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A Comparison Study on ASEAN-Japan and ASEAN-Korea Free Trade Agreements using CGE Model[1]

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***A*bstract:** This study compares the economy-wide impacts of the ASEAN-Japan and ASEAN-Korea free trade agreements (FTAs) by conducting a computable general equilibrium (CGE) analysis with highlighting the role of labor market specification. The ASEAN, Japan and Korea are shown to have more significant real GDP growth under the simulation scenarios of unemployment and perfect labor mobility. The associated benefits of FTAs, in terms of economic growth and the reduction in unemployment, are more significant in Japan and Korea than in the ASEAN. Finally, the ASEAN would experience higher increase in the employment of unskilled labor in the FTA with Korea, while Korea would see a higher increase in the employment of skilled labor.

Keywords: Trade liberalization; Labor market; Computable general equilibrium; ASEAN; Global trade analysis project

JEL Classifications: D58, F16, J64

1. Introduction

Due to the lengthy deferment in the Doha Round negotiations of the World Trade Organization (WTO), many countries have turned to regional or bilateral free trade agreements (FTAs) in the recent years. In Asia, the Association of South East Asian Nations (ASEAN) [2] has strived to promote regional integration and economic cooperation. The ASEAN's ultimate goal is to develop an ASEAN Economic Community (AEC), in which goods, services, investments and skilled labor are free to move across the region. The ASEAN has taken the first step toward realizing this goal by

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[2] The ASEAN is composed of Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

establishing the ASEAN free trade area (AFTA), which technically came into full effect at the beginning of 2004. Since then, the ASEAN countries have been active in forming bilateral FTAs with non-ASEAN members, namely, the "AFTA plus". Among others, the FTAs with China, South Korea, and Japan generally referred to as the ASEAN+3 FTAs, have attracted considerable attention because the three countries are amongst the leading economies in Asia.

In the current literature on AFTA and "AFTA plus", there are many studies focusing on the quantitative impact analysis and providing the estimated magnitudes of macroeconomic effects, trade creation/diversion effects, and the variation in trade flows. The quantitative approaches adopted in these studies consist of computable general equilibrium (CGE) models, gravity models, and a combination of the above two models. Among others, the CGE models have emerged as an important simulation tool to provide an *ex-ante* analysis of the economy-wide impacts of policy changes and play an increasingly important role in the trade policy design (e.g., Wing, 2004). The relevant CGE analyses on "AFTA plus" comprise Adams and Park (1995), Ballard and Cheong (1997), Lee *et al*. (2004), Ariyasajjakorn *et al*. (2009), Ando and Urata (2007), Kitwiwattanachai *et al*. (2010), etc. On the other hand, the studies of gravity models adopt econometric approaches and historical trade data for *ex-post* examination of the impacts of an FTA on bilateral trade flows (e.g., Elliott and Ikemoto, 2004; Lee and Park, 2005; Tang, 2005; Jugurnath *et al*., 2007; Kwan and Qiu, 2010). Finally, the studies combining CGE and gravity models can offer a comprehensive examination of the FTAs, including Gilbert *et al*. (2004), Sudsawasd and Mongsawad (2007), Francois and Wignaraja (2008), etc..

Freer trade can improve a country's resource allocative efficiency and lead to economic growth for a country as a whole. Given the fact that existing tariffs are asymmetric across commodities in most countries, removing these tariffs could lead to different impacts on the trade of different commodities, generally with a more significant impact on the high-tariff products. Therefore, some industries might be positively affected while some might be adversely affected by trade liberalization. The change in commodity trade in turn has an impact on industrial production, derived demand for production factors, and factor market equilibrium. Accordingly, the specification of the factor market is important in evaluating the ensuing impact of trade liberalization because it reflects how the factor market responds to the exogenous shocks of trade liberalization.

As for the studies on "AFTA plus", the role of the labor market is particularly significant given the following three facts. First, the compositions of the labor forces in these countries are distinct. Most of the ASEAN nations are relatively abundant in unskilled labor, while Japan and Korea are relatively abundant in skilled labor. This difference in labor forces provides an important complementary opportunity for the countries to achieve economic gains from international commodity trade. Second, unemployment is the most important problem in the labor markets of the developing Asian countries (e.g., Felipe and Hasan, 2006). Trade liberalization might be one of the policy options to alleviate the unemployment problem. In order to obtain a more reliable prediction of the impacts of "AFTA plus", the associated CGE analysis should incorporate the unemployment mechanism which enables to quantify the effect of an increase in employment due to a higher derived demand for labor after trade liberalization. Finally, labor mobility across the production sectors is also a main determinant of the gains from trade. To our best knowledge, there are few "AFTA plus" studies discussing the factor mobility in the CGE modeling. This setting should be highlighted because it affects the factor reallocation mechanism and the production capacity of individual industries.

In a sum, this study aims at exploring how labor market specifications (i.e., full employment/ unemployment and labor mobility/immobility) can affect the simulated results of trade liberalization in the CGE analysis. The adopted model is the Global Trade Analysis Project (Hertel,

1997) and its version 9 database. The remainder of the study is organized as follows. Section 2 introduces the GTAP model and database. Simulation scenarios and an analysis of the numerical results are provided in Sections 3 and 4, respectively. The policy implications and conclusions are drawn in the final section.

2. The GTAP Model and Database

This section provides a brief overview of the GTAP model and its database. The GTAP model is a comparative-statics, multi-region, multi-sector computable general equilibrium model developed by Hertel (1997). It builds on the neoclassical microeconomic theory of general equilibrium. The model has an ingenious framework which links input and output markets, factor allocation and the production structure for a country or a region, as well as international commodity trade among countries and/or regions. Because the GTAP model has been developed based on general equilibrium theory and incorporates the global database of country-to-country bilateral trade, it is a theoretically-sound model that can be used to conduct the economy-wide impact analysis of FTAs. In what follows, the components of the GTAP model are presented, including the production structure, final demand structure, global transportation, and model closure rules. The detailed model description, database and the applications are provided in Hertel (1997) and on the GTAP website.[3]

