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Evaluation of the Impacts of Trade Restrictions between China and Japan*

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Abstract

Using a simple static computable general equilibrium model, we quantitatively examine the impact of trade restrictions between China and Japan on gross domestic product (GDP) and welfare in both countries. Furthermore, we examine trade flows not only between these two countries, but also between Japan and its other trading partners. We examine export and import quotas' long-run effect (large elasticity of substitution (EOS)) and short-run effect (small EOS) as trade restrictions. When trade restrictions are imposed on manufacturing sectors, we find that regardless of the type of restriction, trade restrictions in either country negatively affect its own GDP. However, because of improvement in terms of trade, the welfare of a country imposing the restriction may increase. We also examine the short-run and long-run impacts of unilateral export restrictions on the ELE (computer, electronic, and optical products) sector, which includes semiconductors. Japan benefits less from its own export restrictions against China than China does from its export restriction against Japan. China can increase its GDP by imposing export restrictions on Japan, whereas Japan cannot. In response to China's export restrictions on Japan, the country increases imports from both major and minor trading partners. This suggests Japan should broaden its import sources to include minor trade partners.

Keywords: Computable general equilibrium, Japan, China, trade restrictions, trade diversion

JEL classification: F13, F14, F17, F51.

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1. Introduction

East Asia exhibits signs of deglobalization. In particular, China imposed an export tax and quotas on rare earths in the mid-2010s.[2] In fact, China imposed a strict restriction on exports to Japan in 2010 and maintained it for several months.[3] Japan also used export controls: in July 2019, it tightened export controls on South Korea for three items used to clean semiconductors, which were lifted in 2023.[4] More recently, in December 2023, China implemented export controls to limit the export of graphite, a key component in lithium-ion batteries used in electric vehicles.[5] By what extent do the trade disputes among the East Asian countries impact their respective economies? We investigate the quantitative impacts of trade restrictions between China and Japan on gross domestic product (GDP), welfare, and trade volumes.

Over the last few decades, the trend toward globalization has intensified in various ways. Removing trade barriers has resulted in integrating regional product markets into the global market. Firms have been establishing business bases overseas through foreign direct investment and constructing global value chain networks, which have expanded and become more complex. Unlike a few decades ago, people can now easily cross national borders as workers or tourists. As a whole, the globalization has contributed to the increases in income

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[2] The United States initiated a WTO trade dispute with China in March 2013, with the cooperation of the European Union (EU) and Japan, over China's export restrictions on various types of rare earths (WTO DS431: China-Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum, (https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds431_e.htm).

[3] China never publicly stated that it had cut rare-earth exports to Japan. Whether China's export controls reduced its rare-earth exports to Japan is debatable. On the one hand, Morrison and Tang (2012) showed a significant decrease in China's rare-earth exports to Japan in October and November 2010. On the other hand, Evenett and Fritz (2023) revisited this issue to examine whether China's rare-earth exports to Japan and other G7 countries were disrupted.

[4] See an article of New York Times, "Japan imposed new broad trade restrictions on South Korea" on August 1, 2019.

[5] According to The Japan News, "China's export of graphite and related products to Japan decreased by over 40% in December compared to the previous month on a quantitative basis, according to trade statistics released by Chinese custom authorities." The Japan News, "China's drastic reduction in graphite exports to Japan; urgent need for diversification in Japanese imports," January 21, 2024 (https://japannews.yomiuri.co.jp/world/asia-pacific/20240121−163587/).

and welfare around the world.

However, bilateral and multilateral trade disputes arose concurrently. In some cases, we can clearly identify trade restrictions resulting from disputes. For example, from the late 1950s to the 1990s, Japan and the United States had trade disputes over the penetration of Japanese products into the US market. In the case of automobiles, Japan implemented voluntary export restraints.[6] More recently, the US–China trade war has received much attention. The US government has increased tariffs on many categories of Chinese products, and China has responded by increasing tariffs on imports from the US. As previously stated, East Asian countries have observed bilateral trade restrictions.

Recent trade disputes may have caused or resulted in the decoupling of global trading networks, also known as *geoeconomic fragmentation*. For example, China's 2023 export control on important chipmaking materials is in response to restrictions on the export of chipmaking tools to China imposed by the US, Japan, and the Netherlands.[7] Geoeconomic fragmentation implies the division of global trade networks into small trading blocs. Several studies estimated the costs of geoeconomic fragmentation under various scenarios and demonstrated that both sides, namely, the countries imposing trade restrictions and those being imposed such restrictions, incur nonnegligible, or large, costs, such as decreases in GDP and welfare (Goes and Bekkers, 2022; Bolhuis et al., 2023; Plummer, 2023; Javorcik et al., 2024).

Observing the trend in global trade networks, it is easy to predict that trade disputes among East Asian countries will result in significant geoeconomic fragmentation. In particular, trade wars between China and Japan may lead to serious negative economic impacts in this region due to the two countries' large economies. Thus, qualitatively and quantitatively analyzing the impact of trade restrictions imposed by China and/or Japan on bilateral trade between these

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[6] See Urata (2020) for the history of US–Japan trade frictions.

[7] See the article of Nikkei Asia "China tightens export restrictions on two chipmaking materials" on Aug 1, 2023 (https://asia.nikkei.com/Economy/Trade/China-tightens-export-restrictions-on-two-chipmaking-materials), and the article of Global Times "China to impose export controls on key materials for chipmaking as West's 'chip war' escalates" on Jul 3, 2023 (https://www.globaltimes.cn/page/202307/1293637.shtml).See also the website of the Ministry of Economy, Trade and Industry, Japan, for the meetings of Japan and China on export controls (https://www.meti.go.jp/english/policy/external_economy/regional_affairs/northeast_asia/china.html#vis).

two countries is crucial. Using a simple static computable general equilibrium (CGE) model and the data of global trade analysis project (GTAP), we quantitatively investigate the impact of export and import controls imposed by (i) China, (ii) Japan, and (iii) both countries on GDP, welfare, and trading volumes.

First, we look at the trade structure between China and Japan. In particular, we focus on the strategic sectors identified by the US government. Second, we use standard static CGE analysis to examine the impacts of export and import quotas as measures of trade restrictions. We assume that constant elasticity of substitution (CES) production functions have different parameter values of substitution elasticities between long run and short run. We interpret large elasticity as long-run because of the high flexibility in the substitution between domestic and imported goods. We consider small elasticity short-run due to high rigidity in the substitution between domestic and imported goods. In both cases, we examine the impact of trade restrictions. If trade restrictions are targeted to manufacturing sectors, we found that trade restrictions by either country tend to harm its own GDP, regardless of the type of restriction. However, either country can benefit from its trade restrictions if its terms of trade (ToT) improve.

We also focus on scenarios involving unilateral export restrictions on the ELE (computer, electronic, and optical products) sector, which includes semiconductor production. We found that China benefits more from its export restrictions against Japan than Japan does from its export restrictions against China. Moreover, Japan loses more from China's export restriction against Japan than China does from Japan's restriction against China. The effects on GDP are also asymmetric between countries: export restrictions allow China to increase its GDP while preventing Japan from doing so. We also determine the impact of export restrictions on Japan's trade flows. We found that export restrictions significantly affect trade flows between Japan, China, and other trading partners. Our findings suggest that potential replacements for China as Japan's export destinations or import sources may not be the country's current major trade partners. This suggests that Japan should diversify its export destinations and import sources beyond its current major trade partners.

1.1 Literature review

Our study primarily concerns the quantitative analysis of trade wars and disputes. Many studies focused on the US–China trade war, whereas others investigated trade disputes between other countries. Furthermore, recent research has begun to examine the impact of trading blocs and geoeconomic fragmentation.

US–China trade war

Several studies have used CGE models to examine the impact of the US–China trade war in the late 2010s. For instance, Li et al. (2020) found that the remaining tariff increases as of March 2020 decrease welfare and trade flows between the US and China. Trade diversion occurs, and other trading partners benefit from the diversion effect. Meanwhile, Itakura (2020) found that the trade war reduces nearly all sectoral imports and outputs in both countries using a dynamic CGE global trade model. He also demonstrated the importance of global value chains in calculating the negative impact of the bilateral trade war. For the three years beginning in 2019, Kumagai et al. (2021) examined the impact of 25% additional tariffs on all goods imported from each other. They found that other countries benefited, whereas the US and China suffered from the trade war. Bouët and Laborde (2018) examined the impact of the US–China trade war and the US–Mexico trade dispute. They showed that protectionism imposed on the two trading partners invariably harms the US. Although some US sectors may benefit from the trade war, the negative impact on others outweighs the benefits.

Some studies focused on other aspects of the US–China trade war. For instance, Mahadevan and Nugroho et al. (2019) examined the role of the Regional Comprehensive Economic Partnership Agreement (RCEP) in the trade war. They found that trade is being diverted to RCEP member countries. However, the diversion is insufficient to mitigate the negative impact of the US–China trade war. Park et al. (2021) also investigated the impact of the concurrent development of RCEP, the Comprehensive and Progressive Agreement for the Trans-Pacific Partnership (CPTPP), and the US–China trade war. They demonstrated that the two regional agreements will largely offset the substantial negative impact of the trade war. Furthermore, Nugroho et al. (2021) investigated the trade war's impact on poverty and inequality in Indonesia. They showed that income inequality can worsen even though the trade war improves the country's ToT and increases the returns of primary factors owned by households.

Several studies investigated the impact of the US–China trade war using methods other than CGE models (Archana, 2020; Liu, 2020; Jiang et al., 2023; Yang and Hayakawa, 2023; Fajgelbaum et al., 2024). For example, using China's monthly customs data, Jiang et al. (2023) found that the trade war reduces Chinese total exports to the US by 16.47% on average, and that a decrease in quantity primarily explains the reduction in exports. As shown in the analysis using the CGE model, they also demonstrated the trade diversion. Moreover, Fajgelbaum et al. (2024) demonstrated that the trade war created net export opportunities for exporters in third countries, with the extent of benefits determined by country-specific tariff elasticities.

Other trade disputes/sanctions

Other trade disputes and sanctions have also been analyzed using CGE models. For example, Chepeliev et al. (2022) examined the trade restrictions imposed by OECD countries on Russia's energy exports. They demonstrated that although the short-run negative impact is nontrivial, the long-term cost to EU countries is minimal, and that the sanction may even positively impact the environment. Hosoe (2021) investigated the impact of Japan's chemical export controls on Korea. He found that a decline in productivity would have a minor negative impact on the Japanese and global economies and that trade diversion causes a decrease in welfare in both Japan and Korea. Shin and Balistreri (2022) also focused on Japan's export control and Korean boycotts of Japanese goods. They found that both countries suffer from welfare losses. However, the decrease in Japanese imports is offset by increases in domestic production and imports from other countries. Hayakawa et al. (2023) empirically examined the effects of export controls on exports using monthly data from Japan's exports by partner country. They found that US restrictions on Huawei significantly decreased Japan's exports of related products to China.

Some studies also focused on the political aspects of trade wars. For example, Wickes (2021) focused on tensions between Japan and the US and showed evidence that increasing Japanese penetration of the American market and growth in the bilateral merchandise trade deficit with Japan were crucial drivers of tensions between 1996 and 2016. Meanwhile, Liebman and Reynolds (2022) examined the factors that influence countries' decisions on sanctions and showed that countries are more likely to sanction products with higher trade values and those in which they can extract ToT improvement.

Geoeconomic fragmentation

In contrast to bilateral trade disputes, geoeconomic fragmentation implies that global markets are divided into subgroups, each of which imposes trade restrictions on the member countries of the other groups. Because positive spillover effects or trade diversion are difficult to generate, the negative impacts of geoeconomic fragmentation may be severe. Goes and Bekkers (2022) developed a multisector and multi-region general equilibrium model with dynamic knowledge diffusion and examined a hypothetical scenario in which the global economy is divided into the US-centered West and the China-centered East. They showed that the projected welfare losses from a decoupling scenario are severe for the global economy, and that the size of the welfare effect is substantially larger in the model with knowledge diffusion than in the model without it. Bolhuis et al. (2023) developed a multi-country and multisector general equilibrium model with two types of goods, commodities and non-commodities, to quantify the economic cost of global trade fragmentation. Two hypothetical situations are considered. The first scenario is strategic decoupling, in which the US–EU and China do not trade in high-tech sectors and the rest of the world does so freely. The second scenario is geoeconomic fragmentation, in which the US–EU and China–Russia do not trade, and the rest of the world divides into two groups based on the strength of its trade relationship with either the US–EU or China–Russia group. It demonstrates that, in strategic decoupling scenarios, low-income countries benefit from trade diversion, but in geoeconomic fragmentation, low-income countries' outputs decrease by 4.3%, suggesting that developing countries are vulnerable to decoupling in global trade.

The impact of the US–China trade wars and geoeconomic fragmentation on US-centered and China-centered groups have been thoroughly explained in the literature. However, there are potential rifts between countries in every region, one of which is in East Asia. Relatively few studies that examine these potential rifts. Thus, we focus on China and Japan's trade restrictions, which may lead to new fragmentation.

The rest of this paper is structured as follows. Section 2 discusses China and Japan's trade interdependencies. Section 3 mentions the methodology for our analysis. It also includes descriptions of the data sources and scenarios. Section 4 explains the results of the analysis using the CGE model, the overall findings, and the policy implications. Finally, Section 5 concludes the paper.

2. Trade Interdependency between China and Japan

This section briefly examines the trade dependency between China and Japan. The US government publishes and periodically revises its Advanced Technology Products (ATP) list. Freund et al. (2023) defined strategic industries (Harmonized System (HS) two-digit level) based on this ATP list and examined the impact of US import tariffs on trade in US strategic industries.[8] They noted that, in strategic industries, China's share of US imports decreased from 36.8% in 2017 to 23.1% in 2022. The strategic industries at the HS 2-digit level are shown in Table 1. Because the trade friction between Japan and China is closely related to the geoeconomic fragmentation described in the previous section, let us look at the trade structure between Japan and China based on the definition of strategic industries.

Figure 1 shows the ratio of imports from China to all imports of Japan. There was no significant change between 2017 and 2022: Japan continues to rely heavily on Chinese imports. It also shows that roughly half of them are products from strategic industries. For each HS classification, Figure 2 shows the dependence on imports from China (imports from China as a percentage of global imports of Japan). HS28 classifies rare-earth metals, whereas HS84 and HS85 cover semiconductors and semiconductor manufacturing equipment, respectively. The dependence on HS28, HS84, and HS85 is high, exceeding 40%. Moreover, the category with the greatest increase in dependence between 2017 and 2022 was HS28 (13%). Overall, the percentage of Japan's import reliance on China in strategic industries remained nearly unchanged at 34%.

Figures 3 and 4 show the export dependence that corresponds to Figures 1 and 2. Although the same trend can be seen for exports, export dependence on China is lower than import dependence. As with import dependence, China is an important export destination for Japan in HS84 and HS85. In addition, HS29, HS38, and HS90 have a dependence greater than 20%. HS29 contains organic chemicals; HS38 includes classifications for gallium, germanium, and graphite; and HS90 features optical instruments. Although many sectors showed decreased

[8] In 2022, the US Department of Commerce will classify 494 exported and 644 imported products as Advanced Technology Products (ATP) at the HS 10-digit level.

dependence between 2017 and 2022, the overall export dependence in strategic industries remained nearly unchanged at 19%.

Let us take a look at China's trade dependence on Japan. Figure 5 show the ratio of imports from Japan to total imports of China. The reliance on Japanese imports is relatively low and has decreased between 2017 and 2022. Figure 6 shows China's import dependence for each HS category (imports from Japan as a percentage of the value of imports from the world as a whole). The dependence of HS38, HS84, HS87 (including motor vehicles) and HS90 exceeds 15%. Many sectors show a decrease in dependence, which decreased by approximately 2.5% between 2017 and 2022. Figures 7 and 8 show the export dependence corresponding to Figures 5 and 6. The dependence is high in HS28, at more than 13%, whereas that for the rest of the sectors are below 10%. Overall, the total dependence is approximately 4.6%, with 80% of sectors decreasing dependence between 2017 and 2022. The overall export dependence decreased by approximately 1.2% in this period.

To summarize, Japan's trade dependence on China exceeds China's trade dependence on Japan. In overall strategic sectors, Japan's import dependence on China is 34% in 2022, whereas China's is only 12%. In terms of overall strategic sector exports, Japan's dependence on China in 2022 is 19%, which is smaller than its import reliance on China. In 2022, China's overall strategic sector export dependence on Japan 4.6%, significantly lower than Japan's counterpart.

3. Methods

CGE model

We use a static global CGE model that includes multiple regions and sectors to achieve our goal. Our model is simple and nearly identical to that used by Li et al. (2020), who used a canonical CGE model provided by GTAP in GAMS (Lanz and Rutherford, 2016).[9] The

[9] Our model is also extremely similar to the GTAP model (Hertel, 1999). First, in the GTAP model, government consumption and investment are variable, and the utility of regional households is determined by private consumption, government consumption, and investment. Meanwhile, in our model, government consumption and investment are fixed, and the utility of each regional household is determined solely by

following section provides an overview of the model. However, due to space constraints, a comprehensive description is not possible. Appendix B provides a detailed mathematical representation of the model.

Data

According to the reference data, the CGE analysis assumes that the economy is in equilibrium. For these benchmark data, we use the GTAP 11 data for the 2017 reference year. GTAP 11 data covers 160 regions and 65 sectors.[10] For our analysis, we aggregate the regions into 23 and the sectors into 38, as shown in Tables 2 and 3.

Model

Our model includes a representative household, 38 productive sectors, and a government in each of the 23 regions (see Figure 9). It is assumed that all markets are perfectly competitive, all prices are flexible, and supply and demand are equal in all markets.[11] Production and utility functions represent the technology of the producing sectors and the preferences of the representative household. Producers are assumed to maximize profit whereas households maximize their utility. Furthermore, as is common in multi-region CGE models, we use the Armington (1969) assumption, which posits that the same good is considered differentiated if produced in different regions.

Production side

Firms in the production sectors in each region determine their output and input (intermediate inputs and primary factors) to maximize profits. The main factors are labor, capital, land, and

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private consumption. Second, the GTAP model employs a constant difference of elasticities (CDE) function for the utility function of consumption, whereas our model employs a Cobb–Douglas-type utility function.

[10] For more information on the classifications, visit the GTAP 11 website. Aguier et al. (2022) also describe the construction of the GTAP data base, version 11.

[11] A sensitivity analysis of the simulation will be performed later, including where unemployment exists (i.e., when the labor market is not in equilibrium).

natural resources. Production technology in sector j is represented by a multistage CES production function with the input structure shown in Figure 10.

Production uses a fixed proportion of intermediate inputs and composite primary factors, implying that the top-level production function has a Leontief-type structure. A CES function with elasticity of substitution (EOS), σ_j^{VA}, aggregates primary factors into a composite primary factor. Based on the Armington assumption, each intermediate input is a composite of domestic and imported goods, aggregated using a CES function, where σ_i^A represents the EOS between domestic and imported goods. As in the GTAP model, we assume that land and natural resources are sluggish factors, exhibiting imperfect mobility across all sectors. The allocation of sluggish factors across sectors uses a constant elasticity of transformation function.

Demand side

We assume that each region has a representative household that supplies primary factors to the production sectors while receiving rewards for factors used for consumption and saving. The household has a fixed endowment of primary factors. Given income, the household solves the utility maximization problem, determining how much of each good to consume. Figure 11 depicts the Cobb–Douglas function, representing the household's utility function. Consumption goods, like intermediate inputs, aggregate domestic and imported goods using a CES function under the Armington assumption.

Other components of the model

Regions are linked through exports and imports of goods, and we adopt the Armington assumption for the trade structure. The Armington aggregation occurs in two stages. First, imports from various regions are aggregated into a composite import using a CES function (see Figure 12). Second, the composite import is further aggregated with domestic goods using a CES function.

Each region's government levies taxes and uses the tax revenue for its own purposes, also known as government consumption. Because we use a static model, investment, government consumption, and trade balance remain constant at the benchmark values.

Parameters

Our model employs many CES functions, each of which includes different EOS parameters. Specifically, the model includes the following parameters:

- EOS between domestic and imported goods (Armington elasticity) (σ_i^A)
- EOS among imported goods from different regions (σ_i^M)
- EOS among primary factors in the production function (σ_i^{VA})

For σ_i^A and σ_i^{VA}, we use values from GTAP data. For σ_i^M, we assume $\sigma_i^M = \sigma_i^A \times 2$, as in the GTAP model. Hertel and van der Mensbrugghe (2024) provide details on the EOS parameter values in the GTAP model, as well as an explanation of their rationale. In summary, the values estimated by Hertel et al. (2003) are used for σ_i^A, whereas the values from Whalley (1985) and Rimmer (1990) are used for σ_i^{VA}.

Given the GTAP model's static nature, the parameter values are intended for long-term analysis. Consequently, the GTAP model's parameters are sufficiently large to account for long-term changes. However, our analysis seeks to assess the long-run effects assumed by the conventional static model and the short-run effects. Short-run assumptions make it more difficult to adjust to economic shocks. For example, substituting labor input for capital input is difficult in the short term. Under the Armington assumption, goods produced in different countries are differentiated, but in the short run, substituting imports from one country with imports from another or domestic production is frequently difficult. The difficulty of substituting imports is a major issue in economic decoupling discussions. As previously stated, to evaluate short-run effects, our simulations will consider scenarios with smaller parameter values in addition to the standard parameter values (GTAP values).

Benchmark data

Because the simulation results heavily rely on the state of the economy at the outset (the state of the benchmark data), let us confirm the initial benchmark trade structure for Japan and China.

Table 4 shows Japan's export shares by goods/sectors and destinations[12]. The rows and columns denote destinations and goods, respectively. The share of goods i to region k is defined as the ratio of the export value of goods i from Japan (with superscript J) to region k to total production value of goods i of Japan (expressed as a percentage):

$$ExportShare_{ik}^{J} = 100 \times ExportValue_{ik}^{J}/TotalProductionValue_{i}^{J}.$$

The table shows that manufactured goods have a large export share to China. China holds significant market shares in computer, electronic, and optical products (**ELE**), textiles (**TEX**), electronic equipment (**EEQ**), manufacturing chemicals and chemical products (**CHM**), and machinery and equipment n.e.c. (**OME**).

