Topics

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A Trade and Welfare Analysis of Tariff Changes Within the TPP

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Abstract: This paper examines the effects of the Trans-Pacific Partnership (TPP) tariff reductions on trade flows and welfare of the TPP members and nonmembers following the Caliendo and Parro (2015) method. We use comprehensive sectoral data on 39 countries and the rest of the world, including those in the Association of Southeast Asian Nations (ASEAN) and the Organization for Economic Co-operation and Development (OECD). Our results show that many TPP nonmembers along with the TPP members gain from the TPP tariff reductions, suggesting the existence of a positive externality, with the welfare gains mainly arising from the changes in the terms of trade. Our analysis also shows that the TPP members increase their imports from other TPP members and decrease from non-TPP members, but the trade creation effects exceed the trade diversion effects. Our calibration results under various assumptions of the model emphasize the role of multiple sectors and sectoral linkages in the welfare analysis of the TPP tariff reductions.

Keywords: preferential trade agreements, Trans-Pacific Partnership, welfare

JEL Classification Numbers: F10, F13, F14, F15

1 Introduction

The Trans-Pacific Partnership (TPP), which began with four members, aims to further liberalize the economies of the Asia-Pacific region, and the ongoing negotiations include a wide range of agreements involving a larger number of countries. These negotiations have attracted both support and criticism from various public groups, even though the actual welfare consequences remain

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unclear and uncertain.¹ Nevertheless, it is indisputable that the economic size of the TPP makes it one of the largest pending trade agreements, especially now that the United States and Japan are engaged; therefore, a rigorous microfounded analysis of its potential impact on national welfare and trade is required. For this purpose, we use a general equilibrium framework with multiple sectors and evaluate the welfare and trade effects of the tariff reductions on both TPP members and nonmembers in the situation where the TPP members eliminate tariffs between them.

One of the most common methods used by policy makers and economists to assess a trade policy *ex ante* is computational general equilibrium (CGE) model, which typically adopts the Armington (1969) model (e.g., Brown, Deardorff, and Stern 1992; Kehoe and Kehoe 1994) even though this method has been criticized because of its poor fit with actual data and the complexity and difficulty in interpreting the results (see Wylie 1995; Clausing 2001; Kehoe 2002). Using this approach, Petri, Plummer, and Zhai (2011) suggest that the TPP's welfare gains would equal 0.1% for the member countries. Other opinion (see Krugman 2015) argues that this is still too large. In this paper, we adopt a frontier method in the literature proposed by Caliendo and Parro (2015) and find that the TPP's welfare effects can be more substantial (at least for some member countries) when we incorporate sectoral linkages in the multisector model with intermediate goods.

Caliendo and Parro (2015) constructed a model with multiple tradable sectors using the model of Eaton and Kortum (2002), thereby incorporating geographic barriers into a Ricardian model with a continuum of goods in many countries. In the model of Eaton and Kortum (2002), bilateral trade relates to distance, the gross domestic product (GDP) of the importing and exporting countries, and the comparative and absolute advantages of the countries, yielding an equation similar to the gravity model, which is one of the most successful empirical trade models. Caliendo and Parro (2015) add sectoral linkages to the model and quantify the welfare effects of the North American Free Trade Agreement (NAFTA) for the member countries. They show that the magnitudes of the welfare effects increase significantly when considering multisectors and sectoral linkages.

¹ For instance, in Japan, the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Economy, Trade and Industry, and the Cabinet Office separately estimated the effects of the TPP on Japan's GDP in 2010. The Ministry of Agriculture, Forestry and Fisheries claimed that the agriculture sector would experience a decrease equivalent to 1.6% of GDP with its implementation. In contrast, the Ministry of Economy, Trade and Industry argued that if Japan, unlike some competing countries such as Korea and the EU, did not join the TPP, then the negative economic impact would be in the order of 1.53% of GDP. Similarly, the Cabinet Office estimated a positive effect of the TPP on Japanese GDP of between 0.48% and 0.65%. For details, see Cabinet-Secretariat (2013).

One of the advantages of the Caliendo and Parro (2015) method is that it allows us to decompose the aggregate welfare effects into the terms of trade and volume of trade effects and further evaluate the sectoral contribution of each term to the aggregate welfare effects. Thus, it helps us to infer how sectoral tariff rates, trade elasticity, the share of intermediate goods, and sectoral linkages play a role in the welfare consequences of a trade policy.

To conduct our analysis, we use comprehensive disaggregated sectoral data on 39 countries and the rest of the world, including Organization for Economic Co-operation and Development (OECD) and Association of Southeast Asian Nations (ASEAN) countries, for 2005. After estimating trade elasticities (the dispersion of productivity) of 20 tradable sectors, we calibrate the model to obtain the welfare effects of the TPP tariff reductions, which are decomposed into the terms of trade and volume of trade effects. We also analyze the sectoral contribution of each welfare term and sectoral changes of import and export shares of both the TPP members and nonmembers after the TPP tariff reductions.

Our calibration results yield the following. First, we find all TPP members benefit from the TPP tariff reductions in our benchmark analysis. In terms of the welfare gains for the TPP members, the terms of trade effects are larger than the volume of trade effects. Second, many non-TPP members also gain, suggesting a positive externality arising from the TPP tariff reductions. Most of these gains are also from the terms of trade effects. Third, sectors with larger shares of intermediate goods in production and greater sectoral linkages tend to make a larger contribution to the overall welfare effects. Lastly, the TPP members increase their imports from other TPP members and decrease from non-TPP members, but the trade creation effects among the TPP members exceed the trade diversion effects between the TPP members and non-TPP members.

In our benchmark analysis of the TPP tariff reductions, Ireland benefits the most among non-TPP members (3.93%) and Malaysia is the largest beneficiary among TPP members (8.47%). However, welfare gains of Malaysia whose exports are relatively diversified across sectors decrease substantially under the assumptions of a single sector, no intermediate goods, and no sectoral linkages. On the other hand, we find that the effect of changes under the assumption of no intermediate goods or no sectoral linkages is smaller on the welfare effect of Ireland whose exports are concentrated in a single sector. It indicates that multiple sectors, intermediate goods, and sectoral linkages play an important role in the evaluation of the welfare effects of the TPP tariff reductions.

As a variation of the TPP tariff reduction scenarios, we also examine how imports and domestic expenditures change if politically sensitive sectors, such as the Japanese agricultural and the US automobile sectors, are exempted from the tariff reductions. We further provide an analysis of the trade effects when the

European Union (EU) and China form a preferential trade agreement (PTA) to counterbalance the trade diversion effects of the TPP tariff reductions.

The remainder of the paper is structured as follows. Section 2 discusses the TPP. Section 3 summarizes the model. Section 4 provides a description of the data and our calibration results and Section 5 concludes.

2 Discussion on the TPP

The TPP was previously the Pacific Three Closer Economic Partnership, with New Zealand, Chile, Singapore, and Brunei, known as the P4 trade bloc, being the initial members in 2005. After the P4 entered into force in 2006, the United States began talks with the P4 members to join the TPP in 2008. Later in the same year, Australia, Vietnam, and Peru joined the P4 trade bloc. After being observers for several years, Malaysia, Canada, and Mexico also formally joined the TPP negotiations. Finally, in 2013, Japan also decided to officially join the negotiations after a long domestic debate. The TPP is now seen as one of the most important and significant pathways toward trade liberalization in the Asia–Pacific region. It currently has 12 member countries (Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, Vietnam, and the United States) with perhaps more countries to join in the near future. The TPP represents approximately 30% of world GDP (\$77,296 billion, relative to world GDP of \$23,429 billion) and the total exports of TPP members roughly account for 22% of the total world exports (\$4,336 billion, relative to world exports of \$19,935 billion) in 2014.

Tables 2 and 3 present the TPP members' import and export shares by sector from other TPP members out of their total imports and exports from the world. All TPP members import at least about 20% or a higher portion of medical sector from other TPP members. Chemicals, machinery, and medical sectors also take large shares of imports among the TPP members. TPP members' imports of textile, petroleum, and minerals sectors from other TPP members are relatively small. This is because the major textile and petroleum exporting countries are not TPP members. Canada and Mexico's import and export share from the other TPP members are relatively large as all NAFTA members are engaged in the TPP. As for Mexico, most of the sectors (all sectors) are imported (exported) more than 30% from (to) the other TPP members. Chile and Japan's trade share with the TPP members are relatively small for many sectors. In particular, they import less than 10% of textile and mineral sectors from other TPP members.

The TPP negotiations have been ongoing for nearly 5 years with the first round held in Melbourne in 2010. These negotiations cover a variety of issues,

including not only those related to the trade in goods and services but also environmental and labor standards, financial services, intellectual property rights, and investment. Overall, the member countries are seeking new markets by aiming to expand trade and investment between the member countries.

Even though these TPP negotiations deal with nontariff-related issues, the elimination of tariffs between members is still the key feature of the TPP negotiations. The General Agreement on Tariffs and Trade (GATT) allows World Trade Organization (WTO) members to establish a PTA as an exception to the most-favored-nation (MFN) treatment as long as they eliminate tariffs on substantially all products between them.² Following this provision, forming a PTA implies an (instantaneous) elimination of tariffs on substantially all products. However, in practice, PTAs usually retain a few exceptions to allow a certain level of tariffs for a long period. These industries are typically import competing and tend to be politically sensitive.

Like other PTA formation processes, such domestic political tension has been one of the key challenges for the TPP negotiations. For example, after Japan announced its intention to join the negotiations, it was opposed by the three Detroit-based US car manufacturers (Ford, General Motors, and Chrysler) on the basis that imports only accounted for 6.5% of total car sales in Japan (see Cooper and Manyin 2013). Conversely, the Japan Agricultural Cooperatives have produced a number of publications and statements claiming that participation in the TPP would destroy Japanese agriculture and threaten food security in Japan.³ Accordingly, some media have reported that Japan will allow the United States to continue to impose tariffs on Japanese vehicles for now as a means of helping to protect various Japanese agricultural products.⁴

As the provisions of the TPP are undergoing change and the negotiations remain confidential, it is difficult to predict what the TPP tariff reduction schedule will exactly look like. However, one possible case would be that all TPP members eliminate tariffs with each other across all sectors. Another scenario could be that some countries, especially economically stronger TPP members, retain tariffs in certain politically sensitive sectors, for example agriculture in Japan and automobiles in the United States. This is because negotiation outcomes of the TPP

² GATT article XXIV states “a free-trade area shall be understood to mean a group of two or more customs territories in which the duties and other restrictive regulations of commerce are eliminated on *substantially all the trade* between the constituent territories in products originating in such territories.”

