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Evaluating the Effects of Free Trade Agreements in the Asia-Pacific Region under Alternative Sequencings*

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Abstract

In the past decade, a growing number of bilateral and plurilateral free-trade agreements (FTAs) involving Asia-Pacific countries have been signed or ratified. Although there have been studies on sequencing of real and monetary integration, studies on optimal sequencing of FTAs are extremely scarce. However, the magnitudes of sectoral output and employment adjustments resulting from trade accords are great concern to policy makers. Using a dynamic computable general equilibrium (CGE) model, the relationship between sequencing of FTAs in the Asia-Pacific region and the magnitudes of welfare gains and sectoral adjustment costs of the member countries is examined.

A different sequencing of FTAs is considered in each policy scenario. If a particular sequencing of FTAs would change the industrial structure within each country closer to that which would prevail under free trade, while increasing economic welfare of the member countries, then it may be considered as a beneficial intermediate step towards global trade liberalization. The preliminary results suggest that the extent of sectoral adjustments differs greatly among alternative FTA sequencings.

JEL classification: F15, F17

Keywords: Sequencing, FTA, regional integration, CGE model

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1. Introduction

In the past decade, a growing number of bilateral and plurilateral free-trade agreements (FTAs) involving Asia-Pacific countries have been signed or ratified. For example, the ASEAN countries have implemented FTAs with six major trading partners in the region – China, Japan, Korea, India, and Australia/New Zealand – while they aim to create a single market (ASEAN Economic Community) across the 10 member states by 2015. Korea became the first country to sign an FTA with the EU, and the EU-Korea FTA is expected to come into force in July 2011. The creation of an East Asian community and Free Trade Area of the Asia Pacific (FTAAP) has been proposed by leaders of several Asia-Pacific countries in recent years. Whether the growth of FTAs has a positive or negative impact on multilateral trade liberalization under the WTO has been debated intensely (e.g., Krueger, 1999; Panagariya, 2000; Lloyd and MacLaren, 2004).

A number of studies have quantified the effects of various FTAs in the Asia-Pacific region using a computable general equilibrium (CGE) model (e.g., Kawai and Wignaraja, 2007; Lee et al., 2004, 2009; Lee and van der Mensbrugghe, 2008; Park, 2006; Urata and Kiyota, 2005). In addition, there have been studies on the sequencing of real and monetary integration (e.g., Baldwin, 2008; Kreinin and Plummer, 2009). In contrast, studies on industrial adjustments and consequent optimum sequencing of FTAs are extremely scarce. Bond (2008) considers the relationship between adjustment costs and sequencing of trade liberalization, such as the elimination of tariffs, liberalization of financial markets, and adoption of common policies, but not the sequencing of FTAs. However, the magnitudes of sectoral output and employment adjustments resulting from different FTAs will be a great concern to policy makers. In this paper, we will shed light on the relationship between sequencing of FTAs and the extent of industrial adjustments for Japan, China, Korea and ASEAN countries.

The objective of this paper is to investigate the optimum sequencing of FTAs in the Asia-Pacific region using a global dynamic CGE model. This requires three steps. We first establish the baseline scenario for the period up to 2030. Second, for each scenario of FTA sequencing, we compute changes in economic welfare and the extent of sectoral output adjustments of the member countries relative to the baseline. Third, we calculate the rank

correlation between the extent of adjustments under each FTA sequencing and the extent of adjustments that would prevail under global trade liberalization (GTL). If a particular FTA sequencing would change the industrial structure within each country closer to that which would prevail under free trade, while increasing economic welfare of the member countries, then that FTA sequencing may be considered as a facilitating intermediate step towards GTL.

The next section gives an overview of the model and data. Section 3 provides a brief description of the baseline and policy scenarios, followed by assessments of computational results in section 4. The final section offers conclusions and possible extensions of the paper.

2. Analytical Framework and Data

2.1 Overview of the Dynamic GTAP Model

The numerical simulations undertaken for this study are derived from the Dynamic GTAP model, described in detail by Ianchovichina and McDougall (2001). This model extends the comparative static framework of the standard GTAP model developed by Hertel (1997) to the dynamic framework by incorporating international capital mobility and capital accumulation. In the standard static GTAP model, capital can move across industries within a region, but not across regions or countries. For a long-run analysis to be more realistic, the model requires a mechanism to capture incentives to invest in different regions, thereby allowing international capital mobility and capital accumulation.

The Dynamic GTAP model preserves all the features of the standard GTAP, such as constant returns to production technology, perfectly competitive markets, and product differentiation by countries of origin, in keeping with the so-called Armington assumption.[1] At the same time, it enhances the investment theory by incorporating international

[1] See Armington (1969). The model uses a nested CES structure, where at the top nested level, each agent chooses to allocate aggregate demand between domestically produced goods and an aggregate import bundle, while minimizing the overall cost of the aggregate demand bundle. At the second level, aggregate import demand is allocated across different trading partners, again using a CES specification, wherein the aggregate costs of imports are minimized.

capital mobility and ownership. In this way it captures important FTA effects on investment and wealth that are missed by a static model.

In the Dynamic GTAP model, each of the regions is endowed with fixed physical capital stock owned by domestic firms. The physical capital is accumulated over the time with new investment. This dynamics is driven by the net investment, which is sourced by regional households' savings. Regional households own indirect claims on the physical capital in the form of equity. There are two types of equities: equity in domestic firms and equity in foreign firms. The households directly own the domestic equity but only indirectly hold the foreign equity. To access equity in foreign firms, the households must own shares in a portfolio of foreign equities provided by the "global trust" that is assumed to be the sole financial intermediary for all foreign investments. The values of the households' equity holdings in domestic firms and in the global trust evolve over the time, and the households allocate all their savings for investment. Collecting such investment funds across regions, the global trust reinvests the funds in firms around the world and offers a portfolio of equities to households. The sum of households' equity holdings in the global trust is equal to the global trust's equity holdings in firms around the world.

The savings in one region are invested directly in domestic firms and indirectly in foreign firms through the global trust, which are in turn reinvested in all regions. The dynamics arising from positive savings in one region is related to the dynamics from the net investment in other regions. Overall, at the global level, it must hold that all the savings across regions are completely invested in home and overseas markets.

In theory, incentives for investments or equity holdings are governed by the rates of return, which will be equalized across regions if capital is perfectly mobile. However, an equalization of the rates of return seems unrealistic, at least in the short run. In addition, there exist well-known empirical observations for "home bias" in savings and investment and households' equity holdings. The observations suggest that the capital is not perfectly mobile, causing some divergence in the rates of return across regions. The dynamic GTAP model allows inter-regional differences in the rates of return in the short run, which will be eventually equalized in the very long run. This may be regarded as a realistic approach, but it calls for a mechanism to allocate equity holdings of the households and the global trust

in a way consistent with the observed data. It is assumed that differences in the rates of return are attributed to the errors in investors' expectations about the future rates of return. During the process, these errors are gradually adjusted to the actual rate of return as time elapses. Eventually the errors are eliminated and a unique rate of return across regions can be attained.

While perfect capital mobility is assumed only in the very long run, investment is induced by a gradual movement in the expected rate of return toward an equality across regions. The expected rate of return may differ from the actual rate of return due to errors in expectations. Explicit modeling of the ownership of regional investment allows one to determine the accumulation of wealth by foreigners. In addition, the ownership of domestic and foreign assets can also be tracked. Income accruing from the ownership of the foreign and domestic assets can then be appropriately incorporated into total regional income.

Participating in an FTA could lead to more investment from abroad. Trade liberalization often makes prices of goods in a participating country lower due to removal of tariffs, creating an increase in demand for the goods. Responding to the increased demand, production of the goods expands in the member country. The expansion of production is attained by using more intermediate inputs, labor, capital, and other primary factor inputs. These increased demands for production inputs raise the corresponding prices, wage rates, and rental rates. Higher rental rates are translated into higher rates of return, attracting more investment from both home and foreign countries.

2.2 Data, aggregation, and initial tariffs

In this study we employ the GTAP version 7 database, which has a 2004 base year and distinguishes 113 countries/regions and 57 sectors (Narayanan and Walmsley, 2008). For the purposes of the present study, the data has been aggregated to 11 countries/regions and 26 sectors, as shown in Table 1. The country/region breakdown includes Japan, China, Korea, Taiwan, ASEAN-5, the rest of ASEAN, Australia/New Zealand, North America, the rest of the FTAAP (Chile, Peru and Russia), EU-27, and the rest of the world. Foreign income data are obtained from the International Monetary Fund (IMF)'s *Balance of*

Payments Statistics, which are used to track international capital mobility and foreign wealth. The values of key parameters, such as demand, supply and CES substitution elasticities, are based upon the previous empirical estimates. The model calibration primarily consists of calculating share and shift parameters to fit the model specifications to the observed data, so as to be able to reproduce a solution for the base year.

The sectoral tariff rates for the 11 countries/regions in 2004 are summarized in Table 2. There are striking differences in the tariff structures across the countries/regions. In Japan, Korea and Taiwan, the extraordinarily high tariff rates on rice particularly stand out. The tariff rates in a number of other agricultural and food products are also high in these three countries. With the exception of Australia and New Zealand, the tariff rates on some agricultural and food products are also relatively high in other regions, such as sugar in North American, the rest of FTAAP and the EU, dairy products in North America, and meats in the rest of ASEAN, the rest of FTAAP and the rest of the world.

In manufacturing the tariff rates on textiles and apparel are relatively high in all regions except the EU. The rates on motor vehicles are quite high in China, Taiwan, ASEAN-5 and the rest of ASEAN. It should be noted that Singapore, which is aggregated into the ASEAN-5 region, is duty free with the exception of alcohol and tobacco. Thus, while the tariff structures of Indonesia, Malaysia, the Philippines and Thailand are different, the average tariff rates of the four countries are comparatively higher than those of ASEAN-5 presented in Table 2.

Although Japan, Korea and Taiwan's tariff rates on agricultural and food products are high, these products constitute rather small shares of the total import values, compared with non-food manufacturing products. Trade-weighted averages of sectoral tariff rates are relatively high in ASEAN-5, the rest of ASEAN, the rest of FTAAP and the rest of the world. In the current version, nontariff barriers (NTBs) on services trade are not incorporated.

3. The Baseline and Policy Scenarios

3.1 The Baseline Scenario

In order to evaluate the effects of various sequencing of FTAs, the baseline scenario is first established, showing the path of each of the 11 economies/regions over the period 2004-2030. The baseline contains information on macroeconomic variables as well as expected policy changes. The macroeconomic variables in the baseline include projections for real GDP, gross investment, capital stocks, population, skilled and unskilled labor, and total labor. Real GDP projections were obtained from IMF's *World Economic Outlook Database* (October 2009). The data on gross fixed capital formation were acquired from IMF's *IFS Online*. Projections for population were taken from U.S. Census Bureau's *International Data Base*, while those for labor were obtained from International Labor Organisation (ILO)'s *Economically Active Population Estimates and Populations*.

The projections for population, investment, skilled labor and unskilled labor obtained for over 150 countries were aggregated, and the growth rates were calculated to obtain the macroeconomic shocks describing the baseline. Changes in the capital stocks were not imposed exogenously, but were determined endogenously as the accumulation of projected investment. Any changes in real GDP not explained by the changes in endowments are attributed to technological change.

In addition, policy projections are also introduced into the baseline. The policies included in the baseline are those which are already agreed upon and legally binding, including the ASEAN-China, ASEAN-Korea, ASEAN-Japan, and ASEAN-Australia-New Zealand FTAs.

