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Simulation for Japan–Korea FTA and Its Economic Impacts on Agriculture: A CGE Approach

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This study aims at conducting a quantitative assessment of the potential economic effects of a Japan–Korea free trade agreement (FTA) on agriculture in both countries at the macroeconomic and microeconomic levels using a multi–region and multi–sector computable general equilibrium model. The GTAP model and GTAP database version 9 released in May 2015 are used for this study. There are three scenarios assumed for the Japan–Korea FTA: a 50% cut of tariffs on all imports between Japan and Korea, a 75% cut of tariffs and a 100% cut of tariffs. In addition, it is assumed that for each of the three scenarios total factor productivity (TFP) of Japan and Korea increases by 0.15%, as trade openness defined as a ratio of a sum of exports and imports to GDP rises by 1% as a result of the FTA and that labor supply increases by 0.8%, as real wage rises by 1%. Japan and Korea are predicted to get additional gains in terms of real GDP, welfare, exports and imports from the FTA. A higher degree of trade liberalization between Japan and Korea leads to bigger macroeconomic effects for both of them. However, its impact on their production and value–added by sector varies.

Key words: Japan–Korea FTA, GTAP model, Agriculture, Economic effects

INTRODUCTION

The 1st negotiation of the Japan–Korea free trade agreement (FTA) was held in Seoul on 22 December 2003. The Japan–Korea FTA negotiation has been suspended since its 6th round held in Tokyo on 1–3 November 2004. In addition, as many as 4 rounds of Working Level Consultations to consider and create a favorable environment for the resumption of the Japan–Korea FTA negotiations were held during 2008–2009, with additional 2 rounds of Director–General–Level Consultations in 2010–2011 and 3 rounds of Director–Level Consultations in 2012. However, no effective compromise to resume the Japan–Korea FTA has been made so far. After China and the United States, Japan is the 3rd largest trading partner of Korea, while Korea is the 3rd largest trading partner of Japan after the United States and China. Japan and Korea need each other to be able to be more competitive in the global market characterized by an intensifying trend of regionalism. Against this backdrop, this paper aims to conduct a quantitative assessment of the potential economic effects of a Japan–Korea FTA on agriculture of its partners at the macroeconomic and microeconomic levels using a multi–region and multi–sector computable general equilibrium (CGE) model. There are some previous studies on the potential economic effects of a Japan-Korea FTA done by the first author of this paper, such as Ko (2000, 2003, 2004, 2005). However, the previous studies used different CGE models and databases. Therefore, a comparison of the potential economic effects of a Japan-Korea FTA between the previous studies and this paper is abandoned in this paper.

MATERIALS AND METHODS

Model

In order to quantify the potential economic effects of a Japan–Korea FTA, a global, multi–region, multi–sector CGE model is used. There is no established definition of a CGE model. However, a CGE model can be defined as a system of non–linear simultaneous equations describing the constrained optimization of behaviors of economic agents such as producers, consumers, exporters, importers, savers, investors, the government, etc. (Ko, 1993). A CGE model is a combination of economic theory, programming and data based on general equilibrium theory, not a partial equilibrium theory. General equilibrium theory is rooted in *Tableau économique* of François Quesnay (1758) and *Eléments d'économie politique pure* of Leon Walras (1874) and deals with mathematical properties of the existence, stability and uniqueness of a solution to a simultaneous equation system developed by Paul Samuelson, Kenneth Arrow and Gérard Debreu. The earliest world CGE models were developed by Whalley (1985) and Deardorff and Stern (1990) to analyze the impact of the Tokyo Round of GATT negotiations.

The CGE model used in this study is an extended version of the standard static GTAP model (Hertel, 1997), which incorporates the interaction between trade liberalization and capital accumulation based on the classic growth theory (Baldwin, 1989 and Francois *et al*., 1996). According to the growth theory, an initial increase in income, as a result of trade liberalization, is to increase savings and investment. The induced savings and investment, thus larger capital stock, lead to larger production capacity and cause a further increase in income.

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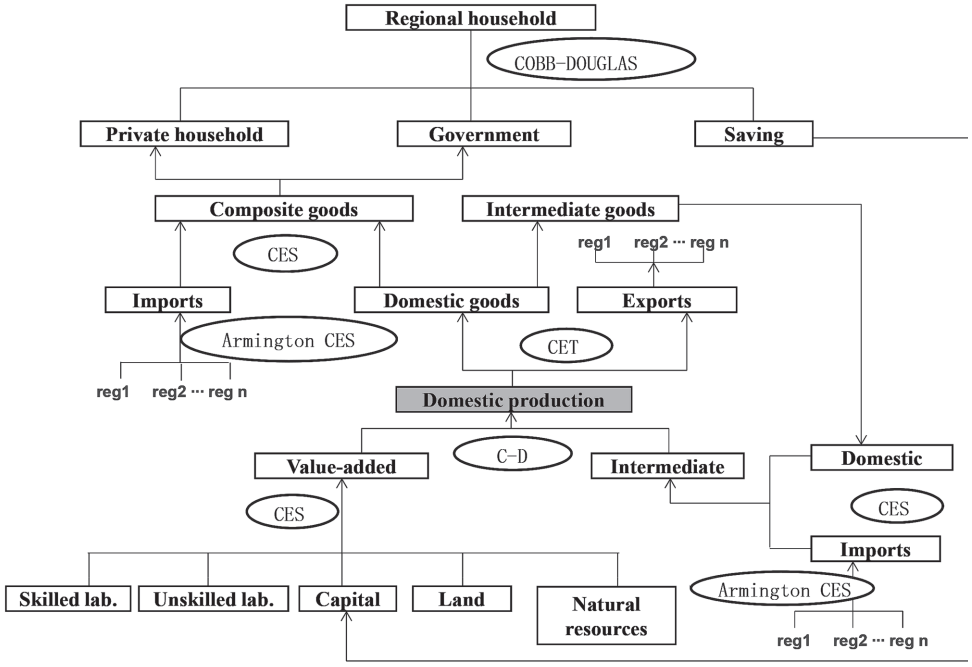

Fig. 1. Structure of the CGE model.

