Institute for Economic Studies, Keio University

Keio-IES Discussion Paper Series

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11 September, 2018
DP 2018-015
https://ies.keio.ac.jp/en/publications/10056/

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Quantifying the EU-Japan Economic Partnership Agreement

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September 3, 2018

Abstract

This paper provides a quantitative analysis of the new EU-Japan free trade agreement (FTA), the biggest bilateral deal that both the EU and Japan have concluded so far. It employs a generalized variant of the Eaton-Kortum (2002) model, featuring multiple sectors, input-output linkages, services trade, and non-tariff barriers (NTBs). It uses the results of an econometric ex post analysis of a related existing FTA, the one between the EU and Korea, to approximate the expected reductions in the costs of NTBs. This approach yields long-run welfare effects for Japan of about 18 bn. USD per year (0.31% of GDP) and of about 15 bn. USD (0.10%) for the EU. On average, the agreement does not appear to harm third countries, but the Americas, Africa and MENA countries slightly lose. 14% of the welfare gains inside the FTA stem from tariffs, the remaining 86% from NTB reform, and the services sector account for more than half. In the EU, value added in the agri-food sector goes up most, while in Japan the manufacturing and services sectors gain.

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1 Introduction

In this paper, we provide a quantitative analysis of the trade and welfare effects of the forthcoming EU-Japan Economic Partnership Agreement (EU-Japan EPA). This free trade agreement (FTA) is the largest agreement that both the EU and Japan have concluded so far, and it is likely to be of systemic relevance. Its conclusion is of strategic importance for both the EU and Japan in times of growing protectionism and unilateralism.

To this end, we employ what Ottaviano (2014) has called "New Quantitative Trade Theory". More precisely, we rely on the model of Eaton and Kortum (2002), extended by Caliendo and Parro (2015), and generalized to include tariffs and non-tariff barriers (NTBs) by Aichele et al. (2016a). While tariff cuts can be directly taken from the text, how the FTA will affect NTBs is hard to ascertain. Our strategy is to evaluate the NTB effects of the recently implemented EU-Korea agreement (entry into force in July 2011) to form expectations about what the EU-Japan agreement can bring. Fittingly, the EU-Japan and the EU-Korea agreement share a common structure, and their provisions are often similar; sometimes, the wording is exactly identical.

This approach complements other studies which have used expert judgements on the expected size of NTB cost reductions. This data-driven strategy makes sure that our assumptions on trade cost savings meet a feasibility checks. One advantage of the theoretical framework is that the model can be solved in changes, so that we do not need to estimate the initial level of trade costs. Information about trade cost changes is enough, and the econometric ex post evaluation of the EU-Korea agreement provides us with just these data for a large number of goods and services sectors, and separately for EU and Japanese market access costs.

The EU-Japan Economic Partnership Agreement was formally signed on July 17, 2018 and came into the ratification process. Both sides aim for a validation by March 2019. Of course, this is just the culmination of a long history of cooperation between Japan and the EU. For example, since 2004, a cooperation framework to promote two-way investment has existed. Since 1999, there is a EU-Japan Business Round Table whose aim is to facilitate dialogue and exchange of views between EU and Japanese businesses. Since 1979 the European Commission has been encouraging European enterprises to enter the Japanese market and has given them concrete assistance through promotion programs such as the Executive Training Program and the EU Gateway Program.

At the EU-Japan Summit of 28 May 2011, the EU and Japan agreed to work towards a new framework for their bilateral relations and to explore the desirability to pursue an FTA. In line with the summit conclusions, a joint scoping exercise was conducted to determine the scope and the level of ambition of the joint undertaking. The exercise defined a number of NTBs to trade that both sides considered as obstacles in bilateral trade and investment. Following the successful completion of the scoping exercise, in July 2012 the Commission recommended the Council to launch negotiations for an FTA and in November 2012 the Council authorized the Commission to start the negotiations. The first round of negotiations took place in Brussels in April 2013. In December 2017, negotiations were formally concluded.

The text of the EU-Japan agreement is available and can be compared with that of other FTAs such as the EU-Korea or the EU-Canada FTAs. Generally, the assessment is that the EU-Japan agreement falls short from the level of ambition adopted in the EU-Canada agreement (CETA); see Dreyer (2018). Rather, there are important parallels between the EU-Japan agreement and the FTA which the EU has negotiated with Korea and which is in force since 2011.

The parties have agreed to gradually phase out virtually all tariffs, often over rather long transition periods, and to increase certain quotas in the area of agriculture. In the area of industrial tariffs, Japan has low or zero most-favored-nations (MFN) tariffs before the agreement; the EU's tariffs on cars or motor cycles are more substantial. In contrast, Japan has stronger tariff protection in the agri-food sectors. Modelling the tariff reductions is straight-forward, even if the high level of aggregation needed in a quantitative model hides some interesting product-level variation. However, much of the text of the FTA deals with NTBs. These concern wide-ranging issues such as the protection of Geographical Indicators, public procurement (both offensive interest of the EU), auto standards, general regulatory cooperation, and many areas more.

Several quantitative impact assessments with respect to the EU-Japan free trade agreement have been presented over the past years with differing main focus. The EU's Directorate General for Trade has published a quantitative study in 2010 conducted by Sunesen et al. (2010) that assesses the impact of bilateral barriers to trade and investment between the EU and Japan. This study accounts for both a reduction in tariffs and the costs of NTBs with two possible extreme scenarios, both informed by expert judgement. Based on a conventional CGE model, the study finds that trade creation effects would be strongest in the area of agrifood, the chemicals (incl. pharmaceuticals) industry, followed by motor vehicles and medical equipment. The study concludes that a combination of both bilateral elimination of tariffs and the reduction of non-tariff measures would be beneficial to firms and consumers in both economies and economic welfare will increase by 33 bn. Euro in the EU and 18 bn. Euro in Japan. A third of the benefits for the EU originate from tariff dismantling, the rest are expected from NTB reduction. For Japan, the vast majority of benefits result from NTB reduction.

A second analysis of an EU-Japan free trade agreement is presented by Benz and Yalcin (2015). The contribution of this paper is to account for the importance of intra-industry trade in a quantitative Melitz (2003) model extended by a search-matching framework of the labor markets. Clearly, there are differences not only in bilateral trade barriers but also in how efficient the EU and Japanese labor markets work. The new and important aspect of this study is the modelling of the different labor markets in the considered economies. The simulations of the specific model predict that tariff elimination will result in a 0.07% increase of Japanese GDP while the EU's GDP is expected to grow by an additional 0.02 %. Growth effects are substantially larger in a comprehensive liberalization including NTB reductions, with Japanese GDP increasing by 0.86 per cent, whereas GDP in the EU will rise by 0.2%. The expected amount of additional employment created from the trade agreement is relatively low. Instead, however, the model predicts strong firm entry and exit dynamics in both Japan and the EU, meaning that less productive firms are forced out of the market and more productive firms expand. Aggregating these effects, Japan and the EU experience a significant increase in productivity in the tariff plus NTB reduction scenario, around 0.5 per cent for Japan and 0.1 per cent in the EU. The downside of the analysis is that it adopts a single-sector perspective and features only three countries (EU, Japan and the rest of the world).

A third report has been carried out by European Commission (2016). This Trade Sustainability Impact Assessment (Trade SIA) expects long-term GDP growth after an EU-Japan FTA amounting to 0.76% for the EU and 0.3% for Japan if symmetric liberalization policy is applied. Moreover, bilateral exports are estimated to increase by 34% for the EU and by 29% for Japan, while the total export increase is at around 4% for the EU and 6% for Japan. Export driven growth is particularly important in food and feed, where bilateral exports from the EU could increase by 294%. Motor vehicles, medical devices, and pharmaceuticals/chemicals are also expected to grow above average. Different from Benz and Yalcin (2015) and our approach, results rely a lot on dynamic gains from trade, where substantial uncertainties pertaining to model choice and calibration exist, so that the effects are likely to define upper bounds.

Further, the European Commission recently published an economic impact assessment of the EPA by applying a recursively dynamic applied general equilibrium model. The implemented trade shocks of the counterfactual scenarios consist of tariff and non-tariff reductions. Tariffs are reduced according to the observable tariff lines of the EPA. Further, the authors qualitatively assess the potential reduction of technical barriers to trade (TBTs) and Sanitary and Phytosanitary Standards (SPSs) by conducting the negotiation achievements in each of the sectors. The agreement leads to a balanced outcome for the EU and Japan. The study expects an increase of 0.14% of GDP, and additional 13 billion EUR of EU exports to Japan. Further, this agreement generates considerable gains in sectors, such as agriculture, beverage, textile products (see European Commission (2018)).

A recent study of Lee-Makiyama (2018) provides profound information on the relationship between the EU and Japan and offers information about the existing potential for growth and prosperity in both regions once the EPA is completely implemented. The author substantiates the existing potential for both trading areas for investments and sales abroad and the concomitant diversification and thus lowering of risks, once easier access is granted to each of these stable market environments.

There is a also a quantification conducted by the Cabinet Office of Japan (2017). Their CGE model takes into account TFP increased by trade liberalization, labor supply in response to real wage and capital accumulation by investment. As a result, they find that the real GDP increases around by 1%, although it is smaller than the impact of TPP11 (1.5%). Again, given the reliance on dynamic gains from trade, the results may identify upper bounds.

Finally, Kawasaki (2017) uses the GTAP model to measures the impact under the assumption that tariff rates go to zero immediately and non-tariff barriers (NTBs) are reduced by 50%. He finds that Japan's real GDP increases by 0.99%, compared to the case of no-EU-Japan FTA. In detail, GDP increases by 0.26% in tariff reduction and 0.73% in NTBs reduction. Furthermore, if the British exit of Britain from the EU is account for, GDP is increased by 0.94% in total. He concludes that NTB reduction is a bigger impact than tariff reduction.

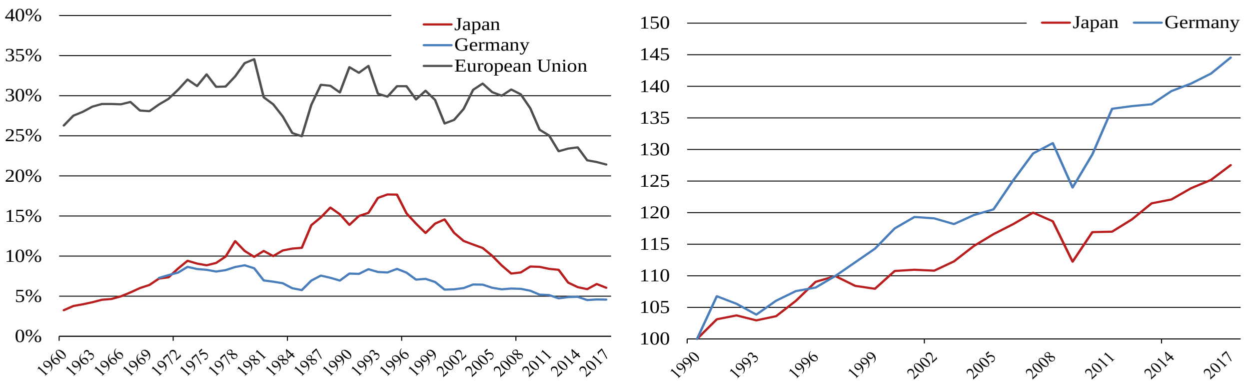
None of the existing studies relies on a New Quantitative Trade Model. All of them require information on the initial size of NTBs for all sectors around the world and depend on expert judgement in determining the size of NTB cost reductions for simulations. However, it turns out that many of the qualitative predictions of earlier work actually are quite comparable to our findings. For ever, we find that the largest gains for Europe are to be found in the agri-food sector, while in Japan various manufacturing sectors are bound to benefit most followed by sevices. However, we document a number of novel results: First, the ex post evaluation of the EU-Korea agreement shows that EU market opening has been less substantial than that of its Asian partner, and quite heterogeneous across sectors. Second, our results suggest that transplanting these results in our simulations, in absolute terms Japan and the EU reap very similar welfare gains, but relative to baseline, Japan's gains are three times as large as Europe's. Third, we find that the structure of Japanese regional value chains changes as firms source more from Eastern Europe but less from ASEAN countries. Fourth, we report a substantial degree of heterogeneity between different EU members and Japan in terms of overall welfare gains and their origin. Italy is bound to benefit more than Germany due to gains in agri-food and fashion. Finally, the Brexit reduces the value of the FTA to Japan by about 20%; the implementation of the Transpacific Partnership agreement, in turn, has little importance.