3.2 Policy Scenarios

Welfare and sectoral output effects of alternative sequencing of FTAs are to be evaluated here. The following five scenarios, as well as the global trade liberalization (GTL) scenario, are designed:

Scenario 1: EU-Korea FTA and EU-ASEAN FTA over the period 2013-2015, ASEAN+3 FTA over the period 2016-2020, and FTAAP over the period 2021-2025.

Scenario 2: EU-Korea FTA and EU-ASEAN FTA over the period 2013-2015, and ASEAN+3 FTA over the period 2016-2025.

Scenario 3: EU-Korea FTA and EU-ASEAN FTA over the period 2013-2015, and EU+ASEAN+3 FTA over the period 2016-2025.

Scenario 4: ASEAN+3 FTA over the period 2013-2020, and FTAAP over the period 2021-2025.

Scenario 5: FTAAP over the period 2013-2025.

GTL: Global trade liberalization over the period 2016-2030.

It is assumed that tariff rates decline linearly during the period in consideration among the member countries. One can design an infinite number of scenarios, but we have chosen to limit to the above five scenarios. In scenarios 1-3, the EU-Korea and EU-ASEAN FTAs are assumed to be implemented by 2015, before a region-wide FTA in the Asia-Pacific region starts. The EU has launched a new generation of FTAs under the "Global Europe" initiative, and the EU-Korea FTA will be the first one to be implemented under this initiative. It has been negotiating an FTA with ASEAN since 2007. The EU-Korea and EU-ASEAN FTAs are followed by ASEAN+3 FTA, FTAAP and EU+ ASEAN+3 FTA in these scenarios. In scenario 4 ASEAN+3 FTA is followed by FTAAP, while in scenario 5 countries in the Asia-Pacific are assumed to implement FTAAP without any additional FTAs.

It should be noted that some of the expected liberalization are not considered in this study because of unavailability of necessary data. First, investment liberalization among the member countries are not considered because it requires the data on foreign direct investment (FDI) flows by source and host countries and industry, which are unavailable. A challenging extension of the paper would be to endogenize FDI flows to consider attraction of these flows to developing member countries, which may have a significant impact, as were the cases of Mexico joining NAFTA (1994) and Spain and Portugal joining the EU (1986). Second, NTBs are not incorporated in this version due to a lack of reliable empirical estimates. However, NTBs exists in trade in services, motor vehicles, pharmaceutical products, and agricultural and food products. In these sectors regulatory

and other barriers, such as stringent standards and testing and certification procedures, exist. Thus, reductions of NTBs are expected to enlarge the benefits of the FTAs.

4. Empirical Findings

4.1 Welfare Effects of Alternative Sequencing of FTAs

Economic welfare is largely determined by four factors: (1) allocative efficiency, (2) the terms of trade, (3) the contribution to equivalent variation (EV) of change in the price of capital investment goods, and (4) the contribution to EV of change in equity owned by a region. The fourth factor is determined by the change in equity income from ownership of capital endowments, and it can be further decomposed into three parts: a change in the domestic capital stock, a change in household income earned on capital abroad, and a change in the domestic capital owned by foreigners.

With respect to these four factors, the direction of a welfare change may be summarized as follows. The allocative efficiency effect is generally positive for members of a particularly FTA. It can become negative when the extent of trade diversion is considerably large. The terms-of-trade effect is usually positive for the members with low average initial tariffs and negative for those with high initial tariffs. Brown (1987) shows that monopoly power implicit in national product differentiation is the source of strong terms-of-trade effects resulting from tariff changes in Armington-type models. An increase in the price of capital investment goods generally raises welfare. A welfare change resulting from a change in the equity holdings is positive if the sum of the region's foreign income receipts and an increase in the domestic capital stock is greater than the foreign income payment, and vice versa.

The welfare results for the five policy scenarios, as percentage point deviation in utility from the baseline for the years 2015, 2020, 2025 and 2030, are summarized in Table 3. Under scenarios 1-3, the welfare level of Korea, ASEAN-5 and the rest of ASEAN increases in 2015, which results from their FTAs with the EU. While Korea's welfare increases more substantially in 2020-2030, ASEAN-5 and the rest of ASEAN's welfare decreases in many of the years from 2020. This is largely caused by deteriorations in their

terms of trade that are greater than efficiency gains under ASEAN+3 FTA, FTAAP and EU+ASEAN+3 FTA. The EU's welfare is predicted to increase by only 0.04% in 2015 under the first three scenarios, but the welfare gain increases to 0.24% in 2030 under the EU+ASEAN+3 FTA (scenario 3). The non-member regions' welfare decreases a little in 2015.

When ASEAN+3 FTA, FTAAP and EU+ASEAN+3 FTA are being implemented in or after 2016, noticeable differences in welfare changes surface. For example, in 2030 welfare changes range from 3.36% for Korea in scenario 2 to -4.94% for the rest of FTAAP in scenario 1. The rest of FTAAP (consisting of Chile, Peru and Russia) is dominated by Russia in terms of real GDP and trade volume. Since Russia's trade with the APEC countries is relatively small compared with the EU, significant trade diversion might occur for Russia when FTAAP is formed. The EV decomposition reveals that allocative efficiency effect is negative and accounts for 83% of the welfare loss for the rest of FTAAP, suggesting that trade diversion is significantly greater than trade diversion for the region.

Whereas the percentage changes in welfare for Japan are comparable to those found in previous studies (e.g., Kawai and Wignaraja, 2007; Lee et al., 2004, 2009; Lee and van der Mensbrugghe, 2008), those for China are substantially smaller and are negative in some cases. The small welfare effect for China is likely to be caused by five factors. First, since most of the previous studies estimating the effects of FTAs in Asia employ an earlier version of the GTAP database, the initial tariff rates used in this study is different from those used in earlier studies. After China's accession to the WTO in 2001, its tariff rates on most products have been reduced considerably, thereby reducing the extent of efficiency gains from an FTA. Second, only tariff liberalization is considered in this paper, while the removal of NTBs and/or a reduction in frictional trade costs resulting from low administrative and technical barriers (e.g., simplification of customs procedures) are considered in a number of previous studies. Third, the current version of the Dynamic GTAP model does not incorporate the exports-productivity effect as does the LINKAGE model used by Lee et al. (2004, 2009) and Lee and van der Mensbrugghe (2008). There is empirical evidence that productivity of firms that export is higher than that of firms that do

not, partly because higher standards are required to access and penetrate the export market than the domestic market.[2] Earlier studies show that China's welfare gains from regional integration increase substantially when the exports-productivity effect is incorporated. [3] Fourth, most of the previous studies do not incorporate the ASEAN-China FTA in the baseline. The inclusion of this FTA reduces percentage deviations in the welfare level of China from the baseline. Finally, the terms-of-trade effect is almost always negative for China, largely offsetting the efficiency gains. Under scenario 2, the negative terms-of-trade effect is larger than the efficiency gains in all years.

When the FTAAP is being implanted under scenarios 1, 4 and 5, the welfare gains for Australia/New Zealand and North America are modest, while Taiwan's welfare increases substantially. Since Taiwan is not a member of the ASEAN+3 grouping and its welfare decreases under scenarios 2 and 3, it has a strong incentive to convince the APEC members of the benefits of FTAAP. However, Russia, aggregated to the rest of FTAAP, incurs welfare losses for the reason that has been stated above.

Under global trade liberalization (GTL), the welfare levels of all regions except ASEAN-5, the rest of ASEAN and the rest of the world increase. In those three regions, positive allocative efficiency is more than offset by the negative sum of the terms of trade, the contribution to EV of change in the price of capital investment goods, and the contribution to EV of change in equity owned by a region. While a large negative terms-of-trade effect is the most important factor for the rest of ASEAN and the rest of the world, a large increase in the net foreign equity holdings and the resulting foreign income payments are the most important factor for ASEAN-5.

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[2] Using a 1983-1992 panel data set covering more than 50,000 U.S. manufacturing plants, Bernard and Jensen (2004) find that plants which always exported during the period were 8-9% more productive than plants that never exported. In addition, if a firm began to export during the period, its productivity grew until it reached nearly the level of firms that exported throughout the period. Similarly, when a firm stopped exporting during the period, its productivity declined, so the exports-productivity link is reversible.

[3] For example, Lee et al. (2009) show that in an ASEAN+3 FTA China's welfare gain increases from 0.10% under the removal of bilateral tariffs among the member countries to 0.77% when a 2.5% reduction in administrative and technical barriers is added. Then it further increases to 2.61% when sectoral productivity becomes endogenous and is positively related to the sectoral export-output ratio.

4.2 Sectoral Output Adjustments and Its Rankings

Structural adjustments and resource reallocations result from trade policy changes including the implementation of FTAs. Sectoral output adjustments, expressed as percentage deviations from the baseline for the years 2015, 2020, 2025 and 2030, and the rankings of sectors ranging from the largest percentage increase to the largest percentage reduction in output for the corresponding years for the five alternative sequencings of FTAs for Japan, China, Korea, ASEAN-5 and the rest of ASEAN are provided in Appendix Tables A.1-A.5. Evidently, the sequencings of FTAs and differences in the initial tariff rates across sectors play a critical role in determining the direction of the adjustments in sectoral output. Other factors that affect the magnitude and direction of output adjustments for each product category include the import-demand ratio, the export-output ratio, the share of each imported intermediate input in total costs, and the elasticity of substitution between domestic and imported products.[4] [Some comments on sectoral output results will be added later.]

For each of the five FTA sequencings, the Spearman rank correlation coefficients between sectoral adjustment rankings in 2015 and 2020, 2020 and 2025, and 2025 and 2030 are computed for Japan, China, Korea, ASEAN-5 and the rest of ASEAN. Since all FTAs considered in this study are assumed to be implemented by 2025, sectoral adjustment rankings under global trade liberalization are used for the year 2030. The results are summarized in Table 4.

After constructing Table 4, we realize that the five policy scenarios must be redesigned. When evaluating the effects of particular FTAs, the FTAs that are currently being implemented need to be included in the baseline scenario, so that the effects of any

[4] A sector with a larger import-demand ratio generally suffers from proportionately larger output contraction through greater import penetration when initial tariff levels are relatively high. In contrast, a sector with a higher export-output ratio typically experiences a larger extent of output expansion, as a result of the removal of tariffs in the member countries. The share of imported intermediate inputs in the total cost of a downstream industry (e.g., the share of imported textiles in the cost of the apparel industry) would evidently affect the magnitude and direction of output adjustments in the latter sector. Finally, the greater the values of substitution elasticities between domestic and imported products, the greater the sensitivity of the import-domestic demand ratio to changes in the relative price of imports, thereby magnifying the effects of FTAs.

specific FTA can be assessed more accurately. However, when an objective of the study is to determine the rank correlation of sectoral adjustments between different FTAs, the FTAs that have already being implemented but not yet completed need to be included in the FTA sequencings and not in the baseline scenario. It implies that the ASEAN-China, ASEAN-Korea, ASEAN-Japan, and ASEAN-Australia-New Zealand FTAs should have been placed at the beginning of each scenario for FTA sequencings. Since Japan and China do not belong to any FTA in 2015 under scenario 1-3, the computed Spearman rank correlation coefficients between sectoral adjustment rankings in 2015 and 2020 for the two countries in the first three scenarios are rather meaningless. Thus, we omit the six rank correlation coefficients for 2015-2020.