The static GTAP model are neoclassical in spirit and are part of a long tradition of models that have been widely used to analyze the impact of global trade liberalization and structural adjustment programs.

The CGE model has solid micro–foundations that are theoretically transparent. As seen in Fig. 1, each regional economy includes economic agents such as a representative household, producers, private household and the government. In each region, it is assumed that a single regional household collects income from primary factors of production as well as all kinds of taxes and financial assets and allocates them across private consumption, government expenditure, and savings according to a Cobb–Douglas utility function (Fig. 1).

Firms supply commodities to domestic and export markets via a Constant Elasticity of Transformation (CET) function, while production costs are minimized. Production structures are represented by nested production functions consisting of Leontief and Constant Elasticity of Substitution (CES) functions. The model includes intermediate inputs and five primary factors of production such as skilled labor, unskilled labor, capital, land, and natural resources. Skilled labor, unskilled labor, and capital are employed by all sectors. Land is used only in agricultural sectors and natural resources are used in forestry, fishing and mining sectors. It is assumed that intermediate inputs and capital are traded between regions, whereas skilled labor, unskilled labor, land and natural resources are not traded among regions.

Private consumption and public expenditure are represented via a Cobb–Douglas functional form. Product differentiation between domestic goods and imports, and imports by region of origin allows for intra–industry trade, that is, two–way trade in each product category, depending on the ease of substitution between products from different regions (Armington, 1969).

Within each region, the model solves for commodity and factor prices that equate demand and supply in all commodity and factor markets. The model also solves for world prices, equating demand for imports and supply of exports by sector across the world economy.

The model is of comparative statics in nature: given the pattern of world output and trade at one moment of time, it generates what the pattern of output and trade would be after the world economy adjusted to policy shocks to be caused by scenarios of Japan–Korea FTA. Thus, the effects of Japan–Korea FTA on its members and its trading partners to be quantified in this study are static ones.

Data

The GTAP database version 9 (Aguiar, Narayanan and McDougall, 2016) released in May 2015 is used. The GTAP database version 9 whose base year is 2011 includes 140 regions and 57 sectors for each of 140 regions. The dataset for Korea in the GTAP database was contributed by the first author of this paper (Ko, 2015).

For the purpose of this study, the 140 regions and the 57 sectors of the GTAP database version 9 are aggregated into 8 regions and 20 sectors, respectively. The 8 regions include Japan, Korea, China, ASEAN (Association of Southeast Asian Nations), USA (United States of America), EU28 (28 members of the European Union), Australia and New Zealand (A_N), and the rest of the world (ROW). China includes Hong Kong and the rest of the world is composed of 95 regions of the world. The 20 sectors included in the model is shown in Table 1. All manufacturing sectors and services are aggregated into one manufacturing sector and one services sector, respec-

Table 1. List of sectors in the model

Sector	Description	Sector	Description
1 Rice	Rice	11 Forestry	Forestry
2 Wheat	Wheat	12 Fishing	Fishing
3 RGrains	Other cereal grains	13 MeatPrd	Meat products
4 VegFrt	Vegetable and fruits	14 VegOils	Vegetable oils and fats
5 OilSeeds	Oil seeds	15 DairyPrd	Dairy products
6 PBFibers	Plant–based fibers	16 Sugar	Sugar cane, sugar beet and sugar
7 RCrops	Other crops	17 RFood	Other processed food
8 Animals	Animals	18 Mining	Mining
9 RawMkl	Raw milk	19 Manuf	Manufacturing sectors
10 WoolSWC	Wool and silk–worm cocoons	20 Services	Services

Source: GTAP database version 9

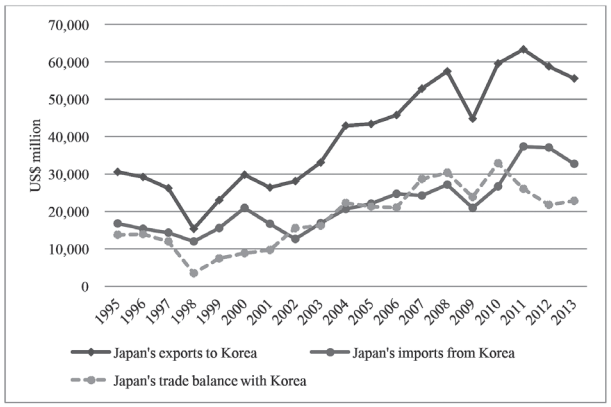

Fig. 2. Bilateral trade between Japan and Korea, 1995–2013.

tively.

Trade relations

As seen in Fig. 2, Japan has run trade surplus with Korea from 1995 to 2013. Except for the Asian financial crisis in 1997–1998 and the global financial crisis in 2008–2009, Japan's trade surplus has widened up to 2010 and decreased since then. In 2013, Japan exported goods and services worth $55.6 billion to Korea and imported goods and services worth $32.8 billion from Korea, with its trade surplus of $2.8 billion.

Table 2 shows the import value matrix at cost, insurance and freight (CIF) prices in terms of the value of imports at world prices by source (VIWS) in 2011, the base year of GTAP data base version 9.

The regions in the first row of Table 2 are importing countries. The last row of Table 2 shows the total imports of the importing regions. For example, Japan's total imports of goods and services amounted to $957 billion and Japan imported goods and services worth $44.7 billion from Korea in 2011, while Korea's total imports of goods and services amounted to $594.2 billion and Korea imported goods and services worth $71.1 billion from Japan. 4.7% of Japan's total imports of goods and services came from Korea, while 12% of Korea's total imports of goods and services came from Japan, seen in Table 3, which implies that Japan is more important to Korea as a source of imports than Korea is to Japan.

