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Can the Japanese Agri-food Sectors Survive by Promoting their Exports?: A General Equilibrium Analysis with Farm Heterogeneity and Product Differentiation

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Can the Japanese Agri-food Sectors Survive by Promoting their Exports?: A General Equilibrium Analysis with Farm Heterogeneity and Product Differentiation[*]

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Abstract

Manufacturing industries have attracted research attention regarding roles of firm heterogeneity and product differentiation in the "new new trade theory." Agricultural sectors also produce new goods by product differentiation through breeding, food processing, quality-upgrading, and branding. In reaction to the recent globalization, the Japanese government has sought strategies to promote its domestic agri-food sectors by means of product differentiation and export promotion. This computable general equilibrium study examines the relevance of these policies by simulating hypothetical trade liberalization in agriculture and/or food. We show that agricultural trade liberalization would not increase Japan's agricultural exports but would increase food exports; and that food trade liberalization would promote food exports. Both types of liberalization would increase domestic production in agri-food sectors through agri-food linkages and variety effects. This finding affords evidence of the relevance of product differentiation strategy through food processing and exportation, but not of agricultural export promotion strategy.

Keywords

Agri-food Exports; Food Supply Chain; Firm Heterogeneity; Product Differentiation

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1.   Introduction

Agri-food trade liberalization has not been expected to be beneficial for Japan in most multilateral and bilateral free trade agreements (FTAs) in which Japan has participated. Japan's agricultural sectors, like those in many other industrialized countries, are minor and traditional, and have contracted over time in the face of severe competition with foreign agricultural exporters. The GDP share of agriculture in Japan, 1.9% in 1994, when the Uruguay Round agreement was signed, fell to 1.2% by 2016. Political power was wielded to keep agricultural border barriers and government supports high. That protection provided room for many low-productivity small farmers to survive. Anticipating more severe competition following the implementation of the Uruguay Round agreements, the Japanese Government spent large amounts of special budget on their promotion programs. That approach proved inefficient and was sometimes abused (*Nikkei* (2016a, 2016b), and Tokyo Foundation (2014)); it did not contribute to revitalization of the agricultural sectors.

Participating in the Trans-Pacific Partnership (TPP), Japan's Ministry of Agriculture, Forestry and Fisheries (MAFF) decided to switch its policy focus to acceptance of free trade, rather than maintaining protection levels. It is expected that even under intensified competition with foreign producers, the country's agri-food sectors will survive thanks to two strategies: an export promotion strategy and a product differentiation strategy. MAFF expects that Japan's agri-food products, such as *wagyu* beef, fruits, and Japanese *sake*, are unique and competitive in the international markets, and thus place less emphasis on the survival of traditional crops, especially rice. The export potential of Japan's agri-food products has been studied for the cases of selected products, major geographical production areas, and brands, with *Aomori* apples being perhaps the best known of the most successful cases (Tanaka (2006), Akashi and Tanemura (2006), and Nakamura et al. (2011)). Shimowatari (2018) has studied several projects for the promotion of agri-food exports to the Asia-Pacific region. MAFF (2018) commends successful agricultural and food exporters. However, those success stories are all individual business-level cases, and examinations are sporadic and limited to a small number of successful case studies—certainly not firm evidence of the macro-level impact of success in export and product differentiation.

From the strategic viewpoint of FTA negotiations, the Japanese Government needs to identify countries with which Japan should establish FTAs; and agri-food sectors in which Japan is highly

competitive in domestic and international markets. Currently, Japan's agri-food exports are concentrated on East Asia, followed by the North American Free Trade Agreement (NAFTA) region, Southeast Asia, and China (Table 1.1). Exports are far smaller than imports and are dominated by food products. This small achievement of Japan's agri-food exportation might be an indication of strong potential for future growth. Freer agri-food trade could achieve this potential as MAFF expects. In the literature, several macroeconomic or general equilibrium studies have examined Japan's agricultural policies under freer trade, but they mostly examined the case of rice and other crops and/or food security issues (Tanaka and Hosoe (2011), Lee and Itakura (2014), and Hosoe (2016)).[1] Studies on agri-food products other than rice and major crops have focused on selected products narrowly defined by product variety and/or geographical production areas, and do not afford comprehensive evidence. For example, other than the abovementioned studies on apples, Peng and Cox (2006) simulate trade liberalization of dairy products in Asia; and Shuto (2011) estimates export competitiveness of the Japanese food industry in Asia, using Balassa's (1965) revealed comparative advantage index.

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[1] Even if a study is not focused on the agri-food sectors, if a multi-sectoral model is used it can identify policy implications about Japan's agricultural policies, and can identify agri-food sectors of interest. See, for example, Petri et al. (2012) and Okubo et al. (2018).

Table 1.1: Japan's Agri-Food Trade [Unit: million USD]

	China	East Asia	Southeast Asia	NAFTA	Latin America	South Asia	EU	Other Europe & Russia	ROW
Japan's Exports									
Vegitables and Fruit	1	27	2	2	0	2	1	0	2
Livestock	5	59	32	1	0	0	4	0	1
Meat Product	4	15	4	6	1	1	18	3	3
Dairy Product	1	10	4	2	0	0	2	0	3
Other Food	202	1,093	422	553	18	35	134	43	150
Total	214	1,204	464	564	19	38	158	47	158
Japan's Imports									
Vegitables and Fruit	154	35	220	275	23	10	16	2	122
Livestock	319	69	28	179	26	13	88	13	145
Meat Product	989	47	889	3,788	1,345	2	967	15	1,705
Dairy Product	8	12	58	213	27	1	399	12	605
Other Food	5,383	1,527	5,587	4,675	2,256	924	3,260	1,757	1,507
Total	6,853	1,690	6,781	9,129	3,676	950	4,729	1,798	4,084

Source: GTAP Database version 9a (base year=2011)

The presence of the agricultural sectors is smaller than that of the food sectors not only in the export markets but also in the domestic market. MAFF (2016) reports that processed food consumption constitutes 51% of total household consumption, fresh food consumption only 16%. However, it should not be assumed that the agricultural and food sectors compete with each other; rather that they are linked tightly and work complementarily. Agricultural products are mostly used as intermediate inputs in the food industry, rather than for direct consumption by households. MAFF (2016) reports that in 2011 in Japan, 59% of total agricultural production was shipped to the food industry.[2] MAFF paid insufficient attention to the complementary role of the food sectors and the agricultural sectors, and the linkages between them, in its heavy policy interventions in the agricultural sectors. For example, MAFF's export promotion policies place stronger emphasis on agricultural exports than food exports. As of the end of 2018, more than 70% of product names registered in Japan's Geographical Indication (GI) protection system were those of

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[2] Aside from agricultural product use for food production purposes, 31% was used for final consumption; 9% went to the restaurant industry.

agricultural and aquatic products.[3] This strong policy preference for agricultural and aquatic products may reduce the effectiveness of promotion policies.

The second strategy is product differentiation to make the agri-food sectors more competitive in the domestic market and enhances their export potential. That product differentiation in agriculture is achieved through two types of producer activities. One is breeding and quality-upgrading, which are conducted within their own business domain. The other, with a wider scope, is food processing in collaboration with local and global agri-food suppliers and synergizing agri-food production with other local industries and enterprises in restaurant, recreation, and tourism sectors. The success of those differentiation measures depends on factors in the domestic and international markets. Moreover, given the observed large variation in productivity or entrepreneurship among farms/firms, only exceptionally productive farms/firms can succeed. There is a strong need for a framework for comprehensively assessing the success of product differentiation strategies for promotion of Japan's agri-food products.

For the comprehensive analysis of agri-food policies with micro-level industry detail and macro-level consistency, computable general equilibrium (CGE) models are rather useful, although many earlier agri-food policy analyses using conventional CGE models did not consider product differentiation or farm/firm heterogeneity. For example, agricultural productivity was assumed to be constant or determined by exogenous factors such as weather conditions and climate. More recently, some studies do give consideration to the above factors; for example, Tanaka and Hosoe (2011) and Hosoe (2016) apply a Monte-

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[3] The Act on Protection of the Names of Specific Agricultural, Forestry and Fishery Products and Foodstuffs Act, also known as the Geographical Indication (GI) Act, which went into force in 2015, provides intellectual property protection of names for specific agricultural, forestry and fishery products and related processed products. These products are registered to certificate their quality, reputation, and other established characteristics in combination with their geographical origins. GI protection is effective not only in Japan but also in other countries which are engaged in trade agreements with Japan. For example, the 2019 Japan-European Union (EU) Economic Partnership Agreement ensures GI protection for agricultural products and foodstuffs: 48 Japanese GIs and 71 EU GIs. Among those, 71% of the Japanese GIs are for agricultural and aquatic products; in contrast, 88% of the EU GIs are for processed foods. Moreover, there are eight Japanese GIs and 139 EU GIs for liquor products.

