Global Trade Analysis Project
https://www.gtap.agecon.purdue.edu/

This paper is from the
GTAP Annual Conference on Global Economic Analysis
https://www.gtap.agecon.purdue.edu/events/conferences/default.asp

Japan's Regional Strategy in Asia: Evaluation by the CGE Model*

Masahiko Tsutsumi and Kozo Kiyota**

Abstract

This paper evaluates nine scenarios of Japan's regional preferential trade agreements (PTAs) by the computable general equilibrium model. This analysis considers recent arguments on PTAs so that exogenous labor migration and FDI-led technological convergence among countries in PTAs are implemented in addition to conventional trade liberalization measures. The analysis presents several domestic and international implications for Japan and other Asian countries on how to understand Japan's shift to regional PTAs, and which forms are favorable or harmful. It also provides the possibility that overall liberalization is not always welfare enhancing in Japan.

Keywords: CGE analysis, preferential trade agreements, labor migration, trade liberalization, technological convergence.

Introduction

Recent arguments on preferential trade agreements (PTAs) around Japan tend to cover the issues on promotion of foreign direct investment (FDI) and skilled labor migration. For example, the official research report on the Japan-Singapore Economic Partnership Agreement (hereafter JSEPA) notes, "in considering the significance of trade in services, it is necessary also to take into account trade through commercial presence and movement of natural persons." It also notes "the Joint Study Group noted the importance, under the JSEPA, of facilitating the movement of professionals between the two countries, and the employment and training of skilled personnel, including nationals of third countries, by Japanese enterprises in Singapore and Singapore enterprises in Japan."[1] In addition, Japanese business associations and the international industrial union of Mexico expect that the bilateral trade agreement between Japan and Mexico will promote investment flows.[2]

While policy arguments have stepped into the issues of factor movements, international harmonization, coordination of rules and regulations, many quantitative analyses related to Japan's PTAs have merely considered its impact. Thus, the analysis incorporating such an aspect is important for the sake of better understanding of policy consequences.

This paper uses the computable general equilibrium (hereafter CGE) model to evaluate Japan's bilateral and regional PTA strategy, e.g. JSEPA. In the next section, we briefly review the previous studies

---

* This paper is prepared for the 5th Conference on Global Economic Analysis -Sustainable Development and the General Equilibrium Approach, in Taipei, Taiwan ROC, June 5-7 2002. All opinions and interpretations expressed here are authors' own and do not attribute to the Cabinet Office of Japan, Yokohama National University or any affiliated organizations.

** Masahiko Tsutsumi and Kozo Kiyota are staff economist with the Cabinet Office of the Government of Japan, and assistant professor with the Faculty of Business Administration, Yokohama National University, Japan, respectively.

[1] Paragraph 46 and 59 in JSEPA Study Group (2000).

[2] Keidanren Report "Joint Statement on the promotion of Japan-Mexico Free Trade Agreement" <http://www.keidanren.or.jp/japanese/policy/2000/016.html> accessed on 12/01/2001.

in this field. The third section explains the model and data, followed by the examination of the results in the fourth section. The last section is a summary of findings and issues for future study.

Factor movements and CGE-based Analyses

Regarding Japan's shift to regionalism, the analyses have been conducted by some economists. The joint study group report of the Institute of Developing Economies (IDE) and the Korean Institute for International Economic Policy (KIEP) (2000) used the CGE model to evaluate the potential impact of the Japan-Korea PTA and concluded that gains would not only be small and asymmetric but also negative in some cases. The differences among cases were attributable to the closure and the setting of exogenous variables. Yamazawa (2000) notes the reservation that the static CGE simulation is inadequate to capture the effect of PTAs since investment induced by competition and trade expansion should be bigger than the direct impact from trade liberalization. However, arbitrary assumption of the exogenous shock of TFP creates tautological results, so it is not persuasive to conclude that a PTA is useful.

On the JSEPA, Tsutsumi (2000) and Economic Planning Agency (EPA) (2000) evaluated the potential effect by the GTAP-based CGE model. These analyses took into account trade liberalization and trade induced investment. On average, they suggest that Japanese GDP will change little while that of Singapore will expand about 0.6%. As for welfare changes, Japan and Singapore will gain 145 million and 572 million US dollars respectively. Since the tariffs on manufacturing goods are already low in both countries, the JSEPA does not generate much efficiency gains. However, changes in relative price alter the comparative advantage so that the industry-level output and employment shares change more than the image of the aggregate figures.

While these analyses give a grand image of the outcome from PTAs, they are not adequate since they do not account for the impact of factor movements and subsequent effects on competition in the service sector. In fact, there are some CGE model analyses in which factor movements are incorporated.

On capital movements, the first way to consider the effect is to model the international equalization of the rate of returns on capital. As the conventional GTAP model has the option to implement this mechanism for the short-run case, this is one of the methods used in KIEP (2000) above and in other examples. However, this setting does not allow specifying the direction of movements due to the lack of bilateral matrix and makes it impossible to model the subsequent capital accumulation due to the theoretical inconsistency to solve the capital-investment path without fixing the trade balance.

The second way is the exogenous treatment of capital movements. Brown, Deardorff and Stern (1992) exogenously changed the regime of capital movements in their Michigan model to analyze the effects of North American Free Trade Agreement (NAFTA). They found that trade liberalization under the free capital flow regime increases the welfare more than the other case.[3]

The third way, done by Dee, Hanslow and Phamduc (2001), makes capital movements endogenous. They focused on the liberalization of service trade and used the FTAP model, which is an extension of the GTAP model.[4] The difference between FTAP and GTAP is the treatment of capital and its mobility. While the GTAP model does not allow the explicit bilateral capital flows, the FTAP assumes the industry-specific capital and allows them to move among countries. The data covers 19 regions and 3

[3] See Brown (1994) for detailed accounts of the technical explanation.
[4] See Hanslow, Phamduc and Verikios (1999) for detailed explanation of the FTAP model.

sectors. They suggest that the trade liberalization including service sector increases welfare in Japan, the PRC, and Hong Kong but decreases welfare in the US, Taiwan, and Singapore.

The FTAP is desirable to capture the effect of FDI. However, it is quite difficult to collect capital stock data by country (location), nationality (ownership) and industry. Kimura and Tsutsumi (1998) tried to construct a CGE dataset by the official survey of the U.S., and Japanese governments on the activities of multinational enterprises. They also raised several theoretical issues to connect the firm level or nationality based data within the industry-based input-output data framework.[5]

On labor migration, Burfisher et al. (1994) analyzed the impact of NAFTA regarding wages and labor movements among countries. The model consists of 3 countries, 11 sectors, and 6 production factors. The results suggest that the Stopler-Samuelson effect is small and that immigration from Mexico to the U.S. decreases as wages in Mexico increase.

In the case of Japan, Goto (1998) analyzed the impact of immigration by using the CGE model with 3 products including non-tradable and 2 production factors. The benchmark year is 1986. The result is that the social utility falls until the number of immigrants reaches 3% of the total labor force (166 million workers) and restores the benchmark level when it reaches 5% of the total labor force (343 million workers).

In sum, previous studies suggest that the treatment of factor movements can alter both the direction and the size of simulation results, and it is important to incorporate these features. Thus, we implement two adjustments in the framework of the standard GTAP CGE model. On the capital side, the third way seems best but the data are not available. Therefore, we manipulate exogenous capital movements, in addition to introducing a technological variable at the industry level, which complements the lack of FDI information. On the labor side, we simply introduce exogenous labor migration and their remittance. The next section explains the simulation plan and these changes in detail.

Model, Dataset and Simulation Plan

The model used in this analysis adds the following amendments to the standard GTAP model.[6] First, following Francois et. al (1996), investment is linked to capital stock so that capital accumulation is endogenized. The saving rate is fixed so that the economy follows the Solow-Swan type growth path. Second, exogenous variables used to capture the remittance of factors abroad are introduced. While the production effect is captured by changing the exogenous growth rate of endowments, income effect by remittance is captured by manipulating the ex-post income of foreign workers and capital in the model. Both modules are depicted in the appendix.

As for data, GTAP Version 4 is decomposed into 16 goods and 19 countries/regions depicted in Table 1. The production factors are aggregated into land, capital (aggregation of capital and energy), skilled, and unskilled labor. Apparently, land is immobile while others are mobile among domestic industries. The initial allocation of endowments among production factors is tabulated in Table 2

Nine scenarios and a standard case are simulated to evaluate the effect of various PTAs. We also assume the impact of PTAs will appear in 15 years, i.e. from 1995 to 2010, so that all cases include

[5] For example, the existence of several heterogeneous firms in the market needs to assume imperfection in 1) market structure, 2) product market, 3) production structure, or 4) capital differentiation.

[6] See Hertel (1996) for detailed account of the standard model. A concrete expression of each module is in appendix 1.

corresponding exogenous growth in skilled and unskilled labor as shown in Table 3, while capital accumulates endogenously with fixed saving rates.[7] In addition, trade liberalization shocks from NAFTA and the abolishment of MFA are incorporated in all cases.[8]

The nine scenarios are;

S1: Japan-Singapore,

S2: Japan-Singapore-Korea,

S3: Japan-Singapore-Mexico,

S4: Japan-Singapore-Korea-Mexico,

S5: Japan-Singapore-Korea-ASEAN4 (Indonesia, Malaysia, Thailand, and The Philippines)-China (including Hong Kong),

S6: Singapore-ASEAN4-China (including Hong Kong),

S7: Japan-the U.S. (immigration from Japan to the U.S.),

S8: Japan-the U.S. (immigration from the U.S. to Japan), and

S9: Japan-China (including Hong Kong).

