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Abstract

Food processing firms differ in productivity, vary in size and engage in a monopolistic competition based on highly differential products. While trade in processed food is becoming more important, the processed food sector is still the most protected one in both the European Union (EU) and the United States (US). This study employs a Computable General Equilibrium model which incorporates a module for heterogeneous firms under monopolistic competition to quantify impacts of a potential Transatlantic Trade and Investment Partnership (TTIP) agreement. Specifically, we evaluate a full removal of bilateral tariff and export subsidies between the EU and the US, and an additional reduction of bi-lateral rents and trade costs related to Non-Tariff Measures (NTMs) in the food processing sector, drawing on cost estimates of existing empirical studies. Simulation results show quite small welfare impacts under both scenarios and limited impact on trade volumes as long as NTMs are not considered. Although transatlantic trade increases significantly in food processing sectors at the extensive margin of trade once changes in NTMs are accounted for, reduction in domestic sales leaves total industry output unchanged in both regions. Our model underlines the importance of considering NTMs and vertical differentiation, but is clearly limited by data availability especially on costs of existing NTMs and their composition.

Keywords: Trade Policy, Imperfect competition, Heterogeneous firms, Simulations

JEL classification: F12, F14, F47

1. Introduction

Ongoing negotiations between the United States of America (US) and the European Union (EU) in the context of the so-called Transatlantic Trade and Investment Partnership (TTIP) seek to eliminate or to reduce tariffs and unify "behind the border barriers", i.e. differences in regulations. Here, the food processing sector receives special attention, not at least due to complex Non-Tariff Measures (NTMs). While removing these barriers could foster bilateral trade and increase welfare on both sides of the Atlantic (Bridges, 2015), especially the European public debate focuses of potential negative consequences such as loss of consumer standards. Food safety issues receive special attention, not at least as the EU and the US trade bilaterally more food products (FAS/USDA, 2014; Olper, 2014) than any other partners globally. EU exports to the US (16.5 billion USD) are significantly higher than EU imports from the US (5.1 billion USD). Furthermore, the EU with an export volume of 97 billion USD and the US with 52 billion USD account as the larger exporters of processed food worldwide together for a third of global trade (UN Comtrade, 2015).

The relatively high bilateral trade volumes occur despite the fact that the processed food sector in both the EU and the US is subject to the highest level of tariffs under all sectors. Specifically, the EU applies on average 14.6% tariffs on imports of processed food, more than four times exceeding the corresponding US tariffs of 3.3%, and much higher than the trade-weighted average MFN tariff for goods overall (Egger et al., 2015). Additionally, both the EU and the US apply a multitude of non-harmonized complex sanitary and phytosanitary measures (Arita et al., 2014) which together with various others trade-related regulatory differences create obstacles to trade. Akhtar and Jones (2013) attribute these differences both to divergent public preferences and opposing approaches to risk management. Berden et al. (2009) estimate that cross-border Non-Tariff Barriers (NTB) measures generate 56.8 % additional cost to export processed food products from the EU to the US, and 73.3 % additional cost from the US to the EU. Accordingly, Egger (2015) found that a deep free trade agreement such as TTIP, if it would remove a larger part of these NTBs, would reduce trade cost between the two partners by 41.99 % in the beverages and tobacco sector and by 33.83 % in other food processing sectors. Given the on-going debate on TTIP and the importance of trade in processed food, our paper aims at a quantitative assessment of TTIP in that sector to better understand potential impacts.

A growing body of literature analyses possible impacts of TTIP with different quantitative methods, sectoral and regional focus and assumptions with regard to the bilateral reductions in trade barriers embedded in a potential agreement. Given the public attention given to the agricultural and food sectors in the TTIP negotiations, several of these studies focus on these sectors. Beckman et al. (2015) employed a variant of the GTAP model to quantify impacts of reduced tariffs and non-tariff measures in several agricultural sectors in the context of TTIP, including changes in Tariff Rate Quotas, estimating an increase of 7 Bio billion USD in agricultural trade between the EU and the US. Using a CGE framework termed “Modeling International Relations in Applied General Equilibrium”, Disdier et al. (2015) found that elimination of tariffs and harmonization of NTBs under TTIP would result in large benefits to the agri-food sector in the US. In particular, the US agri-food trade is estimated to expand by 159%, almost three times the estimated expansion of the EU exports with 55.5%, while changes in trade for other regions are only modest. Results in a similar range from a TTIP agreement are also found by Fontagne et al. (2013).

