A CGE Analysis of Japanese FTAs under Different Market Structures

Shiro Takeda*

Department of Economics, Kanto Gakuen University
200 Fujiakucho, Ota city, Gunma, 373–8515, Japan.

e-mail: <zbc08106@park.zero.ad.jp>

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Abstract

In this paper, we investigate the possible impacts from Japanese FTA policy under various market structures. For this, we employ a multi-region multi-sector static CGE model. The model includes 15 sectors and 15 regions. As the benchmark data, we use GTAP version 5 data. We consider four FTA scenarios (FTA with Korea, China, ASEAN, and Mexico) and seven market structures and examine how the assumptions on market structure alter the results from FTAs.

Our main findings are summarized as follow. First, the formation of FTA increases welfare of Japan in all scenarios and models. Second, the formation of FTA increases welfare of partner regions in most cases, but under some FTA scenarios and models, partner regions can suffer from FTA. Third, with respect to Japan, the perfect competition model generates the smallest welfare gains in most scenarios. Fourth, in contrast to Japan, the perfect competition model does not necessarily generate the small welfare change for partner regions. Finally, the effects of FTAs on the number of firms and firm scale are significantly different across models and FTA scenarios.

1 Introduction

As a result of the dramatic increase in the formation of FTA since 1990's, there are more than 150 FTAs in the world. As to Japan, the government formulated its first FTA with Singapore in 2002 and subsequently reached an agreement of FTA with Mexico in 2004. Moreover, the government seeks FTAs with other regions, mainly Asian countries.

There are already many empirical studies (CGE analyses) which try to investigate the effects of such FTA policies in Japan, for example, Hertel, Walmsley and Itakura (2001),

*Email: zbc08106@park.zero.ad.jp. For doing the simulation in the paper, the author have greatly benefited from programs in the Uruguay round model by Glenn W. Harrison, Thomas. F. Rutherford, David G. Tarr and from GTAPinGAMS package by Thomas. F. Rutherford and Selgey V. Paltsev. The author would like to express acknowledgement to them. All remaining errors are of course the author's. The computer programs for the simulation in this paper is available from the author upon request.

Tsutsumi and Kiyota (2002), Urata and Kiyota (2003), Oyamada (2003), and Kawasaki (2004). To evaluate the impacts from FTA, these studies take account of not only the reduction of tariffs but also other important policies associated with FTA such as international movement of labor and capital, technology transfer, streamlined customs procedure, and dynamic effects. Although they have clarified important aspect of FTA, all of them assume both constant returns to scale (CRTS) technology and perfect competition and exclude scale economies and imperfectly competitive behavior. Since scale economies and imperfectly competitive market structure are often observed in actual economies, it is likely that the analyses ignoring them overlook potential impacts from FTA. In fact, the previous studies intended to evaluate trade policies in North America and Europe report that the results generated from the model with scale economies and imperfectly competitive behavior can be significantly different from those of CRTS technology and perfect competition (see, for example, Baldwin and Venables, 1995).

The purpose of this paper is to investigate the possible impacts from Japanese FTA policy under scale economies and alternative market structures and to clarify how assumptions on market structures alter the effects of FTA. For this, we employ a multi-region multi-sector static CGE model. The model includes 15 sectors and 15 regions. As the benchmark data, we use GTAP version 5.4 data whose benchmark year is 1997. The FTA scenarios in the paper are (1) Japan–Korea, (2) Japan–China, (3) Japan–ASEAN, and (4) Japan–Mexico. In addition to a perfect competition model with CRTS technology, we consider six imperfectly competitive models with scale economies. These models include (i) the quantity competition model with differentiated varieties, (ii) the price competition model with differentiated varieties, (iii) the large group monopolistic competition model, (iv) the quantity competition model with homogeneous varieties, (v) the quantity competition model with fixed number of firms (i.e. no entry–exit), and (vi) the quantity competition model with homogeneous varieties and fixed number of firms. Using these models, we compare the effects of four different FTAs and examine how the assumptions on market structure alter the results.

Our main findings are summarized as follow. First, the formation of FTA increases welfare of Japan in all scenarios and models. Second, the formation of FTA increases welfare of partner regions in most cases, but under some FTA scenarios and models, partner regions can suffer from FTA. Third, with respect to Japan, the perfect competition model generates the smallest welfare gains in most cases. Moreover, in imperfectly competitive models, the large group monopolistic competition model and the quantity competition model with differentiated variety usually bring about large welfare gains and the homogeneous variety models usually bring about small welfare gains. Fourth, in contrast to Japan, the perfect competition model does not necessarily generate the small welfare change for partner regions. Fifth, the order of welfare change by model for partner regions is rather different across FTA scenarios. Specifically, for Korea, China, and ASEAN, the large group monopolistic competition model and the perfect competition model generate relatively large welfare gains and the models with no entry–exit generates relatively small welfare gains. However, for Mexico, the homogeneous variety models produce relatively large gains and the large group monopolistic competition model and the perfect competition model produce relatively small gains. The final result is that the effects of FTAs on the number of firms and firm scale are significantly different across models and therefore the effects on sectoral outputs also can vary across models.

2 Model

The model is a 15 sector and 15 region static general equilibrium model. The lists of sectors and regions are displayed in Table 1 and 2. In imperfect competition models, sectors with asterisk in Table 1 are assumed to have scale economies.

Below, we first explain the model with perfect competition and CRTS technology. Notations are defined as follows:

- i, j $\cdots$ Index of sectors and goods.
- r, s $\cdots$ Index of regions.

2.1 Perfect competition model

For the perfect competition model, we basically use the standard static GTAP model.[1] However, our model differs from the standard GTAP model in several aspects. The main differences are summarized as follows: (i) While the original GTAP model assumes the CDE

[1]For the detail of the standard GTAP model, see Hertel (1997).

Table 1: Sectors and goods (15 sectors)

Symbol	Description	The original GTAP sections
AGR	Agriculture, forestry, and fishery	PDR, WHT, GRO, V_F, OSD, C_B, PFB, OCR, CTL, OAP, RMK, WOL, FRS, FSH.
MIN	Minings*	COL, OIL, GAS, OMN.
FOO	Foods*	CMT, OMT, VOL, MIL, PCR, SGR, OFD, B_T.
TEX	Textile products	TEX, WAP, LEA.
PPP	Pulp, paper and wooden products*	LUM, PPP.
CHM	Chemical and petroleum refinery products*	P_C, CRP.
IAM	Iron and metal*	I_S, NFM, NFM, FMP.
MVT	Motor vehicles and transport equipment*	MVH, OTN
ELE	Electronic equipment*	ELE.
OME	Machinery and equipment nec*	OME
OMF	Manufactures nec*	NMM, OMF
EGW	Electricity, gas manufacture, and water	ELY, GDT, WTR.
CNS	Construction	CNS
TAT	Trade and transport	TRD, OTP, WTP, ATP.
OSP	Other services	CMN, OFI, ISR, OBS, ROS, OSG, DWE.

∗ indicates sectors which are assumed to be imperfectly competitive in imperfectly competitive models.

Table 2: Regions (15 regions)

Symbol	Description	The original GTAP regions
JPN	Japan	JPN
KOR	Korea	KOR
CHN	China	CHN
ASE	ASEAN 5 regions (Indonesia, Malaysia, Philippines, Singapore, and Thailand)	IDN, MYS, PHL, SGP, THA
MEX	Mexico	MEX
HKG	Hong Kong	HKG
TWN	Taiwan	TWN
SAS	Other Asian countries (Viet Nam, Sri Lanka, Rest of South Asia)	VNM, BGD, IND, LKA, XSA
ANZ	Oceania	AUS, NZL
CAN	Canada	CAN
USA	USA	USA
CSA	Central and Southern America	XCM, COL, PER, VEN, XAP, ARG, BRA, CHL, URY, XSM
EUR	European Union	AUT, BEL, DNK, FIN, FRA, DEU, GBR, GRC, IRL, ITA, LUX, NLD, PRT, ESP, SWE, CHE, XEF.
FSU	Former Soviet Union and Central European countries	ALB, BGR, HRV, CZE, HUN, MLT, POL, ROM, SVK, SVN, EST, LVA, LTU, RUS, XSU.
ROW	Rest of the world (Middle East, Africa, and the rest of the world)	CYP, TUR, XME, MAR, XNF, BWA, XSC, MWI, MOZ, TZA, ZMB, ZWE, XSF, UGA, XSS, XRW.

Structure of the model

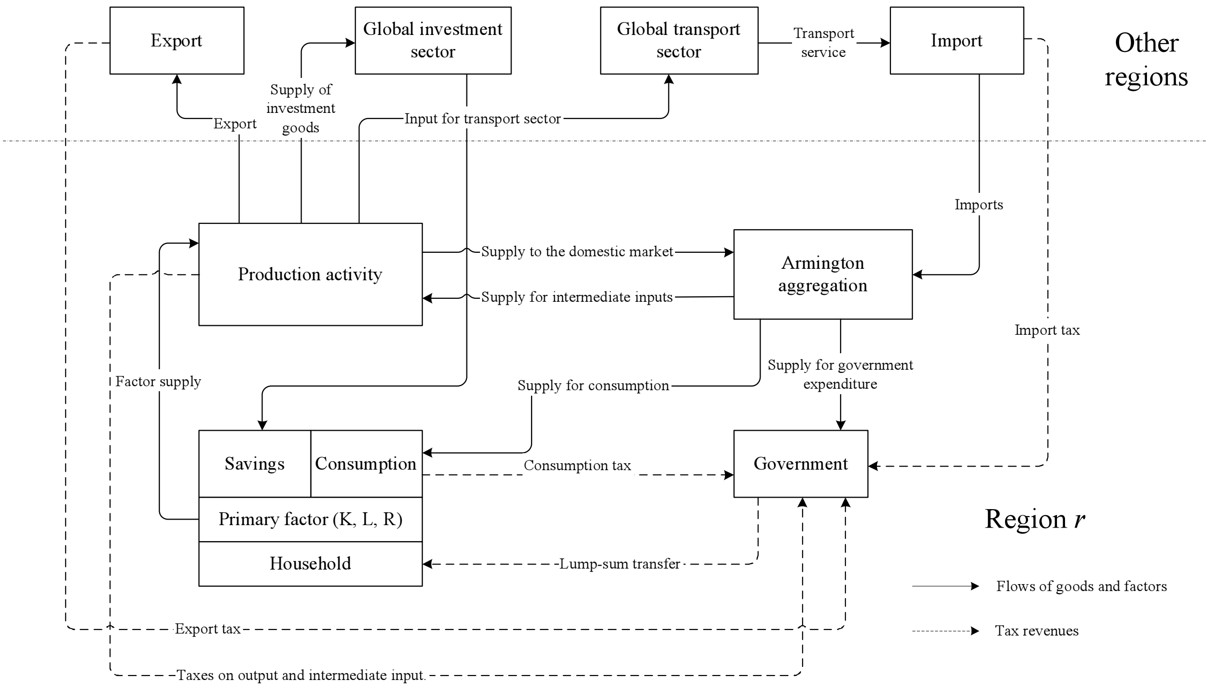

Figure 1: Model structure.

utility over consumption, we use Cobb-Douglas utility function. (ii) In the original GTAP model, Armington aggregation of domestic and imported goods is done separately according to their use (intermediate input, final consumption, and government expenditure). However, Armington aggregation of a goods in our model is done as a whole regardless of their use.

