTAs including Japan as a member or major FTAs in the East Asia in the future. Such potential regional FTAs include: (i) ASEAN10 countries; (ii) China, Japan and Korea: (iii) ASEAN10 plus 3 (China, Japan and Korea); and (iv) ASEAN10 plus six (China, Japan, Korea, Australia, New Zealand and India).

The simulations above adopt basically the same methodology as in the former section of Japan's three existing FTAs, i.e. the static model with the Baldwin accumulation specification.

Three points on the assumptions and model structures deserve to note. First, the simulation shocks for Japan's bilateral FTAs are such that its FTA partners will abolish all tariffs for Japan, and that Japan will abolish its tariffs for the partner in all sectors *except* agriculture, fishery, forestry, and processed food. This asymmetrical assumption reflects the past experiences in Japan's three existing FTAs. In contrast, the regional FTAs assume, as the hypothetical simulation shocks, that all the parties, including Japan, will reduce the tariff rates to zero in all the sectors.

Second, it should be reiterated, as in the former section, that ROOs may significantly curtail the merits of the concession under the regional FTAs by preventing the free movement of materials in the regional production networks. The GTAP simulation, which assumes simple preclusion of the existence of ROOs, may overestimate the impacts.

Third, the GTAP model simulations cannot measure the scale merits from the formation of regional production networks and the economy of agglomeration, which may result from the region-wide multiple FTAs. Therefore, the simulations may underestimate the impacts. The GTAP simulations also ignore the possible effects of the FTAs to stimulate technological progress through promoting competition; i.e. pro-competitive effects.

Fourth, rather technically, China significantly reduced the tariff rates of many sectors as a commitment to its accession to the WTO after 2001. Thus the tariff rates of the GTAP database are based on the data in the year 2001, and the GTAP tariff database is updated by incorporating the WTO commitment.

Results of Static Simulation

Table 6 below summarizes the welfare gains from the potential bilateral and regional FTAs. The equivalence of variation (EV) is used as the measure of the welfare improvement.

Table 6: Welfare Gains from the FTA Scenarios
(Million US$)

	Patners of Japan's Bilateral FTAs					Regional FTAs			
	Existing FTAs	ASEAN10	C+K	ASEAN10 +CK	ASEAN10 +CKANI	ASEAN10	CJK	ASEAN10 +CJK	ASEAN10 +6
AUS	-30	-78	-153	-224	340	-9	-420	-586	8,105
NZL	0	2	-28	-24	129	-15	-46	-72	851
CHN	-145	-621	2,965	2,358	2,163	-329	4,789	6,186	6,906
HKG	10	47	-115	-66	-115	85	-237	-79	-163
JPN	2,301	4,094	5,707	9,838	12,161	-262	5,398	10,332	12,433
KOR	-125	-400	628	237	71	-199	14,163	15,944	18,007
TWN	-137	-336	-668	-978	-1,093	-151	-779	-1,516	-1,843
IDN	-67	1,099	-274	763	706	1,167	-264	3,519	4,078
MYS	822	827	-209	600	555	1,498	-242	3,236	4,224
PHL	-67	412	-223	163	111	909	-207	1,562	1,676
SGP	-18	-47	-188	-233	-304	2,143	-199	3,068	3,508
THA	-110	3,698	-393	3,170	3,005	3,271	-504	10,156	10,209
VNM	0	440	-139	189	180	220	-240	1,724	1,726
XSE	14	211	-61	149	135	472	18	719	492
IND	11	-108	-160	-253	352	-65	-57	-388	4,291
XSA	0	-26	-99	-120	-125	-21	-72	-183	-323
CAN	60	21	-62	-33	-62	68	27	156	-6
USA	-280	-253	-2,387	-2,462	-3,106	679	-1,158	-544	-2,340
MEX	2,892	30	-173	-117	-107	75	492	762	768
PER	12	-6	-42	-45	-52	-19	-31	-78	-135
CHL	0	3	-43	-38	-40	13	-80	-89	-126
EU15	332	18	-2,111	-1,919	-2,597	636	170	1,658	333
RUS	22	-7	-135	-137	-167	68	15	94	35
ROW	107	-123	-1,203	-1,254	-1,803	507	-343	367	-1,248
World	5,603	8,898	434	9,566	10,336	10,742	20,193	55,947	71,457

1. See Appendix 3 for region abbreviations.
2. Author's simulation, using GTAP database and GEMPACK.
3. Japan's existing FTAs consist of those with Singapore, Mexico and Malaysia.
4. Japan's bilateral FTAs assume all bilateral tariff rates become zero except for agriculture, fisheries, forestry, and processed food. Regional FTAs assume all members of the regional FTAs eliminate all tariffs in all sectors.