The remainder of the paper is organized as follows. Section 2 presents the methodological framework. Section 3 discusses the main data sources. Section 4 explains the empirical estimation method and discusses the gravity results. Based on the defined EU-Japan scenarios, we examine general equilibrium consistent results on trade and welfare in section 5. The final section concludes.

2 Descriptive Statistics

Measured at current market prices, the Japanese and EU economies combined account for 22 150 billion US-Dollar of GDP and 640 million consumers. As evidenced by Figure 1, both economies have experienced a decline in their relative importance since the early 1990s. However, the recent growth experience differs. Since 1990, real per capita GDP of Japan has gone up by little more than 20% while in Germany it has increased by about 40%.

Figure 1: Shares in world GDP, current USD (1970-2015) and evolution of real GDP per capita in purchasing power parities, 1990=100, 1990-2015



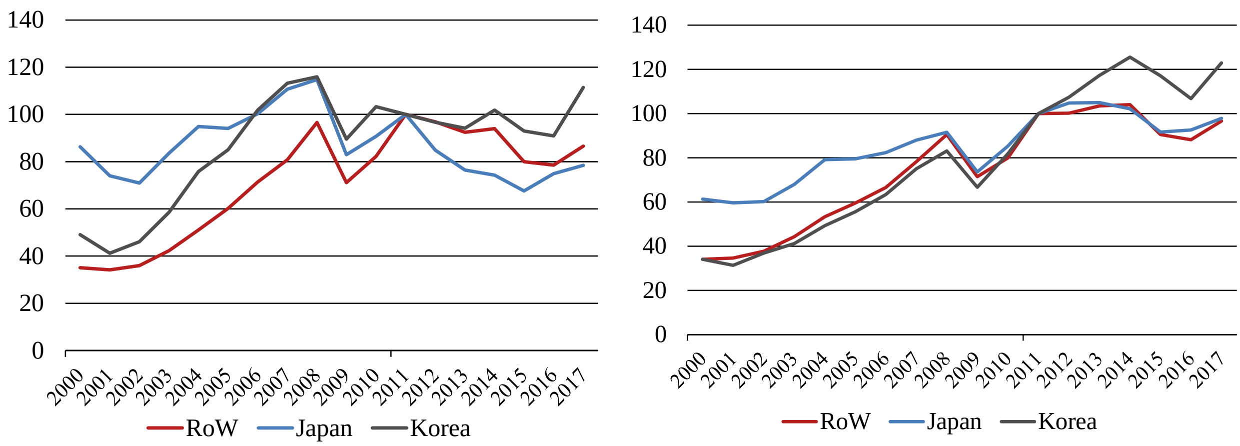
Source: World Development Indicators (2018), World Bank; own calculations.

From the Japanese vantage point, the EU market is interesting and relevant because of its sheer size. So far, due to high tariffs in the EU, Japanese firms have often preferred to establish local production sites rather than to export. From the EU's view, Japan is an extremely interesting but ambivalent market: it is technologically very advanced as a main innovator of automated and robotized manufacturing. It has one of the world's best infrastructures. On the other hand, its economy is dominated by small and medium (SME) companies, and technology adoption in businesses is often sluggish. And the country is

Figure 2: Evolution of EU Bilateral Trade with Japan, Korea and the rest of the world

(a) EU bilateral imports

(b) EU bilateral exports



Source: UN-Comtrade (2017), own calculations. 2011 normalized to 100.

still relatively protectionist, in particular when looking at non-tariff barriers; see European Commission (2016). Moreover, even if China may have surpassed Japan in terms of real GDP in 2012, Japan remains almost equal to the size of the Chinese market measured in consumption, given China's structurally low rates. As investors, Japan and China are also of equal importance, at 8.4 and 8.6% respectively of global FDI outflows. Compared to other OECD countries, Japan is a relatively closed economy. In 2011, only about 13.5% of its final demand is spent on foreign value added. For example, in Germany, the share is about 25%; in the USA it is about 15%. Clearly, larger economies tend to serve a larger fraction of domestic demand with domestic production. Opening the market through the EU-Japan Economic Partnership Agreement might yield positive effects on Japan's economy and also for the EU members.

Figures 2a and 2b depict the evolution of EU-Japan trade relative to EU-Korea trade over the last decade. Using yearly data, the figures show that since the inception of the EU-Korea FTA in July 2011, both EU exports and EU imports to and from Korea have outperformed Japanese trade with the EU as well as overall EU trade. Without providing a formal proof, the illustrations highlight the possibility that the divergence is due to the FTA. It also visualizes the hope that a trade agreement with Japan could trigger a similar development. We turn to a more rigorous econometric analysis below.

Table 1 illustrates the initial bilateral trade relationship between the EU and Japan. The first column shows the different sectors. Column two depicts the volume of the initial total EU exports in bn USD. The third column shows the EU's share of exports to Japan, per sector. The remaining columns show the same patterns for Japan as exporter. If one looks at the shares of exports, it becomes obvious that only a relatively small proportion of EU's exports go to Japan. It is striking that although Japan amounts to almost 8% of world GDP (excluding the EU), the EU countries deliver not more than 3% of their overall exports to it. Thus, there appears ample room to expand trade. The shares are especially small for EU's competitive manufacturing sectors, such as the machinery, automotive, or electronic equipment sectors. This looks different in Japan: Compared to Japan's total exports per sector, the share that goes to the EU is larger. This is especially evident in the services sectors.

Table 1: Initial sectoral bilateral trade between EU and Japan

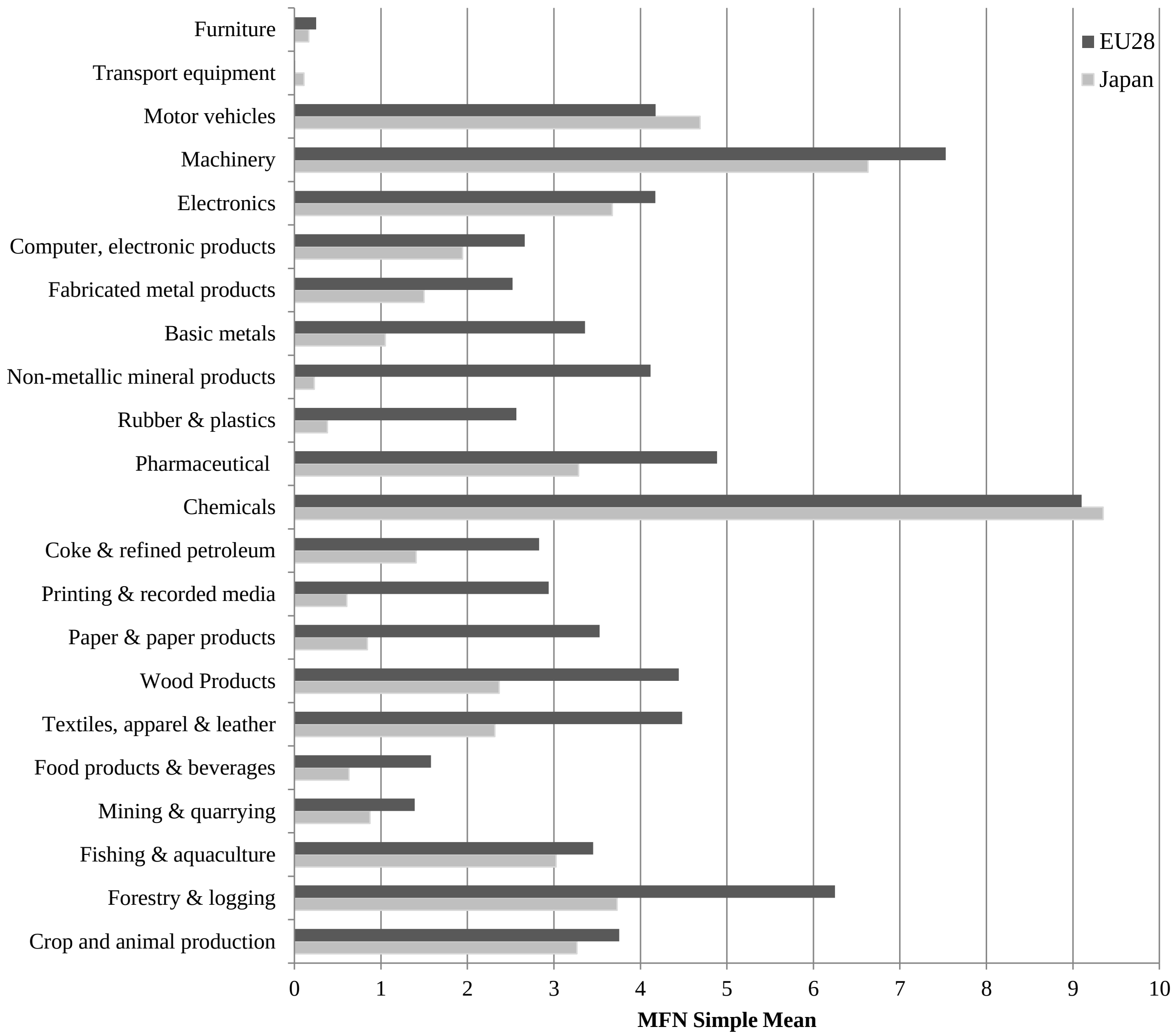
	EU Total Exports in bn USD	Share of Exports to Japan in %	Japanese Total Exports in bn USD	Share of Japanese Exports to EU in %
Agrifood	538	1.3	538	1.3
Automotive	679	1.4	163	11.5
Chemicals	1067	2.1	124	11.8
Electronic Equipment	241	0.8	89	11.8
Energy	32	0.1	0	0.7
Financial & Business Services	722	2.3	30	30.8
Machinery and Equipment	1234	1.3	294	13.5
Other Manufacturing	93	1.7	10	16.4
Metals	537	0.7	91	8.0
Raw Materials	585	0.8	39	8.5
Other Services	341	2.0	21	25.8
Textiles & Apparel	226	1.7	11	9.4
Trade and Transportion	515	2.9	39	31.9

Note: GTAP 9.1 (2011); Own illustration. The shares are based on total EU exports and imports including intra-EU trade.

A large share of these traded products between Japan and the EU is subject to tariffs which comply with the World Trade Organization's (WTO) regulations. At the same time, in both regions around one quarter of products are not subject to such import duties. Across all goods that are protected by tariffs around 85% of the bound duties turn out to be below 10%-points. Except for a handful of traded goods with tariff peaks, the remaining product lines reach import duties of around 30 per cent in the EU and 35 per cent in Japan. Peak tariff rates reach 60 per cent in Japan and 75 per cent in the EU. Figure 3 summarizes the prevailing applied tariff rates for EU industries for which trade data is available. The figure illustrates the simple average tariffs, which sometimes substantially differ from the weighted ones.