Table 5 shows Japan's import shares by goods and origins. The rows and columns denote origins and goods, respectively. The share of goods h from region l is defined as the ratio of the import value of goods h from region l to the total demand (value) of goods h in Japan (expressed as a percentage):

$$ImportShare_{hl}^{J} = 100 \times ImportValue_{hl}^{J}/TotalDemand_{h}^{J}.$$

The goods determine the regions from which large quantities are imported into Japan. Japan imports a large amount of agricultural products from the US, whereas the country imports resources from the Middle East and Australia. Moreover, the US and China have large industrial product market shares. In particular, China holds large market shares in ELE, TEX, EEQ, apparel and leather and allied products (**ALT**), and other manufacturing (**OMF**).

Tables 6 and 7 show China's export and import shares, respectively. The definitions are as follows:

$$ExportShare_{ik}^{C} = 100 \times ExportValue_{ik}^{C}/TotalProductionValue_{i}^{C},$$

$$ImportShare_{hl}^{C} = 100 \times ImportValue_{hl}^{C}/TotalDemand_{h}^{C},$$

where superscript C denotes China. Although the export shares to Japan are slightly higher than those to other countries, they are still small compared to Japan's exports to China. This fact implies that China is not heavily reliant on Japan in terms of export values. On the contrary,

[12] In the current analysis, "sector" and "goods" have the same meaning and are used interchangeably.

some import shares are very large. For example, China's shares of import from Japan in ELE, OME, and motor vehicles and parts (**MVH**) are 8.9%, 3.5%, and 2.4%, respectively.

In general, Japan is more reliant on China for exports and imports than China is on Japan. Table 8 shows Japan's trade figures with China (in billions of US dollars) in 2017. Because Japan's total exports and imports are approximately 78 and 75 trillion JPY, the figures in Table 8 show Japan's high trade reliance on China.[13]

Scenarios

Based on our research objectives, we examine trade restrictions imposed by China, Japan, or both countries. The main scenario assumes a 30% reduction in exports (imports) of the target goods.[14] However, a 30% trade reduction appears unlikely between China and Japan, which rely heavily on trade. However, given the impact of the US–China trade war, it is worth considering such a drastic scenario even between China and Japan. In fact, Bown (2022) reported that US imports from China have decreased significantly due to its import tariffs: the value of US imports of goods subject to 25% tariffs from China is 22% lower than before the trade war. In particular, US semiconductor import volumes from China have fallen by 50% compared to pre-trade war levels. In the labor market, flexible wages are assumed as in the standard CGE model, with the labor market always clearing (no involuntary unemployment). We primarily focus on the impact of trade restrictions on GDP and welfare. We also discuss how the impacts affect industry output and trade flows.

The elasticities ($\sigma_i^A, \sigma_i^M, \sigma_i^{VA}$) in the GTAP data are used, as previously stated. Table 9 shows the EOS values for GTAP. These values are fairly large because they are based on high elasticity, representing long-term impacts. However, in the short run, it will be difficult to substitute goods from one region for goods from another, or imported goods for domestic goods. Also, substituting one production factor for another is difficult in the short term. Thus,

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[13] The source for the export and import values is Trade Statistics Japan, Ministry of Finance (https://www.customs.go.jp/toukei/info/tsdl_e.htm). One dollar was equivalent to between 108 and 116 yen in 2017.

[14] Scenarios involving 10% and 50% reductions will also be examined in the sensitivity analysis.

we also examine the other scenario in which the EOSs are small, which is exactly one-fifth of the elasticities in the GTAP data. We will refer to the long-run and short-run elasticities as **EOS 1.0** and **EOS 0.2**, respectively.

Table 10 summarizes the scenarios considered in this study. **CHN, JPN,** and **J&C** represent trade restrictions imposed by China, Japan, or both. **E** and **I** represent the scenarios with regulated export and import volumes. Moreover, **MAN** represents the scenario that governs all manufacturing industries. **ELE, FMP**, and **NFM** indicate the scenarios that restrict trade of individual sectors. In the scenario that limits individual sectors, the target sectors are chosen based on the importance of trade between China and Japan. In other words, trade dependencies in the target sectors are significant. Furthermore, ELE and NFM were chosen because these two sectors contain products related to recent trade restrictions imposed in Asian countries. Semiconductors are classified as ELE, whereas NFM includes some types of germaniums and gallium. For example, **CHE_E_MAN** represents a scenario in which China restricts the export of manufacturing goods to Japan.

Among the various trade restriction options, we assume a policy of "quotas," which regulate trade based on quantity. Import quotas restrict imports, whereas export quotas restrict exports. A disparity between domestic and foreign prices emerges when a quota policy is implemented. When export quotas are imposed, it is assumed that "domestic price + rents = foreign price." The rents are assumed to be received by the government of the exporting region (country) and returned to households in a lump sum. Import restrictions follow the same scheme. When import quotas are imposed, "domestic price = foreign price + rents" and rents are assumed to be received by the importing region (country) government and returned to households in a lump sum.

For example, CHN_E_ELE represents the scenario in which China restricts ELE exports to Japan. However, China's ELE exports to Japan match Japan's ELE imports from China. This means that the target of JPN_I_ELE is identical to that of CHN_E_ELE. As a result, the two scenarios would have roughly equivalent effects on GDP. However, the effect on welfare can vary greatly depending on which country, China or Japan, implements the restriction and which country receives the rent (tax revenue).

Our model establishes the equivalence of "quotas" and "taxes." Import quotas and tariffs (import taxes) can achieve the same equilibrium. Therefore, the simulation in this study can be interpreted as a trade restriction based on a tax. Using “quotas” rather than “taxes” is to target quantities. Specifically, we aim to consider regulations such as “reduce imports/exports by X%.” In the following analysis of the impacts of trade restrictions targeted at specific sectors, we will use the concept of a “tariff equivalent of a quota,” which is defined as a tax rate that limits trade volume by the same amount as a quota.

4. Results

In this section, we first examine the impact of trade restrictions in all manufacturing sectors, including 19 of 38 industries (Table 3). We show the effects of unilateral and bilateral trade restrictions on either country’s welfare and GDP in the long run (EOS 1.0) and in the short run (EOS0.2). We focus on the most likely scenario: 30 % trade reductions in all manufacturing sectors.

Next, we analyze the impact of trade restrictions in specific industries. We focus on hypothetical scenarios in which each country unilaterally imposes export restrictions on the ELE (computer, electronic, and optical products) sector, which includes semiconductors. We analyze the effects on welfare, GDP, and sectoral output of trade restrictions on ELE using hypothetical scenarios. We also show the impact of export restrictions in each country on Japan’s trade flows.

Trade restrictions on manufacturing sectors

We first examine the results of the main scenario, which is “30% reductions of all manufacturing sectors with no unemployment,” and the impact of trade restrictions on Japan and China. GDP and welfare are used to evaluate macroeconomic impacts on countries.[15] Table 11 shows Japan’s and China’s GDP and welfare impacts (percent changes from base equilibrium, %). The policy scenarios only include scenarios involving trade restrictions on MAN. The upper side corresponds to EOS 1.0, and the lower side to EOS 0.2.

Long-term impacts

[15] Welfare is the level of utility of representative household.

Let us focus on unilateral trade restrictions on MAN with EOS 1.0 first. Japan's GDP and welfare decrease when China imposes trade restrictions on exports or imports. China is also facing declines in both GDP and welfare. However, the magnitudes of the reductions are much smaller than those in Japan. Both Japan and China are negatively impacted, but Japan is more negatively affected than China.

When Japan imposes the trade restrictions, under the export restriction scenario, Japan's GDP and welfare decrease. Under the import restriction scenario, a reduction in GDP is also observed. However, Japan's welfare will increase slightly under the import restriction scenario, in contrast to China's welfare impact. This increase in welfare is due to the ToT effect, or the effect of an improvement in Japan's ToT.

When a country unilaterally imposes a trade restriction, its impact on its own country is typically greater than on the other. In other words, unilateral restrictions can be more detrimental to the other country than the country itself. When comparing the impacts on Japan to those on China, Japan tends to suffer more negative consequences. This means that even with comparable trade restrictions, Japan would suffer more damage than China. Despite the very strict trade restrictions on manufacturing goods (exports, imports, or both) with 30% reductions, the overall effect of trade restrictions in the EOS 1.0 case is minimal. In the most extreme case, Japan's GDP decreased by only 0.1%. This is most likely due to the high value of substitutional elasticities and the fact that substitution works strongly against trade restrictions.

Let us consider the scenario in which China and Japan impose trade restrictions on each other in the manufacturing sector. When both countries restrict trade, the results are similar to the sum of the effects of China and Japan's trade restrictions. However, the former is not identical to the latter. Both Japan and China are experiencing reductions in GDP and welfare. Japan's GDP and welfare tend to be lower than when only one country implements trade restrictions. However, the effect on Japan's welfare in the import restriction case is greater than in the case where only China restricts imports. This is due to the ToT effect. China's GDP and welfare tend to be lower than in cases where one country restricts trade. However, the effect on China's welfare in bilateral export restrictions is smaller than in the case of Japan's unilateral export restrictions against China. Again, this is due to the ToT effect.

Short-term impacts

Second, we examine trade restriction scenarios on MAN with EOS 0.2, which assume lower substitution elasticities. When China imposes trade restrictions, Japan's GDP and welfare changes follow the same pattern as in the EOS 1.0 case. However, the reduction rates are much higher than in the EOS 1.0 case, ranging from 5.67 to 6.57 times GDP and 8.82 to 10.5 times welfare. It is quite intuitive because substitution is difficult in the short run. For China, GDP increases in the case of export restrictions, and welfare increases in both cases of export and import restrictions. These increases in GDP and welfare can be attributed to the low EOS, which allows the ToT effect to benefit the country imposing trade restrictions.

When Japan imposes trade restrictions, the negative impacts on Japan's GDP are less than in the EOS 1.0 case, and welfare increases in both the export and import restriction cases. In the case of export restrictions, welfare increases by 1.05%. It is believed that the ToT effect contributes to welfare increases. Japan's export and import restrictions reduce China's GDP and welfare. Furthermore, the reduction rates are significantly higher than in EOS 1.0 cases: 3.8 to 3.9 times for GDP reductions and 8.3 to 9.6 times for welfare reductions.

When China and Japan impose trade restrictions, GDP and welfare of both countries decrease. Moreover, compared to the EOS 1.0 case, the reduction rates are much higher. In Japan, the EOS 0.2 case has 3.4 to 8.0 times higher rates than the EOS 1.0 case. China's corresponding values range from 2.7 to 6.5. Trade restrictions can have a significant negative impact.

The fact that Japan tends to experience more negative impact is the same as in the EOS 1.0 case. For example, under J&C_I_MAN, where both countries impose MAN import restrictions, Japan's GDP reduction is 2.2 times greater than China's GDP reduction, and Japan's welfare reduction is 3.5 times greater than China's welfare reduction. Because impact is measured by change ratio, the disparity in magnitude between Japan and China is thought to be caused by a difference in trade dependence between the two countries rather than a difference in economic scale. Another interesting point is that the negative impacts of both countries' trade restrictions are greater in the EOS 0.2 case than in the EOS 1.0 case. However, some positive impacts are observed when trade restrictions are imposed by one country. Thus, both countries' trade restrictions significantly negatively impact both countries, particularly in the short term.

Comparisons on welfare impacts between China and Japan

The difference in the impacts on welfare between for China and Japan is noteworthy. In the case of EOS 1.0, Japan can improve its welfare by imposing import restrictions against China. However, when China imposes the import restriction against Japan, its welfare will decrease. The ToT effect plays an important role in determining the welfare impact. The possible reason for the difference in the welfare impacts is that the EOSs for Japan's major exporting goods are relatively high. Thus, when China imposes import restrictions, export destinations for goods from Japan's target sectors can easily be changed to other countries (trade diversion). In contrast, the substitution elasticities of China's main exporting goods are relatively low. Thus, when Japan imposes import restrictions, the magnitude of trade diversion is small, and Japan's ToT improve significantly.

In such a case, a lower restriction rate for China is considered optimal. The sensitivity analysis shows that China's welfare increases when it imposes a 10% import reduction (see Appendix A). Moreover, in the case of EOS 0.2, the difference in the substitution elasticities of major exporting goods does not generate the difference in welfare impacts, increasing the welfare of Japan (China) when Japan (China) imposes import restrictions against China (Japan).

Trade restrictions on individual sectors

This section examines the effect of trade restrictions on specific sectors. We focus on unilateral ELE export restrictions as hypothetical scenarios. There are two reasons. First, in recent years, we have observed trade conflicts in Asia due to export restrictions. Japan's export controls on semiconductor materials are against Korea, and China's export restrictions on chipmaking materials like gallium and germanium are also against countries including Japan. Second, we focus on ELE as a target sector because it includes semiconductors in its classification and accounts for most trade between Japan and China. According to the GTAP 11 database, it accounts for 29% of Japan's exports to China and 30% of its imports from China in 2017. To simplify the analysis, we assume no unemployment in the labor market.

Impacts on welfare

In this section, we examine the welfare effects of export restrictions on ELE. First, let us look at Table 12, which shows the tariff equivalents of each country's export quotas. We can see that tariff equivalents for quotas are higher under EOS 0.2 than under EOS 1.0. For instance, when Japan imposes a quota on ELE exports to China to reduce its export volume by 30%, the tariff equivalent under EOS 0.2 is 31.5%, which is higher than the 5% under EOS1.0. Because substituting domestic and imported goods is more difficult under EOS 0.2 than under EOS 1.0, these results imply that EOS 0.2 requires higher tariff rates to reduce trade volume by the same amount as EOS 1.0.

Effects on the welfare of target countries.

Differences in tariff equivalents have welfare implications for trade restrictions. A trade restriction under EOS 0.2 has a greater welfare impact on a target country than under EOS 1.0. Table 13a shows the welfare impact of Japan's export restrictions against China. The negative effect on China's welfare is greater under EOS 0.2 than under EOS 1.0 for each reduction rate. This is because a smaller elasticity of substitution necessitates a higher tariff equivalent, resulting in a greater degree of deterioration in China's ToT. Furthermore, as Japan tightens the size of the export quota, China's welfare steadily decreases. Similar results were obtained with China's ELE export restrictions against Japan (see Table 13b). These results suggest that export restrictions harm a target country more in the short term than the long run. This is because the target country has more difficulty in switching to substitutes sourced from its domestic suppliers or other trade partners.

Next, let us compare the magnitudes of welfare damages caused by export restrictions in Japan and China. Japan suffers more damage from China's ELE export restriction than China does due to Japan's ELE export restriction. For example, if China restricts ELE exports to Japan by 30%, Japan's welfare will fall by 1.17% in the short run (Table 13b). If Japan reduces its ELE exports to China by 30%, China's welfare would suffer a 0.71% loss in the short run (Table13a). The percentage loss in welfare for Japan is 1.67 times greater than that of China. The difference in each country's import dependence on its trade partners can explain this result. Table 14 shows the import-to-domestic total demand ratios in the ELE sector. China is Japan's largest supplier of ELE. Japan gets 21.4% of its total demand from China. However, Korea is China's largest supplier of ELE. Japan ranks fourth in the ELE supplier ranking, trailing Korea, ASEAN, and MIC (a group of middle-income countries), accounting for only 8.95% of total Chinese ELE demand. Given Japan's reliance on China's ELE, Japan suffers significant welfare damage from China's export reduction in ELE against Japan because such export restrictions could significantly impact Japan's ToT. Meanwhile, Japan's ELE export reduction against China caused less welfare damage because China's import dependency on Japan was lower than Japan's.

Impacts on the welfare of countries conducting export restrictions

The imposition of trade restrictions may benefit or harm Japan and China. Compare the benefits and costs of trade restrictions between China and Japan. Table 13 shows that, for each export reduction rate, China's welfare gain (loss) from imposing an export restriction on ELE against Japan is necessarily greater (smaller) than Japan's benefit from its counterpart against China in either case of EOS. For example, under EOS 0.2, if Japan reduces its ELE exports to China by 30%, its welfare increases by 0.148%. If China reduces its ELE exports to Japan by 30%, its welfare increases by 0.234% under EOS0.2. The percentage increase in China's welfare is 1.5 times greater than that in Japan. It is important to note that the welfare impact on each country can be negative if the export reduction rate exceeds the welfare-maximizing level. Why China's gain (loss) is larger (smaller) than Japan's? The difference in ELE export dependency between the two countries explains the reason. In ELE, Japan's export dependence on China exceeds China's export dependence on Japan. The ratio of ELE export to China to domestic ELE production in Japan is 22.2%, whereas in China, it is 6.8% (Table 15a and b). Because exports depend more on a target country, the welfare gain for the country that imposes an export restriction is less. This could explain why Japan benefits less from the ELE export restriction against China than China does from the same restriction against Japan.

Impacts of export restrictions on GDPs

Let us now consider the GDP effects of ELE export restrictions. Table 16a shows that Japan's export restrictions negatively affect its GDP, regardless of the reduction rate. Furthermore, EOS 0.2 has a greater percentage reduction in Japan's GDP than EOS 1.0 does. For example, under EOS 1.0, Japan's GDP decreases by 0.006% due to a 30% reduction in ELE exports to China, whereas it decreases by 0.011% under EOS0.2. These findings suggest that Japan's export restrictions may have a greater short-run impact on its GDP than long-run effects. Meanwhile, China's ELE export restrictions against Japan yield opposing results. Table 16b shows that under EOS 0.2, ELE export restrictions against Japan cause less damage to China's GDP than under EOS 1.0. Indeed, under EOS 0.2, China's ELE export restrictions can potentially increase its GDP. If China reduces its ELE exports to Japan by 30%, its GDP grows by 0.0014%, but falls by 0.0027% under EOS1.0. This result is somewhat surprising given Japan's GDP effects of ELE export restrictions.

Let us examine these asymmetric impacts on GDPs. In our static CGE model, investment, government expenditure, and trade balance remain constant at the benchmark values. This implies that export restrictions on ELE affects each country's GDP only through changes in its domestic consumption.

A country's export restrictions can positively impact domestic consumption if they can increase its welfare. Improving a country's welfare implies an increase in its real income, which positively affects domestic consumption. Meanwhile, it may negatively affect its domestic consumption due to changes in the relative price. A country's export restrictions reduce the domestic price of domestic goods relative to imported goods, which reduce its domestic consumption of imported goods. Under EOS 0.2, China's export restrictions significantly improve its welfare, and as a result, the positive effects on its consumption of domestic goods outweigh the negative effects on that of imported goods. Thus, China's ELE export restrictions against Japan can increase its GDP in the short run (EOS 0.2). Under EOS 0.2, export restrictions of ELE against China can improve Japan's welfare, just as they do in China. However, the magnitudes are smaller than those of China. Thus, in Japan, the positive effects of export restrictions against China on its consumption of domestic goods are insufficient to compensate for the negative effects on that of imported goods. Thus, Japan's export restrictions of ELE against China reduces its own GDP even in the short run (EOS 0.2).

Impacts on GDPs in target countries

Export restrictions inevitably reduce the GDP of a target country. Table 16a shows that Japan's export restrictions on ELE against China decrease Chinese GDP regardless of the export reduction rates. Table 16b also shows similar results for China's export restrictions against Japan. Moreover, regardless of the rate of export reduction, China's export restrictions against Japan have a greater negative impact on Japanese GDP than Japan's export restrictions against China. For example, if Japan reduces its ELE exports to China by 30%, China's GDP will fall by 0.041% under EOS 0.2. China's 30% reduction in ELE exports to Japan lowers Japan's GDP by 0.107% under EOS 0.2. As we have shown, China's ELE export restrictions against Japan negatively impact Japan's welfare more than Japan' counterparts against China (Table 13a and b). This implies that Japan's domestic consumption would fall more dramatically due to China's export restrictions than the effects of Japan's counterparts on Chinese domestic consumption. As a result, by significantly reducing Japan's domestic consumption, China's ELE export restrictions on Japan cause a greater loss in GDP for Japan than Japan's counterpart on China.

Impacts on output

Export restrictions on ELE have negative impacts on ELE output in the country that imposes them. If Japan reduces its ELE exports to China by 30%, its ELE production decreases by 4.30% in EOS 0.2 and 6.72% in EOS 0.1 (see Table 17). China's export restrictions on Japan decrease its ELE production by 1.26% in EOS 0.2 and 1.77% in EOS 1.0 (Table 18). Japan's production reduction rates are greater than China's because Japan is more reliant on China for imports. Furthermore, the percentage decrease in output is greater in the long run (EOS 1.0) versus the short run (EOS 0.2). Why is there a difference between the short and long run? The reason can be explained by the effects on domestic consumption and total exports. Due to ELE export restrictions, a country's domestic consumption would decrease (increase) more (less) significantly in percentage terms under EOS 1.0 than under EOS 0.2 because a percentage loss (gain) in welfare or real income is larger (smaller) under EOS 1.0 than under EOS 0.2.

Meanwhile, ELE export restrictions decrease total exports from a country that imposes export restrictions and a percentage reduction in total exports is larger in EOS 0.2 than that in EOS 1.0. Tables 17 and 18 show the effects of each country's export restrictions on total global exports. Exports to the world are declining in both China and Japan, with higher percentage reduction rates under EOS 0.2 than under EOS 1.0. The reason for this result is that export restrictions improve its own ToT, which means that the average price of its exporting goods increases relative to that of its importing goods. This implies that a country restricting its exports of ELE can import the same amount of foreign goods while exporting fewer goods, assuming its trade balance remains at the initial value. That is, when a country restricts ELE exports, its total exports fall due to improved ToT. Tables 17 and 18 show that reduction rates in total exports are higher under EOS 0.2 than under EOS 1.0. This is because ToT improvements are greater under EOS 0.2 than under EOS 1.0. (Remember that the tariff equivalents for the quotas are higher under EOS 0.2 than under EOS 1.0). In sum, a country's export restrictions negatively affect its total exports, and the negative effects are greater in the short run (EOS 0.2) than in the long run (EOS 1.0).

Because the effects on domestic consumption are more significant than on total exports, export restrictions on ELE reduce more of its output of a country that conducts the restrictions in the long run (EOS 1.0) than in the short run (EOS 0.2).