Table 4 shows the export value matrix at free–on–board (FOB) prices in terms of the value of exports at world prices by destination (VXWD) in 2011. The regions in the first column of Table 4 shows the exporting countries and the last column shows their total export values.

Table 2. Import value matrix at CIF prices in 2011 (US$ billion)

VIWS	*1 KOR*	2 CHN	3 ASEAN	4 USA	5 EU28	6 *JPN*	7 A_N	8 ROW
1 KOR	0.0	151.1	62.8	70.4	71.6	**44.7**	9.7	173.8
2 CHN	101.8	82.4	187.8	476.3	470.9	186.8	49.6	616.6
3 ASEAN	53.6	190.1	243.4	148.1	189.8	121.5	47.7	244.9
4 USA	64.7	153.6	98.4	0.0	490.3	120.6	41.9	942.3
5 EU28	67.1	261.0	143.2	522.4	4,056.8	111.7	64.3	1,539.7
6 JPN	**71.1**	208.4	122.3	146.5	123.8	0.0	22.1	208.3
7 A_N	29.2	94.9	31.6	22.4	32.7	56.3	18.7	70.1
8 ROW	206.6	692.2	276.2	1,290.5	1,676.6	315.5	47.6	1,716.6
Total	594.2	1,833.6	1,165.7	2,676.5	7,112.5	957.0	301.6	5,512.4

Source: Authors' calculation using GTAP DB version 9

Table 3. Shares of import value matrix at CIF prices in 2011 (%)

VIWS	*1 KOR*	2 CHN	3 ASEAN	4 USA	5 EU28	6 *JPN*	7 A_N	8 ROW
1 KOR	0.0	8.2	5.4	2.6	1.0	**4.7**	3.2	3.2
2 CHN	17.1	4.5	16.1	17.8	6.6	19.5	16.4	11.2
3 ASEAN	9.0	10.4	20.9	5.5	2.7	12.7	15.8	4.4
4 USA	10.9	8.4	8.4	0.0	6.9	12.6	13.9	17.1
5 EU28	11.3	14.2	12.3	19.5	57.0	11.7	21.3	27.9
6 JPN	**12.0**	11.4	10.5	5.5	1.7	0.0	7.3	3.8
7 A_N	4.9	5.2	2.7	0.8	0.5	5.9	6.2	1.3
8 ROW	34.8	37.8	23.7	48.2	23.6	33.0	15.8	31.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculation using GTAP DB version 9

Table 4. Export value matrix at FOB prices in 2011 (US$ billion)

VXWD	1 KOR	2 CHN	3 ASEAN	4 USA	5 EU28	6 JPN	7 A_N	8 ROW	Total
1 *KOR*	0.0	144.3	59.9	68.2	69.5	**42.8**	9.3	167.5	561.3
2 CHN	97.3	80.2	178.1	453.9	450.5	178.0	47.0	584.3	2,069.2
3 ASEAN	50.1	178.3	230.3	142.4	183.8	114.2	45.5	231.3	1,175.8
4 USA	62.4	144.4	94.8	0.0	484.5	116.2	40.5	897.1	1,840.0
5 EU28	65.4	252.6	140.0	510.9	3,987.8	109.0	62.3	1,490.5	6,618.5
6 *JPN*	**68.1**	200.7	117.5	142.5	120.3	0.0	21.2	201.2	871.6
7 A_N	25.9	84.9	29.7	21.7	31.6	49.7	17.8	64.3	325.7
8 ROW	196.1	643.3	264.3	1,233.3	1,614.0	294.9	45.9	1,623.5	5,915.1

Source: Authors' calculation using GTAP DB version 9

Table 5. Shares of export value matrix at FOB prices in 2011 (%)

VXWD	1 KOR	2 CHN	3 ASEAN	4 USA	5 EU28	6 JPN	7 A_N	8 ROW	Total
1 *KOR*	0.0	25.7	10.7	12.1	12.4	**7.6**	1.7	29.8	100.0
2 CHN	4.7	3.9	8.6	21.9	21.8	8.6	2.3	28.2	100.0
3 ASEAN	4.3	15.2	19.6	12.1	15.6	9.7	3.9	19.7	100.0
4 USA	3.4	7.8	5.2	0.0	26.3	6.3	2.2	48.8	100.0
5 EU28	1.0	3.8	2.1	7.7	60.3	1.6	0.9	22.5	100.0
6 *JPN*	**7.8**	23.0	13.5	16.4	13.8	0.0	2.4	23.1	100.0
7 A_N	8.0	26.1	9.1	6.7	9.7	15.3	5.5	19.8	100.0
8 ROW	3.3	10.9	4.5	20.8	27.3	5.0	0.8	27.4	100.0

Source: Authors' calculation using GTAP DB version 9

For example, Japan's total exports of goods and services amounted to $871.6 billion and Japan exported goods and services worth $68.1 billion to Korea, while Korea's total exports of goods and services amounted to $561.3 billion and Korea exported goods and services worth $42.8 billion to Japan. Table 5 shows that 7.8% of Japan's total exports went to Korea and 7.6% of Korea's total exports went to Japan, which implies that Japan and Korea are important to each other as their export destinations almost equally.

Table 6 displays bilateral imports by sector at market prices and ad valorem tariff rates between Japan and Korea in 2011. Of Japan's total imports of $45.3 billion from Korea, Japan spent $23.5 billion on manufactured goods (51.9%), $13.4 billion on mining (29.6%) and $6.4 billion on services (14.3%) imported from Korea. All agricultural products and processed food that Japan imported from Korea amounted to $756 million and its share in Japan's total imports from Korea was 4.19%.

