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The Sectoral and Regional Implications of Trade Liberalization

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Abstract

This paper discusses the sectoral and regional implications of trade liberalization on the Japanese economy, using quantitative simulation analyses and a CGE model of global trade. The dynamic aspects of capital formation and productivity improvements are incorporated into a standard static model based on the most updated version of a global trade database. As a result of global trade liberalization, Japan would gain in transport equipment production, and lose in agricultural and processed foods. The relative significance of those adjustment costs in comparison with the macroeconomic benefits may vary according to the partner of bilateral FTAs. Moreover, it must be noted that trade liberalization in agricultural sectors would also be beneficial to the Japanese economy at the macro level, in particular, to consumers. On the other hand, although trade liberalization might more or less benefit all of Japan's prefectures, the regional differences in income levels would be expanded given the current structures of industries by regions.

Key words: trade liberalization, regional developments, CGE model.
JEL classification: C68, F14, F15, R11.

I. Introduction

According to conventional simulations by a Computable General Equilibrium (CGE) model of global trade, trade liberalization measures, including tariff reductions, will stimulate trade by lowering the prices of tradable goods. This will result in increases in the national output of exporting countries while increasing access to the market of trading partners. Meanwhile, domestic production resources—land, capital, labor, and intermediate inputs—will be used more efficiently in importing countries, in particular, when domestic distortions, including those due to trade barriers, are reduced. These combined effects—one from foreign markets and the other from domestic market—are expected to result in the expansion of production and an increase in income and welfare. In addition, economic benefits would be expanded by dynamic impacts through capital formation mechanisms and productivity improvements. Although negative impacts due to trade diversion effects and the terms of trade effects are suggested by theoretical studies, empirical analyses, including model simulations, have generally indicated macroeconomic benefits from trade liberalization.

The impact of structural reform measures including trade liberalization would

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be more widely observed at sectoral levels compared with those changes in income and production at the macro level. In particular, trade liberalization may result in a realignment of regional production. In principle, it would be in accordance with the comparative advantage of the regions. Successful structural adjustments would be required to realize possible gains from trade liberalization. Moreover, those impacts on income distribution are much more concerned about balanced developments among the regions within a particular country.

The purpose of this paper is to discuss the sectoral and regional rather than macroeconomic aspects of trade liberalization by conventional CGE model simulations.[1] The remaining part of this paper is organized as follows. In Chapter II, the framework of a CGE model employed for the simulation experiments in this paper is presented. In Chapter III, sectoral developments, i.e. the impacts on sectors and of sectoral trade liberalization, are discussed. Chapter IV examines those impacts on the Japanese economy by prefectures. The paper concludes with Chapter V.

II. The Framework of CGE Model Simulations

To analyze the economy-wide impact of trade liberalization, a CGE model of global trade is employed for model simulations in this paper. A CGE model numerically simulates the general equilibrium structure of the economy. It is built on the Walrasian general equilibrium system, the central idea of which is that market demand equals supply for all commodities at a set of relative prices. Moreover, a CGE model has solid micro-foundations that are theoretically transparent. Functional forms are specified in an explicit manner, and interdependencies and feedback are incorporated. Therefore, the model provides a framework for assessing the effects of policy and structural changes on resource allocation by clarifying "who gains and who loses."

These characteristics differentiate it from the partial equilibrium model, which is not economy-wide, the macroeconomic model, which is not multi-sectoral, and the input-output model, in which economic agents do not respond to changes in prices. Moreover, the multi-country model is required to analyze international economic affairs such as trade and investment policies, which affect not just one but a number of economies.

On the other hand, it must be noted that the estimated economic impact of a CGE model is not a forecast. As described in Dee, Geisler and Watts (1996), economic policy measures will be implemented over time and adjustments to those changes may take time. During the course of such adjustments, other economic changes will also take place. However, those changes, including economic growth and structural changes in trade and industries, are not taken into account in the current analysis. The model simulation shows the differences at a certain point in time

[1] The simulations throughout this paper were carried out to assess the impact of the removal of import protection on goods. Trade liberalization in service sectors is not included. Other measures, such as those for investment liberalization and free movement of labor, are not explicitly considered.

between when trade liberalization measures were implemented and when they were not[2].

The basic framework of the trade model is guided by the comparative advantage theory by Hecksher-Ohlin. However, the original theory of comparative advantage cannot explain such aspects as the two-way trade seen in actual trading behavior. This is because the theory makes no distinctions between the same goods from different areas of production. Therefore, the general equilibrium model introduces heterogeneity into the same goods according to their production areas, namely imperfect substitutes of goods between home and abroad—the so-called Armington assumption[3]—and thus describes realistic trade developments.

Among others, the database and the standard version of a model by the Global Trade Analysis Project (GTAP)[4] are utilized as a basis for the simulation experiments in this paper. The GTAP model is a standard CGE model, which depicts the behavior of households, governments and global sectors across each economy in the world. It is composed of regional models that are linked through international trade. Prices and quantities are simultaneously determined in factor markets and commodity markets by accounting relationships, by the equilibrium conditions specified by the behavior of economic agents, and by the structure of international trade. The model includes three main factors of production: labor, capital, and land. Labor and capital are used by all industries, but land is used only in agricultural sectors. Capital and intermediate inputs are traded, while labor and land are not traded between regions.

The GTAP model assumes that firms use a constant-returns-to-scale technology, and minimize the cost of inputs, given a level of output and technology. Firms are assumed to combine a bundle of intermediate inputs in fixed proportion with a bundle of primary factors. The demand for an each intermediate input is also assumed to vary in fixed proportion with the level of output. That is, the production function in the GTAP model has a Leontief structure.

This production structure yields the demand equations for a bundle of primary factors and intermediate inputs. By determining the demand for primary factors, the Constant Elasticity of Substitution (CES) functional forms are assumed. The CES production function yields the demand equations for primary factors and the prices of value-added in industries evaluated at firms. Firms purchase intermediate inputs, some of which are produced domestically, and some of which are imported. Domestic and imported intermediate inputs are substituted according to a constant elasticity of

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[2] Although the structure of the model is non-linear, simulation outcomes tend to be almost linear to external shocks. The impact of trade liberalization is estimated to be not so much different, based either on the current or future economic structures incorporating growth effects as far as it can be estimated in terms of rates of change, given that the general equilibrium elasticities are unchanged.

[3] See Armington (1969) for a description of the Armington assumption.

[4] The GTAP model was applied to the analysis of the economic impact of the Uruguay Round Agreement by the Secretariat of the General Agreement on Tariff and Trade (GATT) for that day, as seen in GATT (1994). And later, in 1997, it was also utilized in the assessment of the economic impact of the Manila Action Plan by the APEC Economic Committee, as seen in APEC (1997). At present, this model and database are widely used by international organizations and researchers on international affairs. See Hertel (1997) for a description of the GTAP database and model.

substitution. Similarly, a constant elasticity of substitution is assumed to capture the degree of substitutability between imports from different sources. The two-level CES functional form yields the demand functions.

Regional household behavior is governed by an aggregate utility function specified over composite private consumption, composite government consumption, and savings. The other features of regional household utility function is the use of an index of current government expenditures to proxy the welfare derived from the government's provision of public goods and services to private household in the region. The share of each of private household expenditures, government expenditures and savings are constant in total income. Once the changes in real government spending has been determined, this spending is allocated across composite goods and aggregate demand for the composite is allocated between imports and domestic products under the assumption of constant elasticity of substitution. Private household demand has a non-homothetic nature. The allocation of private household expenditures across commodities is based on the constant difference of elasticity (CDE) expenditure functions.

The GTAP model introduces two global sectors. One is the global transportation sector, which provides the services that account for the difference between fob and cif values for commodities. The other is the global banking sector. The global banking sector intermediates between global savings and investment. It creates composite investment goods, based on a portfolio of net regional investment, and offers this to regional households to satisfy their savings demand. Therefore, all savers face a common price for this saving commodity. A consistency check on the accounting relationships involves separately computing the supply of the composite investment goods and the demand for aggregate savings. If all other markets are in equilibrium, all firms earn zero profit, and all households are on their budget constraints, then global investment must equal global savings by virtue of Walras' Law.

The standard version of the GTAP model includes several key assumptions.[5] Among others, it must be noted that the amount of total labor—one primary factor of production—is fixed. This means that the model assumes full employment and no unemployment. The amount of total capital is also fixed in the standard GTAP model.

A common criticism has often been that a standard CGE model focuses on evaluation of static efficiency improvements, and therefore the dynamic effects among production, income, and savings and investment are not captured. In fact, concerning the dynamic impact of trade liberalization, the growth effects through productivity gains and capital accumulation have been pointed out. In this paper, certain dynamic aspects are studied in the model simulations.

One deals with the dynamic aspects of capital formation by modifying the standard version of the GTAP model. Two mechanisms are considered in this paper.

[5] It must be noted that the outcomes of model simulations may vary according to these macroeconomic assumptions and closures. These variations are suggested not just in terms of magnitude but also in direction. See, for example, Kawasaki (1999) for a diagnostic analysis of such model sensitivities in case of simulations on the impact of trade liberalization.

First, the important "dynamic" effects of capital accumulation are introduced[6] into the standard static model. The initial increase in income is assumed to increase savings (a fixed share of additional income is saved) and investment. The induced savings and investment (larger capital stock) in turn link to the production capacities and cause a further increase in income. Second, trade balance is endogenously determined and international capital movement is allowed. It is assumed that the expected rate of return on capital would be equalized among the regions.

In addition to these, pro-competitive productivity growth effects[7] are also investigated in the model simulation. It is assumed that productivity of domestic industries would increase to compensate for the lower import prices. Such a rate of productivity increase is set as equal to the rates of change in import prices weighted by a share of imports over total production, including domestic goods.