In the remainder of the section, we briefly explain the model structure. The flows of goods and factors in the model are displayed in Figure 1.

2.1.1 Production side

Using intermediate inputs and primary factors (capital, skilled labor, unskilled labor, and land), firms produce goods under constant returns to scale technology to maximize profits. All markets are assumed to be perfectly competitive and thus all producers are price takers. The production function is a nested CES function represented by Figure 2.

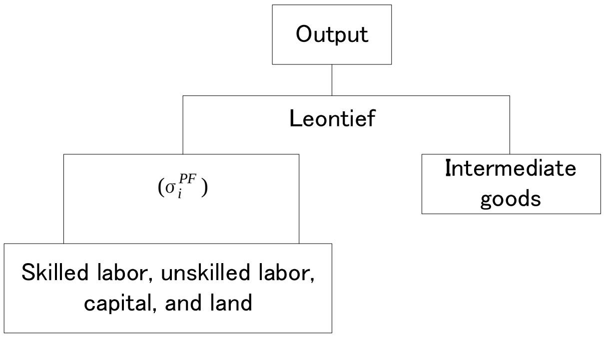

Figure 2: Production function

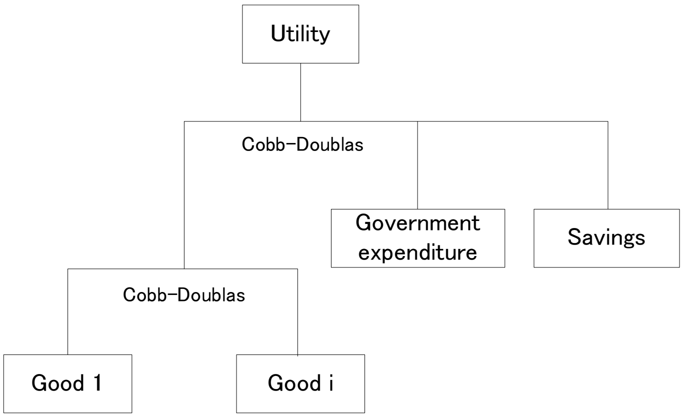

Figure 3: Utility function

2.1.2 Regional household

To represent the demand side, we assume a representative household for each region. Final consumption, savings and government expenditure is derived from the optimizing behavior of this household. The utility function for the household is a nested Cobb-Douglas function in Figure 3. The household is endowed with primary factors and earn factor income. He spend income to consumption, savings, and government expenditure.

2.1.3 International trade

Like other CGE analyses, we use the Armington assumption to explain cross-hauling in trade (Armington, 1969). The Armington assumption implies that domestically produced goods and imported goods are imperfect substitutes. Domestic goods and imported goods are aggregated through a CES function. Moreover, we assume that imports from different

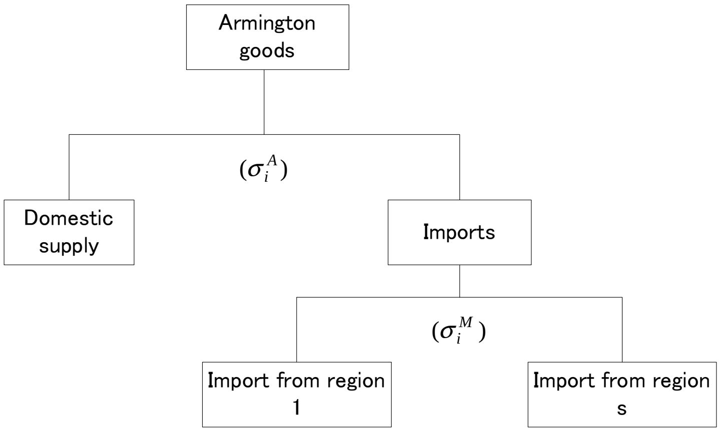

Figure 4: Armington aggregation in CRTS model

regions are imperfect substitutes. Imports from different regions are aggregated through a CES function, too.

2.2 Imperfect competition models

Next, we explain imperfect competition models. There are a lot of approaches to incorporate scale economies and imperfect competition into a CGE model. For example, the following researches employ imperfect competition model in CGE models: Harrison, Rutherford and Tarr (1996, 1997), Francois and Roland-Holst (1997) Grether and Müller (2000), Bchir, Decreux, Guérin and Jean (2002), and de Santis (2002). These studies use different models to incorporate imperfectly competitive behavior and there is no standard approach for modeling imperfect competition. One of our main purposes is to show how the results from Japanese FTA will change according to market structures. Thus, we employ the following six different models (see Table 3):

1. The quantity competition model with differentiated varieties and free entry–exit (QD).

2. The price competition model with differentiated varieties and free entry–exit (PD).

3. The large group monopolistic competition model (MC).

4. The quantity competition model with homogeneous varieties and free entry–exit (QH).

5. The quantity competition model with differentiated varieties and fixed number of firms

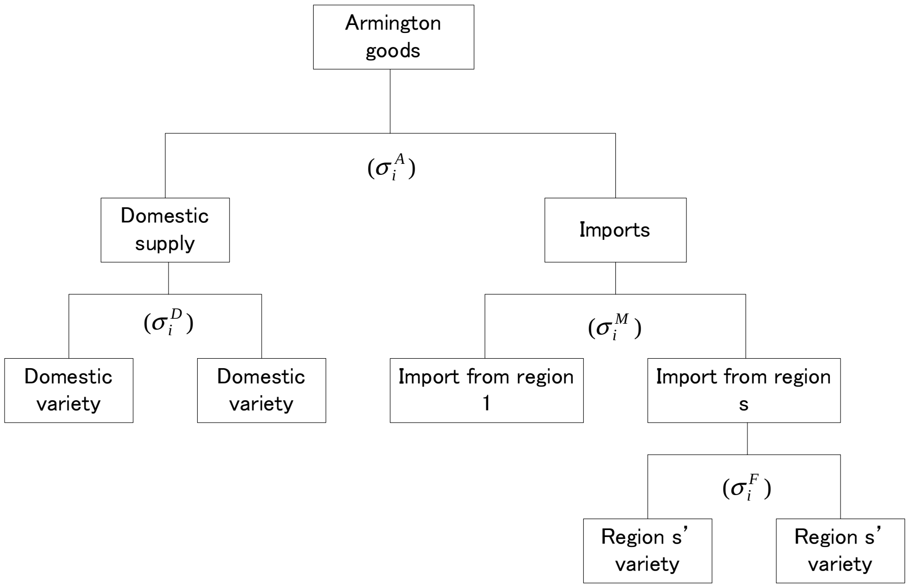

Figure 5: Armington aggregation in IRTS model

(QF).

6. The quantity competition model with homogeneous varieties and fixed number of firms (HF).

Table 3: Model type

Model name	Strategic variable	Variety	Entry and exit
QD	Output	Differentiated	○
PD	Price	Differentiated	○
MC	Output	Differentiated	○
QH	Output	Homogeneous	○
QF	Output	Differentiated	×
HF	Output	Homogeneous	×

2.2.1 Model QD

Below, we first explain model QD and afterward explain other variants. We assume that in model QD, scale economies work at firm level in sectors attached asterisk in Table 1.[2] Scale economies are introduced into the model through the existence of fixed cost. Let X denote

[2]Sector AGR, EGW CNS, TAT, and OSP are assumed to be perfectly competitive even in imperfect competition models.

the output of each firm. Then, total cost of the firm (TC) is given by

$$\mathrm{TC} = \mathrm{MC}(X + \mathrm{fc}) \tag{1}$$

where MC is marginal cost, and MC × fc is fixed cost. The form of MC × fc means that intermediate goods and primary factors for fixed cost are used in the same proportion as variable cost. The input structure (production function) is the same as the perfect competition model.

As to the output side, varieties of different firms in a sector are assumed to be differentiated. Since we assume that each variety is aggregated into a CES function, the Armington structure for model QD is modified to Figure 5. Since markets in different regions are assumed to be segmented, each firm determines the level of supply to different regions separately. Given the Armington structure of Figure 5, the firm determines the optimal supplies to different regions.

The profit of firm v of imperfectly competitive sector i in region r is given by

$$\pi_{vir} = (1 - t_{ir}^{Y}) \left[p_{vir}^{D} q_{vir}^{D} + \sum_{s} p_{virs}^{X} q_{virs}^{X} \right] - c_{vir}^{Y} \left[q_{vir}^{D} + \sum_{s} q_{virs}^{X} - \mathrm{fc}_{vir} \right] \tag{2}$$

where t_{ir}^{Y} is the output tax rate, q_{vir}^{D} is supply to the domestic market, q_{virs}^{X} is supply to region s, p_{vir}^{D} is the price in the domestic market, p_{virs}^{X} is the export price to region s, c_{vir}^{Y} is marginal cost, and fc_{vir} is fixed cost.

FOCs of profit maximization of firm v are

$$\frac{\partial \pi_{vir}}{\partial q_{vir}^{D}} = 0: \quad (1 - t_{ir}^{Y}) p_{vir}^{D} \left[1 - \mu_{vir}^{D} \right] = c_{vir}^{Y} \tag{3}$$

$$\frac{\partial \pi_{vir}}{\partial q_{virs}^{X}} = 0: \quad (1 - t_{ir}^{Y}) p_{virs}^{X} \left[1 - \mu_{virs}^{X} \right] = c_{vir}^{Y} \tag{4}$$

where μ_{vir}^{D} and μ_{virs}^{X} are markup rates for the domestic supply and export supply respectively. Let ε_{vir}^{D} and ε_{virs}^{X} denote perceived elasticities of demand in domestic and export markets. Then, we have $\mu_{vir}^{D} = 1/\varepsilon_{vir}^{D}$ and $\mu_{virs}^{X} = 1/\varepsilon_{virs}^{X}$.

Assuming that all firms (varieties) in an imperfectly competitive sector i are symmetric, markup rates are derived as follows:

$$\mu_{ir}^{D} = \frac{1}{\sigma_{ir}^{D}} + \frac{1}{n_{ir}} \left[\frac{1}{\sigma_{ir}^{A}} - \frac{1}{\sigma_{ir}^{D}} + S_{ir}^{\mathrm{AD}} \left(1 - \frac{1}{\sigma_{ir}^{A}} \right) \right] [1 + (n_{ir} - 1) \phi_{ir}^{D}] \tag{5}$$

$$\mu_{irs}^{X} = \frac{1}{\sigma_{is}^{F}} + \frac{1}{n_{ir}} \left\{ \frac{1}{\sigma_{is}^{M}} - \frac{1}{\sigma_{is}^{F}} + S_{irs}^{M} \left[\frac{1}{\sigma_{is}^{A}} - \frac{1}{\sigma_{is}^{M}} + S_{is}^{\mathrm{AM}} \left(1 - \frac{1}{\sigma_{is}^{A}} \right) \right] \right\} [1 + (n_{ir} - 1) \phi_{irs}^{X}] \tag{6}$$

where

- n_{ir} $\cdots$ The number of firms (varieties) of IRTS sector i in region r.
- S^{AD}_{ir} $\cdots$ Share of domestic good i in region i.
- S^{AM}_{ir} $\cdots$ Share of import good i in region i.
- S^{M}_{irs} $\cdots$ Share of import from region r in region s.
- ϕ^{D}_{ir} $\cdots$ Conjectural variation parameter of rival firms for domestic supply ($\equiv \partial \ln q^{D}_{v'ir} / \partial \ln q^{D}_{vir}$).
- ϕ^{X}_{irs} $\cdots$ Conjectural variation parameter of rival firms for export supply ($\equiv \partial \ln q^{X}_{v'irs} / \partial \ln q^{X}_{virs}$).