Further, figure 3 illustrates the equivalent Japanese tariff distribution across the same industries as depicted for the EU. While Japan also shows a strong tariff variation across the listed industries, interestingly tariff rates in most of the industries turn out to be on average

Figure 3: Japanese and EU import tariffs (%)



Source: WTO Tariff Profiles; own illustration.

lower than in the respective European industry. Tariffs for machinery products e.g. are on average at around 7.5% in the EU and 6.6% in Japan. It is possible for Japan to circumvent relative high tariffs e.g. in the machinery sector because a certain share of Japanese products are produced within the EU, while at the same time European companies serve the Japanese market with the full range of products in the machinery industry predominantly via trade. One expectation resulting from this tariff pattern is that reciprocal tariff liberalization between the EU and Japan will most likely be relatively more beneficial for EU exporters if compared with expected Japanese exports. These simple statistics demonstrate that for a critical number of traded products tariffs still represent a sizeable barrier and their elimination is relevant for additional welfare gains. At the same time it is worth to emphasize, that in comparison to other countries the average tariff rates between the EU and Japan are on average relative low (e.g., China has a simple average MFN-bound rate of 10 per cent). It is therefore unlikely that elimination only of these relatively low tariffs will lead to strong trade and output effects in the aggregate.

3 Model

The model is described in detail in Aichele et al. (2016b) who extend the model of Caliendo and Parro (2015). The framework is a multi-sector version of the Eaton and Kortum (2002) model, a multi-country Ricardian general equilibrium model extended to incorporate rich value chain interactions, and non-tariff trade costs. The general class of models is described in detail by Costinot and Rodriguez-Clare (2014).

3.1 Consumption and production

The model has N countries, which are indexed by i, n and the J sectors by j, k. The representative consumer utility over final goods consumption is indexed by C_n^j and follows Cobb-Douglas preferences. α_n^j denotes the sectoral expenditure shares

$$u(C_n) = \prod_{j=1}^{J} {C_n^j}^{\alpha_n^j}, \tag{1}$$

with $\sum_j \alpha_n^j = 1$ and a country's labor force L_n is mobile across sectors (e.g. $L_n = \sum_{j=1}^{J} L_n^j$), but not across countries.

A continuum of goods ω^j is produced with labor $l_n^j(\omega^j)$ in each sector j and with a composite intermediate input $m_n^{k,j}(\omega^j)$ of each source sector k. This gives us the following production function:

$$q_n^j(\omega^j) = x_n^j(\omega^j)^{-\theta^j} \left[l_n^j(\omega^j)\right]^{\beta_n^j} \left[\prod_{k=1}^{J} m_n^{k,j}(\omega^j)^{\gamma_n^{k,j}}\right]^{(1-\beta_n^j)}, \tag{2}$$

Every sector j of each country n has a value added share, $\beta_n^j \geq 0$ and the cost share of source sector k in sector j's intermediate costs$\gamma_n^{k,j}$, with $\sum_{k=1}^{J} \gamma_n^{k,j} = 1$, which indicates that sectors are interrelated because sector j uses sector k's output as intermediate input and vice versa. The inverse efficiency of good ω^j in sector j and country n is the $x_n^j(\omega^j)$, while θ^j is the dispersion of efficiencies in a sector j. The lower θ^j the lower is the dispersion of productivity across the goods ω^j.

An input bundle's dual cost c_n^j depends on the wage rate w_n and the price of the composite intermediate goods k of country n.

$$c_n^j = \Upsilon_n^j \; w_n{}^{\beta_n^j} \left[\prod_{k=1}^{J} p_n^k{}^{\gamma_n^{k,j}} \right]^{(1-\beta_n^j)}, \tag{3}$$

The only difference between the sectoral goods ω^j is their efficiency $x_n^j(\omega^j)$, thus the goods can be depicted as x_n^j. Υ_n^j is a constant.

We denote by the trade costs of delivering sector j goods from country i to country n by κ_{in}^j. They consist of ad-valorem tariffs $\tau_{in}^j \geq 0$ and iceberg trade costs $d_{in}^j \geq 1$. So, $\kappa_{in}^j = (1 + \tau_{in}^j) d_{in}^j$. In line with the gravity literature, the iceberg trade costs are modelled as a function of bilateral distance, regional trade agreements and observable trade cost proxies as $d_{in}^j = D_{in}^{\rho^j} e^{\delta^j \mathbf{Z}_{in}}$. D_{in} is the measure for bilateral distance, while $\mathbf{Z}_{in}$ is a trade cost shifting vector (e.g. RTAs or other trade policies). With perfect competition and constant returns to scale, firms charge the following unit costs:

$$p_{in}^j(x_i^j) = \kappa_{in}^j \left[x_i^j \right]^{\theta^j} c_i^j. \tag{4}$$

Intermediate goods are characterized by the efficiency $x^j = (x_1^j, \ldots, x_N^j)$ of producing countries, and country n searches across all trading partners for the cheapest supplier. Good x^j is bought for price

$$p_n^j(x^j) = \min_i \left\{ p_{in}^j(x_i^j); i = 1, \ldots, N \right\}. \tag{5}$$

Countries differ in their productivity across sectors, which introduces for comparative advantage. A country's produced set of goods follows an exponential cumulative distribution function, and the productivity distribution is assumed to be independent across countries, sectors, and goods. The joint density of x^j is

$$\phi^j(x^j) = \left(\prod_{n=1}^{N} \lambda_n^j \right) \exp \left\{ - \sum_{n=1}^{N} \lambda_n^j x_n^j \right\}, \tag{6}$$

where λ_n^j shifts the location of the distribution, and measures the absolute advantage. In contrast, $\theta^j > 0$ indexes productivity dispersion, thus, comparative advantage.

Each sector j's composite intermediate good q_n^j is produced with a Dixit-Stiglitz CES technology and η^j denotes the elasticity of substitution. $r_n^j(x^j)$ depicts the demand for intermediate good x^j, with sum of costs for all the intermediate goods x^j being minimized, subject to

$$\left[\int r_n^j(x^j)^{\frac{\eta^j-1}{\eta^j}}\phi^j(x^j)dx^j\right]^{\frac{\eta^j}{\eta^j-1}} \geq q_n^j. \tag{7}$$

The demand for x^j is dependent on the variety's price relative to the sectoral price index $p_n^j = \left[\int p_n^j(x^j)^{(1-\eta^j)}\phi^j(x^j)dx^j\right]^{\frac{1}{1-\eta^j}}$:

$$r_n^j(x^j) = \left(\frac{p_n^j(x^j)}{p_n^j}\right)^{-\eta^j} q_n^j. \tag{8}$$

The composite intermediate good q_n^j can then be used for the production of intermediate inputs of each sector k, for the production of final consumption goods.

3.2 Exports

Once one solves for the price distribution and integrates over the sets of goods where each country i is the lowest cost supplier to country n, the composite intermediate goods price is given by

$$p_n^j = A^j\left(\sum_{i=1}^{N}\lambda_i^j\left(c_i^j\kappa_{in}^j\right)^{\frac{-1}{\theta^j}}\right)^{-\theta^j}, \tag{9}$$

where $A^j = \Gamma\left[1+\theta(1-\eta^j)\right]^{\frac{1}{1-\eta^j}}$ is a constant. The prices are correlated across all sectors (via c_i^j) and the strength of the correlation depends on the input-output table coefficients $\gamma_n^{k,j}$.

The expenditure share π_{in}^j for source country i's goods in sector j of country n follows the common gravity equation, can be applied to gross exports:

$$\pi_{in}^j = \frac{\lambda_i^j\left[c_i^j\kappa_{in}^j\right]^{\frac{-1}{\theta^j}}}{\sum_{i=1}^{N}\lambda_i^j\left[c_i^j\kappa_{in}^j\right]^{\frac{-1}{\theta^j}}}. \tag{10}$$

3.3 General equilibrium

Y_n^j denotes the gross production's value of varieties in sector j. Sector j, Y_n^j has to be equal to the value of demand for sectoral varieties from all countries $i = 1, \ldots, N$.[1] The goods

[1] Our exposition differs from Caliendo and Parro (2015) in that they use total expenditure on composite goods instead of total production of varieties as endogenous variable. So in Caliendo and Parro (2015) the

market clearing condition is given by

$$Y_n^j = \sum_{i=1}^{N} \frac{\pi_{ni}^j}{(1+\tau_{ni}^j)} X_i^j \qquad \text{with} \qquad X_i^j = \sum_{k=1}^{J} \gamma_i^{j,k}(1-\beta_i^k)Y_i^k + \alpha_i^j I_i, \tag{11}$$

where national income consists of labor income, tariff rebates R_i and the (exogenous) trade surplus S_i, i.e. $I_i = w_i L_i + R_i - S_i$ and X_i^j is country i's expenditure on sector j goods. The first term on the right hand side gives demand of sectors k in all countries i for intermediate usage of sector j varieties produced in n, the second term denotes final demand. Tariff rebates are $R_i = \sum_{j=1}^{J} X_i^j \left(1 - \sum_{n=1}^{N} \frac{\pi_{ni}^j}{(1+\tau_{ni}^j)}\right)$.[2]

The model is closed with an income-equals-expenditure condition, which takes into trade imbalances for each country n into account. The value of total imports, domestic demand and the trade surplus has to equal the value of total exports including domestic sales, which is equivalent to total output Y_n:

$$\sum_{j=1}^{J}\sum_{i=1}^{N} \frac{\pi_{in}^j}{(1+\tau_{in}^j)} X_n^j + S_n = \sum_{j=1}^{J}\sum_{i=1}^{N} \frac{\pi_{ni}^j}{(1+\tau_{ni}^j)} X_i^j = \sum_{j=1}^{J} Y_n^j \equiv Y_n \tag{12}$$

3.4 Comparative Statics in General Equilibrium

In accordance with Dekle et al. (2008), the relative, global change in a variable from its initial level z to counterfactual z' is denoted by $\hat{z} \equiv z'/z$. $\hat{\kappa}_{in}^j = \frac{1+\tau_{in}^{j'}}{1+\tau_{in}^j}(e^{\delta^j (Z_{in}' - Z_{in})})$ denotes the change in trade cost due to the implementation of trade integration agreements.

The counterfactual changes in all variables of interest can be solved by using the following

value of gross production comprises all foreign varieties that are bundled into the composite good without generation of value added.

[2] Instead of the goods market clearing condition, one can also use the expenditure equation $X_i^j = \left(\sum_{k=1}^{J} \gamma_i^{j,k}(1-\beta_i^k)(F_i^k X_i^k + S_i^k) + \alpha_i^j I_i\right)$ as in Caliendo and Parro (2015).

system of equations:[3]

$$\hat{c}_n^j = \hat{w}_n^{\beta_n^j} \left(\prod_{i=1}^{N} [\hat{p}_n^j]^{\gamma_n^{k,j}} \right)^{1-\beta_n^j}, \tag{13}$$

$$\hat{p}_n^j = \left(\sum_{i=1}^{N} \pi_{in}^j [\hat{\kappa}_{in}^j \hat{c}_i^j]^{-1/\theta^j} \right)^{-\theta^j}, \tag{14}$$

$$\hat{\pi}_{in}^j = \left(\frac{\hat{c}_i^j}{\hat{p}_n^j} \hat{\kappa}_{in}^j \right)^{-1/\theta^j}, \tag{15}$$

$$X_n^{j'} = \sum_{j=1}^{J} \gamma_n^{j,k} (1-\beta_n^k) \left(\sum_{i=1}^{N} \frac{\pi_{ni}^{k'}}{1+\tau_{ni}^{k'}} X_i^{k'} \right) + \alpha_n^j I_n', \tag{16}$$

$$\frac{1}{B} \sum_{j=1}^{J} F_n^{j'} X_n^{j'} + s_n = \frac{1}{B} \sum_{j=1}^{J} \sum_{i=1}^{N} \frac{\pi_{ni}^{j'}}{1+\tau_{ni}^{j'}} X_i^{j'}, \tag{17}$$

where $\hat{w}_n$ are wage changes, X_n^j are sectoral expenditure levels, $F_n^j \equiv \sum_{i=1}^{N} \frac{\pi_j^{in}}{(1+\tau_{in}^j)}$, $I_n' = \hat{w}_n w_n L_n + \sum_{j=1}^{J} X_n^{j'}(1-F_n^{j'}) - S_n$, L_n denotes country n's labor force, and S_n is the (exogenously given) trade surplus. We fix $s_n \equiv S_n/B$, where $B \equiv \sum_n w_n L_n$ is global labor income, to make sure that the system is homogenous of degree zero in prices.