2.1 The GTAP model

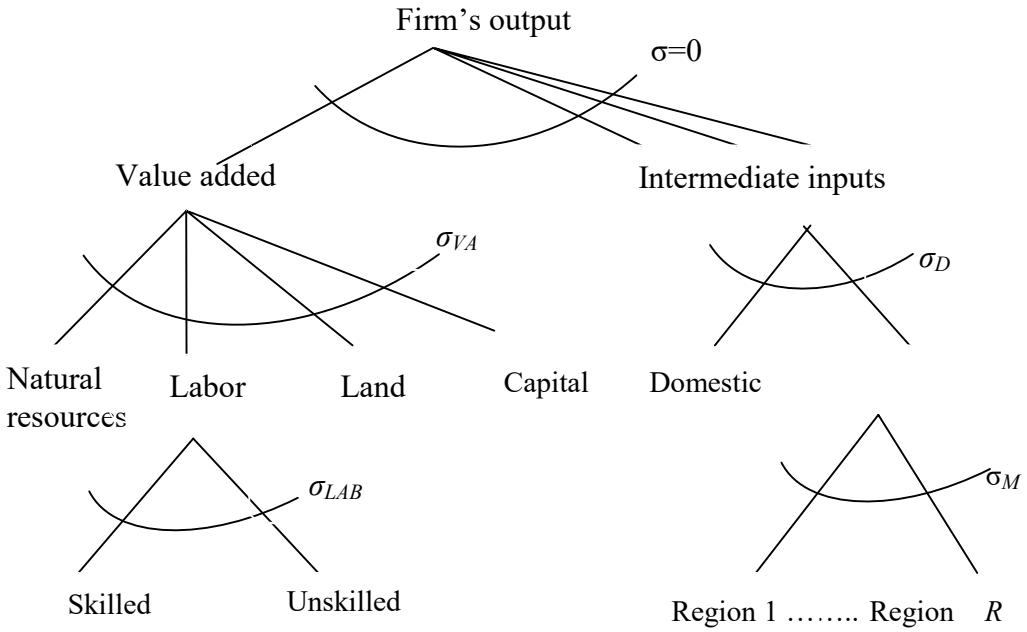

Figure 1. Nested production structure in the GTAP model (**Source:** Hertel, 1997)

Figure 1 above shows the nested production structure in the GTAP model. In addition to the cost minimization assumption, there are two major assumptions in the production structure, consisting of (i) weak separability between primary factors and intermediate inputs, and (ii) a nested

[3] http:// www.gtap.org

constant elasticity of substitution (CES) production technology. The separability assumption in production implies that the substitution elasticity between a particular primary factor and any intermediate inputs are the same. The production technology is further simplified by employing the CES functions in the aggregation of primary factors, as well as in the aggregation of value-added and intermediate inputs. Incorporating these two assumptions significantly reduces the total number of substitution elasticity to be specified in the model.

As shown in Figure 1, optimal output can be determined through a three-stage optimization problem. First, individual firms determine the optimal value-added composite of primary factors (land, capital, natural resources, skilled labor, and unskilled labor) based on the CES function. Second, the firms decide the optimal intermediate input composite by aggregating the domestically produced inputs and imported inputs following the Armington assumption (Armington, 1969). Finally, firms' optimal outputs are determined by aggregating the value-added composites and the intermediate input composites according to the Leontief function.

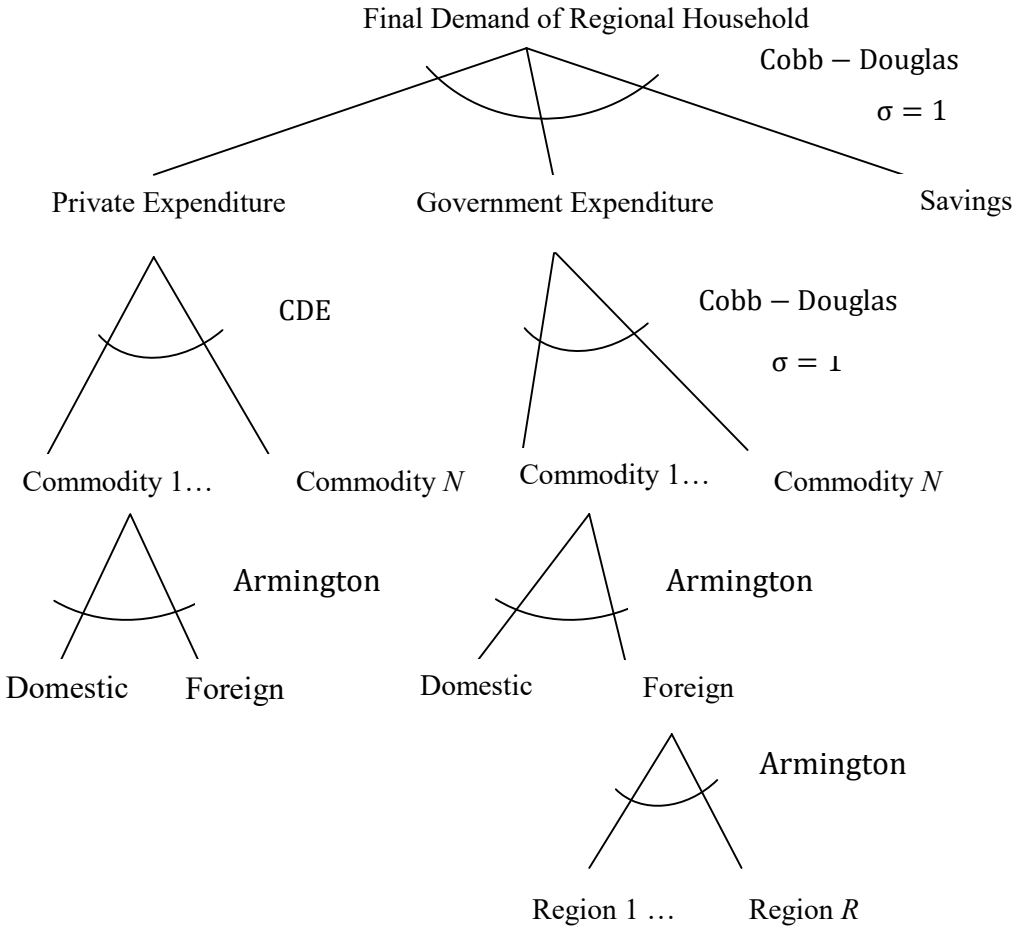

Figure 2. Nested consumption structure in the GTAP model (**Source:** Hertel, 1997)

Figure 2 above shows the regional household's nested consumption structure in the GTAP model. The regional household's demand is composed of private consumption, government consumption, and savings. The regional household allocates total regional income over the three segments according to the Cobb-Douglas utility function, thus implying that the expenditure shares on private consumption, government consumption, and savings are fixed. The demand for private

consumption is characterized by a non-homothetic constant difference elasticity (CDE) function, and the government expenditure is modeled by a Cobb-Douglas function. The final demand of private households and that of government are both composed of domestically produced goods and imported goods. Following the Armington assumption, those foreign imports are firstly aggregated into the composite imports using a CES function. Then the composite imports and the domestic goods are aggregated to the final consumption composite using a CES function.