Of Korea's total imports of $74.4 billion from Japan,

Table 6. Bilateral imports by sector at market prices and tariff rates between Japan and Korea

Sector	Imports (US$ million)		Tariff rates (%)	
	Japan's imports from Korea	Korea's imports from Japan	Japan's tariffs on imports from Korea	Korea's tariffs on imports from Japan
1 Rice	2.2	0.8	487.00	513.00
2 Wheat	0.0	0.0	0.00	0.00
3 RGrains	0.0	0.0	0.00	0.00
4 VegFrt	158.9	2.8	4.68	145.76
5 OilSeeds	0.8	0.1	0.00	19.31
6 PBFibers	0.0	0.0	0.00	0.00
7 RCrops	42.8	25.8	0.85	5.85
8 Animals	3.8	24.7	0.75	3.75
9 RawMkl	0.0	0.0	0.00	0.00
10 WoolSWC	0.2	0.1	0.00	0.00
11 Forestry	1.2	7.9	3.12	0.19
12 Fishing	508.1	165.4	5.88	16.95
13 MeatPrd	23.1	6.4	8.78	6.70
14 VegOils	37.4	18.0	1.63	11.62
15 DairyPrd	36.9	4.5	162.73	99.51
16 Sugar	4.1	0.5	69.81	11.76
17 RFood	1,312.0	414.1	17.44	40.24
18 Mining	13,358.6	27,795.9	1.02	4.46
19 Manuf	23,473.4	41,671.9	1.11	4.85
20 Services	6,377.6	4,273.6	0.00	0.00
Total	45,341.1	74,412.7		

Source: Authors' calculation using GTAP DB version 9

Note: Tariffs are ad valorem tax. Japan's specific tariff on imported rice was converted into ad valorem tariff using the market prices of rice, the quantity of imported rice and the exchange rate as of October 2016 in which a specific tariff rate of ¥341 per kg, the CIF price of $700 per metric ton, 150 tons of imported rice and the exchange rate of ¥100/$ were assumed.

Korea spent $41.7 billion on manufactured goods (55.9%), $27.8 billion on mining (37.4%) and $4.3 billion on services (6.0%) imported from Japan. All agricultural products and processed food that Korea imported from Japan amounted to $224.4 million and its share in Korea's total imports from Japan was 0.73%. Japan's dependence on Korea in terms of the share of imported agricultural products and processed foods in its total imports is much higher than Korea's dependence on Japan.

The major agricultural products and processed food that Japan imported from Korea are other processed food (RFood of $1,312 million), fishing ($508.1 million), vegetable and fruits ($158.9 million), other cereal crops (RCrop of $42.8 million), vegetable oils and fats (VegOils of $37.4 million), dairy products ($36.9 million), and meat products ($23.1 million). The major agricultural products and processed food that Korea imported from Japan are other processed food (RFood of $414.1 million), fishing ($165.4 million), other cereal crops (RCrops of $25.8 million), and animals ($24.7 million).

Tariff rates in Table 6 are ad valorem taxes on imports. Except for forestry, meat produets (MeatPrd) dairy products and sugar, Korea's tariff rates on imports from Japan are higher than Japan's tariff rates on imports from Korea. For instance, Korea's tariff rate on rice imported from Japan is 513%, whereas Japan's tariff rate on rice from Korea is 487%. In reality, Japan levies a specific tariff on imported rice. Japan's specific tariff on imported rice was converted into ad valorem tariff using the market prices of rice, the quantity of imported rice and the exchange rate as of October 2016 in which a specific rate of ¥341 per kg, the CIF price of $700 per metric ton, 150 tons of imported rice and the exchange rate of ¥100/$ were assumed. Korea's tariff rate on vegetable and fruits from Japan is 145.76%, while Japan's tariff rate on vegetable and fruits from Korea is 4.68%.

Japan's tariff rates on dairy products and sugar are higher than Korea's. Japan's tariff rates on dairy products and sugar are 162.73% and 69.81%, respectively, while Korea's rates on dairy products and sugar are 99.51% and 11.76%, respectively.

There are no tariffs on wheat, other cereal grains (RGrains), plant–based fibers (PB fibers), raw milk (RawMkl), wool and silk–worm cocoons (WoolSWC), because there is no trade in these commodities between Japan and Korea. Ad valorem tariff rates are calculated

as a ratio of tariff revenue to import value at CIF prices.

Tariff rates on manufactured commodities and mining products are very low. Korea's tariff rates on manufactured commodities and mining products are 4.85% and 4.46%, respectively, while Japan's tariff rates on manufactured commodities and mining products are 1.11% and 1.02%, respectively.

Scenarios

There are three scenarios for the Japan–Korea FTA: a 50% cut of tariffs on all imports between Japan and Korea, a 75% cut of tariffs and a 100% cut of tariffs. In addition, it is assumed that for each of the three scenarios the total factor productivity (TFP) of Japan and Korea increases by 0.15%, as trade openness defined as a ratio of a sum of exports and imports to GDP rises by 1% as a result of the Japan–Korea FTA and that labor supply increases by 0.8%, as real wage rises by 1%. In other words, the elasticity of total factor productivity with respect to trade openness and the elasticity of labor supply with respect to real wage are assumed to be 0.15 and 0.8, respectively. The data on the total factor productivity and labor supply assumed in this study is based on Cabinet Secretariat Office for TPP Government Strategy (2015).

RESULTS

The potential economic impacts of the Japan–Korea FTA include macroeconomic and microeconomic effects. The macroeconomic effects are about real GDP, welfare in terms of equivalent variance, total export and import volumes, trade balance, and terms of trade. The microeconomic effects are about domestic production by sector, value–added by sector, demand for unskilled and skilled labor and capital by sector, trade balance by sector, wages and capital prices.

Table 7 shows the impact of the Japan–Korea FTA on real GDP. Japan's real GDP is predicted to grow by 0.302% (scenario 1) to 0.813% (scenario 3), while Korea's real GDP is to rise by 0.453% (scenario 1) to 1.27% (scenario 3). A higher degree of trade liberalization between Japan and Korea is expected to lead to higher economic growth for both of them. On the other hand, all non–members of the Japan–Korea FTA are to lose in terms of real GDP, although its negative impact on them is negligibly small.