Each scenario assumes 1) full liberalization except agricultural products (AGR and PDF) among contracting countries, 2) exogenous migration of skilled labor, and 3) exogenous convergence of productivity at industry level. Table 4 summarizes the combination of shocks in each scenario.

Exogenous Skilled Labor Migration

Since one of the important issues for Japan's new PTAs is the treatment of labor immigration, this paper tries to simulate its impact on the economy. In Japan, the government has been claiming that the inflow of skilled labor should be promoted with the controlled manner while being reluctant to accept unskilled labor. However, the fundamental force to promote labor movements is the wage gap so that the pressure of the inflow of unskilled labor is much stronger than that of the skilled. Given the low parameter of the government's social stability, it is safe to treat the number of immigrants exogenously. Even such a government, however, may have difficulty controlling the workplace of these imported workers. Therefore, it is plausible to assume the immigrated workers are treated as nondiscriminatory manners in the labor market.

The number of immigrants in Japan is assumed equivalent to 1% of the skilled labor force in contracting countries in the end of 2010. We also assume that these workers will remit 50% of their income to their home countries. Then, the income transfer is combined to respective national income so that it will stimulate demands of labor exporting countries.

Technology Transfer and Capital Movements

As already noted, the implementation of the impact of FDI or capital movement has several problems. In fact, FDI is fundamentally different from simple capital movements. It does not only increase capital stock of the recipient country but also transfers production and managerial technology. Recent arguments on PTAs also stress the latter points more than the former. Even Japan, which is an

[7] Due to the dataset problem, we treat capital accumulation in Mexico exogenous and keep the capital-labor ratio constant in all cases.

[8] Other schemes that might be plausible to consider are; 1) the PRC and Taiwan's entrance to the WTO, 2) commitment of Asian Free Trade Area (AFTA), and 3) APEC Bogor Declaration.

international net lender, would expect to receive FDI not because capital is scarce but because technology comes in. In addition, FDI in the non-tradable goods sector may increase competition to create efficiency gains. Therefore, we propose an alternative way by separating these two features embedded in FDI.

We need to know the level or gap of technology among countries to capture the potential impact of technological convergence propelled by FDI. Although there is no such data, we calculate the level of industry-based technology by country listed in Table 5. For example, the figure of Japanese and Singaporean ELE are 4.89 and 4.16 respectively. It means that the productivity gap between the two countries is 18%.[9] In the simulation, we assume that 1% of the convergence to the highest will occur in all respective industries except AGR, PDF, and OSG among participating countries.

On capital movements, we consider the theoretical validity that the trade balance should be fixed because the simulation traces the movement of the steady state in a country. In some cases, however, we change the level of trade imbalances exogenously. This treatment satisfies both capital accumulation and exogenous capital movements. For convenience, we reduced trade surplus (or deficits) equivalent to 1% of capital stock.

Evaluation of PTAs: Macroeconomic Perspective

This section examines the simulation results. First, we look at changes in the world variables and then examine changes in production, trade, and welfare. Table 6 tabulates the world economic indicators. As expected, there is a strong correlation between the size of participating economies and changes in variables. The case of S5, which traces ASEAN Plus Three (APT) framework, shows the biggest impact on the world growth rate. It increases cumulative real GDP growth about 1.4% points. Considering the base year, i.e. 1995, and that implemented shocks are not prevalent yet in 2002, S5 (APT) will jump the annual world economic growth rate about 0.04% points from 2002 to 2010. Second, trade liberalization expands world trade and enhances the efficient allocation in each country. S5 (APT) will accelerate the cumulative growth of world exports about 5.0% points and generates 320 billion US dollars as an additional welfare gains. Among other scenarios, S1 tracing the JSEPA, will not change the world economy very much. Also, S2 (with Korea) and S3 or S4 (with Mexico), which have been discussed by the governments, will not alter the state of the world economy drastically.

Then, how will these gains and changes from PTAs be distributed among countries and industries? Looking at the changes in real GDP and national income in the individual countries listed in Table 7 and Table 8, Japanese real GDP will be positive or at least unchanged except in the case of S6 in which Japan does not participate. In the JSEPA, cumulative real GDP growth and the equivalent variations (EVs) rise 0.07% points and 2.7 billion US dollars respectively. In S2 in which Korea also participates, changes in cumulative real GDP growth will be doubled, i.e. 0.14% points while EVs is almost quadrupled. More, in S5, which is equivalent to APT, changes in cumulative real GDP growth become 1.02% points (0.13% points if annualized) and EVs is about 80 billion US dollars. The U.S.-Japan PTA, i.e. S7 and S8, suggests changes in cumulative real GDP and EVs will be 0.77-0.99% points and 41-50 billion US dollars respectively. In the Japan-China PTA, i.e. S9, these changes will be 0.78% points and about 63 billion US dollars respectively.

Other main participants, i.e. Singapore and Korea, also show large gains through the PTAs. In

[9] See appendix 3 for the method of calculation.

Singapore, gains in cumulative real GDP growth vary from 5.8% points in S1 to 16.9% in S5, while these in Korea will vary from 5.9% points in S4 to 9.1% points in S5. ASEAN members also show big gains in S5 and S6 when they participate in the PTAs. It is worth noting that Japanese participation in the PTA is critical not only for Japanese but also for Asian countries. For example, Indonesia's cumulative real GDP will increase more than 13% points by participating in S5 but it will increase only 3% points in S6. In addition to trade, these gains are mainly from technological catch-up and induced investment.[10]

Of course, every PTA is not beneficial to everyone. A PTA usually results in deterioration of welfare in non-participating countries through trade diversion effect. In this simulation, a negative effect of trade diversion also causes sluggish capital accumulation. Taiwan in all cases, Japan in S6, Canada and Mexico in S7 and S8 represent such a situation. Oceania, other Asia, South and Middle America, the EU, the FSU plus East Europe, and the rest of the world sometimes record net gains through bigger trade creation effect. In general, S7 and S8 (US-Japan) result in large net trade diversion effect and being worse the welfare of other countries.

International Political Economy of PTAs

The macroeconomic results suggest two lessons on the regional PTA strategy in Asia. First, competition between ASEAN4 and China, which is sometimes pointed out by specialists, will be mitigated by Japanese participation in the regional PTA. In addition, they can reach the APT (S5) without depending on the path, i.e. the initial combination of members in PTAs. For example, the shift from S6 to S5, i.e. Japanese participation, will not reduce the welfare in ASEAN4 and China. The transfer from S9 to S6 will not reduce the welfare Japan and China either. Therefore, the APT is a stable equilibrium among Asian PTAs. It can also be supported that U.S. welfare is not worsened so that the opposition to Asian integration will not have rational ground.[11]

Second, the U.S.-Japan PTA, i.e. S7 and S8 generates large trade diversion and deteriorates the welfare of other countries. For example, in S7, the welfare change in the world is positive, i.e. 58 billion dollars, but this figure consists of two big winners (the U.S. gains 19 billion US dollars and Japan gains 50 billion US dollars) and many losers (other countries lose 11 billion US dollars in sum). Strong complementarities in liberalization and production between the U.S. and Japan result in a typical "stumbling bloc" and being so worse international income distribution.

Evaluation of PTAs: Microeconomic Perspective

PTAs are generally favorable to the Japanese economy, but it does not mean all sectors gain from changes. A PTA uncovers the real structure of the economy through liberalization. Table 9 depicts the differences in cumulative changes of endowments and industry output in Japan. Changes in skilled labor reflect the size of immigrants, and those in capital mean the size of induced investment. Since changes in GDP are decomposed into factor changes, investment should be a dominant one given the share and changes.

[10] The figures in Hong Kong are minus in real GDP while EVs are positive. This is because Hong Kong has no technological catch-up effects through PTAs but they will enjoy these gains spawned abroad through trade.

[11] Tsutsumi (2000) suggests that the welfare change of NAFTA does not always positively correlate to the size of the bloc so that the U.S. rationally prioritizes bilateral liberalization to multi or regional liberalization while Japanese welfare positively correlates to the size of the bloc so that multi or regional liberalization is consistent with its national interests.

While S1 or S3 seems neutral in terms of industry output growth, other scenarios are biased. For example, TRN output falls about 0.33% points in S2 while MTL and OME output expand 0.33 and 0.68% points respectively. M&T output decreases in the cases including Korea, while it increases more than 5% points in S7. An industry output can fall even in the case of S5 in which the whole economy expands. For example, MNG and OMF output fall about 1.70 and 0.90% points respectively. On the contrary, AGR and PDF can expand at the expense of MTL and M&T in S6 that is unfavorable to Japan as a whole.

These changes are consistent with the movement of Revealed Comparative Advantage (RCA) indices in Table 10. Focusing on the change of Japanese M&T, for example, its RCA in 1995 was 1.85, which means its export share in Japanese total exports is 1.85 times larger than that of the world exports. In 2010, the index will decline to 1.74 in the standard case in which no PTA exists. The index will decline further, i.e. 1.71 if Japan chooses S2 while it increases to 1.93 if Japan chooses S7.