In all the cases, Japan invariably gains welfare from its own bilateral FTAs. The welfare gain of Japan expands as the number of its bilateral FTAs increases. The welfare gain of Japan from the existing three FTAs in total will be much smaller than those from the FTAs with China and Korea, and ASEAN10 countries. In particular, the FTAs with ASEAN10+5 (China, Korea, Australia, New Zealand and India) will bring about welfare gain of more than five times the three existing FTAs. As a standard concern on the preferential trade agreements, Japan's bilateral FTAs tend to bring about welfare loss to the third countries. This is due to the trade diversion effect. In particular, the case of the combination of Japan-China and Japan-Korea FTAs will reduce the total amount of economic welfare of the world, while other cases will not. In this case, even Korea will lose welfare, because of the aggravated terms of trade.

For the simulation cases of the regional FTAs including Japan, countries that are members of a regional FTA invariably gain welfare. The magnitude of welfare gains to the members expands as the members of the regional FTA increase. The largest-scaled regional FTA by ASEAN10+6 will bring about the largest amount of welfare gains to the members, as

well as the world in total. However, the welfare loss to the non-member countries also expands, due to the more serious trade diversion.

Dynamic Simulations: Model Structures and Assumptions

This sub-section assesses the time series impacts of various scenarios for Japan's FTAs in the future by means of a dynamic recursive general equilibrium model, namely the Dynamic GTAP (GTAP-Dyn). The model is essentially the same as the standard GTAP model, but it explicitly incorporates foreign asset ownership and an investment mechanism. As a result, the model simulation can follow the capital accumulation process in a recursive manner (for detail, see Ianchovichina and McDougall [2000]). The aggregation of the region and industry sectors is 18 times 10, reducing the scale of the model to ensure the stable convergence of the model simulation.

Table 7 below summarizes the baseline scenario of Japan's future FTAs, together with alternative scenarios. The baseline scenario assumes that the FTAs presently under negotiation will be concluded and their effects will materialize in or before 2010 to 2013. The FTA with New Zealand will be put in place in the period between 2014 and 2017, and those with China and remaining ASEAN members will be between 2018 and 2020.

Table 7: Scenarios of Japan's Future FTAs

	FTA Partners in Scenarios			
period	Baseline	Expedite FTAs	Japan - the US FTA	Agriculture Liberalizaiton
2006 - 2009	Singapore, Mexico, Malaysia, Phillipines, Thailand, Indonesia	Singapore, Mexico, Malaysia, Phillipines, Thailand, Indonesia	Singapore, Mexico, Malaysia, Phillipines, Thailand, Indonesia	Singapore, Mexico, Malaysia, Phillipines, Thailand, Indonesia
2010 - 2013	Korea, India, Australia	Korea, India, Australia, New Zealand, China, ASEAN10	Korea, India, Australia	Korea, India, Australia
2014 - 2017	New Zealand	--	New Zealand, United States	New Zealand (United States)
2018 - 2020	China, ASEAN10	--	China, ASEAN10	China, ASEAN10

The major alternative scenarios are (i) expediting FTAs with New Zealand, China and ASEAN10+5 to the period between 2010 and 2013; (ii) forming an FTA with the United States; (iii) liberalizing agriculture and related industries in the FTAs under the baseline scenario; and (iv) liberalizing agriculture and related industries and forming an FTA with the

United States. The periods of the Table indicate the approximate time when the price and quantitative adjustment brings about the impacts of the FTAs.

The simulations assume the following assumptions:

1. In the baseline scenario, the FTA partners of Japan will eliminate bilateral tariffs in all sectors to Japan, and Japan will do so except for agriculture, fisheries, forestry, and processed food. In contrast, in the Agriculture Liberalization scenarios (scenario III and IV), Japan will eliminate tariffs in all the sectors including these. The comparison of these scenarios, therefore, demonstrates the effects of the protection of these food-related sectors.

2. Detailed information on tariff reduction schedules in the future is available only in the existing FTAs with Singapore, Mexico and Malaysia. The simulation for these FTAs reflects the scheduled future tariff rate reductions. For the other FTAs, however, the tariff rates are simply assumed to be reduced to zero at the periods indicated in Table 7.