Carlo simulation method to describe productivity shocks, and Lee and Itakura (2018) take account of a trend of productivity improvements arising from learning-by-doing prompted by trade liberalization. In contrast, recent state-of-the-art trade theory with firm heterogeneity (a.k.a. new new trade theory), initiated by Melitz (2003) and Eaton and Kortum (2002), implies that productivity varies significantly among firms and that heterogeneity generates various trade and production patterns.

These analyses focus on manufacturing sectors with firm heterogeneity, intensive intra-industry trade, and product differentiation, while assuming that agricultural sectors are a homogeneous industry lacking those special features. However, as Kano et al. (2013) and Takechi (2015) show, agricultural products are highly differentiated through activities such as breeding, quality control, and detailed product grading. Productivity has always attracted considerable attention in agricultural analysis. The US Department of Agriculture measures productivity of agricultural sectors by means of various indicators, including total factor productivity (TFP) (Ball et al. (2013), Shumway et al. (2016)). Productivity varies widely among farms and correlates positively with farm size in developed countries and negatively in developing countries (Sumner (2014)). Akune and Hosoe (2019) estimate TFP for the Japanese agricultural sectors using farm-level microdata and confirm large variations in TFP among farms. Fontagnué et al. (1997) and Bojnec and Fertő (2016), and Kiminami and Kiminami (2000), find intra-industry trade in agri-food products, for Europe and East Asia, respectively, though on a smaller scale for intra-industry trade than for the manufacture of products. Japan's food industries have become more dependent on imported agri-food inputs as a result of participation in global food value chains. Their imported input share rose steadily, from 16% in 1980 to 30% in 2011 (MAFF (2016)).

The results of the above studies indicate that the new new trade theory framework is also useful for our agri-food analysis. In the literature, Heerman et al. (2015) apply the Eaton and Kortum (2002) model in their analysis of agricultural free trade in the Asia-Pacific region. Rau and van Tongeren (2009) and Luckstead and Devadoss (2016) employ Melitz-type partial equilibrium models to analyze the impact of free trade in meat products between the 15 European Union (EU) member countries and Poland, and that of the Transatlantic Trade and Investment Partnership (TTIP) on processed food trade between the US and the EU, respectively. However, these studies are partial equilibrium analyses on a specific product/industry, and do not consider inter-industry agri-food linkages.

With that background, we develop a Melitz-type world trade CGE model, where productivity and number of producers and exporters are endogenously determined, to simulate hypothetical FTAs in agri-foods between Japan and several major countries/regions. Using a general equilibrium model allows us to describe agri-food industries which are linked and host heterogeneous farms/firms that conduct product differentiation. Here we assess the potential of the Japanese agri-food sectors and their survivability in the globalized agri-food market.

Section 2 below presents an outline of our Melitz-type CGE model and the data and assumed parameters used in the construction of the model. Section 3 explains the FTA scenarios that feature in our policy experiments. Section 4 examines the results of the simulations. Finally, Section 5 concludes with a discussion of the relevance of the two strategies for Japanese agri-food sectors.

2.   Model

We employ a Melitz-type CGE model, where we take account of love of variety and product differentiation, à la Dixit and Stiglitz (1997), and farm/firm heterogeneity in productivity. This is a static model, distinguishing 10 countries/regions and 14 goods (Table 2.1). The static standard CGE model developed by Hosoe et al. (2010) for an open single country is extended to develop this world trade model with Melitz-structure (Hosoe (2018)) and calibrated to the GTAP Database version 9a, whose base year is 2011, with the Armington (1969) elasticity provided in the same database (Hertel (1997))[4].

We assume that the five agri-food sectors of interest here, as well as manufacturing sectors, have Melitz structure. The two key parameters that characterize Melitz structure are a shape parameter of the Pareto distribution of firm productivity k and elasticity of substitution among varieties σ^{MLZ} for the agri-food sectors. For the five agri-food sectors, those parameters are set by taking into account the empirical

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[4] For the details of the model, see the Appendix of Hosoe (2018).

estimates (with Japanese farm-level microdata) by Akune and Hosoe (2019).[5] The parameters for the manufacturing sectors are those by the structural model estimate by Balistreri and Rutherford (2013) (k=4.6) and the estimate by Bernard et al. (2003) (σ^{MLZ}=3.79), following many other Melitz-type CGE analyses. Due to data limitations, we use these values across all the countries/regions.[6]

Table 2.1: Regions and Sectors in the Model and Simulation Scenarios

| Country/Region	Sector	Melitz structure	FTA simulation	
			Agri-FTA	Food-FTA
Japan	Paddy Rice			
China	Wheat			
East Asia	Vegetables and Fruit	x	x	
Southeast Asia	Livestock	x	x	
NAFTA	Other Agriculture			
Latin America	Meat Product	x		x
South Asia	Dairy Product	x		x
European Union (EU)	Processed Rice			
Other Europe and Russia	Other Food	x		x
Rest of the World (ROW)	Mining			

[5] In that study, TFP is estimated by standard methods in the TFP analysis (Olley and Pakes (1996), Levinsohn and Petrin (2003), and Ackerberg et al. (2015)). The elasticity of substitution among varieties σ^{MLZ} is estimated following Crozet and Koenig (2010). The estimates are k=2.15–2.60 (average: 2.45) and σ^{MLZ}=2.20–3.30 (average: 2.73) for vegetables and fruit; and k=1.17–2.67 (average: 1.81) and σ^{MLZ}=1.47–3.10 (average: 2.00) for livestock, which satisfy the parameter condition $k+1>\sigma^{MLZ}$ in the original Melitz model. We use average values of these estimates in our model.

[6] We develop an alternative CGE model without Melitz structure for the five agri-food sectors of our interest and run the same policy experiments. With this alternative model setup, we find quantitatively much smaller but qualitatively same impacts. We also conduct a sensitivity analysis with respect to the assumed parameters and find our results qualitatively robust. Details of the assumed parameters and the results of the sensitivity analysis are provided in the Appendix, available upon request.

Light Manufacturing	x
Heavy Manufacturing	x
Transportation	
Service	

Figure 2.1 shows the structure of the Melitz-CGE model created with nested-constant elasticity of substitution (CES) functions. The k-th variety produced by the i-th sector located in the r-th region is sent to the s-th region. $QT_{k,i,r,s}$ is aggregated to a variety aggregate $QT_{i,r,s}$. In production, a firm incurs a per-variety fixed cost $F_{i,r,s}^{MLZ}$ and a firm setup cost $H_{i,r}^{MLZ}$. These fixed costs are paid with the final output. These fixed costs, along with love of variety preference, bring an economy of scale.

Figure 2.1: Model Structure
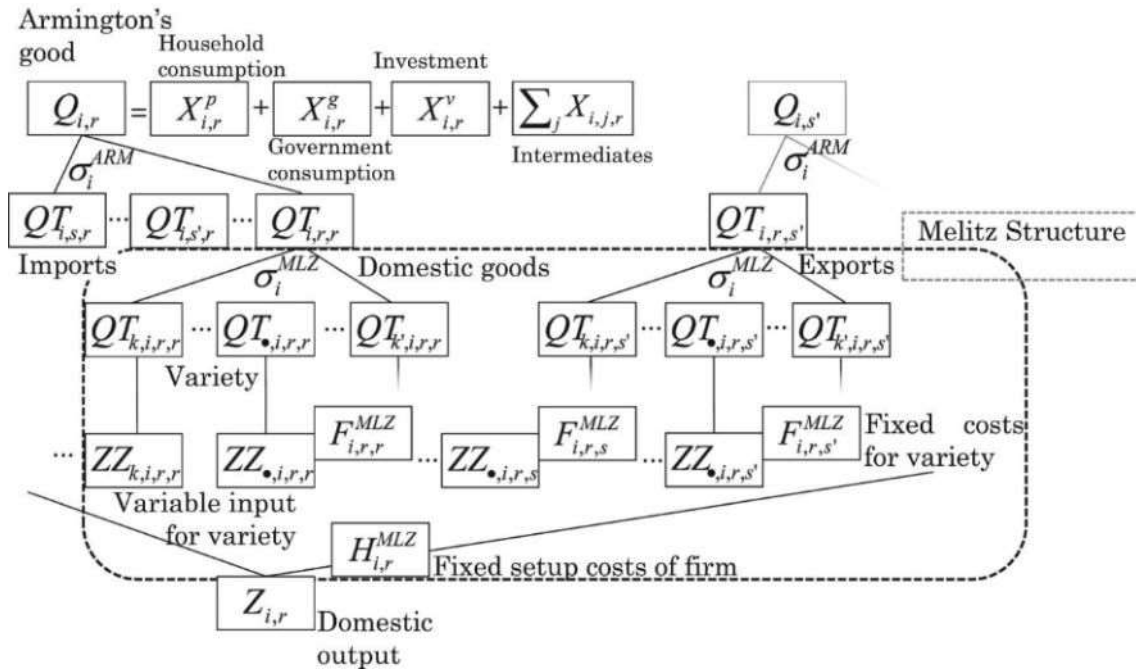
Source: Adopted from Hosoe (2018).