The example above is informative when considering the argument on structural change. Some may see it as a part of dynamic "flying geese" growth while others may call it an unholy "hollowing out" of the industrial base. M&T, which will lose its comparative advantage in response to the changes in endowments, can reverse the course when embraced in the U.S. and accelerate it when embraced in Korea. The choice of the former maintains or strengthens the current comparative advantage while the latter promotes structural changes.

Impact of Agricultural Liberalization in Japan

The above cases exclude agricultural liberalization because it is plausible to assume that the Japanese government cannot overcome long lasting pork barrel politics. However, it is worth noting how it is important to include agricultural commodities in the liberalization menu.

Table 11 lists the changes in endowments and industry output incurred from the inclusion of AGR and PDF in the liberalization shock. Different from general recognition, agricultural liberalization does not enhance economic growth. Moreover, changes in capital stock in S7A and S8A will be significantly negative. Although the manufacturing sector expands rapidly at the expense of a fall in agricultural production, the whole economy shrinks from the case in which AGR and PDF are excluded. Changes in the EVs and its decomposition are tabulated in Table 12. Agricultural liberalization creates big efficiency gains, but sluggish capital accumulation and changes in the terms of trade alter the results although the net gains from trade liberalization are still positive.

In detail, a change in terms of trade (from 3.5% to 0.6%) is caused by the appreciation of the Japanese import price denominated at the world price (from -1.1% to 0.6%). The change in the Japanese import price is generated by the appreciation of the U.S. agricultural product prices at CIF (16.2% to 31.1%). Although the abolishment of tariff and non-tariff barriers (from 0.0% to –62.3%) falls the U.S. agricultural product price in Japan (from 16.3% to –24.5%), the net effect on the Japanese economy becomes negative. Given the fixed saving rate, this result suggests that income transfer through changes in terms of trade will exceed efficiency gains since Japan is not only a big importer in the world agricultural commodity market, but also the share of agricultural commodities in Japanese imports is large. Thus, Japanese reluctance to liberalize agriculture, which is a result of the pork barrel politics, is

ironically rational from the viewpoint of national interests.[12]

Conclusion

This paper examines the impact of Asian PTAs around Japan by using a CGE model. We consider technological convergence led by FDI and international labor migration in addition to trade liberalization. Technological convergence is manipulated exogenously, but the gap in the level of technology that is consistent with GTAP version 4 dataset is calculated by industry and country. Labor migration is also manipulated exogenously since it is rational to assume that the government will control the total amount of labor migration in the foreseeable future. Remittance is also considered.

Results suggest that regional PTAs in Asia generally expand welfare. The ASEAN Plus Three (APT) is proven as the most favorable framework to promote economic prosperity. The path to the APT is also stable since any combination of two among three players is inferior to the APT. It is also important that the U.S.-Japan PTA will worsen the welfare of others so that either Japan or the U.S. should be open to Asia to avoid the worst case.

Industry-level changes suggest that a choice of partners will alter the distribution of business opportunities among industries. It will be important for the whole economy whether a PTA is regarded as an opportunity to enhance the dynamic structural change or not. In this context, we also show a paradoxical result of agricultural liberalization. Different from general perception, agricultural liberalization can deteriorate the welfare of Japan given a set of simulation assumptions. We need to investigate detailed account of this paradox further.

References

Brown, Drusilla K. "Properties of Applied General Equilibrium Trade Models with Monopolistic Competition and Foreign Direct Investment." in Joseph F. Francois and Clinton R. Shiells eds., *Modeling Trade Policy: Applied General Equilibrium Assessments of North American Free Trade*. Cambridge, UK: Cambridge University Press, 1994.

Brown, Drusilla K., Alan V. Deardorff and Robert M. Stern. "A North American Free Trade Agreement: Analytical Issues and a Computational Assessment." *The World Economy*, 15 (January 1992): 11-30.

Burfisher, Mary E., Sherman Robinson and Karen E. Thierfelder. "Wage Changes in a U.S.-Mexico Free Trade Area: Migration Versus Stolper-Samuelson Effects." in Francois, Joseph F. and Clinton R. Shiells eds., *Modeling Trade Policy: Applied General Equilibrium Assessments of NAFTA*. Cambridge UK: Cambridge University Press, 1994.

Coe, David T. and Elehanan Helpman. "International R&D Spillovers," *Europ. Econ. Rev.* 39 (May 1995): 859-889.

Dee, Philippa, Kevin Hanslow and Tien Phamduc. "Measuring the Cost of Barriers to Trade in Services." in Takatoshi Ito and Anne O. Krueger eds. *Services Trade in the Asia-Pacific Region, East Asia Seminar on Economics*, Volume 11. Cambridge, MA: forthcoming from the University of Chicago Press.

[12] It should be noted that we are not supporting the protection of agricultural liberalization by this result. Since the simulation does not include the agricultural productivity convergence, Japanese agricultural sectors lose comparative advantage more than the case in which convergence is considered.

Economic Planning Agency, Research Bureau. *Policy Effects Analysis Report 2000*. Tokyo: Printing Bureau, Ministry of Finance, 2000. (In Japanese)

Francois, Joseph F., Bradley J. McDonald, and Håkan Nordstrom. "Liberalization and Capital Accumulation in the GTAP Model." *GTAP Technical Paper*. No. 7 (July 1996) West Lafayette: GTAP, Purdue University.

Goto, Junichi. "The Impact of Migrant Workers on the Japanese Economy: Trickle vs. Flood." *Japan and the World Economy*. 10 (January 1998): 63-83.

Hanslow, Kevin, Tien Phamduc and George Verikios. "The Structure of FTAP Model." *Research Memorandum*, MC58, Productivity Commission, Australia, 2000.

Hertel, Thomas W. ed. *Global Trade Analysis: Modeling and Applications*. Cambridge UK: Cambridge University Press, 1996.

JSEPA Study Group. *The JSEPA Joint Study Group Report*. (downloaded from www.meti.go.jp accessed on 11/19, 2000).

Kimura Fukunari and Masahiko Tsutsumi. "CGE Modeling Strategies with the Nationalities of Firms." *Mita Journal of Economics*. 91 (July 1998): 199-219. (In Japanese)

Korea Institute for International Economic Policy. *Economic Effects of and Policy-Directions for a Korea-Japan FTA- Executive Summary*. Korea Institute for International Economic Policy, May 2000.

Liu, Jing, Nico van Leeuwen, Tri Thanh Vo, Rod Tyers, and Thomas W. Hertel. "Disaggregating Labor Payments by Skill Level in GTAP." *GTAP Technical Paper*. No. 11 (September 1998) West Lafayette: GTAP, Purdue University.

Robertson, Raymond. "Wage Shocks and North American Labor-Market Integration." *Amer. Econ. Rev.* 90 (September 2000): 742-764.

Tsutsumi, Masahiko, "Advancing Regional Economic Integration and China's Accession to the WTO: A Scenario Analysis by the CGE Model." *JCER Discussion Paper*. No. 60 (April 2000) Japan Center for Economic Research, Tokyo, Japan. (In Japanese)

Tsutsumi, Masahiko and Kozo Kiyota. "Effect of Japan's Free Trade Agreements: CGE Model Analysis." *JCER Discussion Paper*. No. 74 (February 2002) Japan Center for Economic Research, Tokyo, Japan. (In Japanese)

United Nations. *World Population Prospects*. New York: The United Nations, 2000.

World Bank. *World Development Indicators*. Washington D.C.: The World Bank, 2001.

Yamazawa, Ippei. "How the Economic Relation of Japan with Korea Should Be in the 21st Century." in *The Report of the Study Group on Japan-Korea Economic Relations in the 21st Century*. Tokyo: JETRO-IDE, March 2000 (downloaded from www.jetro.or.jp accessed on 11/20, 2000). (In Japanese)

Appendix

1. Module

Following modules are added to the standard model, i.e. GTAP94a. They are written in GEMPACK language.