Table 8 shows the impact of the Japan–Korea FTA on welfare in terms of equivalent variation (EV). The EV represents the money metric equivalent to the utility change brought about by the price change as a result of any economic policy. In other words, the EV can be

Table 7. Impact of Japan–Korea FTA on real GDP (% change)

Region	Scenario 1	Scenario 2	Scenario 3
1 KOR	0.453	0.769	1.270
2 CHN	–0.004	–0.005	–0.007
3 ASEAN	–0.009	–0.014	–0.018
4 USA	0.000	–0.001	–0.001
5 EU28	0.000	–0.001	–0.001
6 JPN	0.302	0.501	0.813
7 A_N	–0.003	–0.006	–0.010
8 ROW	–0.002	–0.003	–0.001

Source: Authors' simulation results

Table 8. Impact of Japan–Korea FTA on welfare (US$ million)

Region	Scenario 1	Scenario 2	Scenario 3
1 KOR	4,186	7,164	12,126
2 CHN	–380	–564	–699
3 ASEAN	–238	–363	–480
4 USA	–139	–209	–261
5 EU28	–89	–126	–129
6 JPN	15,279	25,204	40,539
7 A_N	–69	–130	–227
8 ROW	–550	–749	–653

Source: Authors' simulation results

Table 9. Welfare decomposition in the case of scenario 3 (US$ million)

Region	Allocative efficiency	Endowment	Technical change	Terms of trade	Investment and savings	Total
1 KOR	2,710	5,789	4,355	–787	59	12,126
2 CHN	–181	–196	0	–313	–9	–699
3 ASEAN	–104	–202	0	–169	–5	–480
4 USA	–29	–41	0	–141	–50	–261
5 EU28	–53	–39	0	–23	–14	–129
6 JPN	10,484	16,303	11,740	2,000	13	40,539
7 A_N	–53	–52	0	–128	5	–227
8 ROW	–55	–152	0	–447	1	–653
Total	12,720	21,409	16,095	–8	0	50,217

Source: Authors' simulation results

defined as a tool which measures the maximum amount of income that the consumer is a willing to pay to avoid the price change as a result of the Japan–Korea FTA in this paper.

Japan's welfare is to increase by $15.3 billion (scenario 1) to $40.5 billion (scenario 3), whereas Korea's welfare is to rise by $4.2 billion (scenario 1) to $12.1 billion (scenario 3). A higher degree of trade liberalization between Japan and Korea is also expected to lead to higher welfare for both of them. On the other hand, the welfare of all non–members of the Japan–Korea FTA is to decline.

Table 9 shows welfare decomposition in the case of the scenario 3. Welfare change can be explained by changes in allocative efficiency, endowment, technical change, terms of trade, and investment and savings. Japan's enhanced welfare of $40.5 billion is explained by increased endowment of $16.3 billion, improved technical change of $11.7 billion, more efficient allocation of resources of $10.5 billion, improved terms of trade of $2 billion, and increased investment and savings of $13 million. Korea's enhanced welfare of $12.1 billion is explained by increased endowment of $5.8 billion, improved technical change of $4.4 billion, more efficient allocation of resources of $2.7 billion, deteriorated terms of trade of $787 million, and increased investment and savings of $59 million.

Technical change comes from the total factor productivity assumed for scenarios and changes in endowment come from the labor supply assumed for scenarios and changes in relative prices as a result of simulations. Changes in allocative efficiency, terms of trade, and investment and savings come from changes in relative prices as a result of simulations. All of the non–members of the Japan–Korea FTA are to face decreased welfare due to less efficient allocation of resources, lower endowment, deteriorated terms of trade, and less investment and savings.

Table 10 shows the impact of the Japan–Korea FTA on total export and import volumes. Total export and import volumes of Japan and Korea rise, while total export and import volumes of all non–members of the Japan–Korea FTA drop.

There is a contrasting feature in changes in total import and export volumes between Japan and Korea. Japan's total import volumes in percentage change increase more than Japan's total export volumes in percentage change in all 3 scenarios, while Korea's total export volumes in percentage change increase more than Korea's total import volumes. The increase in Japan's total import volumes ranges from 0.56% (scenario 1) to 1.44% (scenario 3) and that in Japan's total

Table 10. Impact of Japan–Korea FTA on total export and import volumes (% change)

Region	Export volume			Import volume		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
1 KOR	0.80	1.31	2.07	0.74	1.23	1.97
2 CHN	–0.01	–0.02	–0.02	–0.02	–0.03	–0.04
3 ASEAN	–0.01	–0.02	–0.03	–0.02	–0.03	–0.04
4 USA	–0.01	–0.01	–0.02	–0.01	–0.02	–0.02
5 EU28	–0.00	–0.00	–0.00	–0.00	–0.00	–0.01
6 JPN	0.45	0.74	1.23	0.56	0.91	1.44
7 A_N	–0.01	–0.03	–0.05	–0.03	–0.05	–0.09
8 ROW	–0.01	–0.01	–0.01	–0.01	–0.02	–0.02

Source: Authors' simulation results

Table 11. Impact of Japan–Korea FTA on the terms of trade and trade balance

Region	Terms of trade (%)			Trade balance (US$ million)		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
1 KOR	–0.07	–0.11	–0.13	76	133	242
2 CHN	–0.01	–0.01	–0.02	–82	–129	–185
3 ASEAN	–0.01	–0.01	–0.01	–19	–30	–44
4 USA	–0.00	–0.01	–0.01	159	258	385
5 EU28	0.00	0.00	0.00	29	47	70
6 JPN	0.11	0.17	0.21	–55	–89	–135
7 A_N	–0.01	–0.02	–0.04	–8	–14	–24
8 ROW	–0.00	–0.01	–0.01	–99	–174	–309

Source: Authors' simulation results

export volumes from 0.45% (scenario 1) to 1.23% (scenario 3). The increase in Korea's total export volumes ranges from 0.8% (scenario 1) to 2.07% (scenario 3) and that in Korea's total import volumes from 0.74% (scenario 1) to 1.97% (scenario 3).