However, these studies assume perfect competitive behavior in food processing, a sector which is characterized by a high degree of product differentiation and considerable firm size dispersion, characteristics found to a lesser degree in the agricultural sector. Note that in the remaining, we will refer to food processing as encompassing both “processed food” and “beverages and tobacco” unless state otherwise. Berden et al. (2009) as well as Luckstead and Devadoos (2016) underline that food processing firms regularly modify and improve the characteristics of their products to meet the requirements and changing preferences of different consumer groups and to differentiate themselves from competitors. Furthermore, Luckstead and Devadoos (2016) find considerable growth at the extensive margin of trade in that sector, i.e. that new firms, products, and varieties entered the market. At the same time, the sector is characterized by high dispersion in firm size. Berden et al. (2009) observe that the 1% of large food processing firms account for 52% of total sales. Several authors (for instance, Neff et al., 1996; Francois et al., 2013) conclude from high product differentiation and considerable differences in firms' size and productivity that food processing firms engage in monopolistic competition behavior.

Accordingly, Luckstead and Devadoss (2016) assume heterogeneous firms engaging in monopolistic competition in their multi-region partial equilibrium model of the food processing sector, which distinguishes the US, the EU and a Rest of the World aggregate. Based on the model, their analysis of bilateral full removal of tariff measures and partial reduction (30%) of NTBs finds increases in the EU's food processing exports to the US by 87% and in US' exports to the EU by 95%. This results in displacement of exports of the Rest of the World to the EU and the US by 7.6% and 3.2%, respectively. These changes in trade go along with production increases by about 4% in the US food processing industry and by 0.4% in the EU. Lower prices and increased consumption lead to net welfare gains in all three regions.

However, the single sector model by Luckstead and Devadoss (2016) neglects feedback with other sectors, including agriculture as a major upstream link of the food processing sector, which would be subject to trade liberalization under TTIP as well. Such linkages could foster or dampen changes. We, therefore, employ in here a Computable General Equilibrium (CGE) model which encompasses all sectors and their interactions, but at the same time considers monopolistic competition in all manufacturing sectors including food processing, allowing for firm heterogeneity. To our knowledge, our study is the first attempt in assessing the impact of a potential TTIP agreement with such an approach.

2. Modeling framework

Global CGE models are considered especially suited to provide an ex-ante appraisal of trade agreements as they consider bi-lateral trade and related barrier in a consistent behavioral framework while accounting for interlinkages between sectors. We use in here a variant of the flexible and modular CGE model by Van der Mensbrugghe and Britz (2015) in which we incorporate a module based on Melitz (2003). It considers firm heterogeneity, firm entry and exits in the industry as a whole and on specific trade links, and love of variety by the different agents, resulting in monopolistic competition. That module is applied for all manufacturing sectors including food processing while other sectors are assumed to face perfect competition. Our approach is motivated by literature which shows the importance of considering firm heterogeneity in manufacturing sectors, for instance, see Luckstead and Devadoss (2016); Balistreri et al. (2011); and Akgul et al. (2016).