³ For example, see http://www.zenchu-ja.or.jp/pdf/tpp/130313_02.pdf. Viewed: May 22, 2015.

⁴ For example, see <http://ajw.asahi.com/article/business/AJ201303050069>. Accessed: March 30, 2015.

tariff reductions are probably to be affected by the relative bargaining power of the trading partners, and being politically and economically weaker partners could be pressured to accept unfavorable provisions. Perroni and Whalley (2000) compare concessions made by trading partners in various recent PTAs and show that notably more concessions are made by smaller partners.

For our analysis, we first consider the scenario where the TPP eliminates all tariffs on all products traded between the TPP members. Then, we investigate further the scenario where politically sensitive sectors in the major TPP member countries, namely, the United States and Japan, are waived from the TPP tariff reduction and see how it affects the domestic and import share in the corresponding sectors. In addition, we consider the case of the parallel development with the TPP of another PTA by the two biggest economies not engaged in the current TPP negotiations, namely, the EU and China, and study how this additional PTA would affect trade flows among the TPP members and between the TPP members and non-members.

3 The Model

We briefly explain the theoretical framework we employ in the analysis as based on Caliendo and Parro (2015).

There are N countries and J sectors. The sectors are of two types, either tradable or nontradable. All markets are perfectly competitive, and labor is mobile across sectors but not countries.

In each country, there is a measure of L_n representative households that maximize utility by consuming final goods C_n^j . The preferences of the households are given by

$$\log u(C_n) = \sum_{j=1}^J \alpha_n^j \log(C_n^j), \quad [1]$$

where $\sum_{j=1}^J \alpha_n^j = 1$.

A continuum of intermediate goods $\omega^j \in [0, 1]$ is produced in each sector j . The efficiency of producing intermediate good ω^j in country n is denoted by $z_n^j(\omega^j)$. The production technology of a good ω^j is given by

$$q_n^j(\omega^j) = z_n^j(\omega^j) [l_n^j(\omega^j)]^{y_n^j} \prod_{k=1}^J [m_n^{k,j}(\omega^j)]^{y_n^{k,j}}, \quad [2]$$

where $l_n^j(\omega^j)$ is labor and $m_n^{k,j}(\omega^j)$ are the composite intermediate goods from sector k used for the production of ω^j . The parameter $y_n^{k,j}$ is the share of

materials from sector k used in the production ω^j and the parameter $y_n^j \geq 0$ is the share of value added, with $\sum_{k=1}^J y_n^{k,j} = 1 - y_n^j$.

Let c_n^j denote the cost of an input bundle and then

$$c_n^j = \Upsilon_n^j w_n^{y_n^j} \prod_{k=1}^J P_n^{k y_n^{k,j}}, \quad [3]$$

where P_n^k is the price of a composite intermediate good from sector k , and Υ_n^j is a constant.

Let $\sigma^j > 0$ denote the elasticity of substitution across intermediate goods within sector j and $r_n^j(\omega^j)$ denote the demand of intermediate goods ω^j from the lowest cost supplier. Then, the demand for good ω^j is given by

$$r_n^j(\omega^j) = \left(\frac{p_n^j(\omega^j)}{P_n^j} \right)^{-\sigma^j} Q_n^j, \quad [4]$$

where P_n^j is the unit price of the composite intermediate goods with $P_n^j = \left[\int p_n^j(\omega^j)^{1-\sigma^j} d\omega^j \right]^{\frac{1}{1-\sigma^j}}$ for $p_n^j(\omega^j)$ denoting the lowest price of intermediate good ω^j among all countries n .

Under the iceberg assumption of trade costs, one unit of a tradable intermediate good in sector j from country i to country n requires producing $d_{ni}^j \geq 1$ units in country i , with $d_{nn}^j = 1$. An ad valorem flat-rate tariff that country n imposes on goods j from country i is denoted by τ_{ni}^j . We combine these two costs into the following:

$$\kappa_{ni}^j = (1 + \tau_{ni}^j) \cdot d_{ni}^j. \quad [5]$$

The efficiency of producing a good ω^j in country n is assumed to follow a Fréchet distribution with a location parameter that varies by country and sector, denoted by $\lambda_n^j \geq 0$, and a shape parameter that varies by sector, θ^j . We assume that the distributions of the productivities are independent across goods, sectors, and countries, and that $1 + \theta^j > \sigma^j$.

The price of the composite intermediate good for all sectors j and countries n is then given by

$$P_n^j = A^j \left[\sum_{i=1}^N \lambda_i^j (c_i^j \kappa_{ni}^j)^{-\theta^j} \right]^{-\frac{1}{\theta^j}}, \quad [6]$$

where A^j is a constant.

Total expenditure on sector j goods in country n is given by $X_n^j = P_n^j Q_n^j$. Denoted by X_{ni}^j , the expenditure in country n of sector j goods from country i ,

country n 's share of expenditure on goods in country n of sector j goods from country i is given by $\pi_{ni}^j = \frac{X_{ni}^j}{X_n^j}$. Using the properties of the Fréchet distribution, π_{ni}^j can be derived as

$$\pi_{ni}^j = \frac{\lambda_i^j \left[c_i^j \kappa_{ni}^j \right]^{-\theta^j}}{\sum_{h=1}^N \lambda_h^j \left[c_h^j \kappa_{nh}^j \right]^{-\theta^j}}. \quad [7]$$

Let $R_n = \sum_{j=1}^J \sum_{i=1}^N \tau_{ni}^j M_{ni}^j$ and $M_{ni}^j = \frac{\pi_{ni}^j}{1 + \tau_{ni}^j} X_n^j$ denote country n 's imports of sector j goods from country i . Further, let D_n denote the trade deficit in country n and then $\sum_{n=1}^N D_n = 0$ holds. The total expenditure on goods j is the sum of the expenditure on composite intermediate goods by firms and households. Then,

$$X_n^j = \sum_{k=1}^J y_n^{j,k} \sum_{i=1}^N X_i^k \frac{\pi_{in}^k}{1 + \tau_{in}^k} + \alpha_n^j I_n, \quad [8]$$

where households' income I_n is given by $I_n = w_n L_n + R_n + D_n$.

Finally, given the definition of expenditure and the trade deficit, we obtain

$$\sum_{j=1}^J \sum_{i=1}^N X_n^j \frac{\pi_{ni}^j}{1 + \tau_{ni}^j} - D_n = \sum_{j=1}^J \sum_{i=1}^N X_i^j \frac{\pi_{in}^j}{1 + \tau_{in}^j}. \quad [9]$$

Then, we can define the equilibrium under policies $\tau = \{\tau_{ni}^j\}$ in our economy as follows.

Definition 1 Given L_n, D_n, λ_n^j , and d_{ni}^j , an equilibrium under tariff structure τ is a wage vector x and prices $\{P_n^j\}_{j=1, n=1}^{J, N}$ such that conditions [6], [7], [8], and [9] are satisfied for all j and n .

In this economy, the welfare of the representative consumer in country n is given by $W_n = \frac{I_n}{P_n}$. Further, by differentiating W_n , we finally obtain

$$d \ln W_n = \frac{1}{I_n} \sum_{j=1}^J \sum_{i=1}^N \left[\left(E_{ni}^j d \ln c_n^j - M_{ni}^j d \ln c_i^j \right) + \tau_{ni}^j M_{ni}^j \left(d \ln M_{ni}^j - d \ln c_i^j \right) \right]. \quad [10]$$

As defined in Caliendo and Parro (2015), the first term $\left(E_{ni}^j d \ln c_n^j - M_{ni}^j d \ln c_i^j \right)$ represents the *terms of trade effects* and the second term $\tau_{ni}^j M_{ni}^j \left(d \ln M_{ni}^j - d \ln c_i^j \right)$ is the *volume of trade effects*.

4 Calibration

4.1 Data Description

We collect data on value added, gross output, and the input–output tables for 20 tradable and 17 service sectors and trade volume and tariffs for 20 tradable sectors. Our sample includes 39 countries and the rest of world, and all data are for 2005. The list of countries included in our database is Argentina, Australia, Austria, Brazil, Canada, Chile, China, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Slovenia, South Africa, Spain, Sweden, Turkey, United Kingdom, United States, and Vietnam.

We obtain data on gross output and value added at the sector level from three different sources. First, we collect data from the OECD STAN database for industrial analysis that contains gross output and value-added data for OECD countries at the sector level based on ISIC Rev. 3 at current prices and in the national currency. These countries include Australia (value added only), Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Slovenia, Spain, Sweden, United Kingdom, and United States. We then convert these values into US dollars using the OECD STAN exchange rates (except for Argentina, Philippines, and Vietnam for which we use the World Input-Output Database (WIOD) exchange rates). Second, if the selected countries and sectors where data from the above databases are unavailable, we construct sector value added and gross output using information from the input–output database following Caliendo and Parro (2015). These countries include Argentina, Australia (gross output), Brazil, Chile, China, India, Indonesia, South Africa, Turkey, and Vietnam. Finally, value-added and gross output data for the remaining countries or sectors not available from the input–output tables are from the Industrial Statistics Database INDSTAT4 data at current prices in US dollars, which are the data at the sector level based on ISIC Rev. 3 at the four-digit level, aggregated to the ISIC Rev. 3 two-digit level. We also follow Caliendo and Parro (2015) to construct the rest of the world data. The data on world value added for 137 countries over seven ISIC industries are from the United Nations (UN) database.

The OECD database provides data on the input–output tables for the mid-1990s, early 2000s, and mid-2000s and includes information on 37 ISIC Rev. 3 industries. We obtain most of the data for the input–output table from this source except for the Philippines (for which we use the input–output table

developed by the National Statistics Office (NSO), covering 240 sectors) (also aggregated over 37 ISIC Rev. 3 sectors). For some countries, including Vietnam, New Zealand, and Argentina, and sectors, which do not have data available for 2005 or the mid-2000s, we use data from the early 2000s. We extrapolate missing data for some countries and sectors using the median coefficient across our sample of countries. We also use the median coefficients to construct the input–output table for the rest of the world.