Capital Accumulation

This formula is explained in Francois et.al (1996). Capital stock is linked to investment by the equation named BALDWIN, while the equation MUTH derives the real rate of return on investment.

```
VARIABLE (All,i,ENDWC_COMM)(All,r,REG)                    EXPAND(i,r)
VARIABLE (All,r,REG)                                      REAL_RET(r)
EQUATION BALDWIN    (All,i,ENDWC_COMM)(All,r,REG)
EXPAND(i,r) = qcgds(r) - qo(i,r);
EQUATION MUTH (All,r,REG)
REAL_RET(r) = rorc(r) - (yp(r) - up(r));
```

Factor Movements

Factor movements have effects on both supply side and demand side. Since the former effects is accounted by exogenous variables, i.e. labor growth, the latter needs to introduce the variable to transfer the amount of repatriation.

```
COEFFICIENT (all,i, ENDOW_COMM)(all,s,REG)(all,r,REG)          MIGL(i,s,r);
! Share of country s in the production factor i in country r.!
VARIABLE (changes) (all,r,REG)(all,s,REG)                        sendin(r,s);
! Transfer from s to r.!
VARIABLE (changes) (all, s, REG)(All,r, REG)                     sendout(s,r);
! Transfer from r to s.!
VARIABLE (all,r, REG)                                          forginc (r);
! Foreign income in r.!
VARIABLE (change) (all,i, ENDW_COMM) (all,r,REG)                 XVOA(i,r);
! Ex-post domestic factor payment of factor I in country r.!
EQUATION XVOAQ (all,i, endw_comm)(all,r,reg)
XVOA(i,r) = VOA(i,r)*[ps(i,r)+qo(i,r)];
EQUATION MIGsend (all,s,REG)(all,r,REG)
sendout(s,r) = -sum(i,ENDW_COMM,MIGL(i,s,r)*XVOA(i,r));
EQUATION IDENTITY (all,r, REG)(all,s,REG)
sendin (r,s) = - sendout(s,r);
EQUATION FOXINC (all, r, REG)
INCOME (r)*forginc (r) = sum (s, REG, (sendout (s,r)+sendin (s,r)));
```

2. Growth of Skilled and Unskilled Labor until 2010

We split the total labor growth into that of skilled and unskilled by using GTAP data, data in Liu, et al. (1998), and the relationship of skilled labor with education. Suppose that the total labor force (L) consists of skilled (L_s) and unskilled (L_u) workers with wages of w_s and w_u respectively. Then, the ratio of the aggregate data (V_s/V_u) can be decomposed into (L_s/L_u) and (w_s/w_u) as shown in Table A- 1. Since the ratio of skilled and unskilled labor (RSUL) of Taiwan and the FSU are not available, we first calculate them by assuming the linear functional relation between per capita value added (PVAL) and the RSUL.[13]

[13] It should be also noted that this assumption is not always valid. For example, the skilled labor is defined as professional or management and does not reflect the technical maturity or specialty of those in the production process.

PVAL = -1475.8 + 53856.1*(RSUL)

(t:-0.876) (t:7.336)

Adj. R2=0.78, number of observation: 16.

We also assume that the RSUL is a function of education. Among various indices of education, we used the tertiary enrollment rate (TER) because of the definition of skilled labor used in the GTAP data, although there are some ambiguities about the coverage and quality of both skilled labor and education.[14] The functional relationship of the RSUL with the TER is

RSUL=5.145+0.416*(TER)

(t:1.576) (t:5.017)

Adj. R2 = 0.57, number of observations: 19.

3. Technological Parameter

Since there is no explicit variable in the dataset, we calculate the level of technology by using growth accounting. The formula is

$$\ln A_{ir} = \ln Y_{ir} - \alpha_{ir} \ln K_{ir} - \beta \ln Ls_{ir} - \gamma \ln Lu_{ir},$$

where A, Y, K, Ls, and Lu are technology level, value added, capital stock, skilled labor, and unskilled labor respectively.

The above equation requires industry level data of capital and labor. Thus, we decompose both capital stock and labor in GTAP version 4. On capital stock, we divide the aggregate national data by assuming the competitive capital markets, i.e. equalized rate of returns among industries in a country, and the homogeneous industry specific capital-output ratio among countries. The result is in Table A- 2.

On labor, we also assume the competitive labor market, i.e. same wages among industries in a country, and use the ratio of skilled and unskilled labor force and the ratio of their wages in Table A- 1. Then, we derive the specific number of workers in each industry subjecting them to the conditions of two ratios, and total workers. Since this method sometimes derives multiple solutions, i.e. more than two vectors satisfying conditions, we chose the most plausible set of combinations of skilled and unskilled labor.

Finally, α, β, and γ tabulated in Table A- 5 are distribution parameters directly calculated from GTAP data.

[14] For example, the definition of tertiary education in the World Bank (2001) consists of 1) non-mandatory, 2) entrance examination, and 3) graduation of the secondary level. Though Japanese high school education satisfies all conditions, the figures in the WDI indicate post-high school enrolment rate rather than high school enrolment rate.

Tables

Table 1: Commodities and Countries/Regions in the Model

	Name in the model	Contents
1	AGR	Paddy rice, Wheat, Cereal grains nec, Vegetables, Fruit, Nuts, Oil seeds, Sugar cane, Sugar beet, Plant-based fibers, Crops nec, Bovine cattle, sheep and goats, horses, Animal products nec, Raw milk, Wool, Silk-worm Cocoons, Forestry, and Fishing.
2	MNG	Coal, Oil, Gas, and Minerals nec
3	PDF	Bovine cattle, sheep and goat, horse meat prods, Meat products nec, Vegetable oils and fats, Dairy products, Processed rice, Sugar, Food products nec, Beverages and tobacco products
4	TXL	Textiles and Wearing apparel
5	W&P	Wood products, Paper products, publishing
6	P&C	Petroleum, coal products and Chemical, rubber, plastic products
7	MTL	Ferrous metals, and Metals nec, Metal products
8	M&T	Motor vehicles and parts Transport equipment nec
9	ELE	Electronic equipment
10	OME	Machinery and equipment nec
11	OMF	Leather products, Mineral products nec, and Manufactures nec
12	EGW	Electricity, Gas manufacture, distribution, and Water
13	CNS	Construction
14	T&T	Trade, and transport
15	OSP	Financial, business, recreational services, and Dwellings
16	OSG	Public admin and defense, education, health

	Name in the model	Countries and regions
1	ANZ	Australia, New Zealand
2	JPN	Japan
3	KOR	Republic of Korea
4	IND	Indonesia
5	MLY	Malaysia
6	PHL	The Philippines
7	SGP	Singapore
8	THA	Thailand
9	CHN	China
10	HGK	Hong Kong
11	TWN	Taiwan
12	SAS	Viet Nam, India, Sri Lanka, Rest of South Asia
13	CAN	Canada
14	USA	USA
15	MEX	Mexico
16	LAS	Central America and Caribbean Venezuela, Colombia, Rest of Andean Pact, Argentina, Brazil, Uruguay, Rest of South America Chile.
17	EU	United Kingdom, Germany, Denmark, Sweden, Finland, Rest of European Union, European Free Trade Area
18	FSU	Central European Associates, Former Soviet Union
19	ROW	Turkey, Rest of Middle East, Morocco, Rest of North Africa, South African Customs Union, Rest of Southern Africa, Rest of Sub Saharan Africa, Rest of World

Source: GTAP version 4.

Table 2: The Share of Production Factors and Value Added

	Land	Unskilled	Skilled	Capital	Value Added
ANZ	0.79	35.03	23.96	40.22	372381.3
JPN	0.47	36.17	21.70	41.67	4689523.0
KOR	4.94	35.47	13.41	46.19	393982.8
IND	7.99	34.48	6.70	50.83	197233.5
MLY	5.33	26.49	7.72	60.46	70530.5
PHL	6.78	31.63	9.91	51.68	58051.0
SGP	0.47	30.33	16.07	53.12	59341.0
THA	4.78	19.65	6.56	69.01	149573.6
CHN	5.87	35.45	7.66	51.02	552451.5
HGK	0.30	26.08	20.18	53.44	100426.8
TWN	1.14	36.66	25.87	36.33	250044.8
SAS	12.41	40.56	9.44	37.59	370260.7
CAN	0.38	41.32	16.39	41.92	507183.3
USA	0.41	38.18	25.88	35.53	6586751.0
MEX	2.67	22.48	8.78	66.07	253254.8
LAS	2.37	31.33	13.21	53.08	1252196.0
EU	0.32	41.24	25.79	32.65	8070670.0
FSU	1.79	41.86	16.16	40.20	731142.1
ROW	2.52	32.15	12.07	53.25	1244712.0
World	1.13	37.79	21.96	39.12	25909708.0

Note: Figures in each factor are percentage shares and those in the value added are millions of US$ (1995 price).
The factor share by industry in each country and region varies.
Source: GTAP version 4

Table 3: Exogenous Growth of Skilled and Unskilled Labor Forces

	Total	Skilled	Unskilled
ANZ	1.145	2.420	0.477
JPN	0.157	1.128	-0.101
KOR	1.653	6.171	0.676
IND	2.555	10.223	1.867
MLY	1.864	4.985	1.308
PHL	2.615	3.375	2.534
SGP	2.357	3.870	1.378
THA	0.686	0.970	0.667
CHN	0.967	3.109	0.730
HGK	1.214	3.937	0.484
TWN	1.454	2.632	1.024
SAS	1.700	2.544	1.543
CAN	0.828	1.086	0.688
USA	1.202	1.751	0.878
MEX	1.433	1.242	1.465
LAS	1.388	2.264	1.254
EU	0.348	1.967	-0.428
FSU	0.018	3.120	-0.255
ROW	2.562	4.892	2.239

Note: Figures are annual average growth rates (%) from 1995 to 2010.
The growth rate of total labor force is cited from the United Nations (2000) and the World Bank (2001).
See appendix for the decomposition of the skilled and unskilled labor.