Japan has relatively high rank correlation coefficients under all five scenarios, suggesting that the extent of sectoral adjustments between FTAs and between a regionwide FTA and GTL would be relatively mild. Korea has the highest average coefficients among the five regions, implying that the transition between FTAs as well as between a regional FTA and GTL would be rather smooth. For the remaining three regions, some coefficients are less than 0.5, which indicate there can be considerable sectoral adjustments between FTAs.

For China, the transition from the ASEAN+3 FTA to FTAAP involves considerable adjustments in some sectoral output. Specifically, under the ASEAN+3 FTA the rankings of output changes (%) in meats and other grain are respectively the 1st and 3rd; however, under FTAAP that include major agricultural exporters such as the United States and Australia the rankings in the same products respectively fall to 26th and 17th within China. In addition, the transition from the ASEAN+3 FTA to global free trade require some notable sectoral adjustments.

For ASEAN-5, the transition from the EU-ASEAN FTA to the ASEAN+3 FTA under scenario 1, as well as from FTAAP to GTL, entail some notable changes in sectoral output. Under the EU-ASEAN FTA the rankings of percentage changes in output of rice, petroleum products, other transport equipment and other grains are 3rd, 10th, 20th and 22nd, respectively. However, under the ASEAN+3 FTA the rankings of the same products change to 26th, 22nd, 9th and 7th, respectively. Similarly, the rankings change considera-

bly in the transition from FTAAP to GTL for meats, other food products, apparel, wood and paper, and construction and utilities.

For the rest of ASEAN, the Spearman rank correlation coefficient between the FTAAP and GTL under scenario 1, as well as that between the ASEAN+3 FTA and GTL under scenario 2, are either very low (0.16) or negative (-0.06). A closer examination would be needed because the rankings of textiles and apparel fall from the top 3 to the bottom 3. The ranking of petroleum products also moves down considerably, while the rankings of rice, other crops, fossil fuels and natural resources move up substantially. Furthermore, the rank correlations between 2015 and 2020, as well as between 2020 and 2025, under scenario 3 for this region are relatively small.

If a reduction in adjustment costs arising from changes in the composition of output and the resulting reallocation of labor across sectors is an important consideration, scenario 5 that would gradually implement FTAAP appears to be very attractive. However, the long-term benefits of a large regionwide FTA must be weighed against the opportunity costs of not implementing smaller FTAs, particularly when welfare gains and increases in the market shares of some key products in the partner countries may be realized.

5. Conclusion

In this paper, we have used the Dynamic GTAP model to investigate how different sequencings of FTAs might affect the welfare changes and sectoral output adjustments. Since the findings are both preliminary and tentative, we list several points that have been observed:

1. To have more accurate estimates, scenarios for FTA sequencings should include the FTAs that are currently being implemented (e.g. ASEAN+1 FTAs) at the beginning and remove them from the baseline.
2. Large disparities in the initial tariff rates across FTA members and the incorporation of the Armington assumption result in large terms-of-trade effects, which might dominate other welfare effects. In general, the smaller the values of trade substitution elasticities, the greater the terms-of-trade effects. Thus, it might be desirable to increase the values of trade substitution elasticities.

3. Depending upon how much additional work is involved, it might be desirable to incorporate the exports-productivity effect and FDI-productivity effect into the model. Endogenizing an FDI effect at the sectoral level would be extremely difficult because the data on bilateral FDI flows by source and host countries and industry are currently available only in a few countries. However, incorporating the FDI-productivity effect at the aggregate level might be feasible.

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Table 1: Regional and sectoral aggregation

A. Regional aggregation

Country/region	Corresponding economies/regions in the GTAP database
Japan	Japan
China	China, Hong Kong
Korea	Korea
Taiwan	Taiwan
ASEAN-5	Indonesia, Malaysia, Philippines, Singapore, Thailand
Rest of ASEAN	Cambodia, Laos, Myanmar, Vietnam, rest of Southeast Asia
Australia/New Zealand	Australia, New Zealand
North America	United States, Canada, Mexico
Rest of FTAAP	Chile, Peru, Russia
EU-27	27 EU member states
Rest of world	All the other economies/regions

B. Sectoral aggregation

Sector	Corresponding commodities/sectors in the GTAP database
Rice	Paddy rice, processed rice
Other grains	Wheat, cereal grains nec
Sugar	Sugar, sugar cane and sugar beet
Other crops	Vegetables and fruits, oil seeds, plant-based fibers, crops nec
Livestock	Bovine cattle, sheep and goats, animal products nec, raw milk, wool
Fossil fuels	Coal, oil, gas
Natural resources	Forestry, fishing, minerals nec
Meats	Bovine cattle, sheep and goat, horse meat products, meat products nec
Dairy products	Dairy products
Other food products	Vegetable oils, food products nec, beverages and tobacco products.
Textiles	Textiles
Apparel	Wearing apparel, leather products
Wood and paper	Wood products, paper products, publishing
Petroleum products	Petroleum, coal products
Chemical products	Chemical, rubber, plastic products
Metal	Iron and steel, nonferrous metal, fabricated metal products
Machinery	Machinery and equipment
Electronic equipment	Electronic equipment
Motor vehicles	Motor vehicles and parts
Other transport equip.	Transport equipment nec
Other manufactures	Mineral products nec, manufactures nec
Construction and utilities	Construction, electricity, gas manufacture and distribution, water
Trade and transport	Trade, sea transport, air transport, transport nec
Financial services	Insurance, financial services nec
Other private services	Communication, business services, recreation and other services
Government services	Public administration and defense, education, health services

Source: GTAP database, version 7.

Note: nec = not elsewhere classified.

Table 2: Initial sectoral tariff rates, 2004 (%)

Sector	Japan	China	Korea	Taiwan	ASEAN-5	Rest of ASEAN	Australia/ New Zld	North America	Rrest of FTAAP	EU-27	Rest of world
Rice	410.5	1.1	429.2	402.0	17.8	7.6	0.0	1.7	7.5	42.0	14.9
Other grains	51.8	0.2	4.2	1.5	4.4	2.7	0.0	3.6	5.9	6.5	14.4
Sugar	210.2	0.3	4.3	97.9	17.4	7.9	0.0	26.5	23.7	53.2	16.9
Other crops	3.6	3.1	68.9	10.0	10.5	13.6	0.5	2.4	6.1	5.3	12.8
Livestock	6.9	11.8	5.7	3.0	2.3	3.5	0.0	1.7	5.4	0.7	6.0
Fossil fuels	0.0	0.2	4.2	4.9	0.4	0.2	0.0	0.2	2.9	0.0	4.3
Natural resources	0.8	0.7	3.3	4.2	1.8	3.2	0.1	0.4	2.2	0.3	5.7
Meats	49.9	5.0	31.7	31.5	5.4	15.8	0.4	8.0	13.8	8.3	27.8
Dairy products	29.3	8.0	45.3	9.8	3.2	14.3	4.9	33.2	7.2	2.2	13.2
Other food products	11.5	6.1	32.4	17.5	16.4	24.7	2.6	4.4	9.7	2.5	20.0
Textiles	7.0	9.5	9.4	7.0	9.5	24.8	11.2	6.6	10.0	2.2	12.7
Apparel	10.5	10.0	10.3	8.6	6.5	23.0	16.0	10.1	16.1	3.3	12.6
Wood and paper	1.0	3.6	3.2	2.4	6.2	10.3	2.8	0.3	9.4	0.1	7.0
Petroleum products	2.0	5.4	5.1	4.9	2.4	13.3	0.6	1.3	4.4	0.6	8.1
Chemical products	0.9	8.7	6.3	3.1	4.8	4.8	2.7	1.3	7.5	0.4	6.1
Metal	0.6	4.7	3.2	2.3	5.1	4.4	2.9	1.1	6.5	0.4	6.9
Machinery	0.1	6.5	6.1	2.6	3.5	6.2	3.2	1.2	6.3	0.4	6.4
Electronic equipment	0.0	1.7	1.0	0.4	1.0	7.0	0.7	0.4	6.5	0.7	5.0
Motor vehicles	0.0	20.1	8.0	31.4	21.5	35.1	8.2	1.3	11.9	1.0	10.3
Other transport equip.	0.0	2.9	1.9	2.1	1.9	11.9	0.8	0.7	8.6	0.7	5.4
Other manufactures	1.0	6.0	8.1	5.5	5.1	14.4	3.7	1.9	11.8	0.7	7.8
Construction and utilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2
Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: GTAP database, version 7.

Table 3: The welfare effects of alternative scenarios
(Percentage point deviation in utility from the baseline)

	2015	2020	2025	2030
Scenario 1				
Japan	-0.02	0.40	0.58	0.61
China	-0.06	-0.13	0.10	0.13
Korea	0.30	2.34	2.93	3.05
Taiwan	-0.01	-0.62	2.42	2.80
ASEAN-5	0.28	-0.25	-0.37	-0.41
Rest of ASEAN	0.80	0.14	-0.40	0.02
Australia/New Zld	-0.03	-0.16	0.23	0.39
North America	-0.01	-0.05	0.25	0.29
Rest of FTAAP	-0.01	-0.07	-4.79	-4.94
EU-27	0.04	-0.01	-0.35	-0.51
Rest of world	-0.03	-0.11	-0.21	-0.12
Scenario 2				
Japan	-0.02	0.14	0.45	0.55
China	-0.06	-0.07	-0.10	-0.07
Korea	0.30	1.30	2.81	3.36
Taiwan	-0.01	-0.32	-0.68	-0.76
ASEAN-5	0.28	0.14	-0.27	-0.34
Rest of ASEAN	0.80	0.55	0.15	0.14
Australia/New Zld	-0.03	-0.10	-0.18	-0.19
North America	-0.01	-0.03	-0.05	-0.06
Rest of FTAAP	-0.01	-0.04	-0.06	-0.03
EU-27	0.04	0.02	-0.02	-0.03
Rest of world	-0.03	-0.08	-0.12	-0.12
Scenario 3				
Japan	-0.02	0.17	0.49	0.56
China	-0.06	0.16	0.24	0.23
Korea	0.30	1.18	2.48	2.93
Taiwan	-0.01	-0.40	-0.90	-1.07
ASEAN-5	0.28	-0.02	-0.59	-0.69
Rest of ASEAN	0.80	0.13	-0.55	-0.43
Australia/New Zld	-0.03	-0.14	-0.25	-0.26
North America	-0.01	-0.05	-0.10	-0.11
Rest of FTAAP	-0.01	-0.06	-0.07	-0.01
EU-27	0.04	0.09	0.18	0.24
Rest of world	-0.03	-0.14	-0.24	-0.23

Definitions of scenarios:

Scenario 1: EU-Korea FTA and EU-ASEAN FTA over the period 2013-2015, ASEAN+3 FTA over the period 2016-2020, and FTAAP over the period 2021-2025. Scenario 2: EU-Korea FTA and EU-ASEAN FTA over the period 2013-2015, and ASEAN+3 FTA over the period 2016-2025. Scenario 3: EU-Korea FTA and EU-ASEAN FTA over the period 2013-2015, and EU+ASEAN+3 FTA over the period 2016-2025.

Source: Model simulations.