There are four types of behavior parameters in GTAP: elasticities of substitution (in both expenditures and production), transformation elasticities that determine the degree of mobility of primary factors across sectors, the flexibilities of regional investment allocation, and consumer demand elasticities. In this paper, three sets of elasticities of substitution are taken from the GTAP database and aggregated with weights of trade shares. It should be noted that these parameters are commonly applied to all regions in this paper.

The first set of elasticities is a set of parameters for the Armington assumption, which describes the ease of substitution between domestic goods and composite imports, by commodity. Those Armington elasticities vary by sectors but are on average around 2.4 for primary, 3.5 for manufacturing, and 1.9 for services. The second Armington parameter determines the case of substitution among imports from different sources. This is equal to twice the value of the first one. The third set is for primary production factors of labor and capital. Those are 0.20 or 0.24 for primary, 1.12 or 1.26 for manufacturing, and 1.26 to 1.68 for services. The demand of the primary sector for primary production factors is less sensitive to the price changes in production factors.

The GTAP database provides fairly arranged data of countries and regions in which Japan is highly interested, namely the Asian Newly Industrializing Economies (NIEs), the Association of Southeast Asian Nations (ASEAN) countries and others. One notable distinguishing feature of the model is its function to separately evaluate the mutual dependence between Japan and these economies. The GTAP database

[6] See Francois, McDonald and Nordstrom (1996) for the methodology to implement this mechanism into the GTAP model. They explore the interaction between trade policy and capital accumulation in the GTAP model. According to the growth theory, a medium-run growth or accumulation effect induces additional savings and investment, which yields more output. In general, a permanent shock to the GDP is translated into a shock to the steady-state level of capital. The magnitude of this effect crucially depends on the assumed underlying saving behavior. Under the assumption of a fixed saving ratio, the change in steady-state capital stock is proportionate to the change in the steady-state level of GDP.

[7] For examples, see Itakura, Hertel and Reimer (2003) regarding incorporating productivity linkages in general into the GTAP model simulations, and Ianchovichina, Binkley and Hertel (2000) for incorporating pro-competitive productivity effects into a CGE model with an assumption of imperfect competition.

currently consists of 57 disaggregated sectors and 87 economies,[8] which are aggregated into the appropriate version for simulations. In this study, as shown in Table 1, economies are aggregated into 22 areas. The development of larger economies and potential candidates for Japan's bilateral FTAs are analyzed individually in addition to those countries with which Japan has already signed or started negations on FTAs. Industries/commodities are aggregated into 19, in accordance with the medium classifications of standard national accounts (SNA).[9]

Table 1: Regional and Commodity Aggregation

Countries and Regions		Commodities/Industries	
JPN	Japan	AFF	Agriculture, Forestry and Fisheries
KOR	Korea	MNG	Mining
SGP	Singapore	PFD	Processed foods
CHN	China	TXL	Textiles and Apparel
IDN	Indonesia	PPP	Paper products, publishing
MYS	Malaysia	CRP	Chemical, Rubber, Plastic products
PHL	the Philippines	P_C	Petroleum, Coal products
THA	Thailand	NMM	Other mineral products
IND	India	MTL	Metals
OAO	Other Asia and Oceania	FMP	Metal products
AUS	Australia	OME	Other machinery and equipment
NZL	New Zealand	ELE	Electronic equipment
USA	the United States of America	TRN	Transport equipment
CAN	Canada	OMF	Other manufacturing
MEX	Mexico	CNS	Construction
BRA	Brazil	EGW	Electricity, Gas and Water
CHL	Chile	T_C	Trade and Communication
ROM	Rest of MERCOSUR	OSP	Other private services
EUM	European Union	OSG	Public services
CHE	Switzerland		
RUS	Russia		
ROW	Rest of the World		

Trade protection data are also derived from the current GTAP database as they are, without any modification. They are expressed in the form of ad valorem equivalent, tariff barriers, and non-tariff barriers. The best-quality data are those relating to tariffs. Non-tariff information is most complete for agriculture and textiles and apparel. Data for subsidies are also available, distinguishing those for factor-based, intermediates, and ordinary output, but are not comprehensive. Protection of the service sector is especially difficult to quantify, and is mostly neglected in the current database.

[8] This is the version six database, whose beta version was released in November 2004, although the base year is 2001.

[9] See Annex Tables 1-A and 1-B for the concordance of these aggregations and the classification in the GTAP database.

III. Sectoral Developments

III.1. Trade and Protection Structures

The impact of trade liberalization can more or less be determined by actual trade structures and the degree of import liberalization by sectors, in addition to the comparative advantage of the sectors among regions, which is suggested to be a key factor in standard trade theory. Therefore, the structures of trade and protection levels are worthy of consideration prior to simulation experiments. The structures of Japanese exports to and imports from the world as a whole are shown by commodity in Table 2.

Table 2: Japan's Trade Structure

(%)

	Exports	Imports
Agriculture, Forestry and Fisheries	0.3	4.0
Mining	0.0	11.9
Processed foods	0.5	7.2
Textiles and Apparel	2.1	6.0
Paper products, publishing	0.6	1.1
Chemical, Rubber, Plastic products	9.2	6.9
Petroleum, Coal products	0.2	2.0
Other mineral products	1.6	1.3
Metals	4.6	3.2
Metal products	1.4	1.1
Other machinery and equipment	26.1	10.4
Electronic equipment	20.9	13.7
Transport equipment	21.6	3.6
Other manufacturing	2.1	7.1

Source: GTAP version 6 database

Machinery and equipment, including electronic equipment and transport equipment, make up nearly 70 per cent of Japanese exports to the world as a whole. On the other hand, in addition to natural resources including oil and machinery and equipment, share higher ratios in imports to Japan. However, the structure of Japanese trade—and in particular that of imports—varies widely according to trading partners. Those structures are shown in Annex Tables 2-A and 2-B.

Trade liberalization has widely been promoted in the world economy during the last several decades. However, according to the most updated version of the GTAP database, an import protection of around 3.9 per cent[10] remained in world trade on average at the beginning of the 2000s. By regions, trade barriers are lower in North America and the EU, and free trade is mostly realized in Hong Kong, China; and Singapore. However, higher trade protection is still observed mainly in developing economies. By commodities and industries, although variations are smaller compared with regional differences, trade protection is higher in primary products and food,

[10] It may be noted that this figure is weighted by the actual volume of imports. If the import volume of certain products with higher import protection is smaller, an average level of import protection in this measurement would be calculated to be somewhat lower.

followed by textiles and apparel.

The import protection that Japan imposes on and faces in the world on average is shown in Table 3.[11] Japanese import protection, mostly in the manufacturing sectors, is quite low by international standards; actually it's almost zero. However, higher protection remains in the primary industries, food, and textiles and apparel. In contrast, the higher trade protection that Japan faces is widely observed in the other economies across primary and secondary industries. As discussed above, trade protection in textiles and apparel is higher, following that in primary products and food in world trade as a whole. The trade protection rates also vary among the sources of and destination for trade. Detailed data are available in Annex Tables 3-A and 3-B.

Table 3: Import Protection on Japan's Trade

(%)

	Exports	Imports
Agriculture, Forestry and Fisheries	2.2	22.6
Mining	3.0	0.0
Processed foods	13.9	31.4
Textiles and Apparel	16.8	9.0
Paper products, publishing	5.2	0.3
Chemical, Rubber, Plastic products	6.1	1.0
Petroleum, Coal products	3.8	1.6
Other mineral products	6.7	0.6
Metals	6.1	0.6
Metal products	6.9	0.5
Other machinery and equipment	4.5	0.1
Electronic equipment	2.6	0.0
Transport equipment	7.9	0.0
Other manufacturing	4.4	3.6
Average	5.5	5.2

Source: GTAP version 6 database

III.2. Impacts on Sectoral Structures

The impact of structural reform measures, including trade liberalization, would be more widely observed at sectoral levels compared with those changes in income and production at the macro level. In particular, trade liberalization may result in a realignment of regional production. In principle, that would be in accordance with the comparative advantage of the regions. According to conventional simulations by a CGE model of global trade, developing and transition economies are expected to expand production of labor-intensive manufactured products as a result of broadly based trade liberalization measures. On the other hand, developed economies are expected to expand production in the capital- and technology-intensive manufacturing sectors, while in the geographically larger countries agricultural and food industries would expand production.

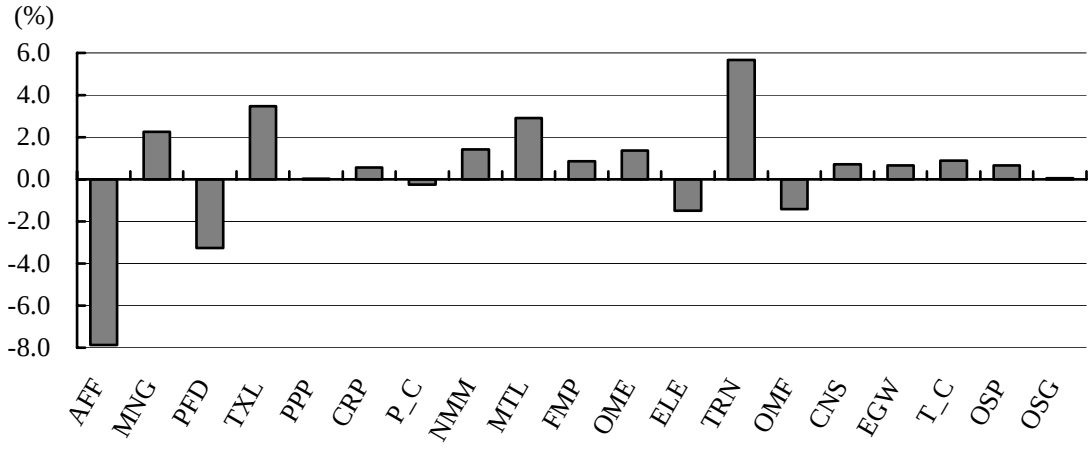
An estimated impact on the structure of sectoral production according to global

[11] The figures in the Tables show the "net" levels of import protection. They can be negative, for example, when subsidies are paid, reducing the price of import goods in the domestic market.

trade liberalization is shown in Annex Table 4.[12] As a result of global trade liberalization, output will increase in transport equipment in Japan, in textiles and apparel in ASEAN countries, China, and Asian NIEs, in agriculture and food industries in Australia, and in agriculture in North America.