The variety aggregate shipped from various regions $QT_{i,s,r}$, $QT_{r,s',r}$, ... is combined to form Armington's (1969) composite good $Q_{i,r}$. This is sold to r-th region domestic agents such as the

representative household, the government, investment, and intermediate users. Exports are determined by the production of the abovementioned variety shipped to the foreign region s. (As exporting is determined by this process, we do not need a constant elasticity of transformation (CET) function as is often used in conventional CGE models.) Splitting the aggregation process into two stage CES nests—among varieties and between imports and domestic goods—we allow their elasticity parameters σ_i^{MLZ} and σ_i^{ARM} to differ. We employ the abovementioned elasticity values for the former and those provided by the GTAP Database for the latter. In contrast, many other Melitz-type CGE models (e.g., Dixon et al. (2018)) consider only one-stage nest, following the original setup by Melitz (2003).

In the balance of payments constraint, current account deficits are assumed to be constant in the rest of the world's (ROW) currency term, while foreign exchange rates are flexibly adjusted. Three types of primary factors (capital, skilled and unskilled labor) are distinguished. Capital is sector-specific and thus immobile across sectors; labor is mobile. Land, which is a major primary factor employed in agriculture, is included in capital and thus immobile.

3.   Simulation Scenarios

We assume Japan's FTAs individually with the eight partners listed in Table 8.1. (We do not consider ROW as an FTA partner.) To determine what type of FTAs could contribute to the promotion of Japan's agri-food exports and domestic production, we specifically consider two types of FTAs (Table 2.1): an agri-FTA, covering vegetables and fruit, and livestock; and a food-FTA, covering meat products, dairy products, and other foods.[7] These two FTAs are expected primarily to increase Japan's agri-food exports by lowering tariffs in the partners with negative impacts by increased import penetration. They can also

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[7] Incidentally, our study does not take into account trade liberalization of crops, such as rice and wheat, which have often been examined in previous studies, as mentioned above. There are two reasons for omitting these crops: they have been well studied; and they are land-intensive crops and are not expected to become more competitive in the export markets, given the scarcity of farmland in Japan. Also, they are still highly protected by border barriers but are "politically sensitive" (Deardorff (2017), Deardorff and Sharma (2018)). We can hardly expect their liberalization without accompanying political commitments.

improve competitiveness of the domestic industries with cheaper and wider varieties of imported intermediates from the partners. While conventional CGE models can capture the effects through prices, our Melitz-type model can do the variety effect. These multiple channels make the total effects complex. Moreover, it is not trivial whether the agricultural sectors or the food sectors can gain (or lose) in outputs and exports because they are tightly linked through food processing.

The depth of border barrier reduction for these sectors is also an important issue in FTAs. In this regard, we employ a hypothetical simple scenario that assumes mutual 10% point tariff cuts between the two FTA parties.[8] Although agri-food sectors are relatively strongly protected by import tariffs, according to the GTAP Database version 9a the observed 2011 tariff rates are below 10% in some countries and sectors,. In such a situation, negative import tariffs (i.e., import subsidies) are assumed for simulation exercise simplicity.[9] We assume no changes in border barriers in the other sectors or in barriers between FTA members and non-FTA members.

4.   Simulation Results

FTAs would increase Japan's agri-food exports generally (Figure 4.1), while the magnitude would differ by region and sector. Comparing impacts among the FTA partners, FTAs with China, Southeast Asia, and NAFTA would markedly promote exports. The agri-FTAs would, contrary to our expectation, decrease Japan's agricultural exports but increase food exports, which are not liberalized in the agri-FTAs. In contrast, the food-FTAs would increase food exports in all FTA cases. In terms of the change rate, meat and dairy products show a marked increase. It should be noted that as the other food sector is sizable in the status quo, its expansion would be found to be the largest in volume.[10] In all the food-FTAs, vegetable and fruit exports would incur a negative side effect, though not so large. Similarly, food-FTAs would negatively

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[8] For example, a tariff rate of 15% in the status quo is reduced to 5%.

[9] This may sound a bit unrealistic in terms of usual FTA practice. This could also be interpreted as a reduction of nontariff barriers, if we can ignore the income effect of tariff revenues. Agri-food nontariff barriers are observed to be very high and to have a good margin for reduction, except for sanitary and phytosanitary measures.

[10] Value changes of exports, imports, and domestic output are shown in the Annex, available upon request.

impact livestock exports, except for those with China and Southeast Asia.

The above simulation results show that agri-FTAs do little to achieve export promotion, though food-FTAs would have some effect. This implies only limited success of the Japanese Government's policy emphasizing agricultural export promotion. However, this is not necessarily bad news, considering the agri-food linkage described in the general equilibrium model. That is, when an FTA partner increases agricultural exports (equivalently, Japan's imports), they have to sacrifice supply to the domestic food sectors (Figure 4.2). As agricultural products are mostly supplied to food sectors as intermediate inputs, such supply destination switching leads to a decrease in domestic food production by the FTA partners. Japan would find an export opportunity to fill the partner's food supply-demand gap. This shows that Japan has comparative advantage in food products, rather than agricultural products. The increase of agricultural imports also contributes to cost reduction of Japan's food sector through the variety effects. This agri-food input-output linkage enables Japan to exploit its comparative advantage in food products under freer trade.

This can be confirmed by examining output changes in Japan (Figure 4.3). Irrespective of FTA partner choice and coverage of trade liberalization, Japan's production would expand in all five agri-food sectors. The magnitude of these agri-food output gains differs by sector, as it is correlated with export changes. That is, output would increase most significantly in FTAs with China, Southeast Asia, and NAFTA. The food-FTAs would bring larger output changes than the agri-FTAs. It is also noteworthy that some sectors would be affected even if they were not directly impacted by FTAs. Examining impact by sector, it is observed that meat products and other food sectors would expand markedly under all FTAs.[11] In contrast, the vegetable and fruit sector, which has been identified by many agri-food business studies as a promising sector with high export potential, would perform as poorly as the dairy products sector. Overall, as long as we assume a simple scenario of 10 percentage point tariff cuts, our simulation results suggest that the Japanese agri-food producers would not suffer, but rather would gain from agri-food FTAs in terms of their domestic production.

While exports of food products would generally increase, and at the same time those of

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[11] Due to variations in output levels in the status quo, the value change of the other food sector is found to be largest, followed by that of the meat products sector. The details are shown in the Appendix, available upon request.

agricultural products would decrease, production for all the agri-food sectors would increase. That increase would be the result of the domestic producers switching their sales destinations between the domestic and export markets. We can confirm this projection by examining the change in the number of varieties by sales destination. Figure 4.4 shows the change in the number of firms induced by FTAs, when both agri-FTAs and food-FTAs are assumed, for simplicity of the figure. On the one hand, the number of varieties of vegetables and fruit; and livestock in particular exported to the FTA partners would decrease and that of exports to domestic users would increase. On the other hand, meat products and other food sectors would produce more export varieties for the FTA partners, intensifying product differentiation. This implies that only the food sectors would succeed in terms of exportation. While the domestic agricultural producers would compete with foreign producers by creating their niche through product differentiation in the domestic market, they would pursue indirect exportation through food processing, rather than their own direct exportation to the international markets.

Reviewing the simulation results presented so far, one may wonder whether (rather than using CGE simulations) Japan's export patterns, shown in Table 1.1, might be of immediate use in predicting the results of FTAs with the abovementioned promising FTA partners (China, Southeast Asia, and NAFTA). However, the same table provides a counter-example, East Asia, consisting mainly of South Korea, Taiwan, and Hong Kong. Based on export patterns, this region should also be found to be a good potential destination for Japan's agri-food exports. In fact, this does not happen in our simulations. The pattern of Japan's imports, rather than that of its exports, provides a clue to this puzzle. Japan imports almost as much from East Asia as it exports to those countries. Our model is a macroeconomic or general equilibrium model; when countries face a balance-of-payments constraint, free trade increases both exports and imports for both parties in an FTA. We should not focus narrowly on the benefit from the partner's tariff reduction that induces an increase in Japan's exports. Japan also obtains an opportunity to increase its exports to the partner in a volume as large as that of the increases in imports. As we assume that the current account imbalance is intrinsically determined by dynamic factors of investment and savings and thus does not

change, an increase in imports must be matched by an increase in exports.[12] In light of the balance of payments constraint, an increase in agri-food imports depreciates the domestic currency. This depreciation improves the competitiveness of Japan's agri-food exports. This effect cannot be captured by case studies on selected agri-food products or by partial equilibrium studies, but only through general equilibrium analysis.

Thus far, we have analyzed the impact of FTAs on agri-food producers. We should also examine the impact on consumer welfare. Equivalent variations measure the change in representative household welfare induced by FTAs, expressing the impacts in terms of expenditure changes (Figure 4.5). In all eight cases, consumers would benefit from FTAs. The welfare impact is found to be relatively large for FTAs with China, Southeast Asia, and NAFTA, followed by that with the EU, as can be seen from the impact on producers. No more than 15% of total FTA impact would be attributable to the agri-FTAs; the food-FTAs are found to be far more important. This reflects the large share of household consumption occupied by food products. Frequently, concern about how much farmers could be affected by free trade leads to decreased emphasis on consumer gains. However, these welfare indicators demonstrate how much consumers would lose if the border barriers were kept high to protect the farmers.