ELE export restrictions positively affect ELE output in a target country. The positive impacts hold in the short (EOS 0.2) and long run (EOS 1.0). If Japan reduces its ELE exports to China by 30%, China's ELE output increases by 0.28% in the short run (EOS 0.2) and 0.10% in the long run (EOS 1.0) (Table 17). China's ELE export reductions also positively affect Japan's ELE output. The output increases by 1.42% in the short term (EOS 0.2) and 1.05% in the long term (EOS 1.0) (Table 18). China's export restrictions result in greater expansions in the production of a target sector in Japan than in China. This is because Japan is more reliant on China for ELE imports than China is. Furthermore, unlike the previous case of the effects on the output of a country implementing export restrictions, the output of a target country increases more in the short run (EOS 0.2) than in the long run (EOS 1.0). The reason is based on the effects on a target country's total exports. Export restrictions increase a target country's total exports in the short run (EOS 0.2) due to a significant deterioration in its ToT, whereas total exports fall slightly in the long run (EOS 0.1). Because of the difference in the effects on a target country's total exports, the short-run effects of export restrictions on ELE output are greater than the long-run impacts.

Impacts on trade flows

We briefly explore the effects of export restrictions on trade flows. First, let us examine the effects of Japan's export restriction on its export flows. Table 19 shows the top ten countries/regions to which Japan increases its total exports when it restricts ELE exports to China by 30%. It also shows that the export restriction on ELE reduces Japan's total exports to China by 7.74%. Korea is an important alternative to China as Japan's export destination. In response to its export restrictions against China, Japan increases its total exports to Korea by 2.15%, the highest percentage increase in total Japanese exports. Korea is also one of Japan's most important export destinations in ELE: 4.7% of Japanese ELE domestic output is exported to Korea, making Korea the third largest ELE market of Japan, after China and ASEAN. Another important replacement is Germany, where Japan increases total exports by 2.04%. Germany is also Japan's fourth largest export destination in the ELE. It is also worth noting that the replacements for China as Japan's export destination are not always large export markets for Japan. For example, Japan increased its exports to Brazil and India by 1.92% and 1.86%, respectively. These two countries are not the primary export destinations for Japan's ELE. Brazil imports only 0.15% of Japan's total ELE production, whereas India accounts for only 0.34% of Japan's domestic production. Because of its ELE export restrictions against China, Japan increased its exports to these two countries at nearly the same rate as it expanded exports to ASEAN, Japan's second largest ELE market. These findings suggest that emerging market nations such as Brazil and India, which are not currently large markets for Japanese ELE, could become important export destinations if Japan restricts its export of ELE to China.

Finally, we explore the impact of China's export restrictions on Japan's import flows. Table 20 shows the top ten countries/regions from which Japan is increasing its imports in response to China's 30% ELE export restriction to Japan. It also shows that due to China's export restrictions, Japan's total import from China decreased by 8.47%. Except for MIC (a group of middle-income countries), Mexico has the highest percentage increase in exports to Japan. This is somewhat surprising given that Mexico is not a major exporter of ELE to Japan, supplying only 0.41% of Japan's total domestic demand for ELE. Japan also increases its total imports from ASEAN by 2.64%, the second highest percentage increase in total imports. ASEAN is Japan's largest supplier of ELE, with its products accounting for 6.92% of total demand. Korea increases its exports to Japan by 2.56%, despite Japan sourcing only 1.65% of its domestic ELE demand from Korea. It is also worth noting that Japan's percentage increase in imports from the United States is only 1.81%, much lower than Mexico's 3.16%, although the US is Japan's second largest supplier of ELE, accounting for 4.73% of total demand, much higher than Mexico's, 0.41%. These results imply that Japan should diversify its import sources beyond its current main suppliers, such as ASEAN and the United States, to include current minor suppliers like Mexico.

Sensitivity analysis

We conducted a sensitivity analysis to ensure that the results obtained thus far were robust. First, we analyze scenarios with various trade volume reduction rates. We consider a 30% reduction in target goods exports (imports) in the main scenarios. Meanwhile, we consider 10% and 50% reductions in target goods exports (imports) in the sensitivity analysis.

We also analyze scenarios with different labor market assumptions. We will examine a case that involves unemployment in particular. In the main scenario, we assume that prices are flexible and that supply and demand are equal in all markets. As a result, there is no involuntary unemployment on the job market. In the short term, prices are unlikely to be flexible. As a result, our sensitivity analysis examines a scenario in which labor market prices are no longer flexible, resulting in involuntary unemployment.

Without unemployment, even if production in one sector falls, labor from that sector moves to another, increasing output in the destination sector and mitigating any overall decrease in output (GDP). On the contrary, when unemployment occurs, a decrease in production in one sector results in decreased employment and increased unemployment. In this scenario, the positive effect on production in other sectors diminishes (or vanishes), potentially resulting in a significant decrease in GDP. The impact of trade restrictions could change substantially as a result.

There are several methods for introducing unemployment (i.e., limiting wage flexibility), but in our analysis, we use the wage curve model. [16] This model assumes a negative relationship between real wages and the unemployment rate, limiting real wage elasticity and introducing unemployment.

Appendix A shows the sensitivity analysis results: Tables A.1 and A.2 show Japan's and China's GDP impacts, whereas Tables A.3 and A.4 show the corresponding welfare impacts. The results are mostly consistent with one another. The greater the reduction rate, the stronger the impact of trade restrictions.

Two points are worth mentioning. First, when focusing on the long-run impact (the EOS 1.0 case), trade restrictions imposed by either country can positively impact its own welfare if the reduction rate is 10%. The rent generated by the trade restrictive policy is included in welfare rather than GDP. Thus, the results show that the optimal trade restriction rate is less than 30%, which is not particularly high. Second, as one might expect, the negative impacts are greater when the wage is rigid (in the presence of unemployment) than when the wage is flexible enough to ensure that labor demand equals labor supply (in the absence of

[16] The wage curve model is employed, for instance, by Takeda et al. (2020). For more information on the wage curve model, see Blanchflower and Oswald (2005).

unemployment).

5. Conclusion

Using a simple static CGE model, we investigated the impact of trade restrictions between China and Japan on GDP and welfare in both countries. Moreover, we examine trade volumes not only between these two countries but also between Japan or China and other countries. The main scenario is “30% reductions in the imports, exports, or both of target sectors,” and we examine both the long-run effect (the case with relatively large EOS) and the short-run effect (the case with relatively small EOS).

Regardless of the type of restrictions, we found that trade restrictions on manufacturing sectors by either country negatively affect its own GDP. However, due to the increase in ToT caused by the restriction, the welfare of a country that imposes the restriction may improve. The impacts are greater in the short term than in the long term because adjusting production structure in the short run is difficult.

We also investigated the impact of export restrictions on the ELE sector. We found that tariff equivalents are higher in the short term than in the long run. The difference in tariff equivalents indicates that export restrictions on ELE result in a greater improvement in ToT for the country implementing the restrictions and a greater deterioration in ToT for the target country in the short term than in the long run. This also implies that export restrictions have a greater short-run welfare impact than long-run welfare impacts. The welfare impact of export restrictions is also determined by trade dependence on a target country in the ELE sector. Japan is more dependent on China than China is on Japan in terms of exports and imports. This implies that Japan benefits less from its own export restrictions against China than China does from its counterpart against Japan, and Japan suffers more from China’s export restrictions against Japan than China does from Japan’s counterpart against China. Furthermore, in the short run, China can increase its GDP by imposing an export restriction on ELE against Japan, despite Japan’s GDP not increasing due to its own export restriction on China.

We found that China’s replacements as Japan’s export destinations may not be Japan’s primary export markets at present. Japan’s export restrictions on ELE against China result in significant percentage increases in exports to Brazil and India, which are not Japan’s primary

ELE export destinations. We also found that an alternative to China as Japan's import sources may not be Japan's current primary supplier. China's ELE export restriction against Japan results in the greatest percentage increase in Japan's imports from Mexico, which is not a major supplier of ELE to Japan. These results suggest that Japan should diversify its export destinations and import sources to include both major and minor trade partners.

Our analysis has an important limitation. In reality, trade restrictions often target goods rather than sectors. Target goods include, for example, ATPs, such as biotechnology and nuclear technology. Countries may choose target goods based on the effectiveness of restrictions. However, using GTAP data makes disaggregating sectoral data into product levels difficult. Our study confirms the targeting effect in sector-level trade restrictions. This effect may be underestimated because governments typically narrow down the target goods to maximize the impacts of trade restrictions.

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Table 1: List of the Harmonized System codes that include strategic industries

HS	Products
28	Inorganic chemicals; organic or inorganic compounds of precious metals, rare-earth metals, radioactive elements, or isotopes.
29	Organic chemicals.
30	Pharmaceutical products.
38	Miscellaneous chemical products.
84	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof.
85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles.
87	Vehicles other than railway or tramway rolling stock, and parts and accessories thereof.
88	Aircraft, spacecraft, and parts thereof.
90	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof.
93	Arms and ammunition; parts and accessories thereof.

Table 2: Region classification

	Symbol	Explanation		Symbol	Explanation
1	ARG	Argentina	13	RUS	Russia
2	ANZ	Australia and New Zealand	14	SAU	Saudi Arabia
3	BRA	Brazil	15	ZAF	South Africa
4	CAN	Canada	16	KOR	Korea
5	CHN	China and Hong Kong	17	TUR	Turkey
6	FRA	France	18	GBR	United Kingdom
7	DEU	Germany	19	USA	United States
8	IND	India	20	REU	Rest of European Union (excluding FRA, DEU, GBR, and ITA)
9	ASE	ASEAN	21	OEX	Other oil exporters
10	ITA	Italy	22	LIC	Other low-income countries
11	JPN	Japan	23	MIC	Other middle-income countries
12	MEX	Mexico			

Note: ASEAN includes Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, and Vietnam.

Table 3: Sector classification

	Symbol	Explanation		Symbol	Explanation
1	AGR	Farms and farm products (111CA)	20	EEQ	Electronic equipment
2	FOF	Forestry and fishing	21	ELE	Computer, electronic and optical products
3	COA	Coal	22	OME	Machinery and equipment nec
4	OIL	Oil	23	MVH	Motor vehicles and parts
5	GAS	Gas	24	OTN	Transport equipment nec
6	OXT	Other Extraction (formerly omn Minerals nec)	25	OMF	Manufactures nec
7	FBP	Food and beverage and tobacco products (311FT)	26	UTI	Utilities (electricity–gas–water)
8	TEX	Textiles	27	CNS	Construction
9	ALT	Apparel and leather and allied products (315AL)	28	TRD	Trade
10	LUM	Lumber and wood products	29	WTP	Water transport
11	PPP	Paper products, publishing	30	ATP	Air transport
12	P_C	Petroleum, coal products	31	OTP	Transport nec
13	CHM	Manufacture of chemicals and chemical products	32	CMN	Communication
14	BPH	Basic pharmaceutical products	33	ISR	Insurance
15	RPP	Rubber and plastic products	34	OFI	Financial services nec
16	NMM	Mineral products nec	35	OBS	Business services nec
17	I_S	Ferrous metals	36	ROS	Recreational and other services
18	NFM	Metals nec	37	OSG	Public Administration, Defense, Education, Health
19	FMP	Metal products	38	DWE	Dwellings and real estate activities

The shaded parts are the manufacturing sectors.

Table 4: Japan's export share by export destination region (%)

	AGR	FOF	COA	OIL	GAS	OXT	FBP	TEX	ALT	LUM	PPP	P_C	CHM	BPH	RPP	NMM	I_S	NFM	FMP	EEQ	ELE	OME	MVH	OTN	OMF
ARG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
ANZ	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.1	1.7	0.1	0.1	0.4	0.2	0.1	1.5	0.1	0.2	0.2	0.6	2.1	0.2	0.3
BRA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.1
CAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.1	0.1	0.3	0.1	0.1	1.2	0.1	0.3	0.2	0.3	1.0	0.2	0.4
CHN	0.3	1.0	0.0	0.0	0.0	1.4	0.4	17.6	1.0	0.2	2.4	2.3	9.8	1.8	5.1	3.8	2.0	7.0	3.2	11.5	22.2	9.7	4.4	0.9	3.2
FRA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.0	0.3	0.3	0.2	0.1	0.0	0.1	0.2	0.4	0.2	0.4	0.6	0.5	0.3
DEU	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.8	0.0	0.0	0.1	0.0	0.6	0.6	0.3	0.5	0.1	0.2	0.3	1.3	2.0	0.9	0.9	0.8	1.2
IND	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.6	0.0	0.0	0.1	0.1	0.7	0.0	0.2	0.2	0.3	0.2	0.3	0.5	0.3	0.7	0.2	0.0	0.3
ASE	0.2	0.2	0.0	0.1	0.0	0.4	0.3	10.5	1.2	0.4	0.9	0.6	3.7	0.3	2.6	1.5	2.8	4.4	3.0	5.0	6.0	4.8	2.9	1.7	1.9
ITA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.2	0.1	0.3	0.3	0.8	0.2
JPN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.2	0.0	0.4	0.1	0.4	0.1	0.7	0.7	0.3	0.6	0.9	0.0	0.2
RUS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.3	0.1	0.0	0.0	0.1	0.2	0.1	0.3	0.9	0.0	0.1
SAU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.2	0.4	0.0	0.1
ZAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.3	0.0	0.0
KOR	0.0	0.6	0.0	0.2	0.0	0.5	0.1	1.7	0.5	0.1	0.4	0.8	4.2	0.7	1.9	1.3	1.5	1.1	0.7	2.2	4.7	2.8	0.5	0.2	1.2
TUR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.3	0.1	0.3	0.3	0.1	0.0
GBR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.1	0.3	0.3	0.2	0.1	0.0	1.6	0.1	0.6	0.3	0.4	0.7	1.8	0.3
USA	0.1	0.2	0.0	0.0	0.0	0.3	0.3	3.2	0.4	0.1	0.4	0.5	2.9	3.2	2.1	1.5	0.5	0.9	2.1	6.8	4.7	6.8	12.0	7.6	3.0
REU	0.0	0.0	0.0	0.0	0.0	0.1	0.0	1.0	0.1	0.0	0.1	0.0	1.2	1.8	0.7	0.5	0.2	2.0	0.6	1.5	1.4	1.8	2.6	1.5	1.7
OEX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.1	0.2	0.0	0.1	0.4	0.1	0.3	1.7	0.2	0.1
LIC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.2	0.5	1.0	0.1
MIC	0.2	0.3	0.0	0.0	0.0	0.4	0.2	1.6	0.4	0.0	0.5	0.5	3.5	0.5	2.0	1.3	1.0	2.4	0.7	1.9	5.2	2.3	3.3	3.2	1.3

Source: GTAP 11 data for the 2017 reference year

Table 5: Japan's import share by import source region (%)

	AGR	FOF	COA	OIL	GAS	OXT	FBP	TEX	ALT	LUM	PPP	P_C	CHM	BPH	RPP	NMM	I_S	NFM	FMP	EEQ	ELE	OME	MVH	OTN	OMF
ARG	0.1	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ANZ	1.7	0.9	64.2	0.1	46.2	16.6	1.3	0.1	0.0	2.6	0.0	0.3	0.2	0.1	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2
BRA	1.2	0.0	0.0	0.0	0.0	8.4	0.4	0.1	0.0	0.4	0.2	0.0	0.1	0.1	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.2	0.0
CAN	2.4	1.3	4.8	0.0	0.0	4.2	0.6	0.1	0.1	2.8	0.3	0.0	0.2	0.5	0.0	0.0	0.0	0.5	0.0	0.0	0.1	0.1	0.0	0.5	0.1
CHN	1.7	2.2	0.9	0.4	0.0	1.9	2.1	30.5	40.9	5.5	1.4	0.8	4.2	1.4	3.8	3.8	0.5	2.0	5.3	13.6	21.4	4.9	1.5	1.6	12.9
FRA	0.1	0.0	0.0	0.0	0.0	0.0	0.5	0.2	1.3	0.0	0.0	0.0	0.9	2.0	0.1	0.2	0.0	0.1	0.1	0.2	0.2	0.3	0.2	0.6	1.2
DEU	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.1	0.3	0.1	0.0	1.2	4.9	0.3	0.3	0.0	0.2	0.3	0.9	1.1	1.0	2.3	0.8	0.8
IND	0.2	0.0	0.0	0.0	0.0	0.9	0.2	0.9	0.6	0.0	0.0	1.1	0.3	0.3	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.4
ASE	1.7	1.4	14.1	1.8	20.8	4.5	2.4	9.2	15.3	11.3	0.7	0.4	2.6	1.2	4.0	1.0	0.1	3.5	1.6	8.3	6.9	1.8	0.9	1.0	4.3
ITA	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.1	3.9	0.1	0.0	0.0	0.4	1.2	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.3	0.4	0.4	0.7
JPN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEX	0.4	0.2	0.0	1.3	0.0	1.6	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.4	0.0	0.3	0.1	0.8
RUS	0.1	0.5	7.9	5.7	4.7	0.3	0.3	0.0	0.0	1.4	0.0	0.8	0.0	0.0	0.0	0.0	0.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAU	0.0	0.0	0.0	45.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.3	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZAF	0.2	0.0	0.1	0.0	0.0	1.8	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0
KOR	0.2	1.7	0.0	0.0	0.0	0.2	0.5	2.0	0.3	0.1	0.2	1.6	1.6	0.4	0.7	0.5	1.0	1.5	1.2	1.1	1.6	1.1	0.3	0.4	0.5
TUR	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GBR	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.0	0.1	0.0	0.3	1.5	0.1	0.1	0.0	0.2	0.1	0.2	0.3	0.3	0.4	0.7	0.2
USA	7.8	2.4	5.4	0.9	2.3	2.4	2.8	1.3	0.4	1.2	1.1	3.0	4.3	5.9	0.8	1.0	0.1	1.2	0.7	1.5	4.7	1.9	0.6	9.7	5.2
REU	0.3	0.8	0.0	0.0	0.0	0.1	1.8	1.1	1.3	4.3	0.4	0.1	1.8	9.3	0.3	0.3	0.1	0.9	0.3	0.7	2.2	0.9	0.9	0.4	2.1
OEX	0.1	0.0	0.0	38.9	21.8	0.0	0.0	0.1	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIC	0.3	0.1	0.5	0.3	0.5	0.4	0.1	0.3	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIC	1.5	1.1	1.6	5.0	3.6	18.3	1.2	2.3	0.8	1.8	0.2	0.3	1.4	0.2	0.6	0.4	0.5	1.1	0.8	0.7	4.1	0.6	0.1	0.8	1.2

Source: GTAP 11 data for the 2017 reference year

Table 6: China's export share by export destination region (%)

	AGR	FOF	COA	OIL	GAS	OXT	FBP	TEX	ALT	LUM	PPP	P_C	CHM	BPH	RPP	NMM	I_S	NFM	FMP	EEQ	ELE	OME	MVH	OTN	OMF
ARG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.0	0.4	0.1
ANZ	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.2	0.2	0.3	0.5	0.4	0.1	0.7	0.2	0.1	0.1	0.6	0.4	1.8	0.4	0.1	0.3	1.7
BRA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.0	0.1	0.1	0.4	0.1	0.3	0.1	0.1	0.0	0.2	0.2	0.8	0.3	0.1	0.3	0.5
CAN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.8	0.2	0.1	0.0	0.1	0.0	0.4	0.1	0.1	0.1	0.3	0.2	0.6	0.2	0.1	0.3	1.2
CHN	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.2	0.1	0.2	1.0	0.2	0.1	0.1	0.1	0.1	2.2	0.1	0.1	2.9	0.1	0.1	0.1	1.3
FRA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.9	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.0	0.0	0.3	0.3	0.6	0.2	0.1	0.4	0.9
DEU	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	1.5	0.2	0.1	0.0	0.3	0.2	0.5	0.1	0.0	0.1	0.6	0.6	2.6	0.6	0.3	0.8	1.7
IND	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.1	0.2	0.3	1.2	0.3	0.4	0.2	0.3	0.2	0.4	0.4	3.2	0.7	0.1	0.4	1.0
ASE	0.6	0.0	0.0	0.3	0.0	0.2	0.6	4.0	2.5	0.7	0.8	1.9	2.5	0.3	1.8	0.8	1.9	0.8	2.0	1.4	8.0	2.4	0.6	2.2	2.8
ITA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.1	0.1	0.0	0.2	0.1	0.2	0.1	0.1	0.0	0.2	0.2	0.6	0.3	0.1	0.3	0.7
JPN	0.1	0.2	0.1	0.4	0.0	0.2	0.4	0.8	3.9	0.7	0.3	0.2	1.1	0.2	1.0	0.3	0.2	0.4	1.0	1.1	6.8	1.2	0.5	0.7	3.4
MEX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.1	0.0	0.1	0.2	0.0	0.3	0.1	0.1	0.1	0.2	0.2	1.7	0.3	0.3	0.3	0.5
RUS	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.6	0.1	0.1	0.1	0.3	0.0	0.3	0.1	0.1	0.1	0.3	0.2	0.9	0.6	0.2	0.3	0.6
SAU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.1	0.1	0.0	0.1	0.0	0.2	0.1	0.1	0.0	0.2	0.1	0.3	0.2	0.0	0.2	0.5
ZAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.3	0.1	0.1	0.1	0.4
KOR	0.1	0.1	0.1	0.2	0.0	0.2	0.2	0.5	1.3	0.2	0.2	0.5	1.2	0.1	0.4	0.4	1.0	0.4	0.5	0.5	5.0	0.5	0.2	0.5	1.2
TUR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.0	0.2	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.5	0.3	0.0	0.3	0.2
GBR	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	2.1	0.3	0.2	0.0	0.2	0.1	0.6	0.1	0.0	0.1	0.5	0.4	1.4	0.3	0.1	0.7	2.1
USA	0.1	0.0	0.0	0.1	0.0	0.1	0.4	2.1	9.0	1.8	1.0	0.6	1.6	0.5	3.7	0.9	0.3	0.5	3.0	3.2	17.4	2.9	1.9	2.6	15.8
REU	0.1	0.0	0.0	0.0	0.0	0.1	0.2	1.0	4.0	0.6	0.3	0.2	0.9	0.3	1.2	0.3	0.3	0.3	1.3	1.2	5.4	1.2	0.5	2.5	3.7
OEX	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.8	1.4	0.3	0.3	0.1	0.4	0.1	0.7	0.3	0.4	0.3	0.6	0.4	1.5	0.7	0.5	0.8	1.2
LIC	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.6	1.6	0.1	0.2	1.0	0.4	0.1	0.5	0.2	0.4	0.1	0.6	0.3	0.6	0.6	0.2	1.6	0.7
MIC	0.2	0.0	0.0	0.0	20.4	0.2	0.3	2.5	4.0	0.6	0.7	0.5	2.1	0.3	2.2	0.8	1.6	0.7	2.0	1.3	5.9	2.0	0.7	4.1	3.5

Source: GTAP 11 data for the 2017 reference year

Table 7: China's import share by import source region (%)