It is indicated that not just "winners" but also "losers" may emerge from implementing trade liberalization measures. It should be noted that the reallocation of resources to more productive uses usually involves some adjustment costs,[13] including the displacement of employment across industries within the economies. In Japan, on the other hand, as shown in Chart 1, production in agricultural and food sectors would shrink. To enjoy the macroeconomic benefits from trade liberalization, successful structural adjustments would be required.

Chart 1: Changes in Japan's Production Structures



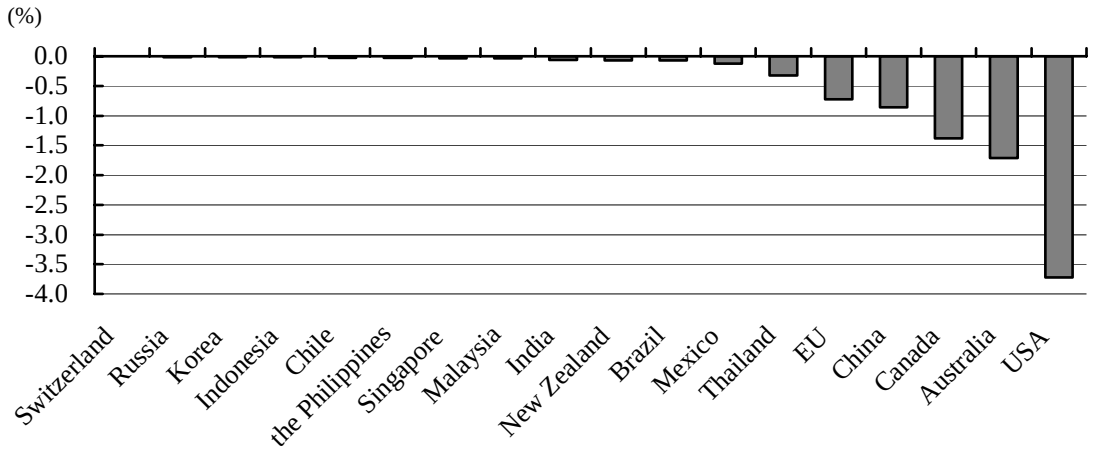
Source: Author's Simulation

In addition to the movements of global trade liberalization, regional efforts have been made through Regional Trade Agreements (RTAs) and bilateral Free Trade Agreements (FTAs). From the perspectives of Japanese policymakers and agricultural industries, some people are worried about those sectors being seriously damaged as a result of trade liberalization. Changes in Japanese agricultural production according to Japan's various bilateral FTAs are estimated in Chart 2. It is shown that agricultural production would shrink most significantly under a Japanese FTA with the United States. Such a loss for Japan would be relatively larger from FTAs with geographically larger economies like Australia, Canada, China, and the EU as a whole.

[12] This estimate is given by running the standard static version of a CGE model in this paper. This version of the model does not incorporate a dynamic capital formation mechanism and the productivity linkages discussed above, which are included in the other simulations in this paper. It measures the static impact of resource allocation due to a comparative advantage. It may be possible, for example, that a negative impact on certain sectors would be more than offset by incorporating these dynamic effects.

[13] These adjustment costs are not considered in the current model simulations.

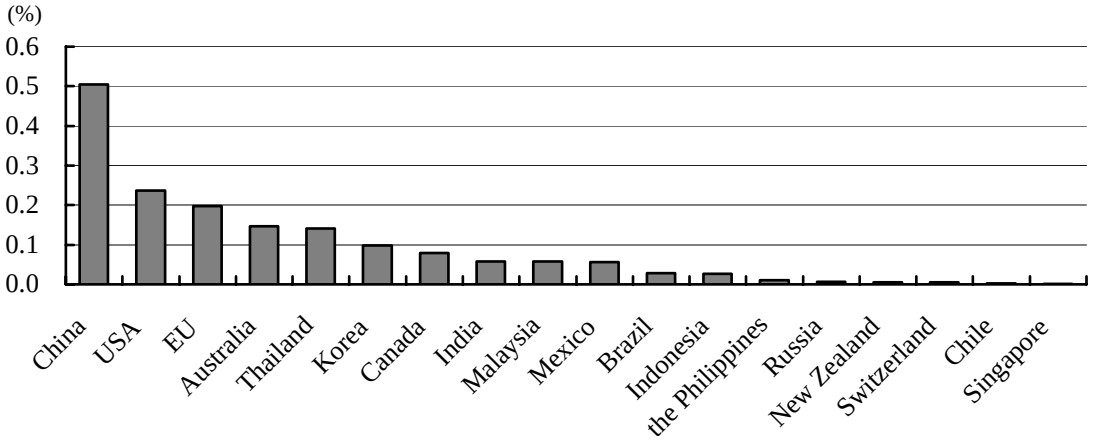
Chart 2: Changes in Agricultural Production



Source: Author's Simulation

On the other hand, it is interesting to estimate which FTAs benefit Japan the most. The macroeconomic benefits of Japan's bilateral FTAs with other economies are compared in Chart 3. As far as real GDP gains are concerned, China is ranked as the top trading partner of Japan.[14] This position is followed by developed economies like the EU, North America, and Oceania, rather than most Asian economies.

Chart 3: Changes in Real GDP

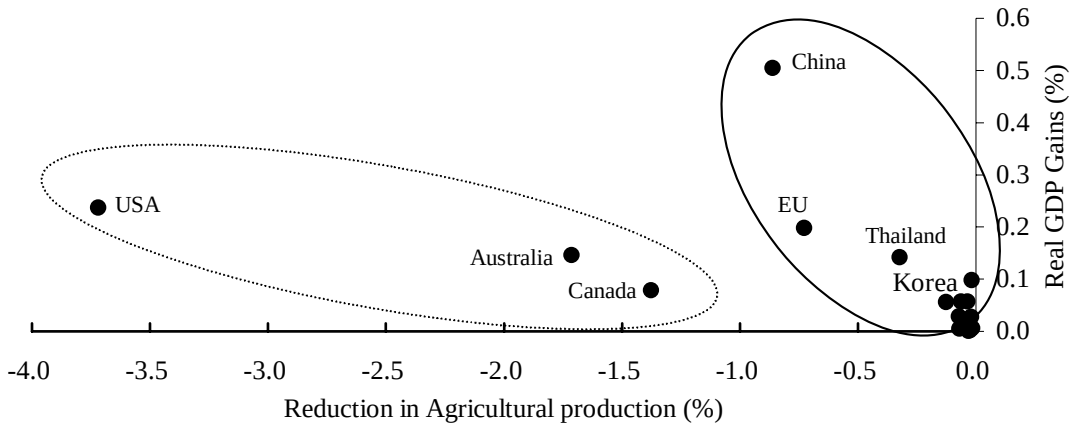


Source: Author's Simulation

Moreover, the relative costs and benefits of Japan's FTAs are worth examining. They are compared in terms of reduction in agricultural production, shown in Chart 2, and real GDP gains, as seen in Chart 3. As shown in Chart 4, Japan would gain relatively more from FTAs with China, the EU, Thailand, and Korea in comparison with those losses. On the contrary, Japan would lose relatively more from FTAs with the United States, Australia, and Canada.

[14] This is not strange in light of the fact that China has become the first Japanese trading partner that is a source region of Japanese imports.

Chart 4: The Costs and Benefits of Japan's Bilateral FTAs

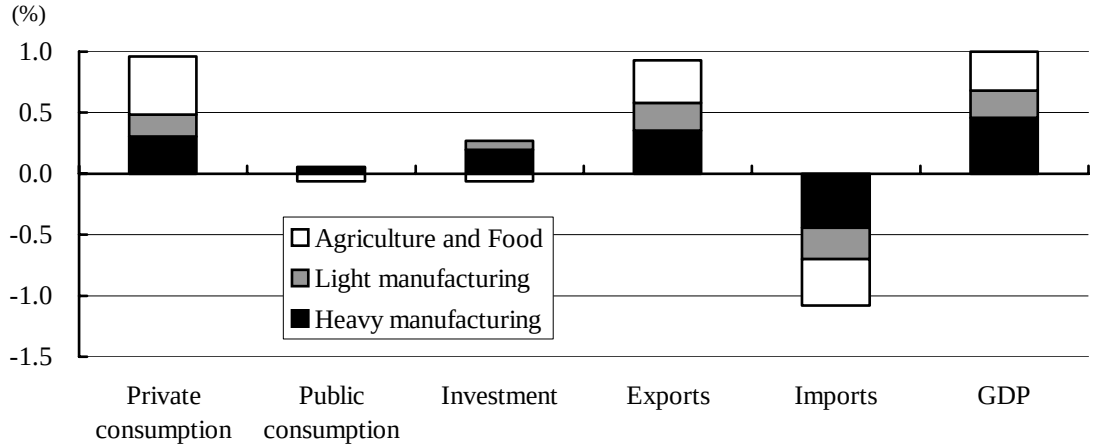


Source: Author's Simulation

III.3. The Impacts of Sectoral Trade Liberalization

The impact of partial and preferential trade liberalization has generally been shown to be limited compared with that of much-wider trade liberalization without any discriminative treatment in earlier studies by CGE model simulations. Moreover, as pointed out in Dee, Hardin and Schuele (1998), which analyzes the economic impact of the Early Voluntary Sectoral Liberalization (EVSL) in APEC, the outcomes of trade liberalization in limited sectors may deviate from efficient resource allocation which would be realized by wider liberalization.