5.　Concluding Remarks

Japan's agri-food policies, a mixture of industrial, rural, and food policies, are oriented to supporting the domestic farmers and agri-food industries under increasing import pressure. Agri-food business analyses referring to selected case studies tend to highlight the success of those agri-food policies. Indeed, such studies can shed light on one aspect of the agri-food policies and their effects, but they do not provide a comprehensive evaluation from a macro perspective. This study employs a general equilibrium model to determine whether trade liberalization would undermine Japan's agri-food industries and what pathways are promising under freer trade.

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[12] As the current account deficit is a de facto receipt of international transfers, changes in which immediately affect household welfare (Hosoe et al. (2010)). In this comparative statics, we assume the current account balance is constant to make the welfare implication clear.

Simulating FTAs, we find freer trade would indeed contribute to the promotion of agri-food production. Trade liberalization would not promote agricultural exports but would promote food exports. This food export promotion is achieved through an increase of volume and variety in imported agricultural intermediate inputs. That is, we can promote indirect agricultural exports through food processing. Our policymaking needs to take account of the participation of the agri-food industries in the global food value chain. Japan's food industries, like other manufacturing sectors, have become more and more dependent on imported inputs. Our finding—that freer agri-food trade would promote both agricultural imports and food exports—implies a comparative advantage for the Japanese food industries. The Japanese agricultural sectors would survive by using their linkage with the domestic food industries. The agri-food FTAs would be beneficial not only for the agri-food producers but also for consumers in Japan. As shown by earlier studies, such as Arkolakis et al. (2012), and by our sensitivity analysis (in the Appendix), these estimated impacts of agri-food FTAs are larger when we take into account farm/firm heterogeneity and product differentiation. This implies that earlier agri-food studies assuming homogeneous goods and farms underestimated the potential competitiveness of the Japanese agri-food industries.

Our study assumed a simple FTA scenario, only bilateral tariff reduction by 10% points. More sophisticated scenarios can be developed which consider factors such as initial levels of border protection, the depth of its reduction, and differences in income and economic size between the two parties. The regional aggregation patterns can be changed, to patterns such as the Asia Pacific Economic Cooperation region, the Regional Comprehensive Economic Partnership region, and the TPP member countries, to take account of the recent mega-FTAs. Our model is equipped with elasticity of substitution among varieties σ_i^{MLZ} and Armington's elasticity σ_i^{ARM}, which represent the degree of product differentiation within country and between countries. As Kang (2008) shows for the manufacturing sectors in China, Korea, and Japan, the elasticity of substitution among varieties has evolved over time, reflecting the deepening of the product differentiation and development of global food value chains that accompany industrial development. We can simulate a change in these elasticities to evaluate their impact on the agri-food trade and production.
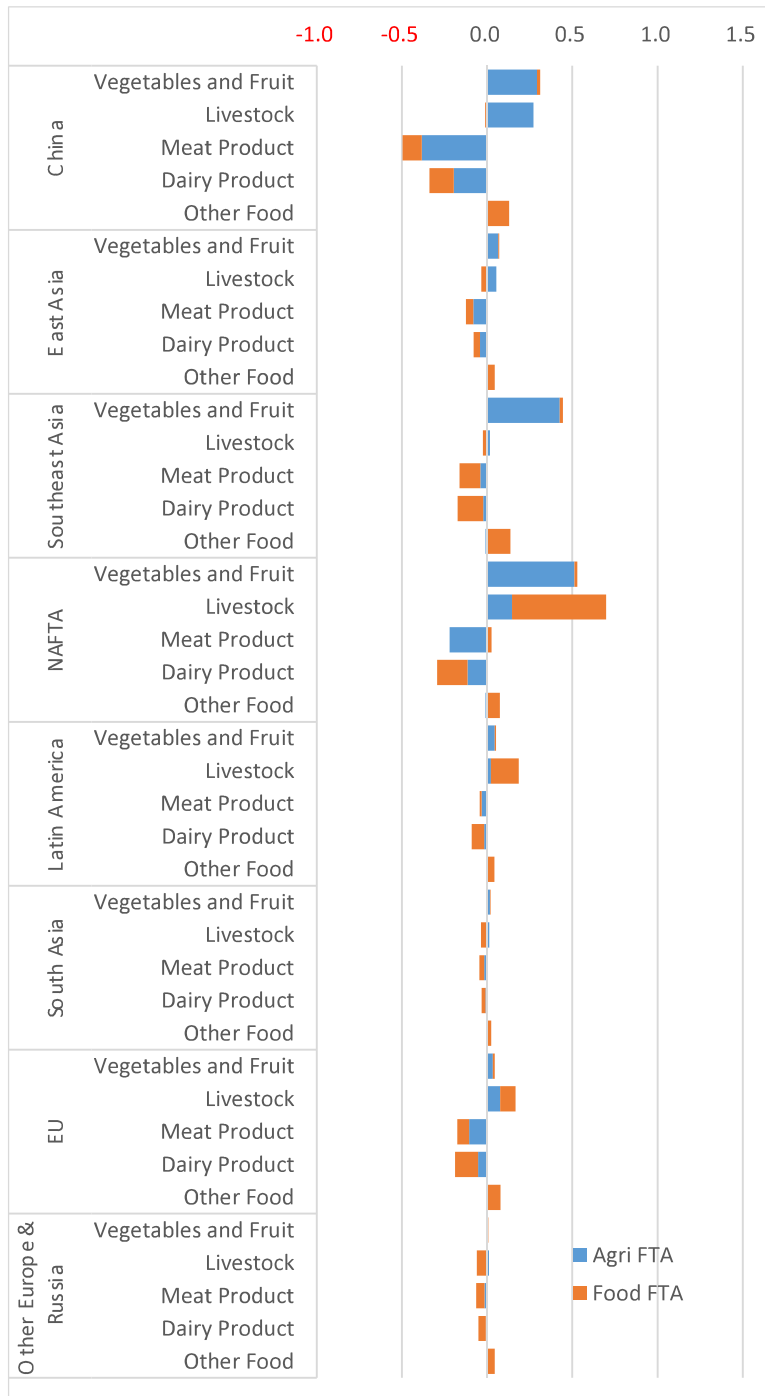
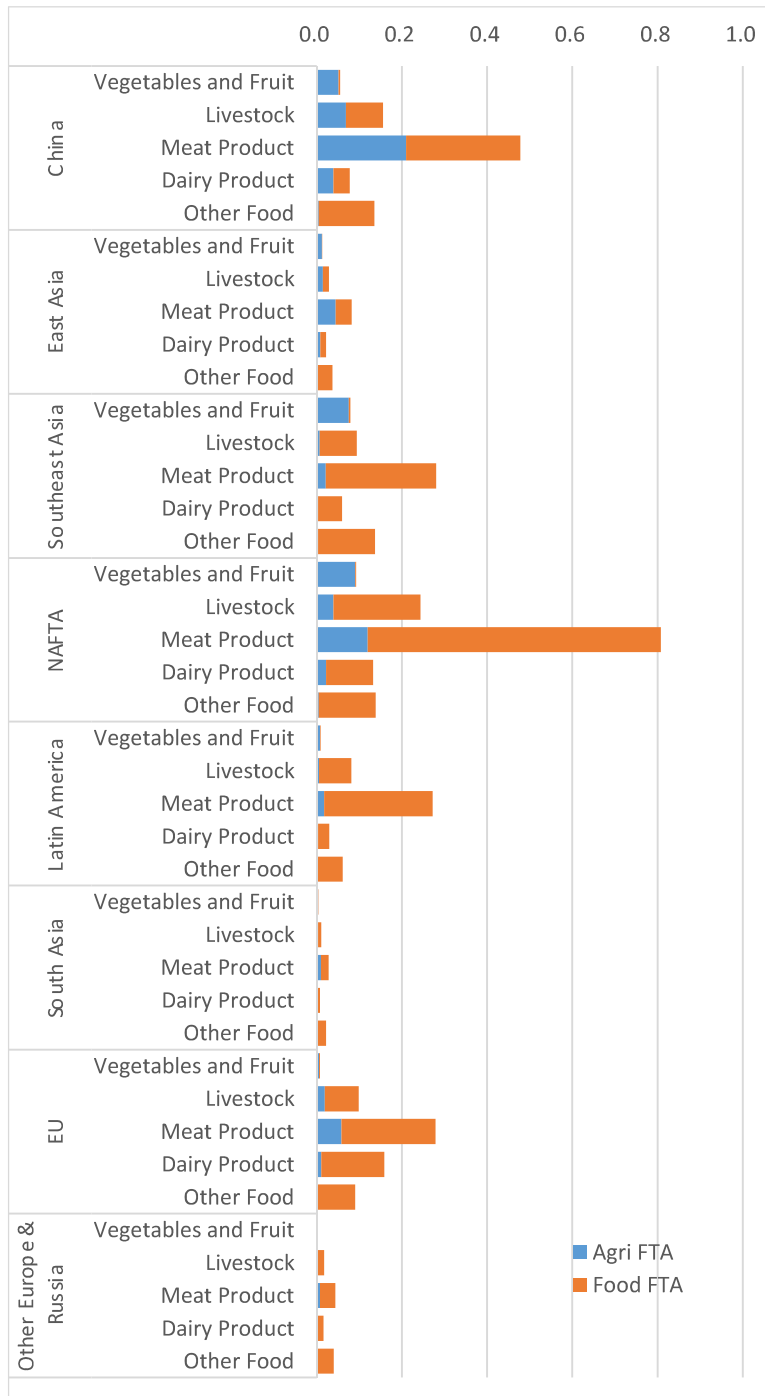Figure 4.1:   Exports from Japan [Changes from the Base, %]
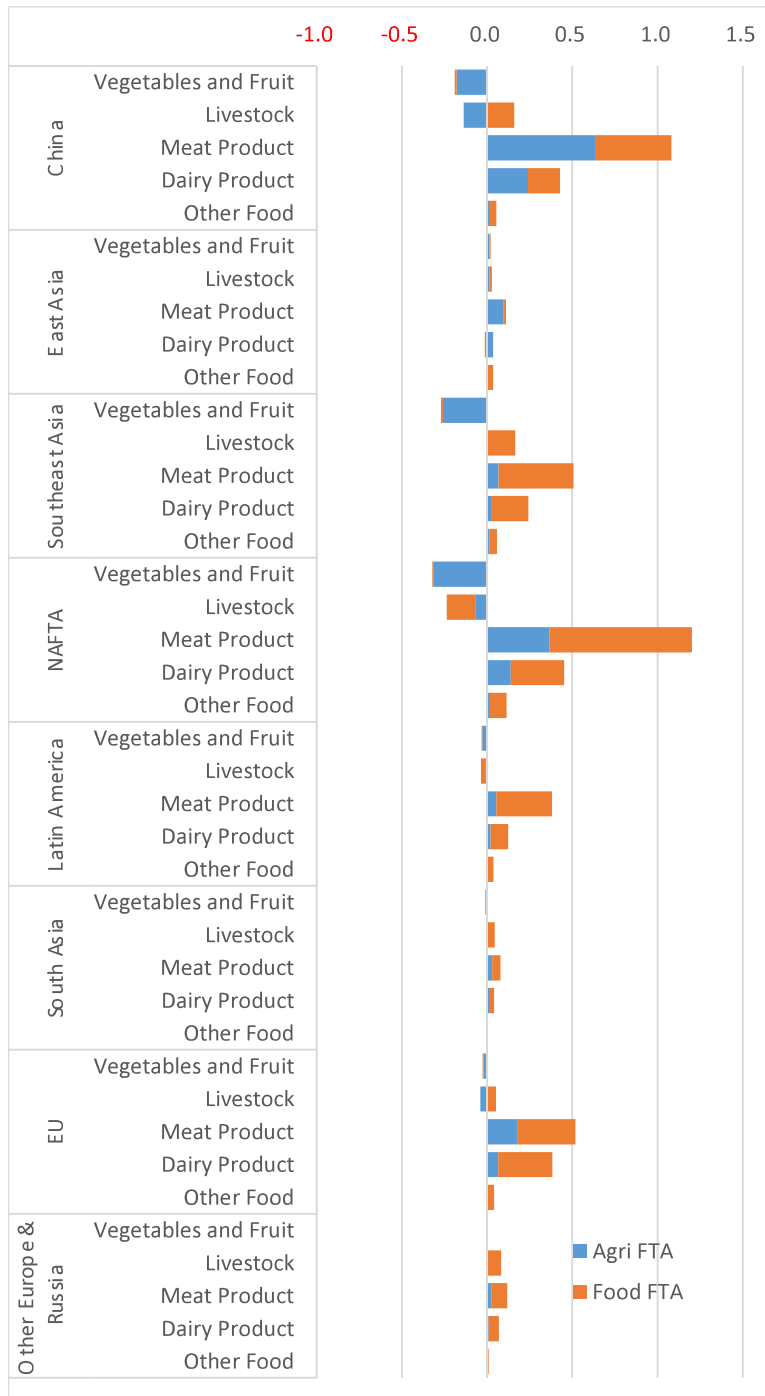
Note: The far left column contains the countries/regions with which it is assumed that Japan will establish FTAs. When we assume agri- and food-FTAs simultaneously, due to interaction effects the results differ slightly from the sum of the results for the two individual FTAs shown in the figure.