Equation 13 shows the shift in unit costs occurring due to changes in input prices (i.e., wage and intermediate price changes). The trade cost changes directly affect the sectoral price index p_n^j, and the changes in unit costs have an indirect effect (see equation (14)).

Once the trade costs, unit costs and prices change, the trade shares will change in response. The intensity of this reaction is driven by the productivity dispersion θ^j. A higher θ^j implies bigger trade changes.

Equation (16) ensures goods market clearing in the new equilibrium and the counterfactual income-equals-expenditure or balanced trade condition is given by equation (17). The change in real income $\hat{W}_n$ is given by

$$\hat{W}_n = \frac{\hat{I}_n}{\prod_{j=1}^{J} (\hat{p}_n^j)^{\alpha_n^j}}, \tag{18}$$

which is the appropriate welfare measure in this model.

To solve the system of equations for multiple sectors, we again relate to Caliendo and Parro

[3]See also Caliendo and Parro (2015). The feature of solving in counterfactual changes rather than levels reduces the set of parameters and moments that have to be estimated or calibrated. In particular, no information on price levels, iceberg trade costs, or productivity levels is needed.

(2015), who extend the single-sector solution algorithm proposed by Alvarez and Lucas (2007). We start with an initial guess about a vector of wage changes. Using (13) and (14), it computes changes in prices, trade shares, expenditure levels, evaluates the trade balance condition (17), and updates the change in wages based on deviations in the trade balance.

The model provides static level effects on real income and trade. As dynamic effects of trade disintegration are not taken into account, it provides a lower bound for the potential effects. Contrary to trade agreements, where effects occur after a phase-in[4], disintegration effects would potentially occur immediately.

4 Model Calibration and Scenario Definition

4.1 Data

We use two main data bases. First, in order to inform our scenarios, we estimate the sector-level trade cost effects of the EU-Korea agreement. For this purpose we use the World Input-Output Database (WIOD) for the period 2000 to 2014. These are the adequate data because we require both a panel dimension and information on intra-national trade to properly identify our estimates.

Second, in order to calibrate the model, we use the Global Trade Analysis Project (GTAP) 9.1 database that provides us the data on expenditure shares α, cost shares β and γ, bilateral trade shares π, countries' total value added $w_n L_n$, and trade surpluses S.[5] The GTAP data is available for the year of 2011. Hence, in what follows, our assumption is that the structure of the world has remained approximately constant since 2011.[6] We do adjust our baseline for observed trade policy changes (new FTAs concluded, changes in tariffs) that occurred between 2011 and 2018.

We take information on bilateral preferential and MFN tariffs from Felbermayr et al. (2018). The trade elasticities for the manufacturing sectors stem from Aichele et al. (2016b) and for services sectors from Egger et al. (2015); see Table A2 in the Appendix.

[4]This is particularly relevant for non-tariff trade costs. Evidence from existing FTAs shows that this phasing-in process usually takes between 10 and 12 years (see, e.g., Jung, 2012).

[5]We could calibrate the model using WIOD, but GTAP has much richer country detail; see Table A4 in the Appendix. This is needed to properly capture the Japanese production networks in the ASEAN region. Further, it can distinguish 56 sectors with 15 of these representing services, while the rest shows agri-food and manufacturing sectors. The GTAP data has no panel dimension, and it does not provide information on intra-national trade.

[6]One could, of course, produce out-of-sample projections on the GTAP data, but we refrain from doing so since this would entail additional measurement error.

4.2 Learning from EU-Korea for EU-Japan

The tariff changes agreed upon in the FTA can be simply taken from the published text. What the numerous vertical and horizontal provisions on NTBs mean for the size of trade costs is however much harder to predict. In this paper, we prefer a data-driven approach over the more conventional strategy to use export judgement. More specifically, we use an econometric ex-post estimation of the trade cost effects of the EU-Korea trade agreement in force since 2011 to approximate the trade cost savings expected from the EU-Japan free trade agreement. This allows us to incorporate sectoral heterogeneity, asymmetry between trade partners, and it also ensures that the scenarios are feasible. The EU-Korea agreement is a modern agreement, which, however, falls short from the most ambitious pacts that the EU (EU-Canada) and Japan (TPP-11) have concluded so far. According to Dreyer (2018), the EU-Japan FTA is more similar to the EU-Korea one in terms of structure, coverage, and depth. Moreover, Korea is more similar to Japan in its economic structure than any other large economy with which the EU has an FTA, i.e., it is a resource-importing country, has significant machinery and automotive sectors, and operates production networks in Asia. Also, Korea and Japan have similar bureaucratic systems and heavy government regulations. Thus, it is plausible that NTBs share similar characteristics. Finally, geographical distance from the EU is similar to Korea and Japan. Likewise, cultural distance (language, business culture) are also comparable. Clearly, our assumption is bold. We view it as complementary to other papers that base scenario definitions on expert judgement.

We use a gravity model consistent with our theoretical framework to estimate the effects of the EU-Korea FTA. The econometric technique isolates the causal effects of the trade agreement from other determinants of bilateral trade such as price levels, the development of the GDP, other trade policy initiatives, or changes in the structure of comparative advantage. Recent developments in the empirical gravity literature as summarized byYotov et al. (2016) are taken into account. The specification uses econometric panel data methods on bilateral sector-level trade flows for the period 2000-2014, which stems from the latest version of the WIOD data. The sample for the main estimation includes all 56 sectors and the estimation is based on more than 1.5 million observations. The use of panel data is necessary because it ensures to comprehensively treat time-invariant trade costs. Second, following Baier and Bergstrand (2007), we are able to treat potential endogeneity of the policy variables of interest. We follow gravity theory to properly define the set of fixed effects that are needed for the estimations. Informed by the sectoral and by the panel gravity literature, the main specification is estimated with exporter-sector-time and importer-sector-time fixed effects in order to account for the unobservable multilateral resistance terms highlighted by Anderson and Van Wincoop (2003). These fixed effects also absorb all other observable and unobservable characteristics on the importer and on the exporter side. Following the recommendations of Santos Silva and Tenreyro (2006) to account for heteroskedasticity and to take into account the information that is contained in the zero trade flows, we use the PPML estimator in order to obtain our main estimates. In the sensitivity analysis we also obtain OLS estimates in the usual log form, hence zero trade flows drop out.

In order to take advantage of all the information contained in the data, we estimate the main specification with data for all years in the sample. This is important because we only have four post-agreement years in the data, namely 2011 until 2014. Bergstrand et al. (2015) argue that the RTA estimates from panel gravity specifications may be biased upward because they may capture general effects of globalisation. In order to address this issue, our main specification follows Bergstrand et al. (2015) and introduces yearly dummy variables.

Baier et al. (2016) further show that the effects of FTAs might be asymmetric. Following Baier et al. (2016), we allow for the effects of the EU-Korea FTA to be different for EU exports to Korea and for Korean exports to the European Union. In addition, we also allow the pair fixed effects to be directional. Finally, in addition to accounting for the specific effects of the EU-Korea FTA, which are of primary interest here, the main estimate also controls for the presence of any other regional trade agreement that may have impacted trade between the countries in our sample during the period of investigation.

Our main estimating equation is derived from equation (10):

$$X_{ij,t}^{k} = \exp\left[\frac{\delta_1^k}{\theta^k} EUKOR_{ij,t} + \frac{\delta_2^k}{\theta^k} KOREU_{ij,t} + \frac{\delta_3^k}{\theta^k}\mathbf{Z}_{ij,t} + \pi_{ij,t}^k + \chi_{ij,t}^k + \mu_{ij,t}^k\right] + \varepsilon_{ij,t}^k. \tag{19}$$

$X_{ij,t}^k$ denotes the nominal bilateral trade flows from exporter i to importer j in sector k at time t, which also include intra-national trade flows. $EUKOR_{ij,t}^k$ is an indicator variable that is equal to one for exports from EU to Korea for the years after 2010, and it is equal to zero otherwise. Similarly, $KOREU_{ij,t}$ is a dummy variable that takes a value of one for Korea's exports to EU after 2010, and it is equal to zero otherwise. $\mathbf{Z}_{ij,t}$ is a vector of included explanatory variables, such as $RTA_{ij,t}$, which is an indicator for the presence of any other regional trade agreement.[7] The control variable is a dummy variables, which takes the value one if both trading partners are part of the agreement at time t and zero otherwise. Further, the vector includes an FTA dummy variable, which takes the value one, if both partners agree to ratify a free trade agreement and again zero otherwise. Moreover, dummy variables for being member of a customs union and GSP-type agreements are included. Further,

[7]The EU Korea FTA is excluded.

the difference between Economic Integration Agreements and other free trade agreements is made. Economic integration agreements go beyond pure tariff reductions and which are more difficult to quantify, because they also affect investments.

Finally, $\pi^k_{ij,t}$, $\chi^k_{ij,t}$ and $\mu^k_{ij,t}$ are exporter-sector-time, importer-sector-time, and directional sector-pair fixed effects, respectively. The two first ones control perfectly for the theoretical multilateral resistances and for all other observable and unobservable variables at the exporter-sector-time and the importer-sector-time dimensions. The latter one absorbs all time-invariant trade costs by allowing them to vary by sector and in each direction of trade. In addition it is equivalent to implementing the average treatment effect methods to account for endogeneity of regional trade agreements following Baier and Bergstrand (2007).

A key aspect for the simulation exercise are unbiased estimates to back out the actual non-tariff barrier effects. Since we are able to also control for observable tariff lines, which then gives us the trade cost elasticities, we can back out the pure non-tariff barrier trade creation effects.[8]

Results based on aggregate trade data. Table 2 shows results based on aggregate trade. The EU-Korea FTA seemingly promoted trade between the EU and Korea, which is supported by the positive and significant estimates of the coefficients on each of the two indicator variables. The agreement increased EU exports to Korea on average by 52% and Korean exports to the EU by 14%.[9] Interestingly, EU exports increased by much more than Korean exports, reflecting an asymmetric reduction in trade costs due to the FTA. This is not surprising, as evidence suggests that NTBs are more pronounced in Korea than in the EU; a similar observation is made for Japan by Lakatos and Nilsson (2017).[10]

Column (2) presents an OLS estimator and finds very similar results. In column (3) we revert to PPML but differentiate between different regional trade agreements. Not surprisingly, we find that membership to the European Customs Union boosts trade quite substantially.[11] One has to be aware of the fact that the estimates presented here are to be understood as partial equilibrium effects, and that additional trade effects from higher incomes as well as

[8]adding $\frac{1}{\theta^k}(1+\tau_{ij,t})$, to the right hand-side of the gravity equation. Since we know the trade cost elasticity $\frac{1}{\theta^k}$, we can then back out the pure non-tariff barrier increase.

[9]The trade creation effects are computed from the estimated effects by applying the formulas $100\% * \exp 0.42 - 1 = 52\%$. All other point estimates presented in the table can be interpreted similarly.

[10]Note that as of 2014, the last year in our sample, the agreement is not fully phased in and the economic effects have certainly not fully ramped up either. Hence, the estimated effects can be understood as lower bounds of the long-run effects. Also note that the asymmetry is not driven by the strong depreciation of the Euro vis-à-vis the Won, as the inclusion of country-year fixed effects effectively controls for currency movements.