Chart 5-A: The Impacts of Sectoral Liberalization - Real GDP Gains -

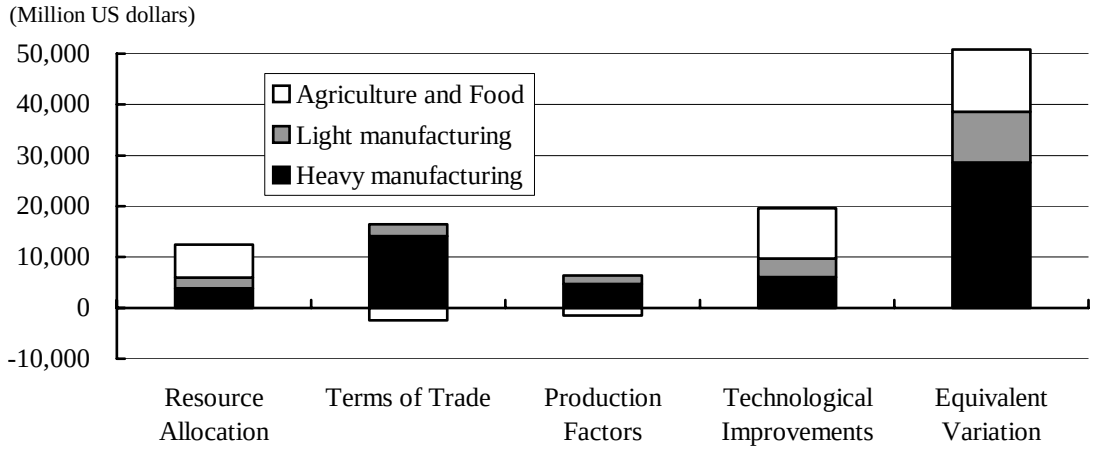


Source: Author's Simulation

However, in the negotiation process for trade liberalization, it is possible that certain economies prefer trade liberalization in limited sectors to protect their less-competitive sectors. From the perspective of interests of domestic industries and policymakers, it is worth looking at the relative significance of trade liberalization by sectors. The degree of macroeconomic impact of global trade liberalization using the three categories of sectors is compared in Chart 5-A and 5-B. The first category is

agriculture, forestry and fisheries, and processed foods, shown in commodity aggregation in Table 1; the second category is light manufacturing, which is composed of textiles and apparel, paper products, publishing, other mineral products, and other manufacturing; the third category is heavy manufacturing composed of mining, chemical, rubber, plastic products, petroleum, coal products, metals, metal products, other machinery and equipment, electronic equipment, and transport equipment.

Chart 5-B: The Impacts of Sectoral Liberalization - Welfare Improvements -



Source: Author's Simulation

It is shown that Japanese real GDP gains would largely come from trade liberalization in heavy manufacturing industries. However, trade liberalization in agriculture and food industries would also be beneficial. Japanese consumers would also mainly benefit from agricultural and food trade liberalization. Moreover, Japanese exporters, i.e. producers, would largely gain from trade liberalization in other manufacturing sectors.

On the other hand, in breaking down the welfare gains measured by changes in Equivalent Variation (EV),[15] it is shown that agricultural and food trade liberalization would be a major source of those gains due to more efficient resource allocation. Heavy manufacturing trade liberalization would be a vital source of the terms of trade gains.

These gains indicate that it would be better to improve resource allocation through trade liberalization and structural reforms, including the sectors in which they are less competitive in international markets. However, it would not necessarily be enough for trade liberalization to be limited in those less-competitive sectors. Trade liberalization, both in the primary and the secondary industries, would be much more beneficial to Japan without discrimination in certain sectors. In any event, the economic impacts of wider trade liberalization covering more sectors would be greater.

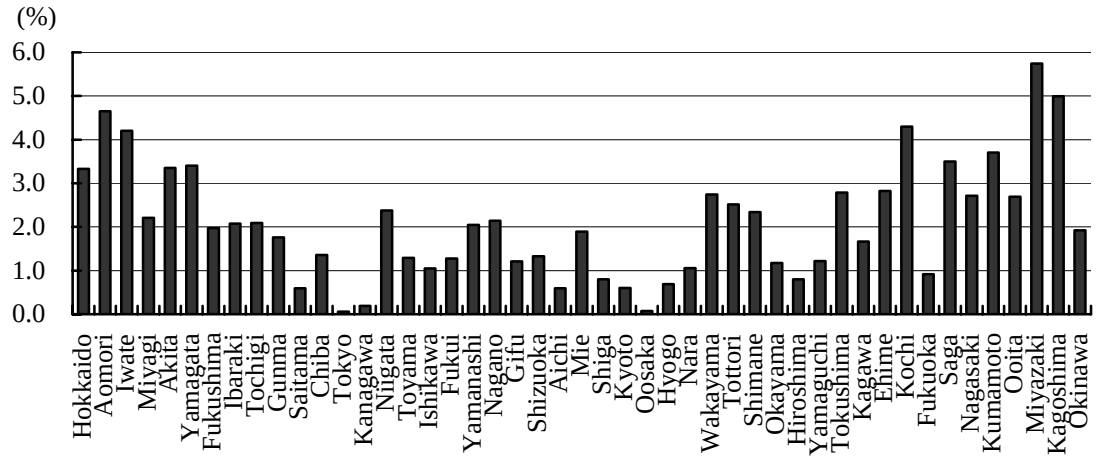
[15] The methodology to break down an aggregated welfare impact was developed and revised by Huff and Hertel (2001) and extended by Hanslow (2000).

IV. Impacts on Regional Economy

The Japanese economy has steadily been recovering from the last trough in the business cycle, in January 2002. However, one distinguished feature in the current recovery phase must be noted. There are significant differences in such recoveries when they are compared by prefectures in Japan. This may be the reflection of economic policy measures that have emphasized the implementation of structural reforms. In fact, the volume of public works, which used to be stimulated by conventional fiscal package measures, has decreased in total. This must have larger impacts on rural economies which have relied more on public sectors.

Some people worry that further structural reform measures like trade liberalization would be harmful to those rural economies. In fact, the ratio of production in agriculture, forestry and fisheries, which is estimated to shrink as trade liberalizes, is higher in lower-income prefectures. Although these sectors comprised 1.3 per cent of Japan's GDP in fiscal 2001, as shown in Chart 6, this figure varies from zero to six per cent by prefectures. A negative correlation between the share of agricultural production and per capita income levels among prefectures is observed.

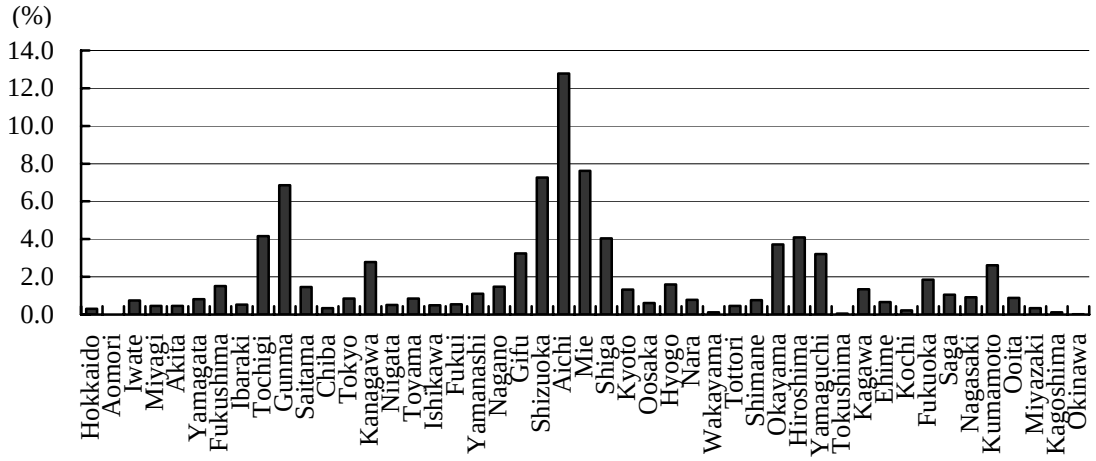
Chart 6: The Ratio of Agricultural Production



Source: *Annual Reports on Prefectural Accounts* , Cabinet Office

On the other hand, as shown in Chart 7, the production of transport equipment—including auto and auto parts, and which is estimated to expand according to trade liberalization—concentrates to several prefectures like Aichi, Shizuoka, and Hiroshima. These industries comprised 2.4 per cent of Japan's GDP in fiscal 2001, but the figure varies widely, from zero to 13 per cent by prefectures. On the contrary, a positive correlation between the share of transport equipment production and per capita income levels among prefectures is suggested. The ratio of transport equipment production is higher in higher-income prefectures.