Note that index v is omitted because symmetry among firms in an industry is assumed.

In model QD, we assume free entry and exit. So, the number of firms n_{ir} is endogenously determined so that the zero profit condition is satisfied:

$$(1 - t^{Y}_{ir}) \left[p^{D}_{ir} q^{D}_{ir} + \sum_{s} p^{X}_{irs} q^{X}_{irs} \right] = c^{Y}_{ir} q^{T}_{ir} \tag{7}$$

where q^{T}_{ir} is defined as follows:

$$q^{T}_{ir} = q^{D}_{ir} + \sum_{s} q^{X}_{irs} + \mathrm{fc}_{ir}$$

Other components of the model is totally the same as the perfect competition model.

2.2.2 Model PD

Next, we explain the structure of model PD. The only difference between model PD and QD is the strategic variable of firms. That is, model PD assumes that the strategic variable of firms is price. Thus, the formulas of markup rates are modified as follows:

$$\begin{aligned} 1/\mu^{D}_{ir} &= \sigma^{D}_{ir} + \frac{1}{n_{ir}} \left[\sigma^{A}_{ir} - \sigma^{D}_{ir} + S^{\mathrm{AD}}_{ir} \left(1 - \sigma^{A}_{ir} \right) \right] \left[1 + (n_{ir} - 1) \psi^{D}_{ir} \right] \\ 1/\mu^{X}_{irs} &= \sigma^{F}_{is} + \frac{1}{n_{ir}} \left\{ \sigma^{M}_{is} - \sigma^{F}_{is} + S^{M}_{irs} \left[\sigma^{A}_{is} - \sigma^{M}_{is} + S^{\mathrm{AM}}_{is} \left(1 - \sigma^{A}_{is} \right) \right] \right\} \left[1 + (n_{ir} - 1) \psi^{X}_{irs} \right] \end{aligned}$$

where

- ψ^{D}_{ir} $\cdots$ Conjectural variation parameter of rival firms for domestic supply ($\equiv \partial \ln p^{D}_{v'ir} / \partial \ln p^{D}_{vir}$).
- ψ^{X}_{irs} $\cdots$ Conjectural variation parameter of rival firms for export supply ($\equiv \partial \ln p^{X}_{v'irs} / \partial \ln p^{X}_{virs}$).

2.2.3 Model MC

A large group monopolistic competition model is the same as model QD except that the number of firms is assumed to be sufficiently large. So, the markup formulas for model MC are derived by setting $n_{ir} \to \infty$ in (5) and (6):

$$\mu_{ir}^{D} = 1/\sigma_{ir}^{D} \qquad \mu_{irs}^{X} = 1/\sigma_{is}^{F}$$

This shows that markup rates in model MC are equal to the reciprocals of elasticities of substitution between varieties and thus exogenously constant.

2.2.4 Model QH

All models presented above assume that varieties (outputs) of firms in an industry are differentiated. On the other hand, model QH assumes that varieties of firms in an industry are homogeneous (perfect substitutes). This model is derived by setting σ_{ir}^{D} and $\sigma_{irs}^{F} \to \infty$ in model QD. Thus, markup rates for the homogeneous goods model are given by

$$\mu_{ir}^{D} = \frac{1}{n_{ir}} \left[\frac{1}{\sigma_{ir}^{A}} + S_{ir}^{\mathrm{AD}} \left(1 - \frac{1}{\sigma_{ir}^{A}} \right) \right] [1 + (n_{ir} - 1)\phi_{ir}^{D}]$$
$$\mu_{irs}^{X} = \frac{1}{n_{ir}} \left\{ \frac{1}{\sigma_{is}^{M}} + S_{irs}^{M} \left[\frac{1}{\sigma_{is}^{A}} - \frac{1}{\sigma_{is}^{M}} + S_{is}^{\mathrm{AM}} \left(1 - \frac{1}{\sigma_{is}^{A}} \right) \right] \right\} [1 + (n_{ir} - 1)\phi_{irs}^{X}]$$

2.2.5 Model QF

All models presented above allow free entry–exit and thus the number of firms is variable. In model QF, we assume that the number of firms n_{ir} is exogenously given constant. This means that zero profit condition is not satisfied at the counter-factual equilibrium.[3] Excess profit is assumed to be transferred to the representative household in a lump-sum fashion.[4]

2.2.6 Model HF

Model HF is the combination of model QH and OF. That is, model HF assumes that varieties of firms are homogeneous and the number of firms is fixed.

[3]However, we assume that zero profit condition is satisfied at the benchmark equilibrium for calibrating parameter.

[4]If profit is negative, loss is compensated by the household in a lump-sum fashion.

3 Policy scenarios

In the simulation, we consider Japan's FTAs with the following four regions: (S1) Korea (KOR), (S2) China (CHN), (S3) ASEAN 5 regions (ASE), and (S4) Mexico (MEX). Four regions which form FTA with Japan are called partner regions. In reality, FTA usually includes not only removal (or reduction) of trade taxes but also agreements on investment, labor movement, customs procedure, and rules of origin. However, FTA in this paper means only removal of trade taxes.

Table 4: FTA scenarios

Scenario name	Description
S1	FTA with Korea (KOR)
S2	FTA with China (CHN)
S3	FTA with ASEAN 5 regions (ASE)
S4	FTA with Mexico (MEX)

4 Data

For the benchmark data, we use GTAP version 5.4 data (the benchmark year is 1997).[5] Using GTAPinGAMS version 5.4 (Rutherford and Paltsev, 2001) by T. F. Rutherford and S. V. Paltsev, we transform GTAP data into the form which can be handled by GAMS and then aggregate them to 15 sector and 15 regions.[6]

4.1 Benchmark data

In this subsection, we overview the benchmark dataset and examine its characteristics.

4.1.1 Consumption, investment, trade, and GDP

First, Table 5 shows consumption, investment, import, GDP, and GDP share of all regions in 1997. JPN's GDP is the third largest in all regions and its share is 14.7%. On the other hand, FTA partner regions (KOR, CHN, ASE, and MEX) have relatively small shares (from 1.3% to 2.9% in world GDP). The fact that the scale of JPN is far larger than those of partner

[5] For GTAP, see the GTAP website <http://www.gtap.agecon.purdue.edu/>

[6] For GTAPinGAMS, see <http://debreu.colorado.edu/gtap5/index.html>. Note that our data are slightly different from the original GTAP data because GTAPinGAMS makes various adjustments to the original GTAP data.

regions suggests that partner regions are likely to be affected more strongly from FTA than JPN.

Table 5: The value of consumption (C), investment (I), import (M), and GDP by region in 1997 (US$ bil.)

	C	I	M	GDP	GDP(%)
JPN	2,521.2	1,222.8	418.2	4,245.3	14.7
KOR	236.1	155.0	158.4	444.5	1.5
CHN	411.0	310.0	215.1	851.8	2.9
ASE	359.6	213.5	402.7	629.7	2.2
MEX	262.4	78.7	101.8	388.0	1.3
HKG	103.2	61.1	94.1	139.6	0.5
TWN	171.4	59.5	111.3	299.0	1.0
SAS	372.1	128.1	88.0	550.8	1.9
ANZ	281.2	99.2	89.6	457.1	1.6
CAN	369.4	118.4	216.9	628.5	2.2
USA	5,484.3	1,398.3	1,022.8	7,931.7	27.4
CSA	1,099.1	321.2	259.0	1,582.9	5.5
EUR	5,093.1	1,574.3	2,498.0	8,349.2	28.9
FSU	580.4	196.7	300.5	904.5	3.1
ROW	974.2	311.1	432.0	1,514.5	5.2
World	18,318.6	6,247.9	6,408.6	28,917.2	100

4.1.2 Trade data

Table 6 reports the value of exports, imports, and net exports (exports less imports) by sector and region in 1997. From this table, we can see trade pattern of each region. First, let us examine JPN' trade. JPN's exports focus on a few sectors, in particular, OME, ELE, and MVT. On the other hand, imports are relatively dispersed. Net export position is highly positive for OME, MVT, and ELE, and highly negative for MIN, FOO, AGR, and TEX. This indicates that Japan has comparative advantages for OME, MVT, and ELE and comparative disadvantages for MIN, FOO, AGR, and TEX.

Korea (KOR) has similar export pattern to Japan although its scale is far less than Japan's. On the other hand, imports focuses on OME, MIN, IAM, ELE, and CHM. Net export position is high for ELE, TEX, and MVT and low for MIN and OME. As to China, his main export is TEX, ELE, OME, and OMF and his main import is OME, CHM, ELE, and TEX. Net export are negative for most goods but net export of TEX and OMF are substantially high. ASE's main export is ELE, CHM, and OME. In particular, the share of

Table 6: Trade data of FTA participants by sector and region in 1997 (US$ bil.)