Trade data are constructed using HS six-digit import data from UN Comtrade and converted into 20 sectors using the correspondence table between HS six and ISIC Rev. 3.

The tariff data are from the Trade Analysis and Information system (TRAINS) in the United Nations Conference on Trade and Development (UNCTAD). First, we download each country's HS six-digit simple average applied MFN tariffs from the World Integrated Trade Solution (WITS). We collect preferential tariffs separately for the applicable pairs for each year also at the HS six-digit level. If an importing country simultaneously imposes preferential tariffs on certain products only applicable to multiple exporting countries, the data are only at the group level. To identify which countries belong to a specific group, we use the Preference Beneficiaries data from TRAINS. The data from Caliendo and Parro (2015) are used for the rest of the world bilateral tariffs for 2005. We convert HS six-digit data into 20 sectors using the correspondence table between HS 6 and ISIC Rev. 3.

Table 1 presents the tariff schedules for the 20 tradable sectors of our sample countries in 2005. The left panel reports the tariff schedules of all sample countries excluding the rest of the world while the right panel reports the tariff schedules of the TPP member countries. The first column in each panel shows each sector's tariff rates charged on average. We compute average tariff rates in two steps. First, for each sector, we average a country's import bilateral tariffs against another country over all partner (or exporting) countries. Next, we then average the tariff rates obtained from the first step over all importing countries. As shown, the average tariff rates range from 1.1% to 9.9%. The average tariff rates for 16 sectors are less than 5% across all the sample countries and range from 1.4% to 9.2%, while the average tariff rates for 12 sectors are less than 5% for TPP member countries. The second column in each panel provides the median tariffs. We compute the median tariffs using the average bilateral tariff for each country in each sector. As shown, in both panels, the median tariffs are lower than the average tariffs. The median tariff rates for all sample countries in 15 sectors are less than 1%. The median tariffs for the TPP member countries are slightly higher and in nine sectors are higher than 3%. The third and last columns in the right panel display the highest tariff rates among the TPP members and the countries that impose these high tariffs, respectively. For

Table 1: Summary of tariff data (unit %).

Sample	The whole set		The TPP members			
Sectors	Average	Median	Average	Median	Max.	Country
Agriculture	5.9	2.1	4	2.3	15	Vietnam
Mining	1.1	0.071	1.5	0.36	4.8	Mexico
Food	9.9	5.6	9.2	5.3	26	Vietnam
Textile	6.3	3	9.2	6.3	24	Vietnam
Wood	3.3	0.99	5	2.7	13	Malaysia
Paper	2.5	0.075	4.1	3.2	15	Vietnam
Petroleum	1.5	0.22	1.6	0.49	4.8	Chile
Chemicals	2.2	0.9	2.2	1.6	5.1	Mexico
Plastic	4.3	1	6.4	4.7	17	Malaysia
Minerals	3.5	0.79	5.7	2.8	18	Vietnam
Basic metals	2.3	0.5	3	1.7	9.8	Malaysia
Metal products	3.8	0.56	5.4	4.6	14	Vietnam
Machinery n.e.c.	2.4	0.39	2.9	3.2	5.4	Vietnam
Office	1.3	0.13	1.4	0.088	4.7	Chile
Electrical	3.1	0.45	4	4.1	10	Vietnam
Com	2.7	0.67	3.3	2.5	12	Vietnam
Medical	2.4	0.45	2.6	1.1	8	Vietnam
Auto	6.4	1.6	8.8	4.5	28	Vietnam
Other transport	2.7	0.49	4	2.8	12	Vietnam
Other	4.1	0.63	5.5	3.7	19	Vietnam

tariffs between the TPP member countries, many of the highest tariffs are imposed by Vietnam with the tariffs for half of its sectors exceeding 10%.

To conduct calibrations, we need to estimate a parameter, trade elasticity (the dispersion of productivity), θ for the 20 tradable sectors. We follow the method of Caliendo and Parro (2015) to obtain θ using the trade and tariff data we collect. See Caliendo and Parro (2015) for details of the estimation. Table 4 presents the values of θ that we use for our calibrations.⁵

4.2 Counterfactuals: TPP Tariff Reductions

In this section, we examine the welfare effects of the TPP tariff reductions when the member countries eliminate all tariffs with each other. We set this analysis

⁵ Some of θ we obtain are negative if we include all countries in our sample. For those θ , we drop a few countries that have a small trade share in that sector to get positive θ in the estimation.

Table 2: Import shares by sector from TPP.

Sectors	Australia	Canada	Chile	Japan	Malaysia	Mexico	New Zealand	United States	Vietnam
Agriculture	27.45	39.04	9.50	30.24	12.25	45.71	33.77	27.82	19.26
Mining	27.11	17.25	2.98	16.05	15.51	44.87	17.06	24.52	5.75
Food	20.56	33.93	3.95	23.82	15.63	41.68	33.55	23.13	16.56
Textile	5.42	15.50	2.77	2.57	7.45	33.50	9.01	7.83	6.97
Wood	24.52	33.38	4.74	21.68	10.33	34.38	24.82	32.63	20.74
Paper	18.35	42.17	11.29	22.06	13.55	41.74	29.26	30.92	9.62
Petroleum	9.38	27.37	29.70	7.95	5.37	34.97	27.87	14.26	2.59
Chemicals	17.62	34.82	15.67	14.60	16.74	34.93	25.18	13.61	9.89
Plastic	21.36	39.36	14.59	10.63	20.70	41.13	25.05	22.11	19.10
Minerals	10.28	33.73	7.41	7.87	16.49	28.56	18.86	13.84	9.11
Basic metals	13.84	32.54	6.51	10.84	20.50	34.55	35.23	22.75	12.71
Metal products	15.70	34.69	10.97	7.23	20.68	38.69	20.25	17.68	18.07
Machinery n.e.c.	22.70	35.10	18.16	13.20	22.47	32.08	21.78	20.26	14.58
Office	18.78	28.22	26.05	8.33	8.66	19.65	23.32	16.80	20.11
Electrical	15.96	36.25	14.58	10.19	17.26	35.55	22.52	24.58	20.77
Communications	16.91	29.84	17.51	13.00	20.74	25.52	20.57	21.49	17.82
Medical	23.74	34.96	22.55	19.10	27.73	33.66	27.37	17.84	22.90
Auto	29.25	45.33	18.91	7.53	25.65	37.13	34.27	35.56	15.35
Other transport	24.55	33.27	18.25	40.43	26.38	28.88	31.32	20.72	4.97
Other	11.40	31.14	8.21	7.97	15.98	26.10	23.24	11.16	11.13

Table 3: Export shares by sector from TPP.

Sectors	Australia	Canada	Chile	Japan	Malaysia	Mexico	New Zealand	United States	Vietnam
Agriculture	14.50	33.41	27.43	12.98	10.41	46.34	18.13	23.70	17.35
Mining	21.87	45.91	19.90	9.05	28.42	43.77	32.38	31.97	28.40
Food	30.67	43.68	28.54	18.39	11.24	44.21	25.29	33.43	26.18
Textile	19.46	45.41	25.13	9.15	23.37	48.46	24.64	32.66	25.50
Wood	40.27	47.97	42.67	17.74	25.89	48.79	41.97	29.69	24.38
Paper	32.81	39.31	6.04	18.63	14.14	40.06	30.53	30.66	24.72
Petroleum	28.42	46.02	31.12	15.10	16.13	49.00	42.50	32.37	0.01
Chemicals	22.26	39.09	16.50	13.46	10.91	30.88	31.95	19.57	21.80
Plastic	28.85	48.06	25.62	17.78	22.24	45.46	42.15	35.57	22.41
Minerals	36.59	47.05	27.37	12.86	16.50	46.56	31.04	29.39	19.08
Basic metals	15.13	41.09	14.53	10.83	17.26	41.07	43.75	32.20	30.44
Metal products	25.55	46.00	11.28	18.89	17.40	46.80	40.01	33.77	24.77
Machinery n.e.c.	20.65	41.66	12.12	17.52	17.58	47.08	39.63	23.92	37.64
Office	24.39	34.64	7.62	18.84	29.48	41.04	30.66	15.68	20.07
Electrical	15.03	41.97	6.40	15.82	17.52	47.73	33.74	28.77	34.58
Communications	15.88	35.39	7.93	14.60	20.29	44.48	25.74	18.90	19.53
Medical	23.89	34.45	5.11	15.43	23.27	40.83	26.94	17.20	34.62
Auto	20.44	49.28	27.37	29.26	15.79	47.00	43.83	40.62	38.47
Other transport	22.84	37.27	18.78	23.94	9.61	43.69	15.91	13.40	5.25
Other	34.41	56.71	38.80	22.09	25.22	49.69	42.90	26.52	29.32

Table 4: Estimates of θ^j (dispersion of productivity).

Agriculture	Mining	Food	Textile	Wood
9.70	17.17	2.48	3.41	6.04
Paper	Petroleum	Chemicals	Plastic	Minerals
7.74	68.05	6.80	1.42	7.53
Basic metals	Metal products	Machinery n.e.c.	Office	Electrical
8.86	2.26	3.00	14.69	7.07
Communications	Medical	Auto	Other transport	Other
7.16	9.33	0.07	6.60	3.48

Note: For details of the estimation procedure, see Caliendo and Parro (2015).

as the benchmark. We provide the calibration results and discussion of welfare effects, presenting each country's aggregate welfare changes, sectoral contributions to the aggregate welfare effects, and changes in export and import shares in the benchmark analysis. To conduct a counterfactual analysis, we include the nine TPP members of Australia, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, United States, and Vietnam as the TPP member group. We do not include Brunei and Peru because of the lack of data. We also do not include Singapore as we were unable to separate the trade flows into consumption within the country and exports.

Further to the benchmark analysis, we account for two more scenarios that are possible. First, we consider the case of the parallel development with the TPP of another PTA by the two biggest economies that do not engage in the current TPP negotiations, namely, the EU and China. Operating as a single market with 28 countries as of 2014, GDP was \$18.451 trillion in the EU and \$10 trillion in China, compared with \$17.53 trillion in the United States and \$4.8 trillion in Japan (see International Monetary Fund 2014). The EU is currently China's largest trading partner, and China is the EU's second largest trading partner after the United States. Just between 2009 and 2010, the EU's exports to China increased by 38% while China's exports to the EU increased by 31%.⁶

When one region, or group of countries, forms a PTA and strengthens their trade relationships by decreasing trade barriers, as shown in Viner (1950), a nonmember country that used to export to the group may lose exports or face

⁶ See European Commission (2014).

more severe competition because of trade diversion. To explore a new market or maintain their exports as before, a third country may want to strengthen its relationships with other nonmember countries of the PTA. For instance, Baier, Bergstrand, and Mariutto (2014) and Cheong, Kwak, and Tang (2015) show that such third-country effects foster the formation of PTAs and that the trade effects from such competitive liberalization are significant and partly explain the growth of recent regionalism. Accordingly, the trade relationship between the EU and China has become increasingly tight.⁷ For this analysis, we focus on the changes in imports from the TPP members and the other countries in our sample.