[11]Note that this effect is identified through the Eastern Enlargement of the EU only; this explains the relative low effects.

trade diversion effects are not accounted for. These will be dealt with in the subsequent GE analysis. However, the estimates presented can be interpreted as causal effects of the EU-Korea FTA, because determinants of trade other than the trade agreement have been controlled for and, following Baier and Bergstrand (2007) the endogeneity of the FTA is taken care of by bilateral fixed effects.

Table 2: Broad estimates of the aggregate trade effects of the EU-Korea FTA

	(1) Main	(2) OLS	(3) Type of agreement
EU → KOR	0.42	0.42	0.43
	(0.04)**	(0.03)**	(0.04)**
KOR → EU	0.13	0.17	0.14
	(0.04)**	(0.02)**	(0.04)**
Other Regional Trade Agreements	0.02	0.2	
	-0.02	(0.01)**	
Economic Integration Agreements			0.07
			(0.02)**
Free Trade Agreements			-0.07
			(0.02)**
Customs Unions			0.28
			(0.02)**
GSP-type Agreements			0.22
			(0.05)**

Note: Own estimation, based on WIOD (2017) data. Note: Standard errors in parentheses, + p < 0.10, * p < .05, ** p < .01. Number of observations: 1,515,818. All regressions include a full set of yearly dummy variables for international borders for each year in our sample. All regressions use PPML estimates, except (2).

Results based on sectoral trade data. The above evaluation of aggregate data illustrates general patterns. However, for our multi-sector trade model, we require sectoral estimates. Consistent with our theoretical model, we specify sector-level gravity regressions that are similar to the aggregate one used above. Results are shown in Table 3 and in table A1.[12]

The table reveals several interesting results. First, in line with the findings of Table 2, on average, the effects on EU exports are stronger than on Korean exports. However, there is substantial heterogeneity across the sectors, and the available time span is relatively short. 92% of the effects of EU-Korea FTA on EU exports to Korea are positive, with 84% being statistically significant. 73% of the estimates of the EU-Korea FTA's effects on Korean exports to the EU are positive, with more than half of them being statistically significant.

[12]The sector classification is based on the WIOD data. We map the WIOD sectors into GTAP sectors using an appropriate concordance table.

Another interesting pattern is the fact that the effects are on average stronger for goods than for services.

Table 3: Aggregated Sectoral trade creation effects (%) of the EU-Korea FTA

	Trade Creation Effects in %			
	Mean EU(%)	p-value	Mean KOR(%)	p-value
Agrifood	32.24	0.02	25.63	0.07
Raw Materials	43.20	0.07	38.67	0.01
Textiles & Apparel	13.00	0.48	21.05	0.08
Energy	76.30	0.00	44.80	0.00
Chemicals	547.00	0.00	130.00	0.00
Metals	57.10	0.01	12.67	0.65
Automotive	53.60	0.00	30.60	0.02
Machinery and Equipment	50.15	0.03	15.45	0.49
Electronic Equipment	31.00	0.00	24.20	0.01
Other Manufacturing	60.50	0.00	15.40	0.17
Trade and Transportation	158.32	0.07	-11.20	0.11
Financial & Business Services	57.13	0.00	24.03	0.12
Other Services	54.49	0.00	15.25	0.52

Note: Own estimates, based on WIOD (2014) data. The table illustrates the simple mean of the coefficients and p-values of all GTAP sectors, which aggregated into the depicted broad categories. A detailed table can be found in the appendix (see table A1). It depicts each of the coefficients, which are translated into percentage trade creation effects. P-values below 0.10 denote statistical significance at least at the 10 percent level. If cell is blank it means that no sectoral estimate could be provided due to the lack of sufficient transactions in this area. + $p < 0.10$, * $p < .05$, ** $p < .01$.

The results suggest a relatively symmetric trade-creating effect ranging between 28% (EU exports) and 34% (Korean exports) for the crop and animal production. This result can be translated to the EU and Japan case, because both regions have relatively restrictive barriers for the agricultural sectors and once these decrease, we can expect equal trade creation effects in both regions. In fishing and aquaculture, the trade creating effects amount to 102% for the EU, while we have no evidence for higher exports from Korea to the EU. This result is also plausible for the EU-Japan example, because Japan's non-tariff barriers seem to be stricter compared to international standards in the fishery sector. Satisfying the required quality and safety standards can be costly. A trade liberalization with accompanying decreases of strict non-tariff barriers will lead to higher trade creation effects for the respective trading partners (here: the EU). In the area of processed food, beverages, and tobacco, the situation is relatively balanced with positive effects of 29% on EU exports and of 18% on Korean exports. Trade in textiles, apparel, and leather was stimulated as well, but the effects do not come out as statistically significant. This is different for the manufacture of wood and cork, where, albeit from low initial levels, exports went up by 41% and 36%, respectively.

Substantial trade creation effects are reported in the manufacturing sectors. The effects tend to be stronger for the EU than for Korea. The automotive sector (ID 20) plays an especially important role. While Korean exports have grown by 47%, the EU exports increased by some 41%. In contrast, EU exports in the transport equipment sector expanded by almost 80% and is thus a much more asymmetric development. The effect is mainly driven by the aircraft sector. Korean exports, on the other hand, did not grow.[13]

Further, the econometric analysis shows strong heterogeneity across the services sectors. Though, some effects are very large numerically, one has to be aware that they are mostly not statistically significant, because the level of trade was almost zero in the initial situation.

The analysis reveals rather symmetric trade creation effects for the construction industry (ID 27). While, the EU exports increased by 39%, the Korean exports expanded by 26%. Retail trade is confronted with positive effects of 54% for the EU and of 27% for Korea.

The air transport services expanded substantially (In the EU by 84% and 33% in Korea). The effects on trade in postal services (ID 35) or in audiovisual media (ID 38) are not statistically significant. The publishing and telecommunication services exports from Korea to the EU could not benefit, while the effect is positive for the vice versa case.

Large trade creation effects are evident in both financial services sectors, but the EU benefits more than Korea. This can also be seen in other services sectors. Exports in the EU's insurance sector (ID 42) more than doubled while Korean exports grew by only 30%. The advertising sector (ID 48), public administration and defence do not experience trade creation effects. Opposed to that, EU exports to Korea increase by 117% in the health care sector. Korean exports to the EU in this sector increased as well, but only by 6%.

4.3 Counterfactual Scenarios

In our scenarios, we assume that tariffs are driven to zero, and non-tariff barriers are reduced in similar fashion as documented above for Korea. For that purpose, we use the results of our ex-post evaluation of the EU-Korea FTA and the estimates of $1/\theta^k$ reported in Table A2 in the Appendix to calculate the implied changes in iceberg trade costs following equation (4).

There are several reasons why our results show a lower bound of the potential outcomes: First, Japan is a larger economy than Korea. Evidence from the literature shows that larger

[13] The point estimates of the petroleum sector (ID 10) is 1.867 for EU exports and suggests that trade has multiplied by a factor of 5. This is a somewhat surprising result, but has also been noticed by Forizs et al. (2016). Accordingly, the EU mineral product exports increased substantially in 2012 and tapered off in the subsequent years. Supposedly the main drivers were increased EU oil exports, liquefied natural gas and oil preparations.

countries have more bargaining power in trade negotiations, which might lead to higher benefits for the ones estimated for Korea. Second, the data available for the structural gravity estimation to identify the causal effects for the NTBs goes from 2011 to 2014. Thus, the effects stemming from the EU-Korea FTA might not fully be observed in the data, because FTAs take longer time to fully unfold. The more general reason for the relatively low welfare gains lies in the calibration used using in this project. Due to a very conservative parameterization, welfare gains are low. Moreover, the model features only static gains; the dynamic gains from trade are not modeled. They can be very substantial; see Felbermayr and Gröschl (2013) for empirical evidence.

Moreover, Japan has a different way of serving foreign markets compared to most EU countries. Rather than producing at home and to export, its firms serve foreign markets via local production. Through this strategy, Japanese firms have insulated themselves from trade costs; however, as a consequence, lowering trade costs is of relatively little advantage to them. So, Japanese exports do not rise too much in absolute and in percentage terms. Imports, bound by the model to exports in order to keep trade surpluses constant at their 2014 level, and cannot increase very strongly, neither. This also keeps welfare gains down. Since Jung (2012) finds that FTAs take between 8 and 12 years to fully unfold, we square the trade cost savings factors, such that we effectively estimate the general equilibrium effects after an implementation period of 8 years. Given the findings of Jung (2012), we may underestimate the true effects by as much as 50%.

S1: The first counterfactual scenario replicates a deep and comprehensive free trade agreement with complete tariff elimination in all sectors. Further, the non-tariff measures modelled to the example of the EU-Korea agreement of 2011 are reduced at the respective amount for the EU-Japan trade partners. Hence, the NTBs are not directly reduced for third countries, but will unambiguously affect third countries via spillover effects. As described above, the baseline assumes the world existing as of January 1st 2018.

S2: Additionally, we compute a scenario that accounts for the exit of the UK from the EU. We therefore construct a baseline, which anticipates Brexit. We model a tough Brexit; i.e., the EU and the UK reintroduce tariff barriers, and non-tariff barriers reemerge to the level observed with other WTO members. Brexit implies that the EU-Japan FTA does not apply to Britain.

S3: The third scenario includes that the TPP-11 agreement of Japan with 10 other pacific nations is already in place. On such a modified baseline, the counterfactual scenario S1 is applied.

5 General Equilibrium Results

Our CGE analysis captures all general equilibrium feedbacks, e.g. those through trade diversion effects or changes in aggregate income. In contrast, the gravity estimates presented in the previous section refer to partial equilibrium effects of the agreement, because incomes and aggregate prices are taken as given. The advantage of our approach is that no direct measures of observed reductions in non-tariff trade costs are needed, and the simulation exercise is cleanly tied to the gravity estimation. The model framework allows for drawing conclusions about the EU-Japan FTA on the structure of bilateral trade flows at the GTAP 9.1. level of aggregation, aggregate trade (volumes and openness measures), levels of value added, employment, emissions, and price levels, both at the sectoral and on the aggregate levels, wages and overall price levels, measures of real per capita GDP and of welfare (compensating variation measures). Simulating the effects of the EU-Japan FTA in the frame of the model, two vectors will change compared to the status quo: first, the vector that reflects tariffs between the EU and Japan and second, the vector that reflects non-tariff measures. While the former is directly observable, the latter one is indirectly estimated by the partial equilibrium analysis.

We report effects on marco- and microeconomic outcomes, such as the real income changes, or sectoral value added and trade changes. In our Ricardian trade model, lowering trade costs allows countries to specialize more strongly in sectors in which the comparative advantage is the strongest. But such a trade liberalization does not necessarily lead to an overall welfare gain. Consumers benefit from lower prices, but they may source from more inefficient countries. At the same time, governments lose tariff income. Moreover, the preferential nature of trade liberalization gives rise to the Viner-ambiguity. The FTA may affect world market prices such that some partner countries could be hurt. Further, the European Union and Japan are both advanced economies with quite similar patterns of their comparative advantage in the manufacturing industry. Once countries have similar technological structures with similar domestic prices, a removal of trade barriers incites small trade flow changes and relatively small welfare gains, respectively. This makes the analysis of the EU-Japan trade agreement especially interesting. The next part will now present the results of the simulations and gives insights about the loser and winners in respect to the trade agreement members, other regions (e.g. Taiwan, ASEAN, etc.) and sectors within these regions.

5.1 Changes in Real Income

This section depicts the real income changes for certain countries and regions (also see equation 18). Table 4 shows the respective real income changes occurring because of an

FTA between the EU and Japan under the three different baseline scenarios. The changes are sorted by the magnitude of effects of S1. The aggregation of the regions can be found in the Appendix A4.