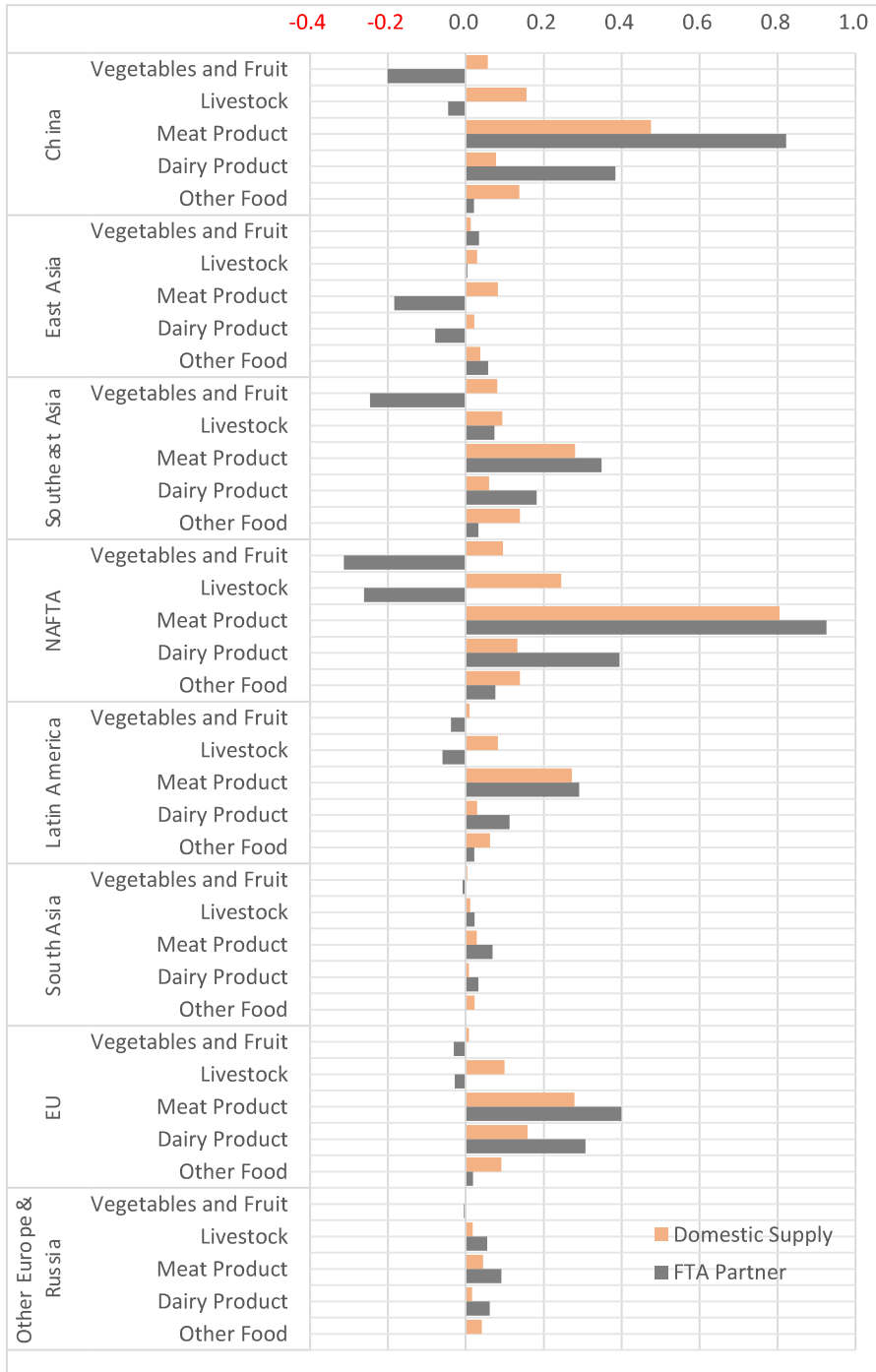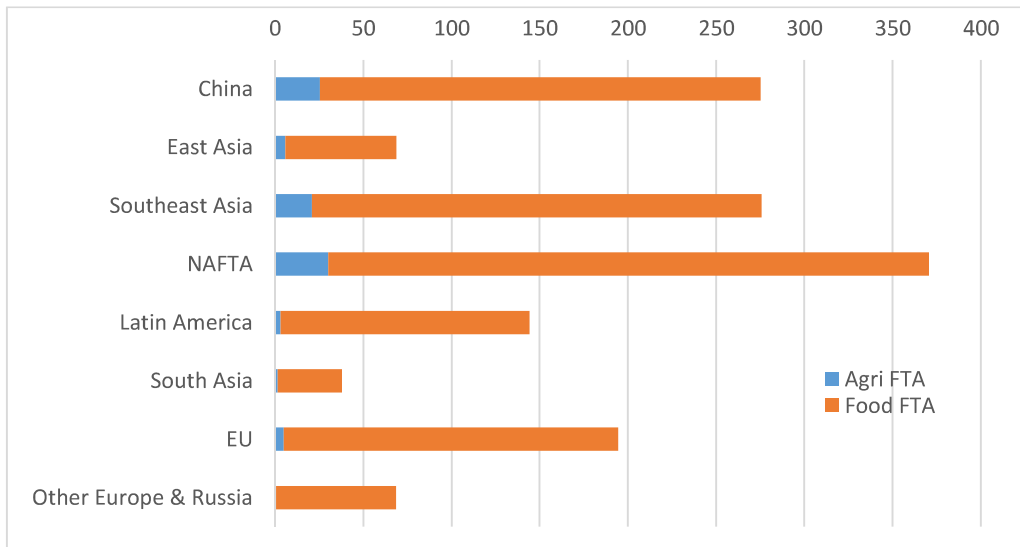Figure 4.2:   Imports by Japan [Changes from the Base, %]