	JPN			KOR			CHN		
	E	M	NE	E	M	NE	E	M	NE
AGR	0.5	21.4	−20.9	0.6	5.8	−5.2	6.2	6.2	−0.1
MIN	0.2	50.2	−50.0	0.1	21.6	−21.5	4.6	7.3	−2.7
FOO	2.8	31.7	−28.9	2.2	4.7	−2.5	7.7	8.3	−0.6
TEX	9.0	28.6	−19.6	19.4	7.0	12.4	68.7	23.7	45.0
PPP	3.4	19.1	−15.8	2.2	3.9	−1.7	5.9	8.3	−2.5
CHM	42.4	35.1	7.3	17.9	17.4	0.5	17.6	36.2	−18.6
IAM	29.1	21.1	8.0	12.8	18.8	−6.1	13.6	18.4	−4.8
MVT	92.6	17.7	74.8	18.0	6.2	11.8	4.7	8.2	−3.5
ELE	106.1	40.5	65.6	38.3	18.5	19.8	31.4	28.6	2.7
OME	127.2	37.5	89.7	17.0	26.7	−9.8	31.0	42.0	−10.9
OMF	14.4	15.1	−0.7	3.1	4.4	−1.3	27.6	5.6	22.0
EGW	0.1	0.7	−0.7	0.0	0.1	−0.1	0.3	0.0	0.2
CNS	6.7	6.9	−0.2				0.6	1.5	−1.0
TAT	49.1	51.8	−2.7	20.0	11.8	8.2	18.4	13.7	4.7
OSP	23.1	40.7	−17.6	10.9	11.6	−0.7	3.5	6.9	−3.4
Total	506.6	418.2	88.4	162.5	158.4	4.1	241.6	215.1	26.5

	ASE			MEX		
	E	M	NE	E	M	NE
AGR	6.6	9.5	−2.9	3.7	4.0	−0.4
MIN	16.5	17.6	−1.1	11.0	0.6	10.5
FOO	19.8	13.4	6.4	2.9	3.2	−0.3
TEX	25.7	12.2	13.4	8.2	5.2	2.9
PPP	16.3	7.3	9.0	3.5	4.1	−0.6
CHM	35.7	43.2	−7.4	5.8	14.6	−8.9
IAM	9.9	29.7	−19.8	5.9	7.5	−1.6
MVT	4.0	25.3	−21.3	17.0	10.5	6.5
ELE	139.3	99.3	40.0	16.9	16.1	0.9
OME	31.8	71.9	−40.2	25.1	22.1	3.0
OMF	10.4	10.9	−0.5	3.4	2.6	0.8
EGW	0.1	0.2	−0.1	0.0	0.1	−0.1
CNS	0.1	1.0	−0.9		0.0	0.0
TAT	42.0	21.9	20.1	8.1	4.0	4.1
OSP	40.1	39.2	0.9	3.4	7.0	−3.6
Total	398.3	402.7	−4.4	114.9	101.8	13.1

E is export, M is import, and NE is net export (= export - import).

export of ELE is about 35% in total export. On the other hand, ASE's main import is ELE, CHM, and OME. In particular, the share of ELE reaches 24.7%. The fact that both export and import of ELE are large means that the share of intra-industry trade is high in ASE's trade. Finally, MEX's net export is highly positive for MIN and MVT, and highly negative for CHM, IAM, and OSP. These data show that FTA participants have rather different trade structure.

4.1.3 Benchmark tariff rates

The effects of FTA can crucially depend on the benchmark trade restriction. So, we examine the benchmark trade restriction (tariff). Table 7 reports JPN's benchmark tariff rates imposed on FTA partner regions. The table shows that JPN's tariff rates are very high for FOO, AGR, and TEX. In particular, tariff rates for FOO exceed 40%. This means that domestic production of these three goods are highly protected at the benchmark equilibrium and thus the formation of FTA is likely to have strong impacts on these goods. On the other hand, tariff rates on other goods are below 5% and tariff rates for some goods (MVT, ELE, and service sectors) are zero.

Table 8 reports benchmark tariff rates that FTA partners impose on JPN. Generally speaking, partner regions impose higher tariff rates than JPN. In particular, CHN's average tariff rates for JPN is 15.4% which is two times higher than JPN's average tariff on CHN. As JPN does, partner regions impose relatively high tariffs on AGR, FOO, and TEX. But at the same time, they impose high tariffs on industrial products such as CHM, IAM, MVT, ELE, OME, and OMF. In particular, tariff rates on MVT are very high. Thus, the formation of FTA is likely to generate strong impacts on manufacturing industries in partner regions.

4.1.4 RCA index

Finally, let us examine the RCA (revealed comparative advantage index). RCA index is defined as follows:

$$\text{RCA}_{ir} \equiv \frac{E_{ir}/E_{Tr}}{E_i^W/E_T^W} \tag{8}$$

where E_{ir} is export of good i of region r, E_{Tr} is total export of region r, E_i^W is world export of good i, and E_T^W is total world export. If the RCA_{ir} index takes the value greater than

Table 7: Japan's benchmark tariff rates against FTA partners (%)

	KOR	CHN	ASE	MEX
AGR	13.7	33.4	16.5	29.7
MIN	0	−1.1	−0.5	− 1.5
FOO	41.8	43.7	49.5	50.5
TEX	11.3	12.3	9.9	13.7
PPP	1.4	2.9	5.6	0.6
CHM	3.0	3.0	1.9	3.0
IAM	2.3	1.4	0.7	0.0
MVT	0	0	0	0
ELE	0	0	0	0
OME	0	1.0	0.3	0
OMF	2.1	2.4	2.3	2.0
EGW	0	0	0	0
CNS	0	0	0	0
TAT	0	0	0	0
OSP	0	0	0	0
Average	6.1	8.8	5.8	5.5

Table 8: FTA partners' benchmark tariff rates against Japan (%)

	KOR	CHN	ASE	MEX
AGR	29.2	11.2	17.3	11.2
MIN	2.4	3.0	1.5	6.4
FOO	44.5	28.8	20.2	22.2
TEX	7.9	28.2	12.2	18.5
PPP	6.4	16.1	10.7	10.4
CHM	8.0	13.9	8.2	10.8
IAM	7.1	9.9	8.0	8.8
MVT	7.2	36.6	27.4	14.2
ELE	8.0	13.0	2.4	9.0
OME	8.0	14.0	4.7	10.0
OMF	7.0	18.8	6.6	14.3
EGW	0	0	0	0
CNS	0	0	0	0
TAT	0	0	0	0
OSP	0.3	0	0	0
Average	7.7	15.4	7.6	9.0

unity, the region has a comparative advantage in good i, and if the RCA_{ir} index takes the value smaller than unity, the region has a comparative disadvantage in good i.

Table 9 reports the RCA index of each region. The table shows that different regions have comparative advantages in different goods. However, all regions have comparative advantages in ELE. Moreover, regions except for JPN have comparative advantages in TEX.

Table 9: RCA (revealed comparative advantage) index

	JPN	KOR	CHN	ASE	MEX
AGR	0.03	0.13	0.89	0.58	1.11
MIN	0.01	0.01	0.37	0.79	1.84
FOO	0.12	0.30	0.70	1.08	0.55
TEX	0.28	1.87	4.45	1.01	1.12
PPP	0.18	0.36	0.65	1.08	0.81
CHM	0.77	1.02	0.67	0.83	0.46
IAM	0.89	1.22	0.87	0.39	0.79
MVT	1.92	1.17	0.20	0.11	1.56
ELE	1.91	2.15	1.18	3.19	1.34
OME	1.70	0.71	0.87	0.54	1.48
OMF	0.75	0.50	3.00	0.68	0.77
EGW	0.04	0.01	0.26	0.05	0.04
CNS	2.38		0.42	0.06	
TAT	0.88	1.11	0.69	0.95	0.64
OSP	0.52	0.76	0.16	1.14	0.34

5 Simulation

5.1 Values of parameters

Values of elasticity parameters are taken from GTAP dataset. Table 10 presents values of elasticity of substitution between primary factors and Table 11 presents values of elasticity of substitution between domestic and imported goods in Armington aggregation. Elasticity of substitution between imports from different regions (σ_i^M) is set to $\sigma_i^M = 2 \times \sigma_i^A$ as in the GTAP standard model. In addition to these parameters, imperfectly competition models have another important elasticity parameters, that is, elasticity of substitution between varieties (σ_i^D and σ_i^F). We assume that $\sigma_i^D = \sigma_i^F = 2 \times \sigma_i^M$.

Table 10: The values of elasticities of substitution between primary factors (σ_i^{PF})

Sectors	Value
AGR	0.231958
MIN	0.2
FOO	1.12
TEX, PPP, CHM, IAM, MVT, ELE, OME, OMF, EGW, OSP	1.26
CNS	1.4
TAT	1.68

Table 11: The values of elasticities of substitution between domestic and imported goods (σ_i^A)

Goods	Value
AGR	2.407048
MIN	2.8
FOO	2.387269
TEX	3.310660
PPP	2.131722
CHM, CNS, TAT, OSP	1.900000
IAM, ELE, OME, OMF, EGW	2.8
MVT	5.2

5.2 Calibration

Imperfect competition models include parameters and variables which do not appear in the perfect competition model, that is, markup rates, fixed cost, the number of firms, conjectural variation parameters, and elasticity of substitution between varieties. To conduct simulations, it is necessary to determine the benchmark values of these variables and parameters. If there is a standard method for determining them, we should follow it. However, different methods have been used by different researches and there is no standard method.[7] In this paper, we use the following approach:

1. As pointed out in Section 5.1, values of elasticity parameters are given exogenously.

2. Determine cost-disadvantage ratio (CDR) and the number of firms exogenously.[8]

3. Calibrate conjectural variation parameters and the benchmark values of markup rates

[7] For example, Smith and Venables (1988), Harrison et al. (1996, 1997), Francois and Roland-Holst (1997) Grether and Müller (2000), Bchir et al. (2002), and Santis (2002) employ different approaches to determine these parameters and variables.

[8] CDR is defined as $\mathrm{CDR} \equiv (\mathrm{AC} - \mathrm{MC})/\mathrm{MC}$.

so that FOCs for profit maximization and zero profit conditions are satisfied.

The detailed procedure is as follows. The cost function is given by (1). So, CDR is represented as follows:

$$\text{CDR} = \frac{\text{AC} - \text{MC}}{\text{MC}} = \frac{\text{FC}}{\text{TC}} \tag{9}$$

Since the benchmark value of total cost TC is given by the benchmark data, if we determine the value of CDR, we can determine the value of fixed cost from (9). In the calibration, we assume 0.015 (15%) as the value of CDR for all sectors and regions.

On the other hand, from FOCs for profit maximization (3)–(4) and zero profit conditions (7), the following relation is derived:

$$(1 - t_{ir}^Y) \left[p_{ir}^D q_{ir}^D \mu_{ir}^D + \sum_s p_{irs}^X q_{irs}^X \mu_{irs}^X \right] = c_{ir}^Y \text{fc}_{ir} \tag{10}$$

Given the benchmark number of firms, the benchmark markup rates (μ_{ir}^D and μ_{irs}^X) and conjectural variation parameters (ϕ_{ir}^D and ϕ_{irs}^X in the quantity competition models and ψ_{ir}^D and ψ_{irs}^X in the price competition model) are calibrated from (10) and markup formulas. The benchmark number of firms is assume to be 10 in all calibrations.

5.3 Computation

To solve the model, we use GAMS (General Algebraic Modeling System) and its solver PATH.[9] In creating GAMS programs for the simulation, we greatly benefited from GAMS programs in Uruguay round model by Harrison et al. (1996, 1997)[10] and programs in GTAPinGAMS by Rutherford and Paltsev (2001).

6 Results of the simulation

In this section, we examine the results from the simulation.

6.1 Welfare effects

First, let us examine the welfare effects of four FTA scenarios. Table 12 compares change in welfare (utility of a representative household) of different models resulted from scenario SC1

[9]For GAMS, see <http://www.gams.com/>

[10]For Uruguay round model, see <http://dmsweb.badm.sc.edu/Glenn/ur_pub.htm>.

(FTA with Korea). PC to HF indicate model name. PC is the perfect competition model and QD to HF are the imperfect competition models (see Table 3).

Let us summarize the results derived from Table 12. First, FTA participants (JPN and KOR) can improve their welfare by forming FTA in all models. Thus, the result that FTA brings about benefit for participants does not depend on model choice at least in SC1.