Table 4: The List of Scenarios and Implemented Shocks

Name of the Scenario	Implemented Shocks
STD: standard	QO，MFA，NAFTA
S1: JPN-SGP	+TL，LM，-CA，AO
S2: JPN-SGP-KOR	+TL，LM，-CA，AO
S3: JPN-SGP-MEX	+TL，LM，-CA，AO
S4: JPN-SGP-KOR-MEX	+TL，LM，-CA，AO
S5: JPN-SGP-KOR-ASEAN4-CHN-HGK	+TL，LM，-CA，AO

S6: CHN-HGK-SGP-ASEAN4	+TL，AO
S7: JPN-USA (labor migration from JPN to the US)	+TL，LM，AO
S8: JPN-USA (labor migration from the US to JPN)	+TL，LM，AO
S9: JPN-CHN-HGK	+TL，LM，-CA，AO

Note: Abbreviations are as follows; QO: factor growth, MFA: abolishment of MFA, NAFTA: full implementation of NAFTA, TL: trade liberalization (except agriculture related industries, i.e. AGR and PDF), LM: labor movement (1% of skilled labor force from PTA members to Japan or the U.S., with 50% of remittance rate), CA: change in current account balance (1% of capital stock), AO: Induced convergence of production technology at industry level (1%)

Table 5: Industry Level Technology Parameter by Region

	AGR	MNG	PDF	TXL	W&P	P&C	MTL	M&T	ELE	OME	OMF	EGW	CNS	T&T	OSP	OSG
ANZ	7.17	0.38	4.83	4.31	6.86	2.77	4.23	5.81	1.33	4.99	2.77	0.71	12.11	24.94	4.58	35.31
JPN	6.09	0.76	6.02	12.71	11.07	3.50	5.97	4.69	4.89	10.82	5.03	0.96	20.03	88.66	3.70	127.94
KOR	7.44	1.43	2.13	2.61	2.75	1.86	1.32	2.47	2.02	3.72	2.30	0.39	10.09	1.75	3.38	19.92
IND	0.49	1.48	1.44	1.23	1.37	1.73	1.05	0.73	1.39	0.66	1.23	0.69	2.30	3.47	2.62	0.95
MLY	2.36	0.27	0.51	1.22	1.67	0.47	1.02	0.77	0.76	1.09	0.76	0.50	4.24	1.86	0.70	10.84
PHL	2.45	0.24	0.63	0.56	0.39	0.36	0.22	0.19	0.33	0.47	0.38	0.26	0.93	0.84	0.66	5.53
SGP	39.25	0.15	1.47	5.48	3.81	0.68	2.14	2.77	4.16	6.28	2.02	0.35	4.85	5.78	3.71	23.12
THA	2.20	0.41	0.58	0.63	0.43	0.42	0.35	0.41	0.29	0.35	0.55	0.52	0.61	0.76	0.84	6.55
CHN	1.58	0.29	0.29	0.40	0.30	0.33	0.35	0.24	0.25	0.50	0.47	0.27	0.94	0.57	0.50	11.51
HGK	25.12	0.30	1.34	11.03	2.43	2.39	2.01	4.90	1.80	4.25	2.06	0.47	5.01	6.41	3.56	33.26
TWN	5.19	1.41	3.38	6.16	6.16	5.23	5.07	3.96	8.91	10.18	5.93	0.84	11.43	20.96	2.15	20.03
SAS	1.12	0.22	0.26	0.59	0.18	0.28	0.25	0.27	0.08	0.30	0.33	0.46	0.60	1.70	0.71	1.09
CAN	2.97	0.51	3.15	4.53	13.08	3.63	9.69	6.66	3.19	6.82	3.86	0.77	28.83	46.07	5.44	8.92
USA	5.54	0.62	2.36	5.85	7.15	3.27	12.77	14.24	5.19	11.76	3.89	1.21	17.65	62.55	5.50	170.12
MEX	5.41	0.36	0.59	0.76	0.56	0.77	0.74	0.73	0.73	1.12	0.66	0.72	2.74	1.00	1.38	5.78
LAS	2.05	0.51	1.11	0.93	1.08	1.35	1.73	1.83	1.00	1.28	1.20	1.87	1.65	2.61	1.58	9.88
EU	4.15	0.38	10.84	18.01	23.85	12.83	35.29	26.76	6.98	28.57	19.60	1.34	25.14	33.29	10.14	41.52
FSU	2.11	0.33	1.08	1.26	1.46	1.15	1.68	1.28	1.10	1.91	1.05	0.50	3.07	4.11	2.57	8.12
ROW	6.57	0.25	0.51	0.57	0.57	0.47	0.65	0.47	0.34	0.54	0.63	0.48	1.68	1.27	0.91	4.79

Note: See the appendix 3 for calculation

Table 6: Changes in the World Economic Variables by Scenario

	S1	S2	S3	S4	S5	S6	S7	S8	S9
World GDP growth	0.02	0.14	0.08	0.19	1.37	0.32	0.24	0.21	0.77
World GDP deflator	0.00	0.01	0.01	0.03	0.64	0.32	-0.02	-0.03	0.44
World real export growth	0.06	0.37	0.15	0.48	5.01	1.83	0.44	0.42	2.09
World export deflator	-0.01	-0.07	-0.02	-0.06	-0.11	0.33	-0.18	-0.19	-0.02

APEC GDP growth	0.04	0.23	0.13	0.31	2.19	0.50	0.39	0.35	1.22
APEC GDP deflator	0.00	0.06	0.01	0.08	1.08	0.30	0.08	0.08	0.78
APEC real export growth	0.12	0.78	0.31	1.00	10.58	3.90	0.95	0.93	4.37
APEC export deflator	-0.01	-0.07	-0.03	-0.06	-0.08	0.33	-0.17	-0.18	0.12
World investment change	0.05	0.40	0.14	0.48	4.62	1.17	0.32	0.26	2.70
EVs	5,932	34,298	20,139	47,378	322,580	75,854	57,571	51,439	179,889

Note: Figures are difference in the cumulative change from the standard case.
The unit of figures is percentage point except EVs. EVs are millions of US$.

Table 7: Changes in Cumulative Real GDP Growth Rate by Region

	S1	S2	S3	S4	S5	S6	S7	S8	S9
ANZ	0.00	0.02	0.01	0.03	0.35	0.14	0.00	-0.01	0.21
JPN	0.07	0.14	0.10	0.18	1.02	-0.05	0.99	0.77	0.78
KOR	0.00	6.33	-0.01	5.89	9.05	-0.16	-0.12	-0.13	-0.28
IND	0.02	0.08	0.04	0.08	13.36	3.16	-0.09	-0.11	-0.10
MLY	0.10	0.21	0.18	0.39	18.52	7.24	-0.46	-0.48	-0.48
PHL	0.00	0.01	-0.01	-0.01	8.43	2.69	0.06	0.07	-0.26
SGP	5.76	7.23	7.04	9.77	16.85	10.40	-0.27	-0.28	0.13
THA	0.00	-0.01	0.00	-0.01	18.44	6.03	-0.02	-0.04	-0.10
CHN	0.01	-0.03	0.00	-0.03	27.69	9.17	-0.20	-0.22	24.95
HGK	0.00	0.06	0.02	0.06	-0.20	-6.68	0.16	0.16	-1.80
TWN	0.01	-0.08	-0.01	-0.09	-2.56	-0.92	-0.23	-0.24	-1.64
SAS	0.00	0.03	0.01	0.03	0.07	0.00	-0.02	-0.02	0.27
CAN	0.00	0.00	0.00	0.01	0.33	0.19	-0.32	-0.31	0.12
USA	0.00	0.01	0.01	0.02	0.07	0.00	0.35	0.41	0.03
MEX	0.00	0.00	4.20	4.22	-0.02	0.01	-0.02	-0.02	0.01
LAS	0.01	0.03	0.02	0.05	0.32	0.07	0.02	0.02	0.25
EU	0.00	0.00	0.00	0.00	-0.01	0.02	-0.02	-0.02	0.01
FSU	0.00	0.00	0.00	0.01	0.11	0.08	-0.03	-0.03	0.07
ROW	0.00	0.03	0.01	0.03	0.28	0.02	0.03	0.03	0.22

Note: Figures are the percentage point differences from the standard case.
Shaded regions are participants of each PTA.

Table 8: Changes in Equivalent Variations by Region

	S1	S2	S3	S4	S5	S6	S7	S8	S9
ANZ	14	142	71	217	2,705	1,145	-168	-193	1,469
JPN	2,705	9,626	5,099	12,216	79,802	-4,895	50,309	41,150	62,367
KOR	-11	21,779	-103	19,324	43,894	-1,740	-1,106	-1,141	-2,979
IND	31	140	90	172	17,812	6,824	-343	-382	-847
MLY	100	204	191	367	10,959	6,252	-486	-511	-345
PHL	5	15	3	1	3,052	1,640	-30	-30	-10
SGP	2,985	3,412	3,232	4,375	12,032	9,972	-297	-308	126
THA	6	-16	29	20	17,488	7,066	-145	-177	111
CHN	39	-541	-18	-457	122,691	40,881	-1,882	-1,989	110,208
HGK	8	60	8	47	6,422	4,762	-58	-57	6,282
TWN	36	-338	-36	-353	-9,986	-3,819	-827	-860	-6,329
SAS	22	59	52	88	-592	64	-225	-236	958
CAN	-0	6	-6	40	2,471	1,274	-2,261	-2,235	866
USA	3	-27	66	-93	7,511	854	19,067	22,485	1,963
MEX	-2	-21	11,135	11,137	-148	132	-441	-435	98
LAS	20	305	292	539	5,046	1,668	-119	-118	3,956
EU	14	-858	-213	-834	-2,249	1,729	-3,040	-3,099	-483
FSU	-31	-56	4	-2	673	747	-385	-404	412
ROW	-12	408	241	571	2,997	1,297	7	-22	2,066