Second, we investigate the case where the TPP negotiations permit sectoral exceptions, given the domestic political resistance we discussed in Section 2. In this analysis, we consider the situation where the agricultural sector receives a waiver from the tariff elimination in Japan and the automobile sector obtains a similar waiver in the United States. For this analysis, we focus on the domestic market and import shares of each sector in the corresponding countries.

We report our calibration results for the benchmark case in the following sections. Before we present the details of our results, we summarize the main findings as follows.

- All TPP members benefit from the TPP tariff reductions with the welfare gains ranging from 0.05% to 8.47%. For most TPP members, the terms of trade effects exceed the volume of trade effects.
- Many TPP nonmembers also benefit, suggesting a positive externality from the TPP tariff reductions. Most of these gains are in the form of terms of trade effects.
- Sectors with greater shares of the intermediate goods in production and stronger sectoral linkages tend to make a larger contribution to the overall welfare effects.
- The TPP members increase their imports from other TPP members and decrease from non-TPP members such as China and the EU countries, but the trade creation effects among the TPP members exceed the trade diversion effects between the TPP members and non-TPP members.

4.2.1 Aggregate Welfare Effects

Table 5 presents the welfare effects arising from the tariff reductions of TPP member countries between themselves. We decompose the changes in the total welfare effects into those arising from the changes in terms of trade and the

⁷ For example, see <https://euobserver.com/eu-china/128042>. Accessed: March 20, 2015

Table 5: Welfare effects from *TPP* tariff reductions (unit: %).

	Country	Total	Terms of trade	Volume of trade	Real wages
TPP members	Australia	0.276	0.254	0.022	0.464
	Canada	0.598	0.588	0.010	0.547
	Chile	1.465	1.062	0.403	1.506
	Japan	0.148	0.123	0.025	0.170
	Malaysia	8.473	7.682	0.792	2.566
	Mexico	0.761	0.511	0.249	0.979
	New Zealand	0.453	0.413	0.039	0.829
	United States	0.047	0.043	0.004	0.124
	Vietnam	4.652	2.027	2.625	4.629
EU members and China	Austria	0.563	0.562	0.001	0.778
	China	-1.599	-1.584	-0.015	-0.835
	Czech	1.063	1.062	0.001	1.411
	Denmark	0.383	0.381	0.001	0.376
	Finland	0.765	0.764	0.001	0.501
	France	0.134	0.134	-0.000	0.170
	Germany	0.536	0.534	0.001	0.359
	Greece	0.020	0.019	0.001	0.184
	Hungary	0.129	0.127	0.002	0.184
	Ireland	3.930	3.927	0.003	0.781
	Italy	0.180	0.178	0.002	0.192
	Netherlands	0.852	0.853	-0.001	0.734
	Poland	0.398	0.397	0.001	0.680
	Portugal	0.219	0.219	0.000	0.554
	Slovenia	0.434	0.433	0.001	0.791
	Spain	0.137	0.135	0.002	0.299
	Sweden	0.873	0.870	0.003	0.684
	United Kingdom	0.232	0.230	0.002	0.414
Nonmembers and rest of the world	Argentina	0.159	0.164	-0.005	0.099
	Brazil	0.242	0.246	-0.004	0.152
	Iceland	0.632	0.633	-0.001	2.531
	India	-0.156	-0.150	-0.006	-0.175
	Indonesia	0.602	0.600	0.002	0.200
	Israel	-0.193	-0.195	0.003	-0.190
	Korea	0.227	0.228	-0.001	0.181
	Norway	1.810	1.808	0.003	0.864
	Philippines	-2.724	-2.720	-0.004	-1.614
	South Africa	0.117	0.116	0.001	0.107
	Switzerland	0.254	0.254	0.000	0.204
	Turkey	0.033	0.036	-0.003	0.110
	ROW	-0.156	-0.151	-0.005	-0.270

volume of trade and obtain the changes in real wages from eq. [10]. The logarithmic change in real wages is given by

$$\ln \frac{\hat{w}_n}{\hat{P}_n} = - \underbrace{\sum_{j=1}^J \frac{\alpha_n^j}{\theta^j} \ln \hat{\pi}_{nn}^j}_{\text{Final goods}} - \underbrace{\sum_{j=1}^J \frac{\alpha_n^j}{\theta^j} \frac{1-y_n^j}{y_n^j} \ln \hat{\pi}_{nn}^j}_{\text{Intermediate goods}} - \underbrace{\sum_{j=1}^J \frac{\alpha_n^j}{y_n^j} \ln \prod_{k=1}^J \left(\frac{\hat{P}_n^k}{\hat{P}_n^j} \right)^{y_n^{k,j}}}_{\text{Sectoral linkages}}. \quad [11]$$

By eq. [10], the change in the sectoral terms of trade is

$$d \ln tot_n^j = \sum_{i=1}^N \left(E_{ni}^j d \ln c_n^i - M_{ni}^j d \ln c_i^j \right), \quad [12]$$

and the change in sectoral volume of trade is

$$d \ln vot_n^j = \sum_{i=1}^N \tau_{ni}^j M_{ni}^j \left(d \ln M_{ni}^j - d \ln c_i^j \right). \quad [13]$$

The welfare effects for the TPP member countries range from 0.05% (the United States) to 8.47% (Malaysia), showing that all member countries are better off. Malaysia gains the most, followed by Vietnam, Chile, and Mexico. The welfare gains arising from the TPP tariff reductions are smallest for the United States. The major sources of welfare changes also vary, although in most member countries the welfare gains mainly come from changes in the terms of trade. The contributions of the changes in the volume of trade to the aggregate welfare effects are relatively small for all countries. This may be because of the relatively low tariffs between TPP members already in place.

Compared with other TPP members, welfare gains from the TPP tariff reductions are relatively high for Malaysia and Vietnam. Their large welfare gains would be attributed to relatively high tariffs, large share of intermediate goods in production, and high sectoral linkages. Table 6 reports Malaysia, Vietnam, and the TPP members' average tariffs, shares of intermediate goods, and self-sectoral linkages. For both Malaysia and Vietnam, they are all higher

Table 6: Malaysia and Vietnam's TPP – comparison of three factors.

	Tariffs			Intermediate ^a			Linkage ^b		
	ML ^c	VN ^d	TPP	ML	VN	TPP	ML	VN	TPP
Average	7.55%	12.31%	4.50%	78.39	69.37%	64.57%	27.71%	38.35%	25.91%

Notes: ^aIntermediate is the percentage of intermediate goods used for production in each sector; ^bLinkage is the percentage of own sector inputs used for production in each sector; ^cML stands for Malaysia, ^dVN stands for Vietnam.

than those of TPP members. In particular, Vietnam's tariffs are significantly higher than those of TPP members. It explains why the contributions of the volume of trade effects to aggregate welfare gains are larger in Vietnam unlike other TPP members. On the other hand, the share of intermediate goods in production is much larger in Malaysia compared with that for other TPP members, and the self-linkage is significantly higher in Vietnam. As we show later, Malaysia and Vietnam's welfare gains decrease substantially when we assume there are no intermediate goods in production or no linkage between sectors.

The real wages in all member countries also increase as their terms of trade improve. As shown in eqs [3] and [6], the change in the terms of trade (or export prices) increases wages and the price of intermediate goods, which in turn is a function of tariffs. Thus, given a welfare improvement, the same positive sign for the terms of trade and real wages for member countries imply that the increased real wages raise export prices, and the effect of the higher real wages on the terms of trade is greater than that of the effect of the lower prices of intermediate goods from the tariff changes.

Many nonmember countries also benefit from the TPP tariff reductions. Ireland gains the most (3.93%) from these positive externalities, along with other EU members. The welfare of South American countries and some Asian countries also increases while that in China, India, Israel, the Philippines, and the rest of world decreases. The major sources of welfare changes also vary for nonmember countries. For instance, China loses because of decreases in both the terms of trade and the volume of trade, while the welfare in Israel decreases because of a decrease in the terms of trade even though its volume of trade increases. Finally, in contrast with Malaysia, Ireland's welfare gain is still significant even when we change the underlying assumptions about the number of sectors, and sectoral linkages (as presented in Table 16).

Some EU members gain from both the changes in the terms of trade and the volume of trade while most of them primarily gain from the changes in their terms of trade. The relatively larger contribution of the changes in terms of trade to welfare change indicates that for most nonmember countries the gains arise from the changes in terms of trade attributable to the changes in real wages, rather than effects of tariffs on the price of intermediate goods.

4.2.2 Sectoral Contribution to Welfare Effects

The sectoral contribution of each welfare term for TPP member countries is shown in Table 10. These figures are obtained using eqs [12] and [13]. Each figure represents how much each sector contributes to the changes in aggregate terms

of trade and the volume of trade. Thus, the sum of each sector’s contribution becomes 1. The negative sign indicates that the aggregate welfare and the terms of trade or volume of trade in that sector move in the opposite direction. We find a substantial variation in sectoral contribution that also varies across countries.

Mining is the most important sector with regard to the terms of trade for Australia, Canada, Chile, Mexico, and Vietnam. The sectoral contributions from the terms of trades for the textile, machinery, communications, and office sectors are significant for the United States, and those for textile, machinery, communications, and electrical sectors are large for Japan. As noted in Caliendo and Parro (2015), we can attribute this sectoral variation to three factors: the size of tariff reductions, the share of intermediate goods in production, and the importance of sectoral linkages.

For instance, as shown in Tables 7 and 8, the pre-TPP tariffs in machinery sector of 0.13% for Japan and 0.46% for the United States are lower than the

Table 7: Japan’s data on relevant five sectors.