Table 3: The welfare effects of alternative scenarios (continued)
(Percentage point deviation in utility from the baseline)

	2015	2020	2025	2030
Scenario 4				
Japan	0.11	0.44	0.63	0.65
China	-0.01	-0.06	0.17	0.18
Korea	0.54	2.03	2.56	2.71
Taiwan	-0.22	-0.65	2.43	2.84
ASEAN-5	-0.13	-0.59	-0.69	-0.68
Rest of ASEAN	-0.16	-0.59	-1.04	-0.50
Australia/New Zld	-0.04	-0.13	0.27	0.44
North America	-0.01	-0.04	0.26	0.31
Rest of FTAAP	-0.02	-0.05	-4.77	-4.93
EU-27	-0.02	-0.06	-0.41	-0.57
Rest of world	-0.03	-0.07	-0.16	-0.08
Scenario 5				
Japan	0.11	0.31	0.57	0.61
China	-0.01	0.19	0.18	0.14
Korea	0.54	1.12	2.27	2.55
Taiwan	-0.22	1.47	2.74	2.91
ASEAN-5	-0.13	-0.44	-0.67	-0.70
Rest of ASEAN	-0.16	-0.32	-0.79	-0.38
Australia/New Zld	-0.04	0.20	0.41	0.49
North America	-0.01	0.13	0.27	0.31
Rest of FTAAP	-0.02	-1.86	-4.84	-4.84
EU-27	-0.02	-0.24	-0.47	-0.59
Rest of world	-0.03	-0.06	-0.11	-0.04
GTL				
Japan	n.a.	0.48	0.90	1.13
China	n.a.	0.70	1.19	1.27
Korea	n.a.	1.84	3.64	4.90
Taiwan	n.a.	1.89	3.78	4.96
ASEAN-5	n.a.	0.05	-0.02	-0.33
Rest of ASEAN	n.a.	-1.34	-2.05	-1.85
Australia/New Zld	n.a.	-0.04	0.02	0.27
North America	n.a.	0.14	0.24	0.31
Rest of FTAAP	n.a.	1.37	1.99	1.26
EU-27	n.a.	0.32	0.49	0.49
Rest of world	n.a.	-0.54	-0.58	-0.21

Definitions of scenarios:

Scenario 4: ASEAN+3 FTA over the period 2013-2020, and FTAAP over the period 2021-2025. Scenario 5: FTAAP over the period 2013-2025. GTL: Global trade liberalization over the period 2016-2030.

Source: Model simulations.

Table 4: Spearman rank correlation coefficients between sectoral adjustment rankings in 2015-20, 2020-25 and 2025-30 for Japan, China, Korea and ASEAN regions under each scenario

	2015-20	2020-25	2025-30
Scenario 1			
Japan	-0.54	0.92	0.63
China	-0.31	0.37	0.93
Korea	0.71	0.90	0.83
ASEAN-5	0.44	0.88	0.42
Rest of ASEAN	0.55	0.85	0.19
Scenario 2			
Japan	-0.41	0.93	0.59
China	-0.21	0.93	0.48
Korea	0.89	0.88	0.78
ASEAN-5	0.86	0.59	0.58
Rest of ASEAN	0.78	0.74	-0.06
Scenario 3			
Japan	-0.48	0.97	0.66
China	-0.32	0.94	0.77
Korea	0.84	0.92	0.88
ASEAN-5	0.79	0.48	0.60
Rest of ASEAN	0.35	0.29	0.51
Scenario 4			
Japan	1.00	0.98	0.63
China	1.00	0.42	0.93
Korea	1.00	0.70	0.87
ASEAN-5	1.00	0.73	0.58
Rest of ASEAN	1.00	0.67	0.71
Scenario 5			
Japan	0.99	0.99	0.63
China	0.88	0.94	0.94
Korea	0.96	0.99	0.87
ASEAN-5	0.83	0.89	0.57
Rest of ASEAN	0.94	0.83	0.69

Definitions of scenarios:

Scenario 1: EU-Korea FTA and EU-ASEAN FTA over the period 2013-2015, ASEAN+3 FTA over the period 2016-2020, and FTAAP over the period 2021-2025. Scenario 2: EU-Korea FTA and EU-ASEAN FTA over the period 2013-2015, and ASEAN+3 FTA over the period 2016-2025. Scenario 3: EU-Korea FTA and EU-ASEAN FTA over the period 2013-2015, and EU+ASEAN+3 FTA over the period 2016-2025. Scenario 4: ASEAN+3 FTA over the period 2013-2020, and FTAAP over the period 2021-2025. Scenario 5: FTAAP over the period 2013-2025. GTL: Global trade liberalization over the period 2016-2030.

Source: The authors' calculation based on the results of sectoral rankings provided in Appendix Tables A.1-A.5.

Appendix Tables

Table A.1: Japan's sectoral output adjustments and its rankings under alternative scenarios
(Percentage deviation from the baseline)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 1								
Rice	4.134	-56.668	-57.731	-56.170	1	26	26	26
Other grains	-0.001	-11.200	-53.309	-50.955	16	24	25	24
Sugar	0.287	-0.688	-1.233	-1.694	5	18	18	13
Other crops	0.078	-1.868	-3.272	-3.476	7	20	19	19
Livestock	0.049	-6.856	-22.493	-22.057	9	22	23	23
Fossil fuels	0.013	-0.132	-0.130	-0.570	12	13	15	9
Natural resources	-0.061	0.136	0.424	0.350	22	8	9	5
Meats	0.073	-14.584	-49.843	-51.615	8	25	24	25
Dairy products	0.028	-0.412	-3.440	-4.609	10	16	20	21
Other food products	-0.051	0.009	0.230	0.000	21	10	11	7
Textiles	0.718	12.507	13.664	15.062	2	1	1	1
Apparel	0.201	-8.756	-8.932	-10.299	6	23	22	22
Wood and paper	-0.014	-0.469	-0.611	-1.853	18	17	16	14
Petroleum products	-0.041	1.370	1.066	-1.425	20	4	7	12
Chemical products	-0.023	2.652	1.929	0.833	19	2	4	4
Metal	-0.132	0.295	0.705	-3.047	24	7	8	16
Machinery	0.012	1.890	2.227	-3.281	13	3	3	17
Electronic equipment	0.512	-1.747	-0.730	-3.454	4	19	17	18
Motor vehicles	-0.528	-0.173	3.605	4.484	26	15	2	2
Other transport equip.	0.717	-4.156	-3.928	3.603	3	21	21	3
Other manufactures	-0.090	0.761	1.335	-2.238	23	6	6	15
Construction and utilities	-0.230	0.876	1.384	-4.328	25	5	5	20
Trade and transport	0.006	-0.015	0.247	-0.193	15	11	10	8
Financial services	0.014	-0.159	-0.080	-0.860	11	14	14	11
Other private services	-0.009	0.026	0.201	-0.797	17	9	12	10
Government services	0.008	-0.026	0.002	0.283	14	12	13	6

Note: For sectoral rankings, "1" indicates the largest percentage increase in output among all the sectors, and "26" indicates the largest percentage reduction in output.

Source: Model simulations.

Table A.1: Japan's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 2								
Rice	4.134	-0.702	-57.751	-56.170	1	20	26	26
Other grains	-0.001	-4.978	-16.293	-50.955	16	25	24	24
Sugar	0.287	-0.037	-0.867	-1.694	5	12	18	13
Other crops	0.078	-0.732	-2.412	-3.476	7	21	20	19
Livestock	0.049	-3.136	-9.652	-22.057	9	23	23	23
Fossil fuels	0.013	-0.056	-0.124	-0.570	12	13	15	9
Natural resources	-0.061	-0.033	0.172	0.350	22	11	9	5
Meats	0.073	-6.591	-21.554	-51.615	8	26	25	25
Dairy products	0.028	-0.202	-0.604	-4.609	10	15	17	21
Other food products	-0.051	-0.204	-0.035	0.000	21	16	13	7
Textiles	0.718	4.766	12.111	15.062	2	1	1	1
Apparel	0.201	-4.349	-9.453	-10.299	6	24	22	22
Wood and paper	-0.014	-0.254	-0.512	-1.853	18	17	16	14
Petroleum products	-0.041	0.625	1.796	-1.425	20	4	4	12
Chemical products	-0.023	1.229	3.115	0.833	19	2	2	4
Metal	-0.132	0.061	0.377	-3.047	24	7	7	16
Machinery	0.012	0.906	2.065	-3.281	13	3	3	17
Electronic equipment	0.512	-0.624	-1.834	-3.454	4	19	19	18
Motor vehicles	-0.528	-0.570	0.375	4.484	26	18	8	2
Other transport equip.	0.717	-1.772	-3.917	3.603	3	22	21	3
Other manufactures	-0.090	0.248	0.785	-2.238	23	6	6	15
Construction and utilities	-0.230	0.261	0.981	-4.328	25	5	5	20
Trade and transport	0.006	-0.031	0.029	-0.193	15	10	11	8
Financial services	0.014	-0.082	-0.115	-0.860	11	14	14	11
Other private services	-0.009	-0.023	0.082	-0.797	17	8	10	10
Government services	0.008	-0.027	-0.009	0.283	14	9	12	6

Table A.1: Japan's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 3								
Rice	4.134	-1.491	-57.029	-56.170	1	22	26	26
Other grains	-0.001	-5.105	-16.030	-50.955	16	24	23	24
Sugar	0.287	-0.183	-1.105	-1.694	5	15	17	13
Other crops	0.078	-0.837	-2.596	-3.476	7	19	21	19
Livestock	0.049	-6.573	-16.538	-22.057	9	25	24	23
Fossil fuels	0.013	-0.070	-0.131	-0.570	12	12	13	9
Natural resources	-0.061	-0.092	0.082	0.350	22	13	9	5
Meats	0.073	-13.761	-36.746	-51.615	8	26	25	25
Dairy products	0.028	-0.894	-1.940	-4.609	10	20	19	21
Other food products	-0.051	-0.353	-0.343	0.000	21	17	15	7
Textiles	0.718	6.667	17.103	15.062	2	1	1	1
Apparel	0.201	-4.189	-9.093	-10.299	6	23	22	22
Wood and paper	-0.014	-0.324	-0.599	-1.853	18	16	16	14
Petroleum products	-0.041	0.597	1.726	-1.425	20	4	4	12
Chemical products	-0.023	1.229	3.163	0.833	19	2	2	4
Metal	-0.132	-0.035	0.278	-3.047	24	11	8	16
Machinery	0.012	0.601	1.524	-3.281	13	3	5	17
Electronic equipment	0.512	-0.404	-1.349	-3.454	4	18	18	18
Motor vehicles	-0.528	0.532	2.061	4.484	26	5	3	2
Other transport equip.	0.717	-0.894	-2.007	3.603	3	21	20	3
Other manufactures	-0.090	0.304	0.867	-2.238	23	6	6	15
Construction and utilities	-0.230	0.208	0.742	-4.328	25	7	7	20
Trade and transport	0.006	-0.023	0.051	-0.193	15	9	10	8
Financial services	0.014	-0.099	-0.143	-0.860	11	14	14	11
Other private services	-0.009	-0.031	0.048	-0.797	17	10	11	10
Government services	0.008	-0.019	-0.009	0.283	14	8	12	6