Note: Figures are the deviation (millions of US$) from the standard case
Shaded regions are participants of each PTA

Table 9: Changes in Endowments and Output by Industry in Japan

	S1	S2	S3	S4	S5	S6	S7	S8	S9
Land (exogenous)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unskilled (exogenous)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skilled (shocked)	0.01	0.06	0.05	0.10	1.02	0.00	0.49	-0.12	0.76
Capital (endogenous)	0.16	0.30	0.21	0.36	1.90	-0.09	1.32	1.07	1.44
AGR	0.02	-0.01	0.03	0.00	0.47	0.43	0.05	-0.05	0.12
MNG	0.08	0.08	0.11	0.09	-1.70	0.25	0.34	0.10	-1.43
PDF	0.03	0.04	0.03	0.04	0.38	0.08	0.32	0.21	0.23
TXL	0.03	-0.27	0.00	-0.23	2.61	-1.82	-0.24	-0.41	9.47
W&P	0.08	0.14	0.10	0.16	0.91	0.02	0.55	0.32	0.69
P&C	0.08	0.30	0.11	0.30	1.58	-0.12	0.67	0.45	0.90
MTL	0.09	0.33	0.14	0.41	1.71	-0.03	1.31	1.08	0.25
M&T	0.31	-0.33	0.43	-0.22	4.61	-0.34	5.67	5.39	3.96
ELE	0.11	0.08	0.12	0.06	0.01	-0.40	1.02	0.78	0.47
OME	0.04	0.68	0.16	0.82	1.09	0.01	0.93	0.70	-0.67
OMF	0.09	0.15	0.16	0.19	-0.90	-0.96	0.70	0.47	0.05
EGW	0.08	0.18	0.11	0.22	1.24	-0.11	0.89	0.66	0.93
CNS	0.13	0.26	0.18	0.31	1.68	-0.09	1.19	0.95	1.28
T&T	0.03	0.02	0.04	0.03	0.58	0.11	0.49	0.26	0.50
OSP	0.08	0.16	0.12	0.19	1.06	0.00	0.94	0.70	0.76
OSG	0.02	0.07	0.05	0.10	0.70	-0.03	0.48	0.26	0.51

Note: Figures are difference in cumulative changes from the baseline and percentage point.

Table 10: Changes in Japan's RCA

	1995	2010	S1	S2	S3	S4	S5	S6	S7	S8	S9
AGR	0.04	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.06
MNG	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
PDF	0.07	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.09	0.09	0.09
TXL	0.33	0.33	0.33	0.33	0.33	0.33	0.57	0.26	0.32	0.32	0.86
W&P	0.18	0.20	0.20	0.20	0.20	0.20	0.22	0.20	0.19	0.19	0.20
P&C	0.72	0.77	0.77	0.79	0.77	0.78	0.80	0.78	0.75	0.75	0.75
MTL	0.90	0.93	0.93	0.95	0.93	0.95	0.98	0.94	0.93	0.93	0.88
M&T	1.85	1.74	1.75	1.71	1.75	1.71	1.85	1.72	1.93	1.93	1.85
ELE	1.66	1.58	1.58	1.56	1.58	1.55	1.46	1.55	1.55	1.55	1.52
OME	2.04	2.07	2.06	2.08	2.07	2.09	2.00	2.07	2.03	2.03	1.95
OMF	0.94	0.90	0.90	0.91	0.91	0.91	0.85	0.83	0.89	0.89	0.93
EGW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T&T	0.86	0.90	0.90	0.88	0.89	0.88	0.82	0.95	0.86	0.86	0.83
OSP	0.60	0.63	0.63	0.62	0.63	0.62	0.58	0.66	0.60	0.60	0.57
OSG	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03

Note: RCA (Revealed Comparative Advantage) = (export share of goods i in total exports of country j) / (export share of goods i in the world trade)

Source: Authors' calculation

Table 11: Agricultural Liberalization in Japan

	S1A	S2A	S3A	S4A	S5A	S6A	S7A	S8A	S9A
Land (exogenous)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unskilled (exogenous)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skilled (shocked)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital (endogenous)	-0.01	0.00	-0.01	-0.01	-0.13	0.00	-1.35	-1.34	-0.05
AGR	0.02	0.01	0.00	-0.01	-0.46	-0.09	-21.56	-21.55	-0.22
MNG	0.00	-0.01	0.00	-0.01	-0.02	-0.01	0.56	0.56	0.01
PDF	-0.01	0.05	-0.03	0.02	-0.16	-0.03	2.27	2.25	-0.13
TXL	0.00	0.00	0.01	0.00	0.19	0.00	2.90	2.89	0.34
W&P	0.00	-0.01	-0.01	-0.01	0.01	0.02	0.60	0.60	-0.01
P&C	0.00	0.00	0.00	0.00	0.02	0.01	0.20	0.20	-0.01
MTL	0.00	-0.01	0.00	-0.01	0.03	0.01	0.96	0.95	-0.01
M&T	0.00	-0.02	0.02	0.00	0.12	-0.03	4.12	4.11	0.01
ELE	0.00	-0.01	0.00	0.00	-0.02	0.02	0.36	0.36	-0.01
OME	0.00	-0.01	0.01	0.00	0.06	-0.02	1.78	1.78	0.01
OMF	0.00	0.00	0.01	0.00	0.08	0.01	1.04	1.03	0.08
EGW	-0.01	0.00	0.00	-0.01	-0.04	0.00	0.05	0.06	-0.02
CNS	0.00	-0.01	-0.01	-0.02	-0.11	0.00	-1.20	-1.20	-0.05
T&T	0.00	-0.01	0.00	-0.01	-0.03	0.01	0.19	0.19	-0.01
OSP	0.00	0.00	-0.01	0.00	-0.06	0.00	-0.24	-0.24	-0.02
OSG	0.00	0.00	-0.01	-0.01	-0.07	0.00	-0.49	-0.49	-0.03

Note. Figures are differences in cumulative changes from the case that agricultural liberalization is not implemented. Figures are percentage points.

Table 12: Changes in EVs and its Decomposition in Agricultural Liberalization in Japan

	S1A	S2A	S3A	S4A	S5A	S6A	S7A	S8A	S9A
Total	-69	-63	-284	-282	-3,052	309	-10,730	-10,692	-1,324
Efficiency	-50	-29	-111	-92	-405	142	26,470	26,461	-270
Terms of Trade	22	14	-6	-14	-950	120	-14,260	-14,230	-282
Investments	2	30	-34	-7	-282	32	-7,989	-7,978	-144
Factor Endowments	-71	-129	-216	-276	-2,311	23	-24,343	-24,335	-1,026
Technology	0	0	0	0	0	0	118	118	0
Capital Depreciation	28	52	84	109	914	-6	9,822	9,800	405
Marginal Utility	-1	-2	-1	-3	-19	-3	-552	-531	-9

Note: Figures are differences in EVs between cases with agricultural liberalization and those without it. Figures are millions of US$

Table A- 1: Decomposition of Labor Data in GTAP version 4

	Ls/Lt	Vs/Vu	Ls/Lu	Ws/Wu	PVAL
ANZ	0.25	0.684	0.32	2.10	17,235
JPN	0.16	0.600	0.19	3.21	37,211
KOR	0.10	0.378	0.11	3.39	8,779
IND	0.04	0.194	0.04	5.20	993
MLY	0.09	0.292	0.10	2.79	3,434
PHL	0.07	0.313	0.08	4.16	846
SGP	0.29	0.530	0.41	1.29	15,600
THA	0.05	0.334	0.05	6.64	2,468
CHN	0.07	0.216	0.07	3.04	450
HGK	0.14	0.774	0.16	4.75	15,351
TWN	n.a.	0.706	0.25	2.86	11,828
SAS	0.12	0.233	0.13	1.78	296
CAN	0.30	0.397	0.42	0.94	17,216
USA	0.30	0.678	0.42	1.60	24,176
MEX	0.12	0.391	0.13	3.00	2,763
LAS	0.10	0.422	0.11	3.92	3,203
EU	0.23	0.625	0.31	2.04	21,430
FSU	n.a.	0.386	0.05	7.43	1,324
ROW	0.08	0.376	0.09	4.31	1,327

Note: the shaded figures are authors' estimation.

Source: Liu, Jing, Nico van Leeuwen, Tri Thanh Vo, Rod Tyers, and Thomas W. Hertel (1998) Table 26 ,GTAP version 4, and the United Nation (2000).

Table A- 2: Decomposition of Capital Stock by Industry and Country.