3. The dynamic simulation will measure the deviations of the values of the model variables between that of an economic situation along the assumed future baseline growth path without any policy shocks and that with the tariff reductions under the FTA scenarios. The assumed future growth path is not critically important, because the simulated impacts of the trade policy reflect only the differences of the variables, and their levels will be cancelled out.

The Results of Dynamic Simulation: Baseline Scenario

The simulation result of the Baseline Scenario is summarized in Table 8 below. The Table uses the GDP as a measure of the effects, not the EV. This is partly due to the fact that the Dynamic GTAP measures the welfare of the nations both incomes from domestic production and incomes generated from overseas investment. Trade liberalization policies, such as an FTA, may improve domestic efficiency which will attract foreign investment in the short and medium run. However, the accumulated investment inflows will result in increased payments back to abroad as the remittance of investment incomes in the future. The GDP measure will avoid such complication to assess the impacts of FTAs, although the GDP measures also indirectly reflect the mechanism.

Table 8: Baseline Scenario: Impacts of Japan's Future FTAs

(percentage of real GDP)

	2006 - 2009	2010 - 2013	2014 - 2017	2018 - 2020	static result
AUS	-0.01	0.04	0.04	0.00	0.25
NZL	-0.01	-0.10	-0.17	-0.08	0.32
CHN	-0.01	0.00	-0.03	-0.02	0.31
HKG	0.00	-0.02	-0.06	-0.07	-0.06
JPN	0.01	0.05	0.10	0.15	0.21
KOR	-0.03	0.12	0.35	0.34	0.31
IDN	-0.01	0.38	0.86	0.88	0.61
MYS	0.35	1.21	1.45	1.42	1.16
PHL	0.30	0.86	2.86	3.27	0.51
SGP	-0.08	-0.28	-0.32	-0.32	-0.29
THA	1.11	5.16	5.40	4.49	4.23
XSE	0.00	0.00	0.02	0.06	0.60
IND	-0.02	0.10	0.42	0.63	0.27
CAN	0.00	0.00	-0.02	-0.02	-0.01
USA	0.00	-0.01	-0.03	-0.03	-0.03
MEX	0.07	0.22	0.28	0.26	-0.03
EU15	0.00	-0.02	-0.04	-0.06	-0.03
ROW	-0.01	-0.04	-0.08	-0.08	-0.05

1. See Appendix 3 for region abbreviations.
2. Author's simulation, using GTAP database, GTAP-Dyn and GEMPACK.
3. Calculated as the deviation from an assumed growth path without policy shocks.

Generally, the FTA will bring about net positive impacts to both Japan and its FTA partners, except for China, Singapore and New Zealand. The existing tariffs of China and New Zealand are comparatively low and they will suffer from trade diversion effects from Japan's other FTAs, leading to the negative net impacts. China will also face negative net impacts on its GDP, but the impacts will become smaller in the period of 2018 – 2020. Non-member countries will generally suffer from Japan's FTAs.

The results of the dynamic and static simulations are generally comparable in the period of 2018 - 2020, except for New Zealand, China and Mexico. The simulated impacts on the GDP of New Zealand and China by the dynamic model are slightly negative, but those by the static model are positive; around 0.3 percent. The major difference of the model is the simulated investment process with international capital mobility. Both countries, as latecomers, will suffer from capital outflows brought about by Japan's other FTAs before they form their FTAs with Japan.

The positive impacts on Japan increase over time, as the number of its FTAs increases. Malaysia and Mexico, as their tariff reductions are scheduled periodically, also receive increasing positive impacts. Other countries will generally enjoy the largest positive impacts when they conclude FTAs with Japan.

Alternative Scenarios: Expediting Forming Japan's FTAs

The second scenario represents the case in which Japan forms FTAs more rapidly (see Table 7). Under this scenario, the counterparts are to conclude FTAs with Japan in the period of 2010 – 2013. Table 9 below summarizes the impact on regions' GDPs.