Table 11 shows the impact of the Japan–Korea FTA on the terms of trade and trade balance. There is a contrasting feature in changes in the terms of trade and trade balance between Japan and Korea. Whereas Japan's terms of trade will improve, Korea's terms of trade will deteriorate. Japan will run additional trade deficit, while Korea will run additional trade surplus. The reason why Korea is expected to run additional trade surplus is that Korea's total export volumes increase more than its total import volumes in all 3 scenarios, even though Korea's terms of trade deteriorate. The reason why Japan is expected to run additional trade deficit is that Japan's total import volumes increase more than its total export volumes, although Japan's terms of trade improve.

Of non–members of the Japan–Korea FTA, the United States of America and EU28 are expected to run additional trade surpluses. It is because the total import volumes of the United States of America and EU28 decline more than their decreased export volumes with their deteriorated terms of trade. Such a trade surplus

Table 12. Impact of Japan–Korea FTA on bilateral trade in the case of scenario 3 (US$ million)

DTOT	1 KOR	2 CHN	3 ASEAN	4 USA	5 EU28	6 JPN	7 A_N	8 ROW	Total
1 KOR	0	1,527	574	731	536	7,624	90	1,577	12,659
2 CHN	–2,598	53	156	169	165	1,332	0	136	–586
3 ASEAN	–1,123	–9	78	4	13	680	–18	–23	–398
4 USA	–1,339	52	51	0	125	692	–7	37	–389
5 EU28	–1,140	83	50	20	–176	549	–32	–245	–891
6 JPN	22,483	–2,704	–1,557	–1,931	–1,578	0	–291	–2,720	11,701
7 A_N	–476	109	66	46	60	–122	21	120	–176
8 ROW	–4,368	158	130	428	483	2,148	–6	218	–810
Total	11,440	–729	–451	–534	–373	12,903	–244	–901	21,111

Source: Authors' simulation results

Table 13. Impact of Japan–Korea FTA on domestic production by sector (% change)

Sector	Japan			Korea		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
1 Rice	–0.00	–0.17	–2.36	0.12	0.39	2.58
2 Wheat	–0.15	–0.13	0.65	–0.33	–0.96	–3.45
3 RGrains	0.04	0.09	0.33	0.11	0.11	–0.29
4 VegFrt	0.04	0.10	0.31	0.08	0.04	–0.44
5 OilSeeds	–0.02	0.05	0.60	–0.32	–0.91	–3.34
6 PBFibers	0.13	0.25	0.73	–0.38	–1.00	–3.47
7 RCrops	0.01	–0.03	–0.25	0.04	–0.10	–1.00
8 Animals	0.18	0.34	0.75	0.26	0.36	0.23
9 RawMkl	–0.11	–0.96	–4.47	2.52	10.33	35.36
10 WoolSWC	0.23	0.40	0.76	–0.03	–0.27	–1.61
11 Forestry	0.17	0.29	0.48	0.33	0.62	1.37
12 Fishing	0.19	0.32	0.56	0.40	0.67	1.08
13 MeatPrd	0.20	0.37	0.84	0.32	0.47	0.38
14 VegOils	0.31	0.54	0.97	0.64	1.26	2.51
15 DairyPrd	–0.25	–1.57	–6.93	2.91	11.91	40.79
16 Sugar	0.13	0.11	–0.20	1.06	2.65	6.59
17 RFood	0.27	0.49	0.91	0.95	1.68	2.87
18 Mining	0.25	0.42	0.73	0.55	0.90	1.29
19 Manuf	0.27	0.44	0.70	0.26	0.43	0.68
20 Services	0.26	0.43	0.68	0.33	0.57	0.96

Source: Authors' simulation results

is referred to as the trade surplus in recession.

Table 12 shows the impact of the Japan–Korea FTA on bilateral trade in the case of scenario 3. There are 3 distinguishing features in bilateral trade. First, the total export and import values of Japan and Korea will increase, while the total exports and import values of all non–members of the Japan–Korea FTA will decrease. Second, Korea will import more goods and services from Japan by reducing the imports of goods and services from the non–members of the Japan–Korea FTA which is a so–called trade–diverting effect on the import side of Korea, while Japan will import more goods and services not only from Korea, but also from the non–members of the Japan–Korea FTA except Australia and New Zealand (A_N). Third, Korea will export more goods and services not only to Japan, but also to all non–members of the Japan–Korea FTA, while Japan will export more goods and services to Korea by reducing its exports to all non–member countries of the Japan–Korea FTA which is a so–called trade–diverting effect on the export side of Japan.

Table 13 shows the impact of the Japan–Korea FTA on domestic production by sector. Japan and Korea are predicted to increase their production in many of their industries such as services, manufacturing, mining, other processed food (RFood), vegetable oils and fats (VegOils), meat products (MeatPrd), fishing, forestry, and animals. A higher level of trade liberalization in these sectors lead to a higher level production.

There are some sectors in which Japan and Korea show different directions of changes in production. For example, Korea's production of rice, raw milk and dairy products will increase, while Japan's production of them will decline. Japan's production of plant–based fibers (PBFibers) and wool and silk–worm cocoons (WoolSWC) will rise, while Korea's production of them will drop. It should be noted that the changes in the production of dairy products by Korea in the case of scenario 3 are very big and that it is because of the elimination of high tariff rates on them. However, the production of dairy products and raw milk is too sensitive in the case of scenario 3 for Korea.

Table 14 shows the impact of the Japan–Korea FTA on value–added by sector which reflects the changes in production by sector in Table 13.

Table 15 shows the impact of the Japan–Korea FTA on Japan's demand for unskilled and skilled labor and capital by sector and Table 16 shows its impact on Korea's demand for unskilled and skilled labor and capital by sector.