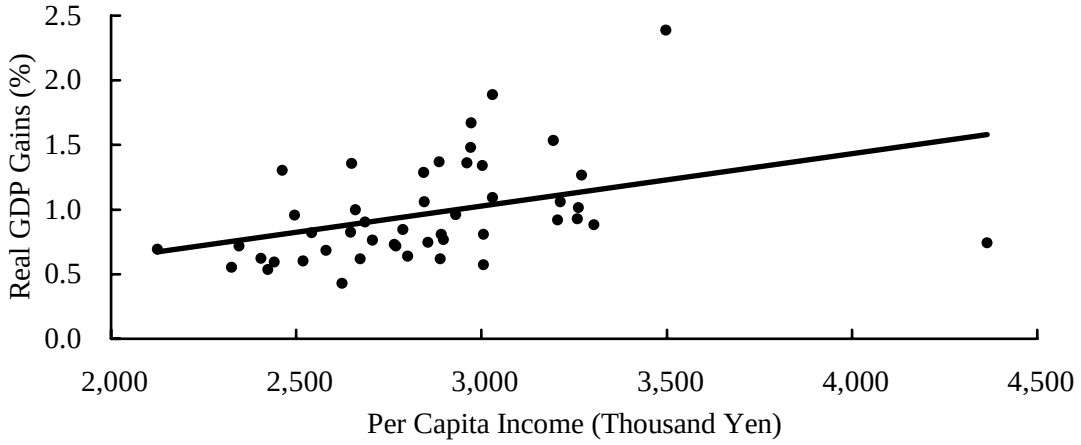
Chart 7: The Ratio of Transport Equipment Production



Source: *Annual Reports on Prefectural Accounts* , Cabinet Office

The macroeconomic benefits of trade liberalization in terms of real GDP gains by 47 prefectures are compared in Chart 8 in relation to their income levels. These real GDP gains by prefectures are estimated from the changes in sectoral production once solved by the CGE model of global trade given the matrix of sectoral GDP in prefectures. This is achieved by a simple top-down conversion rather than a simultaneous solution by the endogenous models of prefectures.

Chart 8 Impacts on Regional Economy



Source: Author's Simulation

It is shown that all prefectures would gain from trade liberalization. However, those gains range between 0.4 per cent in Tottori to 2.4 per cent in Aichi. The nation-wide average of 1.0 per cent reflects the differences in sectoral GDP among the prefectures, as seen above. Moreover, a positive correlation between the real GDP gains from trade liberalization and income levels are suggested. Income differentials would expand rather than shrink as a result of further structural reforms like trade liberalization, given the current structure of sectoral production.

V. Summary and Conclusions

This study has looked at the sectoral and regional implications of trade liberalization on the Japanese economy by quantitative simulation analyses using a CGE model of global trade. In model simulations, the dynamic impacts of trade liberalization through capital formation mechanisms and productivity improvements are taken into account in addition to standard static efficiency gains. It also provides the most updated estimates on this subject based on the GTAP database released in November 2004.

Trade liberalization measures would result in a realignment of regional trade and protection in accordance with the comparative advantage of the regions. According to global trade liberalization, Japan would gain in transport equipment production, and lose in agricultural and processed foods.

The relative significance of those adjustment costs in comparison with macroeconomic benefits may vary according to the partner of bilateral FTAs. Japan would gain relatively more in real GDPs from FTAs with China, the EU, Thailand, and Korea in comparison with those losses in agricultural production. On the contrary, Japan would lose relatively more from FTAs with the Unites States, Australia, and Canada.

Meanwhile, it must be noted that trade liberalization in agricultural sectors would also be beneficial to the Japanese economy, although such gains would be smaller compared with the impacts of trade liberalization in manufacturing sectors, in particular in heavy manufacturing. The economic impacts of wider trade liberalization covering more sectors would be greater.

Trade liberalization might more or less benefit all of Japan's prefectures. However, the ratio of agricultural production, which is estimated to shrink according to trade liberalization, is higher in lower-income prefectures. On the contrary, the ratio of transport equipment production, which is estimated to expand according to trade liberalization, is higher in higher-income prefectures. Regional differences in income levels would be expanded given such current structures of industries by regions. The structural reforms of the economy would be required in implementing trade liberalization measures.

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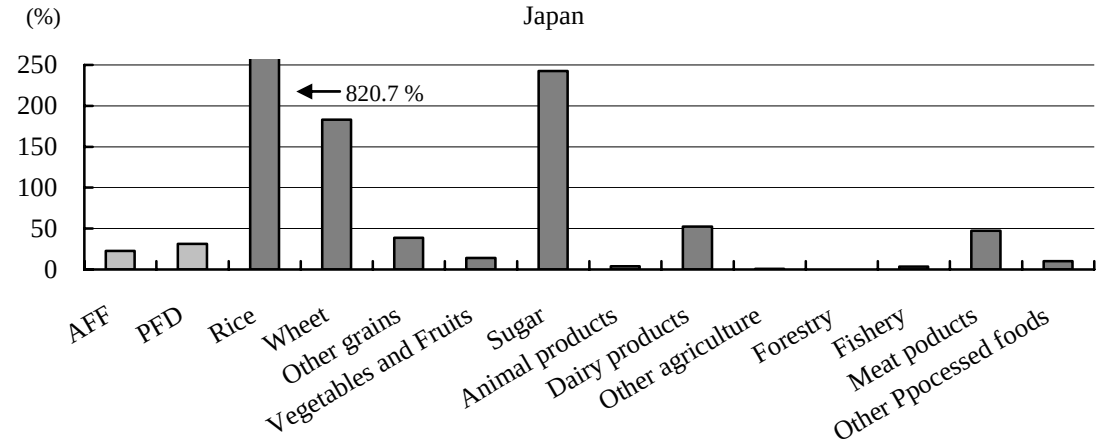
Annex: Aggregation Biases

Trade and protection structures shown in actual data as well as those behaviors represented by parameters like demand and price elasticities in terms of modeling vary widely at very individual levels of commodities and industries. In light of this, the aggregation biases of quantitative studies have been pointed out when aggregating certain different sectors.

Annex Chart 1: Variation in Import Protection



Source: GTAP version 6 database

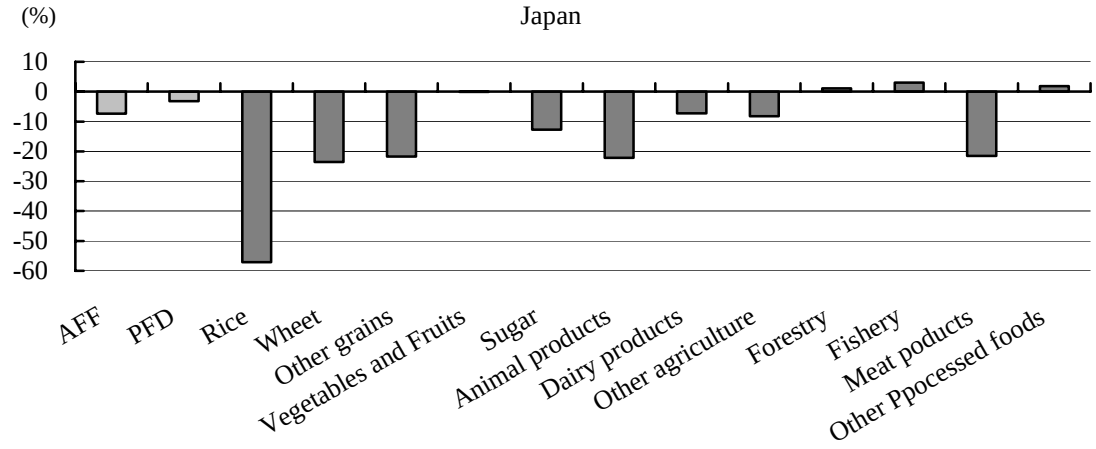
In fact, as shown in Annex Chart 1, Japan's import protection, for example, by more dis-aggregated levels of sectors vary significantly. According to the current

GTAP database, the rate of import protection on average is 22.6 per cent in the agriculture, forestry and fisheries (AFF) sector and 31.4 per cent in processed foods (PFD) respectively. However, the rate ranges widely between almost zero in forestry and more than 800 per cent in rice within agricultural and food sectors.

The impacts of trade liberalization are estimated again by the same structure of a CGE model but by two different levels of sectoral aggregation. One is with the same sectoral aggregation employed in this paper. The other is with more dis-aggregated sectors whose variation in import protection is looked at in Annex Chart 1.

It was estimated by the first model that reduction in production is 7.4 per cent in agriculture, forestry and fisheries sector and 3.2 per cent in processed foods respectively. However, as compared in Annex Chart 2, this rate of reduction is estimated to be nearly 60 per cent in rice production by the second version of the model. On the other hand, sectoral production might even increase rather than decrease in certain sectors, although that increase would be slight. A detailed description of such sectoral differences is one advantage of the model having more sectors. Moreover, the average rate of reduction in these agricultural and food sectors is estimated to be no longer the same. It is 4.2 per cent by the model of broad aggregation, and 7.5 per cent with detailed aggregation.

Annex Chart 2: Impacts on Sectoral Production

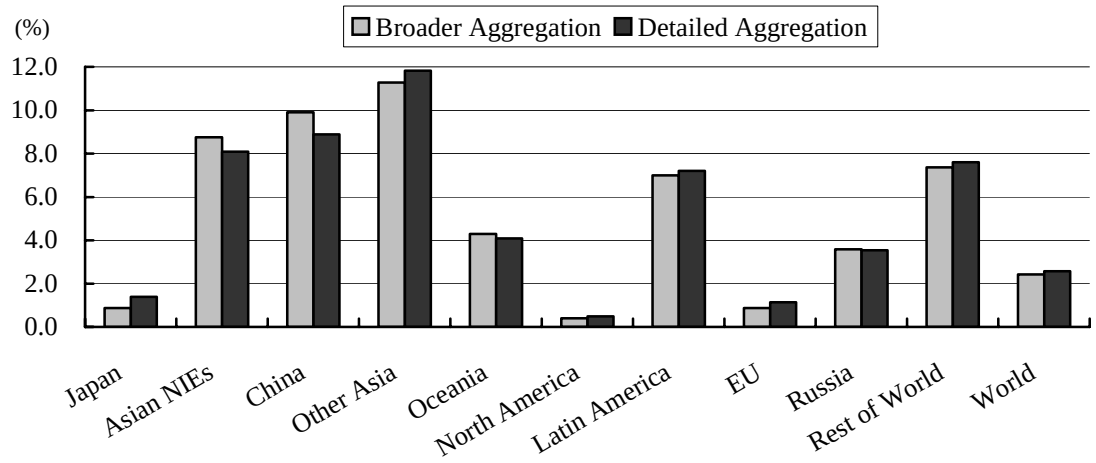


Source: Author's Simulation

This suggests the significance of aggregation biases in model simulations, not just in terms of the precise and detailed descriptions of individual sectors, but also in terms of looking at the impact at a macroeconomic level. In fact, macroeconomic impacts in terms of real GDP gains are compared in Annex Chart 3.[16] Japan's real GDP gain is estimated to be 0.9 per cent by the broader aggregation model. This is compared with 1.4 per cent by the detailed aggregation model. Real GDP gains would also be estimated to be larger by the detailed aggregation model in North America and the EU. They would, however, be smaller in Asian NIEs and China.