However, the table also shows that the size of welfare improvements does depend on which model is used for the simulation. For example, the following characteristics are observed from the table. First, with respect to JPN, the perfect competition model generates the smallest welfare gains in all models. Moreover, among imperfect competition models, model PD and QF generate relatively large gains and model HF and QH generate relatively small gains. This suggests that homogeneous goods models tend to produce less benefit than differentiated goods model.

On the other hand, the following results hold for KOR. First, KOR obtains larger gains from the formation of FTA than JPN. This is mainly because the size of KOR is far smaller than JPN. Second, in contrast to JPN, the welfare gains from model PC are not the smallest and model HF and QF generate smaller gains than model PC. This means that imperfect competition models with scale economies do not necessarily generate larger gains than a perfect competition model with CRTS technology. Moreover, the difference in welfare change among different models is quite large. Specifically, the rate of increase in welfare in the model with the largest gains (model MC) is about 1.86 times higher than that in the model with the smallest gains (model HF).

Finally, with respect to non-participating regions, they incur losses from FTA between JPN and KOR. Except for several cases, losses are the largest in model MC and the smallest in model PC or model HF.

Next, let us examine the results from SC2. Table 13 compares welfare changes resulted from scenario SC2 (FTA with China). The following results are obtained under SC2. First, as in SC1, JPN obtains gains in all models. On the other hand, CHN incurs losses in all models. Compared to SC1, gains for JPN become larger in SC2. This is mainly because JPN's trade with CHN is far larger than that with KOR and because benchmark tariff rates between JPN and CHN are relatively high.

Table 12: Percentage change in welfare from SC1 (FTA with Korea) (%)

	PC	QD	PD	MC	QH	QF	HF
JPN	0.062	0.068	0.070	0.069	0.065	0.070	0.065
KOR	0.332	0.342	0.377	0.416	0.340	0.322	0.224
CHN	−0.069	−0.067	−0.069	−0.071	−0.067	−0.067	−0.064
ASE	−0.061	−0.063	−0.066	−0.070	−0.057	−0.062	−0.058
MEX	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003	−0.004
HKG	−0.020	−0.026	−0.027	−0.027	−0.021	−0.022	−0.022
TWN	−0.039	−0.039	−0.041	−0.043	−0.037	−0.038	−0.035
SAS	−0.020	−0.020	−0.021	−0.021	−0.020	−0.020	−0.019
ANZ	−0.031	−0.035	−0.036	−0.037	−0.032	−0.034	−0.031
CAN	−0.006	−0.011	−0.012	−0.006	−0.011	−0.009	−0.010
USA	−0.011	−0.011	−0.012	−0.012	−0.011	−0.011	−0.011
CSA	−0.011	−0.011	−0.012	−0.012	−0.011	−0.011	−0.011
EUR	−0.008	−0.010	−0.010	−0.010	−0.008	−0.009	−0.008
FSU	−0.009	−0.012	−0.012	−0.012	−0.010	−0.012	−0.011
ROW	−0.017	−0.019	−0.020	−0.020	−0.018	−0.018	−0.017

With respect to the order of welfare change by model, it is slightly different from SC1, but the result that model PC generates the smallest welfare gains holds also in SC2. In imperfect competition models, model MC and QD generate relatively large gains and model HF and QH generate relatively small gains. As in SC1, welfare gains are small in homogeneous goods models.

Contrast to JPN, CHN's welfare decreases in all model. The rate of decrease in welfare is the largest under model HF (−0.388%) and it is far larger than the rate of decrease under model PC (in absolute value). This indicates that the size of welfare effects crucially depends on model choice. The effects on non-participating regions are almost the same as SC1. All non-participating regions faces welfare losses. Except for several cases, losses are the largest in model MC and the smallest in model PC or model HF.

Table 14 compares welfare changes resulted from scenario SC3 (FTA with ASEAN 5 regions). Under SC3, JPN's welfare increases in all models and ASE's welfare increases except for model HF. For JPN, The order of welfare change by model is slightly different both from SC1 and SC2. However, the result that model PC generates the smallest welfare gains remains the same. In imperfect competition models, model QD and MC generate relatively large gains and model PD and QH generate relatively small gains. On the other hand, ASE obtains the largest welfare gains from model MC and incurs loss from model HF.

Table 13: Percentage change in welfare from SC2 (FTA with China) (%)

	PC	QD	PD	MC	QH	QF	HF
JPN	0.291	0.333	0.327	0.346	0.309	0.319	0.292
KOR	−0.328	−0.350	−0.354	−0.373	−0.325	−0.342	−0.324
CHN	−0.046	−0.203	−0.114	−0.085	−0.067	−0.262	−0.388
ASE	−0.200	−0.213	−0.216	−0.235	−0.190	−0.198	−0.183
MEX	−0.008	−0.015	−0.013	−0.011	−0.018	−0.008	−0.012
HKG	−0.398	−0.405	−0.419	−0.445	−0.382	−0.440	−0.400
TWN	−0.447	−0.481	−0.480	−0.511	−0.439	−0.448	−0.416
SAS	−0.087	−0.094	−0.095	−0.101	−0.089	−0.088	−0.086
ANZ	−0.069	−0.068	−0.069	−0.071	−0.068	−0.068	−0.064
CAN	−0.015	−0.028	−0.030	−0.014	−0.033	−0.020	−0.025
USA	−0.028	−0.029	−0.030	−0.030	−0.030	−0.028	−0.028
CSA	−0.029	−0.029	−0.030	−0.030	−0.031	−0.028	−0.029
EUR	−0.024	−0.033	−0.033	−0.034	−0.028	−0.031	−0.030
FSU	−0.026	−0.033	−0.032	−0.034	−0.028	−0.035	−0.033
ROW	−0.018	−0.021	−0.021	−0.021	−0.020	−0.020	−0.019

As in SC1 and SC2, all non-participating regions experience welfare loss.

Table 14: Percentage change in welfare from SC3 (FTA with ASEAN regions) (%)

	PC	QD	PD	MC	QH	QF	HF
JPN	0.219	0.276	0.250	0.264	0.239	0.259	0.258
KOR	−0.176	−0.180	−0.179	−0.194	−0.175	−0.165	−0.159
CHN	−0.133	−0.124	−0.125	−0.134	−0.124	−0.116	−0.110
ASE	0.247	0.178	0.239	0.326	0.207	0.100	−0.077
MEX	0.000	−0.019	−0.012	−0.006	−0.021	−0.003	−0.009
HKG	−0.093	−0.108	−0.110	−0.110	−0.093	−0.088	−0.085
TWN	−0.155	−0.149	−0.153	−0.166	−0.144	−0.133	−0.123
SAS	−0.062	−0.063	−0.063	−0.065	−0.062	−0.061	−0.058
ANZ	−0.085	−0.100	−0.102	−0.107	−0.085	−0.093	−0.084
CAN	−0.017	−0.037	−0.034	−0.028	−0.036	−0.028	−0.029
USA	−0.037	−0.039	−0.038	−0.040	−0.038	−0.034	−0.033
CSA	−0.027	−0.030	−0.031	−0.032	−0.027	−0.026	−0.024
EUR	−0.031	−0.037	−0.035	−0.037	−0.033	−0.033	−0.032
FSU	−0.025	−0.029	−0.029	−0.030	−0.026	−0.028	−0.026
ROW	−0.045	−0.048	−0.048	−0.050	−0.042	−0.043	−0.040

Finally, Table 15 compares welfare changes resulted from scenario SC4 (FTA with Mexico). Under SC4, FTA participants obtain gains in all models as under SC1. JPN's welfare gains are the smallest in four scenarios. It is because MEX's scale is the smallest in four FTA partners and because JPN's trade with MEX is far smaller than that with other partners. Moreover, contrast to SC1–SC3, the model with the smallest welfare gains for JPN is not model PC but model QH. However, model PC's welfare gains are still small (the second smallest). In imperfect competition models, model QD, PD, and MC yield relatively large welfare gains.

With respect to ASE, the order of welfare change by model is quite different from those in SC1–SC3. Model PC and MC that produce large gains in SC1–SC3 produce small gains in SC4. Similarly, model HF that produce small gains in SC1–SC3 produce large gains in SC4. The rate of increase in welfare in the model with the largest gains is about 3.44 times higher than that in the model with the smallest gains. Finally, non-participating regions except for ROW and CAN experience welfare loss.

Table 15: Percentage change in welfare from SC4 (FTA with Mexico regions) (%)

	PC	QD	PD	MC	QH	QF	HF
JPN	0.023	0.025	0.025	0.027	0.020	0.023	0.023
KOR	−0.007	−0.009	−0.009	−0.008	−0.012	−0.010	−0.015
CHN	−0.007	−0.006	−0.006	−0.007	−0.006	−0.005	−0.005
ASE	−0.012	−0.011	−0.012	−0.011	−0.012	−0.012	−0.015
MEX	0.078	0.125	0.123	0.072	0.248	0.111	0.152
HKG	−0.005	−0.005	−0.005	−0.005	−0.001	−0.002	−0.001
TWN	−0.009	−0.009	−0.009	−0.009	−0.011	−0.009	−0.013
SAS	−0.003	−0.003	−0.003	−0.003	−0.002	−0.002	−0.002
ANZ	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004	−0.003
CAN	0.001	−0.001	−0.002	0.000	0.002	−0.001	−0.001
USA	−0.011	−0.012	−0.011	−0.011	−0.008	−0.013	−0.009
CSA	−0.002	−0.003	−0.003	−0.003	−0.003	−0.002	−0.002
EUR	−0.002	−0.002	−0.002	−0.002	−0.003	−0.003	−0.003
FSU	−0.001	−0.001	−0.001	−0.001	−0.001	−0.001	−0.001
ROW	0.000	−0.001	−0.001	0.000	0.000	0.000	0.000

6.1.1 Summary of welfare effects

Let us summarize the welfare effects of FTAs. Table 16 and 17 report the order of welfare change of Japan and its FTA partners by model. The results for JPN is summarized as follows. First, imperfect competition models generate larger welfare gains than perfect competition model in most cases. Second, in imperfect competition models, welfare gains of model MC, PD, and QD are relatively large, and welfare gains of model PC, HF, and QH are relatively small. These results suggest that model choice is likely to affect the magnitude of welfare effects of FTAs in a systematic way.

On the other hand, the following insights are obtained for partner regions. First, FTA partners obtain welfare gains in most cases. Only exceptions are scenario SC2 (CHN) and model HF in scenario SC3 (ASE). Second, scenario SC1–SC3 and SC4 bring about quite different effects on FTA partner. In SC1–SC3, model MC, PC, and PD tend to generate large welfare gains and model HF and QF tend to yield small gains (loss in some cases). On the other hand, in SC4, model QH and HF generate relatively high welfare gains and model MC and PC generate relatively small welfare gains. What is worth pointing out is that for partner regions, model PC does not necessarily bring about the smallest welfare gains.