The global transportation sector deals with the international shipments of traded commodities across countries or regions. The international shipment services are supplied by firms, and can be regarded as services exports. The demand for international shipment services is implicit in the margins between the price of free on board (fob) and the price comprising cost, insurance, and freight (cif) for merchandise trade. The global transportation sector is employed to balance the supply and demand in equilibrium.

The closure rules in the CGE models are the classifications of the endogenous and exogenous variables. The specification of closure rules reflects the real-world situation of an economy, particularly the mechanism through which the economy responds to an exogenous shock. Therefore, it crucially affects the simulation results. A valid closure should follow the basic mathematical principle whereby the number of endogenous variables equals the number of equations. The standard GTAP model adopts a neoclassical macroeconomic closure at the global level. The model introduces one fictitious entity, the global bank, which is a device for aggregating savings and allocating investment to the countries or regions. The global bank receives savings from the sale of homogeneous capital portfolios to the individual regional households, and uses receipts to purchase regional investment goods. In equilibrium, global savings are exactly equal to global investment. The neoclassical macroeconomic closure rule makes the margins between savings and investment endogenous. Under such circumstances, the effects of trade policies on the regional current account can be explored. The GTAP model is implemented using GEMPACK (Harrison and Pearson, 1996).

2.2 The GTAP database

This study adopts the GTAP version 9 database with 2011 as the base year (Aguiar *et al*., 2016). The database divides the world economy into 140 countries/regions, and each country/region has 57 production sectors. Given our focus on the impacts of "AFTA plus" on the East Asian economies, the 140 countries/regions are aggregated into 9 countries/regions according to their significance in the "AFTA plus". The 9 countries/regions are the ASEAN, China, Japan, Korea, Taiwan, the North America Free Trade Area (NAFTA), the European Union (EU), the Australia-New Zealand Closer Economic Relations group (CER), and the Rest of the World (ROW).

The main principle for sectoral aggregation in this study is based on Fouquin (2008), who points out that trade specialization in Asia constitutes a vertical division of labor between the developing countries that export natural resources and/or labor-intensive products and the developed countries that export machinery, sophisticated parts and components, as well as high-technical products. In order to highlight these specialized trade patterns, the 57 sectors are aggregated into 8 sectors, consisting of grains and crops, livestock and meat products, extraction, processed food, textiles and clothing, light manufacturing, heavy manufacturing, and other services. The detailed descriptions of the regional and sectoral aggregations are provided in Tables 1 and 2, respectively.

Table 1. Regional aggregation for "AFTA plus" analysis

Regional Economy	Comprising the GTAP Version 9 countries/regions
ASEAN	Cambodia, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam, Lao People's Democratic Republic, Rest of Southeast Asia (Brunei Darussalam, Myanmar, Timor-Leste)
China	China, Hong Kong
Japan	Japan
Korea	Korea
Taiwan	Taiwan
North American Free Trade Area (NAFTA)	Canada, United States of America, Mexico
European Union (EU)	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom, Romania
The Australia-New Zealand Closer Economic Relations Group (CER)	Australia, New Zealand
Rest of World (ROW)	Rest of countries/regions in the GTAP Version 9 Database*

Source: own classification.
*: The detailed list is available upon request.

Table 2. Sectoral aggregation for "AFTA plus" analysis

Sectoral description	Comprising the GTAP Version 9 sectors
Grains and crops	Paddy rice, wheat, cereal grains nec, vegetables, fruit, nuts, oil seeds, sugar cane, sugar beet, plant-based fibers, crops nec
Livestock and meat	Bovine cattle, sheep and goats, horses, animal products nec, raw milk, wool, silk-worm cocoons, bovine meat products, meat products nec
Extraction	Forestry, fishing, coal, oil, gas, minerals nec
Processed food	Vegetable oils and fats, dairy products, processed rice, sugar, food products nec, beverages and tobacco products
Textiles and clothing	Textiles, wearing apparel
Light manufacturing	Leather products, wood products, paper products, publishing, metal products, motor vehicles and parts, transport equipment nec, manufactures nec
Heavy manufacturing	Petroleum, coal products, chemical, rubber and plastic products, mineral products nec, ferrous metals, metals nec, electronic equipment, machinery and equipment nec
Other services	Electricity, gas manufacture, distribution, water, construction, trade, transport nec, water transport, air transport, communication, financial services nec, insurance, business services nec, recreational and other services, public administration, defense, education, health, dwellings

Source: own classification; **Notes:** 'nec' means 'not elsewhere classified'.

3. Simulation Scenarios

This section is concerned with the design of the simulation scenarios. Given our research focus on the role of labor market specifications in the economy-wide impact analysis of "AFTA plus", the simulation scenarios are designed in a way to highlight the two key assumptions related to sluggish labor market adjustments, consisting of (1) wage rigidities and unemployment, and (2) labor immobility across production sectors. Specifically, the following simulation scenarios are designed to reflect the significance of labor market adjustments in determining the simulation results of "AFTA plus". First, because the ASEAN-China and ASEAN-Korea FTAs have come into effect in 2010, we conduct four simulation scenarios of removing trade barriers between ASEAN and China and between ASEAN and Korea under two labor market assumptions (i.e., full employment/ unemployment and labor mobility/immobility). Second, the associated post-simulation equilibrium is used as the baseline data for the four simulation scenarios of the ASEAN-Japan FTA. The detailed descriptions of the simulation scenarios are provided in Table 3.