In general, we see a positive change in real income for Japan and the EU across all scenarios. The potential for growth is evident. Japan's economy has been growing slowly after the burst of a real estate bubble in 1992. Measured in purchasing power parities the real per capita income has grown by only about 0.77% per year, while Germany's real per capita income increased by 1.35% per year. This resulted in a strong collapse of Japan's share in the value of world output (and demand, both measured in USD) from about 15% in 1990s to the value of 5.6% observed today (Germany: 4.6%). Nonetheless, together the EU and Japan account for more than a third of the world's GDP. Indeed, Japan is the third biggest economy of the world (USD 4,120 bn. as of 2015, measured in current prices), after the US and China, and about 25% greater than Germany. An impulse in the form of a free trade agreement can therefore lead to relatively high changes of Japan's and EU's real income.

The effects for Japan are positive in all depicted scenarios, with the largest effects being evident in S1 and S3. When Japan ratifies the TPP (with Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Vietnam) the changes in real income increase slightly (0.308 to 0.314%) (S3) compared to the S1, because Japan's economy is stronger under the existence of TPP and can therefore trade even more with European Union compared to the first scenario. The positive change on Japan's real income shrinks, once the baseline takes account of Brexit. Not only will a Brexit lead to UK leaving the European Union, but this also connotes that the UK dissolves from existing trade agreements. Japan will then have access to a smaller market with less consumers and potential buyers of Japanese products, which explains the somewhat smaller positive real income effects of Japan in S2. Japan is one of Europe's most important trading partners, which explains the relatively large results for the European countries. All EU countries are expected to benefit. For Germany, the fourth largest economy in the world (measured in current market prices), the effect of the FTA is the largest under Brexit, because Germany will be able to substitute large parts of UK's initial trade with Japan.[14] The ratification of a TPP leads to slightly smaller positive changes than under S1. Interestingly the UK profits more from a Brexit than without.

But as the scenarios show, the remaining countries and regions will most likely loose slightly because of this agreement. The largest losses can be expected in Taiwan, Thailand and South Korea, which are quite dependent on Japan. With the new FTA, there will be trade creation

[14] Germany's real income increases by 0.0775% in scenario 1 and by 0.0804% in scenario 2.

Table 4: Real Income Changes of all Regions, in %

	Real Income Changes in %				Real Income Changes in %		
	S1	S2	S3		S1	S2	S3
Japan	0.31	0.30	0.31	Europe, n.e.c.	0.00	0.00	0.00
UK	0.11	0.12	0.11	India	0.00	0.00	0.00
RoEU	0.10	0.10	0.10	Middle East	-0.00	-0.00	-0.00
Germany	0.08	0.08	0.07	Africa	-0.00	-0.00	-0.00
France	0.07	0.07	0.07	Latin America	-0.00	0.00	0.00
Italy	0.06	0.06	0.07	ASEAN, n.e.c.	-0.00	-0.00	-0.01
Vietnam	0.01	0.01	0.00	Malaysia	-0.01	-0.00	-0.01
Rest of World	0.01	0.01	0.01	China	-0.01	-0.00	-0.01
Oceania	0.01	0.01	0.00	Singapore	-0.01	-0.01	-0.01
Philippines	0.00	0.01	0.00	South Korea	-0.01	-0.01	-0.01
USA & Canada	0.00	0.00	-0.00	Thailand	-0.02	-0.02	-0.02
Indonesia	0.00	0.00	0.00	Taiwan	-0.03	-0.03	-0.03
World	**0.05**	**0.05**	**0.05**				

Note: S1 simulates the EU-JPN FTA based on the baseline that assumes the world existing as of January 1st 2018. S2 simulates the EU-JPN FTA under a hard Brexit. S3 simulates the EU-JPN FTA based on a world with a ratified TPP11.

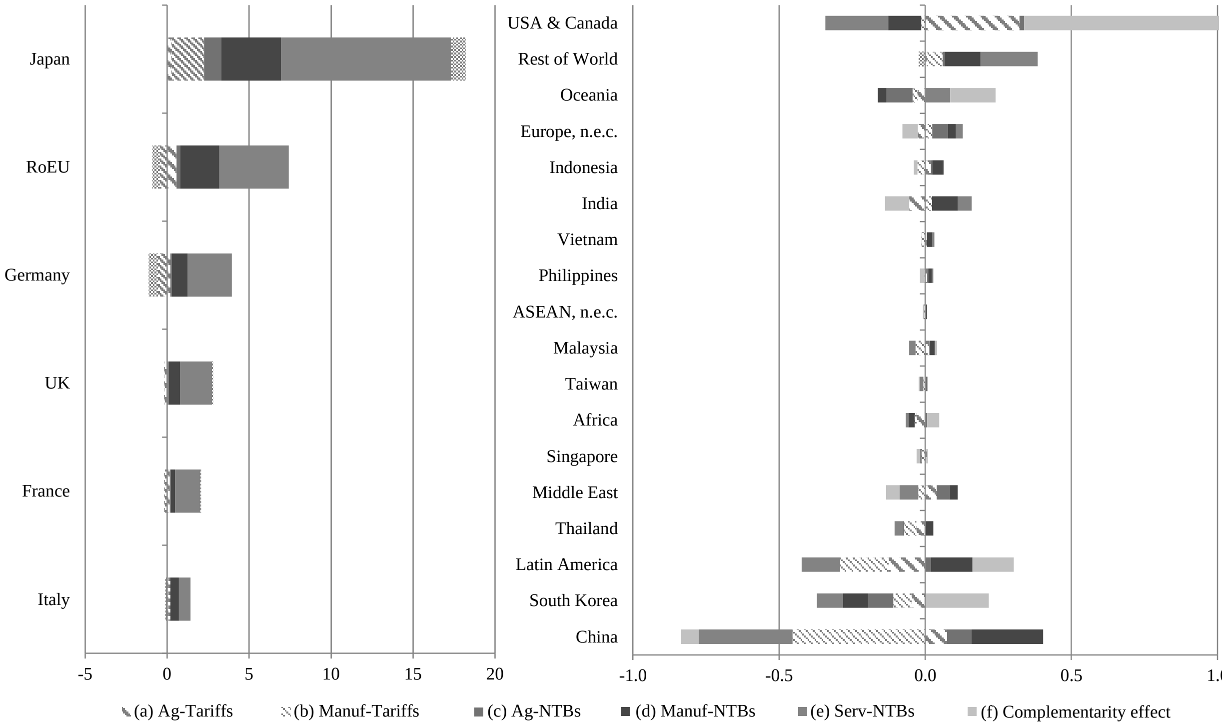
to some extent, but also trade diversion that will substitute existing trade relationships with new ones. A more profound explanation can be found in section 5.4. Interestingly, Vietnam will be able to generate income gains as soon as Japan ratifies the agreement. The gains will even be larger without the TPP 11 than with its existence (compare S1, S2 with S3).

5.2 Welfare Decomposition

Next we decompose the aggregate welfare effects shown above into different parts. More specifically, we distinguish the welfare effect attributable to (a) the elimination of agri-food tariffs, (b) the elimination of manufacturing tariffs, the reduction of NTBs in (c) the agri-food sector, (d) the manufacturing sector and (e) the services sector. This different liberalization steps interact with each other: e.g., the benefits that accrue from NTB liberalization increase when tariffs are lowered, too, as the lowering of NTBs applies to a larger trade base. However, that complementarity effect (f) need not be positive, e.g., if tariff liberalization leads to expansion of trade which is relatively strongly affected by NTBs.

Figure 4 shows the main trade cost drivers of Scenario S1. In both panels, the total gains in real income changes are sorted in decreasing order. The sum of income gains for Japan is 18.8 bn USD. 11% of the total is due to the reduction of manufacturing tariffs; agri-food tariffs add almost nothing. In Europe, the share of gains due to agricultural tariffs is 6%, while tariffs in manufacturing sectors almost shred this positive increase. The reduction of

Figure 4: Welfare Decomposition for Scenario S1, Changes in bn. US-Dollars



NTBs in the services sectors contribute 57% and 73% of welfare gains in Japan and the EU, respectively. The relatively minor role of tariffs for welfare gains is easily understood, given their low initial levels.[15] The complementarity effect is positive in Japan, contributing about 6% to total gains from trade. The reduction of NTB costs allows Japan to diversify its input sourcing particularly in those sectors which benefit strongly from tariff cuts (e.g., automotive). For the EU, in total, the complementarity effect is almost zero.

A couple of interesting additional observations stand out: The UK slightly loses from the elimination of agri-food tariffs between the EU and Japan, because it is a strong net importer of food from the EU where additional demand from Japan drives up prices. The Rest of the World loses from tariff liberalization between the EU and Japan, but slightly benefits from lower NTBs. The reason is that the former measure tends to damage RoW's terms-of-trade, while the latter leads to resource savings which tend to benefit third parties as well. Finally, China is interesting: it loses from the elimination of manufacturing tariffs, but actually benefits from the elimination of agri-food barriers: as Japanese imports are diverted away from the US from where China imports a lot of agricultural goods, China benefits from

[15] As tariff levels are low to start with, "triangular" welfare losses associated to them are small, too. NTB changes, in contrast, give rise to "rectangular" gains.

better prices.

5.3 Changes in sectoral value added

The next part looks at the sectoral value added effects of the EU and Japan. For this purpose, we concentrate on Scenario S1. When interpreting the findings illustrated by Figure 5 one should bear in mind that a reduction in a sector's value added does not necessarily mean that that sector's output shrinks and its gross exports shrink, since the FTA can affect the sectoral depth of value added.

In the services sectors, value added tends to expand in both regions (except finance, which shrinks in the EU). This is due to the fact that substantial NTB (i.e. iceberg) cost reductions act like productivity boosters for manufacturing, and this frees up resources to be used in the sector with the smaller NTB cuts.

The sector with the largest action appears to be agri-food. It adds 7 bn. US-Dollars value added in EU while it sheds 3.1 bn. US-Dollars in Japan. As detailed in the tables A5 and A6 in the Appendix, this is an increase of 0.82% of value added in Europe and a decrease of almost 1.5% in Japan. This result suggest the danger of a disruption in Japanese agriculture, but one needs to bear in mind that the results pertain to the (very) long run, as agri-food liberalization is staged over periods of up to 15 years.