	AGR	FOF	COA	OIL	GAS	OXT	FBP	TEX	ALT	LUM	PPP	P_C	CHM	BPH	RPP	NMM	I_S	NFM	FMP	EEQ	ELE	OME	MVH	OTN	OMF
ARG	0.2	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ANZ	0.7	1.2	6.3	0.2	27.1	12.3	0.6	0.0	0.0	0.5	0.1	0.1	0.1	0.1	0.1	0.0	0.0	2.6	0.0	0.0	0.1	0.0	0.0	0.0	0.1
BRA	1.9	0.0	0.0	3.8	0.0	5.0	0.3	0.0	0.2	0.1	0.8	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.5	0.0
CAN	0.4	0.4	0.4	0.1	0.1	0.3	0.2	0.0	0.0	0.5	0.8	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.1	0.1	0.2	0.1
CHN	0.1	0.1	0.0	0.0	0.0	0.1	0.2	0.1	0.4	0.1	0.2	1.0	0.2	0.1	0.1	0.1	0.1	1.9	0.2	0.1	3.2	0.1	0.0	0.1	1.9
FRA	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.1	0.3	0.0	0.1	0.0	0.6	0.4	0.1	0.0	0.1	0.1	0.1	0.1	0.3	0.3	0.1	4.2	0.4
DEU	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.1	0.1	0.1	1.0	1.1	0.7	0.1	0.2	0.3	0.7	0.8	2.3	2.3	3.0	2.9	1.0
IND	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	0.2	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.1	0.1	0.0	0.0	2.9
ASE	0.4	0.4	4.4	1.4	16.2	1.4	0.9	0.8	1.7	1.9	0.8	1.5	3.7	0.1	2.4	0.4	0.4	1.0	0.2	0.6	15.9	0.6	0.2	0.7	1.2
ITA	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	1.2	0.0	0.1	0.0	0.2	0.3	0.2	0.0	0.0	0.1	0.1	0.1	0.2	0.6	0.3	0.3	0.8
JPN	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.6	0.1	0.0	0.8	0.7	3.0	0.2	2.0	0.4	1.0	1.2	0.9	1.3	8.9	3.5	2.4	0.5	1.2
MEX	0.0	0.0	0.0	0.2	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.7	0.0	0.1	0.0	0.4
RUS	0.0	0.6	1.4	10.6	13.0	0.4	0.1	0.0	0.0	1.4	0.2	0.3	0.2	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.2
SAU	0.0	0.0	0.0	10.5	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZAF	0.1	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	1.8	0.0	0.0	0.0	0.0	0.0	0.0	1.8
KOR	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.2	0.0	0.2	1.7	4.1	0.0	1.0	0.4	0.6	0.6	0.5	0.5	18.2	1.3	0.4	0.2	0.3
TUR	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GBR	0.0	0.1	0.0	0.7	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.1	0.2	0.1	0.0	0.0	0.5	0.1	0.0	0.4	0.2	0.8	0.7	0.4
USA	1.7	0.4	0.3	1.4	3.1	0.4	0.4	0.2	0.2	0.8	1.1	1.3	1.9	0.4	0.8	0.2	0.2	1.2	0.3	0.3	3.9	1.0	1.9	0.2	2.6
REU	0.1	0.2	0.0	0.4	0.1	0.6	0.6	0.2	0.4	0.6	0.9	0.1	1.1	1.3	0.6	0.1	0.2	5.8	0.4	0.7	3.1	1.2	1.2	0.4	2.1
OEX	0.0	0.2	0.0	11.5	9.6	0.9	0.0	0.0	0.0	0.0	0.0	2.1	1.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3
LIC	0.1	0.6	0.0	13.2	0.3	1.2	0.1	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIC	0.5	0.9	1.9	17.4	29.2	7.3	0.4	0.8	0.6	0.4	0.6	0.4	2.6	0.0	0.5	0.2	0.5	3.2	0.3	0.2	10.3	0.9	0.0	0.4	1.1

Source: GTAP 11 data for the 2017 reference year

Table 8: Japan's trade with China in 2017 (billion US$)

	Import	Export		Import	Export
AGR	1.8	0.2	ELE	59.1	67.6
FOF	0.5	0.2	OME	12.9	33.6
COA	0.2	0.0	MVH	4.4	19.2
OIL	0.2	0.0	OTN	1.4	0.8
GAS	0.0	0.0	OMF	13.1	2.7
OXT	0.7	0.2	UTI	0.0	0.0
FBP	8.5	1.3	CNS	0.3	0.2
TEX	6.4	3.2	TRD	4.2	0.8
ALT	28.5	0.2	WTP	1.3	0.6
LUM	1.9	0.0	ATP	0.5	0.9
PPP	1.7	3.0	OTP	0.4	0.9
P_C	1.1	3.0	CMN	1.5	0.7
CHM	9.0	23.4	ISR	0.1	0.8
BPH	1.2	1.2	OFI	0.6	0.6
RPP	5.2	7.5	OBS	3.6	2.1
NMM	2.9	3.0	ROS	1.4	11.1
I_S	1.7	7.1	OSG	0.4	2.7
NFM	2.3	8.5	DWE	0.0	0.3
FMP	6.8	4.1	sum	204.0	228.7
EEQ	17.9	16.7			

Source: GTAP 11 data for the 2017 reference year

Table 9: Original values of Armington elasticity and EOS between primary factors.

Goods	EOS_DM	EOS_VA	Goods	EOS_DM	EOS_VA
1 AGR	2.43	0.26	20 EEQ	4.40	1.26
2 FOF	1.83	0.20	21 ELE	4.40	1.26
3 COA	3.05	0.20	22 OME	4.05	1.26
4 OIL	5.20	0.20	23 MVH	2.80	1.26
5 GAS	17.20	0.20	24 OTN	4.30	1.26
6 OXT	0.90	0.20	25 OMF	3.75	1.26
7 FBP	2.53	1.12	26 UTI	2.80	1.26
8 TEX	3.75	1.26	27 CNS	1.90	1.40
9 ALT	3.81	1.26	28 TRD	1.90	1.68
10 LUM	3.40	1.26	29 WTP	1.90	1.68
11 PPP	2.95	1.26	30 ATP	1.90	1.68
12 P_C	2.10	1.26	31 OTP	1.90	1.68
13 CHM	3.30	1.26	32 CMN	1.90	1.26
14 BPH	3.30	1.26	33 ISR	1.90	1.26
15 RPP	3.30	1.26	34 OFI	1.90	1.26
16 NMM	2.90	1.26	35 OBS	1.90	1.26
17 I_S	2.95	1.26	36 ROS	1.90	1.47
18 NFM	4.20	1.26	37 OSG	1.90	1.26
19 FMP	3.75	1.26	38 DWE	1.90	1.26

Table 10: Policy scenarios

Scenario name	Explanation
CHN_E_MAN	China restricts exports of manufacturing products to Japan
CHN_I_MAN	China restricts imports of manufacturing products from Japan
JPN_E_MAN	Japan restricts exports of manufacturing products to China
JPN_I_MAN	Japan restricts imports of manufacturing products from China
J&C_E_MAN	JPN_E_MAN + CHN_E_MAN
J&C_I_MAN	JPN_I_MAN + CHN_I_MAN
CHN_E_ELE	China restricts ELE exports to Japan
CHN_E_FMP	China restricts FMP exports to Japan
CHN_E_NFM	China restricts NFM exports to Japan
CHN_I_ELE	China restricts ELE imports from Japan
CHN_I_FMP	China restricts FMP imports from Japan
CHN_I_NFM	China restricts NFM imports from Japan
JPN_E_ELE	Japan restricts ELE exports to China
JPN_E_FMP	Japan restricts FMP exports to China
JPN_E_NFM	Japan restricts NFM exports to China
JPN_I_ELE	Japan restricts ELE imports from China
JPN_I_FMP	Japan restricts FMP imports from China
JPN_I_NFM	Japan restricts NFM imports from China

Table 11: Restrictions on All Manufacturing Industries: Macroeconomic impacts on Japan and China (%)

		CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN
EOS1.0							
JPN	GDP	-0.06	-0.06	-0.04	-0.05	-0.10	-0.10
JPN	Welfare	-0.39	-0.50	-0.05	0.01	-0.41	-0.45
CHN	GDP	-0.02	-0.04	-0.04	-0.02	-0.05	-0.05
CHN	Welfare	-0.01	-0.04	-0.28	-0.23	-0.26	-0.24
EOS0.2							
JPN	GDP	-0.34	-0.39	-0.02	-0.17	-0.34	-0.42
JPN	Welfare	-3.45	-5.28	1.05	0.95	-2.25	-3.57
CHN	GDP	0.00	-0.10	-0.15	-0.08	-0.16	-0.14
CHN	Welfare	0.75	0.55	-2.30	-2.24	-1.71	-1.02

Table 12: Tariff equivalents of quotas

Export tariff equivalents of quotas to reduce export volume by 30%

	EOS 1.0 (%)	EOS 0.2 (%)
JPN’s tariff rates on ELE export to CHN	5.0	31.5
CHN’s tariff rates on ELE export to CHN	6.3	35.8

Table 13: Welfare impacts of unilateral export restrictions in ELE (%)

13a: Welfare impacts of Japan’s export restrictions on ELE

Reduction rate (%)	EOS	JPN (%)	CHN (%)
10	1.0	−0.0015	−0.0229
30	1.0	−0.0190	−0.0688
50	1.0	−0.0600	−0.1154
10	0.2	0.0741	−0.2230
30	0.2	0.1485	−0.7160
50	0.2	0.0861	−1.3002

13b: Welfare impacts of China’s export restrictions on ELE

Reduction rate (%)	EOS	CHN (%)	JPN (%)
10	1.0	0.0045	−0.0390
30	1.0	0.0028	−0.1136
50	1.0	−0.0147	−0.1845
10	0.2	0.0887	−0.3583
30	0.2	0.2342	−1.1762
50	0.2	0.3142	−2.1934

Table 14: Rankings of import share in ELE (%)

14a: Japan's ratio of import-to-domestic total demand in ELE (%)	
CHN	21.40
ASE	6.92
USA	4.73
MIC	4.12
REU	2.22
KOR	1.65
DEU	1.05
MEX	0.41
GBR	0.27
FRA	0.18

14b: China's ratio of import-to-domestic total demand in ELE (%)	
KOR	18.24
ASE	15.85
MIC	10.25
JPN	8.95
USA	3.87
CHN	3.19
REU	3.12
DEU	2.32
MEX	0.73
GBR	0.36

Source: GTAP 11 data for the 2017 reference year

Table 15: Rankings of export share in ELE (%)

15a: Japan's ratio of export to domestic output in ELE (%)

CHN	22.24
ASE	6.01
MIC	5.23
USA	4.73
KOR	4.66
DEU	2.0
REU	1.4
IND	0.3
GBR	0.3
MEX	0.3

15b: China's ratio of export to domestic output in ELE (%)

USA	17.43
ASE	8.02
JPN	6.80
MIC	5.90
REU	5.41
KOR	4.99
IND	3.22
CHN	2.91
DEU	2.61
ANZ	1.83

Source: GTAP 11 data for the 2017 reference year

Table 16: Impacts on GDP of export restrictions on ELE (%)

16a: GDP impacts of Japan's export restrictions on ELE

Reduction rate (%)	EOS	JPN (%)	CHN (%)
10	1.0	−0.002	−0.002
30	1.0	−0.006	−0.009
50	1.0	−0.010	−0.020
10	0.2	−0.002	−0.009
30	0.2	−0.011	−0.041
50	0.2	−0.031	−0.102

16b: GDP impacts of China's export restrictions on ELE

Reduction rate (%)	EOS	CHN (%)	JPN (%)
10	1.0	−0.0008	−0.0039
30	1.0	−0.0027	−0.0188
50	1.0	−0.0049	−0.0450
10	0.2	0.0008	−0.0212
30	0.2	0.0014	−0.1078
50	0.2	−0.0001	−0.2815

Table 17: Impacts of Japan's export restrictions on exports and output (%)

Japan's export restrictions on ELE (%)

Reduction rate (%)	EOS	JPN's export to the world (%)	JPN's output of ELE (%)	CHN's export to the world (%)	CHN's output of ELE (%)
30	1.0	−0.724	−6.721	−0.034	0.105
30	0.2	−1.127	−4.305	0.653	0.287

Table 18: Impacts of China's export restrictions on exports and output (%)

China's export restrictions on ELE (%)

Reduction rate (%)	EOS	CHN's export to the world (%)	CHN's output of ELE (%)	JPN's export to the world (%)	JPN's output of ELE (%)
30	1.0	−0.271	−1.775	−0.491	1.050
30	0.2	−0.507	−1.261	1.302	1.423

Table 19: Impacts of Japan's export restrictions on its export flows

Japan's ER on ELE export to China (30% reduction in EOS 1.0)		
Importer	Impact on total export of JPN (%)	JPN's ratio of export to domestic output in ELE (%)
KOR	2.15	4.70
DEU	2.04	2.00
MIC	2.02	1.96
ASE	1.95	6.01
BRA	1.92	0.15
ITA	1.92	0.10
IND	1.86	0.34
TUR	1.86	0.06
REU	1.85	1.40
MEX	1.83	0.29
CHN	−7.74	22.24

Source of Japan's ratio of export to domestic output in ELE: GTAP 11 data for the 2017 reference year

Table 20: Impacts of China's export restrictions on Japan's import flows

China's ER on ELE export to Japan's (30% reduction in EOS 1.0)		
Exporter	Impact on total import of JPN (%)	JPN's ratio of import to domestic total demand in ELE (%)
MIC	3.75	4.12
MEX	3.16	0.41
ASE	2.64	6.92
KOR	2.56	1.65
REU	1.96	2.22
DEU	1.85	1.05
USA	1.81	4.73
GBR	0.77	0.27
FRA	0.60	0.18
ITA	0.38	0.13
CHN	−8.47	21.40

Source of Japan's ratio of import to domestic total demand in ELE: GTAP 11 data for the 2017 reference year

Table 21: Trade restrictions on individual sectors: impacts on welfare and GDP

		CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
EOS1.0													
JPN	GDP	-0.02	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.02	0.00	0.00
JPN	Welfare	-0.11	-0.01	0.00	-0.13	-0.01	-0.02	-0.02	0.00	0.00	0.00	0.00	0.00
CHN	GDP	0.00	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
CHN	Welfare	0.00	0.00	0.00	-0.01	0.00	0.00	-0.07	-0.01	-0.01	-0.06	-0.01	0.00
EOS0.2													
JPN	GDP	-0.11	-0.01	0.00	-0.08	0.00	-0.01	-0.01	0.00	0.00	-0.05	-0.01	0.00
JPN	Welfare	-1.18	-0.12	-0.03	-1.32	-0.08	-0.14	0.15	0.01	0.01	0.23	0.05	0.01
CHN	GDP	0.00	0.00	0.00	-0.03	0.00	0.00	-0.04	0.00	0.00	-0.02	0.00	0.00
CHN	Welfare	0.23	0.03	0.00	0.08	0.02	0.01	-0.72	-0.04	-0.08	-0.61	-0.07	-0.03

Table 22: % changes in sectoral outputs in Japan (%) in EOS1.0 scenario

	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
AGR	-0.07	0.41	0.55	0.06	0.45	0.44	-0.02	-0.02	0.00	0.15	0.01	0.02	0.19	0.01	0.02	0.02	-0.01	0.00
FOF	0.07	0.33	0.46	0.19	0.50	0.49	-0.02	-0.02	0.00	0.08	0.01	0.07	0.11	0.01	0.07	0.01	-0.01	0.00
COA																		
OIL																		
GAS																		
OXT	0.22	0.59	-0.05	-0.36	0.09	0.14	0.10	0.05	0.06	0.73	-0.02	-0.67	0.57	-0.03	-0.69	-0.07	0.03	0.06
FBP	0.07	0.06	0.34	0.33	0.38	0.36	-0.05	-0.02	0.00	0.07	0.00	0.01	0.14	0.01	0.02	0.02	-0.01	0.00
TEX	3.37	-2.13	-2.86	2.66	1.46	1.51	0.06	-0.07	0.01	1.46	0.11	0.16	1.25	0.09	0.13	-0.15	-0.09	0.00
ALT	6.20	1.80	1.63	6.22	7.63	7.63	-0.03	-0.04	0.00	0.56	0.04	0.06	0.52	0.04	0.06	-0.06	-0.04	0.00
LUM	1.19	1.63	1.30	0.94	2.34	2.37	0.05	-0.02	0.00	0.51	0.03	0.07	0.43	0.03	0.06	-0.02	-0.03	0.00
PPP	0.31	-0.49	-0.57	0.22	-0.28	-0.28	0.03	-0.01	0.00	0.11	0.02	0.04	0.08	0.02	0.04	0.01	-0.02	0.00
P_C	0.14	-1.39	-1.41	0.11	-1.25	-1.25	0.00	0.00	0.00	0.19	0.00	0.01	0.18	0.00	0.01	-0.01	0.00	0.00
CHM	0.38	-2.11	-2.61	-0.13	-2.19	-2.15	0.12	-0.04	0.00	0.89	0.07	0.11	0.75	0.06	0.09	-0.03	-0.06	0.00
BPH	0.06	1.39	1.10	-0.17	1.06	1.09	0.08	-0.03	0.00	0.53	0.04	0.07	0.47	0.04	0.06	0.01	-0.03	0.00
RPP	0.53	-0.21	-0.68	0.08	-0.21	-0.17	0.09	-0.04	0.00	0.52	0.06	0.10	0.40	0.06	0.08	-0.04	-0.06	0.00
NMM	0.78	-0.59	-0.93	0.45	-0.19	-0.16	0.13	-0.03	0.00	-0.26	0.04	0.05	-0.35	0.03	0.04	0.04	-0.04	0.00
I_S	0.26	0.29	-0.28	-0.25	-0.10	-0.06	0.01	0.15	-0.01	0.84	-0.12	0.13	0.70	-0.13	0.11	-0.14	0.14	-0.01
NFM	0.32	-0.15	-0.98	-0.49	-0.72	-0.66	0.18	0.01	0.22	0.68	0.04	-2.74	0.46	0.03	-2.76	-0.05	-0.02	0.22
FMP	1.02	0.42	0.02	0.67	0.90	0.93	0.05	1.00	-0.01	0.40	-0.96	0.09	0.30	-0.97	0.08	-0.05	0.99	-0.01
EEQ	0.92	0.06	-0.73	0.17	0.22	0.28	-0.36	-0.09	-0.03	1.27	0.11	0.19	1.06	0.09	0.17	-0.58	-0.12	-0.04
ELE	0.29	-3.26	-4.10	-0.63	-3.30	-3.24	1.05	-0.10	-0.02	-6.55	0.13	0.22	-6.72	0.11	0.19	0.79	-0.14	-0.03
OME	-0.02	-0.05	-0.61	-0.55	-0.64	-0.60	-0.17	-0.07	-0.01	1.11	0.08	0.13	0.96	0.07	0.12	-0.33	-0.09	-0.01
MVH	-0.56	1.48	0.91	-1.05	0.27	0.32	-0.01	-0.05	-0.01	1.13	0.08	0.13	1.00	0.07	0.11	-0.15	-0.07	-0.01
OTN	-0.21	3.00	2.47	-0.61	2.08	2.12	0.04	-0.05	0.00	0.92	0.06	0.10	0.80	0.05	0.09	-0.07	-0.07	0.00
OMF	1.72	1.48	1.08	1.42	2.61	2.64	-0.13	-0.06	-0.01	0.71	0.06	0.09	0.62	0.05	0.08	-0.22	-0.07	-0.01
UTI	0.00	-0.28	-0.24	0.03	-0.24	-0.24	0.00	0.00	0.00	0.00	-0.01	-0.04	0.00	-0.01	-0.04	0.01	0.01	0.00
CNS	0.00	0.04	0.04	-0.01	0.03	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
TRD	-0.05	-0.07	0.04	0.05	-0.01	-0.02	-0.02	0.00	0.00	0.01	0.00	-0.01	0.03	0.00	0.00	0.01	0.00	0.00
WTP	-0.20	0.90	0.68	-0.39	0.44	0.46	0.03	-0.02	0.00	0.34	0.01	0.00	0.29	0.01	-0.01	-0.03	-0.03	0.00
ATP	-0.17	0.93	0.91	-0.17	0.68	0.69	0.00	-0.01	0.00	0.26	0.02	0.03	0.26	0.02	0.03	0.00	-0.01	0.00
OTP	-0.04	-0.08	0.00	0.03	-0.04	-0.05	-0.02	0.00	0.00	0.01	0.00	-0.02	0.03	0.00	-0.01	0.00	0.00	0.00
CMN	-0.08	0.12	0.21	0.00	0.12	0.11	-0.01	-0.01	0.00	0.00	0.00	0.01	0.03	0.01	0.01	0.01	0.00	0.00
ISR	-0.19	0.05	0.34	0.08	0.14	0.12	-0.05	-0.01	0.00	0.03	0.00	0.00	0.10	0.01	0.01	0.02	0.00	0.00
OFI	-0.07	0.32	0.41	0.02	0.32	0.31	-0.01	0.00	0.00	0.09	0.00	0.01	0.12	0.01	0.01	0.01	0.00	0.00
OBS	-0.03	0.36	0.31	-0.07	0.26	0.27	0.01	-0.01	0.00	0.07	0.01	0.02	0.06	0.01	0.01	0.00	-0.01	0.00
ROS	-0.26	0.01	0.29	0.01	0.03	0.01	-0.06	-0.01	0.00	0.02	0.00	0.00	0.09	0.01	0.01	0.02	0.00	0.00
OSG	-0.04	-0.03	0.00	-0.01	-0.03	-0.04	0.00	-0.01	0.00	-0.04	0.00	0.00	-0.04	0.01	0.01	0.01	0.00	0.00
DWE	-0.18	-0.18	0.16	0.13	-0.02	-0.04	-0.06	-0.01	0.00	-0.04	0.00	0.00	0.04	0.00	0.01	0.03	0.00	0.00