Sectors	Tariffs	Intermediate ^a	Linkage ^b
Food, %	8.55	60.48	23.36
Textile, %	4.58	64.54	38.99
Machinery n.e.c., %	0.13	60.53	30.92
Electrical, %	0.15	60.58	36.45
Communications, %	0.00	62.14	3.83
Average, %	1.13	49.80	18.34
Median, %	0.47	54.87	14.16

Notes: ^aMaterial is the percentage of intermediate goods used for production in each sector; ^bLinkage is the percentage of own sector inputs used for production in each sector.

Table 8: US data on relevant five sectors.

Sectors	Tariffs (%)	Intermediate ^a (%)	Linkage ^b (%)
Food	3.31	73.91	18.22
Textile	4.65	65.17	33.94
Machinery n.e.c.	0.46	62.43	12.27
Office	0.13	57.87	17.06
Communications	0.62	51.51	30.05
Average	1.13	51.96	18.39
Median	0.88	50.91	17.06

Notes: ^aMaterial is the percentage of intermediate goods used for production in each sector; ^bLinkage is the percentage of own-sector inputs used for production in each sector.

average (1.13% for both) and median tariffs (0.47% and 0.88%, respectively) in each country. Therefore, the direct effect from the TPP tariff reductions on final goods for machinery sector may not explain a large part of the effect on prices. However, the secondary effects from the feedback arising from a large share in intermediate goods and high sectoral linkages may explain a substantial part of the effect on prices. Tables 7 and 8 show that the share of intermediate goods in machinery production in Japan and the United States is 61% and 62%, respectively, and both are higher than the average (50% and 52%, respectively) and median (55% and 51%, respectively) share in each country. In addition, the Japanese share of intermediate goods in their own sector products, machinery production, is 31%, and this is much higher than the average (18%) and median (14%) share (as an example of sectoral linkages, we report self-sector linkage (the share of intermediate goods from its own sector)).

While the contributions of the volume of trade to the aggregate welfare effects are relatively small, as shown in Table 5, it still varies across countries and sectors. We attribute these differences to the sectoral differences in the size of the tariff reductions and the import elasticity with respect to tariffs. The sectoral contribution to Japan and the US volume of trade by food and textile are large. As shown in Tables 7 and 8, the food and textile sector tariffs in both countries are 8.55% and 3.31%, and 4.58% and 4.65%, respectively, which are significantly higher than the average (1.13% for both) and median (0.47% and 0.88%, respectively) tariffs. The sectoral contribution of the US volume of trade by Chemicals is also relatively large. Even though the tariff in chemical sector (1.15%) is not significantly higher than the average and median tariffs, it has a relatively high import elasticity with respect to tariffs (6.8) as shown in Table 4.

Table 11 details the sectoral contribution to each welfare term for some of the nonmember countries (China and EU members).⁸ As the most benefited nonmember country, more than 60% of Ireland's terms of trade improvement is accounted for by a single sector, chemicals, which provided more than 50% of its total exports in 2005.

Among non-TPP member countries, China is one of the countries that loses the most after the TPP tariff reductions and its welfare losses mostly arise from a

⁸ The France's sectoral contributions to the volume of trade are significantly larger than most sectors in other countries. This is because France's volume of trade is negligible (−0.00, as shown in Table 5), thus very small variations in the volume of trade across sectors may make significant differences in each sector's contribution.

decrease in the terms of trade, as shown in Table 5. The textile sector accounts for nearly 20% of this term of trade deterioration, while the machinery, office, electrical, and communications sectors account for another 30% of the aggregate terms of trade changes. This may be due to the feedback effects from their large share in intermediate goods and the high interrelation of the sectors.

As shown in Table 9, the shares of intermediate goods in these sectors in China are 74% (textile), 73% (machinery), 83% (office), 73% (electrical), and 77% (communications), which are all higher than the average (62%) and median (69%) shares. Furthermore, the self-sector linkages for these sectors is 48% (textile), 18% (machinery), 17% (office), 22% (electrical), and 6.5% (communications), and those for the first three sectors are significantly larger than the average (15%) and median (11%) for the country. The office sector has relatively low tariff rates (3.91%) compared with the mean or average, but the other two factors are significantly high. Similarly, the communications sector has a relatively low self-sector linkage, while the other two factors are high. However, these two sectors remain important in terms of the contribution to overall welfare consequences in China.

When the TPP members eliminate the tariffs, we can see the sectoral contributions to overall welfare changes are from a combination of three factors, namely, tariff rates, the share of material in production, and the self-linkages and interrelations between sectors. Tariff rates certainly differ across countries. However, sectors also share common features across countries. For this reason, some sectors, such as textile and communications are important in this respect in many countries. Our results support this.

Table 9: China’s data on relevant five sectors.

Sectors	Tariffs (%)	Intermediate ^a (%)	Linkage ^b (%)
Textile	12.15	73.75	47.57
Machinery n.e.c.	9.63	72.67	18.45
Office	3.91	83.05	17.26
Electrical	9.17	73.23	22.10
Communications	9.29	76.95	6.51
Average	9.14	62.43	14.60
Median	9.32	69.11	10.77

Notes: ^aMaterial is the percentage of intermediate goods used for production in each sector; ^bLinkage is the percentage of own sector inputs used for production in each sector.

Table 10: Sectoral contribution to welfare effects from *TPP* tariff reductions (TPP members) (unit: %).

Countries	Australia		Canada		Chile		Japan		Malaysia	
Sectors	ToT	VoT	ToT	VoT	ToT	VoT	ToT	VoT	ToT	VoT
Agriculture	6.58	0.34	3.37	7.65	9.22	4.06	1.55	9.21	3.37	2.38
Mining	54.38	0.23	31.89	11.79	42.94	4.70	5.53	1.29	15.63	0.11
Food	10.16	1.86	4.14	21.21	13.54	0.74	1.64	59.74	5.15	11.11
Textile	5.89	23.66	3.13	22.15	4.08	0.44	13.43	8.99	1.87	2.81
Wood	0.82	1.20	5.10	6.09	4.76	0.30	0.03	1.52	2.99	3.27
Paper	0.90	5.26	9.98	1.61	6.43	2.25	0.66	0.10	1.13	3.98
Petroleum	0.57	0.28	2.22	-2.34	-1.26	69.66	-0.16	3.32	-1.33	0.04
Chemicals	0.15	0.20	4.19	4.38	3.99	6.20	4.39	4.59	7.48	0.61
Plastic	0.59	6.24	3.18	2.92	1.02	0.52	3.10	0.69	3.84	16.08
Minerals	0.73	1.77	1.22	0.66	0.56	0.55	1.86	1.56	0.95	6.90
Basic metals	11.46	7.21	5.26	-4.43	13.14	1.44	4.30	1.04	0.67	35.18
Metal products	0.95	4.69	2.64	3.51	0.55	0.55	2.96	0.37	0.84	1.56
Machinery n.e.c.	0.56	10.12	4.08	2.15	-0.38	4.11	10.59	0.03	1.93	1.19
Office	1.54	0.04	1.19	2.85	0.39	2.36	5.95	0.11	16.66	0.03
Electrical	0.96	8.36	1.68	-1.24	0.15	-1.62	11.99	5.79	2.63	1.34
Communications	1.28	6.73	2.78	-1.17	0.47	1.16	10.49	0.49	31.45	5.27
Medical	0.71	0.17	0.50	-0.62	0.12	1.04	4.43	0.18	1.97	0.06
Auto	-0.90	13.32	7.89	8.19	-1.17	0.71	11.77	0.11	0.00	4.96
Other transport	0.33	3.94	2.25	10.56	0.43	0.64	1.42	0.13	0.12	0.45
Other	2.33	4.39	3.31	4.07	1.02	0.20	4.06	0.72	2.65	2.66

Countries	Mexico		New Zealand		USA		Vietnam	
Sectors	ToT	VoT	ToT	VoT	ToT	VoT	ToT	VoT
Agriculture	4.63	1.83	13.28	12.80	3.13	1.85	9.93	15.58
Mining	34.24	11.07	6.82	9.69	2.54	2.25	74.21	0.09
Food	4.23	6.53	39.18	4.04	1.30	10.18	5.74	6.14
Textile	5.39	4.32	8.56	10.35	25.08	38.19	-10.98	53.30
Wood	0.22	0.59	5.47	1.17	0.07	1.25	1.34	0.19
Paper	1.21	0.42	6.00	3.58	3.36	0.06	0.19	2.26
Petroleum	-1.11	13.46	-2.29	-1.34	-4.93	1.66	11.68	0.24
Chemicals	2.46	2.37	1.86	0.44	2.94	9.39	1.73	0.11
Plastic	1.87	1.68	1.68	5.16	4.47	2.67	0.95	4.12
Minerals	3.04	3.55	0.50	1.55	2.02	2.95	1.66	2.35
Basic metals	3.80	3.45	8.07	0.91	0.03	1.03	1.27	0.10
Metal products	3.77	2.14	2.83	1.98	5.23	2.32	0.50	1.65
Machinery n.e.c.	6.16	2.56	3.08	11.55	7.76	1.55	1.95	0.22
Office	1.79	2.46	1.30	6.54	11.57	0.31	0.70	0.08
Electrical	6.89	11.62	1.17	4.94	6.80	-1.52	-1.03	1.39
Communications	2.04	15.71	1.13	1.90	12.69	2.45	-0.67	3.29
Medical	3.09	9.34	1.09	0.47	4.65	5.28	0.40	0.13
Auto	12.07	5.79	-2.14	19.51	-9.04	10.53	0.15	2.01
Other transport	0.32	0.26	0.58	-0.12	4.46	2.31	0.70	0.98
Other	3.90	0.85	1.83	4.85	15.86	5.29	-0.45	5.79

Table 11: Sectoral contribution to welfare effects from TPP tariff reductions (nonmembers: EU and China) (unit: %).