[16] To allow more sectoral dis-aggregation in the simulations, regions are aggregated to 10, as shown in the charts, due to computational capacity constraints.

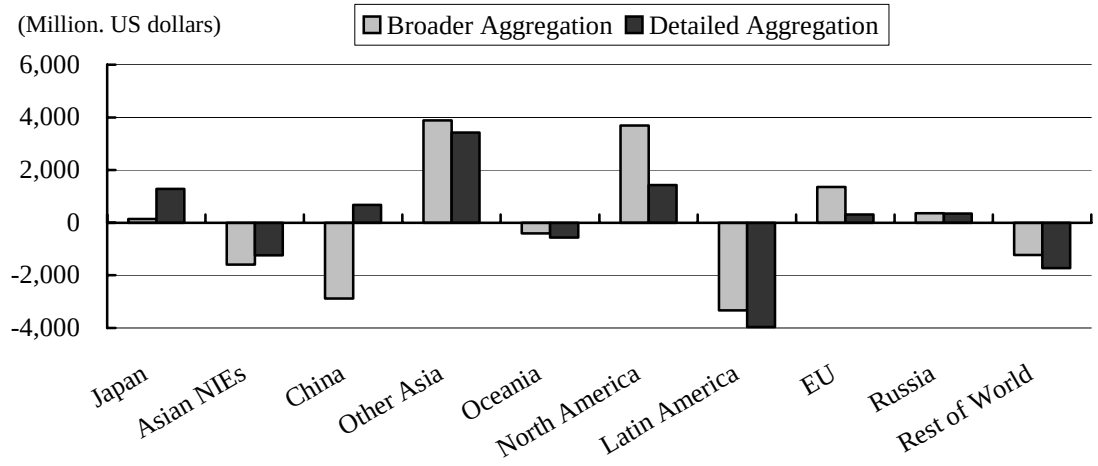
Annnex Chart 3: The Comparison of Real GDP Gains



Source: Author's Simulation

Changes in trade balances would also more or less vary between the two models with different levels of sectoral aggregation shown in Annex Chart 4.

Annnex Chart 4: The Comparison of Changes in Trade Balances



Source: Author's Simulation

Annex Table 1-A: Regional Aggregation

Countries and Regions		GTAP Classification	
JPN	Japan	jpn	Japan
KOR	Korea	kor	Korea
SGP	Singapore	sgp	Singapore
CHN	China	chn	China
		hkg	Hong Kong
IDN	Indonesia	idn	Indonesia
MYS	Malaysia	mys	Malaysia
PHL	the Philippines	phl	Philippines
THA	Thailand	tha	Thailand
IND	India	ind	India
OAO	Other Asia and Oceania	xoc	Rest of Oceania
		twn	Taiwan
		xea	Rest of East Asia
		vnm	Viet Nam
		xse	Rest of Southeast Asia
		bgd	Bangladesh
		lka	Sri Lanka
		xsa	Rest of South Asia
AUS	Australia	aus	Australia
NZL	New Zealand	nzl	New Zealand
USA	the United States of America	usa	United States of America
CAN	Canada	can	Canada
MEX	Mexico	mex	Mexico
BRA	Brazil	bra	Brazil
CHL	Chile	chl	Chile
ROM	Rest of MERCOSUR	col	Colombia
		ven	Venezuela
		xap	Rest of Andean Pact
		arg	Argentina
		ury	Uruguay
EUM	European Union	aut	Austria
		bel	Belgium
		dnk	Denmark
		fin	Finland
		fra	France
		deu	Germany
		gbr	United Kingdom
		grc	Greece
		irl	Ireland
		ita	Italy
		lux	Luxembourg
		nld	Netherlands
		prt	Portugal
		esp	Spain
		swe	Sweden
		cyp	Cyprus
		cze	Czech Republic
		hun	Hungary
		mlt	Malta
		pol	Poland
		svk	Slovakia
		svn	Slovenia

		est	Estonia
		lva	Latvia
		ltu	Lithuania
		bgr	Bulgaria
		rom	Romania
CHE	Switzerland	che	Switzerland
RUS	Russia	rus	Russian Federation
ROW	Rest of the World	xna	Rest of North America
		per	Peru
		xsm	Rest of South America
		xca	Central America
		xfa	Rest of FTAA
		xcb	Rest of the Caribbean
		xef	Rest of EFTA
		xer	Rest of Europe
		alb	Albania
		hrv	Croatia
		xsu	Rest of Former Soviet Union
		tur	Turkey
		xme	Rest of Middle East
		mar	Morocco
		tun	Tunisia
		xnf	Rest of North Africa
		bwa	Botswana
		zaf	South Africa
		xsc	Rest of SACU
		mwi	Malawi
		moz	Mozambique
		tza	Tanzania
		zmb	Zambia
		zwe	Zimbabwe
		xsd	Rest of SADC
		mdg	Madagascar
		uga	Uganda
		xss	Rest of Sub Saharan

Annex Table 1-B: Sectoral Aggregation

Commodities/Industries		GTAP Classification	
AFF	Agriculture, Forestry and Fisheries	pdr	Paddy rice
		wht	Wheat
		gro	Cereal grains nec
		v_f	Vegetables, fruit, nuts
		osd	Oil seeds
		c_b	Sugar cane, sugar beet
		pfb	Plant-based fibers
		ocr	Crops nec
		ctl	Bovine cattle, sheep and goats, horses
		oap	Animal products nec
		rmk	Raw milk
		wol	Wool silk-worm cocoons
		frs	Forestry
		fsh	Fishing
MNG	Mining	coa	Coal
		oil	Oil
		gas	Gas
		omn	Minerals nec
PFD	Processed foods	cmt	Bovine cattle, sheep and goat, horse meat prods
		omt	Meat products nec
		vol	Vegetable oils and fats
		mil	Dairy products
		pcr	Processed rice
		sgr	Sugar
		ofd	Food products nec
		b_t	Beverages and tobacco products
TXL	Textiles and Apparel	tex	Textiles
		wap	Wearing apparel
PPP	Paper products, publishing	ppp	Paper products, publishing
CRP	Chemical, Rubber, Plastic products	crp	Chemical, rubber, plastic products
P_C	Petroleum, Coal products	p_c	Petroleum, coal products
NMM	Other mineral products	nmm	Mineral products nec
MTL	Metals	i_s	Ferrous metals
		nfm	Metals nec
FMP	Metal products	fmp	Metal products
OME	Other machinery and equipment	ome	Machinery and equipment nec
ELE	Electronic equipment	ele	Electronic equipment
TRN	Transport equipment	mvh	Motor vehicles and parts
		otn	Transport equipment nec
OMF	Other manufacturing	lea	Leather products
		lum	Wood products
		omf	Manufactures nec
CNS	Construction	cns	Construction
EGW	Electricity, Gas and Water	ely	Electricity
		gdt	Gas manufacture, distribution
		wtr	Water
T_C	Trade and Communication	trd	Trade
		otp	Transport nec
		wtp	Sea transport
		atp	Air transport
		cmn	Communication
OSP	Other private services	ofi	Financial services nec
		isr	Insurance
		obs	Business services nec
		ros	Recreation and other services
		dwe	Dwellings
OSG	Public services	osg	Public admin and defense, education, health

Annex Table 2-A: Japan's Import Structure

(%)

	Korea	Singapore	China	Indonesia	Malaysia	Philippines	Thailand	India	OAO	Australia	New Zealand
Agriculture, Forestry and Fisheries	3.1	1.3	2.8	2.7	2.2	4.7	5.5	4.6	3.6	8.5	19.2
Mining	0.1	0.0	2.4	36.1	10.5	3.8	0.0	6.8	7.7	50.0	3.6
Processed foods	5.9	4.2	5.7	6.7	2.2	3.3	17.8	18.4	6.5	16.0	23.7
Textiles and Apparel	6.2	0.2	26.1	4.4	1.1	2.3	3.3	11.0	5.7	0.1	0.3
Paper products, publishing	1.1	1.2	0.4	3.0	0.2	0.3	0.4	0.1	0.3	0.1	2.5
Chemical, Rubber, Plastic products	8.8	7.9	4.3	4.8	5.4	2.3	9.2	4.1	6.6	1.3	10.5
Petroleum, Coal products	9.2	1.9	0.3	1.6	0.6	0.7	0.2	5.3	0.3	0.7	0.4
Other mineral products	1.7	0.3	2.3	0.4	0.7	0.5	1.5	1.2	1.2	0.7	0.1
Metals	6.7	1.7	1.4	7.7	1.1	1.2	1.2	1.8	2.7	8.9	14.4
Metal products	3.5	0.3	1.9	0.6	0.6	1.1	2.8	0.5	2.0	0.2	0.3
Other machinery and equipment	11.8	9.5	12.6	5.7	7.1	12.3	14.6	3.4	10.3	1.0	1.2
Electronic equipment	29.6	49.5	14.2	8.2	47.1	58.6	26.3	0.2	31.4	0.2	0.1
Transport equipment	1.5	1.2	1.5	0.8	0.5	1.8	2.8	0.3	1.8	0.6	0.2
Other manufacturing	4.2	0.6	13.6	15.1	10.2	4.6	8.4	16.1	8.6	5.3	14.4