Table 23: % changes in sectoral outputs in Japan (%) in EOS 0.2 scenario

	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
AGR	-0.85	-1.21	0.40	0.29	-0.35	-0.70	-0.24	-0.04	-0.01	-0.27	-0.01	-0.03	0.08	0.01	0.01	0.10	0.01	0.00
FOF	-0.83	-1.32	0.41	0.41	-0.32	-0.70	-0.27	-0.04	-0.01	-0.34	-0.01	0.02	0.05	0.01	0.06	0.10	0.01	0.00
COA																		
OIL																		
GAS																		
OXT	2.84	4.75	-1.28	-1.58	1.40	2.73	0.99	0.13	0.07	1.51	0.06	-0.29	0.09	-0.03	-0.43	-0.35	-0.04	0.03
FBP	-2.00	-3.39	0.59	0.73	-1.31	-2.17	-0.62	-0.09	-0.02	-0.79	-0.04	-0.08	0.09	0.01	0.01	0.22	0.02	0.00
TEX	3.03	1.85	-3.54	-1.42	-0.31	0.80	1.03	0.08	0.03	1.70	0.11	0.17	0.22	0.02	0.02	-0.37	-0.10	-0.01
ALT	-3.46	-3.09	0.78	-0.72	-2.57	-3.40	-0.61	-0.08	-0.02	-0.79	-0.04	-0.09	0.11	0.01	0.01	0.26	0.03	0.01
LUM	2.47	3.79	0.09	0.12	2.62	3.39	0.59	0.04	0.02	0.97	0.06	0.11	0.15	0.01	0.02	-0.18	-0.06	0.00
PPP	0.79	0.15	-0.78	-0.12	-0.13	0.05	0.22	0.01	0.01	0.32	0.03	0.05	0.01	0.01	0.02	-0.07	-0.03	0.00
P_C	-1.10	-4.00	-1.24	0.78	-2.38	-2.99	-0.45	-0.05	-0.02	-0.59	-0.04	-0.07	0.00	0.00	-0.01	0.13	0.03	0.00
CHM	2.42	1.36	-3.08	-1.41	-1.03	-0.05	0.88	0.06	0.02	1.40	0.10	0.16	0.17	0.02	0.03	-0.28	-0.09	-0.01
BPH	1.27	2.96	0.11	-0.64	1.35	1.97	0.49	0.03	0.02	0.82	0.06	0.09	0.18	0.02	0.03	-0.10	-0.05	0.00
RPP	2.29	2.69	-1.50	-0.93	0.60	1.50	0.74	0.04	0.02	1.09	0.09	0.13	0.04	0.02	0.03	-0.25	-0.08	-0.01
NMM	2.19	1.78	-1.46	-0.37	0.54	1.23	0.59	0.04	0.01	0.54	0.06	0.10	-0.28	0.01	0.01	-0.21	-0.06	-0.01
I_S	2.55	3.69	-1.50	-1.35	0.86	2.00	0.83	0.20	0.02	1.40	-0.02	0.18	0.14	-0.10	0.05	-0.36	0.05	-0.01
NFM	3.37	4.67	-2.25	-1.91	0.84	2.36	1.18	0.13	0.19	1.64	0.10	-1.71	-0.04	0.00	-1.86	-0.42	-0.07	0.15
FMP	2.48	2.88	-0.87	-0.21	1.48	2.26	0.62	0.94	0.01	0.92	-0.74	0.14	0.01	-0.79	0.05	-0.24	0.84	-0.02
EEQ	3.58	4.52	-2.10	-1.41	1.36	2.79	0.77	0.05	0.01	1.89	0.14	0.27	0.25	0.04	0.10	-0.78	-0.15	-0.04
ELE	3.14	2.43	-4.14	-2.47	-1.27	0.17	1.42	0.06	0.01	-2.91	0.14	0.25	-4.31	0.03	0.07	-0.25	-0.15	-0.03
OME	2.19	3.31	-1.54	-1.51	0.45	1.51	0.65	0.02	0.02	1.48	0.11	0.17	0.27	0.04	0.05	-0.48	-0.12	-0.01
MVH	1.58	4.19	-0.45	-1.69	1.05	2.09	0.69	0.03	0.01	1.40	0.10	0.17	0.33	0.03	0.07	-0.29	-0.09	-0.01
OTN	1.82	5.47	0.55	-1.32	2.41	3.50	0.72	0.02	0.02	1.30	0.10	0.15	0.27	0.03	0.04	-0.24	-0.10	-0.01
OMF	2.25	3.09	-0.13	0.19	2.13	2.77	0.38	0.00	0.01	0.98	0.07	0.12	0.23	0.03	0.04	-0.32	-0.09	-0.01
UTI	-0.77	-1.75	0.03	0.42	-0.71	-1.11	-0.27	-0.03	-0.01	-0.38	-0.02	-0.06	0.01	0.00	-0.02	0.09	0.02	0.00
CNS	0.04	0.13	0.01	-0.03	0.06	0.09	0.02	0.00	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
TRD	-0.55	-0.82	0.33	0.32	-0.14	-0.40	-0.18	-0.02	0.00	-0.19	-0.01	-0.02	0.08	0.01	0.01	0.08	0.01	0.00
WTP	2.36	6.12	0.20	-1.66	2.52	3.85	0.95	0.07	0.03	1.54	0.09	0.15	0.25	0.01	0.02	-0.26	-0.08	0.00
ATP	-0.46	-0.06	0.54	0.18	0.16	0.03	-0.13	-0.02	0.00	-0.05	0.00	-0.01	0.14	0.01	0.02	0.07	0.00	0.00
OTP	-0.65	-1.14	0.27	0.36	-0.32	-0.63	-0.22	-0.03	-0.01	-0.25	-0.01	-0.04	0.06	0.00	0.00	0.08	0.01	0.00
CMN	-0.48	-0.56	0.36	0.25	-0.04	-0.25	-0.16	-0.02	0.00	-0.15	-0.01	-0.01	0.07	0.01	0.01	0.06	0.00	0.00
ISR	-0.92	-1.38	0.58	0.56	-0.23	-0.66	-0.32	-0.04	-0.01	-0.33	-0.02	-0.04	0.13	0.01	0.01	0.13	0.02	0.00
OFI	-0.25	-0.11	0.38	0.20	0.19	0.08	-0.08	-0.01	0.00	-0.03	0.00	0.00	0.10	0.01	0.01	0.05	0.00	0.00
OBS	0.14	0.60	0.14	-0.12	0.32	0.42	0.06	0.00	0.00	0.13	0.01	0.02	0.04	0.01	0.01	-0.02	-0.01	0.00
ROS	-1.20	-1.73	0.61	0.50	-0.49	-1.00	-0.38	-0.05	-0.01	-0.42	-0.02	-0.04	0.12	0.01	0.01	0.14	0.01	0.00
OSG	-0.28	-0.40	0.16	0.14	-0.09	-0.21	-0.09	-0.02	0.00	-0.11	0.00	-0.01	0.02	0.01	0.01	0.04	0.00	0.00
DWE	-0.68	-0.99	0.50	0.47	-0.08	-0.41	-0.23	-0.03	-0.01	-0.25	-0.01	-0.02	0.10	0.01	0.02	0.11	0.01	0.00

Table 24: % change in sectoral output in China (%) in EOS1.0 scenario

	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
AGR	0.03	-0.01	-0.07	-0.03	-0.04	-0.04	0.04	0.00	0.00	0.01	0.00	0.00	-0.01	0.00	0.00	0.02	0.00	0.00
FOF	-0.02	-0.02	-0.09	-0.09	-0.11	-0.10	0.03	0.00	0.00	0.01	0.00	0.00	-0.01	0.00	-0.01	0.01	0.00	0.00
COA	0.08	0.04	0.07	0.10	0.13	0.13	0.03	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.04	0.00	0.00
OIL	0.33	-0.05	0.03	0.42	0.33	0.32	0.06	0.01	0.02	0.01	0.00	-0.01	0.03	0.00	-0.01	0.08	0.02	0.02
GAS	2.16	-1.52	-1.05	2.64	0.87	0.83	0.46	0.08	0.05	0.08	-0.03	0.01	0.19	-0.02	0.03	0.58	0.10	0.05
OXT	0.15	0.11	0.23	0.27	0.35	0.34	0.05	-0.02	-0.03	-0.01	0.01	0.05	0.02	0.01	0.06	0.08	-0.01	-0.03
FBP	-0.08	-0.01	-0.12	-0.19	-0.19	-0.18	0.03	0.00	0.00	0.01	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00
TEX	-0.21	-0.05	0.08	-0.09	-0.17	-0.18	0.19	0.02	0.01	0.03	-0.01	0.00	0.06	-0.01	0.01	0.22	0.03	0.01
ALT	-0.73	-0.20	-0.11	-0.67	-0.83	-0.83	0.18	0.02	0.01	0.04	-0.01	0.00	0.06	-0.01	0.01	0.20	0.03	0.01
LUM	-0.14	-0.09	0.03	-0.03	-0.12	-0.13	0.14	0.01	0.01	0.02	0.00	0.00	0.05	0.00	0.00	0.18	0.01	0.01
PPP	0.03	0.09	0.10	0.05	0.13	0.13	0.04	0.01	0.00	0.00	0.00	-0.01	0.00	0.00	-0.01	0.05	0.01	0.00
P_C	-0.01	0.17	0.17	-0.01	0.15	0.15	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00
CHM	0.05	0.38	0.52	0.20	0.54	0.53	0.13	0.02	0.01	0.01	-0.01	-0.01	0.05	0.00	0.00	0.17	0.02	0.01
BPH	0.07	0.11	0.14	0.10	0.19	0.19	0.07	0.01	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.08	0.01	0.00
RPP	-0.07	0.15	0.28	0.06	0.20	0.19	0.05	0.02	0.01	-0.01	-0.01	-0.01	0.03	-0.01	-0.01	0.09	0.02	0.01
NMM	-0.02	0.05	0.09	0.02	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
I_S	0.06	0.19	0.27	0.15	0.32	0.31	0.05	-0.05	0.00	-0.03	0.02	-0.01	-0.01	0.02	-0.01	0.07	-0.04	0.00
NFM	0.18	0.18	0.39	0.39	0.54	0.52	0.02	-0.01	-0.13	-0.02	0.00	0.24	0.03	0.01	0.24	0.08	0.00	-0.13
FMP	-0.07	0.02	0.13	0.04	0.07	0.06	0.07	-0.33	0.01	-0.02	0.15	-0.02	0.01	0.16	-0.02	0.10	-0.33	0.01
EEQ	-0.24	-0.13	0.04	-0.08	-0.17	-0.18	-0.28	0.03	0.01	-0.02	-0.02	-0.04	0.02	-0.01	-0.03	-0.23	0.04	0.01
ELE	-0.92	-0.84	-0.55	-0.67	-1.28	-1.31	-1.77	0.05	0.01	0.04	-0.02	-0.04	0.10	-0.02	-0.03	-1.71	0.06	0.02
OME	0.11	0.33	0.49	0.27	0.57	0.56	0.14	0.02	0.01	-0.07	-0.01	-0.03	-0.02	-0.01	-0.02	0.18	0.03	0.01
MVH	0.07	0.32	0.34	0.10	0.38	0.38	0.07	0.01	0.00	-0.03	-0.01	-0.01	-0.03	-0.01	-0.01	0.08	0.01	0.00
OTN	0.37	-0.29	-0.18	0.48	0.17	0.16	0.17	0.03	0.01	-0.02	-0.01	-0.02	0.00	-0.01	-0.01	0.20	0.03	0.01
OMF	-0.18	-0.13	0.07	0.01	-0.11	-0.13	0.25	0.02	0.01	0.02	-0.01	0.00	0.07	-0.01	0.01	0.31	0.03	0.01
UTI	0.02	0.06	0.06	0.02	0.07	0.07	0.02	-0.01	-0.01	0.00	0.00	0.02	0.00	0.00	0.02	0.03	-0.01	-0.01
CNS	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRD	0.00	-0.01	-0.01	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00
WTP	0.12	-0.21	-0.17	0.16	-0.06	-0.06	0.05	0.00	0.00	-0.01	-0.01	-0.01	0.00	0.00	-0.01	0.06	0.00	0.00
ATP	0.25	-0.08	-0.05	0.28	0.17	0.17	0.06	0.01	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.07	0.01	0.00
OTP	0.01	0.00	-0.01	-0.01	-0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
CMN	0.09	-0.04	-0.09	0.04	-0.01	0.00	0.02	0.00	0.00	-0.01	0.00	0.00	-0.03	0.00	0.00	0.01	0.00	0.00
ISR	0.09	-0.02	-0.15	-0.04	-0.06	-0.05	0.03	0.00	0.00	0.01	0.00	0.00	-0.03	0.00	0.00	0.00	0.00	0.00
OFI	0.05	0.00	-0.03	0.03	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OBS	0.05	-0.02	-0.01	0.06	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
ROS	0.10	-0.04	-0.12	0.03	-0.01	-0.01	0.03	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.01	0.00	0.00
OSG	0.02	-0.01	-0.04	-0.01	-0.02	-0.02	0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
DWE	0.05	0.00	-0.12	-0.07	-0.07	-0.06	0.02	0.00	0.00	0.01	0.00	0.00	-0.02	0.00	0.00	-0.02	0.00	0.00

Table 25: % change in sectoral output in China (%) in EOS 0.2 scenario

	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
AGR	0.10	0.08	-0.21	-0.20	-0.13	-0.06	0.04	0.01	0.00	0.03	0.00	0.00	-0.05	0.00	-0.01	-0.04	0.00	0.00
FOF	0.14	0.16	-0.46	-0.51	-0.36	-0.20	0.06	0.01	0.00	0.05	0.00	0.00	-0.12	-0.01	-0.02	-0.12	-0.01	0.00
COA	0.01	-0.01	0.09	0.12	0.10	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.01	0.04	0.00	0.00
OIL	-0.03	-0.31	0.68	1.04	0.70	0.44	-0.03	0.00	0.01	-0.04	-0.01	-0.01	0.23	0.01	0.02	0.26	0.03	0.02
GAS	-0.42	-4.21	4.37	8.23	4.31	2.18	-0.32	-0.01	0.05	-0.31	-0.09	-0.03	1.97	0.06	0.23	2.11	0.29	0.12
OXT	-0.22	-0.17	0.87	0.92	0.73	0.46	-0.07	-0.02	-0.02	-0.08	0.00	0.05	0.22	0.02	0.08	0.24	0.01	-0.01
FBP	0.18	0.21	-0.68	-0.78	-0.55	-0.32	0.09	0.01	0.00	0.07	0.00	0.00	-0.18	-0.01	-0.02	-0.17	-0.02	-0.01
TEX	-0.40	-0.41	1.00	0.98	0.64	0.31	0.00	0.00	0.01	-0.03	-0.02	0.00	0.35	0.01	0.04	0.41	0.05	0.02
ALT	-0.55	-0.58	0.49	0.16	-0.10	-0.27	0.00	0.00	0.00	-0.05	-0.01	0.00	0.23	0.00	0.03	0.30	0.04	0.01
LUM	-0.39	-0.34	0.77	0.72	0.41	0.15	-0.01	-0.01	0.00	-0.04	-0.01	0.00	0.26	0.01	0.03	0.31	0.03	0.01
PPP	-0.02	0.05	0.10	0.07	0.10	0.09	0.02	0.01	0.00	0.00	0.00	-0.01	0.02	0.00	-0.01	0.04	0.01	0.00
P_C	0.02	0.28	-0.22	-0.48	-0.21	-0.09	0.04	0.00	0.00	0.03	0.00	0.00	-0.10	0.00	-0.02	-0.10	-0.02	0.00
CHM	-0.42	0.01	1.36	1.08	1.05	0.72	-0.06	0.00	0.01	-0.07	-0.02	-0.01	0.32	0.01	0.03	0.36	0.05	0.02
BPH	-0.04	0.02	0.26	0.24	0.24	0.17	0.02	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.01	0.10	0.01	0.00
RPP	-0.44	-0.21	1.01	0.84	0.66	0.37	-0.09	0.00	0.00	-0.09	-0.02	-0.01	0.26	0.01	0.02	0.28	0.04	0.01
NMM	-0.14	-0.04	0.35	0.27	0.23	0.14	-0.04	0.00	0.00	-0.03	0.00	0.00	0.08	0.00	0.01	0.08	0.01	0.00
I_S	-0.25	-0.06	0.76	0.63	0.58	0.37	-0.06	-0.04	0.00	-0.09	0.01	-0.02	0.15	0.03	0.01	0.18	-0.01	0.01
NFM	-0.44	-0.31	1.42	1.42	1.10	0.67	-0.15	-0.03	-0.10	-0.15	-0.01	0.22	0.34	0.02	0.27	0.36	0.04	-0.08
FMP	-0.39	-0.28	0.75	0.66	0.43	0.18	-0.06	-0.28	0.01	-0.08	0.13	-0.03	0.21	0.15	0.01	0.24	-0.24	0.01
EEQ	-0.55	-0.47	0.81	0.72	0.34	0.03	-0.26	0.00	0.01	-0.12	-0.02	-0.04	0.22	0.00	0.00	0.09	0.05	0.02
ELE	-1.17	-1.34	0.72	0.66	-0.31	-0.78	-1.26	0.00	0.01	-0.23	-0.03	-0.04	0.29	0.01	0.02	-0.78	0.07	0.02
OME	-0.49	-0.17	1.33	1.10	0.96	0.60	-0.10	0.00	0.00	-0.18	-0.02	-0.03	0.26	0.00	0.01	0.36	0.05	0.02
MVH	0.00	0.13	0.05	-0.07	0.04	0.06	0.04	0.01	0.00	-0.01	-0.01	-0.02	-0.03	-0.01	-0.02	0.02	0.01	0.00
OTN	-0.05	-0.54	0.44	0.95	0.42	0.16	0.01	0.01	0.01	-0.06	-0.02	-0.02	0.19	0.00	0.01	0.28	0.04	0.01
OMF	-0.51	-0.47	1.10	1.06	0.65	0.28	-0.01	0.00	0.01	-0.07	-0.02	0.00	0.36	0.01	0.05	0.45	0.05	0.02
UTI	0.05	0.09	-0.14	-0.17	-0.09	-0.04	0.03	0.00	-0.01	0.02	0.00	0.01	-0.04	0.00	0.01	-0.03	-0.01	-0.01
CNS	0.00	-0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRD	0.04	0.02	-0.08	-0.06	-0.04	-0.02	0.01	0.00	0.00	0.01	0.00	0.00	-0.02	0.00	0.00	-0.02	0.00	0.00
WTP	-0.12	-0.63	0.55	1.08	0.46	0.16	-0.04	-0.01	0.00	-0.08	-0.02	-0.01	0.22	0.00	0.03	0.29	0.03	0.01
ATP	0.11	-0.10	0.19	0.46	0.31	0.22	0.03	0.01	0.00	0.01	0.00	0.00	0.09	0.00	0.01	0.11	0.02	0.01
OTP	0.08	0.05	-0.19	-0.17	-0.12	-0.07	0.03	0.00	0.00	0.02	0.00	0.00	-0.05	0.00	-0.01	-0.04	0.00	0.00
CMN	0.20	0.09	-0.45	-0.35	-0.28	-0.15	0.06	0.01	0.00	-0.01	0.00	0.00	-0.16	-0.01	-0.01	-0.10	-0.01	0.00
ISR	0.33	0.31	-0.69	-0.65	-0.40	-0.16	0.11	0.02	0.00	0.08	0.01	0.01	-0.19	-0.01	-0.02	-0.17	-0.02	-0.01
OFI	0.11	0.08	-0.16	-0.12	-0.06	0.00	0.04	0.00	0.00	0.02	0.00	0.00	-0.04	0.00	0.00	-0.03	0.00	0.00
OBS	0.01	-0.05	0.05	0.13	0.07	0.04	0.00	0.00	0.00	-0.01	0.00	0.00	0.02	0.00	0.00	0.03	0.01	0.00
ROS	0.26	0.20	-0.56	-0.49	-0.33	-0.15	0.09	0.01	0.00	0.06	0.00	0.00	-0.15	-0.01	-0.02	-0.13	-0.01	-0.01
OSG	0.14	0.11	-0.30	-0.27	-0.18	-0.08	0.05	0.01	0.00	0.03	0.00	0.00	-0.08	-0.01	-0.01	-0.07	-0.01	0.00
DWE	0.27	0.23	-0.53	-0.49	-0.30	-0.12	0.09	0.01	0.00	0.07	0.00	0.00	-0.14	-0.01	-0.02	-0.13	-0.01	-0.01

Table 26: Percentage change in export of Japan in EOS1.0 scenario (%)