The demand for unskilled and skilled labor and capital by Japan and Korea increases in the sectors, such as services, manufacturing, mining, other processed food (RFood), vegetable oils and fats (VegOils), fishing, forestry, and animals where their domestic production rises. A higher level of trade liberalization in these sectors lead to a higher demand for labor and capital caused by a higher level of production.

Table 14. Impact of Japan–Korea FTA on value–added by sector (% change)

Sector	Japan			Korea		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
1 Rice	–0.03	–0.22	–2.45	0.07	0.30	2.44
2 Wheat	–0.18	–0.18	0.56	–0.38	–1.05	–3.57
3 RGrains	0.01	0.04	0.24	0.06	0.03	–0.42
4 VegFrt	0.01	0.04	0.22	0.03	–0.05	–0.57
5 OilSeeds	–0.05	–0.00	0.50	–0.37	–0.99	–3.47
6 PBFibers	0.10	0.20	0.64	–0.43	–1.09	–3.59
7 RCrops	–0.02	–0.08	–0.34	–0.01	–0.19	–1.12
8 Animals	0.15	0.28	0.65	0.21	0.28	0.10
9 RawMkl	–0.14	–1.01	–4.56	2.47	10.23	35.18
10 WoolSWC	0.20	0.34	0.66	–0.08	–0.36	–1.74
11 Forestry	0.14	0.24	0.38	0.29	0.53	1.24
12 Fishing	0.16	0.27	0.47	0.35	0.58	0.95
13 MeatPrd	0.17	0.32	0.75	0.27	0.39	0.25
14 VegOils	0.28	0.49	0.88	0.59	1.17	2.38
15 DairyPrd	–0.27	–1.62	–7.02	2.86	11.82	40.60
16 Sugar	0.10	0.06	–0.29	1.01	2.56	6.45
17 RFood	0.24	0.43	0.81	0.90	1.60	2.73
18 Mining	0.22	0.37	0.64	0.50	0.81	1.16
19 Manuf	0.24	0.39	0.60	0.21	0.35	0.55
20 Services	0.23	0.38	0.59	0.28	0.48	0.83

Source: Authors' simulation results

Table 15. Impact of Japan–Korea FTA on Japan's demand for unskilled and skilled labor and capital by sector (% change)

Sector	Scenario 1			Scenario 2			Scenario 3		
	UnskLab	SkLab	Capital	UnskLab	SkLab	Capital	UnskLab	SkLab	Capital
1 Rice	–0.08	–0.08	0.00	–0.32	–0.32	–0.18	–2.84	–2.85	–2.61
2 Wheat	–0.20	–0.21	–0.16	–0.23	–0.24	–0.16	0.37	0.37	0.51
3 RGrains	–0.01	–0.01	0.04	–0.01	–0.01	0.07	0.04	0.04	0.17
4 VegFrt	–0.01	–0.01	0.04	–0.00	–0.00	0.08	0.03	0.02	0.16
5 OilSeeds	–0.07	–0.07	–0.03	–0.05	–0.05	0.03	0.32	0.31	0.45
6 PBFibers	0.08	0.08	0.13	0.16	0.16	0.24	0.46	0.45	0.59
7 RCrops	–0.04	–0.04	0.01	–0.13	–0.13	–0.05	–0.55	–0.56	–0.42
8 Animals	0.14	0.14	0.19	0.25	0.25	0.32	0.47	0.47	0.61
9 RawMkl	–0.17	–0.17	–0.12	–1.10	–1.10	–1.02	–4.92	–4.92	–4.79
10 WoolSWC	0.19	0.19	0.23	0.31	0.31	0.39	0.48	0.48	0.62
11 Forestry	0.13	0.13	0.17	0.22	0.22	0.28	0.35	0.35	0.45
12 Fishing	0.26	0.26	0.30	0.46	0.45	0.51	0.80	0.79	0.90
13 MeatPrd	0.06	0.05	0.25	0.13	0.12	0.45	0.43	0.40	0.99
14 VegOils	0.20	0.20	0.39	0.36	0.35	0.69	0.66	0.64	1.23
15 DairyPrd	–0.38	–0.38	–0.19	–1.79	–1.81	–1.48	–7.30	–7.32	–6.78
16 Sugar	0.04	0.04	0.15	–0.06	–0.06	0.13	–0.54	–0.55	–0.22
17 RFood	0.15	0.15	0.34	0.28	0.27	0.61	0.55	0.53	1.12
18 Mining	0.17	0.17	0.32	0.29	0.28	0.53	0.50	0.48	0.92
19 Manuf	0.17	0.16	0.39	0.27	0.26	0.65	0.40	0.37	1.05
20 Services	0.11	0.10	0.35	0.17	0.16	0.57	0.23	0.20	0.93

Source: Authors' simulation results

There are some sectors in which Japan and Korea show different directions of changes in demand for labor and capital. For example, Korea's demand for labor and capital will increase in rice, raw milk and dairy products where its production rises, while Japan's demand for labor and capital will decline in these sectors where Japan's production drops. Japan's demand for labor and capital will increase in plant–based fibers (PBFibers) and wool and silk–worm cocoons (WoolSWC) where its production rises, while Korea's demand for labor and capital will decrease in these sectors where its production declines. Demand for labor and capital required to produce dairy products and raw milk is too sensitive in the case of scenario 3 for Korea, as indicated in the changes in production by sedor in Table 13.

Finally, Table 17 shows the impact of the Japan–Korea FTA on wages and capital prices. Because of the assumption of perfect competition and constant returns to scale, wages and capital prices are equal in all sectors of Japan and Korea. There are one common and two different features in the changes in wages and capital prices between Japan and Korea. One common thing is that a higher degree of trade liberalization will lead to a higher increase in wages and capital prices in both countries. Two different things are that wages for unskilled and skilled labor will increase more in Korea than in Japan, whereas capital prices will increase more in Japan than in Korea.