	USA	Canada	Mexico	Brazil	Chile	ROM	EU	Switzerland	Russia	ROW	World
Agriculture, Forestry and Fisheries	7.4	13.2	7.9	15.2	4.4	17.3	1.0	0.1	9.1	2.2	4.0
Mining	0.8	10.1	9.1	19.0	35.4	11.6	0.1	0.0	6.1	56.2	11.9
Processed foods	9.8	12.7	12.9	11.8	26.3	13.8	4.6	0.8	21.1	3.1	7.2
Textiles and Apparel	0.9	0.3	1.6	0.4	0.1	1.2	2.9	1.2	0.1	0.5	6.0
Paper products, publishing	2.3	7.7	0.2	4.5	2.4	0.4	0.8	0.4	0.2	0.2	1.1
Chemical, Rubber, Plastic products	9.4	2.6	7.2	4.1	1.6	2.8	10.9	26.1	1.0	2.1	6.9
Petroleum, Coal products	0.3	0.1	0.4	0.1	0.2	0.3	0.2	0.0	1.6	10.2	2.0
Other mineral products	1.9	0.1	0.6	1.9	0.1	0.1	1.3	0.7	0.4	0.2	1.3
Metals	1.1	2.9	2.9	15.3	6.0	15.8	1.1	1.6	41.6	4.9	3.2
Metal products	0.8	1.2	0.3	0.2	0.1	0.3	1.0	1.1	0.1	0.1	1.1
Other machinery and equipment	18.4	3.1	7.1	1.2	0.1	0.5	10.9	32.8	0.3	0.9	10.4
Electronic equipment	15.0	2.4	12.3	1.1	0.0	0.1	5.1	1.8	0.1	0.7	13.7
Transport equipment	7.3	2.4	2.8	0.4	0.0	0.3	7.2	0.4	0.8	1.0	3.6
Other manufacturing	3.9	15.4	1.0	6.9	15.5	4.2	6.1	4.5	4.4	1.5	7.1

Source: GTAP version 6 database

Annex Table 2-B: Japan's Export Structure

(%)

	Korea	Singapore	China	Indonesia	Malaysia	Philippines	Thailand	India	OAO	Australia	New Zealand
Agriculture, Forestry and Fisheries	0.4	0.1	0.2	0.1	0.0	0.0	0.1	0.1	3.0	0.1	0.2
Mining	0.0	0.0	0.1	0.2	0.0	0.2	0.0	0.1	0.0	0.0	0.0
Processed foods	0.8	1.3	0.8	0.3	0.2	0.2	0.8	0.1	1.4	0.6	1.9
Textiles and Apparel	1.8	0.5	9.9	2.7	0.6	1.8	1.8	1.6	2.2	0.6	1.0
Paper products, publishing	0.6	0.6	1.1	0.8	0.8	0.4	1.1	0.4	0.8	0.8	1.2
Chemical, Rubber, Plastic products	16.1	7.5	12.4	12.5	7.9	7.5	11.4	17.3	14.0	7.5	8.1
Petroleum, Coal products	0.9	0.1	0.2	0.2	0.0	0.2	0.0	1.0	0.5	1.4	0.3
Other mineral products	3.9	1.5	2.1	1.9	2.1	2.0	2.4	2.0	2.7	2.0	1.1
Metals	11.9	5.2	8.4	8.0	11.9	3.8	10.8	8.0	7.6	3.1	3.1
Metal products	1.3	1.6	1.1	3.3	1.5	2.1	3.0	2.6	1.3	1.2	0.5
Other machinery and equipment	30.2	26.0	26.6	31.8	25.3	24.7	33.3	27.2	34.8	24.1	22.9
Electronic equipment	23.4	43.4	27.5	12.3	35.2	48.3	21.6	4.1	16.0	12.7	7.0
Transport equipment	3.4	7.1	4.7	17.7	9.1	6.4	10.7	12.4	6.6	41.3	44.2
Other manufacturing	1.3	1.1	1.5	1.6	1.4	0.7	1.2	1.6	1.3	1.5	1.8

	USA	Canada	Mexico	Brazil	Chile	ROM	EU	Switzerland	Russia	ROW	World
Agriculture, Forestry and Fisheries	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.3
Mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Processed foods	0.3	0.3	0.1	0.2	0.1	0.1	0.2	0.2	1.4	0.3	0.5
Textiles and Apparel	0.4	0.5	0.4	0.4	0.4	0.6	0.8	0.7	0.9	1.4	2.1
Paper products, publishing	0.5	0.4	0.4	0.3	0.6	0.3	0.4	0.2	0.2	0.2	0.6
Chemical, Rubber, Plastic products	7.4	4.5	6.2	8.8	11.1	9.6	7.8	17.5	7.2	5.0	9.2
Petroleum, Coal products	0.1	0.1	0.1	0.4	0.1	0.0	0.1	0.1	0.0	0.1	0.2
Other mineral products	1.0	0.7	1.7	1.3	0.5	0.5	1.1	0.9	0.6	0.7	1.6
Metals	1.6	2.5	6.4	1.8	2.0	5.5	1.2	4.6	2.0	4.8	4.6
Metal products	1.5	1.7	2.5	2.7	0.5	1.0	1.1	1.6	0.3	1.0	1.4
Other machinery and equipment	25.2	22.0	28.2	33.6	27.7	22.7	23.4	21.2	22.1	21.0	26.1
Electronic equipment	19.3	17.3	34.3	15.8	4.1	4.5	19.6	10.5	7.5	4.8	20.9
Transport equipment	37.1	38.7	12.5	17.7	28.4	41.5	17.7	29.0	22.4	43.7	21.6
Other manufacturing	2.2	3.7	1.2	0.7	2.0	1.0	3.9	3.8	0.5	0.8	2.1

Source: GTAP version 6 database

Annex Table 3-A: Trade Protection by Japan

(%)

	Korea	Singapore	China	Indonesia	Malaysia	Philippines	Thailand	India	OAO	Australia	New Zealand
Agriculture, Forestry and Fisheries	5.0	2.9	11.7	1.6	2.1	8.5	3.1	3.9	4.0	51.6	3.7
Mining	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Processed foods	15.4	27.3	25.1	4.0	4.5	8.8	46.4	5.1	10.4	66.6	29.8
Textiles and Apparel	9.5	9.1	9.4	6.0	4.8	8.4	6.7	5.4	7.4	5.0	8.3
Paper products, publishing	0.6	0.1	0.1	0.2	0.0	0.3	0.1	0.2	0.4	0.4	0.4
Chemical, Rubber, Plastic products	2.5	1.3	0.2	0.2	0.0	0.1	0.1	0.3	1.9	1.4	1.2
Petroleum, Coal products	3.7	3.8	0.8	1.3	1.9	3.5	3.4	3.1	3.1	0.2	3.8
Other mineral products	1.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.8	0.2
Metals	1.0	0.3	0.7	0.1	0.0	0.4	0.0	1.6	0.9	0.4	0.0
Metal products	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.6	1.6
Other machinery and equipment	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Electronic equipment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transport equipment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other manufacturing	5.5	9.5	4.2	3.9	2.7	1.8	1.2	0.6	2.2	0.3	2.8
Average	2.8	1.8	5.4	1.2	0.5	1.0	9.3	2.7	1.8	16.2	9.2

	USA	Canada	Mexico	Brazil	Chile	ROM	EU	Switzerland	Russia	ROW	World
Agriculture, Forestry and Fisheries	35.3	56.9	3.1	5.1	4.3	9.4	3.9	4.5	0.2	10.4	22.6
Mining	0.0	0.0	3.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Processed foods	39.2	39.8	53.7	13.2	10.3	14.7	34.7	27.2	4.5	15.6	31.4
Textiles and Apparel	8.4	10.2	7.5	8.2	6.9	7.1	9.7	9.2	6.1	6.5	9.0
Paper products, publishing	0.3	0.5	0.0	0.4	0.4	0.2	0.3	0.2	0.3	0.2	0.3
Chemical, Rubber, Plastic products	1.3	1.4	0.0	0.6	0.0	0.0	1.0	0.6	1.1	0.3	1.0
Petroleum, Coal products	1.4	0.1	3.8	3.4	3.8	0.1	2.9	3.5	4.3	0.8	1.6
Other mineral products	0.6	0.5	0.0	0.0	0.0	0.0	1.5	2.0	2.3	0.1	0.6
Metals	1.2	0.6	0.0	0.5	1.1	0.0	0.9	0.0	0.3	0.6	0.6
Metal products	0.9	0.2	0.0	0.0	0.0	0.0	0.8	1.0	2.9	0.3	0.5
Other machinery and equipment	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Electronic equipment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transport equipment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other manufacturing	2.0	1.5	4.1	2.3	0.1	0.5	6.8	5.2	1.6	0.7	3.6
Average	8.6	17.4	11.5	3.2	3.3	5.5	4.7	1.1	1.4	1.0	5.2

Source: GTAP version 6 database

Annex Table 3-B: Trade Protection Japan Faces

(%)