Note: The far left column indicates the countries/regions with which it is assumed that Japan will establish FTAs. When we assume agri- and food-FTAs simultaneously, due to interaction effects the results differ slightly from the sum of the results for the two individual FTAs shown in the figure.

Figure 4.3:	Domestic Production in Japan [Changes from the Base, %]

Note: The far left column indicates the countries/regions with which it is assumed that Japan will establish FTAs. When we assume agri- and food-FTAs simultaneously, due to interaction effects the results differ slightly from the sum of the results for the two individual FTAs shown in the figure.

Figure 4.4:　　　　　　　Number of Firms/Varieties Produced in Japan [Changes from the Base, %]

Note: The far left column indicates the countries/regions with which it is assumed that Japan will establish FTAs. When we assume agri- and food-FTAs simultaneously, due to interaction effects the results differ slightly from the sum of the results for the two individual FTAs shown in the figure.

Figure 4.5: Impacts on Consumer Welfare in Japan [Equivalent Variations, million USD]

Note: The far left column indicates the countries/regions with which it is assumed that Japan will establish FTAs. When we assume agri- and food-FTAs simultaneously, due to interaction effects the results differ slightly from the sum of the results for the two individual FTAs shown in the figure.

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Appendix: Sensitivity Analysis

A.1   Constant-Returns-to-Scale Cases in Agri-food Sectors

We examine the robustness of our simulation results by employing an alternative assumption of constant-returns-to-scale (CRS) production technology for the five agri-food sectors of our interest: vegetables and fruit, livestock, meat products, dairy products, and the other food sectors (Table 2.1). (The other two light and heavy manufacturing sectors are kept as the increasing-returns-to-scale (IRS) sectors.) Under this alternative assumption, we conduct the same simulation experiments and find smaller impacts in many aspects (Figure A.1–A.2). Impacts on exports and imports are found to be the same qualitatively under the agri-FTAs. In contrast, the food-FTAs would bring about qualitatively different results for exports and imports of livestock and meat products, compared with the results shown in the main part of the paper (Figures 4.1–4.2). However, the qualitative difference in the export and import changes would not be translated at all into a qualitative difference in the output changes. Quantitatively, the output changes are found to be about half of those of the results in the main part of the paper (Figure 4.3). The welfare impacts are found to be about a quarter of those found in Figure 4.5. The welfare gains originate solely from the food-FTAs; an agri-FTA would bring about negative welfare changes due to deterioration of terms of trade, though those changes would be very marginal.

Figure A.1:　　　　　　　Japan's Agri-Food Exports, Imports, and Production (Constant-returns-to-scale
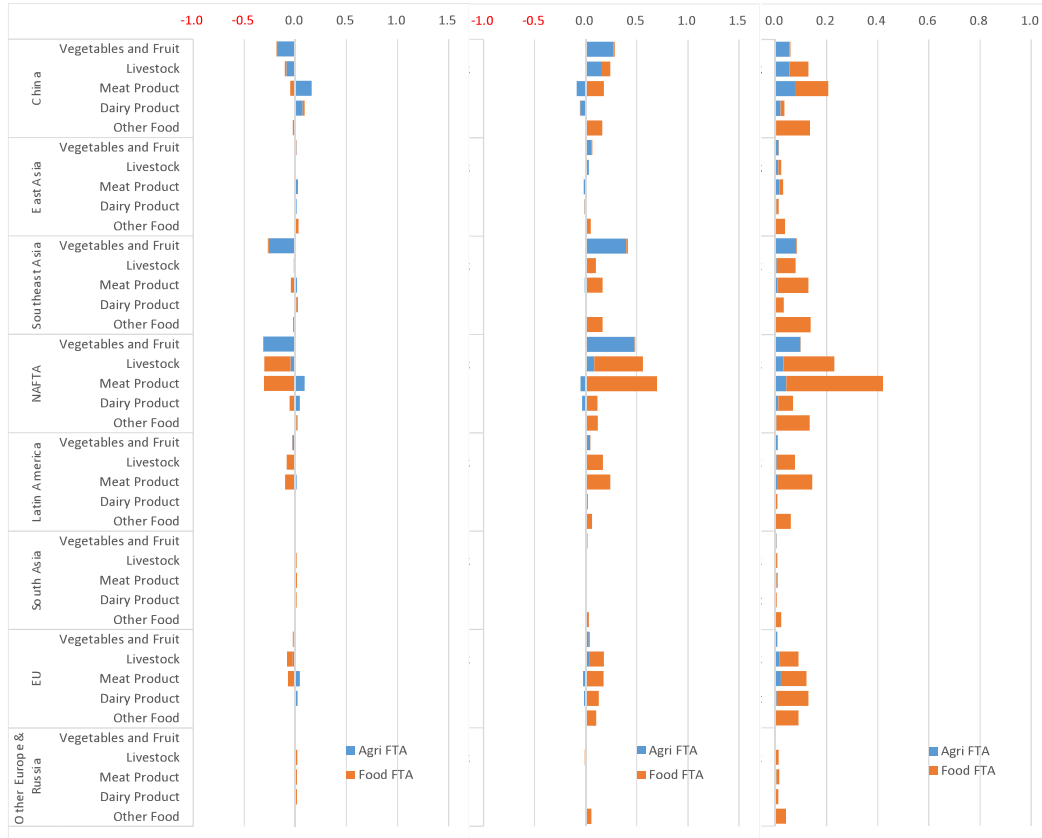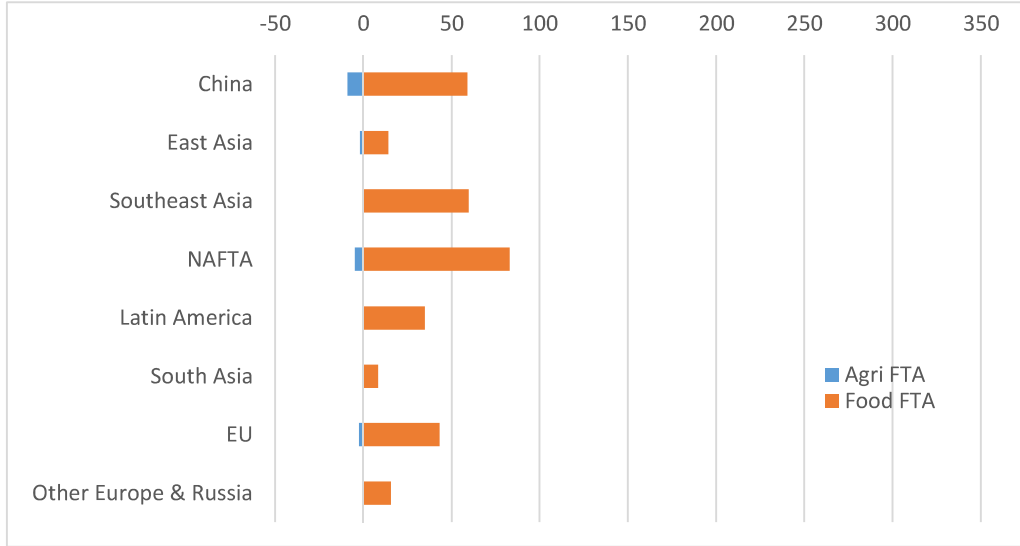
Case) [Changes from the Base, %]

Figure A.2:   Impacts on Consumer Welfare in Japan (Constant-returns-to-scale Case) [Equivalent Variations, million USD]

A.2   Alternative Parameter Values

We conduct sensitivity analyses with respect to the three key elasticity parameters in our Melitz-type CGE model (Table A.1). For the five agri-food sectors, we alternatively assume 20% larger and 20% smaller values for Armington's elasticity of substitution σ_i^{ARM}, 10% smaller and 20% larger ones for the elasticity of substitution among varieties σ_i^{MLZ}, and 20% larger and 20% smaller ones for the shape parameter of the Pareto distribution of the firm's productivity k_i.[13] The results show that changes in exports, imports, and domestic production increase with larger σ_i^{ARM} and k_i, and smaller σ_i^{MLZ} (Figure A.3–A.5). The welfare impacts increase with larger σ_i^{ARM} and smaller σ_i^{MLZ} (Figure A.6). Perturbing k_i upward and downward by 20% alters the welfare impacts little. While some quantitative differences are found, the results are all found to be robust and consistent qualitatively.