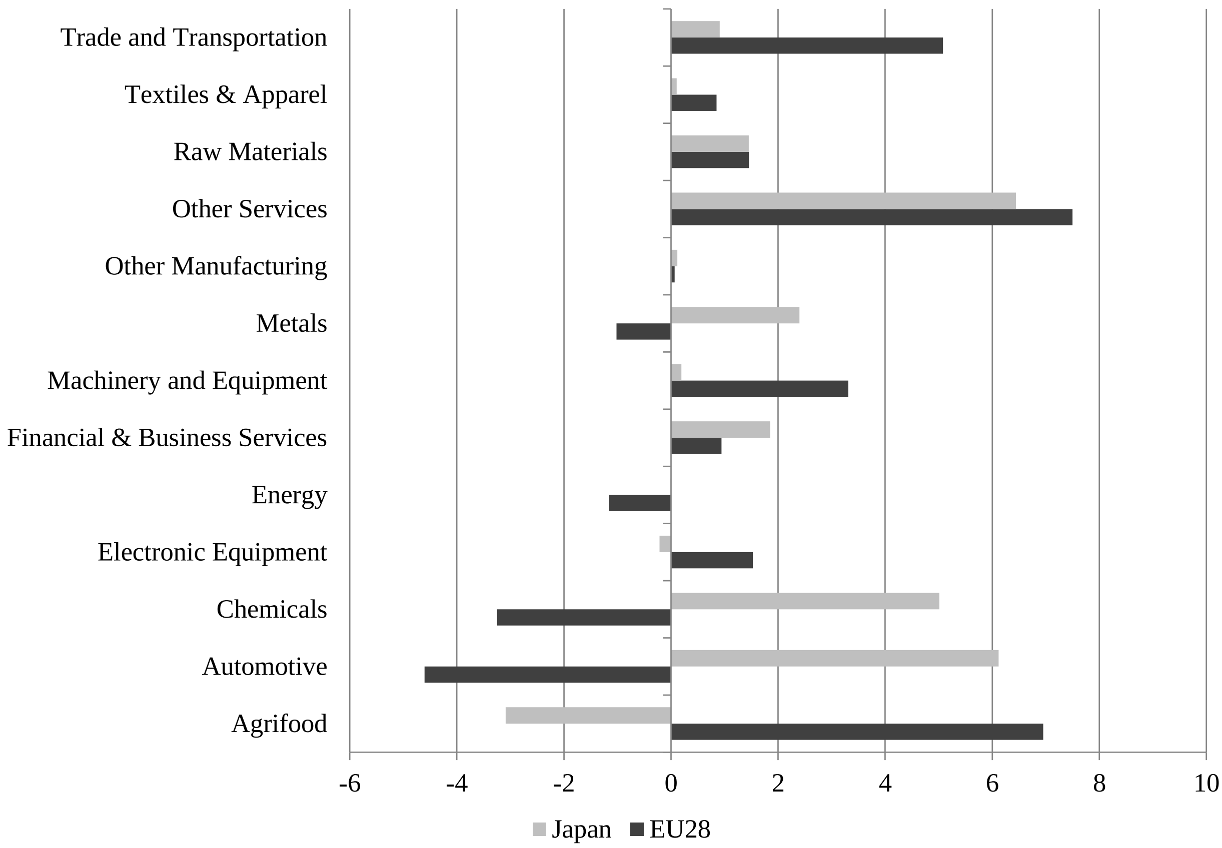
Another sector of substantial churning would be automotive sector. Value added goes up by 6.1 bn. US-Dollars (6.6%) in Japan, while it shrinks by 4.6 bn. USD (1.6%) in the EU. This is because the EU has the higher tariffs, and NTB cost reduction is quite symmetric. A similar situation exists in the chemicals sector, which grows by 3.7% in Japan but shrinks in the EU by 0.5%.

The value added in the service industries increases by a total of 13.5 bn. US-Dollar in the EU and by 9.2 bn. US-Dollar in Japan. Generally, the services sectors tends to absorb resources shed in the shrinking manufacturing (EU) and agri-food sectors (Japan).

5.4 Changes in trade

Outcomes of the two trading regions look quite complementary in the agri-food and goods sector. All the sectors that can generate gains in terms of value added are losing in the other region and vice versa. The only exceptions are the electronic equipment, machinery sector and the textiles and apparel sector. The services sectors behave similarly and are confronted with positive value added effects in both regions. The EU-Japan trade agreement would seemingly lead to diversion effects in the agri-food and goods sectors and to output creation

Figure 5: Effects on Sectoral Value Added, in bn. US-Dollars



in the service industry. The next part will now look into the changes of the trade patterns between Japan and its trade partners on an aggregate and sectoral level. Table 5 shows the change of Japanese exports, while table 6 shows the respective imports. Both tables are identical in their structure. The first column depicts the sectors, which were already shown in the table A5. The remaining columns show the changes of Japanese exports/imports with the EU28, China, ASEAN, Rest of the World and USA/Canada as relative and absolutes changes (in mn USD). The last line shows the aggregate, bilateral trade change per bilateral partner. Let's first concentrate on the Japanese export structure.

Overall, Japan is able to increase its exports towards all countries and regions. Not surprisingly, Japan's exports to the EU increase to the largest extent, by 79 bn USD, which is equivalent to a 64% increase in Japanese exports towards the EU. The export increases towards the remaining countries and regions cannot be neglected either. Chinese imports of Japanese products increases by 23% (470 mio USD), ASEAN by 0.2% (200 mio USD), USA/Canada by 0.33% (520 mio USD) and imports of the rest of the world from Japan by .2% (690 mio USD). Japanese imports from the EU increase by 74%, which is equal to an increase of 83 bn USD. Other than on the export side, Japanese imports from the remaining world decreases by 6.5 bn USD. Trade diversion away from third countries and towards the EU is evident on the import side.

The largest export increase towards the EU can be expected in the automotive sector (20.8 bn USD). Further, Japanese exports towards the EU increase in the chemical industry (14.9 bn USD). The same is true for the machinery and equipment, raw materials and metal industry that export additional products worth 25.3 bn USD more towards the EU. The increase of exports in the Japanese service industry is not negligible either. While the EU is already successfully active in Japan in some service sectors, such as in the construction, health and machinery services, with an export volume of around 2.5 billion, 760 million, and 670 million Euros in 2014, Japanese exports in these sectors turn out to be negligible so far, while in other industries a reversed pattern is prevailing. E.g. in the whole sale services, water transport, and technical activities Japan achieves trade volumes between 2.3 billion and 1 billion Euros while EU exports in the same industries remain on a relative low level. Implicitly, the new trade agreement somewhat balances the observed asymmetries across the different service sectors while at the same time there are several service industries in which both Japan and the EU can increase bilateral trade by eliminating non-tariff barriers and market access regulations, which are the only trade restricting measures in services compared to the primary and secondary industries.

Table 5: Change of Japanese bilateral Exports, in bn USD

	Change of Japanese Exports to				
	EU28 in bn USD	China in bn USD	ASEAN in bn USD	USA & Canada in bn USD	Total in bn USD
Agrifood	0.39	0.01	0.00	0.01	0.41
Automotive	20.76	0.07	0.05	0.21	21.29
Chemicals	14.93	0.01	0.01	0.01	15.00
Electronic Equipment	0.71	0.08	0.03	0.03	0.91
Energy	0.00	-0.00	-0.00	-0.00	-0.00
Financial & Business Services	7.11	-0.01	-0.02	-0.07	6.96
Machinery and Equipment	9.18	0.40	0.17	0.37	10.66
Metals	5.48	-0.02	-0.02	-0.01	5.39
Other Manufacturing	0.11	0.00	0.00	0.00	0.11
Other Services	2.29	-0.02	-0.01	-0.04	2.18
Raw Materials	10.61	-0.03	-0.01	-0.01	10.53
Textiles & Apparel	0.94	0.01	0.01	0.00	0.98
Trade and Transportation	6.71	-0.03	-0.02	0.00	6.66
Total per region	79.21	0.47	0.20	0.52	81.09

Note: The list shows the aggregated sector categories. A detailed sector list can be found in the Appendix, table A3.

Table 6: Change of Japanese bilateral Imports, in % and mn USD

	Change of Japanese Imports from				
	EU28 in bn USD	China in bn USD	ASEAN in bn USD	USA & Canada in bn USD	Total in bn USD
Agrifood	11.51	-1.74	-1.71	-6.15	-5.45
Automotive	2.83	0.09	0.08	0.06	3.13
Chemicals	3.91	0.17	0.14	-0.02	4.16
Electronic Equipment	4.41	-0.30	-0.13	-0.06	3.77
Energy	0.00	0.01	0.29	0.03	2.71
Financial & Business Services	7.29	0.03	0.02	0.14	7.56
Machinery and Equipment	14.62	-1.24	-0.57	-1.03	11.22
Metals	1.15	0.07	0.10	0.02	1.62
Other Manufacturing	0.18	-0.01	-0.00	-0.02	0.13
Other Services	7.19	0.02	0.01	0.12	7.38
Raw Materials	10.46	-0.23	-0.22	-0.06	9.99
Textiles & Apparel	2.20	-4.18	-0.19	-0.12	-2.62
Trade and Transportation	17.36	-0.38	-0.27	-0.84	14.91
Total per region	83.10	-2.93	-0.99	-2.77	76.63

Note: The list shows the aggregated sector categories. A detailed sector list can be found in the Appendix, table A3.

6 Conclusions

This paper provides a quantitative analysis of the trade and welfare effects of the forthcoming EU-Japan Economic partnership Agreement, the so far largest agreement that both the EU and Japan have concluded as of today. Its conclusion is of strategic importance for both the EU and Japan in times of growing protectionism and unilateralism.

We argue that the EU-Japan EPA is comparable to the existing agreement between the EU and Korea in terms of how NTBs are treated by the text. Thus, we carry out an econometric ex post evaluation of the EU-Korea, which entered into force in 2011, to form expectations about how the Japan-EU FTA can affect NTBs. We find substantial NTB cost reductions in all sectors. However, NTBs have fallen more in the Asian country than in Europe. Interestingly and importantly, trade costs appear to go down in sectors which are not explicitly covered by sector-specific provisions, probably due to horizontal provisions and complementarity effects.

Feeding tariff cuts and NTB reductions into our general equilibrium trade model, we find that EU exports to Japan go up by 73% (83 bn. USD); Japanese exports to EU go up by 63% (79 bn USD). In particular, there is very strong growth in agrifood exports for EU, but from much lower level; substantial growth in **automotive** trade; large growth in chemicals (pharma) exports for Japan. We find some evidence that Japanese firms switch input sourcing from ASEAN countries to Eastern Europe.

Europe has large value added gains in the electronic equipment sector which shrinks in Japan. In contrast, Japan gains in automotive and chemicals; both gain in services and machinery. Overall, aggregate welfare effects are quite balanced in absolute size (between 15.2 and 18.2 bn. USD), but three times larger in relative terms in Japan (0.31%) than in EU (0.10%)

In general, the conclusion of the Transpacific Partnership (TPP) agreement (Japan plus 10 other Pacific countries) has little importance for the effects of the EU-Japan FTA. The exit of Britain from the EU, in contrast, slightly reduces gains for Japan. In general, third country welfare effects are small as input-output linkages contribute towards a diffusion of the gains from trade; some ASEAN countries benefit while the Americas, Africa tend to lose a bit from the FTA.