Countries		Austria		China		Denmark		Finland		France		Germany	
Sectors	ToT	VoT	ToT	VoT	ToT	VoT	ToT	VoT	ToT	VoT	ToT	VoT	ToT
Agriculture	0.64	-2.03	1.48	4.48	3.09	-6.09	0.84	-6.81	4.23	0.59	0.71	0.26	0.71
Mining	2.28	-0.00	2.48	-2.24	19.41	46.32	1.37	5.62	2.04	0.12	4.65	17.14	4.65
Food	5.96	-4.79	2.22	3.53	16.40	-31.50	0.61	-15.11	8.93	60.82	3.51	-9.16	3.51
Textile	5.91	140.24	19.32	2.24	7.38	68.19	2.35	167.22	12.23	-820.99	4.52	74.16	4.52
Wood	4.08	0.66	1.26	0.38	0.50	4.64	5.83	13.40	0.61	-16.85	0.76	4.14	0.76
Paper	11.25	-0.02	2.50	1.12	2.09	0.09	32.67	-0.13	4.14	-15.80	5.31	0.36	5.31
Petroleum	-1.80	-0.05	4.88	2.00	-0.25	-10.08	0.82	-3.24	-1.70	1732.02	-0.14	-25.15	-0.14
Chemicals	8.12	-7.49	4.95	9.80	14.90	-2.64	2.99	-14.96	13.10	135.01	12.09	-18.87	12.09
Plastic	4.77	1.49	3.90	1.98	3.54	0.08	2.35	-0.70	3.89	-9.44	4.59	0.36	4.59
Minerals	5.24	3.23	3.43	1.28	1.90	2.13	1.75	5.75	2.91	-16.42	2.41	1.90	2.41
Basic metals	10.45	-2.15	4.59	3.91	-0.20	-4.69	7.50	-14.45	4.69	41.09	4.33	-9.26	4.33
Metal products	7.57	-0.46	5.27	1.37	4.16	4.27	2.53	-0.69	3.83	-25.02	5.90	2.60	5.90
Machinery n.e.c.	12.41	-2.52	6.60	11.30	9.74	-1.28	8.99	-6.53	6.84	-49.12	14.53	2.56	14.53
Office	1.00	-1.92	7.66	-4.58	0.14	24.96	0.68	-3.33	3.10	-839.11	2.95	37.38	2.95
Electrical	5.12	-3.00	6.99	37.99	4.94	-0.64	5.18	22.14	5.17	15.97	5.58	-2.65	5.58
Communications	3.97	-5.65	9.10	11.52	3.14	7.45	19.98	-26.90	5.31	2.52	4.33	5.85	4.33
Medical	2.13	-4.45	2.31	7.18	4.75	2.72	2.00	-6.47	3.11	10.26	4.46	23.06	4.46
Auto	6.21	-8.19	0.89	3.12	-1.77	-2.12	0.18	-11.87	7.47	42.55	15.38	-6.30	15.38
Other Transport	1.66	-1.76	0.92	0.48	0.81	-2.08	0.41	-2.63	5.47	-15.10	1.43	-0.93	1.43
Other	3.04	-1.16	9.26	3.15	5.33	0.26	0.99	-0.31	4.63	-133.08	2.72	2.56	2.72

Countries		Ireland		Italy		Netherlands		Portugal		Spain		UK	
Sectors	ToT	VoT	ToT	VoT	ToT	VoT	ToT	VoT	ToT	VoT	ToT	VoT	ToT
Agriculture	0.68	12.67	1.85	-1.69	7.19	20.26	3.16	-5.72	10.93	-3.90	0.68	-0.74	
Mining	0.11	11.13	7.46	54.88	11.54	-2.92	6.05	131.98	5.84	9.24	17.45	28.28	
Food	8.13	-5.31	4.01	-2.11	9.29	35.66	6.15	-30.07	8.57	-4.54	-0.50	-11.32	
Textile	0.55	23.02	18.51	28.35	3.94	-87.88	23.76	108.68	13.35	34.41	8.08	33.58	
Wood	0.26	0.25	0.26	0.42	0.33	-0.24	6.36	5.32	1.02	0.01	-0.03	0.26	
Paper	2.35	-0.20	3.52	-0.02	4.10	0.09	13.38	0.84	4.80	-0.00	3.69	0.11	
Petroleum	-0.46	-84.63	-0.01	-4.00	3.23	2.74	-3.12	-78.84	-2.63	-3.93	3.07	-3.71	
Chemicals	64.37	-23.16	3.60	0.26	14.19	48.91	0.48	-13.86	7.52	-4.33	16.56	-4.67	
Plastic	0.76	-1.60	5.44	-0.01	2.93	2.50	5.46	-0.03	4.66	-0.12	3.28	-0.29	
Minerals	0.42	0.26	5.87	0.25	1.39	0.06	9.09	7.86	7.00	0.50	1.68	0.40	
Basic metals	0.23	-0.56	3.62	-15.40	4.76	6.29	-0.13	-22.69	5.18	-5.38	5.99	-2.01	
Metal products	0.69	-0.01	7.96	2.28	3.22	0.96	5.83	3.66	5.00	3.90	3.34	1.80	
Machinery n.e.c.	1.45	-1.70	20.99	0.29	5.58	11.26	4.36	-4.95	5.24	5.90	8.53	-1.56	
Office	8.30	181.66	0.28	18.69	8.11	12.62	4.75	7.12	1.05	27.33	3.39	42.08	
Electrical	1.27	1.16	4.35	2.24	2.36	8.92	3.97	9.28	3.60	3.76	3.80	0.55	
Communications	2.87	-4.60	1.95	5.09	7.96	7.44	2.24	2.86	2.47	10.11	3.89	7.83	
Medical	6.31	-10.17	2.18	12.77	4.09	23.43	0.22	-1.28	0.88	25.00	3.43	13.30	
Auto	-0.01	-2.99	0.66	-1.57	2.76	3.72	3.79	-17.51	10.64	-2.76	4.75	-2.64	
Other transport	0.44	-1.71	1.62	-1.26	0.76	5.01	1.33	-4.67	1.43	2.11	4.87	-1.01	
Other	1.28	6.50	5.89	0.53	2.30	1.17	2.88	2.02	3.44	2.68	4.03	-0.22	

4.2.3 Export Shares

Table 12 provides details on the TPP member export shares by sector before and after the TPP tariff reductions. Before the TPP tariff reductions, just two sectors, mining and food, account for about 50% of the export shares of Australia and New Zealand. About 60% of Malaysia's exports are from office and communications sectors. Food and mining along with textile also account for more than 60% of exports in Vietnam. This contrasts with Mexico and the United States, where the export shares are relatively diversified with no single sector accounting for more than 20%.

Our results indicate that the TPP tariff reductions change the sectoral export shares, but not in a drastic manner. For the TPP member countries, the export shares of many sectors change by no more than 1 or 2 percentage points. As a few exceptions, the export share of mining in many countries, including Australia, Canada, Chile, Malaysia, Mexico, and Vietnam, increases substantially following the TPP tariff reductions, whereas the export share of food in many countries including Australia, Chile, Mexico, New Zealand, and the United States decreases more than 2 percentage points following the TPP tariff reductions.

Table 13 provides the export shares for some of nonmember countries (China and EU members) by sector before and after the TPP tariff reductions. As shown, the changes in export shares vary across countries, but they are not substantial for most of countries. Chemicals in Ireland maintains a very high export share after the TPP tariff reductions. Chemicals and auto are the two major sectors with high export shares in many EU countries. For all EU members except for Ireland, the export shares of chemical and auto decrease after the TPP tariff reductions. As for China, the export shares of the textile and communications sectors decrease more than 2 percentage points.

4.2.4 Change in Imports: TPP versus TPP + EU and China

In this section, we examine how imports from a certain group of countries change after the TPP tariff reductions, in particular when the EU and China form an additional PTA between them in response to the TPP tariff reductions.

The upper and lower tables in Table 14 present the results for the TPP members and the EU members and China, respectively. The first three columns in the upper table show how much the TPP member countries change their imports from other TPP members (the first column), the EU (the second column) and China (the third column) given the TPP tariff reductions. The first column shows that all TPP members increase their imports from other TPP members and

Table 12: Export shares by sector before and after *TPP* tariff reductions (TPP members) (unit: %).

Countries	Australia		Canada		Chile		Japan		Malaysia	
Sectors	Before	After	Before	After	Before	After	Before	After	Before	After
Agriculture	6.88	5.13	3.05	2.60	9.10	7.35	0.08	0.08	2.07	1.77
Mining	42.9	50.47	18.06	21.42	25.23	28.88	0.04	0.07	7.83	9.95
Food	13.2	9.32	4.65	3.77	15.08	11.33	0.34	0.29	4.87	4.90
Textile	1.31	0.99	1.13	0.94	0.48	0.36	1.15	1.21	1.62	1.77
Wood	1.1	0.84	5.00	4.12	5.34	4.21	0.02	0.02	2.40	2.58
Paper	0.833	1.29	5.89	9.84	4.00	6.45	0.60	1.18	0.37	0.82
Petroleum	2.74	2.90	4.05	4.88	1.64	2.25	0.62	1.13	2.16	0.47
Chemicals	3.66	2.80	7.43	6.47	4.80	3.82	9.90	9.46	5.67	5.65
Plastic	0.494	0.54	2.81	3.18	0.73	0.81	2.82	3.67	2.31	3.68
Minerals	0.31	0.37	0.69	0.90	0.21	0.27	0.97	1.46	0.44	0.73
Basic metals	15.9	17.10	6.45	6.89	31.19	32.41	5.62	6.88	1.59	2.29
Metal products	0.535	0.66	1.78	2.33	0.35	0.46	1.78	2.62	0.81	1.60
Machinery n.e.c.	2.23	1.64	5.19	4.36	0.59	0.46	15.82	14.11	2.61	2.82
Office	0.403	0.28	0.99	0.76	0.05	0.03	5.86	5.65	19.78	15.95
Electrical	0.928	0.86	1.65	1.49	0.10	0.08	6.56	9.68	2.47	3.57
Communications	0.563	0.39	2.91	2.29	0.04	0.02	15.71	13.57	38.24	36.62
Medical	1.48	1.04	1.18	0.95	0.06	0.04	6.63	5.90	1.88	1.61
Auto	2.84	2.06	20.81	17.66	0.41	0.31	21.43	18.90	0.28	0.32
Other transport	0.81	0.57	3.76	2.98	0.33	0.23	2.56	2.23	0.30	0.29
Other	0.918	0.76	2.54	2.16	0.27	0.21	1.49	1.92	2.30	2.59