Sectors with perfect competition are depicted as in the GTAP Standard model (Hertel, 1997), a comparative static, global Computable General Equilibrium (CGE) model based on the Walrasian general equilibrium structure. It assumes cost minimizing behavior under constant returns to scale (CRS) production technologies along with utility maximizing consumers in competitive markets. There is a single virtual representative household in each region which owns the production factors and receives factor returns net of taxes. That so-called regional household also collects income from taxation such as tariff revenues and rents accruing from export or import licenses which are depicted as exogenous ad-valorem price wedges. The regional income is then allocated to different agents (private household, government, and saving) based on a modified Cobb-Douglas (CD) utility function. The private household's demands for Armington commodities are derived from a non-homothetic Constant Difference Elasticity (CDE) implicit expenditure function, while government and saving demands for Armington commodities are driven by a constant elasticity of substitution function. The Armington demand for each agent and commodity is defined as a CES composite of domestic and import demand. The import demand composition from bi-lateral trade flows is depicted by a second CES nest which is not agent specific. On the supply side, production is defined as the Leontief aggregate of value added and intermediate inputs bundles; the value added composition is based on a CES aggregate of primary factors while the composition of intermediate demand is based on fixed physical input coefficients. As for the final demand agents, each sector features its own Armington nest to determine the composition of intermediate input demand for each commodity from domestic product and imports. However, the import composition is identical across sectors and final demand, as mentioned above. The model assumes full mobility for capital, skilled and unskilled labor, sluggish mobility for land and sector specific and thus immobile natural resources. These primary factors are depicted by fixed stocks. Details of the model which provides an exact replica of GTAP Standard model, however coded in GAMS in levels, can be found in Van der Mensbrugghe and Britz (2015). Note that the GTAP Standard model as coded in GEMPACK presents a mix of equations in levels and in linearized relative differences instead, as detailed in Hertel (1997).

The imperfect competition sectors are modelled to the large extent based on Balistreri et al. (2011, 2013) and Akgul et al. (2016) which follow the average firm definition from Melitz (2003)[1]. On the demand side, the composite demand of each agent for each commodity is defined as the Dixit-Stiglitz composite of demand for average firm level varieties around the world. Each productivity heterogeneous firm produces one single unique variety over a continuum of varieties under conditions of monopolistic competition arising from the imperfect substitution in demand for these varieties. Accordingly, the number of varieties produced in a regional industry is equal to the number of firms operating. Production in the monopolistic sectors is defined as in Akgul al. (2016) and

[1] The Melitz model defines the so-called “average firm” depicting the average productivity of all firms operating on a specific trade link.

extends the GTAP Standard model by introducing fixed and variable cost components. The variable costs are proportional to the quantity of output produced and use the nesting of the production function in the GTAP Standard model as described above. Specific fixed costs are associated with establishing the firm and with operating on each bilateral trade link; they typically only use primary factors[2]. Consistent with the large group monopolistic assumption, each small firm does not consider its impact on the aggregate price index. Therefore, the usual markup pricing rule is applied where the marginal cost is corrected for the average productivity effect of firms operating on each bilateral trade link.

The average productivity of firms on each trade link is determined from a Pareto distribution function as discussed in Balistreri et al. (2011) which encompasses a so-called cut-off productivity level. Only firms with productivity equal or higher than that specific threshold level for each bilateral trade link will operate on that link while the remaining entered firms are forced to exit. The number of operating firm on a link is hence derived from a zero profit condition where the revenue of the average firm must be equal to its bilateral fixed cost. However, ensuring zero profit for operating firms on each trade link does not ensure zero profits for the industry as a whole due to sunk costs associated with the entry of new firms in the industry. Therefore, zero profit at industry level is assured by a free entry condition in the industry, indicating that the expected profit for firms over their life time must be equal to the overall industry fixed set up costs.

A major advantage of the Melitz model is that it requires relatively little information on the industry and its consumers, namely firstly parameters which describe the productivity based on a Pareto distribution and secondly the elasticity of substitution among varieties. These two key parameters sets for the

[2] The model uses a threshold during calibration which ensures that variable costs always comprise some minimum share of primary factor cost. That implies that in some cases the fix cost nest might also comprise intermediates.

manufacturing sector including food processing are obtained from Balistreri et al. (2011, 2013). The value of the shape parameter of the Pareto distribution in these studies is 4.6. Additionally, the so-called scale parameter reflects the minimum productivity of the firms. Here, Akgul et al. (2015, 2016) assumed a value of 1 while Bernard et al. (2007) estimated it to be 0.2, a value used as well in other models with heterogeneous firms (for example, Balistreri et al., 2011). However, in the framework of Balistreri et al. (2011), the parameter can be freely chosen as it changes the average firm's productivity and the domestic iceberg transport parameter in the benchmark point in opposite directions such that their impact on simulation behavior just cancels out. Sensitivity analysis confirms that indeed results are not affected by changes in that scale parameter.