Table 9: Alternative Scenario: Expediting FTAs

Impacts of Japan's Future FTAs (percentage of real GDP)

	2006 - 2009	2010 - 2013	2014 - 2017	2018 - 2020	static result
AUS	-0.01	0.03	0.04	0.00	0.25
NZL	-0.01	0.01	0.06	0.05	0.32
CHN	-0.01	0.14	0.33	0.35	0.31
HKG	0.00	-0.03	-0.10	-0.10	-0.06
JPN	0.01	0.07	0.13	0.17	0.21
KOR	-0.03	0.06	0.20	0.20	0.31
IDN	-0.01	0.41	0.92	0.93	0.61
MYS	0.35	1.18	1.37	1.35	1.16
PHL	0.30	0.81	2.55	2.98	0.51
SGP	-0.08	-0.32	-0.41	-0.41	-0.29
THA	1.11	5.10	5.14	4.23	4.23
XSE	0.00	0.17	0.31	0.32	0.60
IND	-0.02	0.10	0.41	0.62	0.27
CAN	0.00	0.00	-0.01	-0.02	-0.01
USA	0.00	-0.01	-0.04	-0.03	-0.03
MEX	0.07	0.22	0.28	0.27	-0.03
EU15	0.00	-0.02	-0.05	-0.06	-0.03
ROW	-0.01	-0.05	-0.10	-0.09	-0.05

1. See Appendix 3 for region abbreviations.
2. Author's simulation, using GTAP database, GTAP-Dyn and GEMPACK.
3. Calculated as the deviation from an assumed growth path without policy shocks.

In the alternative scenarios, the simulated impacts become similar to those of the static simulation. The impact on Japan will be almost the same. In contrast, China will receive a larger positive benefit in the alternative scenarios than in the baseline scenario. The earlier FTA with Japan will improve economic efficiency in China during the early stage, leading to more inflow of capital and investment at the end. This case underscores the importance of timing. The same discussion applies in the case of New Zealand and other ASEAN countries (XSE).

Alternative Scenarios: An FTA with the US and Liberalizing Agriculture

The third scenario (Scenario III) represents the case in which Japan forms an FTA with the United States in the period of 2014 – 2017. The fourth scenario (Scenario IV) will make Japan eliminate the tariff of the sectors of the agriculture, fisheries, forestry, and processed food, with other assumptions the same as the baseline. The fifth scenario (Scenario V) is the combination of the fourth and fifth, assuming both liberalization of agriculture and

the related sectors and forming an FTA with the United States. The following Table 10 summarizes the impacts on the GDP of the region under the third, fourth and fifth scenarios in the period of 2018 – 2020.

Table 10: Scenario III, IV and V of FTAs

Impacts of Japan's Future FTAs (percentage of real GDP)

	Period 2018 - 2020			
	Baseline	Scenario III US Join	Scenario IV Agriculture	Scenario V
AUS	0.00	0.00	0.16	0.09
NZL	-0.08	-0.09	0.19	-0.13
CHN	-0.02	-0.02	-0.01	-0.03
HKG	-0.07	-0.07	-0.01	-0.05
JPN	0.15	0.17	0.22	0.31
KOR	0.34	0.33	0.41	0.32
IDN	0.88	0.89	-0.95	0.61
MYS	1.42	1.41	1.37	1.34
PHL	3.27	3.25	3.45	3.28
SGP	-0.32	-0.33	-0.18	-0.19
THA	4.49	4.46	6.53	6.05
XSE	0.06	0.05	-0.03	-0.16
IND	0.63	0.64	1.01	0.96
CAN	-0.02	-0.04	-0.07	-0.15
USA	-0.03	-0.02	-0.06	-0.05
MEX	0.26	0.23	0.25	0.08
EU15	-0.06	-0.06	-0.08	-0.12
ROW	-0.08	-0.09	-0.09	-0.15

1. See Appendix 3 for region abbreviations.
2. Author's simulation, using GTAP database, GTAP-Dyn and GEMPACK.
3. Calculated as the deviation from an assumed growth path without policy shocks.

Under Scenario III, the Japan – US FTA will bring about very small changes in impacts. Japan and the US will increase their GDP in marginal but positive amounts, compared to the baseline. The Agriculture Liberalization Scenario will generally increase the GDP impacts to the FTA partners with exporting agricultural products, in particular including Australia, New Zealand and Thailand. Scenario V, compared to Scenario VI, assumes the US will also enjoy the liberalization of the Japanese agriculture sectors. This brings about positive impacts on the US GDP, but some trade diversion effects will reduce the positive impacts on Australia, New Zealand and Mexico.

For Japan, the wider and deeper the liberalization is, the larger the positive impact on GDP will materialize. The dynamic gain of GDP under Scenario V will be more than seven times. The large increase of GDP under Scenario III – V underlines the significance of the liberalization of the agriculture and the related sectors of Japan.