Table 3. The design of simulation scenarios

Descriptions	Scenarios	Employment	Labor mobility
ASEAN-China & ASEAN-Korea FTAs	Scenario 1(a)	Full employment	Mobile
	Scenario 1(b)	Full employment	Immobile
	Scenario 1(c)	Unemployment	Mobile
	Scenario 1(d)	Unemployment	Immobile
ASEAN-Japan FTA	Scenario 2(a)	Full employment	Mobile
	Scenario 2(b)	Full employment	Immobile
	Scenario 2(c)	Unemployment	Mobile
	Scenario 2(d)	Unemployment	Immobile

Source: this study.

In the standard GTAP model, the labor supply is fixed exogenously. Labor demand is derived as a function of the wage, and is equal to the labor supply in equilibrium. Under these circumstances, wage rate adjusts in order to achieve the labor market-clearing condition and the economy-wide full employment equilibrium. In contrast, some of the CGE studies on the unemployment issue adopt the approach of equilibrium unemployment rate by assuming a certain rate of involuntary employment. This approach makes the unemployment situation compatible with a general equilibrium framework. Following this approach and Barros, *et al*. (2001), the present study employs the assumption of wage rigidity to model involuntary unemployment. In our simulation scenarios, trade liberalization leads to a higher derived demand for labor because of an expansion in production which is necessary to meet increased exports. To keep the real wage unchanged, the labor market has to adjust by

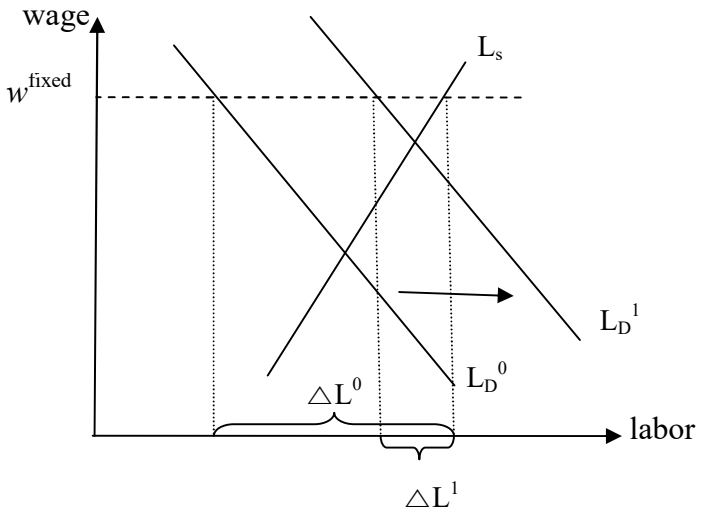

Figure 3. Unemployment and wage rigidity (**Source:** this study)

increasing the employment level, and the additional employment is drawn from the pool of unemployed workers. This associated idea is illustrated in Figure 3.

According to Figure 3, wage is fixed at w^{fixed} before trade liberalization and there is an unemployment level of ΔL^0, i.e., the difference between labor supply (Ls) and labor demand (L_D^0) at w^{fixed}. Trade liberalization shifts the labor demand curve to the right (L_D^1), and consequently unemployment reduces to ΔL^1.[4]

In all simulation scenarios in Table 3, capital is assumed to be perfectly mobile, while land and natural resources are immobile. The skilled and unskilled labor is assumed to be either mobile or immobile.[5] To conduct the simulation scenarios in Table 3, we need to calculate the existing trade barriers (i.e., import tariff rates and export subsidy rates) between ASEAN and China, between ASEAN and Korea, and between ASEAN and Japan based on the GTAP version 9 database. The calculated trade barriers are reported in Table 4. As shown in the table, Korea and Japan both levy relatively high import tariff rates on food-related commodities from the ASEAN, consisting of processed food, livestock and meat products, and grains and crops (i.e., the import tariff rates in Korea are 17.19%, 25.01%, and 79.73%, respectively; and those in Japan are 13.75%, 8.06%, and 5.10%, respectively). In contrast, the ASEAN imposes relatively high import tariff rates on labor-intensive commodities from Korea and Japan, particularly in light manufacturing. The tariff rates for light manufacturing are 11.38% for Korea and 15.27% for Japan. In addition, Korea is confronted with relatively high import tariffs on processed food (16.95%) and grains and crops (16.03%).

Table 4. Existing import tariff rates and export subsidy rates for "AFTA plus" analysis

Sectoral description/	Import tariff rates (%)				Export subsidy rates (%)			
Trade routes (origin-destination)	ASEAN-Korea	Korea-ASEAN	ASEAN-Japan	Japan-ASEAN	ASEAN-Korea	Korea-ASEAN	ASEAN-Japan	Japan-ASEAN
Grains and crops	79.73	16.03	5.10	5.74	0.00	4.86	0.00	0.00
Livestock and meat	25.01	6.26	8.06	4.09	0.00	0.00	0.00	0.00
Extraction	1.07	4.89	0.02	1.85	-0.84	0.00	-1.23	0.00
Processed food	17.19	16.95	13.75	8.55	0.00	0.05	0.00	0.00
Textiles and clothing	6.68	6.51	0.02	7.34	-0.22	0.00	-0.29	0.00
Light manufacturing	3.42	11.38	1.45	15.27	-0.70	0.00	-0.79	0.00
Heavy manufacturing	1.64	2.47	0.01	4.13	-0.38	0.00	-0.53	0.00
Other services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: calculation based on the GTAP version 9 database.

The export subsidy rates on the four trade routes are relatively low, as compared to the associated import tariff rates. Only ASEAN imposes export taxes on four exports to Korea and Japan, consisting of extraction, textiles and clothing, light manufacturing, and heavy manufacturing.

[4] To capture the unemployment situation in the GTAP model, the two variables "real wage (pfactreal)" and "labor employment (qo)" are swapped. Specifically, in the unemployment scenarios, the real wages for both skilled and unskilled labor are assumed to be exogenous, and the corresponding labor employment is assumed to be endogenous. The base-data reflect employment, rather than endowment. Any positive change in "labor employment (qo)" is covered from the pool of unemployed.

[5] This assumption is implemented in the GTAP model by a binary parameter "SLUG". If the production factor is perfectly mobile (immobile), then the parameter "SLUG" is equal to 0 (1).