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[13] When we assume 20% smaller values for σ_i^{MLZ}, we encounter a computational difficulty, probably due to too large markups, generated by the small elasticity.

Table A.1: Assumed Elasticity Values and Shape Parameters

	Armington's Elasticity, σ_i^{ARMa}	Elasticity of Substitution Among Varieties, σ_i^{MLZ}	Shape Parameter of Pareto Distribution, k_i
Rice	5.05		
Wheat	2.55		
Vegetables and Fruit	1.85	2.73[b]	2.45[b]
Livestock	2.07	2.00[b]	1.81[b]
Other Agriculture	2.54		
Meat Products	4.14	3.79[c]	4.60[d]
Dairy Products	3.65	3.79[c]	4.60[d]
Processed Rice	2.60		
Other Food	1.89	3.79[c]	4.60[d]
Mining	5.31	3.79[c]	4.60[d]
Light Manufacturing	3.43	3.79[c]	4.60[d]
Heavy Manufacturing	3.39		
Transportation	1.90		
Services	1.94		

Sources: a: GTAP Database version 9a; b: averages of estimates by Akune and Hosoe (2019); c: Bernard et al. (2003); d: Balistreri and Rutherford (2013).

FigureA.3:　　　　　　Exports from Japan [Changes from the Base, %]

(From the left, cases with $\sigma_i^{\mathrm{ARM}}(-20\%)$, $\sigma_i^{\mathrm{ARM}}(+20\%)$, $\sigma_i^{\mathrm{MLZ}}(-10\%)$, $\sigma_i^{\mathrm{MLZ}}(+20\%)$, $k_i(-20\%)$, and $k_i(+20\%)$)
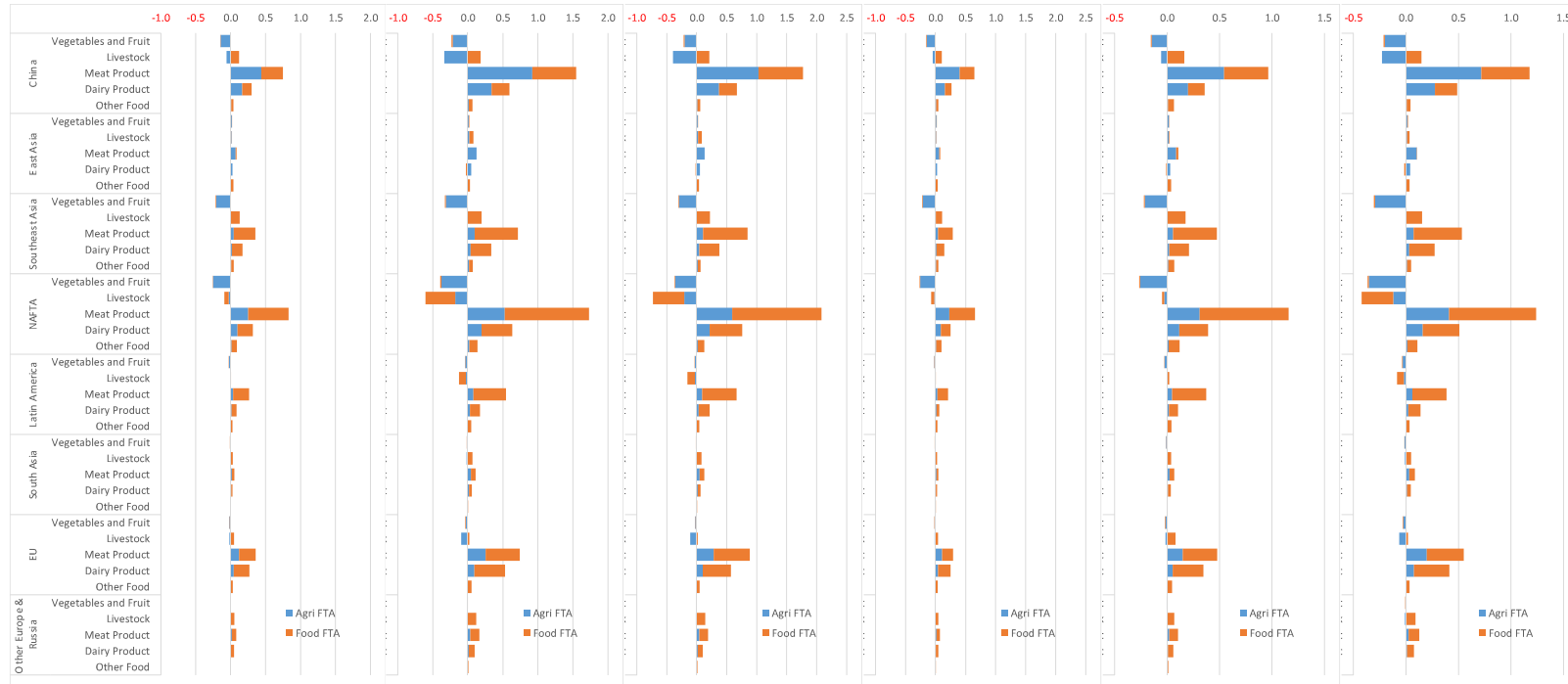
Figure A.4:   Imports by Japan [Changes from the Base, %]