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7 Appendix

Table A1: Sectoral trade creation effects (%) of the EU-Korea FTA

GTAP ID	Sector Description	EU (%)	p-value	KOR (%)	p-value
1	Crop and animal production	28.0**	0.002	33.8**	0.001
2	Forestry and logging	88.5**	0	55.0**	0.009
3	Fishing and aquaculture	102.4**	0	-6.3	0.718
4	Mining and quarrying	76.3**	0	44.8**	0.001
5	Manufacture of food beverages, tobacco	29.3*	0.04	18.4+	0.088
6	Manufacture of textiles, apparel, leather	8	0.643	16.8	0.109
7	Manufacture of wood and cork;	40.9*	0.02	35.7*	0.022
8	Manufacture of paper and paper products	9.3	0.299	31.1**	0.007
9	Printing and reproduction of recorded media	23.0*	0.022	26.0*	0.028
10	Manufacture of coke and refined petroleum	547**	0	130**	0
11	Manufacture of chemicals and chemical products	21.2+	0.074	39.4**	0
12	Manufacture of basic pharmaceutical products	73.8**	0	0.3	0.975
13	Manufacture of rubber and plastic products	23.7*	0.022	37.4**	0
14	Manufacture of other non-metallic minerals	53.6**	0.003	30.6*	0.021
15	Manufacture of basic metals	19.2+	0.054	32.4+	0.053
16	Manufacture of fabricated metal products	31.0**	0.001	24.2*	0.014
17	Manufacture of computer, electronic and optical	81.1**	0	-1.5	0.922
18	Manufacture of electrical equipment	60.5**	0	15.4	0.17
19	Manufacture of machinery and equipment nec.	50.4**	0	0.8	0.942
20	Manufacture of motor vehicles, trailers and semi-trailers	41.2**	0	47.0*	0.04
21	Manufacture of other transport equipment	79.3**	0	2.2	0.823
22	Manufacture of furniture; other manufacturing	10.3	0.265	-12.9	0.144
23	Repair and installation of machinery and equipment	-	-	-10	0.251
24	Electricity, gas, steam and air conditioning supply	238**	0.001	32.6*	0.035
25	Water collection, treatment and supply	385**	0.001	-54.5*	0.027
26	Sewerage; waste collection, disposal;	48.6**	0	3	0.882
27	Construction	39.4**	0	26.1**	0.002
28	Wholesale, repair of vehicles and motorcycles	72.5**	0	25.1	0.252
29	Wholesale trade, except of vehicles and motorcycles	59.5**	0	20.9+	0.092
30	Retail trade, except of motor vehicles and motorcycles	53.6**	0.001	26.7*	0.056
31	Land transport and transport via pipelines	73.0**	0	15.4	0.458
32	Water transport	22.5	0.261	28	0.112
33	Air transport	84.2*	0.033	32.6+	0.079
34	Warehousing and support activities for transportation	45.6**	0.001	1.9	0.862
35	Postal and courier activities	10.6	0.452	-5.2	0.835
36	Accommodation and food service activities	26.2*	0.013	17.9+	0.081
37	Publishing activities	31.4*	0.029	-9.3	0.646
38	Motion picture, video and television, sound	15.7	0.342	-17.6	0.295
39	Telecommunications	78.6**	0	-17.9	0.331
40	Computer programming, consultancy; information	74.9**	0.001	-5.2	0.841
41	Financial services, except insurance and pension	55.9+	0.082	10.4	0.537
42	Insurance, reinsurance and pension funding	106.3**	0	30.2+	0.083
43	Auxiliary to financial and insurance activities	13.2	0.744	-8.2	0.727
44	Real estate activities	-15.5	0.523	40.4*	0.032
45	Legal and accounting, management, consultancy	-27.7*	0.044	26.9*	0.022
46	Architectural, engineering, technical testing	53.3**	0.01	8.4	0.662
47	Scientific research and development	26.0*	0.029	5.2	0.594
48	Advertising and market research	-47.7+	0.061	-18.9	0.214
49	Other professional, scientific, veterinary activities	49.6**	0.024	9.2	0.271
50	Administrative and support service activities	30.9*	0.035	15.6	0.217
51	Public administration and defence	-0.2	0.988	-14.4+	0.054
52	Education	10.4	0.363	-3.3	0.772
53	Human health and social work activities	117**	0	6	0.658
54	Other service activities	42**	0.001	4.9	0.66
55	Undifferentiated goods- and services activities				0
56	Activities of extraterritorial organisations				

Note: Own estimates, based on WIOD (2014) data. The coefficients are translated into percentage trade creation effects. P-values below 0.10 denote statistical significance at least at the 10 percent level. If cell is blank it means that no sectoral estimate could be provided due to the lack of sufficient transactions in this area. + p < 0.10, * p < .05, ** p < .01.

Table A2: Trade Cost Elasticities

GTAP ID	Description	Trade Elasticities
1	Paddy rice	-5.8230
2	Wheat	-1.3217
3	Cereal grains nec	-1.2893
4	Vegetables, fruit, nuts	-1.4956
5	Oil seeds	-1.3217
6	Sugar cane, sugar beet	-1.3217
7	Plant-based fibers	-14.4952
8	Crops nec	-1.8446
9	Cattle, sheep, goats, horses	-2.5031
10	Animal products nec	-3.5222
11	Raw milk	-2.5486
12	Wool, silk-worm cocoons	-2.5486
13	Forestry	-3.7834
14	Fishing	-3.6693
15	Coal	-10.3915
16	Oil	-26.6757
17	Gas	-26.6757
18	Minerals nec	-4.1475
19	Meat: cattle, sheep, goats, horses	-2.5486
20	Meat products nec	-2.5486
21	Vegetable oils and fats	-3.7847
22	Dairy products	-2.8907
23	Processed rice	-9.8984
24	Sugar	-2.5073
25	Food products nec	-3.2790
26	Beverages and tobacco products	-1.3169
27	Textiles	-5.2618
28	Wearing apparel	-2.1010
29	Leather products	-3.7073
30	Wood products	-3.3775
31	Paper products, publishing	-4.6448
32	Petroleum, coal products	-8.6460
33	Chemical, rubber, plastic prods	-4.4832
34	Mineral products nec	-3.3516
35	Ferrous metals	-1.5660
36	Metals nec	-4.8543
37	Metal products	-2.5564
38	Motor vehicles and parts	-4.0680
39	Transport equipment nec	-4.0118
40	Electronic equipment	-2.0006
41	Machinery and equipment nec	-3.3853
42	Manufactures nec	-2.5133
43-57	All Services	-5.9591

Note: The trade cost elasticities for the goods stem from Aichele et al. (2016b). The trade cost elasticities for services stem from (Egger et al., 2015).

Table A3: List of GTAP Sectors

GTAP sector ID	GTAP Sector	GTAP sector ID	GTAP Sector
	Agrifood		**Energy**
1	Paddy rice	15	Coal
2	Wheat	16	Oil
3	Cereal grains nec	17	Gas
4	Vegetables, fruit, nuts		
5	Oil seeds		**Metals**
6	Sugar cane, sugar beet	35	Ferrous metals
7	Plant-based fibers	36	Metals nec
8	Crops nec	37	Metal products
9	Cattle, sheep, goats, horses		
10	Animal products nec		**Raw Materials**
11	Raw milk	13	Forestry
14	Fishing	18	Minerals nec
19	Meat: cattle, sheep, goats, horses	30	Wood products
20	Meat products nec	31	Paper products, publishing
21	Vegetable oils and fats	32	Petroleum, coal products
22	Dairy products	34	Mineral products nec
23	Processed rice		
24	Sugar		**Other Services**
25	Food products nec	43	Electricity
26	Beverages and tobacco products	44	Gas manufacture, distribution
		45	Water
38	**Automotive**	46	Construction
		51	Communication
33	**Chemicals**	55	Recreation and other services
		56	PubAdmin/Defence/Health/Education
40	**Electronic Equipment**	57	Dwellings
	Finance & Business Services		**Textiles & Apparel**
52	Financial services nec	12	Wool, silk-worm cocoons
53	Insurance	27	Textiles
54	Business services nec	28	Wearing apparel
		29	Leather products
	Machinery and Equipment		
39	Transport equipment nec		**Trade and Transportation**
41	Machinery and equipment nec	47	Trade
		48	Transport nec
42	**Other Manufacturing**	49	Sea transport
		50	Air transport

Note: The list depicts all sector,s available in the GTAP 9.0 data. The aggregated sectors used in the above analyses are underlined and bold. Individual underlined and bold sectors, such as the automotive industry are separately illustrated, which is why they are not categorized into another sector.

Table A4: List of GTAP Regions and Countries

Africa	**Japan**	Israel	Ukraine
Ghana			Rest of EFTA
Mozambique	**Latin America**	**Oceania**	Croatia
Kenya	Brazil	New Zealand	Albania
Cameroon	Argentina	Australia	Norway
Uganda	Uruguay	Rest of Oceania	Switzerland
Rest of Eastern Africa	Puerto Rico		Turkey
South Central Africa	Rest of South America	**Philippines**	Rest of Europe
Namibia	Colombia		
Burkina Faso	Dominican Republic	**ASEAN, n.e.c.**	**Rest of World**
Rest of South African Customs Union	El Salvador	Rest of Southeast Asia	Kazakhstan
Nigeria	Chile	Brunei Darussalam	Belarus
South Africa	Panama	Cambodia	Sri Lanka
Benin	Trinidad and Tobago	Lao PDR	Rest of South Asia
Mauritius	Guatemala		Nepal
Ethiopia	Nicaragua	**Rest of European Union (RoEU)**	Rest of former Soviet Union
Zambia	Paraguay	Hungary	Mongolia
Zimbabwe	Venezuela, RB	Spain	Pakistan
Rwanda	Costa Rica	Sweden	Rest of East Asia
Senegal	Honduras	Lithuania	Bangladesh
Côte d'Ivoire	Ecuador	Slovak Republic	Georgia
Malawi	Mexico	Luxembourg	Azerbaijan
Central Africa	Peru	Finland	Armenia
Togo	Jamaica	Malta	Rest of World
Botswana	Belize	Netherlands	Russian Federation
Guinea	Bolivia	Belgium	Kyrgyz Republic
Rest of Western Africa		Latvia	
Tanzania	**Malaysia**	Poland	**Singapore**
Madagascar		Greece	
	Middle East	Cyprus	**South Korea**
China	Rest of North Africa	Austria	
Hong Kong SAR, China	Bahrain	Portugal	**Taiwan**
China	Qatar	Czech Republic	
	United Arab Emirates	Bulgaria	**Thailand**
France	Jordan	Denmark	
	Oman	Ireland	**USA& Canada**
Germany	Saudi Arabia	Romania	Rest of North America
	Morocco	Slovenia	Canada
India	Rest of Western Asia	Estonia	United States
	Tunisia		
Indonesia	Kuwait	**Europe, n.e.c.**	**United Kingdom (UK)**
	Iran, Islamic Rep.		
Italy	Egypt, Arab Rep.	Moldova	**Vietnam**

Note: The list depicts all countries available in the GTAP 9.0 data. The aggregated regions used in the above analyses are underlined and bold. Individual underlined and bold countries, such as Japan are separately illustrated, which is why they are not categorized into another region.

Table A5: Change in sectoral value added, EU28 and Japan

	EU28 Sectoral Value Added		Japan Sectoral Value Added	
	Initital in bn USD	Change in %	Initital in bn USD	Change in %
Agrifood	848	0.82	206	-1.50
Automotive	289	-1.59	93	6.55
Chemicals	602	-0.54	134	3.73
Electronic Equipment	143	1.07	98	-0.22
Energy	82	-1.41	0	-2.07
Financial & Business Services	3148	0.03	925	0.20
Machinery and Equipment	808	0.41	193	0.10
Metals	463	-0.22	146	1.64
Other Manufacturing	133	0.05	29	0.40
Other Services	6817	0.11	2478	0.26
Raw Materials	856	0.17	191	0.76
Textiles & Apparel	230	0.37	21	0.51
Trade and Transportation	1751	0.29	1139	0.08
Total	16172	0.11	5654	0.38

Note: The list depicts the aggregated sector categories. A detailled sector list can be found in the Appendix, table A3.

Table A6: Change in sectoral value added of Agrifood, EU28 and Japan

	EU28 Sectoral Value Added		Japan Sectoral Value Added	
	Change			
	in bn USD	in %	in bn USD	in %
Animal products nec	1.04	2.79	-0.30	-13.35
Beverages and tobacco products	1.01	0.63	-0.85	-1.22
Cattle, sheep, goats, horses	0.10	0.75	-0.01	-0.62
Cereal grains nec	0.17	0.80	-0.00	-0.79
Crops nec	0.20	0.39	-0.17	-1.36
Dairy products	1.00	1.48	-0.74	-11.92
Fishing	0.10	0.63	-0.05	-0.49
Food products nec	1.13	0.49	-0.40	-0.68
Meat products nec	1.00	1.81	-0.24	-17.70
Meat: cattle, sheep, goats, horses	0.04	0.16	-0.00	-0.05
Oil seeds	0.03	0.25	0.00	0.11
Paddy rice	0.00	0.05	-0.02	-0.15
Plant-based fibers	-0.01	-1.00	0.00	0.71
Processed rice	-0.00	-0.10	0.00	0.01
Raw milk	0.84	2.08	-0.27	-8.83
Sugar	0.05	0.29	-0.03	-1.95
Sugar cane, sugar beet	0.01	0.25	-0.00	-1.67
Vegetable oils and fats	0.03	0.19	-0.00	-0.00
Vegetables, fruit, nuts	0.10	0.18	-0.02	-0.10
Wheat	0.13	0.61	-0.00	-0.86
Agrifood Total	6.98	0.82	-3.09	-1.50

Note: The list depicts the all sectors of the aggregated sector category Agrifood. A detailed sector list can be found in the Appendix, table A3.