Appendix 1 provides further detail with the exact sector mapping to the GTAP 8 data used in our study. It should be noted that we only aggregate the processed food sectors into two new sectors "processed food" and "beverages and tobacco" sectors due to limited data availability on NTM measures. Avoiding further sectoral pre-aggregation prevents bias (see, Britz and Van der Mensbrugghe, 2016). However, post aggregation (see also Appendix 1) summarizes results for analysis. Note again that the processed food sectors and other manufacturing sectors apply the Melitz model while other sectors follow the Armington structure in competitive markets from the GTAP Standard model. Further, in order to capture the impact of a proposed TTIP agreement on third countries, we aggregated the GTAP data into 10 regions (European Union, United States, Canada, MERCOSUR, China, ASEAN 10, Mediterranean countries, Other Northern Europe[3], low-income countries, Other OECD and Rest of World). Our mapping of regions to the low-income countries aggregate follows the current World Bank classification.

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[3] Other Northern Europe include Switzerland, Norway and Rest of European Free trade Association (EFTA)

3. Quantifying the policy experiment

The model is calibrated based on the Global Trade Analysis Project database (Narayanan et al., 2012). Whereas bi-lateral tariffs are part of the GTAP database, non-tariff measures are not covered directly and might need to be incorporated in the data-set before they can be subject to policy experiments. When simulating impacts of a potential TTIP agreement, most literature relies on the –25% reduction in the trade restrictiveness of NTMs from Berden et al. (2009) which reflects expectations of European and American entrepreneurs and regulators about the potential outcome of an agreement. However, given current opposition to the agreement among the civil society, these expectations might not be met (Disdier, 2015).

Egger & Larch (2011) show that the impact of a FTA can be assessed as a reduction in Ad-Valorem Equivalents (AVE) of both changes in tariffs and NTMs. Accordingly, changing NTMs in a FTA can be seen and estimated as ‘beyond tariff reductions’. Egger et al. (2015) present an approach to estimate NTMs impacts of a deep TTIP agreement based on a three step approach. First, they estimate a gravity model with country-specific fixed effects, bilateral control variables, a measure of political distance, and tariff margins by country-pair (within or outside FTAs). In order to assess existing NTMs, they add two explanatory variables: an integer value ranging from 0 (shallow) to 7 (deep) that measures the depth of existing FTAs based on Dür et al. (2014) and a dummy intra-EU relationship to distinguish EU membership and access to the EU common market from a FTA. Second, they simulate with that gravity model trade volume changes when introducing a deep FTA between the EU and the US. Finally, they solve for the changes in the tariff rates which would yield the simulated bi-lateral trade volumes under a deep agreement without changing the “depth of FTA” variable. These changes in the AVE tariff rates provide an estimate for the cost related to the existing NTMs, quantified as 33.83% for the “processed food” sector and 41.99% for “beverage and tobacco” products, both for the EU and the US. That overall cost saving effect of moving to a deeper level of agreement in TTIP, beyond removing import duties and export subsidies, is used in our study.