Korea levies export subsidies on food-related commodities, consisting of grains and crops (4.86%) and processed food (0.05%) while Japan does not intervene in commodity exports. Each of the simulation scenarios of "AFTA plus" in Table 3 is implemented by shocking the exogenous variables of the import tariff rates and export subsidy rates on the associated trade routes such that they all reduce to zero.

4. Simulation Results and Analysis

This section provides an analysis on the simulation results. We will begin with the results of changes in real GDP, followed by the bilateral trade flows, employment effects, and welfare effects.

4.1 The impacts on real GDP

Table 5 presents the changes in real GDP under different simulation scenarios. There are several interesting implications that can be drawn from the results. First, the FTA member countries would experience economic gains in terms of real GDP growth, but the magnitudes of the economic gains vary across countries and simulation scenarios. Under the scenarios of unemployment (Scenarios (c) and (d)), ASEAN, Japan, and Korea would respectively have more significant real GDP growth, as compared with the scenarios of full employment. This is because in the unemployment scenarios of wage rigidity, the industries with higher labor demand after trade liberalization draw workers from the pool of the unemployed. The increase in the effective labor force implies an expanded production capacity. As a consequence, the unemployment scenarios have higher output than the full employment scenarios. In addition, the scenarios with perfect labor mobility can be thought of as the longer-term scenarios in which labor allocation across the production sectors is more efficient. Hence, all other things being equal, the three countries are more likely to experience higher real GDP growth in the scenarios of perfect labor mobility.

Second, Table 5 shows that "AFTA plus" may bring about different effects on the other Asian countries and non-Asian economies. The Asian countries excluded from a particular FTA are likely to have a negative GDP growth. The loss of GDP for these Asian countries is more significant in the unemployment scenarios. This result can be explained by the fact that the member countries in a particular FTA would have a higher production capacity (from an increase in the effective labor force), and are able to produce more for bilateral trade with each other, consequently leading to a significant trade creation effect within member countries of a particular FTA. The other Asian countries having a close economic relationship with the member countries of a particular FTA would suffer GDP losses due to a considerable trade diversion effect. The non-Asian economies are almost not affected by the formation of "AFTA plus" under the scenarios of full employment. Some of them (i.e., CER) might have economic gains under the unemployment scenarios. The latter case reveals the fact that the non-Asian economies may turn to pursue intra-regional trade with nearby countries, consequently experiencing an economic gain of real GDP growth.

Third, the significance of labor market specification on the real GDP growth depends on the existing trade patterns among the member countries in the FTAs. The growth rate of Japan's real GDP is higher than that of Korea's. Take Scenario (c) as an example. The real GDP growth rate for Japan is 4.66% in the ASEAN-Japan FTA, but that for Korea is 3.98% in the ASEAN-Korea FTA. This result can be explained by the amount of increase in trade flows after trade liberalization. As shown in Table 6, Japan will have a better chance to export capital-intensive commodities (such as light manufacturing and heavy manufacturing) to ASEAN, as compared with Korea after trade liberalization. The detailed analysis on bilateral trade flows will be provided in Section 4.2.

Table 5. The impacts on real GDP induced by the ASEAN-China & ASEAN-Korea FTAs and ASEAN-Japan FTA

Scenario / Regional Economies	Scenario (a) Full employment Mobile	Scenario (b) Full employment Immobile	Scenario (c) Unemployment Mobile	Scenario (d) Unemployment Immobile
ASEAN-China & ASEAN-Korea FTAs	Scenario 1(a)	Scenario 1(b)	Scenario 1(c)	Scenario 1(d)
ASEAN	12.10 (0.55)	11.67 (0.53)	43.51 (1.97)	40.07 (1.81)
China	4.72 (0.06)	4.46 (0.06)	39.09 (0.52)	28.91 (0.38)
Japan	-3.41 (-0.06)	-2.41 (-0.04)	-24.97 (-0.42)	-27.75 (-0.47)
Korea	1.81 (0.15)	1.55 (0.13)	47.82 (3.98)	36.50 (3.04)
Taiwan	-0.56 (-0.12)	-0.49 (-0.11)	-2.88 (-0.62)	-3.28 (-0.71)
NAFTA	-4.25 (-0.02)	-2.18 (-0.01)	-24.96 (-0.14)	-8.36 (-0.05)
EU	-6.54 (-0.04)	-3.11 (-0.02)	-17.26 (-0.10)	-1.28 (-0.01)
CER	-0.55 (-0.04)	-0.29 (-0.02)	2.21 (0.14)	6.47 (0.42)
ROW	-8.51 (-0.05)	-5.31 (-0.03)	-1.42 (-0.01)	20.01 (0.12)
ASEAN-Japan FTA	Scenario 2(a)	Scenario 2(b)	Scenario 2(c)	Scenario 2(d)
ASEAN	11.45 (0.52)	11.67 (0. 53)	34.84 (1.57)	32.21 (1.45)
China	-3.89 (-0.05)	-3.96 (-0.05)	-13.89 (-0.18)	-17.43 (-0.23)
Japan	10.26 (0.17)	8.15 (0.14)	274.80 (4.66)	224.17 (3.80)
Korea	-1.41 (-0.12)	-1.28 (-0.11)	-7.68 (-0.64)	-8.42 (-0.70)
Taiwan	-0.54 (-0.12)	-0.49 (-0.11)	-1.40 (-0.30)	-1.85 (-0.40)
NAFTA	-2.03 (-0.01)	-1.43 (-0.01)	-28.01 (-0.15)	-13.35 (-0.07)
EU	-2.91 (-0.02)	-1.74 (-0.01)	-34.51 (-0.20)	-17.61 (-0.10)
CER	-0.40 (-0.03)	-0.37 (-0.02)	1.75 (0.11)	4.80 (0.31)
ROW	-3.63 (-0.02)	-2.75 (-0.02)	-10.67 (-0.06)	8.59 (0.05)

Source: this study.
Unit: billion USD (% change from the baseline)

4.2 The impacts on bilateral trade flows

Table 6 reports the changes in the bilateral trade flows of member countries under different simulation scenarios. As shown in the table, the FTAs will promote the member countries' trade. However, the changes in magnitudes and percentage in trade flows differ by commodities and trade routes. Under the ASEAN-China & ASEAN-Korea FTAs, ASEAN would increase exports of all commodities to Korea, particularly with substantial increase in grains and crops. Korea would have a significant increase in exports of light manufacturing and heavy manufacturing to ASEAN. Under the ASEAN-Japan FTA, ASEAN would have significant increase in the exports of processed food to Japan. Japan would experience significant increase in the exports of light manufacturing to ASEAN.