Table 16: The order of welfare change of Japan by model

Scenario	
SC1	PD = QF > MC > QD > QH = HF > PC
SC2	MC > QD > PD > QF > QH > HF > PC
SC3	QD > MC > QF > HF > PD > QH > PC
SC4	MC > QD = PD > QF = HF = PC > QH

Table 17: The order of welfare change of FTA partners by model

Scenario	
SC1 (KOR)	MC > PD > QD > QH > PC > QF > HF
SC2 (CHN)	PC > QH > MC > PD > QD > QF > HF
SC3 (ASE)	MC > PC > PD > QH > QD > QF > HF
SC4 (MEX)	QH > HF > QD > PD > QF > PC > MC

6.2 The effects on GDP

Next, we see the effects of FTAs on GDP. Table 18–21 report percentage change in GDP in four FTA scenarios and Table 22 and 23 report the order of GDP change by model.

The following insights are obtained from these results. First, the order of GDP change by model for JPN is rather different from that of welfare change. In particular, model HF which generates small welfare change produces relatively large GDP change and model MC which generates large welfare change produces relatively small GDP change. However, the result that model PC produces small change remains the same. At to partner regions, the order of GDP change by model is similar to that of welfare change.

Table 18: Percentage change in GDP from SC1 (%)

	PC	QD	PD	MC	QH	QF	HF
JPN	0.044	0.042	0.045	0.044	0.046	0.052	0.049
KOR	0.055	0.159	0.178	0.211	0.085	0.056	−0.040
CHN	−0.033	−0.034	−0.034	−0.035	−0.034	−0.032	−0.030
ASE	−0.035	−0.040	−0.041	−0.044	−0.033	−0.037	−0.033
MEX	0.002	0.001	0.002	0.002	0.002	0.002	0.002
HKG	−0.016	−0.022	−0.023	−0.023	−0.018	−0.019	−0.019
TWN	−0.022	−0.023	−0.024	−0.025	−0.021	−0.021	−0.018
SAS	−0.006	−0.007	−0.007	−0.008	−0.007	−0.007	−0.006
ANZ	−0.017	−0.023	−0.023	−0.024	−0.018	−0.019	−0.017
CAN	0.000	−0.006	−0.007	−0.002	−0.005	−0.003	−0.003
USA	−0.005	−0.006	−0.006	−0.006	−0.005	−0.005	−0.005
CSA	−0.006	−0.007	−0.007	−0.007	−0.006	−0.006	−0.005
EUR	−0.003	−0.005	−0.005	−0.005	−0.004	−0.004	−0.003
FSU	−0.005	−0.008	−0.008	−0.008	−0.006	−0.007	−0.007
ROW	−0.010	−0.012	−0.013	−0.013	−0.011	−0.011	−0.010

Table 19: Percentage change in GDP from SC2 (%)

	PC	QD	PD	MC	QH	QF	HF
JPN	0.206	0.233	0.231	0.244	0.220	0.233	0.213
KOR	−0.191	−0.227	−0.225	−0.236	−0.197	−0.205	−0.190
CHN	−0.423	−0.412	−0.364	−0.333	−0.400	−0.608	−0.738
ASE	−0.108	−0.125	−0.127	−0.140	−0.102	−0.106	−0.094
MEX	0.013	0.007	0.008	0.009	0.008	0.015	0.014
HKG	−0.356	−0.360	−0.372	−0.393	−0.343	−0.394	−0.361
TWN	−0.247	−0.288	−0.282	−0.299	−0.249	−0.253	−0.227
SAS	−0.025	−0.033	−0.033	−0.037	−0.027	−0.026	−0.023
ANZ	−0.029	−0.033	−0.034	−0.035	−0.029	−0.027	−0.023
CAN	0.004	−0.006	−0.009	0.004	−0.009	0.002	0.000
USA	−0.009	−0.010	−0.010	−0.011	−0.010	−0.007	−0.006
CSA	−0.010	−0.011	−0.011	−0.011	−0.011	−0.008	−0.008
EUR	−0.006	−0.013	−0.014	−0.014	−0.009	−0.011	−0.010
FSU	−0.011	−0.016	−0.016	−0.017	−0.011	−0.017	−0.016
ROW	−0.001	−0.004	−0.004	−0.004	−0.002	−0.002	−0.001

Table 20: Percentage change in GDP from SC3 (%)

	PC	QD	PD	MC	QH	QF	HF
JPN	0.157	0.182	0.166	0.171	0.175	0.211	0.217
KOR	−0.104	−0.106	−0.105	−0.114	−0.106	−0.101	−0.097
CHN	−0.075	−0.067	−0.068	−0.073	−0.070	−0.064	−0.059
ASE	−0.092	−0.030	0.011	0.106	−0.110	−0.221	−0.384
MEX	0.009	−0.001	0.003	0.006	−0.003	0.007	0.003
HKG	−0.089	−0.102	−0.104	−0.103	−0.090	−0.085	−0.083
TWN	−0.097	−0.097	−0.100	−0.110	−0.091	−0.082	−0.074
SAS	−0.047	−0.039	−0.039	−0.039	−0.045	−0.046	−0.044
ANZ	−0.054	−0.069	−0.070	−0.073	−0.056	−0.062	−0.055
CAN	−0.006	−0.018	−0.018	−0.013	−0.020	−0.016	−0.017
USA	−0.020	−0.021	−0.020	−0.021	−0.021	−0.018	−0.017
CSA	−0.015	−0.016	−0.016	−0.017	−0.015	−0.015	−0.013
EUR	−0.018	−0.020	−0.019	−0.020	−0.020	−0.021	−0.020
FSU	−0.014	−0.018	−0.018	−0.018	−0.015	−0.018	−0.016
ROW	−0.033	−0.033	−0.033	−0.034	−0.031	−0.032	−0.031

Table 21: Percentage change in GDP from SC4 (%)

	PC	QD	PD	MC	QH	QF	HF
JPN	0.015	0.015	0.014	0.015	0.014	0.018	0.018
KOR	−0.002	−0.004	−0.004	−0.003	−0.007	−0.005	−0.010
CHN	−0.002	−0.001	−0.001	−0.002	−0.001	0.000	−0.001
ASE	−0.006	−0.006	−0.006	−0.006	−0.007	−0.006	−0.010
MEX	−0.012	0.033	0.033	0.004	0.095	−0.010	0.003
HKG	−0.004	−0.004	−0.004	−0.004	−0.001	−0.002	−0.001
TWN	−0.004	−0.004	−0.005	−0.004	−0.006	−0.005	−0.009
SAS	0.000	0.000	0.000	−0.001	0.000	0.000	0.000
ANZ	−0.002	−0.002	−0.002	−0.002	−0.002	−0.001	−0.001
CAN	0.002	0.000	0.000	0.002	0.002	0.000	−0.001
USA	−0.006	−0.007	−0.007	−0.006	−0.005	−0.009	−0.007
CSA	−0.001	−0.002	−0.002	−0.001	−0.002	−0.002	−0.002
EUR	−0.001	−0.001	−0.001	−0.001	−0.002	−0.002	−0.002
FSU	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ROW	0.001	0.000	0.000	0.000	0.000	0.001	0.000

Table 22: Percentage change in Japan's GDP (%)

Scenario	
SC1	QF > HF > QH > PD > MC = PC > QD
SC2	MC > QF = QD > PD > QH > HF > PC
SC3	HF > QF > QD > QH > MC > PD > PC
SC4	HF = QF > QD = MC = PC > PD = QH

Table 23: Percentage change in FTA partner's GDP (%)

Scenario	
SC1 (KOR)	MC > PD > QD > QH > QF > PC > HF
SC2 (CHN)	MC > PD > QH > QD > PC > QF > HF
SC3 (ASE)	MC > PD > QD > PC > QH > QF > HF
SC4 (MEX)	QH > QD = PD > MC > HF > QF > PC

6.3 Comparison among different models

In this subsection, we further investigate the results from different models by examining various variables. The variables we check are volume of trade, terms of trade, firm scale, the number of firms, and sectoral outputs.

6.4 Volume of trade

Table 24 and 25 report percentage change in total export and import.

With respect to export, we can see that for JPN, model MC generates large increase in export and model QH and HF generate small increase under all FTA scenarios. The similar argument can be applied to partner regions. That is, for partner regions, model MC generates large increase in export and model QH generates small increase. This result indicates that the effect of FTAs on the volume of export is likely to be large under model MC and small under model QH and HF. The similar argument holds also for the volume of import. However, one exception is scenario SC4. In scenario SC4, the model with the largest increase in import is model HF and the model with the smallest increase in import is model MC.

Table 24: Percentage change in total export (%)

		PC	QD	PD	MC	QH	QF	HF
JPN	SC1	0.92	0.89	0.90	0.92	0.85	0.90	0.86
	SC2	3.56	3.37	3.37	3.60	3.15	3.35	3.14
	SC3	2.79	2.47	2.64	3.02	2.14	2.40	2.21
	SC4	0.24	0.21	0.23	0.24	0.20	0.22	0.22
Partner	SC1	3.98	4.01	4.06	4.16	3.76	3.75	3.54
	SC2	10.42	10.23	10.17	11.00	9.36	9.10	8.37
	SC3	2.92	2.70	2.70	3.13	2.37	2.36	2.09
	SC4	0.75	0.71	0.80	0.80	0.53	0.60	0.46

Table 25: Percentage change in total import (%)

		PC	QD	PD	MC	QH	QF	HF
JPN	SC1	1.49	1.52	1.54	1.54	1.45	1.47	1.44
	SC2	5.85	5.85	5.84	6.09	5.51	5.57	5.38
	SC3	4.53	4.69	4.73	5.00	4.13	4.12	3.91
	SC4	0.41	0.40	0.41	0.44	0.35	0.36	0.33
Partner	SC1	4.25	4.12	4.22	4.36	3.95	4.10	3.99
	SC2	12.01	11.35	11.40	12.47	10.53	11.19	10.67
	SC3	3.60	2.92	3.04	3.70	2.72	2.94	2.73
	SC4	1.29	1.52	1.57	1.26	1.84	1.64	1.89

Table 26: Percentage change in import

6.4.1 Terms of trade

Next, let us examine the change in terms of trade. Below, we only consider SC2 and SC3.

Table 27 reports percentage change in terms of trade under scenario SC2. The table shows that terms of trade for JPN improve in all model. On the other hand, terms of trade for CHN deteriorate in all models. This is one of the reasons why CHN incurs welfare loss from joining FTA. Terms of trade for non-participating regions deteriorate except for a few regions and models. Terms of trade of Mexico and Canada improve in some models even if they are non-participating regions.

Table 28 reports percentage change in terms of trade under scenario SC3. As under SC2, terms of trade for JPN improve in all model. On the other hand, ASE's terms of trade deteriorate in some models. Terms of trade for non-participating regions deteriorate except for MEX.

The above results show that the formation of FTA always improves terms of trade for JPN, but it does not necessarily improve terms of trade for partner regions.