We analyze in the following two scenarios (see Table 1): the first scenario considers removing any import tariffs and export subsidies for all commodities between the EU and the US, while the second one changes additionally AVEs measuring the impact of NTMs for ‘processed food’ and ‘beverages and tobacco products’ such that a deep agreement is reached. While removal of tariff measures is straightforward since tariff data is observed, the second scenario requires allocating the estimated costs of NTMs. Several authors (Andriamananjara, 2003; Walkenhorst and Yasui, 2005; Fugazza and Maur, 2008; among others) point out three general trade effects associated with NTMs and thus ways to allocate their cost*: trade cost* effect (or protectionism effect), *supply-shifting* effect, and *demand-shifting* effect. The trade cost effect refers to an increase in bi-lateral export cost, for instance, costs for obtaining certification, while production costs for the exported and domestically quantities stay identical. Supply shifting effects result from additional cost in production for the export market, such as Technical Barriers to Trade (TBT) regulations which provoke compliance cost. The demand-shifting effect occurs when regulations affect consumer behavior, such as product labeling requirements. While trade cost and supply-shifting effects are always trade-impeding, the impact of demand shifting effects is ambiguous. Furthermore, Fugazza and Maur (2008) underline that empirical quantification of demand shifting effects is both challenging and scarce. They acknowledge that changing the Armington elasticities might technically capture demand shifting effects, but existing examples of that approach seem somewhat ad-hoc. Beckman et al. (2015), for instance, assume that a TTIP agreement will reduce the Armington demand elasticity by half. Furthermore, allowing for changes in the Armington elasticity on a specific trade link requires structural changes by introducing new CES nests. Although demand side shifting effects might be important for TTIP, we leave them out due to missing empirical evidence.

We however address in detail the supply side, i.e. cost effects, drawing on the discussed studies which estimate the AVEs of NTMs. Trade cost effects of non-tariff barriers are modeled in CGEs in three different ways: as a pure *efficiency loss* also called “sand-in-the-wheels” or “productivity shock”, as an *export tax equivalent* and as *tariff equivalent* approach. Which approach or mix of approaches is appropriate depends on the nature of the NTMs, especially whether they are rent-generating, i.e. allow market access only for certain agents, are cost raising or both (Breden et al., 2009 ; Francoise et al., 2013).

The tariff equivalent approach is appropriate when rents occur from NTMs and are captured by agents in the importing economy. Rents accruing in the exporter country are modeled as an export tax equivalent, instead. Here, Disdier et al. (2015) point out that in the presence of licensing measures, monopolistic rents can benefit the government of exporting countries if licenses are allocated via auctions or alternatively generate rents for foreign or local firms depending on the license allocation method (see also Junker and Heckelei, 2012). In our modelling framework, the rents are collected via ad-valorem taxes by the government in the importer and/or exporter country where they generate income while they increase at the same time demand prices in the importing country. Note that due to the regional household approach in our CGE, an allocation of the rents to private households would not change results.

The efficiency loss approach is appropriate when NTMs and other regulatory measures increase costs while no rents are captured, for instance in case of customs and administrative procedures, technical regulations or sanitary and phytosanitary (SPS) regulations, and should hence be correctly captured in the SAM. In its simplest form, the efficiency loss approach however increases the offer price of the exporter based on a wedge, i.e. not considering related cost, which hence focuses on import demand effects (Hertel et al., 2001). Owing to the Melitz structure incorporated in our CGE model, we explicitly increase production cost on the specific bi-lateral trade link instead, based on the ad valorem estimates of these costs. Without further information, we allocated them proportionally to fixed and variable cost of trade. Interestingly, the relative simple alternative implementation in a CGE model with competitive markets which updates bi-lateral transport cost margins to reflect cost of NTMs linked to trade was not observed by us in literature.

In order to allocate AVE estimates of NTMs in a TTIP assessment to the different types of cost, the literature relies on the split-up of NTMs effects for the EU-US relation proposed by Breden et al. (2009). They report cost increases in 60% of the cases and rents in the remaining 40%. Both Francoise (2013) and Egger et al. (2015) model the 60% cost-increasing effect as a pure efficiency loss, i.e. following Hertel et al. (2001), while the remaining 40%, i.e, the rent generating cases, where distributed to import and export taxes on a 2/3:1/3 basis. In this study, we avoid the efficiency loss approach based on wedges. Accordingly, 60 percent of the shock is introduced as a change in bilateral fixed and variable trade cost, while the rest of the shock is divided based on the 2/3:1/3 basis to represent the rent-generating of NTMs, corresponding to import duties and export taxes (see Table 1).