Countries	Mexico		New Zealand		United States		Vietnam	
Sectors	Before	After	Before	After	Before	After	Before	After
Agriculture	2.87	2.60	11.65	10.92	4.08	3.86	6.00	4.86
Mining	14.41	17.09	2.70	5.53	2.05	3.56	21.82	26.82
Food	3.06	2.76	45.47	38.71	4.34	3.68	10.61	8.77
Textile	4.49	4.15	4.50	4.08	1.86	1.65	31.19	28.30
Wood	0.18	0.16	5.16	4.88	0.58	0.76	1.19	1.05
Paper	0.72	1.42	4.30	7.86	2.79	5.52	0.22	0.41
Petroleum	1.35	1.06	0.35	0.54	2.14	3.45	8.54	8.53
Chemicals	3.35	3.15	4.69	4.44	15.77	14.97	0.86	0.75
Plastic	1.44	1.85	1.69	2.07	3.18	3.90	1.32	1.72
Minerals	1.29	1.83	0.18	0.28	0.88	1.30	1.01	1.44
Basic metals	3.00	3.41	5.49	7.33	3.11	3.87	0.31	0.35
Metal products	2.13	3.14	1.40	2.02	2.33	3.33	1.01	1.46
Machinery n.e.c.	6.95	6.56	4.82	4.36	11.39	10.10	1.24	1.09
Office	4.98	4.31	0.43	0.37	4.76	4.00	1.37	1.08
Electrical	10.53	10.21	1.82	1.89	4.57	4.88	2.94	4.11
Communications	12.88	11.70	0.81	0.70	8.66	7.20	2.02	1.67
Medical	4.56	3.93	1.79	1.56	7.02	5.97	0.37	0.31
Auto	18.08	17.24	0.87	0.78	10.19	8.93	0.33	0.28
Other transport	0.26	0.22	1.10	0.94	8.10	6.77	0.73	0.59
Other	3.46	3.21	0.79	0.72	2.21	2.30	6.94	6.41

Table 13: Export shares by sector before and after TPP tariff reductions (nonmembers: EU and China) (unit: %).

Countries		Austria		China		Denmark		Finland		France		Germany	
Sectors		Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Agriculture		0.88	0.77	0.87	0.98	3.30	3.12	0.74	0.58	2.97	2.87	0.89	0.84
Mining		0.41	0.50	1.07	2.34	8.65	11.94	0.28	0.38	0.23	0.38	2.00	3.29
Food		6.09	5.11	1.85	1.52	18.43	15.89	1.57	1.15	8.76	7.58	4.28	3.68
Textile		3.88	3.30	18.89	16.20	3.87	3.41	1.00	0.77	3.69	3.27	2.37	2.08
Wood		3.91	3.33	0.98	0.98	1.06	0.97	5.03	3.83	0.57	0.53	0.77	0.71
Paper		5.66	10.28	0.92	1.99	1.73	3.73	17.87	29.77	2.45	4.87	2.74	5.26
Petroleum		1.04	1.54	0.74	4.44	2.27	2.88	4.45	5.49	2.60	4.17	1.66	2.50
Chemicals		10.05	8.89	3.82	3.80	15.23	14.12	6.96	5.58	18.34	17.40	14.56	13.47
Plastic		3.66	4.43	2.78	3.22	3.11	3.80	2.04	2.19	3.13	3.92	3.57	4.39
Minerals		2.65	3.69	1.72	2.81	1.17	1.67	1.01	1.30	1.41	2.14	1.32	1.91
Basic metals		10.13	11.58	2.95	3.94	2.00	2.39	11.53	11.84	5.41	6.57	5.17	6.18
Metal products		4.65	6.41	3.30	4.54	2.84	4.03	1.67	2.12	2.11	3.10	3.43	4.93
Machinery n.e.c.		13.49	11.60	6.75	5.80	11.45	10.14	11.43	8.76	8.68	7.78	15.37	13.61
Office		1.03	0.76	15.28	13.58	1.06	0.82	0.62	0.45	1.40	1.14	2.44	1.94
Electrical		5.40	5.02	7.10	7.22	6.24	6.04	4.19	4.13	4.13	4.44	4.87	5.07
Communications		4.30	3.40	16.29	13.89	4.38	3.68	22.20	15.88	3.77	3.16	4.39	3.61
Medical		2.24	1.70	2.92	2.63	4.49	3.66	2.43	1.70	3.12	2.64	4.29	3.49
Auto		13.76	11.82	0.88	0.70	2.48	2.17	3.48	2.68	16.67	14.74	21.62	19.19
Other transport		2.21	1.79	0.95	0.83	1.38	1.18	0.63	0.46	7.88	6.75	2.06	1.69
Other		4.55	4.08	9.92	8.61	4.87	4.37	0.86	0.96	2.67	2.57	2.20	2.15

Countries		Ireland		Italy		Netherlands		Portugal		Spain		United Kingdom	
Sectors		Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Agriculture		0.82	0.85	1.63	1.53	6.07	5.56	2.43	2.17	6.86	6.46	0.95	0.85
Mining		0.41	0.71	0.45	0.70	4.01	6.08	1.17	1.51	0.84	1.26	9.60	13.68
Food		8.17	8.11	6.36	5.42	12.50	10.71	6.70	5.72	9.06	7.83	2.29	2.03
Textile		0.51	0.52	12.66	11.00	2.83	2.46	18.97	16.41	5.19	4.54	2.44	2.03
Wood		0.32	0.32	0.50	0.45	0.34	0.29	4.24	3.96	0.82	0.76	0.18	0.14
Paper		0.98	2.05	2.24	4.23	2.18	4.20	5.31	9.84	2.61	4.99	2.43	4.55
Petroleum		0.48	0.34	2.62	4.50	8.46	12.07	2.17	3.49	1.92	3.03	5.15	5.53
Chemicals		54.78	55.08	11.73	10.85	19.03	17.55	7.03	6.40	13.89	12.96	19.70	18.05
Plastic		0.77	1.09	4.14	5.02	2.34	2.90	3.89	4.70	3.52	4.31	2.60	3.16
Minerals		0.29	0.46	3.10	4.49	0.69	1.00	3.81	5.31	2.88	4.23	0.94	1.30
Basic metals		0.49	0.62	5.92	7.02	4.30	4.98	3.13	3.49	5.66	6.69	5.67	6.75
Metal products		0.60	0.98	4.26	6.03	1.79	2.59	3.05	4.26	2.63	3.76	1.83	2.61
Machinery n.e.c.		1.84	1.89	19.81	17.28	5.77	5.05	5.42	4.78	6.72	5.97	9.62	8.36
Office		13.68	11.96	0.70	0.56	9.33	7.29	4.26	3.32	0.80	0.64	4.57	3.42
Electrical		1.48	1.54	3.75	3.68	2.19	2.11	4.11	3.71	3.56	3.57	3.25	3.21
Communications		3.98	3.59	2.46	2.01	6.77	5.54	6.73	5.61	3.27	2.79	5.15	4.17
Medical		7.76	7.02	2.50	2.05	4.21	3.33	0.82	0.65	1.26	1.04	3.89	3.08
Auto		0.40	0.42	8.26	7.14	4.71	4.13	12.68	11.09	24.61	21.76	12.19	10.66
Other Transport		0.53	0.49	1.93	1.60	0.93	0.75	1.01	0.82	1.86	1.55	5.06	4.11
Other		1.70	1.96	4.98	4.43	1.56	1.42	3.10	2.76	2.03	1.84	2.48	2.31

Table 14: Import growth from various groups and under different scenarios (unit: %).

Scenario		TPP			TPP + EU and China		
From members of:		TPP	EU	China	TPP	EU	China
TPP members	Australia	9.90	-0.89	-0.83	9.95	-0.81	0.25
	Canada	0.91	-0.21	-0.31	0.91	-0.25	0.81
	Chile	91.83	-4.50	-6.17	91.86	-4.58	-5.40
	Japan	13.89	1.06	1.12	13.42	1.12	1.65
	Malaysia	42.44	-0.96	0.31	41.98	0.05	2.54
	Mexico	12.59	-4.45	-5.63	12.54	-4.21	-4.06
	New Zealand	6.69	-0.01	0.13	6.72	0.06	1.20
	United States	3.49	-0.37	-0.49	3.37	-0.17	0.74
	Vietnam	100.38	-3.53	-2.97	100.33	-3.92	-3.21
EU members and China	Austria	-0.35	0.01	-0.06	0.13	0.06	11.18
	China	-1.11	0.01	-	-3.51	73.28	-
	Czech	-0.64	-0.01	-0.09	-0.44	0.28	9.60
	Denmark	-0.34	-0.02	-0.09	0.21	0.47	11.46
	Finland	-0.55	0.00	-0.09	-0.10	0.68	9.79
	France	-0.34	-0.01	-0.06	0.30	0.89	10.24
	Germany	-0.42	-0.01	-0.04	0.04	1.21	9.26
	Greece	-0.16	-0.01	-0.03	-0.10	0.12	9.25
	Hungary	-0.78	-0.02	-0.12	-0.64	0.27	9.39
	Ireland	-0.30	-0.06	-0.13	-0.01	0.70	7.61
	Italy	-0.32	-0.05	-0.07	0.14	0.75	11.24
	Netherlands	-0.29	0.05	-0.07	-0.34	0.68	7.75
	Poland	-0.29	-0.02	-0.07	-0.34	0.82	16.40
	Portugal	-0.24	-0.03	-0.07	0.04	-0.23	9.00
	Slovenia	-0.82	0.07	-0.06	-0.38	0.26	10.48
	Spain	-0.30	-0.03	-0.07	-0.05	0.51	10.24
	Sweden	-0.46	0.03	-0.00	0.07	0.15	9.57
	United Kingdom	-0.30	-0.01	-0.05	-0.09	0.80	9.59

Note: Values are the percentage change in total imports from each group to each country compared with the case where the TPP is not formed under each scenario.

this varies from 0.91% in Canada to 100.38% in Vietnam. Chile and Malaysia also substantially increase their imports from other TPP member countries. On the other hand, as shown in the second column, many TPP member countries decrease their imports from the EU and China even though the magnitude is relatively small compared to trade creation effects among the TPP members.

As shown in column 4, when the EU forms a PTA with China in response to the TPP tariff reductions, some of the TPP members increase their imports even more from other TPP members while some of them decrease, but the changes are almost negligible. Columns 5 and 6 show that some TPP member countries

slightly increase their trade with the EU and China compared with the case where there is only the TPP.

The lower table shows how much the EU and China change their imports from the TPP members (the first column), and the EU and China (the second the third columns, respectively) given the TPP tariff reductions. The EU members decrease their imports from the TPP members after the TPP tariff reductions, but the decrease is less than 1 percentage point. China also decreases its imports from the TPP members but the magnitude is small. Changes in trade volume between the EU and China due to the TPP tariff reductions are almost negligible.