Table A.1: Japan's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 4								
Rice	-56.892	-56.892	-57.877	-56.170	26	26	26	26
Other grains	-11.223	-11.223	-53.357	-50.955	24	24	25	24
Sugar	-0.892	-0.892	-1.382	-1.694	18	18	18	13
Other crops	-1.916	-1.916	-3.327	-3.476	19	19	19	19
Livestock	-6.842	-6.842	-22.496	-22.057	22	22	23	23
Fossil fuels	-0.134	-0.134	-0.131	-0.570	15	15	15	9
Natural resources	0.258	0.258	0.524	0.350	9	9	9	5
Meats	-14.577	-14.577	-49.861	-51.615	25	25	24	25
Dairy products	-0.375	-0.375	-3.400	-4.609	17	17	20	21
Other food products	0.094	0.094	0.299	0.000	11	11	10	7
Textiles	11.798	11.798	13.123	15.062	1	1	1	1
Apparel	-8.848	-8.848	-8.979	-10.299	23	23	22	22
Wood and paper	-0.373	-0.373	-0.506	-1.853	16	16	16	14
Petroleum products	1.480	1.480	1.168	-1.425	4	4	7	12
Chemical products	2.869	2.869	2.193	0.833	2	2	4	4
Metal	0.556	0.556	0.997	-3.047	8	8	8	16
Machinery	2.014	2.014	2.432	-3.281	3	3	3	17
Electronic equipment	-1.964	-1.964	-0.737	-3.454	20	20	17	18
Motor vehicles	0.574	0.574	4.498	4.484	7	7	2	2
Other transport equip.	-4.532	-4.532	-4.138	3.603	21	21	21	3
Other manufactures	0.929	0.929	1.486	-2.238	6	6	6	15
Construction and utilities	1.149	1.149	1.566	-4.328	5	5	5	20
Trade and transport	0.033	0.033	0.293	-0.193	12	12	11	8
Financial services	-0.096	-0.096	-0.010	-0.860	14	14	14	11
Other private services	0.106	0.106	0.281	-0.797	10	10	12	10
Government services	-0.002	-0.002	0.033	0.283	13	13	13	6

Table A.1: Japan's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 5								
Rice	-0.619	-10.164	-57.922	-56.170	21	23	26	26
Other grains	-13.678	-35.357	-53.272	-50.955	26	26	25	24
Sugar	-0.017	-0.299	-1.445	-1.694	14	16	18	13
Other crops	-0.388	-1.610	-3.330	-3.476	19	19	19	19
Livestock	-4.750	-14.161	-22.516	-22.057	24	24	23	23
Fossil fuels	-0.031	-0.057	-0.090	-0.570	15	14	15	9
Natural resources	0.040	0.175	0.374	0.350	10	9	9	5
Meats	-9.841	-29.961	-49.866	-51.615	25	25	24	25
Dairy products	-0.474	-1.729	-3.425	-4.609	20	20	20	21
Other food products	0.049	0.041	0.260	0.000	9	12	11	7
Textiles	1.996	6.351	12.587	15.062	1	1	1	1
Apparel	-1.684	-5.188	-9.230	-10.299	23	22	22	22
Wood and paper	-0.134	-0.356	-0.566	-1.853	17	17	16	14
Petroleum products	0.097	0.444	1.120	-1.425	8	8	8	12
Chemical products	0.284	1.035	2.146	0.833	4	4	4	4
Metal	0.118	0.490	1.150	-3.047	7	7	7	16
Machinery	0.394	1.189	2.163	-3.281	3	3	3	17
Electronic equipment	-0.300	-0.753	-1.270	-3.454	18	18	17	18
Motor vehicles	0.744	2.266	4.642	4.484	2	2	2	2
Other transport equip.	-1.118	-2.815	-4.105	3.603	22	21	21	3
Other manufactures	0.251	0.792	1.408	-2.238	5	6	6	15
Construction and utilities	0.212	0.837	1.501	-4.328	6	5	5	20
Trade and transport	0.013	0.091	0.268	-0.193	11	10	10	8
Financial services	-0.048	-0.088	-0.051	-0.860	16	15	14	11
Other private services	0.010	0.082	0.229	-0.797	12	11	12	10
Government services	0.000	-0.008	-0.004	0.283	13	13	13	6

Table A.2: China's sectoral output adjustments and its rankings under alternative scenarios
(Percentage deviation from the baseline)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 1								
Rice	-0.138	9.712	7.358	8.849	21	2	2	5
Other grains	-0.050	3.329	0.036	1.583	18	3	16	11
Sugar	0.128	1.209	3.421	4.424	2	6	6	6
Other crops	0.031	-0.133	0.938	3.981	9	19	9	8
Livestock	-0.059	1.124	0.357	1.358	19	7	12	13
Fossil fuels	0.006	-0.012	-0.098	-0.244	13	14	18	21
Natural resources	-0.017	0.024	0.229	0.912	15	12	13	17
Meats	-0.096	9.719	-3.321	-4.440	20	1	26	25
Dairy products	-0.153	2.559	5.596	10.918	22	4	4	3
Other food products	-0.221	0.920	-0.134	0.687	25	8	19	18
Textiles	0.094	-1.083	6.460	16.734	3	25	3	2
Apparel	-0.717	0.678	12.539	26.486	26	11	1	1
Wood and paper	0.006	-0.132	-0.149	1.274	14	18	20	14
Petroleum products	0.011	-0.534	0.123	-1.315	11	23	15	23
Chemical products	0.085	-0.987	-1.881	-1.803	5	24	24	24
Metal	0.011	-0.404	-0.265	0.061	12	21	21	19
Machinery	0.048	-0.506	-0.554	-0.301	6	22	23	22
Electronic equipment	0.092	1.301	0.732	1.752	4	5	10	10
Motor vehicles	-0.169	-3.198	-2.914	-4.773	23	26	25	26
Other transport equip.	0.330	0.825	2.242	9.127	1	9	7	4
Other manufactures	-0.028	-0.110	1.038	3.031	16	16	8	9
Construction and utilities	-0.181	0.710	4.053	4.203	24	10	5	7
Trade and transport	0.041	0.008	0.538	1.454	8	13	11	12
Financial services	0.041	-0.125	-0.051	0.983	7	17	17	16
Other private services	0.018	-0.082	0.184	1.207	10	15	14	15
Government services	-0.029	-0.249	-0.526	-0.041	17	20	22	20

Note: For sectoral rankings, "1" indicates the largest percentage increase in output among all the sectors, and "26" indicates the largest percentage reduction in output.

Source: Model simulations.

Table A.2: China's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 2								
Rice	-0.138	0.217	7.728	8.849	21	9	2	5
Other grains	-0.050	1.464	3.532	1.583	18	2	3	11
Sugar	0.128	0.171	1.381	4.424	2	10	5	6
Other crops	0.031	0.072	0.088	3.981	9	11	13	8
Livestock	-0.059	0.530	1.291	1.358	19	5	6	13
Fossil fuels	0.006	-0.003	-0.004	-0.244	13	13	18	21
Natural resources	-0.017	-0.026	0.054	0.912	15	16	14	17
Meats	-0.096	4.413	9.152	-4.440	20	1	1	25
Dairy products	-0.153	0.439	3.289	10.918	22	6	4	3
Other food products	-0.221	0.374	1.053	0.687	25	7	8	18
Textiles	0.094	-0.337	-0.717	16.734	3	24	24	2
Apparel	-0.717	-0.021	0.639	26.486	26	14	10	1
Wood and paper	0.006	-0.059	0.003	1.274	14	19	17	14
Petroleum products	0.011	-0.249	-0.469	-1.315	11	23	23	23
Chemical products	0.085	-0.418	-0.723	-1.803	5	25	25	24
Metal	0.011	-0.172	-0.227	0.061	12	21	21	19
Machinery	0.048	-0.220	-0.282	-0.301	6	22	22	22
Electronic equipment	0.092	0.670	1.152	1.752	4	3	7	10
Motor vehicles	-0.169	-1.515	-2.829	-4.773	23	26	26	26
Other transport equip.	0.330	0.589	0.784	9.127	1	4	9	4
Other manufactures	-0.028	-0.043	0.039	3.031	16	18	15	9
Construction and utilities	-0.181	0.256	0.593	4.203	24	8	11	7
Trade and transport	0.041	0.026	0.106	1.454	8	12	12	12
Financial services	0.041	-0.041	-0.012	0.983	7	17	19	16
Other private services	0.018	-0.025	0.008	1.207	10	15	16	15
Government services	-0.029	-0.119	-0.191	-0.041	17	20	20	20

Table A.2: China's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 3								
Rice	-0.138	0.851	9.784	8.849	21	8	2	5
Other grains	-0.050	1.395	3.531	1.583	18	4	6	11
Sugar	0.128	1.256	8.172	4.424	2	7	5	6
Other crops	0.031	0.768	2.153	3.981	9	9	8	8
Livestock	-0.059	0.534	0.848	1.358	19	10	10	13
Fossil fuels	0.006	-0.038	-0.045	-0.244	13	15	17	21
Natural resources	-0.017	-0.158	-0.071	0.912	15	17	18	17
Meats	-0.096	1.339	0.173	-4.440	20	6	15	25
Dairy products	-0.153	2.732	8.387	10.918	22	3	4	3
Other food products	-0.221	0.229	0.984	0.687	25	11	9	18
Textiles	0.094	4.306	9.227	16.734	3	2	3	2
Apparel	-0.717	8.199	17.381	26.486	26	1	1	1
Wood and paper	0.006	-0.601	-0.587	1.274	14	22	21	14
Petroleum products	0.011	-0.393	-0.516	-1.315	11	20	20	23
Chemical products	0.085	-0.968	-1.288	-1.803	5	24	23	24
Metal	0.011	-0.943	-1.319	0.061	12	23	24	19
Machinery	0.048	-1.340	-1.882	-0.301	6	25	25	22
Electronic equipment	0.092	0.014	0.644	1.752	4	12	11	10
Motor vehicles	-0.169	-3.106	-5.688	-4.773	23	26	26	26
Other transport equip.	0.330	-0.469	-0.662	9.127	1	21	22	4
Other manufactures	-0.028	-0.102	0.311	3.031	16	16	13	9
Construction and utilities	-0.181	1.392	2.708	4.203	24	5	7	7
Trade and transport	0.041	-0.021	0.324	1.454	8	13	12	12
Financial services	0.041	-0.198	0.033	0.983	7	19	16	16
Other private services	0.018	-0.028	0.260	1.207	10	14	14	15
Government services	-0.029	-0.159	-0.287	-0.041	17	18	19	20

Table A.2: China's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 4								
Rice	9.682	9.682	7.417	8.849	2	2	2	5
Other grains	3.415	3.415	0.066	1.583	3	3	17	11
Sugar	1.139	1.139	3.363	4.424	9	9	6	6
Other crops	-0.138	-0.138	0.912	3.981	19	19	10	8
Livestock	1.268	1.268	0.449	1.358	8	8	12	13
Fossil fuels	-0.010	-0.010	-0.097	-0.244	18	18	20	21
Natural resources	0.107	0.107	0.305	0.912	12	12	13	17
Meats	10.096	10.096	-3.210	-4.440	1	1	26	25
Dairy products	3.128	3.128	5.899	10.918	4	4	4	3
Other food products	1.275	1.275	0.107	0.687	7	7	16	18
Textiles	-1.029	-1.029	6.541	16.734	25	25	3	2
Apparel	1.685	1.685	13.453	26.486	5	5	1	1
Wood and paper	0.028	0.028	-0.003	1.274	16	16	19	14
Petroleum products	-0.452	-0.452	0.200	-1.315	23	23	15	23
Chemical products	-0.849	-0.849	-1.731	-1.803	24	24	24	24
Metal	-0.262	-0.262	-0.124	0.061	21	21	21	19
Machinery	-0.332	-0.332	-0.376	-0.301	22	22	22	22
Electronic equipment	1.499	1.499	0.957	1.752	6	6	9	10
Motor vehicles	-2.868	-2.868	-2.622	-4.773	26	26	25	26
Other transport equip.	0.719	0.719	2.203	9.127	11	11	7	4
Other manufactures	0.056	0.056	1.177	3.031	14	14	8	9
Construction and utilities	0.932	0.932	4.204	4.203	10	10	5	7
Trade and transport	0.102	0.102	0.615	1.454	13	13	11	12
Financial services	-0.008	-0.008	0.043	0.983	17	17	18	16
Other private services	0.032	0.032	0.272	1.207	15	15	14	15
Government services	-0.178	-0.178	-0.472	-0.041	20	20	23	20