Table 1: Scenario layout

	Tariffs shocks	**AVEs shocks**			
		Total AVEs (100%)	Import tax (26.7%)	Export tax (13.3%)	Cost generating AVEs (60%)
Processed food	-100%	-33.8 %	-9.0 %	-4.5 %	-20.3%
Beverages and tobacco	-100%	-42.0%	-11.2%	-5.6%	-25.2%
Modeled as	Reduction in bilateral tariff and export subsidies	Total reduction in AVEs is divided into the last three columns	Reduction in import tariffs representing rents in importer country	Reduction in export taxes representing rents in exporter country	Converted to an equivalent reduction in bilateral fixed and variable trade cost

4. Scenario analysis

While we presume that costs related to NTMs are already observed in the global SAM, rents related to NTMs probably hide in capital income flows and are clearly so far not allocated bi-laterally. We therefore first run a simulation to include the rent generating effects associated with NTMs currently in place between the US and the EU by introducing respectively increasing bi-lateral import and/or export taxes. That augmented database serves as the benchmark[4]. In the following, we discuss the simulated impacts of both scenarios on trade, welfare, GDP and factor income, as well as the trade balance in each region. Finally, we turn to the specific outcomes for the food processing sector with a focus on the variables simulated in the Melitz module.

Effects on aggregate trade flows

Table 2 shows simulated changes in the volume of total export flows, measured in constant Mio US$. Exports of the EU to the US increase by 4.7%, while US exports to the EU raise by 6.8% considering tariff removals only, while taking additionally into account changes in NTMs in the food processing boosts trade further, by 9.7 % from the EU to the US, and by 8.5% from the US to the EU. As a consequence, not only transatlantic trade, but also the overall export volume of both regions is likely to grow. However, with increasees of 0.3% and 0.5%, respectively, the changes in global EU exports are minor; while total US exports are expanding more significantly by 1.4% and 2.6%. Some regions including China, ASEAN 10, “low-income countries”, and “Other Northern Europe” marginally increase their exports to the transatlantic block, while in the second scenario all regions (except Canada and China) are simulated to reduce them. In the

[4] We use the filtering approach discussed in Britz and Van der Mensbrugghe 2016 to first remove very small transactions from the global SAM to improve solution behavior.

second scenario, Canada is expected to export less to the US but more to the EU, while important EU trade partners such as “Other Northern Europe” and the EU Mediterranean partner are foreseen to export more to the EU but less to the US. In summary of these changes in regional trade flows, overall world trade increase marginally by 0.3% and 0.4%, respectively.

Table 2: Total export volumes by region [% change]

	Scenario 1				Scenario 2			
Regions	EU	US	TTIP	Total	EU	US	TTIP	Total
World	0.21	1.08	0.44	0.26	0.38	1.76	0.75	0.43
EU	-0.24	4.75	0.32	0.22	-0.32	9.74	0.80	0.45
Other Northern Europe	0.05	0.19	0.07	0.18	0.04	-0.43	-0.02	-0.14
US	6.82		6.82	1.42	8.46		8.46	2.61
Canada	-0.14	-0.27	-0.25	-0.19	1.25	-0.09	0.08	0.16
Mercosur	-0.24	0.12	-0.06	0.00	-0.12	-0.50	-0.30	-0.07
China	-0.01	0.26	0.13	0.15	0.54	-0.45	0.04	0.06
ASEAN 10	-0.38	0.46	0.00	0.65	0.21	-0.67	-0.19	0.24
Other OECD	-0.16	-0.01	-0.06	-0.01	0.47	-0.60	-0.21	0.00
EU Mediterranean Partners	-0.32	0.32	-0.16	-0.06	0.13	-0.51	-0.04	-0.04
Low Income	-0.29	0.28	0.02	-0.06	0.09	-0.09	-0.02	0.03
Rest of World	-0.16	0.11	-0.07	-0.04	0.12	-0.45	-0.08	-0.03

Source: Simulation results; exporters in rows, importers in columns
Note: TTIP include changes in the export of both the EU, and US. Intra EU trade is included.