6.4.2 Firm scale, the number of firms, and sectoral outputs

Finally, let us examine firm scale (output of a single firm), the number of firms, and sectoral outputs. Among these variables, firm scale and the number of firms have important welfare implication for imperfect competition models because their changes have the following impacts:

Table 27: Percentage change in terms of trade resulted from FTA with China

	PC	QD	PD	MC	QH	QF	HF
JPN	0.983	1.114	1.102	1.088	1.055	0.997	1.008
KOR	−0.389	−0.384	−0.401	−0.427	−0.368	−0.381	−0.381
CHN	−0.182	−0.517	−0.409	−0.267	−0.440	−0.189	−0.198
ASE	−0.181	−0.169	−0.181	−0.197	−0.155	−0.165	−0.157
MEX	0.029	0.014	0.022	0.035	−0.004	0.013	−0.003
HKG	−0.571	−0.577	−0.610	−0.656	−0.540	−0.562	−0.558
TWN	−0.688	−0.663	−0.694	−0.738	−0.637	−0.652	−0.635
SAS	−0.204	−0.190	−0.198	−0.211	−0.197	−0.203	−0.205
ANZ	−0.177	−0.162	−0.168	−0.173	−0.168	−0.178	−0.177
CAN	0.011	−0.009	−0.013	0.021	−0.024	−0.013	−0.023
USA	−0.112	−0.100	−0.103	−0.113	−0.104	−0.120	−0.124
CSA	−0.073	−0.068	−0.069	−0.070	−0.073	−0.078	−0.082
EUR	−0.021	−0.025	−0.026	−0.026	−0.024	−0.026	−0.028
FSU	−0.024	−0.022	−0.022	−0.023	−0.023	−0.025	−0.027
ROW	−0.019	−0.017	−0.016	−0.014	−0.022	−0.021	−0.023

Table 28: Percentage change in terms of trade resulted from FTA with ASEAN

	PC	QD	PD	MC	QH	QF	HF
JPN	0.741	1.059	0.981	0.858	0.949	0.860	0.874
KOR	−0.232	−0.223	−0.225	−0.240	−0.221	−0.217	−0.215
CHN	−0.226	−0.220	−0.222	−0.233	−0.213	−0.213	−0.211
ASE	0.280	−0.084	0.021	0.227	−0.003	0.091	0.070
MEX	0.034	−0.014	0.004	0.031	−0.033	0.006	−0.019
HKG	−0.123	−0.136	−0.140	−0.143	−0.122	−0.117	−0.115
TWN	−0.264	−0.244	−0.250	−0.272	−0.231	−0.234	−0.221
SAS	−0.148	−0.155	−0.160	−0.164	−0.154	−0.152	−0.156
ANZ	−0.219	−0.224	−0.238	−0.250	−0.210	−0.220	−0.218
CAN	−0.003	−0.035	−0.032	−0.012	−0.043	−0.031	−0.040
USA	−0.175	−0.167	−0.169	−0.184	−0.158	−0.162	−0.158
CSA	−0.072	−0.074	−0.080	−0.084	−0.066	−0.071	−0.071
EUR	−0.046	−0.050	−0.049	−0.051	−0.048	−0.046	−0.046
FSU	−0.030	−0.028	−0.029	−0.028	−0.030	−0.030	−0.031
ROW	−0.085	−0.092	−0.095	−0.098	−0.082	−0.077	−0.077

- Increase in the number of firms leads to increase in varieties, and thus it improves welfare.[11]

- Increase in firm scale leads to decrease in average cost, and thus it improves welfare.

Below, we examine how these variables moves in different models. As in previous subsection, we only consider SC2 and SC3.

First, see Table 29. This shows percentage change in firm scale, the number of firms, and sectoral outputs in JPN under SC2. The rates of increase in sectoral ouput of TEX, MVT, and OME are high in all models. In particular, output of TEX increases substantially. On the other hand, sectoral output decreases sharply in sector MIN, AGR, and FOO.

With respect to imperfectly competitive sectors, rates of change in sectoral output are not so different across models. However, factors for output change differ across models. Since model QF and HF assume the fixed number of firms, change in total ouput in these two models are attributable to change in firm scales. Thus, firm scale changes substantially in these models. On the other hand, model MC produces small change in firm scale but large change in the number of firms. So, in model MC, change in total ouput is attributable mostly to change in the number of firms. With respect to other models (model QD, PD, and QH), both firm scale and the number of firms change. Thus, change in total ouput in these models are caused by both factors.

Table 30 reports firm scale, the number of firms, and sectoral outputs in the partner region (CHN) under SC2. The rates of increase in total ouput are high for FOO, TEX, and AGR. In particular, output of FOO increases largely. On the other hand, total ouput decreases sharply in MVT, OME, and IAM. In particular, output of MVT decreases at more than 10%. Moreover, rates of change in sectoral output differ substantially across models. For example, rates of change in output of sector TEX, MVT, and ELE under some models are about two times higher. In addition to this, factors for output change differ across models as observed in JPN.

Next, we see change in firm scale, the number of firms, and sectoral outputs under SC3. Table 31 reports percentage change in these variables in JPN under SC3. The rates of increase

[11] In homogeneous goods models, this welfare effect does not exits.

in total ouput are high for MVT, IAM, and CHM. In particular, output of MVT increases largely. On the other hand, total ouput decrease sharply in MIN, FOO, and AGR. This shows that sectors which experience large increase in output are different from those under SC2 but sectors which experience large decrease in output are the same as SC2. As under SC2, rates of change in output of some sectors vary substantially across models and factors for output change differ across models.

Finally, Table 32 reports percentage change in three variables in ASE under SC3. The rates of increase in total ouput are high for FOO, AGR, and CNS. In particular, output of FOO increases largely (above 10%). On the other hand, total ouput decrease sharply in MVT, IAM, and CHM. In particular, the rate of decrease in output of MVT exceeds 20% in some models. With respect to sector MVT, the rate of decrease in output under model MC (-32.74%) is two times larger than that under model HF (-14.35%). This indicates that rates of change in output vary substantially across models also under scenario SC3.

7 Concluding remarks

In this paper, we try to examine the possible impacts from Japanese FTAs under various market structures. For this, we employ a multi-region multi-sector static CGE model with 15 sectors and 15 regions. As the benchmark data, we use GTAP version 5.4 data. The FTA scenarios are (1) Japan–Korea, (2) Japan–China, (3) Japan–ASEAN, and (4) Japan–Mexico. As market structures, we consider not only perfect competition but also six types of imperfect competition. Based on the above model, we compare the effects of four different FTAs and examine how the assumptions on market structure alter the results.

Our main findings are summarized as follow. First, in almost all scenarios, the formation of FTA increases welfare of Japan. This suggests that the formation of FTA is likely to be beneficial at least to Japan. Second, the formation of FTA increases welfare of partner regions in most cases, but under some FTA scenarios and models, partner regions can suffer from FTA. One of the reasons why partner regions face the decrease in welfare is that terms of trade for them deteriorate as a result of FTA.

Third, with respect to Japan, the perfect competition model generates the smallest welfare gains in most cases. Moreover, in imperfectly competitive models, the large group monopolistic competition model and the quantity competition model with differentiated variety usually bring about large welfare gains and the homogeneous variety models usually bring about small welfare gains. This means that welfare gains from FTA can vary substantially according to market structures although Japan benefits from FTA in all market structures.

Fourth, in contrast to Japan, the perfect competition model does not necessarily generate the small welfare change for partner regions. Fifth, the order of welfare change by model for partner regions is rather different across FTA scenarios. Specifically, for Korea, China, and ASEAN, the large group monopolistic competition model and the perfect competition model generate relatively large welfare gains and the models with no entry–exit generates relatively small welfare gains. However, for Mexico, the homogeneous variety models produce relatively large gains and the large group monopolistic competition model and the perfect competition model produce relatively small gains. This implies that the effects of FTA depend in a complicated way on which region is the participant and on which market structure is used to evaluate it, and therefore it is difficult to derive a simple and intuitive perspective for the effects of FTAs.

The final result is that the effects of FTAs on the number of firms and firm scale are significantly different across models and therefore the effects on sectoral outputs also can vary across models.

References

Armington, Paul S. (1969) "A Theory of Demand for Products Distinguished by Place of Production". IMF Staff Papers 16.

Baldwin, Richard E. and Anthony J. Venables (1995) "Regional Economic Integration", in Gene M. Grossman and Kenneth Rogoff eds. *Handbook of International Economics*, Vol. 3, Amsterdam: North-Holland, Chap. 31, pp. 1597–1645.

Bchir, Mohamed Hedi, Yvan Decreux, Jean-Louis Guérin, and Sébastien Jean (2002) "MIRAGE, a Computable General Equilibrium Model for Trade Policy Analysis", Dec. CEPII working paper, No 2002–17.

Francois, Joseph F. and David W. Roland-Holst (1997) "Scale Economies and Imperfect Competition", in Joseph F. Francois and Kenneth A. Reinert eds. *Applied Methods for Trade Policy Analysis: A Handbook*, New York: Cambridge University Press, Chap. 11, pp. 331–363.

Grether, Jean-Marie and Tobias Müller (2000) "Decomposing the Economic Costs and Benefits of Accession to the EU: the Swiss Case". Départment d'économétrie, Université de Genève, working paper, No. 2000.02.

Harrison, Glenn W., Thomas F. Rutherford, and David G. Tarr (1996) "Quantifying the Uruguay Round", in Will Martin and Alan L. Winters eds. *The Uruguay Round and the Developing Economies*, New York: Cambridge University Press, pp. 215–284.

——— (1997) "Quantifying the Uruguay Round", *Economic Journal*, Vol. 107, pp. 1405–1430, Sep.

Hertel, Thomas W., Terrie L. Walmsley, and Ken Itakura (2001) "Dynamic Effects of the New Age Free Trade Agreement between Japan and Singapore". GTAP working paper, (available at: `http://www.gtap.agecon.purdue.edu/`).

Hertel, Thomas W. ed. (1997) *Global Trade Analysis: Modeling and Applications*, New York: Cambridge University Press.

Kawasaki, Kenichi (2004) "The Impact of Free Trade Aggreement in Asia", Jun. mimeo.

Oyamada, Kazuhiko (2003) "Forward-Looking Effects of Trade Liberalization between Japan and ASEAN Members: In the Framework of Ramsey-Cass-Koopmans Type Economic Growth".

Rutherford, Thomas F. and Sergey V. Paltsev (2001) "The GTAPinGAMS package (version 5.3)".
(available at: `http://debreu.colorado.edu/gtap5/`).

de Santis, Roberto A. (2002) "A Conjectural Variation Computable General Equilibrium Model with Free Entry", in Amedeo Fossati and Wolfgang Wiegard eds. *Policy Evaluation with Computable General Equilibrium*, London: Routledge, Chap. 6, pp. 105–121.

Smith, M. Alasdair M. and Anthony J. Venables (1988) "Completing the Internal Market in the European Community", *European Economic Review*, Vol. 32, pp. 1501–1525.

Tsutsumi, Masahiko and Kozo Kiyota (2002) "The Effect of Free Trade Agreement in Japan: A CGE Analysis", 2. JCER Discussion Paper No.74 (in Japanese).

Urata, Shujiro and Kozo Kiyota (2003) "The Impacts of East Asia FTA on Foreign Trade in East Asia", Aug.