	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
ARG	-1.34	7.81	6.43	-2.35	4.68	4.80	-0.23	-0.10	-0.01	2.06	0.14	0.24	1.78	0.12	0.21	-0.52	-0.14	-0.01
ANZ	-0.90	5.97	4.95	-1.67	3.74	3.82	-0.07	-0.07	-0.03	1.60	0.11	0.20	1.39	0.09	0.18	-0.28	-0.10	-0.03
BRA	-1.60	8.41	6.93	-2.68	4.89	5.02	-0.35	-0.12	-0.01	2.22	0.15	0.26	1.92	0.13	0.22	-0.65	-0.15	-0.02
CAN	-1.18	7.69	6.37	-2.15	4.79	4.89	-0.12	-0.09	-0.05	2.05	0.14	0.25	1.78	0.12	0.22	-0.39	-0.12	-0.05
CHN	-2.37	-26.53	-26.64	-3.42	-26.74	-26.73	-1.04	-0.11	-0.03	-7.55	-0.40	-0.89	-7.74	-0.42	-0.92	-1.33	-0.14	-0.04
FRA	-1.17	7.81	6.47	-2.14	4.89	5.00	-0.11	-0.10	-0.01	2.05	0.14	0.24	1.78	0.12	0.21	-0.39	-0.13	-0.02
DEU	-1.82	8.74	7.25	-2.89	4.98	5.10	-0.68	-0.11	-0.02	2.34	0.15	0.26	2.04	0.13	0.23	-0.98	-0.15	-0.02
IND	-1.58	8.19	6.74	-2.64	4.74	4.86	-0.34	-0.11	-0.02	2.15	0.14	0.25	1.86	0.13	0.22	-0.64	-0.15	-0.03
ASE	-1.33	7.81	6.48	-2.31	4.72	4.83	-0.34	-0.09	-0.02	2.22	0.13	0.23	1.95	0.12	0.20	-0.61	-0.12	-0.03
ITA	-1.51	8.52	7.05	-2.57	5.09	5.21	-0.18	-0.11	-0.01	2.22	0.15	0.26	1.92	0.13	0.23	-0.48	-0.15	-0.02
MEX	-1.24	7.77	6.44	-2.22	4.79	4.90	-0.16	-0.10	-0.01	2.10	0.14	0.23	1.83	0.12	0.20	-0.44	-0.14	-0.02
RUS	-1.29	7.12	5.90	-2.20	4.25	4.35	-0.14	-0.09	-0.01	1.88	0.13	0.22	1.63	0.11	0.19	-0.39	-0.12	-0.01
SAU	-1.09	6.98	5.78	-1.98	4.32	4.42	-0.04	-0.09	0.00	1.84	0.12	0.21	1.59	0.11	0.19	-0.29	-0.12	-0.01
ZAF	-1.25	7.25	6.00	-2.17	4.38	4.49	-0.13	-0.09	-0.01	1.90	0.13	0.23	1.64	0.11	0.21	-0.39	-0.12	-0.01
KOR	-1.58	7.84	6.55	-2.52	4.56	4.66	-0.54	-0.09	-0.02	2.41	0.13	0.22	2.15	0.11	0.19	-0.80	-0.12	-0.02
TUR	-1.40	8.20	6.79	-2.44	4.96	5.07	-0.21	-0.11	-0.01	2.15	0.15	0.25	1.86	0.13	0.22	-0.50	-0.15	-0.02
GBR	-0.96	7.67	6.35	-1.92	4.98	5.09	-0.07	-0.08	-0.04	2.01	0.14	0.25	1.75	0.12	0.22	-0.34	-0.12	-0.04
USA	-1.38	7.65	6.33	-2.36	4.55	4.66	-0.28	-0.10	-0.01	2.05	0.14	0.23	1.78	0.12	0.20	-0.55	-0.13	-0.02
REU	-1.25	8.08	6.71	-2.25	5.03	5.14	-0.22	-0.10	-0.02	2.13	0.14	0.26	1.85	0.13	0.23	-0.50	-0.13	-0.03
OEX	-1.11	6.58	5.43	-1.96	3.99	4.09	-0.06	-0.08	0.00	1.73	0.12	0.20	1.49	0.10	0.18	-0.30	-0.11	-0.01
LIC	-1.24	7.30	6.01	-2.20	4.39	4.50	-0.06	-0.10	0.00	1.89	0.13	0.24	1.62	0.11	0.22	-0.33	-0.13	-0.01
MIC	-1.57	8.10	6.72	-2.58	4.72	4.83	-0.44	-0.10	-0.02	2.30	0.14	0.24	2.02	0.12	0.21	-0.72	-0.13	-0.03
sum	-1.59	-1.54	-2.50	-2.56	-3.79	-3.71	-0.49	-0.10	-0.02	-0.48	-0.01	-0.07	-0.72	-0.03	-0.10	-0.76	-0.13	-0.03

Table 27: Percentage change in import of Japan in EOS1.0 scenario (%)

	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
ARG	1.58	-2.46	-1.98	2.03	-0.39	-0.44	-0.09	0.02	0.20	-0.55	-0.05	-0.25	-0.45	-0.04	-0.24	0.02	0.04	0.20
ANZ	0.68	-1.01	-0.93	0.75	-0.26	-0.27	0.01	0.02	0.07	-0.06	-0.02	-0.21	-0.04	-0.02	-0.21	0.03	0.03	0.07
BRA	1.75	-1.86	-1.68	1.92	0.00	-0.02	-0.03	0.06	0.12	-0.17	-0.05	-0.46	-0.14	-0.05	-0.45	0.01	0.06	0.13
CAN	2.43	-2.16	-1.80	2.78	0.51	0.47	0.37	0.06	0.10	-0.45	-0.04	-0.22	-0.37	-0.03	-0.22	0.45	0.07	0.10
CHN	-27.27	-3.80	-3.14	-27.21	-27.42	-27.43	-8.47	-0.95	-0.32	-1.31	-0.05	-0.08	-1.17	-0.04	-0.07	-8.35	-0.93	-0.32
FRA	6.72	-3.01	-2.55	7.23	3.72	3.67	0.60	0.16	0.01	-0.75	-0.04	-0.08	-0.65	-0.03	-0.07	0.70	0.17	0.01
DEU	6.17	-3.07	-2.71	6.53	2.90	2.86	1.85	0.17	0.02	-0.76	-0.04	-0.06	-0.68	-0.03	-0.06	1.93	0.18	0.02
IND	5.01	-2.38	-2.05	5.36	2.69	2.65	0.17	0.11	0.04	-0.47	-0.04	-0.12	-0.40	-0.03	-0.11	0.25	0.12	0.04
ASE	9.15	-2.80	-2.50	9.53	5.91	5.86	2.64	0.20	0.06	-1.04	-0.03	-0.09	-0.98	-0.02	-0.08	2.70	0.21	0.07
ITA	10.95	-2.78	-2.30	11.59	8.02	7.96	0.38	0.09	0.00	-0.68	-0.04	-0.08	-0.58	-0.04	-0.07	0.50	0.11	0.00
MEX	6.99	-2.32	-2.07	7.30	4.26	4.22	3.16	0.06	0.08	-0.67	-0.03	-0.16	-0.62	-0.02	-0.15	3.22	0.07	0.08
RUS	1.16	-1.81	-1.69	1.25	-0.56	-0.57	-0.01	0.02	0.34	-0.20	-0.03	-0.20	-0.18	-0.03	-0.20	0.01	0.02	0.34
SAU	0.35	-1.43	-1.42	0.34	-1.07	-1.07	0.00	0.00	0.04	0.14	0.00	-0.01	0.13	0.00	-0.01	0.00	0.00	0.04
ZAF	2.65	-2.94	-2.88	2.66	-0.36	-0.37	0.03	0.09	1.06	-0.49	-0.07	-0.81	-0.50	-0.07	-0.81	0.02	0.09	1.06
KOR	7.47	-3.74	-3.47	7.74	3.32	3.28	2.56	0.61	0.12	-1.40	-0.05	-0.09	-1.35	-0.05	-0.09	2.61	0.62	0.12
TUR	6.09	-2.44	-1.95	6.65	3.89	3.83	-0.08	0.07	0.03	-0.59	-0.05	-0.11	-0.48	-0.04	-0.10	0.04	0.08	0.03
GBR	3.07	-2.79	-2.33	3.50	0.56	0.51	0.77	0.07	0.02	-0.75	-0.04	-0.09	-0.65	-0.04	-0.08	0.88	0.08	0.03
USA	4.46	-2.74	-2.32	4.86	1.77	1.73	1.81	0.09	0.02	-0.82	-0.04	-0.08	-0.73	-0.03	-0.07	1.91	0.11	0.02
REU	5.35	-2.93	-2.49	5.80	2.44	2.39	1.96	0.11	0.04	-0.85	-0.04	-0.10	-0.76	-0.03	-0.09	2.06	0.12	0.04
OEX	0.36	-1.37	-1.31	0.40	-0.93	-0.94	0.00	0.01	0.05	0.03	-0.01	-0.04	0.04	-0.01	-0.03	0.01	0.01	0.05
LIC	8.98	-2.21	-1.80	9.53	6.76	6.71	-0.06	0.02	0.15	-0.50	-0.04	-0.22	-0.41	-0.03	-0.21	0.04	0.03	0.16
MIC	6.60	-2.57	-2.35	6.85	3.60	3.57	3.75	0.25	0.05	-0.83	-0.04	-0.20	-0.78	-0.03	-0.19	3.81	0.25	0.05
sum	-2.46	-2.78	-2.41	-2.21	-4.48	-4.50	-0.74	-0.11	-0.03	-0.83	-0.04	-0.11	-0.75	-0.03	-0.10	-0.66	-0.10	-0.02

Table 28: Percentage change in export of China in EOS1.0 scenario (%)

	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
ANZ	1.24	-0.69	-0.41	1.51	0.73	0.71	0.33	0.04	0.02	-0.09	-0.02	0.00	-0.03	-0.01	0.00	0.40	0.05	0.02
BRA	1.41	-0.77	-0.46	1.71	0.83	0.81	0.39	0.05	0.02	-0.09	-0.02	-0.02	-0.02	-0.01	-0.02	0.46	0.06	0.02
CAN	1.63	-0.78	-0.42	1.97	1.06	1.02	0.47	0.06	0.02	-0.05	-0.02	-0.02	0.03	-0.02	-0.01	0.56	0.07	0.02
CHN	0.75	0.60	0.75	0.92	1.37	1.35	0.13	0.03	0.01	0.50	0.01	0.07	0.53	0.01	0.07	0.18	0.04	0.01
FRA	1.68	-0.66	-0.30	2.03	1.22	1.19	0.44	0.06	0.02	-0.04	-0.02	-0.02	0.04	-0.01	-0.01	0.54	0.07	0.02
DEU	1.68	-0.81	-0.45	2.04	1.09	1.06	0.49	0.06	0.02	-0.12	-0.02	-0.02	-0.03	-0.02	-0.01	0.58	0.07	0.02
IND	1.29	-0.76	-0.47	1.57	0.72	0.70	0.34	0.05	0.02	-0.13	-0.02	-0.02	-0.06	-0.01	-0.01	0.41	0.06	0.02
ASE	1.83	-0.89	-0.52	2.19	1.14	1.11	0.50	0.06	0.02	0.02	-0.03	-0.04	0.10	-0.02	-0.03	0.60	0.07	0.02
ITA	1.70	-0.67	-0.32	2.04	1.22	1.19	0.43	0.06	0.02	-0.06	-0.02	-0.02	0.02	-0.01	-0.01	0.52	0.07	0.02
JPN	-27.18	-3.83	-3.17	-27.12	-27.34	-27.35	-8.78	-0.94	-0.32	-1.34	-0.05	-0.08	-1.19	-0.04	-0.07	-8.66	-0.92	-0.32
MEX	1.68	-1.01	-0.64	2.02	0.90	0.87	0.54	0.06	0.02	-0.12	-0.02	-0.04	-0.04	-0.02	-0.03	0.63	0.07	0.02
RUS	1.33	-0.64	-0.34	1.62	0.87	0.84	0.35	0.05	0.02	-0.05	-0.02	-0.01	0.02	-0.01	0.00	0.42	0.06	0.02
SAU	1.35	-0.57	-0.27	1.64	0.96	0.93	0.35	0.05	0.02	-0.03	-0.02	-0.01	0.04	-0.01	-0.01	0.42	0.06	0.02
ZAF	1.27	-0.58	-0.29	1.54	0.86	0.84	0.32	0.05	0.03	-0.08	-0.02	0.02	-0.01	-0.01	0.03	0.40	0.05	0.03
KOR	1.62	-0.95	-0.54	2.01	0.93	0.90	0.52	0.06	0.02	0.19	-0.03	-0.05	0.28	-0.03	-0.04	0.62	0.07	0.02
TUR	1.55	-0.80	-0.46	1.88	0.96	0.93	0.41	0.06	0.02	-0.09	-0.02	-0.02	-0.01	-0.01	-0.02	0.50	0.07	0.02
GBR	1.53	-0.65	-0.31	1.85	1.08	1.05	0.42	0.05	0.02	-0.07	-0.02	-0.01	0.01	-0.01	0.00	0.50	0.06	0.02
USA	1.50	-0.94	-0.60	1.83	0.79	0.76	0.44	0.05	0.02	-0.15	-0.02	-0.03	-0.08	-0.02	-0.02	0.52	0.06	0.02
REU	1.64	-0.70	-0.35	1.98	1.14	1.11	0.46	0.06	0.02	-0.09	-0.02	-0.02	-0.01	-0.01	-0.01	0.55	0.07	0.02
OEX	1.35	-0.69	-0.38	1.65	0.86	0.83	0.35	0.05	0.02	-0.06	-0.02	-0.02	0.01	-0.01	-0.01	0.43	0.06	0.02
LIC	1.17	-0.49	-0.24	1.42	0.83	0.80	0.28	0.04	0.02	0.00	-0.02	0.00	0.05	-0.01	0.01	0.35	0.05	0.02
MIC	1.58	-0.74	-0.39	1.92	1.04	1.01	0.51	0.06	0.02	0.03	-0.02	-0.02	0.11	-0.02	-0.01	0.60	0.07	0.02
sum	-0.67	-0.93	-0.58	-0.37	-1.15	-1.17	-0.27	-0.02	-0.01	-0.11	-0.02	-0.02	-0.03	-0.02	-0.01	-0.18	-0.01	-0.01

Table 29: Percentage change in import of China in EOS1.0 scenario (%)

	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
ARG	-0.61	0.32	0.05	-0.87	-0.50	-0.48	-0.09	-0.01	-0.01	-0.03	0.00	-0.01	-0.09	0.00	-0.01	-0.16	-0.02	-0.01
ANZ	-0.33	0.46	0.40	-0.37	0.09	0.09	-0.05	-0.02	-0.03	0.00	0.01	0.16	-0.01	0.01	0.16	-0.06	-0.02	-0.03
BRA	-0.35	0.43	0.29	-0.48	-0.04	-0.03	-0.04	-0.02	-0.01	0.00	0.01	0.03	-0.03	0.00	0.03	-0.07	-0.02	-0.02
CAN	-0.59	1.45	1.25	-0.74	0.65	0.67	-0.14	-0.02	-0.01	0.16	0.03	0.09	0.12	0.03	0.08	-0.18	-0.02	-0.01
CHN	0.75	0.62	0.77	0.93	1.38	1.37	0.13	0.03	0.01	0.50	0.01	0.07	0.54	0.01	0.07	0.18	0.04	0.01
FRA	-0.69	2.08	1.89	-0.81	1.14	1.16	-0.19	-0.02	-0.01	0.19	0.05	0.00	0.16	0.05	0.00	-0.22	-0.02	-0.01
DEU	-0.56	3.93	3.77	-0.58	3.03	3.04	-0.22	-0.01	0.00	0.38	0.10	0.00	0.38	0.10	0.00	-0.23	-0.01	0.00
IND	-0.58	1.57	1.44	-0.65	0.82	0.83	-0.14	-0.02	-0.01	-0.01	0.02	0.14	-0.03	0.01	0.13	-0.15	-0.02	-0.01
ASE	-0.93	2.64	2.53	-0.96	1.46	1.47	-0.35	-0.01	-0.01	1.44	0.01	0.01	1.42	0.01	0.01	-0.35	-0.01	-0.01
ITA	-0.78	3.06	2.87	-0.87	1.96	1.98	-0.17	-0.01	-0.01	0.10	0.09	0.00	0.08	0.09	0.00	-0.19	-0.02	-0.01
JPN	-2.36	-26.78	-26.88	-3.41	-26.97	-26.96	-1.01	-0.11	-0.03	-7.25	-0.43	-0.85	-7.44	-0.45	-0.88	-1.30	-0.14	-0.04
MEX	-0.33	3.00	2.90	-0.33	2.35	2.36	-0.21	0.00	-0.01	1.38	0.02	0.06	1.37	0.02	0.06	-0.21	0.00	-0.01
RUS	-0.30	0.58	0.51	-0.35	0.22	0.23	-0.03	-0.02	-0.02	0.01	0.01	0.08	0.00	0.01	0.08	-0.04	-0.02	-0.02
SAU	-0.25	1.30	1.26	-0.27	0.98	0.99	0.00	-0.01	-0.01	-0.02	0.00	0.00	-0.03	0.00	0.00	-0.01	-0.01	-0.01
ZAF	-0.43	1.10	1.06	-0.44	0.63	0.64	-0.10	-0.03	-0.07	-0.03	0.01	0.41	-0.03	0.01	0.41	-0.10	-0.03	-0.07
KOR	-0.47	3.02	2.92	-0.46	2.25	2.26	-0.29	-0.03	0.00	1.69	0.02	0.01	1.68	0.02	0.01	-0.29	-0.02	0.00
TUR	-0.44	1.08	0.98	-0.50	0.52	0.53	-0.10	-0.02	-0.01	-0.05	0.12	0.03	-0.06	0.12	0.03	-0.12	-0.02	-0.01
GBR	-0.57	2.20	2.04	-0.66	1.42	1.43	-0.19	-0.02	-0.01	0.18	0.03	0.10	0.16	0.03	0.10	-0.21	-0.02	-0.01
USA	-0.63	2.15	1.97	-0.74	1.27	1.29	-0.25	-0.01	-0.01	0.48	0.03	0.04	0.45	0.02	0.03	-0.28	-0.02	-0.01
REU	-0.59	2.43	2.30	-0.64	1.61	1.63	-0.23	-0.02	-0.01	0.44	0.05	0.26	0.42	0.05	0.25	-0.24	-0.02	-0.01
OEX	-0.27	1.03	0.96	-0.32	0.68	0.69	-0.03	-0.01	-0.01	0.00	0.00	0.02	-0.01	0.00	0.02	-0.04	-0.01	-0.01
LIC	-0.30	0.35	0.30	-0.33	0.02	0.03	-0.04	-0.01	-0.01	-0.02	0.00	0.17	-0.03	0.00	0.17	-0.05	-0.02	-0.01
MIC	-0.38	1.97	1.90	-0.39	1.40	1.41	-0.21	-0.01	-0.01	1.03	0.02	0.07	1.02	0.02	0.07	-0.21	-0.01	-0.01

2017 **2022**

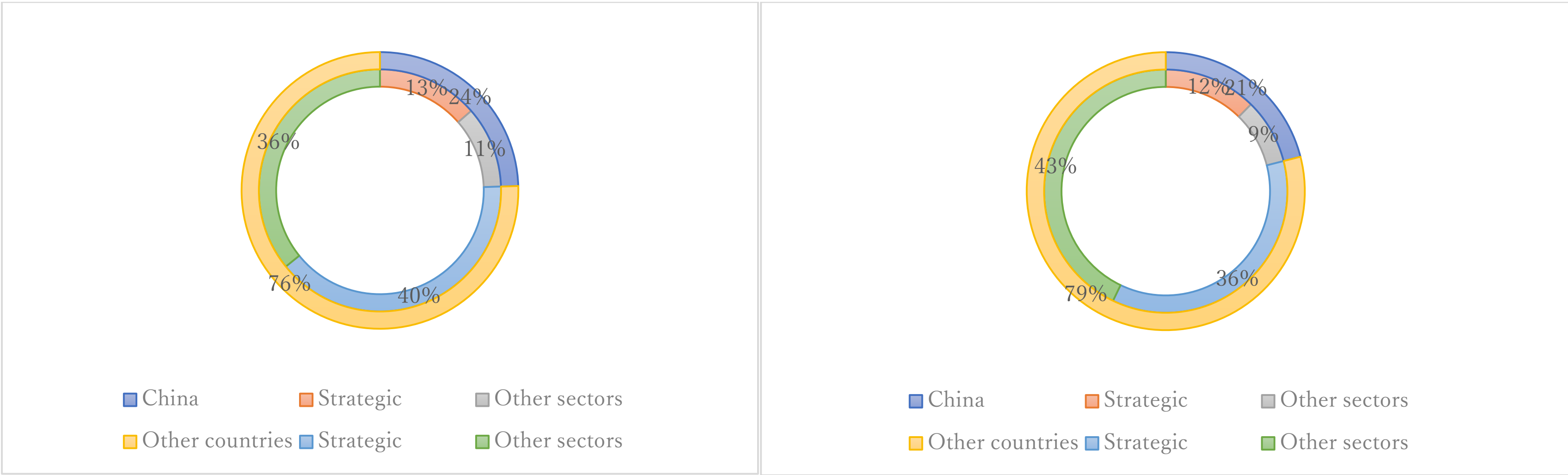


Figure 1: Ratio of imports, Japan (source: World Integrated Trade Solution)

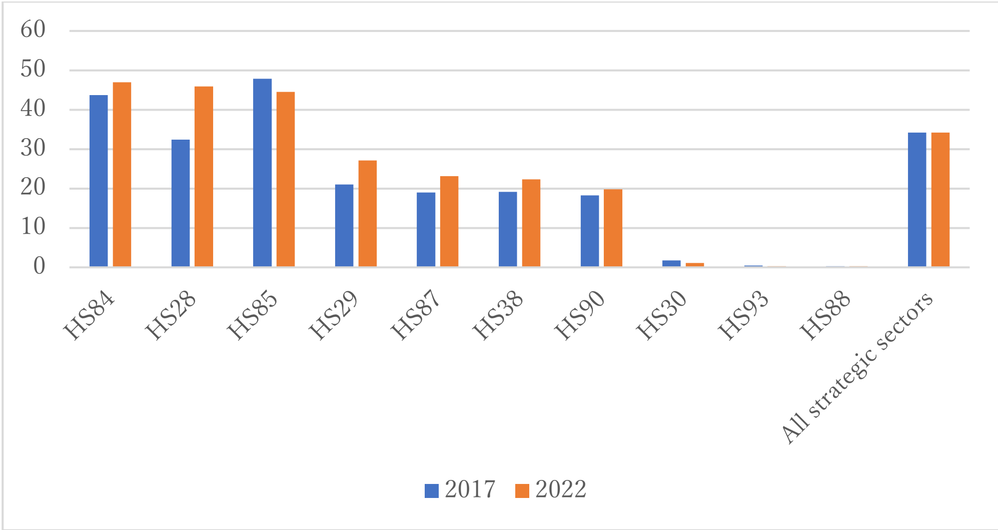


Figure 2: Dependence on imports from China for each HS classification (%) (source: World Integrated Trade Solution)

2017 **2022**

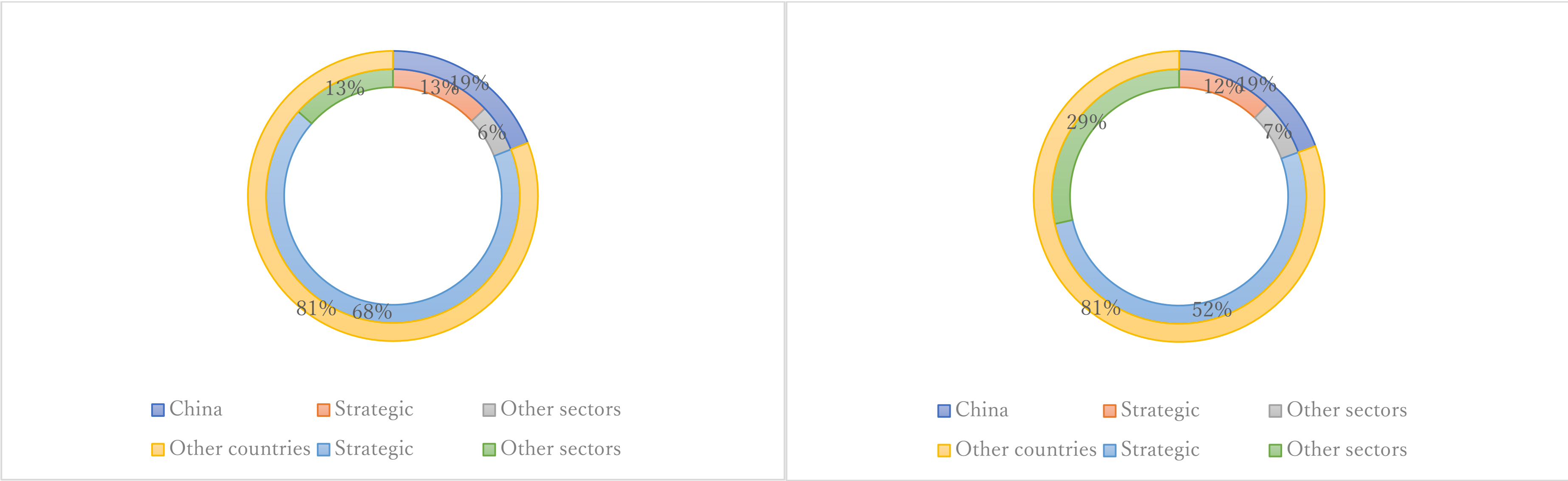


Figure 3: Ratio of exports, Japan (source: World Integrated Trade Solution)