4. Implications from the Study and Remaining Research Issues

Implications from the Study

The model study provides the following implications. First, Japan's three existing FTAs may bring about only small benefits. Much larger potential welfare gains are expected from the bilateral FTAs with ASEAN10, China, Korea, Australia, New Zealand, and India. Japan should proceed to expand its FTA partners. Both static and dynamic model simulation underscore the importance.

Second, the earlier formation of Japan's FTAs will provide both Japan and potential FTA partners with larger increases in GDP. The simulation of the dynamic model, which incorporates the mechanism of international capital mobility and capital accumulation, demonstrates the importance of earlier formation of an FTA, particularly in the case of New Zealand and China.

Third, regional FTAs including Japan will bring about welfare gains to all members in the region, while minimizing trade diversion. In consideration of the benefits of forming regional production networks, which were not included in the analysis, Japan should seek the formation of FTA networks to make them regional. In order to do so, ROOs should be harmonized to prevent them from hindering the optimal location of the production process.

Fourth, preferential trade arrangements, including FTAs, inevitably cause trade diversion, especially to non-member countries. Expansion of FTA members in the region will reduce the loss to such non-member countries, and contribute to building achievement toward the multi-lateral arrangements.

Remaining Research Issues

The model simulation inevitably faces limitations both from the model technology and the availability of data. Particularly, the model adopted in this paper assumes constant returns to scale. But in reality, the large part of the effects from trade liberalization may be brought about from the scale merits and the economy of agglomeration. The model should explore to duly assess such effects in the future.

Moreover, an FTA, particularly in the type of the EPA of Japan, includes a wide range of liberalization and cooperation measures in the clauses. The CGE models tend to assess only tariff reduction. The model should be improved to cover these effects both in theoretical and empirical sides. The modelers should also construct the required database.

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Appendix 1: Simplified framework for welfare analysis

The text adopts an analytical framework which greatly simplified the formulation by Baldwin and Venables (1995). Suppose that the welfare of the representative consumer in a country can be represented by an indirect utility function

$V = V(p + t, E)$ where p is a border price vector, t is a vector of import tariff (domestically captured rent), and E is total expenditure on consumption. Total expenditure is equal to the sum of factor income, profits and domestically accruing trade rents including tariff revenue, net of investment. Therefore,

$E = wL + rK + tm$ where m is the net import vector.

Totally differentiating V and dividing through by the marginal utility of expenditure and assuming perfect competition in the market for used capital we find:

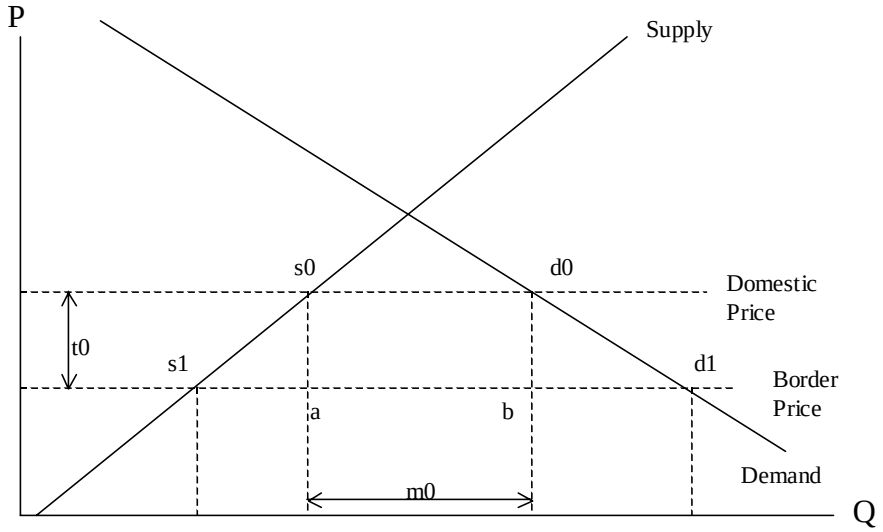
$$dE \approx dV / V_E = tdm - mdp$$

The first term is trade volume effect, and the second, terms of trade effect.