A focus on export flows for the “processed food" sector excluding “Tobacco and beverages” provides Table 3. The higher tariff protection in that sector leads to larger changes compared to the averages reported above: EU exports to the US for processed food increase by 40% while US exports to the EU increase by 121%, even with only tariff removals considered. As the ad-valorem equivalent estimates of the expected changes in existing NTMs between the EU and US are quite high and exceeding considerably existing tariffs, bi-lateral trade volumes increase considerably for “processed food” in the second scenario. The EU is simulated to almost quadruple its exports to the EU, while US exports to the EU are estimated to multiply by more than seven, which also implies changes in total exports of processed food for the EU by almost 8% and by 63% for the US. The trade diversion effects of that second scenario in the processed food sector is accordingly sizeable: most EU trading partners lose about 4% of their exports while exports to the US from the non-EU countries drop even by around 10%.

Table 3: Export volumes by region for "processed food" [% change]

	Scenario 1				**Scenario 2**			
Regions	EU	US	TTIP	Total	EU	US	TTIP	Total
World	1.49	5.30	2.09	1.10	7.22	46.16	13.38	7.44
EU	0.15	39.38	1.43	1.17	-1.73	394.22	11.18	9.29
Other Northern Europe	-0.68	-0.07	-0.59	-0.41	-5.40	-10.77	-5.87	-4.36
US	120.94		121.00	9.40	748.45		749.00	63.39
Canada	-0.98	-0.39	-0.44	-0.39	-5.65	-11.26	-10.81	-8.59
Mercosur	-0.67	-0.02	-0.53	-0.16	-3.86	-9.08	-4.81	-1.61
China	-0.68	-0.02	-0.39	-0.09	-3.93	-9.26	-6.51	-2.39
ASEAN 10	-0.95	-0.28	-0.63	-0.34	-3.74	-8.88	-6.42	-1.67
Other OECD	-0.72	-0.08	-0.33	-0.10	-3.78	-9.28	-7.57	-2.66
EU Mediterranean Partners	-0.63	0.03	-0.59	-0.27	-4.46	-9.66	-5.12	-2.54
Low Income	-0.63	0.03	-0.59	-0.27	-4.47	-9.48	-4.73	-2.46
Rest of World	-0.67	-0.01	-0.49	-0.16	-4.11	-9.37	-5.50	-2.06

Source: Simulation results

The changes for beverages and tobacco" products as depicted in Table 4 are somewhat smaller, but still considerably higher than the average across all sectors. US exports to the EU boost by factor 3 in the second scenario while the EU is simulated to still face an increase of 46%. As a consequence, the EU and the US are expected to increase their overall exports by 36% and 61%, respectively. Similar to the "processed food" sector, the impact on the export of EU and US to other regions is not significant, while considerable trade diversion effects are simulated.

Table 4: Exports volume by region for "beverages and tobacco" [% change]

	Scenario 1				Scenario 2			
Regions	EU	US	TTIP	Total	EU	US	TTIP	Total
World	0.58	3.16	1.26	0.82	6.69	129.94	39.11	26.10
EU	0.08	5.22	1.09	0.85	-0.06	236.08	46.44	36.78
Other Northern Europe	-0.25	0.16	0.00	0.00	-8.52	-25.14	-13.33	-7.22
US	21.02		21.31	4.10	298.23		297.54	61.08
Canada	-0.33	0.06	0.00	0.00	-8.44	-24.98	-23.64	-18.31
Mercosur	-0.20	0.21	0.00	0.00	-6.83	-22.44	-14.81	-6.02
China	-0.27	0.13	0.00	0.00	-6.14	-21.87	-18.75	-2.75
ASEAN 10	-0.88	-0.48	0.00	0.00	-6.62	-22.92	-13.33	-2.22
Other OECD	-0.20	0.22	0.17	0.10	-6.92	-23.17	-16.72	-10.29
EU Mediterranean Partners	-0.14	0.27	0.00	0.00	-6.93	-21.94	-9.09	-2.86
Low Income	-0.16	0.23	0.00	0.00	-6.57	-21.07	0.00	0.00
Rest of World	-0.21	0.21	0.00	0.00	-7.15	-22.86	-14.05	-5.53