	ANZ	JPN	KOR	IND	MLY	PHL	SGP	THA	CHN	HGK
AGR	43,963	582,371	54,329	37,035	20,677	23,141	954	23,377	116,711	983
MNG	109,097	65,785	10,828	51,378	32,505	2,477	139	11,352	144,256	4,882
PDF	38,276	514,076	31,030	38,687	7,056	27,796	4,092	29,303	49,074	7,122
TXL	5,404	141,303	25,419	9,567	2,368	3,036	1,146	23,294	61,464	11,238
W&P	24,447	404,745	19,935	13,557	6,190	3,090	4,919	18,347	29,198	4,363
P&C	33,174	1,000,934	71,178	19,977	8,284	4,445	48,641	31,219	101,619	2,995
MTL	34,448	755,942	62,760	7,064	4,402	2,451	3,685	12,589	96,562	2,157
M&T	6,923	302,997	23,776	2,822	7,060	415	2,414	23,394	28,187	1,902
ELE	5,900	736,110	45,647	10,382	16,800	2,042	26,439	34,150	25,031	6,122
OME	13,623	813,859	49,746	2,095	14,442	2,737	14,944	41,461	113,296	10,663
OMF	11,516	329,820	39,803	9,214	6,729	2,892	3,200	31,327	85,606	4,063
EGW	45,375	1,456,614	112,086	7,846	8,015	8,688	3,257	10,154	92,008	17,575

CNS	62,487	1,064,582	84,282	39,801	5,596	8,391	8,476	24,455	54,785	14,963
T&T	278,650	2,544,862	289,121	90,987	51,393	61,617	89,283	119,794	379,008	198,815
OSP	458,496	7,513,329	250,546	54,243	28,300	45,886	31,787	45,973	185,859	76,942
OSG	55,068	392,058	50,342	28,601	3,507	4,911	1,501	8,493	53,782	2,716

(Continued)

	TWN	SAS	CAN	USA	MEX	LAS	EU	FSU	ROW
AGR	9,685	198,871	46,651	311,386	32,205	336,156	669,671	68,978	336,917
MNG	3,008	85,393	87,968	484,249	75,757	170,448	574,365	317,193	1,082,938
PDF	8,658	31,214	44,868	718,120	47,733	249,779	936,021	121,320	245,068
TXL	12,086	62,198	9,287	189,862	18,045	150,760	280,442	42,301	111,791
W&P	8,227	7,032	55,873	510,354	17,939	117,029	496,416	58,965	96,699
P&C	31,659	28,609	48,503	807,808	25,104	203,142	952,870	173,951	309,729
MTL	26,096	16,548	29,234	289,958	17,921	107,720	465,328	87,659	114,922
M&T	6,148	10,415	27,965	355,648	15,811	44,473	407,353	22,727	71,713
ELE	19,147	2,000	16,209	381,641	15,043	47,411	311,433	35,652	36,777
OME	15,501	25,442	23,393	557,336	20,167	61,739	640,058	46,959	53,840
OMF	11,006	39,422	10,730	207,905	21,963	94,546	533,129	48,988	122,329
EGW	24,378	43,293	132,153	707,366	17,788	127,169	952,994	206,575	259,760
CNS	11,131	57,735	35,484	953,354	9,166	219,105	1,467,181	102,631	154,583
T&T	90,977	137,210	206,390	2,449,642	212,616	604,729	5,197,449	382,906	1,067,506
OSP	173,345	101,039	516,810	6,642,655	100,715	1,061,669	11,474,444	574,505	806,439
OSG	38,166	166,644	88,524	269,869	24,685	104,096	1,350,242	62,610	213,282

Note: Figures are million US dollar.
Source: GTAP version 4 and authors' calculation.

Table A- 3: Skilled Labor Force by Industry and Country

	AGR	MNG	PDF	TXL	W&P	P&C	MTL	M&T	ELE	OME	OMF	EGW	CNS	T&T	OSP	OSG
ANZ	8	59	64	71	66	151	74	65	142	152	65	137	67	79	276	1,203
JPN	8	812	456	212	740	630	607	762	678	678	533	850	1,482	700	797	607
KOR	1	55	109	61	127	140	91	102	131	131	73	55	63	85	217	771
IND	10	108	31	45	54	117	117	124	117	117	49	824	54	20	129	1,310
MLY	2	33	35	27	30	41	34	36	41	41	28	96	35	43	54	198
PHL	8	51	67	55	53	104	55	86	119	119	45	133	44	39	444	548
SGP	0	15	22	14	26	36	21	25	33	33	20	54	24	31	50	110
THA	0	48	60	46	45	73	54	63	78	78	47	153	54	62	225	574
CHN	145	1,924	2,714	2,266	2,469	2,948	2,628	2,617	2,996	2,996	2,293	7,182	2,676	3,305	7,700	926
HGK	0	10	17	13	25	24	16	32	32	32	23	36	13	29	32	111
TWN	7	66	89	60	60	82	60	89	119	119	63	169	65	128	136	1,580
SAS	50	2,481	3,296	2,587	2,705	3,525	2,828	3,103	3,613	3,654	2,303	8,714	2,933	3,538	1,639	14,750

CAN	59	277	160	117	246	416	164	333	471	471	174	260	175	177	497	613
USA	30	1,521	1,091	787	1,620	3,262	1,153	2,489	4,130	4,130	1,176	1,826	1,123	836	10,213	4,521
MEX	5	138	132	102	118	171	121	149	188	188	109	345	123	141	630	1,449
LAS	43	175	338	309	354	478	344	448	437	421	325	1,000	391	375	3,537	5,995
EU	593	2,215	785	314	1,068	2,424	884	1,293	2,357	2,606	727	5,149	932	1,387	3,287	14,946
FSU	24	209	283	235	259	351	267	362	477	476	238	751	251	269	1,798	4,433
ROW	13	1,138	1,197	936	1,048	1,412	1,133	1,229	1,499	1,485	988	3,457	1,119	1,359	4,862	13,826

Note: Figures are 1,000 persons.

Table A- 4: Unskilled Labor Force by Industry and Country

	AGR	MNG	PDF	TXL	W&P	P&C	MTL	M&T	ELE	OME	OMF	EGW	CNS	T&T	OSP	OSG
ANZ	328	414	420	429	424	520	433	422	511	520	422	505	425	440	627	1,404
JPN	1,698	3,751	3,084	2,481	3,628	3,431	3,388	3,665	3,519	3,519	3,244	3,812	6,540	3,559	3,725	3,388
KOR	894	1,043	1,164	1,057	1,199	1,223	1,125	1,148	1,206	1,206	1,086	1,044	1,062	1,113	1,357	2,910
IND	54,463	1,884	1,251	1,471	1,474	1,941	1,941	2,052	1,941	1,942	1,428	4,409	1,557	1,108	2,016	5,512
MLY	457	469	470	467	468	472	469	470	472	472	467	492	470	473	477	380
PHL	1,629	1,642	1,646	1,643	1,642	1,657	1,643	1,652	1,661	1,661	1,640	1,665	1,640	1,638	1,747	1,322
SGP	4	51	76	69	79	86	75	79	84	84	75	98	78	83	96	128
THA	1,809	2,024	2,036	2,022	2,020	2,050	2,030	2,040	2,055	2,055	2,022	2,129	2,030	2,039	2,196	2,479
CHN	54,793	45,187	44,668	44,964	44,830	44,512	44,726	44,732	44,480	44,480	44,945	41,459	44,694	44,272	38,137	1,838
HGK	9	162	171	166	179	178	170	186	186	186	177	190	166	183	186	247
TWN	627	678	696	673	674	691	673	696	719	719	676	753	678	725	731	1,311
SAS	29,813	30,213	30,344	30,229	30,249	30,381	30,269	30,313	30,395	30,401	30,184	31,191	30,286	30,383	30,076	16,830
CAN	659	714	685	674	707	745	687	727	757	757	689	710	689	690	763	324
USA	638	5,673	5,345	5,091	5,744	6,768	5,395	6,317	7,226	7,226	5,413	5,888	5,371	5,134	9,694	7,420
MEX	902	1,932	1,926	1,892	1,910	1,968	1,914	1,944	1,985	1,985	1,900	2,138	1,915	1,935	2,375	2,908
LAS	6,827	3,478	6,988	7,483	7,662	8,132	7,623	8,022	7,980	7,921	7,547	9,756	7,809	7,747	14,816	19,327
EU	18,442	7,821	4,135	2,397	4,930	7,756	4,427	5,489	7,640	8,067	3,955	11,615	4,561	5,706	9,142	27,276
FSU	10,137	11,557	12,122	11,986	12,055	12,312	12,076	12,342	12,646	12,645	11,993	13,328	12,031	12,083	15,504	20,692
ROW	5,064	26,277	26,364	25,974	26,143	26,677	26,270	26,412	26,803	26,782	26,053	29,375	26,249	26,601	31,005	39,175

Note: Figures are 1,000 persons.