In the case of tariff elimination the trade volumes effect amounts to the following integral:

$$dE \approx \int_{t0}^{0} t \frac{dm}{dt} dt = [tm]_{t0}^{0} - \int_{t0}^{0} m dt = \int_{0}^{t0} m dt - t_0 m_0$$

where t_0 is the level of import tariff before the tariff elimination, and m_0 is the amount of import before the tariff elimination. In a partial equilibrium framework, the first term denotes the trapezoid $s_o d_o d_1 s_1$, and the second term is the rectangular $s_o d_o ba$ in the chart below. The two terms add up to the sum of two triangles $s_o a\, s_1$ and $d_o b d_1$.

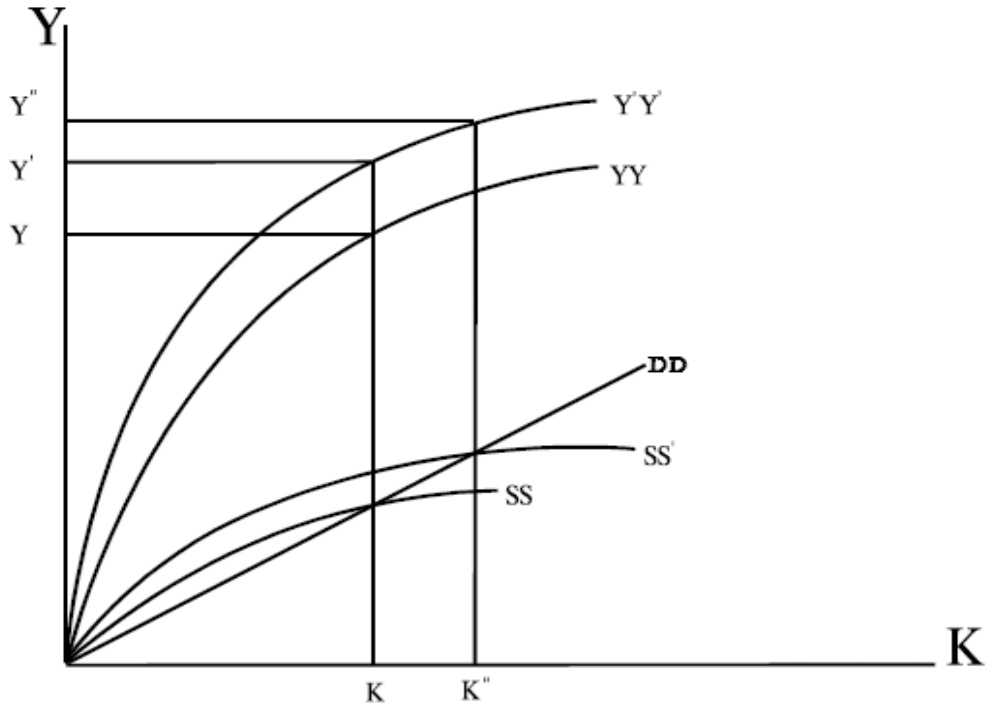


Appendix 2: Baldwin dynamic specification

According to Baldwin (1989, 1992) and Francois, et. al. (1996), the following specification is applied to the model of simulation. The first element is an aggregate production function linking output (Y) at time t to the amount of capital (K) and labor (L) employed:

$$Y = F(A, K, L)$$

where A is an overall productivity parameter, and the production function F is linearly homogeneous and diminishing returns with respect to capital (K) and labor (L). The relation between the stock of capital and output is plotted as YY in the figure below. Note the curvature of YY reflecting diminishing return to capital when the labor force is held constant.



For a given flow of investment, the capital stock evolves over time according to

$$K_{t+1} = (1 - \delta)\ K_{t+1} + I_t$$

where δ is the depreciation rate of the capital stock each year, and I_t is the flow of gross investment. The capital stock will be higher next period if today's investment is sufficiently large to both replace worn out capital and add new units to the stock. To complete the model, we must specify how much of current output is set aside for savings and investment. We adopt the classical assumption that consumers save a fixed share (s) of income,

$$S = s\ Y_t$$

where *S* is total saving. Abstracting from international capital flows, savings equals to investment. Furthermore, since savings depends on income that in turn depends on the capital stock, savings depends (indirectly) on the stock of capital. The savings function is plotted as SS in the figure. The final relation plotted in figure 1 is DD=δK, the amount of investment needed to replace worn out capital in each period. The capital stock grows over time if savings and investment are larger than the rate at which capital depreciates (SS > DD), it is constant if savings and investment are just enough to replace depreciated capital (SS = DD), and it falls otherwise (SS < DD).