As shown in columns 4 and 5, compared with the case where there is only the TPP, further tariff reductions between the EU and China decrease China's imports from the TPP countries while increasing its imports from the EU members by 73%. However, as shown in the fourth and last columns, many EU members decrease less their import from the TPP member countries compared with the case where there is only the TPP and substantially increase their imports from China.

In summary, the TPP tariff reductions have substantial trade creation effects while trade diversion effects are relatively small. Further tariff reductions between the EU and China also generate trade creation effects between them, which are larger than the trade diversion effects from the TPP tariff reductions.

4.2.5 Sectoral Exceptions from the TPP

As discussed in Section 2, the internal politics involved in the TPP negotiations have been tense, and thus play an important role in how the TPP will actually be formed. The wish of some potential members to protect their own domestic markets indeed motivates some of the arguments used against joining the TPP. Typical examples include the agricultural sector in Japan and the automobile sector in the United States. Indeed, these are the two largest economies of the participants in the TPP negotiations.

In this section, we allow the possibility where a country's politically sensitive sector is waived from the TPP tariff reductions at the negotiation table, and see how the domestic shares and imports of the waived sectors change after the TPP tariff reductions.⁹

⁹ There are many rumors surrounding these issues as the negotiations are essentially confidential. For example, *The Japan Daily Press* stated: "Local media reports have said today that Japan and the United States have agreed in principle that the US auto industry will be able to keep tariffs on automobile imports for at least 5 to 10 years, with 2.5 percent for passenger cars and 25 percent on trucks." (March 6, 2013) See <http://japandailynews.com/japan-and-us-reach-agreements-on-auto-exceptions-in-tpp-0624657/>.

Table 15: Sectoral exceptions and growth compared with the TPP.

	Domestic expenditure ^a (%)	Import from TPP ^b (%)
Japan agriculture	2.19	-25.05
US automobile	0.03	-1.37

Notes: ^a*Domestic expenditure* is the percentage change in domestic expenditure when the Japan agriculture and US automobile sectors are waived from the TPP, compared with the case where they are not. ^bImport from TPP is the percentage change in total sectoral imports from TPP members in each sector of each country (i.e., Japan agriculture or US automobile) when Japan agriculture and US automobile are waived from the TPP, compared with the case where they are not.

We consider the scenario where the agricultural sector (agriculture) in Japan and the automobile sector (auto) in the United States both receive waivers from the TPP tariff reductions. The results are shown in Table 15. As shown, the sectoral exclusions for these two sectors result in an increasing domestic expenditure in the Japan's agricultural sector and US automobile sector by 2.19% and 0.03%, respectively. The effects on the import share in these sectors from the TPP members are more substantial. Protection from the TPP tariff reductions in Japan's agriculture decreases its import share from the TPP members by 25% compared with the case when it eliminates tariffs on this sector under the TPP. The import share of auto in the United States decreases by 1.37% when it protects the auto sector from the TPP tariff reductions. These results partly explain the fact that the internal politics in protecting these industries in Japan and the United States are particularly intense.

We can attribute import share changes of the protection of the US automobile sector from the TPP tariff reduction to its existing relatively high tariffs. Among the TPP member countries, Japan is the only major automobile exporting country on which the United States levies tariffs, especially given that the other major competing TPP member countries, Canada and Mexico, already pay no tariffs under NAFTA. The US tariff on Japanese automobiles is about 3.85%, which is higher than its average tariff of 1.13%, and also higher than its average tariff on automobiles from other TPP member countries of 1.64%.

Japan's simple average tariff in the agricultural sector is 2.31%, which is also higher than its average tariff of 1.13%. The relatively high tariffs on the agricultural sector are mainly the result of a prohibitive level of tariffs on some particular products, with zero tariffs on many products. For example, the tariffs on rice and a particular kind of potato (*konjac potato*) are 778% and 990%, respectively. This suggests that even though the protection effects for the agricultural sector overall may not be very significant, the TPP could still lead to

strident political debate in Japan about protecting the agricultural sector, especially for certain products with exceptionally high current tariffs.

4.2.6 The Analysis Under Different Assumptions

In this section, we present the welfare effects from the TPP tariff reductions under various model assumptions, followed by Caliendo and Parro (2015). First, we assume that there is a single tradable and nontradable sectors instead of multiple tradable and nontradable sectors. We then assume that there are no intermediate goods used in production so that labor is the only input. Lastly, we assume there is no interrelation between sectors so that only goods from its own sector serve as intermediate goods. The results are shown in Table 16.

The upper panel presents the results for the TPP members. The first column presents the welfare effects from the TPP tariff reductions under the assumption of a single tradable sector. For most member countries, the welfare gains of the TPP tariff reduction become smaller under the assumption of a single tradable sector. When we assume no intermediate goods used in production, as shown by comparison between the second and third columns, the welfare effect for all TPP member countries becomes smaller. Especially, welfare gains in Malaysia and Vietnam are substantially reduced, being less than a 1% gain. If we do not consider interrelated sectoral linkages, the TPP members' welfare effects remain still relatively small.

The middle panel presents the results for the EU members and China. The results are similar to those for the TPP member countries. When we assume no intermediate goods, for the EU countries and China, the welfare effects become smaller except for the Netherlands. If we assume no sectoral linkages, many EU countries' welfare effects remain as negative. These results indicate that substantial parts of positive externalities of the TPP tariff reductions come from the intermediate goods and sectoral linkages.

The lower panel of this table presents the results for the other TPP non-member countries. When we assume a single tradable sector, welfare increases for some countries while for others it decreases. Accounting for intermediate goods and sectoral linkages in production increases the welfare effects for many countries.

It is worth noting that Ireland remains as one of the largest beneficiary among non-TPP members across different assumptions while welfare gains in Malaysia, the largest beneficiary among the TPP members, decrease substantially when we introduce different assumptions, indicating that Malaysia benefits largely from sectoral linkages and trading intermediate goods. Unlike

Table 16: Welfare effects from *TPP* tariff reductions under different settings (unit: %).

		One sector	No intermediate	No I–O linkage
TPP members	Australia	−0.45	−0.08	−0.15
	Canada	0.84	0.07	0.08
	Chile	2.53	0.76	1.04
	Japan	0.64	0.22	0.25
	Malaysia	5.52	0.97	1.36
	Mexico	−0.74	−0.29	−0.38
	New Zealand	−1.57	−0.54	−0.75
	United States	−1.36	−0.39	−0.49
	Vietnam	2.06	0.63	0.75
EU members and China	Austria	−2.43	−0.61	−1.00
	China	3.22	0.96	1.24
	Czech	−2.10	−0.47	−0.92
	Denmark	−0.53	−0.05	−0.14
	Finland	2.49	0.50	0.79
	France	−1.21	−0.26	−0.42
	Germany	2.40	0.68	1.11
	Greece	−2.97	−0.60	−0.68
	Hungary	−2.06	−0.40	−0.71
	Ireland	14.50	1.81	3.08
	Italy	−0.43	−0.13	−0.22
	Netherlands	0.37	0.02	−0.03
	Poland	−2.45	−0.65	−0.87
	Portugal	−2.90	−0.67	−0.84
	Slovenia	−2.54	−0.75	−1.22
	Spain	−2.25	−0.65	−0.83
	Sweden	1.37	0.40	0.55
	United Kingdom	−2.19	−0.43	−0.61
Nonmembers and rest of world	Argentina	1.79	0.53	0.74
	Brazil	1.82	0.58	0.70
	Iceland	−4.17	−1.28	−1.62
	India	0.03	0.01	−0.01
	Indonesia	7.47	2.05	3.60
	Israel	0.33	0.04	0.05
	Korea	1.34	0.38	0.48
	Norway	9.72	0.83	1.14
	Philippines	5.30	1.30	2.13
	South Africa	0.36	0.08	0.09
	Switzerland	0.61	0.18	0.29
	Turkey	−4.26	−1.22	−1.55
	ROW	0.08	−0.01	−0.03

Note: Caliendo and Parro (2015) propose two calibration procedures. In the first method, trade deficits are assumed constant at those levels given by the data. In the second method, trade deficits are assumed zero. It might be controversial that even if the underlying assumptions of the model change, trade deficits do not. Accordingly, to conduct this analysis, we use the method with the assumption of zero-trade surpluses.

Malaysia whose exports are relatively diversified, Ireland has chemicals as a major exporting sector, which is a driving force of the welfare gains for Ireland. This result emphasizes the importance of taking into account multiple sectors and intermediate goods in the evaluation of the impact of trade policy on welfare.

5 Concluding Remarks

Because the TPP is one of the largest ongoing economic integration agreements in terms of economic size and trade volume, we should carefully study its associated welfare and trade effects on not only member countries but also nonmember countries. This paper analyzed the trade and welfare effects of the TPP tariff reductions using comprehensive data on the TPP members and nonmembers alike, including members of the ASEAN and the OECD, and the rest of the world.

For the analysis, we employed the frontier method proposed by Caliendo and Parro (2015), which incorporate multiple sectors, intermediate goods, and sectoral linkages. Our findings are as follows. All TPP members gain from the TPP tariff reductions, and the terms of trade effects are larger than the volume of trade effects. Many nonmembers also gain, suggesting positive externalities arising from the TPP tariff reductions. For these countries, the volume of trade effect is relatively small and most of gains are from the terms of trade effect. Sectors with higher shares of intermediate goods in production and greater sectoral linkages such as textile and machinery tend to have larger contributions to the overall welfare effects. The TPP members increase their imports from other TPP members and decrease from non-TPP members, but the trade creation effects among the TPP members exceed the trade diversion effects between the TPP members and non-TPP members.

We also find that the welfare gain is greatest for Malaysia among members, Ireland among the nonmembers and Malaysia's gains are greater than those of Ireland. However, under different assumptions of the model (i.e., assuming one sector, no intermediate goods, or no sectoral linkages), the results do not remain robust. Ireland, where a single sector, chemicals, accounts for more than 50% of its total exports, remains as one of the largest beneficiary among non-TPP members across different assumptions, while most of gains in Malaysia, where exports are relatively diversified, diminish under different assumptions. This result emphasizes the importance of taking into account multiple sectors and sectoral linkages in the evaluation of the welfare effects of trade policies.

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