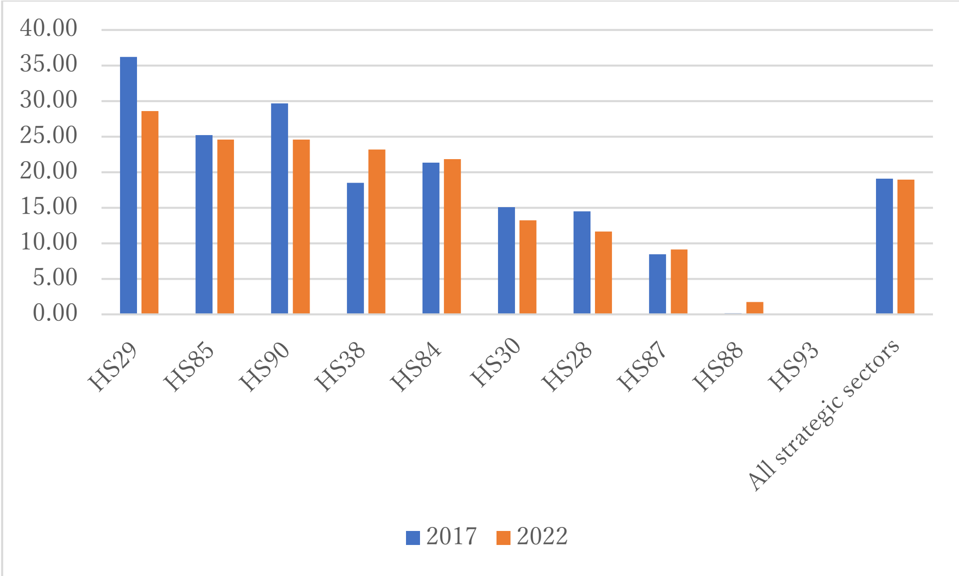
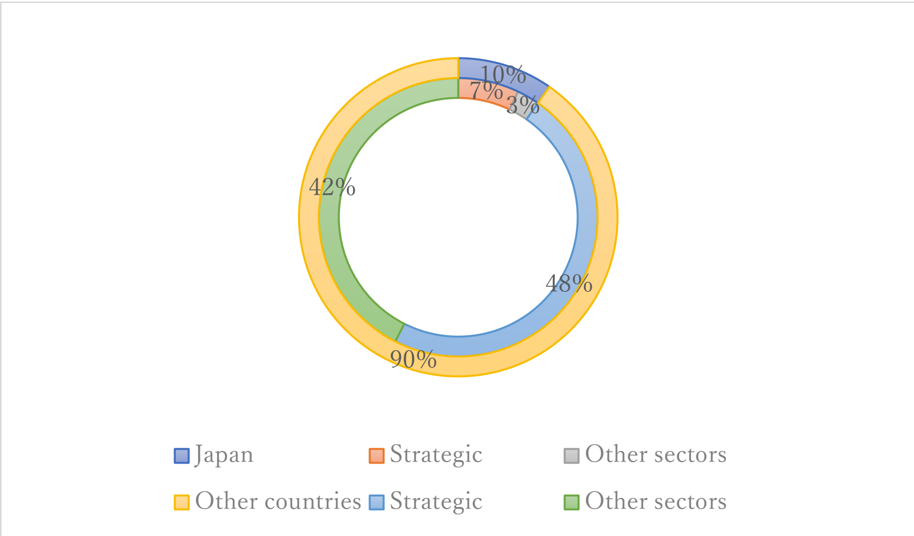


Figure 4: Dependence on exports to China for each HS classification (%) (source: World Integrated Trade Solution)

2017



2022

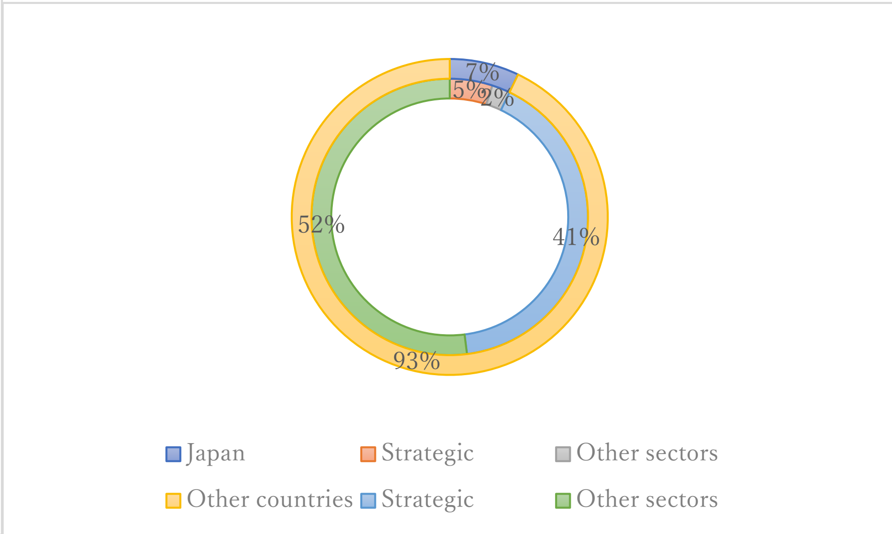


Figure 5: Ratio of imports, China (source: World Integrated Trade Solution)

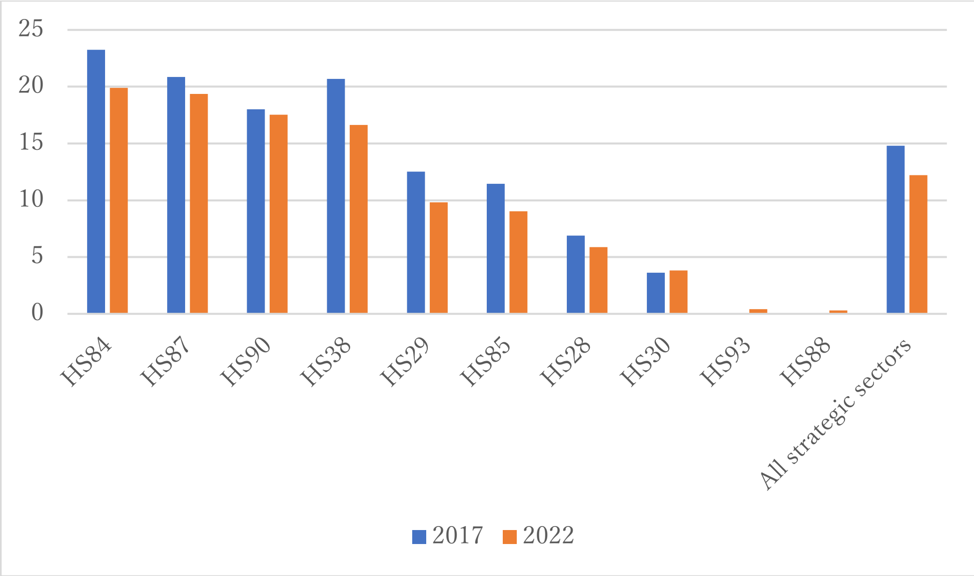
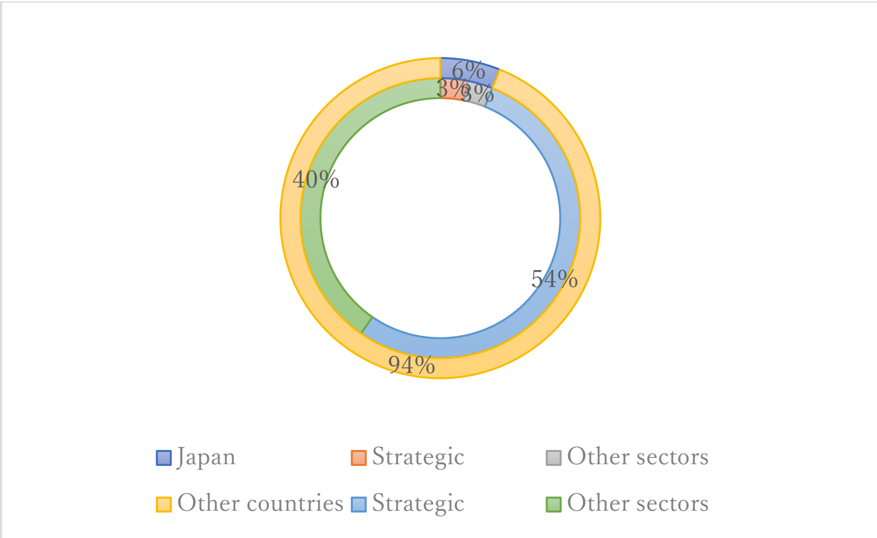


Figure 6: Dependence on imports from Japan for each HS classification (%) (source: World Integrated Trade Solution)

2017



2022

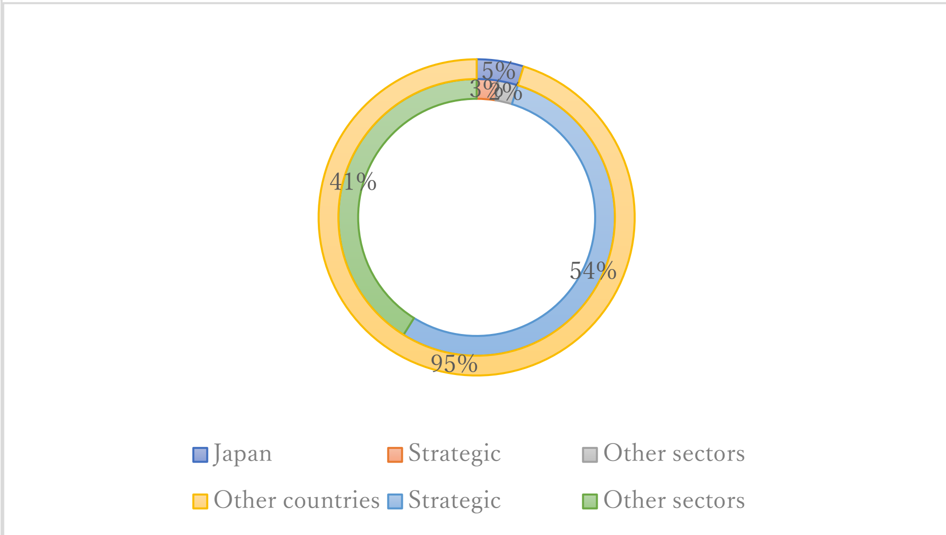


Figure 7: Ratio of exports, China (source: World Integrated Trade Solution)

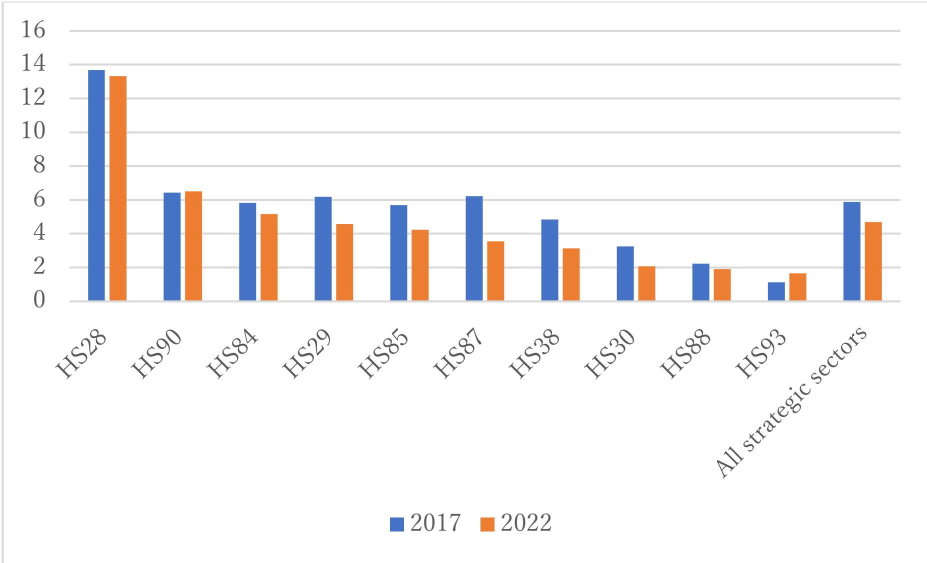


Figure 8: Dependence on exports to Japan for each HS classification (%) (source: World Integrated Trade Solution)

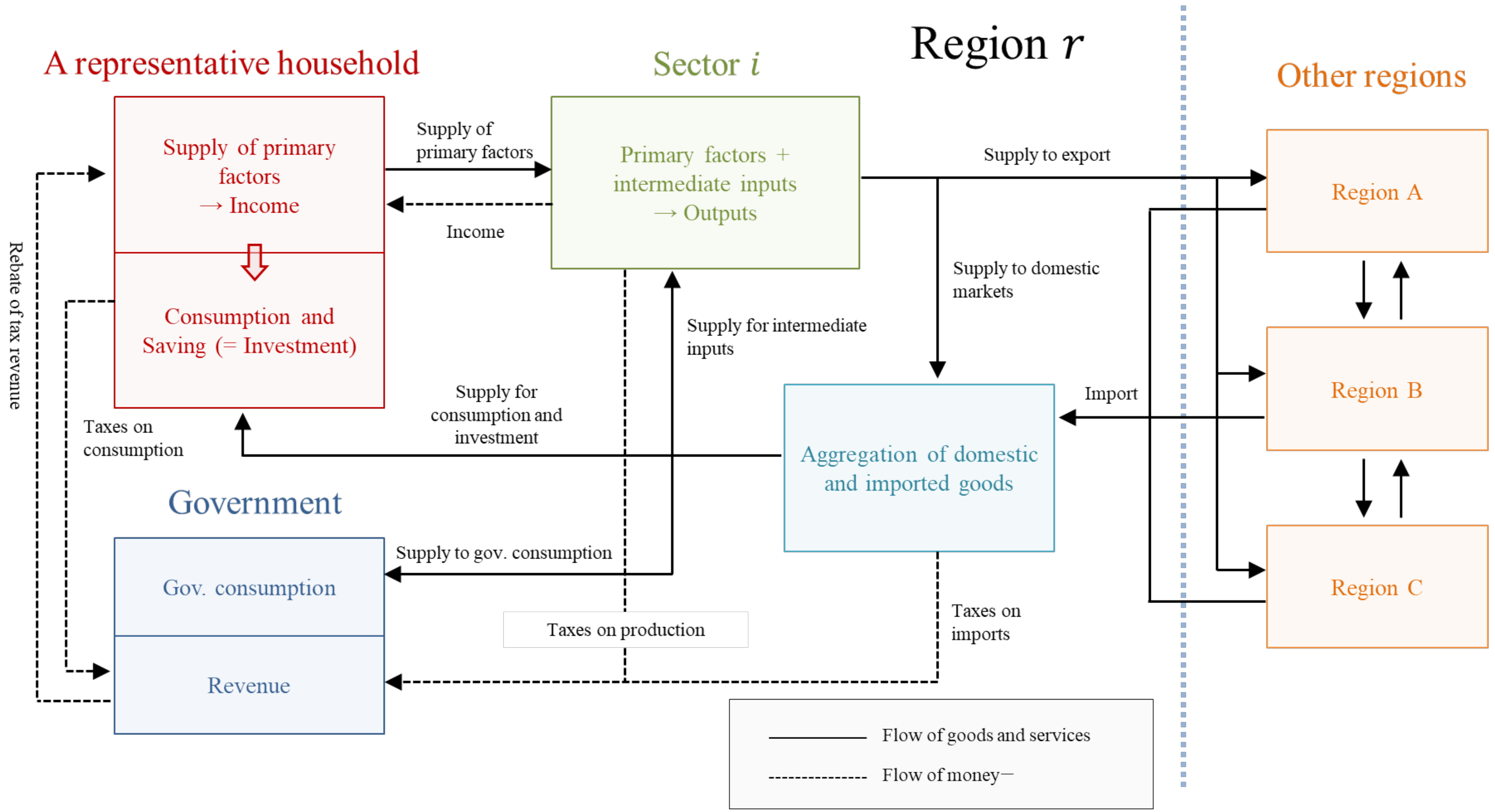


Figure 9: The model's brief structure.

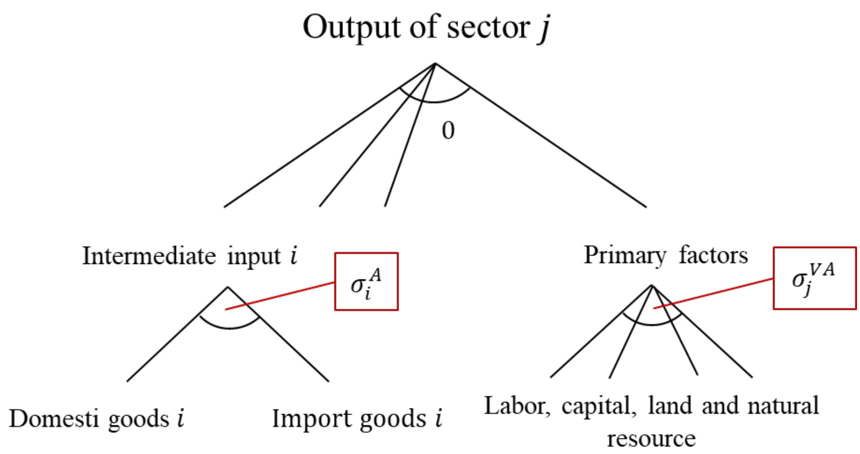


Figure 10: Production function

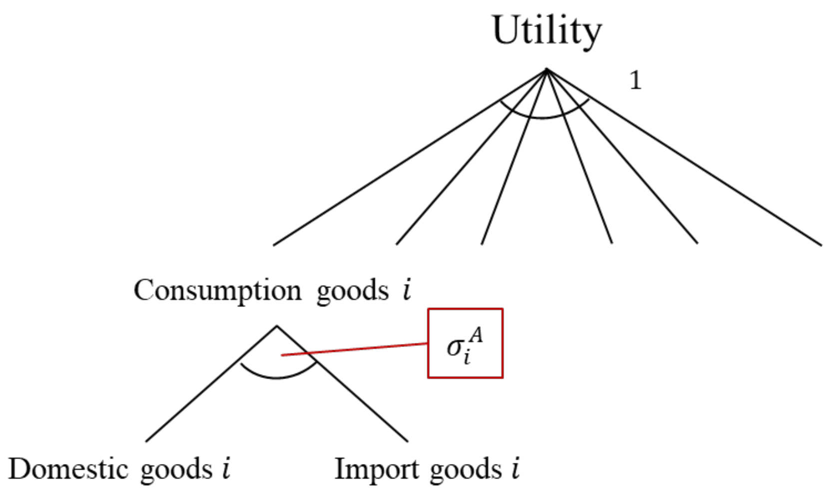


Figure 11: Utility function

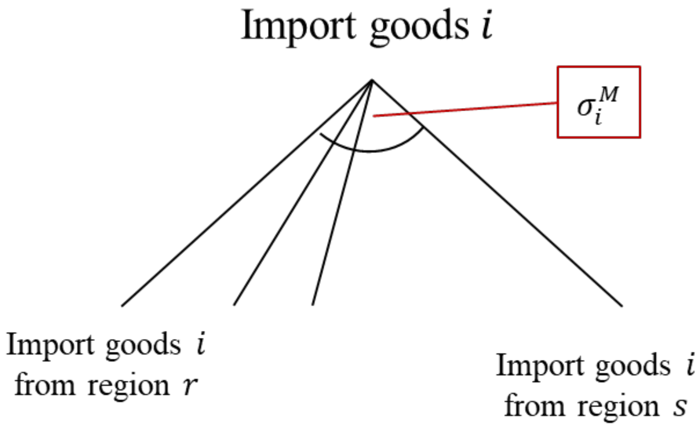


Figure 12: Import aggregation function

Appendix A: Sensitivity analysis

Table A.1: The impacts on GDP of Japan (% change)

Reduction rate (%)	EOS	Unemployment	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
10	1.0		-0.01	-0.02	-0.01	-0.01	-0.02	-0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.0	○	-0.02	-0.03	-0.02	-0.02	-0.04	-0.04	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
10	0.2		-0.06	-0.11	0.00	0.00	-0.06	-0.09	-0.02	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.2	○	-0.08	-0.16	-0.03	-0.03	-0.12	-0.14	-0.03	0.00	0.00	-0.04	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00
30	1.0		-0.06	-0.06	-0.04	-0.05	-0.10	-0.10	-0.02	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.02	0.00	0.00
30	1.0	○	-0.08	-0.09	-0.07	-0.07	-0.15	-0.15	-0.02	0.00	0.00	-0.02	0.00	0.00	-0.02	0.00	0.00	-0.02	0.00	0.00
30	0.2		-0.34	-0.39	-0.02	-0.17	-0.34	-0.42	-0.11	-0.01	0.00	-0.08	0.00	-0.01	-0.01	0.00	0.00	-0.05	-0.01	0.00
30	0.2	○	-0.41	-0.52	-0.11	-0.25	-0.51	-0.59	-0.13	-0.01	0.00	-0.12	-0.01	-0.01	-0.05	0.00	0.00	-0.07	0.00	0.00
50	1.0		-0.15	-0.09	-0.08	-0.14	-0.22	-0.22	-0.05	-0.01	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.04	0.00	0.00
50	1.0	○	-0.18	-0.15	-0.13	-0.17	-0.30	-0.30	-0.05	0.00	0.00	-0.03	0.00	0.00	-0.03	0.00	0.00	-0.05	0.00	0.00
50	0.2		-0.93	-0.71	-0.06	-0.62	-0.94	-1.06	-0.28	-0.03	-0.01	-0.14	-0.01	-0.01	-0.03	0.00	0.00	-0.18	-0.02	-0.01
50	0.2	○	-1.05	-0.91	-0.21	-0.77	-1.25	-1.37	-0.31	-0.03	-0.01	-0.20	-0.01	-0.02	-0.09	-0.01	-0.01	-0.22	-0.02	-0.01