DISCUSSION

Japan and Korea are predicted to get an additional gain in terms of real GDP and welfare. Japan's real GDP is to increase by 0.302% to 0.813%, while Korea's real GDP is to grow by 0.453% to 1.27%. Japan's welfare is to rise by $15.3 billion to $40.5 billion, whereas Korea's welfare is to increase by $4.2 billion to $12.1 billion. A higher degree of trade liberalization between Japan and Korea is expected to lead to higher economic growth and enhanced welfare for both of them. On the other hand, all non–members of the Japan–Korea FTA are to lose in terms of real GDP and welfare.

More efficient allocation of resources, more endowment in terms of increased supply of labor, increased total factor productivity, improved terms of trade, and higher investment and savings which are expected to take place as a result of the Japan–Korea FTA will lead to higher welfare of both countries.

There is a contrasting feature in changes in the terms of trade and trade balance between Japan and Korea. Japan's terms of trade is predicted to improve, while Korea's terms of trade is to deteriorate. Japan is to run additional trade deficit, while Korea is to run additional trade surplus. The reason why Korea is expected to run additional trade surplus is that Korea's total export volumes increase more than its total import volumes in all 3 scenarios, although Korea's terms of trade deteriorate.

Table 16. Impact of Japan–Korea FTA on Korea's demand for unskilled and skilled labor and capital by sector (% change)

Sector	Scenario 1			Scenario 2			Scenario 3		
	UnskLab	SkLab	Capital	UnskLab	SkLab	Capital	UnskLab	SkLab	Capital
1 Rice	0.19	0.19	0.33	0.72	0.72	0.96	4.46	4.48	4.89
2 Wheat	–0.36	–0.36	–0.28	–0.95	–0.95	–0.81	–3.08	–3.07	–2.86
3 RGrains	0.14	0.14	0.22	0.26	0.26	0.40	0.49	0.50	0.73
4 VegFrt	0.11	0.11	0.19	0.17	0.18	0.31	0.32	0.32	0.55
5 OilSeeds	–0.34	–0.34	–0.27	–0.88	–0.88	–0.75	–2.96	–2.96	–2.74
6 PBFibers	–0.41	–0.41	–0.33	–0.99	–0.99	–0.86	–3.10	–3.09	–2.88
7 RCrops	0.06	0.06	0.14	0.02	0.02	0.15	–0.31	–0.31	–0.09
8 Animals	0.30	0.30	0.38	0.54	0.54	0.68	1.07	1.08	1.30
9 RawMkl	2.85	2.85	2.93	11.81	11.81	11.96	41.77	41.78	42.09
10 WoolSWC	–0.02	–0.02	0.06	–0.17	–0.17	–0.04	–1.01	–1.01	–0.79
11 Forestry	0.27	0.27	0.33	0.51	0.51	0.61	1.25	1.25	1.42
12 Fishing	0.66	0.66	0.72	1.10	1.10	1.21	1.81	1.82	1.99
13 MeatPrd	0.10	0.10	0.43	0.08	0.09	0.66	–0.26	–0.24	0.71
14 VegOils	0.39	0.39	0.73	0.83	0.83	1.41	1.79	1.82	2.78
15 DairyPrd	2.70	2.70	3.04	11.51	11.52	12.16	39.97	40.00	41.32
16 Sugar	0.92	0.92	1.11	2.39	2.39	2.73	6.16	6.18	6.76
17 RFood	0.75	0.75	1.08	1.33	1.34	1.92	2.28	2.31	3.28
18 Mining	0.35	0.36	0.61	0.55	0.55	0.99	0.72	0.74	1.46
19 Manuf	0.05	0.06	0.44	0.07	0.08	0.74	0.07	0.10	1.20
20 Services	0.05	0.05	0.47	0.08	0.09	0.81	0.16	0.19	1.37

Source: Authors' simulation results

Table 17. Impact of Japan–Korea FTA on wages and capital prices (% change)

Sector	Scenario 1			Scenario 2			Scenario 3		
	UnskLab	SkLab	Capital	UnskLab	SkLab	Capital	UnskLab	SkLab	Capital
Japan	0.25	0.26	0.09	0.41	0.42	0.13	0.65	0.67	0.15
Korea	0.33	0.33	0.03	0.57	0.56	0.05	0.91	0.88	0.04

Source: Authors' simulation results

The reason why Japan is expected to run additional trade deficit is that Japan's total import volumes rise more than its total export volumes, even though Japan's terms of trade improve.

The impact of the Japan–Korea FTA on their production and value–added varies by sector. Japan and Korea are predicted to increase their production in many of their industries, such as services, manufacturing, mining, other processed food (RFood), vegetable oils and fats (VegOils), meat products (MeatPrd), fishing, forestry, and animals. A higher level of trade liberalization in these sectors lead to a higher level production of both countries.

There are also some sectors in which Japan and Korea show different directions of changes in production. For example, Korea's production of rice, raw milk and dairy products will grow, while Japan's production of them will decrease. Japan's production of plant–based fibers (PBFibers) and wool and silk–worm cocoons (WoolSWC) will increase, while Korea's production of them will decline.

The demand for unskilled and skilled labor and capital by sector in Japan and Korea is predicted to move in the same direction of production by sector.

Wages and capital prices will be equal in all sectors of Japan and Korea due to the assumption of perfect competition and constant returns to scale. There will be one common and two different things in the changes in wages and capital prices between Japan and Korea as a result of the Japan–Korea FTA. One common thing is that a higher degree of trade liberalization will lead to a higher increase in wages and capital prices in both countries. Two different things are that wages for unskilled and skilled labor will increase more in Korea than in Japan, whereas capital prices will increase more in Japan than in Korea.

An analysis of the potential economic effects of the Japan–Korea FTA using a dynamic CGE model remains

future work, which will make it possible to consider different timing of policy implementation and its impacts taking place over time as well as capital accumulation over time.

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