	Korea	Singapore	China	Indonesia	Malaysia	Philippines	Thailand	India	OAO	Australia	New Zealand
Agriculture, Forestry and Fisheries	13.7	0.0	6.1	2.1	0.7	4.0	16.3	12.6	0.2	0.0	0.2
Mining	2.6	0.0	2.8	2.4	0.1	2.4	4.7	29.4	0.7	0.0	0.0
Processed foods	26.6	1.3	12.1	12.6	10.3	7.7	44.5	66.4	20.5	1.0	1.3
Textiles and Apparel	8.9	0.0	20.8	5.7	10.7	5.8	15.8	24.9	17.1	9.5	1.3
Paper products, publishing	4.0	0.0	9.7	3.7	8.0	3.6	12.0	31.9	5.8	3.6	0.5
Chemical, Rubber, Plastic products	6.9	0.0	10.9	5.1	7.7	5.3	13.5	30.3	4.0	5.4	2.7
Petroleum, Coal products	5.8	0.0	5.8	3.3	0.2	2.0	2.0	17.5	6.1	0.0	0.9
Other mineral products	7.7	0.0	10.1	4.1	8.2	3.6	12.5	34.1	6.8	5.4	2.3
Metals	3.5	0.0	6.6	7.2	12.6	2.6	11.4	34.3	5.1	4.7	2.8
Metal products	7.7	0.0	9.8	10.2	12.5	6.1	19.1	34.3	7.7	8.1	3.7
Other machinery and equipment	6.4	0.0	11.3	3.2	3.8	2.0	7.3	26.0	3.5	4.0	3.5
Electronic equipment	1.7	0.0	8.3	0.7	0.1	0.1	2.9	17.0	0.9	1.4	1.0
Transport equipment	7.4	0.0	27.5	12.4	43.0	12.8	32.6	36.7	26.1	16.3	7.4
Other manufacturing	7.2	0.0	11.6	7.3	13.1	7.4	13.0	34.5	7.0	2.8	4.6
Average	5.3	0.0	11.7	5.7	8.1	2.3	11.4	29.7	5.6	9.0	4.9

	USA	Canada	Mexico	Brazil	Chile	ROM	EU	Switzerland	Russia	ROW	World
Agriculture, Forestry and Fisheries	0.6	0.4	5.6	0.8	6.8	1.9	2.6	1.9	9.0	7.9	2.2
Mining	0.1	0.1	12.9	4.6	6.5	5.4	0.1	0.4	4.6	2.1	3.0
Processed foods	3.7	7.4	20.7	16.2	6.9	14.8	10.4	21.0	17.4	15.2	13.9
Textiles and Apparel	8.3	7.1	19.6	16.2	7.0	14.6	7.4	7.5	9.2	13.7	16.8
Paper products, publishing	0.2	0.9	13.5	11.8	7.0	12.9	1.6	4.8	10.4	8.5	5.2
Chemical, Rubber, Plastic products	2.4	3.7	14.9	9.9	7.0	10.4	3.8	0.5	8.9	8.9	6.1
Petroleum, Coal products	0.3	3.5	3.3	0.0	7.0	6.7	0.8	0.0	5.0	3.8	3.8
Other mineral products	3.6	2.2	15.7	9.2	7.0	12.2	3.5	1.9	15.5	7.6	6.7
Metals	1.7	0.4	13.1	13.4	7.0	10.7	3.3	0.4	9.0	7.8	6.1
Metal products	2.9	3.2	15.8	16.3	7.0	15.4	3.0	1.6	12.0	9.4	6.9
Other machinery and equipment	1.5	1.5	12.9	12.8	7.0	8.6	2.1	0.6	6.9	7.1	4.5
Electronic equipment	0.5	0.3	7.9	11.1	7.0	8.5	2.2	0.3	8.0	5.6	2.6
Transport equipment	2.2	5.0	16.9	21.2	6.8	23.4	7.4	1.3	17.0	11.3	7.9
Other manufacturing	1.7	2.3	20.0	18.4	7.0	18.3	1.7	30.5	12.1	9.2	4.4
Average	1.7	2.9	12.0	14.0	6.9	16.2	3.6	2.2	11.2	9.5	5.5

Source: GTAP version 6 database

Annex Table 4: Changes in Production Structures

(%)

	Japan	Korea	Singapore	China	Indonesia	Malaysia	Philippines	Thailand	India	OAO	Australia
Agriculture, Forestry and Fisheries	-10.3	-22.8	-0.8	-2.3	0.4	-6.9	-0.8	0.8	-0.4	-1.2	5.8
Mining	2.9	-5.3	-8.5	-0.9	-5.2	-0.5	-5.8	-7.4	-9.0	-1.3	-3.6
Processed foods	-6.2	24.6	33.2	1.5	1.2	48.8	-2.2	9.9	-9.1	-5.0	19.1
Textiles and Apparel	0.5	32.3	16.9	13.8	22.1	56.9	36.9	2.0	16.1	15.2	-18.6
Paper products, publishing	-0.3	1.3	0.4	-2.2	-4.3	-2.2	0.8	-2.8	-2.9	-1.4	-0.4
Chemical, Rubber, Plastic products	1.3	1.2	4.5	-5.5	1.6	4.1	2.0	8.2	0.7	5.5	-2.8
Petroleum, Coal products	-0.5	4.9	4.2	-2.5	-0.7	1.9	1.1	-0.4	4.6	-2.2	0.4
Other mineral products	1.0	-5.0	6.1	0.1	5.5	-5.3	-2.3	-5.6	4.9	-2.4	-3.0
Metals	2.8	-7.9	-1.5	-5.5	-9.3	-2.2	-4.0	-1.5	-10.2	-2.7	-4.2
Metal products	0.8	-4.5	1.5	0.5	-5.3	6.0	-5.6	-8.1	4.2	0.9	-2.6
Other machinery and equipment	1.3	-11.5	3.4	-6.1	3.4	7.6	6.0	13.8	0.8	1.9	-6.7
Electronic equipment	-0.7	-7.2	-5.9	6.9	-6.4	-6.3	-3.1	4.6	5.2	-3.0	-2.0
Transport equipment	7.2	4.7	-18.4	-7.9	-6.9	-0.9	13.0	3.0	-2.5	-9.9	-8.1
Other manufacturing	-1.7	28.2	71.7	7.9	4.9	5.2	2.7	-7.3	-2.0	6.5	-7.1
Construction	0.0	1.2	0.7	1.0	3.6	5.8	0.0	5.1	1.0	0.7	0.7
Electricity, Gas and Water	0.5	1.9	3.0	-1.3	-0.5	2.1	0.7	0.8	-0.6	0.8	-1.0
Trade and Communication	0.3	2.3	-0.3	0.3	-0.1	-2.0	-0.1	-2.5	1.2	0.1	0.2
Other private services	0.0	0.4	-4.2	-0.4	-1.0	-3.6	-0.4	-2.3	1.6	-0.7	-0.2
Public services	-0.2	-1.1	0.9	-0.6	-1.4	0.4	-1.0	-2.7	-1.6	-1.4	-0.5

	New Zealand	USA	Canada	Mexico	Brazil	Chile	ROM	EU	Switzerland	Russia	ROW
Agriculture, Forestry and Fisheries	-0.6	4.3	6.0	-2.1	15.2	2.1	12.3	-2.1	2.5	-4.7	-1.1
Mining	-1.7	-2.4	-1.6	3.1	-12.0	-0.6	-7.7	3.9	-8.1	2.0	2.1
Processed foods	15.5	1.8	0.1	-0.4	10.6	-0.4	0.7	-1.7	5.0	-7.6	-1.6
Textiles and Apparel	-13.7	-11.6	-17.4	-18.8	-7.3	-4.7	-8.7	-8.7	-14.0	2.5	-1.2
Paper products, publishing	-2.1	0.4	1.3	0.1	-3.1	0.4	-3.6	0.6	-0.5	2.4	-2.1
Chemical, Rubber, Plastic products	0.4	0.0	-0.7	-1.4	-5.8	3.1	-6.0	0.2	-7.3	-0.4	-0.4
Petroleum, Coal products	-0.7	-0.5	-0.4	-0.6	-1.2	3.3	-1.3	0.2	0.8	3.1	0.3
Other mineral products	-1.5	0.0	-2.3	-1.7	-3.6	-0.6	-3.3	1.3	-1.3	-3.0	-1.7
Metals	-7.7	-0.3	-1.1	2.1	-7.3	-2.3	-3.8	0.3	-11.8	7.3	5.0
Metal products	-3.9	-0.3	-0.6	-0.3	-6.7	-0.6	-8.6	1.0	-3.9	-3.5	-4.1
Other machinery and equipment	-5.7	0.6	1.1	4.9	-14.3	3.9	-12.4	2.1	-6.5	0.1	-1.5
Electronic equipment	-7.0	0.7	4.2	13.4	-4.3	-12.9	-11.0	0.9	-6.5	11.1	3.0
Transport equipment	-7.7	-1.5	-0.6	5.6	0.9	-6.7	0.7	0.1	-2.2	-5.9	-2.6
Other manufacturing	-6.3	-1.1	-7.0	-6.6	-3.6	-6.5	-5.9	-2.3	27.2	-10.6	-5.2
Construction	1.4	0.0	-0.2	0.3	1.0	0.6	1.0	0.0	1.9	-0.7	0.6
Electricity, Gas and Water	-0.9	-0.2	0.1	0.3	-1.7	-0.8	-1.5	0.0	-2.0	0.5	0.5
Trade and Communication	-0.1	0.1	0.5	0.2	0.0	1.0	0.0	0.5	1.2	1.5	1.1
Other private services	-0.3	0.0	0.4	0.3	-0.3	-0.3	-0.1	0.1	1.1	1.1	0.6
Public services	-0.2	0.0	-0.2	-0.4	-0.1	-0.5	0.1	-0.2	2.0	0.3	-0.8

Source: Author's Simulation