Table A.2: The impacts on GDP of China (% change)

Reduction rate (%)	EOS	Unemployment	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
10	1.0		0.00	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.0	○	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.2		0.00	-0.01	-0.03	-0.02	-0.03	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00
10	0.2	○	-0.01	-0.02	-0.05	-0.04	-0.06	-0.05	0.00	0.00	0.00	-0.01	0.00	0.00	-0.02	0.00	0.00	-0.01	0.00	0.00
30	1.0		-0.02	-0.04	-0.04	-0.02	-0.05	-0.05	0.00	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
30	1.0	○	-0.03	-0.05	-0.05	-0.03	-0.08	-0.08	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00
30	0.2		0.00	-0.10	-0.15	-0.08	-0.16	-0.14	0.00	0.00	0.00	-0.03	0.00	0.00	-0.04	0.00	0.00	-0.02	0.00	0.00
30	0.2	○	-0.02	-0.14	-0.21	-0.14	-0.24	-0.22	-0.01	0.00	0.00	-0.04	0.00	0.00	-0.06	0.00	-0.01	-0.04	0.00	0.00
50	1.0		-0.03	-0.08	-0.09	-0.03	-0.11	-0.11	0.00	0.00	0.00	-0.02	0.00	0.00	-0.02	0.00	0.00	-0.01	0.00	0.00
50	1.0	○	-0.05	-0.10	-0.11	-0.06	-0.15	-0.15	-0.02	0.00	0.00	-0.03	0.00	0.00	-0.03	0.00	0.00	-0.02	0.00	0.00
50	0.2		0.00	-0.32	-0.40	-0.13	-0.41	-0.39	0.00	0.00	0.00	-0.08	-0.01	-0.01	-0.10	-0.01	-0.01	-0.03	0.00	0.00
50	0.2	○	-0.05	-0.40	-0.51	-0.23	-0.56	-0.53	-0.02	0.00	0.00	-0.11	-0.01	-0.01	-0.14	-0.01	-0.02	-0.06	-0.01	0.00

Table A.3: The impacts on the welfare of Japan (% change)

Reduction rate (%)	EOS	nemployme	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
10	1.0		-0.13	-0.17	0.00	0.02	-0.12	-0.13	-0.04	0.00	0.00	-0.04	0.00	-0.01	0.00	0.00	0.00	0.01	0.00	0.00
10	1.0	○	-0.15	-0.19	-0.02	0.01	-0.15	-0.16	-0.04	0.00	0.00	-0.05	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
10	0.2		-1.03	-1.86	0.40	0.54	-0.58	-1.14	-0.36	-0.04	-0.01	-0.46	-0.03	-0.05	0.07	0.01	0.01	0.13	0.02	0.00
10	0.2	○	-1.05	-1.89	0.37	0.50	-0.64	-1.18	-0.36	-0.04	-0.01	-0.47	-0.03	-0.05	0.06	0.00	0.01	0.12	0.02	0.00
30	1.0		-0.39	-0.50	-0.05	0.01	-0.41	-0.45	-0.11	-0.01	0.00	-0.13	-0.01	-0.02	-0.02	0.00	0.00	0.00	0.00	0.00
30	1.0	○	-0.43	-0.56	-0.11	-0.02	-0.49	-0.53	-0.12	-0.01	0.00	-0.15	-0.01	-0.02	-0.04	0.00	0.00	0.00	0.00	0.00
30	0.2		-3.45	-5.28	1.05	0.95	-2.25	-3.57	-1.18	-0.12	-0.03	-1.32	-0.08	-0.14	0.15	0.01	0.01	0.23	0.05	0.01
30	0.2	○	-3.51	-5.37	0.95	0.86	-2.43	-3.71	-1.19	-0.12	-0.03	-1.36	-0.08	-0.14	0.11	0.01	0.01	0.21	0.06	0.00
50	1.0		-0.65	-0.82	-0.20	-0.10	-0.78	-0.84	-0.18	-0.02	-0.01	-0.21	-0.02	-0.03	-0.06	-0.01	-0.01	-0.03	0.00	0.00
50	1.0	○	-0.70	-0.91	-0.29	-0.15	-0.92	-0.98	-0.20	-0.02	-0.01	-0.24	-0.02	-0.03	-0.09	-0.01	-0.01	-0.04	0.00	0.00
50	0.2		-6.64	-8.39	1.41	0.29	-4.97	-6.74	-2.19	-0.23	-0.06	-2.11	-0.13	-0.23	0.09	0.02	0.00	0.02	0.05	0.00
50	0.2	○	-6.75	-8.55	1.23	0.13	-5.28	-6.99	-2.22	-0.23	-0.06	-2.18	-0.13	-0.23	0.02	0.01	0.00	-0.02	0.05	0.00

Table A.4: The impacts on the welfare of China (% change)

Reduction rate (%)	EOS	nemployme	CHN_E_MAN	CHN_I_MAN	JPN_E_MAN	JPN_I_MAN	J&C_E_MAN	J&C_I_MAN	CHN_E_ELE	CHN_E_FMP	CHN_E_NFM	CHN_I_ELE	CHN_I_FMP	CHN_I_NFM	JPN_E_ELE	JPN_E_FMP	JPN_E_NFM	JPN_I_ELE	JPN_I_FMP	JPN_I_NFM
10	1.0		0.01	0.00	-0.09	-0.08	-0.08	-0.07	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	-0.02	0.00	0.00
10	1.0	○	0.00	-0.01	-0.10	-0.09	-0.09	-0.09	0.00	0.00	0.00	0.00	0.00	0.00	-0.03	0.00	0.00	-0.03	0.00	0.00
10	0.2		0.27	0.40	-0.69	-0.77	-0.48	-0.17	0.09	0.01	0.00	0.07	0.01	0.01	-0.22	-0.01	-0.03	-0.21	-0.02	-0.01
10	0.2	○	0.26	0.38	-0.71	-0.79	-0.50	-0.20	0.08	0.01	0.00	0.07	0.01	0.01	-0.23	-0.01	-0.03	-0.21	-0.02	-0.01
30	1.0		-0.01	-0.04	-0.28	-0.23	-0.26	-0.24	0.00	0.00	0.00	-0.01	0.00	0.00	-0.07	-0.01	-0.01	-0.06	-0.01	0.00
30	1.0	○	-0.04	-0.07	-0.31	-0.27	-0.32	-0.30	-0.01	0.00	0.00	-0.02	0.00	0.00	-0.08	-0.01	-0.01	-0.08	-0.01	0.00
30	0.2		0.75	0.55	-2.30	-2.24	-1.71	-1.02	0.23	0.03	0.00	0.08	0.02	0.01	-0.72	-0.04	-0.08	-0.61	-0.07	-0.03
30	0.2	○	0.72	0.50	-2.35	-2.30	-1.78	-1.11	0.22	0.03	0.00	0.06	0.02	0.00	-0.74	-0.04	-0.09	-0.64	-0.07	-0.03
50	1.0		-0.08	-0.15	-0.47	-0.38	-0.50	-0.47	-0.01	0.00	0.00	-0.04	0.00	0.00	-0.12	-0.01	-0.01	-0.10	-0.02	-0.01
50	1.0	○	-0.13	-0.20	-0.52	-0.44	-0.59	-0.57	-0.04	-0.01	0.00	-0.05	0.00	-0.01	-0.13	-0.01	-0.01	-0.13	-0.02	-0.01
50	0.2		1.12	-0.20	-4.36	-3.61	-3.54	-2.67	0.31	0.05	-0.01	-0.13	0.02	-0.02	-1.30	-0.07	-0.16	-1.01	-0.12	-0.04
50	0.2	○	1.07	-0.28	-4.45	-3.71	-3.66	-2.81	0.29	0.05	-0.01	-0.16	0.02	-0.02	-1.34	-0.07	-0.16	-1.05	-0.12	-0.04

Appendix B: Mathematical expression of the model.

Notes

- All taxes except for lump-sum taxes have been omitted for notational simplicity.
- All functions are written in calibrated share form. See Böhringer et al. (2003) for details of the calibrated share form.
- All reference prices have been omitted for notational simplicity.

Notations.

Index

Symbol	Description
i, j	Sectors and goods
r, s	Regions
f	Primary factors: labor (LAB), capital (CAP), land (LND), natural resource.
MF	Set of mobile factors. Labor and capital for the EOS 1.0 scenario.
SF	Set of sluggish factors. Land and natural resources for the EOS 1.0 scenario and all primary factors for the EOS 0.2 scenario.

Activity variables:

Symbol	Description
Y_{ir}	Production in sector i and region r.
T_{fr}^{SF}	Allocation of sluggish factors in region r $(f \in SF)$
A_{jir}^{F}	Armington aggregate for good j used for sector i in region r
A_{ir}^{P}	Armington aggregate for good j used for private consumption in region r
A_{ir}^{G}	Armington aggregate for good j used for government consumption in region r
A_{ir}^{I}	Armington aggregate for good j used for investment in region r
M_{ir}	Aggregate imports of good i in region r
U_r	Household utility in r
Y_i^T	Global transport services.
G_r	Government expenditure in region r.

INV_r	Investment in region r.

Price variables:

Symbol	Description
p_{ir}^{Y}	Output price of goods i produced in region r.
p_{ir}^{VA}	Price of VA for sector i in region.
p_{ir}^{M}	Import price aggregate for good i imported to region r
p_{irs}^{MM}	Cost, insurance, and freight (CIF) price of goods i imported from r to region s.
p_{irs}^{X}	Free on board (FOB) price of goods i exported from r to region s.
p_{ijr}^{AF}	Price of Armington good i used for sector j in region r.
p_{ir}^{AP}	Price of Armington good i used for private consumption in region r.
p_{ir}^{AG}	Price of Armington good i used for government expenditure in region r.
p_{ir}^{AI}	Price of Armington good i used for investment in region r.
p_{r}^{U}	Price of household utility in region r
p_{fr}^{F}	Price of primary factor f in region r.
p_{fir}^{SF}	Price of sluggish factor f for sector i in region r
p_{r}^{G}	Price index of government expenditure in region r.
p_{i}^{T}	Price of global transport service i.
ϕ_{isr}^{E}	Rent related to export quota on export of goods i from region s to region r.
ϕ_{isr}^{M}	Rent related to import quota on import of goods i from region s to region r.

Cost shares:

Symbol	Description
θ_{jir}	Share of Armington goods j for intermediate input from sector i in region r.
θ_{ir}^{VA}	Share of the primary factor composite for sector i in region r.
θ_{fir}^{F}	Share of primary factor f in primary factor composite for sector i in region r.
θ_{fir}^{SF}	Share of sector i in supply of sluggish factor f in region r ($f \in SF$).
θ_{ijr}^{AF}	Share of domestic goods in Armington good i used for sector j of region r.

θ_{ir}^{AP}	Share of domestic goods in Armington good i for private consumption in region r.
θ_{ir}^{AG}	Share of domestic goods in Armington good i for government consumption in region r.
θ_{ir}^{AI}	Share of domestic goods in Armington good i for investment in region r.
θ_{isr}^{M}	Share of imports of good i from region s to region r.
θ_{ir}^{C}	Share of Armington good i in household consumption demand in region r.
θ_{ir}^{T}	Share of supply from region r in global transport sector i.
θ_{ir}^{G}	Share of Armington good i in government consumption in region r.
θ_{ir}^{I}	Share of Armington good i in investment in region r.

Income and policy variables:

Symbol	Description
H_r	Household income in region r
H_r^G	Government income in region r
T_r^L	Lump-sum tax in region r
Q_{isr}^E	Export quota imposed on export of goods i from region s to region r
Q_{isr}^M	Import quota imposed on import of goods i from region s to region r
$\bar{G}_r$	Exogenous level of government expenditure in region r.
$\overline{INV}_r$	Exogenous investment in region r.

Endowments:

Symbol	Description
$\overline{E}_r$	Aggregate endowment of primary factor f for region r
$\overline{TB}_r$	Trade balance (trade surplus) of region r ($\sum_r \overline{TB}_r = 0$)
τ_{jirs}	Amount of global transport service j required for the shipment of goods i from r to s.

Elasticity parameters:

Symbol	Description

η_f	Elasticity of transformation for sluggish factor allocation.	$\eta_{LND} = \eta_{NRS} = 1$
σ_i^{VA}	Substitution between primary factors in the VA composite of production in sector i	GTAP values
σ_i^{A}	Substitution between the import aggregate and the domestic input	GTAP values
σ_i^{M}	Substitution between imports from different regions	GTAP values

Variables for the wage curve model

Symbol	Description
ue_r	Unemployment in region r
ur_r	Unemployment rate in region r
ω_r	Wage curve elasticity in region r (we assume $\omega_r = 1$)

Model

Zero profit conditions and price index

Production of sector i:

$$\Pi_{ir}^{Y} = p_{ir}^{Y} - \sum_{j} \theta_{jir} p_{jir}^{AF} - \theta_{ir}^{VA}\, p_{ir}^{VA} = 0 \qquad \{Y_{ir}\}$$

Price index of primary factor:

$$p_{ir}^{VA} = \left[\sum_{f \in MF} \theta_{fir}^{F}\, {p_{fr}^{F}}^{1-\sigma_i^{VA}} + \sum_{f \in SF} \theta_{fir}^{F}\, {p_{fir}^{SF}}^{1-\sigma_i^{VA}} \right]^{\frac{1}{1-\sigma_i^{VA}}} \qquad \{p_{ir}^{VA}\}$$

Allocation of sluggish factor ($f \in SF$):

$$\Pi_{fr}^{SF} = \left(\sum_i \theta_{fir}^{SF} p_{fir}^{SF\;1+\eta_f}\right)^{\frac{1}{1+\eta_f}} - p_{fr}^F = 0 \qquad \{T_{fr}^{SF}\}$$

Armington aggregate for intermediate inputs:

$$\Pi_{ijr}^{AF} = p_{ijr}^{AF} - \left(\theta_{ijr}^{AF} p_{ir}^{Y\;1-\sigma_i^A} + \left(1-\theta_{ijr}^{AF}\right) p_{ir}^{M\;1-\sigma_i^A}\right)^{\frac{1}{1-\sigma_i^A}} = 0 \qquad \{A_{ijr}^F\}$$

Armington aggregate for private consumption:

$$\Pi_{ir}^{AP} = p_{ir}^{AP} - \left(\theta_{ir}^{AP} p_{ir}^{Y\;1-\sigma_i^A} + \left(1-\theta_{ir}^{AP}\right) p_{ir}^{M\;1-\sigma_i^A}\right)^{\frac{1}{1-\sigma_i^A}} = 0 \qquad \{A_{ir}^P\}$$

Armington aggregate for government expenditure:

$$\Pi_{ir}^{AG} = p_{ir}^{AG} - \left(\theta_{ir}^{AG} p_{ir}^{Y\;1-\sigma_i^A} + \left(1-\theta_{ir}^{AG}\right) p_{ir}^{M\;1-\sigma_i^A}\right)^{\frac{1}{1-\sigma_i^A}} = 0 \qquad \{A_{ir}^G\}$$

Armington aggregate for investment:

$$\Pi_{ir}^{AI} = p_{ir}^{AI} - \left(\theta_{ir}^{AI} p_{ir}^{Y\;1-\sigma_i^A} + \left(1-\theta_{ir}^{AI}\right) p_{ir}^{M\;1-\sigma_i^A}\right)^{\frac{1}{1-\sigma_i^A}} = 0 \qquad \{A_{ir}^I\}$$

Aggregate imports across import regions:

$$\Pi_{ir}^{M} = p_{ir}^{M} - \left(\sum_s \theta_{isr}^{M} p_{isr}^{MM\;1-\sigma_i^M}\right)^{\frac{1}{1-\sigma_i^M}} = 0 \qquad \{M_{ir}\}$$

CIF price of imports (= FOB price + transport cost):

$$p_{isr}^{MM} = p_{isr}^{X} + \sum_j p_j^T \tau_{jisr} + \phi_{isr}^M \qquad \{P_{isr}^{MM}\}$$

FOB price:

$$p_{isr}^{X} = p_{is}^{Y} + \phi_{isr}^{X} \qquad \{P_{isr}^{X}\}$$

Household utility:

$$\Pi_{r}^{U} = p_{r}^{U} - \prod_i \left(p_{ir}^{AP}\right)^{\theta_{ir}^C} = 0 \qquad \{U_r\}$$

Global transport sector:

$$\Pi_{i}^{T} = p_{i}^{T} - \prod_r \left(p_{ir}^{Y}\right)^{\theta_{ir}^T} = 0 \qquad \{Y_i^T\}$$

Government expenditure:

$$\Pi_r^G = p_r^G - \sum_i \theta_{ir}^G p_{ir}^{AG} = 0 \qquad \{G_r\}$$

Investment:

$$\Pi_r^{INV} = p_r^{INV} - \sum_i \theta_{ir}^I p_{ir}^{AI} = 0 \qquad \{INV_r\}$$

Market Clearance Conditions

Mobile factors $(f \in MF)$:

$$\bar{E}_{fr} = -\sum_i Y_{ir} \frac{\partial \Pi_{ir}^Y}{\partial p_{fr}^F} \qquad \{p_{fr}^F\}$$

Sluggish factors $(f \in SF)$:

$$\bar{E}_{fr} = T_{fr}^{SF} \qquad \{p_{fr}^F\}$$

Sector specific sluggish factors $(f \in SF)$:

$$T_{fr}^{SF} \frac{\partial \Pi_{fr}^{SF}}{\partial p_{fir}^{SF}} = -Y_{ir} \frac{\partial \Pi_{ir}^Y}{\partial p_{fir}^{SF}} \qquad \{p_{fir}^{SF}\}$$

Output:

$$Y_{ir} = -\sum_j A_{ijr}^F \frac{\partial \Pi_{ijr}^{AF}}{\partial p_{ir}^Y} - A_{ir}^P \frac{\partial \Pi_{ir}^{AP}}{\partial p_{ir}^Y} - A_{ir}^G \frac{\partial \Pi_{ir}^{AG}}{\partial p_{ir}^Y} - A_{ir}^I \frac{\partial \Pi_{ir}^{AI}}{\partial p_{ir}^Y} - \sum_s M_{is} \frac{\partial \Pi_{is}^M}{\partial p_{ir}^Y} - Y_i^T \frac{\partial \Pi_{\mathrm{i}}^T}{\partial p_{ir}^Y} \qquad \{p_{ir}^Y\}$$

Import aggregate:

$$M_{ir} = -\sum_j A_{ijr}^F \frac{\partial \Pi_{ijr}^{AF}}{\partial p_{ir}^M} - A_{ir}^P \frac{\partial \Pi_{ir}^{AP}}{\partial p_{ir}^M} - A_{ir}^G \frac{\partial \Pi_{ir}^{AG}}{\partial p_{ir}^M} - A_{ir}^I \frac{\partial \Pi_{ir}^{AI}}{\partial p_{ir}^M} \qquad \{p_{ir}^M\}$$

Armington goods for intermediate inputs:

$$A_{ijr}^{F} = -Y_{jr} \frac{\partial \Pi_{jr}^{Y}}{\partial p_{ijr}^{AF}} \qquad \{p_{ijr}^{AF}\}$$

Armington goods for government consumption:

$$A_{ir}^{G} = -G_{r} \frac{\partial \Pi_{r}^{G}}{\partial p_{ir}^{AG}} \qquad \{p_{ir}^{AG}\}$$

Armington goods for private consumption:

$$A_{ir}^{P} = -U_{r} \frac{\partial \Pi_{r}^{U}}{\partial p_{ir}^{AP}} \qquad \{p_{ir}^{AP}\}$$

Armington goods for investment:

$$A_{ir}^{I} = -INV_{r} \frac{\partial \Pi_{r}^{INV}}{\partial p_{ir}^{AI}} \qquad \{p_{ir}^{AI}\}$$

Household utility:

$$U_{r} = p_{r}^{U} H_{r} \qquad \{p_{r}^{U}\}$$

Government consumption:

$$G_{r} = p_{r}^{G} H_{r}^{G} \qquad \{p_{r}^{G}\}$$

Investment:

$$INV_{r} = \overline{INV_{r}} \qquad \{p_{r}^{INV}\}$$

Global transport service:

$$Y_{i}^{T} = \sum_{j,r,s} \tau_{ijrs} M_{jrs} \qquad \{p_{i}^{T}\}$$

Rent for export quota:

$$Q_{irs}^{X} = -M_{is} \frac{\partial \Pi_{is}^{M}}{\partial p_{ir}^{Y}} \qquad \{\phi_{irs}^{X}\}$$

Rent for import quota:

$$Q_{irs}^{M} = -M_{is} \frac{\partial \Pi_{is}^{M}}{\partial p_{ir}^{Y}} \qquad \{\phi_{irs}^{M}\}$$

Income.

Household income:

$$H_r = \sum_{f \in FL} p_{fr}^F \, \bar{E}_{fr} + p_r^{LE} \, \bar{E}_{Lr} + p_r^{INV} \overline{INV}_r - p_{USA}^{INV} \overline{TB}_r - p_r^C T_r^L + \sum_{i,s} \phi_{irs}^X Q_{irs}^X + \sum_{i,s} \phi_{isr}^M Q_{isr}^M \qquad \{H_r\}$$

Government income:

$$H_r^G = p_r^C T_r^L + \text{other tax revenue} \qquad \{H_r^G\}$$

Lump-sum transfer (tax) to household:

$$G_r = \bar{G}_r \qquad \{T_r^L\}$$

Model with unemployment (wage curve model).

Unemployment rate:

$$\frac{p_{LAB,r}^F}{p_r^U} = \alpha_r (ur_r)^{-\omega_r} \qquad \{ur_r\}$$

Unemployment (ue_r):

$$ue_r = ur_r \, \bar{E}_{LAB,r} \qquad \{ue_r\}$$

Labor market:

$$\bar{E}_{LAB,r} = -\sum_i Y_{ir} \frac{\partial \Pi_{ir}^Y}{\partial p_{LAB,r}^F} + ue_r \qquad \{p_{LAB,r}^F\}$$