The above results of asymmetric growth in commodity export patterns can be explained by the uneven reduction in the existing bilateral tariff rates. As shown in Table 4, Korea and Japan respectively imposes high tariff rates on the imports of processed food, livestock and meat, and grains and crops from the ASEAN. The ASEAN imposes high tariff rates on the imports of light manufacturing, processed food, grains and crops from both Japan and Korea. Therefore, there is a sharp increase in the trade of these commodities on the associated trade routes after trade liberalization.

Table 6. The impacts on bilateral trade under the ASEAN-China & ASEAN-Korea FTAs and ASEAN-Japan FTA

Scenario (a)	**ASEAN-China & ASEAN- Korea FTAs**		**ASEAN-Japan FTA**		**Scenario (b)**	**ASEAN-China & ASEAN- Korea FTAs**		**ASEAN-Japan FTA**	
Trade route (origin-destination)	ASEAN Korea	Korea ASEAN	ASEAN Japan	Japan ASEAN	Trade route (origin-destination)	ASEAN Korea	Korea ASEAN	ASEAN Japan	Japan ASEAN
Grains and crops	5666 (1101.62)	48 (158.90)	364 (22.35)	12 (33.81)	Grains and crops	5440 (1057.65)	55 (180.42)	338 (20.76)	14 (38.25)
Livestock and meat	213 (351.25)	59 (81.61)	757 (65.49)	15 (31.70)	Livestock and meat	218 (359.61)	54 (74.19)	670 (57.90)	18 (38.01)
Extraction	1441 (9.61)	29 (72.01)	-12 (-0.05)	30 (21.10)	Extraction	1459 (9.73)	29 (72.32)	-25 (-0.10)	32 (22.53)
Processed food	1810 (75.12)	857 (123.98)	4935 (65.39)	270 (43.03)	Processed food	1807 (74.99)	843 (121.96)	4816 (63.82)	281 (44.84)
Textiles and clothing	1624 (63.67)	1121 (24.82)	155 (3.14)	861 (59.63)	Textiles and clothing	1580 (61.93)	1027 (22.23)	145 (2.93)	855 (59.24)
Light manufacturing	733 (28.74)	6000 (82.57)	1892 (15.90)	21833 (111.86)	Light manufacturing	774 (30.37)	5842 (80.39)	2114 (17.77)	20987 (107.53)
Heavy manufacturing	2870 (13.69)	6343 (14.23)	1945 (3.76)	19556 (24.11)	Heavy manufacturing	2824 (13.47)	6445 (14.46)	1834 (3.54)	20169 (24.87)
Other services	34 (0.58)	-14 (-0.54)	229 (2.40)	-282 (-2.90)	Other services	45 (0.77)	-5 (-0.21)	213 (2.23)	-242 (-2.48)
Scenario (c)	**ASEAN-China & ASEAN- Korea FTAs**		**ASEAN-Japan FTA**		**Scenario (d)**	**ASEAN-China & ASEAN- Korea FTAs**		**ASEAN-Japan FTA**	
Trade route (origin-destination)	ASEAN Korea	Korea ASEAN	ASEAN Japan	Japan ASEAN	Trade route (origin-destination)	ASEAN Korea	Korea ASEAN	ASEAN Japan	Japan ASEAN
Grains and crops	5749 (1117.80)	47 (154.41)	404 (24.82)	13 (34.98)	Grains and crops	5547 (1078.50)	56 (183.26)	355 (21.81)	17 (46.87)
Livestock and meat	221 (363.87)	62 (85.05)	816 (70.56)	18 (36.93)	Livestock and meat	225 (370.51)	55 (75.97)	711 (61.47)	21 (43.60)
Extraction	1938 (12.92)	28 (69.08)	888 (3.57)	21 (15.22)	Extraction	1955 (13.04)	30 (73.73)	828 (3.32)	29 (20.52)
Processed food	1913 (79.36)	883 (127.65)	5273 (69.86)	298 (47.47)	Processed food	1899 (78.81)	873 (126.30)	5095 (67.51)	313 (49.91)
Textiles and clothing	1801 (70.57)	1412 (30.57)	396 (8.02)	989 (68.51)	Textiles and clothing	1701 (66.68)	1236 (26.78)	332 (6.73)	944 (65.36)
Light manufacturing	862 (33.83)	6730 (92.61)	2412 (20.27)	23769 (121.78)	Light manufacturing	871 (34.16)	6360 (87.52)	2525 (21.22)	22481 (115.19)
Heavy manufacturing	3952 (18.85)	8618 (19.33)	4103 (7.93)	24430 (30.12)	Heavy manufacturing	3620 (17.27)	8229 (18.46)	3506 (6.77)	24128 (29.75)
Other services	260 (4.44)	108 (4.21)	640 (6.72)	94 (0.96)	Other services	205 (3.50)	105 (4.10)	528 (5.54)	100 (1.03)

Source: this study.
Unit: million USD (% change from the baseline).

4.3 The impacts on employment

In addition to the standard GTAP setting of full employment, this study also considers the unemployment scenarios (Scenarios (c) and (d)) and explores the impacts of FTAs on the reduction in unemployment. The associated results are shown in Table 7. For Korea, the effectiveness of the ASEAN-Korea FTA would lead to a significant employment growth. The employment for unskilled labor and skilled labor respectively increases by 4.47% and 4.56% under the scenario of perfect labor mobility, and by 3.33% and 3.65% under the scenario of labor immobility. With respect to Japan, the FTA with the ASEAN would increase the employment of unskilled labor by 4.73%, and skilled labor by 4.71% under the scenario of perfect labor mobility. On the other hand, this FTA would increase the employment of unskilled labor by 3.87%, and skilled labor by 3.89% under the scenario of labor immobility.