Table A- 5: Distribution Parameters (α, β, γ)

α	AGR	MNG	PDF	TXL	W&P	P&C	MTL	M&T	ELE	OME	OMF	EGW	CNS	T&T	OSP	OSG
ANZ	0.39	0.84	0.43	0.26	0.34	0.48	0.44	0.25	0.45	0.32	0.41	0.71	0.35	0.37	0.56	0.10
JPN	0.45	0.59	0.44	0.25	0.33	0.54	0.46	0.42	0.48	0.39	0.43	0.71	0.29	0.25	0.62	0.10
KOR	0.33	0.46	0.49	0.44	0.41	0.58	0.63	0.44	0.53	0.44	0.50	0.85	0.35	0.66	0.57	0.15

IND	0.38	0.65	0.65	0.55	0.57	0.54	0.55	0.52	0.52	0.51	0.55	0.60	0.55	0.56	0.55	0.63
MLY	0.52	0.94	0.77	0.46	0.50	0.80	0.58	0.68	0.74	0.66	0.68	0.79	0.32	0.64	0.77	0.16
PHL	0.36	0.75	0.68	0.46	0.58	0.67	0.79	0.52	0.61	0.53	0.58	0.83	0.46	0.66	0.71	0.13
SGP	0.23	0.95	0.57	0.25	0.43	0.79	0.50	0.42	0.53	0.44	0.50	0.79	0.44	0.56	0.55	0.06
THA	0.42	0.80	0.77	0.73	0.81	0.84	0.85	0.84	0.93	0.89	0.78	0.75	0.75	0.78	0.73	0.18
CHN	0.21	0.80	0.71	0.58	0.58	0.74	0.70	0.71	0.67	0.61	0.58	0.83	0.29	0.69	0.69	0.26
HGK	0.25	0.86	0.61	0.34	0.48	0.45	0.45	0.28	0.55	0.46	0.50	0.82	0.47	0.58	0.61	0.07
TWN	0.28	0.42	0.37	0.31	0.27	0.43	0.42	0.31	0.30	0.27	0.31	0.71	0.22	0.33	0.66	0.15
SAS	0.39	0.82	0.61	0.42	0.36	0.57	0.47	0.31	0.49	0.50	0.55	0.45	0.41	0.30	0.44	0.46
CAN	0.49	0.81	0.48	0.27	0.30	0.46	0.28	0.32	0.37	0.29	0.31	0.76	0.17	0.27	0.55	0.40
USA	0.53	0.76	0.58	0.34	0.40	0.52	0.28	0.26	0.38	0.31	0.41	0.67	0.34	0.27	0.54	0.04
MEX	0.41	0.93	0.82	0.71	0.79	0.73	0.72	0.71	0.71	0.63	0.76	0.73	0.34	0.78	0.69	0.27
LAS	0.55	0.81	0.66	0.65	0.60	0.60	0.50	0.39	0.53	0.50	0.56	0.49	0.57	0.57	0.65	0.14
EU	0.32	0.77	0.37	0.26	0.22	0.30	0.18	0.18	0.28	0.18	0.26	0.57	0.30	0.35	0.48	0.10
FSU	0.26	0.80	0.49	0.32	0.34	0.52	0.37	0.25	0.35	0.28	0.38	0.71	0.28	0.37	0.50	0.10
ROW	0.34	0.88	0.66	0.54	0.53	0.69	0.52	0.55	0.56	0.47	0.53	0.68	0.34	0.59	0.63	0.18

(Continued)

β	AGR	MNG	PDF	TXL	W&P	P&C	MTL	M&T	ELE	OME	OMF	EGW	CNS	T&T	OSP	OSG
ANZ	0.58	0.12	0.43	0.55	0.49	0.32	0.41	0.57	0.35	0.42	0.45	0.18	0.49	0.45	0.23	0.32
JPN	0.54	0.24	0.38	0.59	0.40	0.29	0.34	0.35	0.32	0.38	0.38	0.17	0.41	0.46	0.22	0.57
KOR	0.67	0.45	0.38	0.47	0.44	0.30	0.29	0.43	0.34	0.41	0.41	0.13	0.54	0.27	0.28	0.45
IND	0.62	0.27	0.31	0.39	0.36	0.35	0.34	0.36	0.36	0.37	0.38	0.20	0.38	0.41	0.34	0.17
MLY	0.47	0.05	0.19	0.46	0.42	0.16	0.35	0.26	0.21	0.27	0.27	0.14	0.56	0.28	0.17	0.34
PHL	0.63	0.23	0.28	0.48	0.37	0.26	0.19	0.39	0.30	0.37	0.38	0.12	0.48	0.30	0.14	0.32
SGP	0.74	0.04	0.32	0.59	0.40	0.14	0.37	0.41	0.31	0.37	0.37	0.12	0.40	0.30	0.27	0.45
THA	0.58	0.17	0.19	0.23	0.16	0.13	0.12	0.13	0.06	0.09	0.19	0.17	0.22	0.18	0.16	0.32
CHN	0.78	0.17	0.25	0.36	0.36	0.22	0.25	0.25	0.27	0.33	0.36	0.11	0.60	0.25	0.19	0.29
HGK	0.71	0.11	0.26	0.48	0.31	0.34	0.38	0.40	0.25	0.30	0.31	0.10	0.39	0.24	0.22	0.30
TWN	0.70	0.45	0.46	0.55	0.58	0.43	0.47	0.51	0.47	0.50	0.55	0.17	0.61	0.44	0.22	0.19
SAS	0.61	0.16	0.32	0.50	0.55	0.36	0.45	0.58	0.42	0.41	0.40	0.36	0.50	0.58	0.51	0.21
CAN	0.47	0.14	0.42	0.62	0.53	0.36	0.58	0.47	0.40	0.45	0.55	0.18	0.67	0.59	0.28	0.22
USA	0.43	0.17	0.32	0.53	0.42	0.27	0.54	0.45	0.32	0.36	0.44	0.22	0.50	0.58	0.17	0.49
MEX	0.58	0.06	0.15	0.25	0.18	0.21	0.24	0.23	0.22	0.29	0.21	0.18	0.55	0.18	0.17	0.29
LAS	0.44	0.16	0.29	0.30	0.34	0.33	0.43	0.50	0.39	0.41	0.38	0.36	0.36	0.37	0.18	0.39
EU	0.64	0.14	0.45	0.59	0.54	0.43	0.58	0.55	0.44	0.49	0.54	0.22	0.49	0.44	0.30	0.42
FSU	0.72	0.17	0.43	0.59	0.57	0.40	0.54	0.62	0.51	0.56	0.54	0.21	0.63	0.54	0.27	0.35
ROW	0.66	0.10	0.29	0.39	0.40	0.25	0.41	0.38	0.35	0.43	0.40	0.21	0.56	0.34	0.22	0.32

(Continued)

γ	AGR	MNG	PDF	TXL	W&P	P&C	MTL	M&T	ELE	OME	OMF	EGW	CNS	T&T	OSP	OSG
ANZ	0.03	0.04	0.14	0.19	0.16	0.20	0.15	0.19	0.20	0.26	0.15	0.10	0.16	0.17	0.21	0.58
JPN	0.01	0.17	0.18	0.16	0.26	0.17	0.20	0.23	0.20	0.23	0.20	0.12	0.30	0.29	0.15	0.33
KOR	0.00	0.08	0.12	0.09	0.16	0.12	0.08	0.13	0.13	0.15	0.09	0.02	0.11	0.07	0.15	0.40
IND	0.00	0.08	0.04	0.06	0.07	0.11	0.11	0.11	0.11	0.12	0.07	0.20	0.07	0.04	0.11	0.21
MLY	0.01	0.01	0.04	0.08	0.07	0.04	0.07	0.06	0.05	0.07	0.05	0.08	0.12	0.07	0.05	0.50
PHL	0.01	0.03	0.05	0.07	0.05	0.07	0.03	0.08	0.09	0.11	0.04	0.04	0.05	0.03	0.15	0.55
SGP	0.03	0.01	0.12	0.16	0.17	0.07	0.13	0.17	0.16	0.19	0.13	0.08	0.16	0.14	0.18	0.49
THA	0.00	0.03	0.04	0.04	0.02	0.03	0.02	0.03	0.01	0.02	0.03	0.08	0.04	0.04	0.11	0.50
CHN	0.01	0.02	0.05	0.06	0.06	0.04	0.05	0.04	0.06	0.07	0.06	0.06	0.11	0.06	0.12	0.45
HGK	0.04	0.03	0.13	0.18	0.21	0.22	0.17	0.32	0.20	0.24	0.19	0.09	0.14	0.18	0.18	0.64
TWN	0.02	0.13	0.17	0.14	0.15	0.14	0.12	0.19	0.22	0.24	0.15	0.11	0.17	0.22	0.12	0.66
SAS	0.00	0.02	0.06	0.08	0.09	0.07	0.07	0.11	0.09	0.09	0.05	0.18	0.09	0.12	0.05	0.33
CAN	0.04	0.05	0.09	0.10	0.17	0.19	0.13	0.20	0.23	0.26	0.13	0.06	0.16	0.14	0.17	0.39
USA	0.03	0.07	0.10	0.13	0.19	0.21	0.18	0.29	0.29	0.33	0.15	0.11	0.17	0.15	0.29	0.48
MEX	0.01	0.01	0.03	0.04	0.03	0.06	0.05	0.05	0.06	0.08	0.04	0.09	0.11	0.04	0.14	0.43
LAS	0.01	0.03	0.05	0.05	0.06	0.08	0.08	0.11	0.08	0.09	0.06	0.15	0.07	0.07	0.17	0.47
EU	0.04	0.08	0.18	0.16	0.24	0.27	0.24	0.26	0.28	0.33	0.20	0.20	0.20	0.22	0.22	0.47
FSU	0.01	0.02	0.07	0.09	0.09	0.08	0.09	0.13	0.14	0.16	0.08	0.09	0.10	0.09	0.23	0.55
ROW	0.01	0.02	0.06	0.06	0.07	0.06	0.08	0.08	0.09	0.10	0.07	0.11	0.10	0.07	0.15	0.49

Source: Authors' calculation from GTAP version 4.