Starting from a low capital stock with high returns on investment, income will grow over time as capital is accumulated through savings and investment. In the absence of technical progress, this process will eventually come to an end because of the diminishing returns of adding more capital per worker. In the long run, growth in per capita income will stop at the point where savings is just enough to replace depreciated capital. The "steady state" capital stock and output (distinguished by absence of time subscripts) are eventually reached.

Now, consider the impact of efficiency-enhancing changes, i.e. tariff reduction in this study. We assume that the region we are modeling is initially in a steady-state, and that the changes enhances the efficiency of capital and labor by moving resources into sectors where they are more valuable at the margin. In the figure, this is represented by an increase in the economy-wide productivity parameter *A*, which shifts out the production function from YY to Y'Y' for any given level of capital and labor. That is, the same amount of labor and capital can now produce more than before, as illustrated by the difference between Y' and Y in the figure. This is the short-run or static gain. Part of the additional income will be saved and invested in new capital, which in turn yields an additional income gain. (Note the positive difference between S'S' and DD for the initial capital stock K, implying positive net investments). The economy will, over time, move up to a new higher steady state capital stock and corresponding higher output, marked in the figure by K" and Y" respectively.

Decomposing the total income gain into static and induced (medium-run) gains we have

$$(Y''-Y)/Y = (Y'-Y)/Y + (Y''-Y')/Y$$

where the first part is the static income gain and the second part is the induced (medium-run) gain. It turns out that the latter is simply a multiple of the static gain.

$$(Y''-Y')/Y = (a/1-a)(Y'-Y)/Y$$

That is, for each percentage increase in static income one gets an additional fraction in induced income gain over the medium run. (Of course, *any* policy change that improves productivity will induce higher incomes with a savings-investment linkage). The size of the induced income gain depends on the curvature of the YY schedule, which in turn depends on the elasticity of output with respect to capital, measured by the parameter "*a*" in the production function. The larger the output capital elasticity, the less the curvature of the YY schedule, and the larger the induced gain in income.

Appendix 3: Sector and Region Aggregation

1. Sector Aggregation

#	Code	Contents
1	GRN	Paddy rice; Wheat; Other cereal grains
2	CROP	Vegetables, fruit, nuts; Oil seeds; Sugar cane, sugar beet; Plant-based fibers; Other crops
3	LSK	Cattles; Animal products; Raw milk; Wool, silk-worm cocoons; Meats; Meat products; Dairy products
4	FRS	Forestry
5	FSH	Fishing
6	MNG	Coal; Oil; Gas; Other minerals
7	FDP	Vegetable oils and fats; Processed rice; Sugar; Other food products; Beverages and tobacco products.
8	TEX	Textiles
9	WAP	Wearing apparel; Leather products
10	CHM	Petroleum, coal products; Chemical,rubber,plastic prods
11	MET	Mineral products (excluding coal, oil, gas and other extracted minerals); Ferrous metals; Other metals; Metal products.
12	MVH	Motor vehicles and parts.
13	OTN	Other transport equipment
14	ELE	Electronic equipment
15	OME	Other machinery and equipment
16	OMF	Wood products; Paper products, publishing; Other manufactures
17	EGW	Electricity; Gas manufacture, distribution; Water
18	CNS	Construction
19	TRD	Trade
20	TRS	Transport
21	CMN	Communication
22	FIN	Financial services; Insurance.
23	PRS	Other business services; Recreation and other services
24	OFS	PubAdmin/Defence/Health/Education
25	DWE	Dwellings.

2. Region Aggregation

#	Code	Countries and Regions
1	AUS	Australia
2	NZL	New Zealand
3	CHN	China
4	HKG	Hong Kong
5	JPN	Japan
6	KOR	Korea
7	TWN	Taiwan
8	IDN	Indonesia
9	MYS	Malaysia
10	PHL	Philippines
11	SGP	Singapore
12	THA	Thailand
13	VNM	Vietnam
14	XSE	Rest of Southeast Asia
15	IND	India
16	XSA	Bangladesh; Sri Lanka; Rest of South Asia
17	CAN	Canada
18	USA	United States
19	MEX	Mexico
20	PER	Peru
21	CHL	Chile
22	EU15	Austria; Belgium; Denmark; Finland; France; Germany; United Kingdom; Greece; Ireland; Italy; Luxembourg; Netherlands; Portugal; Spain; Switzerland
23	RUS	Russian Federation; Rest of Former Soviet Union
24	ROW	Rest of the World