Table A.2: China's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 5								
Rice	0.087	1.135	7.598	8.849	9	7	2	5
Other grains	0.070	0.191	0.303	1.583	10	14	20	11
Sugar	0.265	1.213	3.604	4.424	5	5	6	6
Other crops	0.093	0.531	1.124	3.981	8	9	10	8
Livestock	0.250	0.530	0.731	1.358	6	10	12	13
Fossil fuels	-0.034	-0.056	-0.055	-0.244	15	19	22	21
Natural resources	-0.047	0.093	0.429	0.912	17	16	18	17
Meats	0.031	-1.153	-2.414	-4.440	11	24	26	25
Dairy products	1.279	3.724	6.673	10.918	3	3	4	3
Other food products	-0.042	0.089	0.449	0.687	16	17	17	18
Textiles	1.620	4.588	7.289	16.734	2	2	3	2
Apparel	4.112	9.920	14.295	26.486	1	1	1	1
Wood and paper	-0.222	-0.106	0.532	1.274	22	20	14	14
Petroleum products	-0.182	0.104	0.501	-1.315	21	15	16	23
Chemical products	-0.797	-1.261	-1.107	-1.803	25	25	24	24
Metal	-0.428	-0.367	0.419	0.061	23	22	19	19
Machinery	-0.585	-0.605	0.239	-0.301	24	23	21	22
Electronic equipment	-0.076	0.464	1.737	1.752	18	11	8	10
Motor vehicles	-0.856	-1.694	-2.312	-4.773	26	26	25	26
Other transport equip.	0.221	1.203	2.848	9.127	7	6	7	4
Other manufactures	0.016	0.600	1.579	3.031	12	8	9	9
Construction and utilities	0.822	2.597	3.890	4.203	4	4	5	7
Trade and transport	-0.007	0.380	1.038	1.454	13	12	11	12
Financial services	-0.132	0.043	0.523	0.983	20	18	15	16
Other private services	-0.029	0.217	0.658	1.207	14	13	13	15
Government services	-0.077	-0.199	-0.309	-0.041	19	21	23	20

Table A.3: Korea's sectoral output adjustments and its rankings under alternative scenarios
(Percentage deviation from the baseline)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 1								
Rice	2.793	-29.112	-33.753	-39.638	4	26	26	26
Other grains	-2.943	-2.720	-7.436	-0.665	24	23	22	19
Sugar	-1.156	-1.549	-0.760	2.786	18	18	19	9
Other crops	0.099	-0.813	0.595	1.450	6	14	14	12
Livestock	-4.117	-2.540	-10.223	-8.331	25	22	23	23
Fossil fuels	-0.066	-0.281	-0.281	-0.711	12	12	17	20
Natural resources	-0.337	-0.407	0.165	0.970	16	13	16	13
Meats	-5.851	-4.866	-16.038	-14.229	26	24	25	24
Dairy products	-2.873	-1.250	-5.046	-4.008	23	15	21	22
Other food products	-2.455	-1.486	-3.610	-0.662	22	16	20	18
Textiles	9.848	19.618	22.643	21.376	2	1	1	1
Apparel	14.146	9.191	7.155	-0.486	1	3	4	17
Wood and paper	-1.058	-1.935	-0.395	2.255	17	20	18	11
Petroleum products	0.045	4.765	5.412	9.533	8	5	5	4
Chemical products	-0.214	3.921	3.759	11.304	15	6	6	3
Metal	-1.637	-1.495	1.416	0.714	19	17	13	16
Machinery	-1.909	-1.828	1.552	-1.152	20	19	12	21
Electronic equipment	-0.183	-2.501	2.508	0.734	14	21	10	15
Motor vehicles	5.413	5.837	10.035	9.267	3	4	3	5
Other transport equip.	-2.410	-16.090	-15.118	-17.494	21	25	24	25
Other manufactures	-0.051	0.493	3.666	3.680	10	9	7	8
Construction and utilities	1.358	9.353	14.111	14.705	5	2	2	2
Trade and transport	-0.002	0.798	2.795	6.058	9	8	9	6
Financial services	-0.052	0.325	1.817	2.540	11	10	11	10
Other private services	0.065	1.310	3.166	4.307	7	7	8	7
Government services	-0.182	-0.110	0.296	0.811	13	11	15	14

Note: For sectoral rankings, "1" indicates the largest percentage increase in output among all the sectors, and "26" indicates the largest percentage reduction in output.

Source: Model simulations.

Table A.3: Korea's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 2								
Rice	2.793	-0.535	-32.166	-39.638	4	15	26	26
Other grains	-2.943	-4.645	-4.743	-0.665	24	24	23	19
Sugar	-1.156	-1.294	-1.225	2.786	18	19	19	9
Other crops	0.099	-0.520	-1.606	1.450	6	14	21	12
Livestock	-4.117	-3.849	-3.655	-8.331	25	23	22	23
Fossil fuels	-0.066	-0.155	-0.257	-0.711	12	12	15	20
Natural resources	-0.337	-0.305	-0.075	0.970	16	13	14	13
Meats	-5.851	-5.831	-6.627	-14.229	26	25	24	24
Dairy products	-2.873	-2.218	-0.819	-4.008	23	22	16	22
Other food products	-2.455	-2.046	-1.395	-0.662	22	21	20	18
Textiles	9.848	13.814	20.919	21.376	2	1	1	1
Apparel	14.146	11.131	7.403	-0.486	1	2	3	17
Wood and paper	-1.058	-1.231	-0.942	2.255	17	18	17	11
Petroleum products	0.045	2.414	6.172	9.533	8	5	5	4
Chemical products	-0.214	1.885	5.426	11.304	15	6	6	3
Metal	-1.637	-1.109	0.505	0.714	19	17	11	16
Machinery	-1.909	-1.367	0.414	-1.152	20	20	12	21
Electronic equipment	-0.183	-0.874	-1.221	0.734	14	16	18	15
Motor vehicles	5.413	5.687	7.160	9.267	3	3	4	5
Other transport equip.	-2.410	-8.620	-15.439	-17.494	21	26	25	25
Other manufactures	-0.051	0.445	1.901	3.680	10	9	8	8
Construction and utilities	1.358	5.338	11.298	14.705	5	4	2	2
Trade and transport	-0.002	0.457	1.682	6.058	9	8	9	6
Financial services	-0.052	0.271	1.225	2.540	11	10	10	10
Other private services	0.065	0.810	2.370	4.307	7	7	7	7
Government services	-0.182	-0.060	0.294	0.811	13	11	13	14

Table A.3: Korea's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 3								
Rice	2.793	-1.530	-34.987	-39.638	4	20	26	26
Other grains	-2.943	-3.886	-3.146	-0.665	24	24	22	19
Sugar	-1.156	-0.696	-0.188	2.786	18	16	16	9
Other crops	0.099	-0.169	-0.384	1.450	6	13	18	12
Livestock	-4.117	-3.848	-3.557	-8.331	25	23	23	23
Fossil fuels	-0.066	-0.146	-0.229	-0.711	12	12	17	20
Natural resources	-0.337	-0.286	-0.057	0.970	16	14	14	13
Meats	-5.851	-5.838	-6.438	-14.229	26	25	24	24
Dairy products	-2.873	-2.277	-1.067	-4.008	23	22	20	22
Other food products	-2.455	-2.092	-1.530	-0.662	22	21	21	18
Textiles	9.848	12.977	20.293	21.376	2	1	1	1
Apparel	14.146	7.846	1.658	-0.486	1	2	9	17
Wood and paper	-1.058	-1.071	-0.630	2.255	17	18	19	11
Petroleum products	0.045	2.364	5.986	9.533	8	5	3	4
Chemical products	-0.214	1.853	5.142	11.304	15	6	4	3
Metal	-1.637	-0.882	0.865	0.714	19	17	11	16
Machinery	-1.909	-1.172	0.615	-1.152	20	19	12	21
Electronic equipment	-0.183	-0.418	-0.148	0.734	14	15	15	15
Motor vehicles	5.413	4.888	4.910	9.267	3	4	5	5
Other transport equip.	-2.410	-8.392	-14.713	-17.494	21	26	25	25
Other manufactures	-0.051	0.482	1.767	3.680	10	9	8	8
Construction and utilities	1.358	4.981	10.145	14.705	5	3	2	2
Trade and transport	-0.002	0.538	1.789	6.058	9	8	7	6
Financial services	-0.052	0.242	1.094	2.540	11	10	10	10
Other private services	0.065	0.744	2.118	4.307	7	7	6	7
Government services	-0.182	-0.084	0.221	0.811	13	11	13	14

Table A.3: Korea's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 4								
Rice	-30.795	-30.795	-35.298	-39.638	26	26	26	26
Other grains	-0.405	-0.405	-5.915	-0.665	18	18	22	19
Sugar	-0.688	-0.688	-0.435	2.786	20	20	18	9
Other crops	-1.167	-1.167	0.109	1.450	22	22	16	12
Livestock	0.566	0.566	-9.195	-8.331	10	10	23	23
Fossil fuels	-0.230	-0.230	-0.244	-0.711	17	17	17	20
Natural resources	-0.123	-0.123	0.251	0.970	16	16	14	13
Meats	-0.526	-0.526	-14.506	-14.229	19	19	25	24
Dairy products	1.332	1.332	-4.322	-4.008	5	5	21	22
Other food products	0.237	0.237	-2.594	-0.662	12	12	19	18
Textiles	10.718	10.718	13.844	21.376	1	1	1	1
Apparel	-3.899	-3.899	-4.315	-0.486	24	24	20	17
Wood and paper	-0.939	-0.939	0.142	2.255	21	21	15	11
Petroleum products	4.793	4.793	5.189	9.533	3	3	4	4
Chemical products	4.293	4.293	3.778	11.304	4	4	5	3
Metal	0.171	0.171	2.384	0.714	13	13	11	16
Machinery	0.099	0.099	2.739	-1.152	14	14	8	21
Electronic equipment	-2.034	-2.034	2.496	0.734	23	23	10	15
Motor vehicles	1.266	1.266	5.687	9.267	7	7	3	5
Other transport equip.	-14.228	-14.228	-14.102	-17.494	25	25	24	25
Other manufactures	0.587	0.587	3.345	3.680	9	9	6	8
Construction and utilities	8.139	8.139	12.454	14.705	2	2	2	2
Trade and transport	0.806	0.806	2.543	6.058	8	8	9	6
Financial services	0.408	0.408	1.614	2.540	11	11	12	10
Other private services	1.266	1.266	2.803	4.307	6	6	7	7
Government services	0.016	0.016	0.282	0.811	15	15	13	14