(From the left, cases with $\sigma_i^{ARM}(-20\%)$, $\sigma_i^{ARM}(+20\%)$, $\sigma_i^{MLZ}(-10\%)$, $\sigma_i^{MLZ}(+20\%)$, $k_i(-20\%)$, and $k_i(+20\%)$)
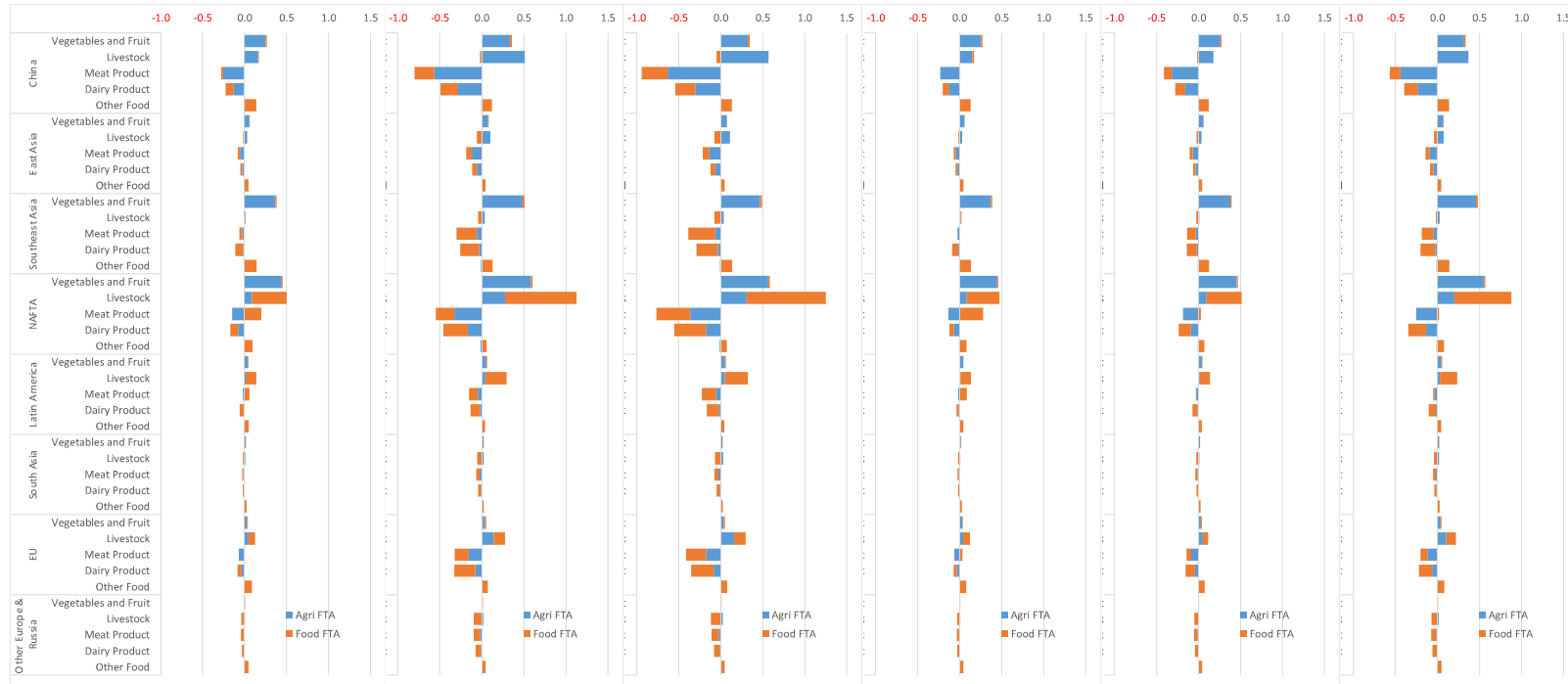
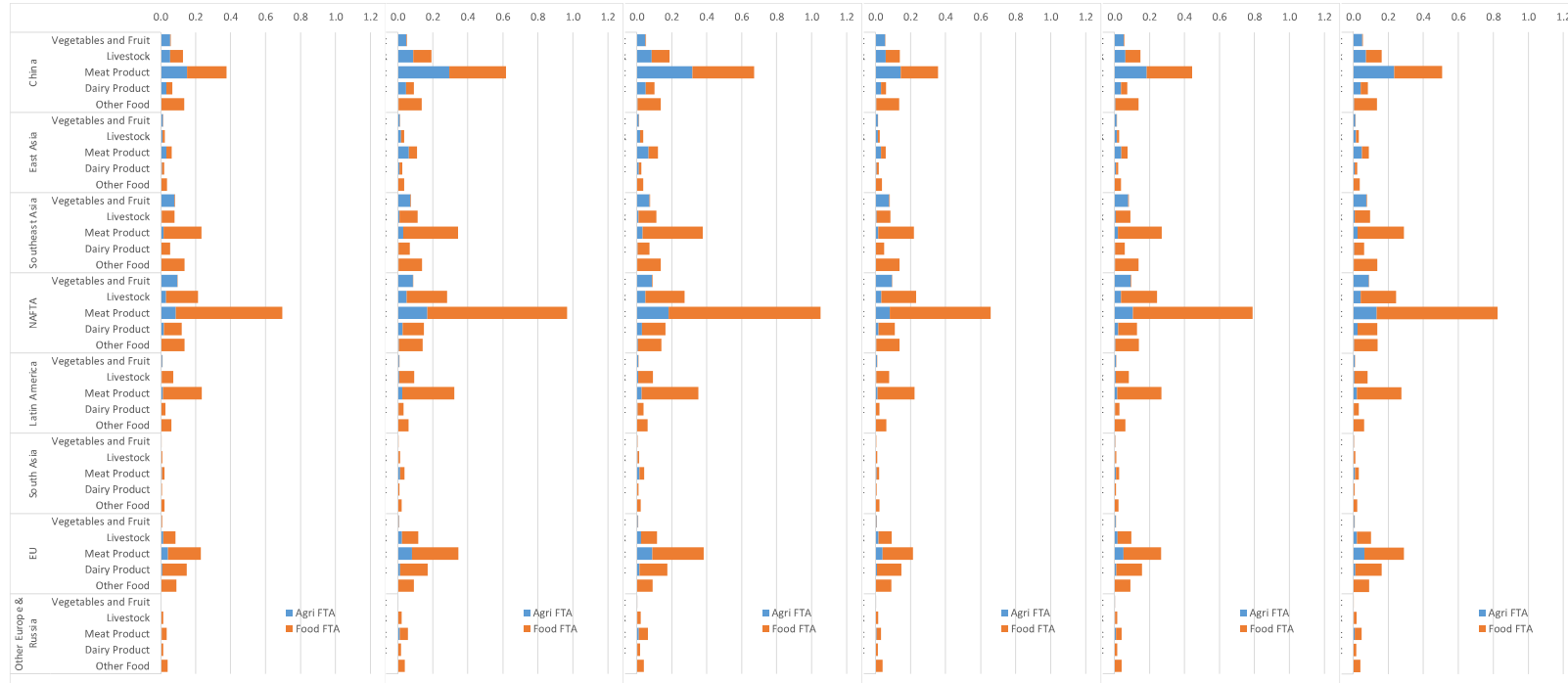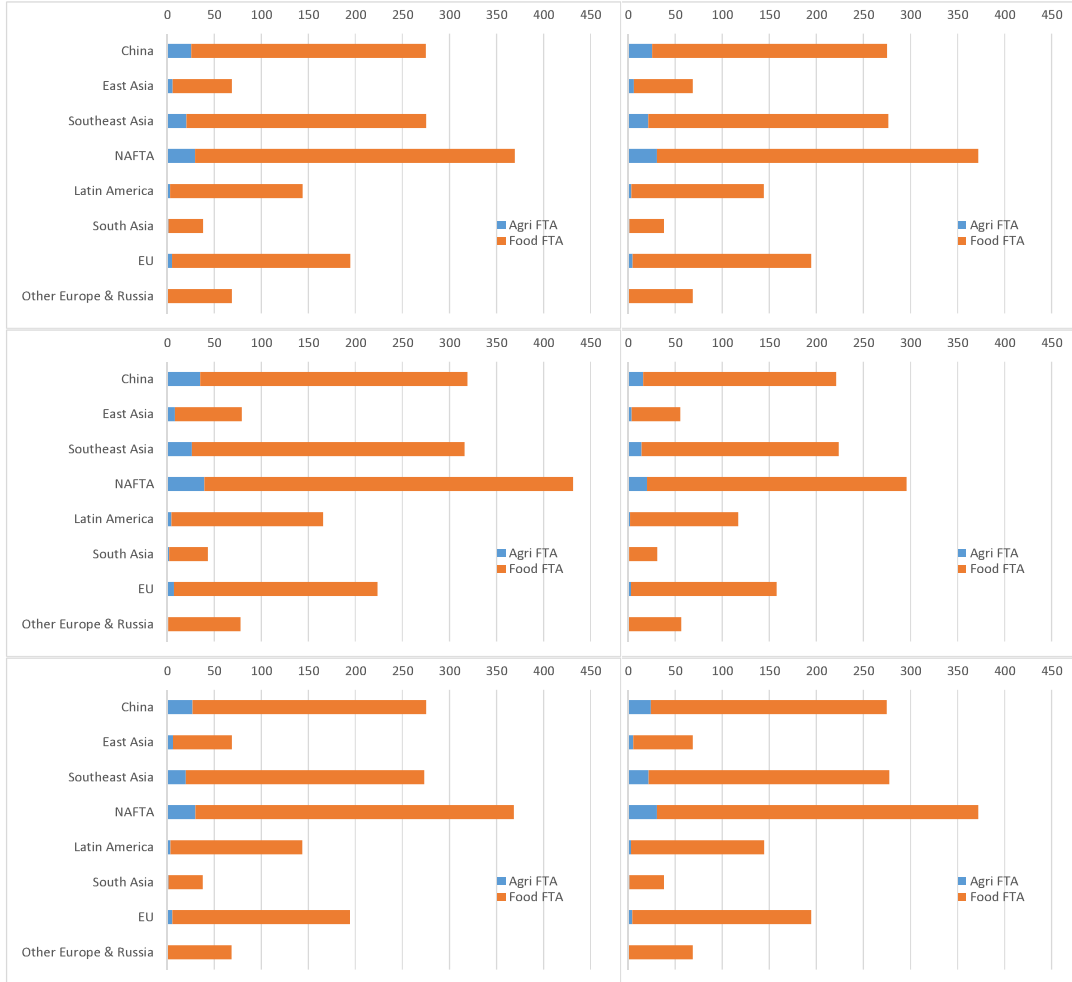Figure A.5: Domestic Production in Japan [Changes from the Base, %]

(From the left, cases with $\sigma_i^{\text{ARM}}(-20\%)$, $\sigma_i^{\text{ARM}}(+20\%)$, $\sigma_i^{\text{MLZ}}(-10\%)$, $\sigma_i^{\text{MLZ}}(+20\%)$, $k_i(-20\%)$, and $k_i(+20\%)$))

Figure A.6: Impacts on Consumer Welfare in Japan [Equivalent Variations, million USD]

(From the top-left, cases with $\sigma_i^{\mathrm{ARM}}(-20\%)$, $\sigma_i^{\mathrm{ARM}}(+20\%)$, $\sigma_i^{\mathrm{MLZ}}(-10\%)$, $\sigma_i^{\mathrm{MLZ}}(+20\%)$, $k_i(-20\%)$, and $k_i(+20\%)$)

Annex: Additional Figures

While we show the impact of FTAs in percentage changes from the base in Figures 4.1–4.3, the figures below show the impact in changes in value (million USD in 2011).

Figure B.1:   Japan's Exports, Imports, and Domestic Production in Value [Changes from the Base, million USD]