Table 29: Percentage change in firm scale, the number of firms, and sectoral output in JPN under SC2 (%)

	PC	QD			PD			MC			QH			QF			HF		
	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO
AGR	-1.89			-1.96			-1.95			-1.97			-1.89			-1.80			-1.76
MIN	-2.00	-0.36	-2.25	-2.61	-0.14	-2.39	-2.53	0.00	-2.65	-2.65	-0.11	-1.90	-2.01	-1.89	0	-1.89	-1.75	0	-1.75
FOO	-0.89	-0.23	-0.75	-0.98	-0.01	-0.94	-0.95	-0.02	-0.95	-0.97	0.14	-0.99	-0.85	-0.80	0	-0.80	-0.71	0	-0.71
TEX	6.48	5.37	1.95	7.42	2.33	4.88	7.32	-0.88	8.51	7.56	7.93	-0.66	7.22	6.91	0	6.91	7.46	0	7.46
PPP	-0.04	-0.01	-0.06	-0.07	-0.01	-0.05	-0.06	-0.03	-0.05	-0.08	0.12	-0.15	-0.03	-0.02	0	-0.02	0.01	0	0.01
CHM	0.45	0.15	0.27	0.42	-0.01	0.43	0.42	-0.07	0.47	0.40	0.35	0.12	0.46	0.42	0	0.42	0.47	0	0.47
IAM	0.38	0.22	0.15	0.37	0.06	0.29	0.35	-0.03	0.33	0.30	0.36	0.07	0.43	0.39	0	0.39	0.44	0	0.44
MVT	1.15	0.73	0.88	1.61	0.00	1.22	1.22	-0.18	1.62	1.43	0.74	0.52	1.27	0.93	0	0.93	0.89	0	0.89
ELE	-0.16	-0.24	-0.11	-0.35	-0.15	-0.18	-0.33	-0.08	-0.34	-0.42	-0.32	0.08	-0.24	-0.18	0	-0.18	-0.24	0	-0.24
OME	0.66	0.48	0.24	0.73	0.05	0.67	0.72	-0.23	0.85	0.62	0.94	-0.11	0.83	0.81	0	0.81	0.90	0	0.90
OMF	0.13	0.14	-0.04	0.10	0.04	0.06	0.10	-0.08	0.14	0.07	0.36	-0.19	0.17	0.18	0	0.18	0.23	0	0.23
EGW	0.07			0.07			0.07			0.07			0.07			0.06			0.07
CNS	0.14			0.18			0.17			0.17			0.16			0.13			0.13
TAT	-0.14			-0.15			-0.15			-0.15			-0.14			-0.13			-0.14
OSP	-0.13			-0.12			-0.13			-0.13			-0.12			-0.11			-0.13

SO is sectoral output, Scale is firm scale, and N is the number of firms.

Table 30: Percentage change in firm scale, the number of firms, and sectoral output in CHN under SC2 (%)

	PC	QD			PD			MC			QH			QF			QHF		
	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO
AGR	1.69			1.82			1.81			1.85			1.67			1.33			1.28
MIN	-1.79	-0.73	-1.15	-1.87	-0.18	-1.73	-1.91	0.04	-1.99	-1.95	-0.73	-1.12	-1.84	-1.67	0	-1.67	-1.76	0	-1.76
FOO	6.38	3.63	3.39	7.14	1.14	5.60	6.81	-0.39	7.15	6.73	5.84	1.14	7.04	6.12	0	6.12	6.34	0	6.34
TEX	2.61	2.67	2.16	4.89	0.77	3.53	4.33	-0.45	5.21	4.74	3.59	-0.36	3.22	2.20	0	2.20	2.32	0	2.32
PPP	-0.56	-0.18	-0.40	-0.57	-0.05	-0.57	-0.62	-0.02	-0.59	-0.61	0.00	-0.58	-0.59	-0.75	0	-0.75	-0.82	0	-0.82
CHM	-1.37	-0.50	-0.87	-1.37	-0.12	-1.26	-1.38	-0.01	-1.37	-1.38	-0.31	-1.09	-1.39	-1.43	0	-1.43	-1.46	0	-1.46
IAM	-3.03	-1.18	-2.47	-3.63	-0.21	-3.34	-3.54	-0.02	-3.71	-3.72	-0.69	-2.39	-3.07	-2.44	0	-2.44	-2.36	0	-2.36
MVT	-17.54	-0.73	-17.80	-18.40	4.66	-20.74	-17.05	-0.11	-20.49	-20.58	2.53	-16.95	-14.85	-12.55	0	-12.55	-11.40	0	-11.40
ELE	0.93	1.60	-1.14	0.44	0.70	-0.04	0.66	-0.35	1.61	1.26	3.57	-2.38	1.11	0.62	0	0.62	0.85	0	0.85
OME	-2.89	-0.72	-2.95	-3.64	-0.06	-3.50	-3.57	-0.11	-3.57	-3.68	0.27	-3.15	-2.89	-2.65	0	-2.65	-2.50	0	-2.50
OMF	-0.50	-0.14	-0.55	-0.69	0.00	-0.70	-0.70	-0.01	-0.70	-0.71	0.05	-0.61	-0.56	-0.56	0	-0.56	-0.62	0	-0.62
EGW	-0.74			-0.81			-0.83			-0.88			-0.72			-0.61			-0.62
CNS	1.09			0.61			0.74			0.78			0.92			1.26			1.35
TAT	-0.29			-0.30			-0.31			-0.30			-0.33			-0.45			-0.54
OSP	-0.13			-0.27			-0.23			-0.23			-0.17			-0.37			-0.50

SO is sectoral output, Scale is firm scale, and N is the number of firms.

Table 31: Percentage change in firm scale, the number of firms, and sectoral output in JPN under SC3 (%)

	PC	QD			PD			MC			QH			QF			HF		
	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO
AGR	-1.30			-1.41			-1.40			-1.45			-1.26			-1.05			-0.96
MIN	-2.90	-0.57	-3.46	-4.01	-0.21	-3.55	-3.75	0.00	-3.89	-3.88	-0.17	-2.82	-2.99	-2.53	0	-2.53	-2.39	0	-2.39
FOO	-1.85	-0.57	-1.50	-2.06	-0.06	-1.95	-2.02	-0.01	-2.05	-2.07	-0.01	-1.76	-1.77	-1.65	0	-1.65	-1.46	0	-1.46
TEX	-0.32	0.16	-0.75	-0.59	0.20	-0.70	-0.51	-0.03	-0.57	-0.60	0.56	-0.79	-0.24	-0.01	0	-0.01	0.11	0	0.11
PPP	-0.43	-0.16	-0.30	-0.46	-0.03	-0.40	-0.43	-0.01	-0.46	-0.47	-0.06	-0.34	-0.39	-0.32	0	-0.32	-0.28	0	-0.28
CHM	0.42	0.16	0.24	0.40	0.04	0.38	0.42	-0.01	0.41	0.40	0.21	0.22	0.43	0.42	0	0.42	0.44	0	0.44
IAM	0.87	0.29	0.50	0.79	0.07	0.77	0.84	-0.02	0.85	0.83	0.27	0.50	0.77	0.72	0	0.72	0.67	0	0.67
MVT	5.87	1.63	5.64	7.37	-0.11	7.02	6.90	-0.13	8.09	7.95	0.91	4.53	5.48	4.21	0	4.21	3.95	0	3.95
ELE	-0.41	-0.35	-0.35	-0.70	-0.15	-0.48	-0.62	0.02	-0.77	-0.75	-0.38	-0.03	-0.41	-0.27	0	-0.27	-0.28	0	-0.28
OME	-0.38	-0.83	-0.08	-0.91	-0.32	-0.38	-0.70	0.03	-0.91	-0.88	-1.19	0.53	-0.66	-0.37	0	-0.37	-0.49	0	-0.49
OMF	0.02	0.02	-0.05	-0.03	0.01	-0.02	-0.02	-0.01	-0.05	-0.06	0.12	-0.05	0.07	0.11	0	0.11	0.14	0	0.14
EGW	0.12			0.13			0.13			0.15			0.11			0.10			0.09
CNS	0.10			0.19			0.15			0.14			0.16			0.10			0.10
TAT	-0.13			-0.15			-0.15			-0.16			-0.12			-0.08			-0.07
OSP	-0.11			-0.10			-0.10			-0.11			-0.09			-0.06			-0.06

SO is sectoral output, Scale is firm scale, and N is the number of firms.

Table 32: Percentage change in firm scale, the number of firms, and sectoral output in ASE under SC3 (%)

	PC	QD			PD			MC			QH			QF			HF		
	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO	Scale	N	SO
AGR	2.01			2.23			2.26			2.34			1.93			1.67			1.68
MIN	0.59	0.30	0.64	0.94	0.13	0.71	0.84	-0.45	1.49	1.03	0.70	-0.43	0.27	0.07	0	0.07	-0.03	0	-0.03
FOO	11.95	6.28	7.41	14.16	1.87	11.66	13.75	-0.52	14.43	13.83	9.85	2.91	13.04	11.91	0	11.91	12.28	0	12.28
TEX	-0.29	0.80	-1.04	-0.25	0.57	-0.92	-0.36	-0.03	-0.08	-0.10	1.52	-1.68	-0.19	-0.37	0	-0.37	-0.28	0	-0.28
PPP	-0.19	0.06	-0.20	-0.14	-0.04	-0.20	-0.24	-0.06	-0.12	-0.19	0.59	-0.82	-0.24	-0.30	0	-0.30	-0.32	0	-0.32
CHM	-2.33	-0.76	-1.96	-2.71	-0.20	-2.58	-2.78	0.02	-2.79	-2.77	-0.42	-1.98	-2.40	-2.28	0	-2.28	-2.25	0	-2.25
IAM	-3.72	-0.69	-4.20	-4.86	-0.13	-4.77	-4.90	-0.01	-4.97	-4.98	0.21	-3.78	-3.58	-3.23	0	-3.23	-2.94	0	-2.94
MVT	-26.41	2.10	-27.20	-25.68	5.44	-29.63	-25.81	-0.06	-32.70	-32.74	5.57	-22.95	-18.65	-16.36	0	-16.36	-14.35	0	-14.35
ELE	-0.51	0.17	-1.13	-0.96	0.18	-1.22	-1.04	0.00	-0.70	-0.70	0.37	-1.05	-0.68	-0.88	0	-0.88	-0.88	0	-0.88
OME	-0.65	0.51	-1.85	-1.35	0.29	-1.59	-1.30	-0.03	-0.89	-0.92	1.16	-1.85	-0.71	-0.78	0	-0.78	-0.71	0	-0.71
OMF	-0.93	-0.23	-0.98	-1.20	-0.03	-1.17	-1.20	0.01	-1.07	-1.06	-0.06	-1.09	-1.15	-1.18	0	-1.18	-1.24	0	-1.24
EGW	0.04			-0.03			-0.03			0.05			-0.01			-0.08			-0.12
CNS	1.86			1.34			1.47			1.66			1.54			1.76			1.74
TAT	-0.20			-0.32			-0.30			-0.20			-0.37			-0.42			-0.51
OSP	-0.66			-0.59			-0.60			-0.54			-0.74			-0.92			-1.06

SO is sectoral output, Scale is firm scale, and N is the number of firms.