Table A.3: Korea's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 5								
Rice	-1.129	-7.023	-35.329	-39.638	22	24	26	26
Other grains	-1.460	-4.294	-6.356	-0.665	23	22	22	19
Sugar	-0.289	-0.640	-0.769	2.786	16	17	18	9
Other crops	0.039	0.008	0.233	1.450	8	13	13	12
Livestock	-2.049	-5.945	-9.489	-8.331	24	23	23	23
Fossil fuels	-0.062	-0.132	-0.214	-0.711	11	15	16	20
Natural resources	-0.151	-0.197	-0.034	0.970	14	16	15	13
Meats	-3.085	-8.999	-14.790	-14.229	26	26	25	24
Dairy products	-0.958	-2.842	-4.629	-4.008	21	21	20	22
Other food products	-0.748	-1.959	-2.833	-0.662	20	19	19	18
Textiles	1.861	6.079	12.489	21.376	1	1	1	1
Apparel	-0.703	-2.727	-4.934	-0.486	19	20	21	17
Wood and paper	-0.457	-0.780	-0.446	2.255	18	18	17	11
Petroleum products	0.496	2.047	4.731	9.533	3	3	4	4
Chemical products	0.082	0.814	2.756	11.304	5	5	5	3
Metal	-0.324	0.060	1.845	0.714	17	12	9	16
Machinery	-0.276	0.120	1.693	-1.152	15	11	10	21
Electronic equipment	0.000	0.351	1.373	0.734	9	9	11	15
Motor vehicles	0.435	1.999	5.211	9.267	4	4	3	5
Other transport equip.	-3.008	-8.624	-14.219	-17.494	25	25	24	25
Other manufactures	-0.049	0.780	2.536	3.680	10	6	6	8
Construction and utilities	1.426	5.605	11.365	14.705	2	2	2	2
Trade and transport	0.069	0.688	2.113	6.058	7	8	8	6
Financial services	-0.073	0.205	1.125	2.540	12	10	12	10
Other private services	0.079	0.777	2.249	4.307	6	7	7	7
Government services	-0.090	-0.126	0.056	0.811	13	14	14	14

Table A.4: ASEAN-5's sectoral output adjustments and its rankings under alternative scenarios
(Percentage deviation from the baseline)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 1								
Rice	3.350	-11.865	-11.551	-7.991	3	26	26	26
Other grains	-1.357	1.978	1.153	3.023	22	7	13	5
Sugar	0.992	2.174	4.123	5.292	7	6	5	3
Other crops	-1.325	1.966	1.343	1.244	21	8	11	10
Livestock	0.686	3.139	3.421	1.199	9	5	7	11
Fossil fuels	-0.078	0.006	-0.031	-0.314	12	21	21	18
Natural resources	-0.177	0.108	0.119	0.551	15	20	20	13
Meats	2.401	6.087	6.048	0.364	4	3	4	14
Dairy products	2.274	5.885	7.490	8.530	5	4	3	1
Other food products	-0.154	1.163	-0.201	8.171	14	12	22	2
Textiles	10.331	11.095	10.276	1.855	2	2	2	7
Apparel	18.901	20.599	12.761	-4.722	1	1	1	24
Wood and paper	-1.644	0.237	0.217	1.367	25	17	17	8
Petroleum products	0.057	-0.147	0.235	-3.142	10	22	16	23
Chemical products	-1.628	-0.952	-3.579	-5.448	24	25	25	25
Metal	-1.370	0.148	0.422	-2.062	23	19	14	22
Machinery	-1.701	-0.714	0.152	-0.327	26	24	19	19
Electronic equipment	-0.534	1.182	3.851	3.292	19	11	6	4
Motor vehicles	0.739	1.578	0.417	1.261	8	10	15	9
Other transport equip.	-0.927	1.919	2.154	0.076	20	9	8	15
Other manufactures	-0.194	0.638	1.734	0.856	16	14	9	12
Construction and utilities	1.496	0.646	1.533	-1.078	6	13	10	21
Trade and transport	-0.050	0.625	1.194	1.922	11	15	12	6
Financial services	-0.343	0.342	0.166	0.027	17	16	18	16
Other private services	-0.466	0.163	-0.241	-0.186	18	18	23	17
Government services	-0.135	-0.397	-0.695	-0.996	13	23	24	20

Note: For sectoral rankings, "1" indicates the largest percentage increase in output among all the sectors, and "26" indicates the largest percentage reduction in output.

Source: Model simulations.

Table A.4: ASEAN-5's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 2								
Rice	3.350	2.377	-11.448	-7.991	3	5	26	26
Other grains	-1.357	-1.028	1.704	3.023	22	25	9	5
Sugar	0.992	1.410	1.953	5.292	7	6	7	3
Other crops	-1.325	-0.951	1.705	1.244	21	24	8	10
Livestock	0.686	1.161	3.142	1.199	9	8	5	11
Fossil fuels	-0.078	-0.007	0.021	-0.314	12	19	21	18
Natural resources	-0.177	0.012	0.097	0.551	15	18	20	13
Meats	2.401	3.448	6.641	0.364	4	3	3	14
Dairy products	2.274	3.266	5.706	8.530	5	4	4	1
Other food products	-0.154	0.235	1.154	8.171	14	15	12	2
Textiles	10.331	10.892	10.968	1.855	2	2	2	7
Apparel	18.901	20.059	20.102	-4.722	1	1	1	24
Wood and paper	-1.644	-0.582	0.446	1.367	25	22	16	8
Petroleum products	0.057	0.042	-0.237	-3.142	10	17	22	23
Chemical products	-1.628	-1.312	-0.644	-5.448	24	26	25	25
Metal	-1.370	-0.352	0.220	-2.062	23	21	18	22
Machinery	-1.701	-0.782	-0.361	-0.327	26	23	24	19
Electronic equipment	-0.534	0.639	1.480	3.292	19	11	10	4
Motor vehicles	0.739	1.371	1.277	1.261	8	7	11	9
Other transport equip.	-0.927	0.901	2.270	0.076	20	10	6	15
Other manufactures	-0.194	0.481	0.654	0.856	16	12	13	12
Construction and utilities	1.496	1.152	0.136	-1.078	6	9	19	21
Trade and transport	-0.050	0.425	0.650	1.922	11	13	14	6
Financial services	-0.343	0.237	0.471	0.027	17	14	15	16
Other private services	-0.466	0.108	0.330	-0.186	18	16	17	17
Government services	-0.135	-0.113	-0.330	-0.996	13	20	23	20

Table A.4: ASEAN-5's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 3								
Rice	3.350	1.520	-14.264	-7.991	3	5	26	26
Other grains	-1.357	-0.723	2.497	3.023	22	25	7	5
Sugar	0.992	1.514	2.250	5.292	7	6	9	3
Other crops	-1.325	-0.579	2.493	1.244	21	24	8	10
Livestock	0.686	1.157	3.340	1.199	9	9	3	11
Fossil fuels	-0.078	0.005	0.039	-0.314	12	18	20	18
Natural resources	-0.177	0.018	0.085	0.551	15	17	19	13
Meats	2.401	3.426	7.107	0.364	4	3	1	14
Dairy products	2.274	3.223	5.725	8.530	5	4	2	1
Other food products	-0.154	0.244	1.152	8.171	14	15	12	2
Textiles	10.331	7.598	3.109	1.855	2	2	5	7
Apparel	18.901	11.950	3.308	-4.722	1	1	4	24
Wood and paper	-1.644	-0.145	1.191	1.367	25	21	11	8
Petroleum products	0.057	-0.056	-0.527	-3.142	10	19	23	23
Chemical products	-1.628	-1.183	-0.640	-5.448	24	26	24	25
Metal	-1.370	-0.088	0.465	-2.062	23	20	15	22
Machinery	-1.701	-0.565	-0.501	-0.327	26	23	22	19
Electronic equipment	-0.534	1.174	2.155	3.292	19	8	10	4
Motor vehicles	0.739	0.939	0.206	1.261	8	10	18	9
Other transport equip.	-0.927	1.257	2.730	0.076	20	7	6	15
Other manufactures	-0.194	0.574	0.565	0.856	16	12	14	12
Construction and utilities	1.496	0.623	-1.080	-1.078	6	11	25	21
Trade and transport	-0.050	0.471	0.607	1.922	11	13	13	6
Financial services	-0.343	0.271	0.384	0.027	17	14	16	16
Other private services	-0.466	0.152	0.306	-0.186	18	16	17	17
Government services	-0.135	-0.149	-0.412	-0.996	13	22	21	20

Table A.4: ASEAN-5's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 4								
Rice	-15.491	-15.491	-14.977	-7.991	26	26	26	26
Other grains	3.390	3.390	2.435	3.023	1	1	4	5
Sugar	0.856	0.856	2.719	5.292	8	8	2	3
Other crops	3.212	3.212	2.418	1.244	2	2	5	10
Livestock	1.685	1.685	1.670	1.199	5	5	6	11
Fossil fuels	0.020	0.020	-0.042	-0.314	15	15	15	18
Natural resources	0.073	0.073	0.030	0.551	14	14	14	13
Meats	1.714	1.714	0.780	0.364	4	4	9	14
Dairy products	2.612	2.612	3.023	8.530	3	3	1	1
Other food products	0.807	0.807	-0.863	8.171	9	9	21	2
Textiles	-0.663	-0.663	-1.358	1.855	24	24	23	7
Apparel	-0.117	-0.117	-7.542	-4.722	19	19	25	24
Wood and paper	1.189	1.189	0.730	1.367	7	7	10	8
Petroleum products	-0.600	-0.600	-0.283	-3.142	23	23	16	23
Chemical products	-0.272	-0.272	-3.512	-5.448	20	20	24	25
Metal	0.636	0.636	0.595	-2.062	10	10	11	22
Machinery	-0.501	-0.501	-0.364	-0.327	22	22	17	19
Electronic equipment	0.406	0.406	2.469	3.292	11	11	3	4
Motor vehicles	0.162	0.162	-0.895	1.261	12	12	22	9
Other transport equip.	1.476	1.476	1.028	0.076	6	6	7	15
Other manufactures	-0.028	-0.028	0.873	0.856	18	18	8	12
Construction and utilities	-1.245	-1.245	0.111	-1.078	25	25	13	21
Trade and transport	0.110	0.110	0.498	1.922	13	13	12	6
Financial services	-0.002	-0.002	-0.476	0.027	17	17	18	16
Other private services	0.014	0.014	-0.688	-0.186	16	16	19	17
Government services	-0.353	-0.353	-0.713	-0.996	21	21	20	20

Table A.4: ASEAN-5's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 5								
Rice	-0.082	-2.776	-14.896	-7.991	17	25	26	26
Other grains	-0.098	0.392	2.415	3.023	19	8	5	5
Sugar	0.692	1.933	2.871	5.292	1	1	1	3
Other crops	0.012	0.517	2.532	1.244	12	5	4	10
Livestock	-0.171	0.071	1.669	1.199	20	12	7	11
Fossil fuels	0.015	0.032	0.016	-0.314	11	13	15	18
Natural resources	0.000	0.012	0.074	0.551	14	14	14	13
Meats	-0.693	-0.867	0.840	0.364	24	22	11	14
Dairy products	0.043	0.516	2.580	8.530	10	6	3	1
Other food products	-0.278	-0.668	-0.607	8.171	22	21	22	2
Textiles	0.345	-0.092	-1.164	1.855	4	16	23	7
Apparel	-0.834	-4.018	-7.309	-4.722	25	26	25	24
Wood and paper	0.279	0.689	1.137	1.367	5	4	9	8
Petroleum products	-0.447	-0.976	-0.187	-3.142	23	23	18	23
Chemical products	-0.960	-2.305	-2.966	-5.448	26	24	24	25
Metal	0.167	0.491	1.172	-2.062	6	7	8	22
Machinery	0.105	0.203	0.099	-0.327	8	11	13	19
Electronic equipment	0.684	1.768	2.619	3.292	2	2	2	4
Motor vehicles	-0.049	-0.265	-0.397	1.261	16	18	20	9
Other transport equip.	0.477	1.132	1.695	0.076	3	3	6	15
Other manufactures	0.164	0.390	1.024	0.856	7	9	10	12
Construction and utilities	-0.234	-0.552	-0.074	-1.078	21	20	16	21
Trade and transport	0.090	0.227	0.693	1.922	9	10	12	6
Financial services	0.006	-0.090	-0.129	0.027	13	15	17	16
Other private services	-0.010	-0.157	-0.269	-0.186	15	17	19	17
Government services	-0.085	-0.287	-0.593	-0.996	18	19	21	20