Table 7. Economic impacts on employment under the ASEAN-China & ASEAN-Korea FTAs and ASEAN-Japan FTA (% change from benchmark)

Scenario / Labor in regional economies		ASEAN-China & ASEAN-Korea FTAs		ASEAN-Japan FTA	
		Perfect mobility	Immobility	Perfect mobility	Immobility
Unskilled labor	ASEAN	1.88	1.76	1.36	1.19
	China	0.49	0.38	-0.18	-0.19
	Japan	-0.45	-0.49	4.73	3.87
	Korea	4.47	3.33	-0.67	-0.71
	Taiwan	-0.67	-0.74	-0.32	-0.42
	NAFTA	-0.16	-0.07	-0.17	-0.09
	EU	-0.12	-0.02	-0.20	-0.11
	CER	0.10	0.41	0.09	0.31
	ROW	-0.05	0.13	-0.08	0.06
Skilled labor	ASEAN	1.85	1.59	1.39	1.22
	China	0.48	0.29	-0.19	-0.28
	Japan	-0.44	-0.51	4.71	3.89
	Korea	4.56	3.65	-0.67	-0.76
	Taiwan	-0.65	-0.77	-0.31	-0.43
	NAFTA	-0.15	-0.06	-0.15	-0.08
	EU	-0.12	-0.04	-0.20	-0.12
	CER	0.12	0.42	0.10	0.32
	ROW	-0.05	0.07	-0.09	0.02

Source: this study.

Two important implications can be drawn from the above numerical results. First, the unemployment problem in the ASEAN is likely to be alleviated after the effectiveness of the "AFTA plus". This result coincides with our finding on trade flows, indicating that there is more job opportunity because of a better export chance to Korea and Japan. Korea and Japan would also benefit from the FTAs with ASEAN, in terms of the reduction in unemployment. Second, the ASEAN would experience higher increase in the employment of unskilled labor in the FTA with Korea, while Korea would see a higher increase in the employment of skilled labor. This result can be attributed to the countries' comparative advantage arising from relative factor abundance. Because the ASEAN countries have an abundance of unskilled labor, trade liberalization would

enhance their specialization in the unskilled labor-intensive sectors. As compared with the ASEAN, Korea is endowed with abundant skilled labor, and would produce more skilled labor-intensive products after trade liberalization.

4.4 Welfare effects

In the GTAP model, the equivalent variation (EV) is adopted as a measure of welfare changes induced by an exogenous shock such as trade policy reforms. The main sources of the welfare changes can be grouped into four categories, consisting of (i) allocative efficiency effects which arise from a more efficient use of the existing resources; (ii) terms-of-trade effects that measure the welfare changes due to a variation in export and import prices; (iii) investment-savings effects which reflect the gains or losses from the change in the capital price; and (iv) endowment effects that result from the use of factors previously unemployed (e.g., unemployed labor) or a change in the amount of resource endowments. It should be noted that positive endowment effects occur as a result of capital accumulation under all simulation scenarios and increase in employment of unemployed labor under the unemployment scenarios.

Tables 8 and 9 report the welfare changes and decomposition in all countries/regions under the ASEAN-China & ASEAN-Korea FTAs and ASEAN-Japan FTA, respectively. As shown in the tables, the FTA member countries will have welfare gains in all scenarios. The welfare gains under the unemployment scenarios (Scenarios 1(c), 1(d), 2(c), 2(d)) are higher than those under full employment scenarios (Scenarios 1(a), 1(b), 2(a), 2(b)), mainly because of significant endowment effects from the employment of previously unemployed labor. In contrast, most of the non-member countries have minor welfare losses in the full employment scenarios, but instead welfare gains in the unemployment scenarios. The difference in the results is attributed to the fact that trade barriers distort the resource allocation in these non-member countries. After removing the trade barriers, more trade is promoted between the FTA member countries under the unemployment scenarios, as compared with the full employment scenarios. Accordingly, these countries reduce the trade with the FTA member countries and their resources are reallocated toward a more efficient way.

5. Policy Implications and Concluding Remarks

This study has provided a comparison analysis on the economy-wide impacts of the ASEAN-China & ASEAN-Korea FTAs and ASEAN-Japan FTA. We attach special importance to the specification of the labor market and consider the scenarios of full employment/unemployment and labor mobility/immobility. Based on our numerical results, it is evident that the labor market specification plays a key role in determining the simulated impacts of the FTAs. Hence it is essential for the subsequent CGE analysis on trade liberalization to adopt a proper specification of the labor market.

As expected, the bilateral trade liberalization between ASEAN-Korea and ASEAN-Japan would lead to an increase in trade volumes between the member countries. The ASEAN, Korea, and Japan would respectively have more significant real GDP growth under the scenarios of unemployment and perfect labor mobility. The associated benefits of FTAs, in terms of economic growth and the reduction in unemployment, are significantly higher in Japan and Korea than in the ASEAN. Finally, the ASEAN would experience a more significant increase in the employment of unskilled labor in the FTAs with Korea, while Korea would see a higher increase in the employment of skilled labor. The above numerical results and insights will be useful for various stakeholders including policy makers, international commerce operators, and workers in the ASEAN members and other Asian countries.

Table 8. Changes and decomposition of welfare in terms of Equivalent Variation under ASEAN-China & ASEAN-Korea FTAs (Unit: billions USD)