Table A.5: The rest of ASEAN's sectoral output adjustments and its rankings under alternative scenarios
(Percentage deviation from the baseline)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 1								
Rice	-0.194	-1.982	-2.008	0.186	8	25	24	8
Other grains	-2.433	3.443	4.200	-0.043	20	5	8	9
Sugar	7.594	8.302	7.467	-1.835	2	4	4	15
Other crops	-1.656	-2.035	-1.178	1.820	15	26	23	5
Livestock	0.729	1.367	0.566	-2.064	6	10	16	16
Fossil fuels	-0.328	-0.011	-0.016	-0.243	10	18	20	10
Natural resources	-1.055	-0.038	0.498	1.041	12	19	17	6
Meats	-0.155	0.568	0.120	-2.088	7	15	19	17
Dairy products	-4.639	-1.472	-7.458	-12.513	24	24	26	25
Other food products	-2.172	0.739	0.571	-2.935	19	12	15	20
Textiles	1.547	9.418	10.964	-11.424	5	3	3	24
Apparel	14.218	21.147	15.877	-20.250	1	1	2	26
Wood and paper	-4.681	-0.381	-0.391	-2.639	25	21	21	19
Petroleum products	-0.899	0.698	1.119	-4.334	11	14	11	22
Chemical products	-3.753	0.092	0.693	-2.613	22	17	14	18
Metal	-2.686	1.988	4.346	3.267	21	9	6	4
Machinery	-5.350	-0.337	5.202	5.943	26	20	5	3
Electronic equipment	-1.771	1.170	4.306	6.204	16	11	7	2
Motor vehicles	-3.789	-0.959	-2.093	-4.742	23	23	25	23
Other transport equip.	5.361	12.105	16.798	13.702	4	2	1	1
Other manufactures	-1.325	2.133	3.218	-1.736	14	7	9	14
Construction and utilities	6.600	2.962	1.005	-3.777	3	6	13	21
Trade and transport	-0.278	2.018	2.789	0.937	9	8	10	7
Financial services	-2.000	0.726	1.025	-0.526	17	13	12	11
Other private services	-2.163	0.328	0.456	-0.760	18	16	18	12
Government services	-1.285	-0.663	-0.688	-1.277	13	22	22	13

Note: For sectoral rankings, "1" indicates the largest percentage increase in output among all the sectors, and "26" indicates the largest percentage reduction in output.

Source: Model simulations.

Table A.5: The rest of ASEAN's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 2								
Rice	-0.194	0.495	-1.702	0.186	8	12	25	8
Other grains	-2.433	-0.916	3.367	-0.043	20	21	5	9
Sugar	7.594	7.944	7.974	-1.835	2	4	4	15
Other crops	-1.656	-1.757	-1.759	1.820	15	26	26	5
Livestock	0.729	0.797	1.193	-2.064	6	9	9	16
Fossil fuels	-0.328	-0.046	0.041	-0.243	10	16	20	10
Natural resources	-1.055	-0.220	0.105	1.041	12	18	19	6
Meats	-0.155	0.217	0.650	-2.088	7	14	16	17
Dairy products	-4.639	-1.520	-1.132	-12.513	24	25	24	25
Other food products	-2.172	-0.849	0.822	-2.935	19	20	11	20
Textiles	1.547	8.377	11.195	-11.424	5	3	3	24
Apparel	14.218	20.683	22.679	-20.250	1	1	1	26
Wood and paper	-4.681	-0.936	0.411	-2.639	25	22	18	19
Petroleum products	-0.899	0.643	0.788	-4.334	11	11	13	22
Chemical products	-3.753	-0.130	0.770	-2.613	22	17	14	18
Metal	-2.686	1.033	1.722	3.267	21	8	8	4
Machinery	-5.350	-1.265	-0.091	5.943	26	23	21	3
Electronic equipment	-1.771	0.762	0.703	6.204	16	10	15	2
Motor vehicles	-3.789	-1.445	-0.795	-4.742	23	24	23	23
Other transport equip.	5.361	10.526	12.115	13.702	4	2	2	1
Other manufactures	-1.325	1.668	1.878	-1.736	14	7	7	14
Construction and utilities	6.600	3.812	0.549	-3.777	3	5	17	21
Trade and transport	-0.278	1.763	2.052	0.937	9	6	6	7
Financial services	-2.000	0.469	1.125	-0.526	17	13	10	11
Other private services	-2.163	0.138	0.807	-0.760	18	15	12	12
Government services	-1.285	-0.470	-0.229	-1.277	13	19	22	13

Table A.5: The rest of ASEAN's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 3								
Rice	-0.194	0.884	-1.595	0.186	8	14	22	8
Other grains	-2.433	0.187	5.540	-0.043	20	18	3	9
Sugar	7.594	8.243	7.886	-1.835	2	3	2	15
Other crops	-1.656	-0.916	-0.151	1.820	15	25	19	5
Livestock	0.729	0.312	0.373	-2.064	6	16	17	16
Fossil fuels	-0.328	0.073	0.158	-0.243	10	22	18	10
Natural resources	-1.055	0.179	0.512	1.041	12	19	15	6
Meats	-0.155	0.172	0.570	-2.088	7	20	13	17
Dairy products	-4.639	-2.491	-4.396	-12.513	24	26	24	25
Other food products	-2.172	-0.099	1.818	-2.935	19	23	7	20
Textiles	1.547	5.243	-1.687	-11.424	5	4	23	24
Apparel	14.218	9.141	-6.075	-20.250	1	2	26	26
Wood and paper	-4.681	0.925	2.165	-2.639	25	13	5	19
Petroleum products	-0.899	0.869	0.500	-4.334	11	15	16	22
Chemical products	-3.753	1.076	1.054	-2.613	22	11	10	18
Metal	-2.686	2.054	2.111	3.267	21	5	6	4
Machinery	-5.350	1.128	2.380	5.943	26	10	4	3
Electronic equipment	-1.771	1.473	0.790	6.204	16	7	11	2
Motor vehicles	-3.789	-0.685	-0.351	-4.742	23	24	20	23
Other transport equip.	5.361	14.235	17.258	13.702	4	1	1	1
Other manufactures	-1.325	1.276	-0.443	-1.736	14	8	21	14
Construction and utilities	6.600	0.227	-4.715	-3.777	3	17	25	21
Trade and transport	-0.278	1.602	0.722	0.937	9	6	12	7
Financial services	-2.000	1.174	1.347	-0.526	17	9	9	11
Other private services	-2.163	0.998	1.440	-0.760	18	12	8	12
Government services	-1.285	0.109	0.514	-1.277	13	21	14	13

Table A.5: The rest of ASEAN's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 4								
Rice	-2.363	-2.363	-2.619	0.186	26	26	24	8
Other grains	5.220	5.220	5.591	-0.043	1	1	3	9
Sugar	-0.097	-0.097	-0.629	-1.835	20	20	20	15
Other crops	-0.593	-0.593	-0.048	1.820	23	23	13	5
Livestock	0.537	0.537	-0.147	-2.064	8	8	14	16
Fossil fuels	0.045	0.045	-0.023	-0.243	17	17	12	10
Natural resources	0.191	0.191	0.510	1.041	14	14	9	6
Meats	0.345	0.345	-0.164	-2.088	9	9	15	17
Dairy products	0.077	0.077	-6.924	-12.513	16	16	25	25
Other food products	1.409	1.409	0.636	-2.935	3	3	8	20
Textiles	-0.085	-0.085	-0.845	-11.424	18	18	22	24
Apparel	-1.104	-1.104	-9.065	-20.250	24	24	26	26
Wood and paper	0.785	0.785	-0.185	-2.639	6	6	16	19
Petroleum products	-0.093	-0.093	0.145	-4.334	19	19	10	22
Chemical products	-0.226	-0.226	-0.535	-2.613	22	22	18	18
Metal	1.058	1.058	3.427	3.267	4	4	5	4
Machinery	0.872	0.872	5.938	5.943	5	5	1	3
Electronic equipment	0.200	0.200	3.680	6.204	13	13	4	2
Motor vehicles	0.714	0.714	-0.844	-4.742	7	7	21	23
Other transport equip.	1.486	1.486	5.906	13.702	2	2	2	1
Other manufactures	0.235	0.235	1.355	-1.736	10	10	6	14
Construction and utilities	-1.526	-1.526	-0.905	-3.777	25	25	23	21
Trade and transport	0.131	0.131	0.706	0.937	15	15	7	7
Financial services	0.230	0.230	0.014	-0.526	11	11	11	11
Other private services	0.200	0.200	-0.227	-0.760	12	12	17	12
Government services	-0.208	-0.208	-0.604	-1.277	21	21	19	13

Table A.5: The rest of ASEAN's sectoral output adjustments and its rankings under alternative scenarios (continued)

Scenario and sector	Sectoral output adjustments (%)				Rankings of % deviation in sectoral output			
	2015	2020	2025	(GTL) 2030	2015	2020	2025	(GTL) 2030
Scenario 5								
Rice	0.002	-0.344	-2.512	0.186	16	22	24	8
Other grains	0.413	2.069	5.538	-0.043	6	3	2	9
Sugar	-0.067	-0.218	-0.457	-1.835	19	21	20	15
Other crops	-0.044	-0.167	-0.059	1.820	17	19	16	5
Livestock	-0.075	-0.151	0.012	-2.064	20	18	14	16
Fossil fuels	0.013	0.031	0.021	-0.243	15	14	13	10
Natural resources	0.099	0.336	0.549	1.041	13	9	9	6
Meats	-0.136	-0.199	0.009	-2.088	21	20	15	17
Dairy products	-1.729	-4.550	-7.111	-12.513	26	25	25	25
Other food products	-0.176	-0.021	0.769	-2.935	22	17	7	20
Textiles	1.005	0.936	-0.702	-11.424	1	6	21	24
Apparel	-1.276	-5.133	-8.834	-20.250	25	26	26	26
Wood and paper	0.166	0.205	-0.059	-2.639	9	12	17	19
Petroleum products	-0.057	0.115	0.376	-4.334	18	13	10	22
Chemical products	-0.242	-0.402	-0.404	-2.613	23	23	19	18
Metal	0.484	1.638	3.527	3.267	5	5	4	4
Machinery	0.885	2.925	5.511	5.943	3	2	3	3
Electronic equipment	0.722	1.820	2.958	6.204	4	4	5	2
Motor vehicles	0.106	-0.014	-0.770	-4.742	12	16	22	23
Other transport equip.	0.941	2.995	5.639	13.702	2	1	1	1
Other manufactures	0.316	0.648	1.104	-1.736	7	7	6	14
Construction and utilities	-0.272	-0.882	-1.086	-3.777	24	24	23	21
Trade and transport	0.206	0.428	0.742	0.937	8	8	8	7
Financial services	0.142	0.276	0.276	-0.526	11	10	11	11
Other private services	0.143	0.259	0.166	-0.760	10	11	12	12
Government services	0.032	0.018	-0.292	-1.277	14	15	18	13