	Economies	Allocative efficiency	Terms-of-trade effects	Investment-savings effects	Endowment effects	Total
Scenario 1(a)	ASEAN	1.55	-0.40	-0.82	7.09	7.43
	China	1.16	3.38	2.83	2.18	9.55
	Japan	-0.77	-1.13	-0.23	-1.34	-3.46
	Korea	-2.20	0.75	0.36	2.59	1.50
	Taiwan	-0.09	-0.42	-0.08	-0.34	-0.93
	NAFTA	-0.72	-0.92	-0.65	-1.84	-4.13
	EU	-1.72	-0.83	-0.40	-2.85	-5.80
	CER	-0.16	-0.08	-0.17	-0.21	-0.61
	ROW	-1.95	-0.35	-0.86	-4.57	-7.73
Scenario 1(b)	ASEAN	1.52	-0.48	-1.03	6.83	6.84
	China	1.07	3.01	2.67	2.08	8.83
	Japan	-0.59	-1.39	-0.22	-0.92	-3.12
	Korea	-2.43	0.60	0.20	2.57	0.94
	Taiwan	-0.08	-0.47	-0.06	-0.29	-0.90
	NAFTA	-0.43	-0.65	-0.61	-0.91	-2.60
	EU	-0.98	-1.12	-0.33	-1.26	-3.69
	CER	-0.09	0.07	-0.11	-0.11	-0.24
	ROW	-1.51	0.42	-0.53	-2.66	-4.27
Scenario 1(c)	ASEAN	5.03	-2.53	-1.70	30.90	31.70
	China	4.63	1.59	2.03	28.17	36.41
	Japan	-6.92	-0.59	-0.03	-14.01	-21.55
	Korea	5.68	-3.88	-1.12	34.78	35.46
	Taiwan	-0.72	-0.13	0.02	-1.90	-2.72
	NAFTA	-7.70	0.12	-0.21	-14.89	-22.68
	EU	-8.31	-1.17	0.04	-7.53	-16.97
	CER	0.62	0.61	0.02	1.15	2.40
	ROW	-0.83	5.90	0.92	-1.26	4.73
Scenario 1(d)	ASEAN	1.88	0.70	-0.04	3.58	6.12
	China	4.01	7.50	0.83	12.87	25.21
	Japan	3.52	1.02	2.51	20.65	27.70
	Korea	-7.71	-1.08	-0.03	-15.63	-24.44
	Taiwan	3.42	-3.19	-1.08	27.12	26.27
	NAFTA	-0.82	-0.20	0.06	-2.17	-3.13
	EU	4.66	-2.33	-1.69	28.36	29.01
	CER	-2.87	-0.12	-0.52	-5.30	-8.80
	ROW	-2.01	-2.38	-0.09	-0.22	-4.70

Source: this study.

Table 9. Changes and decomposition of welfare in terms of Equivalent Variation under ASEAN-Japan FTA (Unit: billions USD)

	Economies	Allocative efficiency	Terms-of-trade effects	Investment-savings effects	Endowment effects	Total
Scenario 2(a)	ASEAN	2.58	-2.77	-1.34	5.98	4.46
	China	-1.18	-1.62	-0.31	-1.66	-4.76
	Japan	1.99	6.69	1.28	4.18	14.15
	Korea	-0.24	-0.68	-0.08	-0.76	-1.75
	Taiwan	-0.10	-0.32	0.03	-0.31	-0.70
	NAFTA	-0.36	-0.55	-0.07	-0.87	-1.85
	EU	-0.76	-0.36	0.08	-1.27	-2.31
	CER	-0.17	-0.06	0.00	-0.12	-0.36
	ROW	-0.80	-0.37	0.40	-1.98	-2.75
Scenario 2(b)	ASEAN	2.59	-2.82	-1.37	6.12	4.53
	China	-1.25	-1.74	-0.45	-1.66	-5.10
	Japan	1.66	6.64	1.16	3.29	12.74
	Korea	-0.19	-0.70	-0.06	-0.70	-1.66
	Taiwan	-0.10	-0.33	0.04	-0.28	-0.67
	NAFTA	-0.26	-0.53	-0.03	-0.61	-1.43
	EU	-0.54	-0.41	0.13	-0.71	-1.54
	CER	-0.18	-0.01	0.01	-0.10	-0.28
	ROW	-0.72	-0.12	0.57	-1.42	-1.70
Scenario 2(c)	ASEAN	5.24	-3.93	-2.21	23.62	22.72
	China	-1.72	-0.26	0.51	-10.13	-11.59
	Japan	74.03	-0.70	-0.08	153.27	226.51
	Korea	-1.23	-0.04	0.09	-5.30	-6.48
	Taiwan	-0.35	-0.03	0.03	-0.92	-1.27
	NAFTA	-8.47	0.53	0.14	-16.34	-24.14
	EU	-14.55	-0.08	0.28	-15.59	-29.94
	CER	0.49	0.56	0.04	0.95	2.04
	ROW	-2.43	3.95	1.19	-7.18	-4.46
Scenario 2(d)	ASEAN	4.91	-3.79	-2.02	21.60	20.71
	China	-2.26	-1.13	0.53	-12.48	-15.34
	Japan	60.44	0.27	-0.04	125.35	186.01
	Korea	-1.38	-0.27	0.15	-5.79	-7.28
	Taiwan	-0.46	-0.10	0.06	-1.22	-1.72
	NAFTA	-4.19	0.02	-0.09	-7.96	-12.22
	EU	-8.00	-1.29	0.19	-7.82	-16.92
	CER	1.36	0.63	0.02	2.70	4.72
	ROW	1.87	5.65	1.19	5.43	14.13

Source: this study.

Trade liberalization indeed gives the developing ASEAN countries an impulse to economic growth. It may also alleviate or deteriorate the unemployment problem. According to our simulation results, in the short term in which labor cannot move freely across the production sectors, skilled labor of the import-competing industries in the developing ASEAN countries may suffer from the FTA with Korea. In order to avoid the potential social costs or conflicts caused by the effectiveness of the FTA, the policy makers should set up the coordinated sets of measures to relieve the negative impacts on skilled labor. The potential policy options include, among others, income redistribution policies (such as tax-based reforms), unemployment insurance and relief system, career guidance and job training for switching to another line of business, work, or profession, etc.

At the industrial level, the differences in abundance of different types of labor (i.e., skilled and unskilled) signify the distinct comparative advantages in the production of different commodities in the ASEAN, Korea, and Japan. The differences offer a great complementary opportunity for the countries to reap higher economic gains from freer trade. Inevitably, the openness of markets will lead to a harmful impact on the import-competing industries in these countries. In order to avoid large profit erosion, these industries should pay due attention to the development of competitive strategies. The practicable options include, among others, forming the strategic alliance with same or different business fields, product promotion and marketing, boosting operational efficiency wherever possible, etc.

The directions for future researches are provided as follows. First, this study models unemployment scenarios by specifying the closures of wage rigidity. One limitation of this approach is that we cannot estimate the impacts of trade liberalization on the real wages for different types of labor. Future researches can adopt other assumptions (such as the wage curve) and compare the numerical results under different unemployment specification. Second, the reason causing the unemployment of unskilled labor may be different from that of skilled labor. For example, unskilled labor could suffer from involuntary unemployment because of wage rigidity or a minimum wage. However, skilled labor has irreplaceable expertise, and hence their wages are generally not fixed. Further studies are suggested to consider different treatments in modeling the unemployment for skilled labor and unskilled labor.

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