Source: Simulation results

Effects on real GDP and domestic output quantities

For both the US and the EU, removal of bilateral tariff and export subsidies results in almost zero increases in yearly real GDP. For the EU, dismantling bilateral tariffs led to a real GDP increase of 0.02%, while further reduction of NTBs in processing food sectors add an extra 0.07%, thus 0.09% compared to the benchmark. Likewise, for the US some tiny changes in GDP ranging from 0.04% to 0.06% are found, depending on the scenario. The impact on the other regions is even smaller and negative in the first scenario (except for China), while regions generally increase their real GDP very slightly in the second scenario. However, ASEAN, Mercosur, Canada, and "other OECD" are likely to experience small negative impacts.

The output of "processed food" in both scenarios is anticipated to face a marginal reduction in the EU, while that of the US is predicted to increase (see

Table 5). Opposite and stronger effects are simulated for “beverages and tobacco” with a 5% increase in the EU and a 16% decrease in the US. Other sectors of the economy are found to change only marginally, an exception provides the output of “Textiles and Clothing” with a 2.5% increase in the EU, however only in the first scenario. Overall, the domestic output of food processing sectors in the EU is simulated to somewhat increase by 1.4% in the second scenario, while US output drops by 2.9%.

Table 5: Industrial output by sector [% change]

	EU		US	
Sectors	**Scenario 1**	**Scenario 2**	**Scenario 1**	**Scenario 2**
Total	0.00	-0.01	0.02	0.00
Processed food	**-0.11**	**-0.05**	**0.30**	**0.46**
Beverages and Tobacco	**0.13**	**5.67**	**-0.23**	**-16.00**
Food processing sectors				
(Sum “Processed food” and “Beverages and Tobacco”)	**0.01**	**1.41**	**0.01**	**-2.86**
Grains and Crops	-0.13	0.29	0.23	-0.24
Livestock	-0.08	0.03	0.22	0.23
Mining and Extraction	-0.01	-0.05	-0.05	0.07
Textiles and Clothing	2.52	-0.01	0.28	1.11
Light Manufacturing	-0.09	-0.24	0.51	0.15
Heavy Manufacturing	-0.13	-0.40	-0.25	0.30
Utilities and Construction	0.00	0.00	0.05	-0.01
Transport and Communication	0.02	0.07	0.01	0.02
Other Services	-0.01	0.01	-0.01	0.02

Source: Simulation results

Effects on welfare and trade balance

Welfare impacts are measured based on the equivalent variation (EV) criterion, i.e. the amount of money to be added to the regional household’ benchmark income at benchmark prices to reach the same utility as under simulated income and prices. Global welfare gains of 5.56 billion USD are found when TTIP would only remove tariffs (see table 6). With gains of 2.79 billion USD for the EU and 4.98 billion USD for US, the remaining countries, with the exception of China, would lose slightly. All regions are better off compared to the first scenario when also NTMs are reduced, and several regions more now experience welfare increases under a global gain of 22.36 billion USD. Still, limited welfare losses in Canada, Mercosur, ASEAN 10, and other OECD countries are found. The EU experiences the largest additional gains, from 2.79 billion USD under the first to 13.89 billion USD under the second scenario, followed by a further 2.77 billion USD for the US to a total of 7.75 billion USD. The welfare improvements in the second scenario match findings by Balistreri et al (2011) who also report that reduction in non-tariff measures in the Melitz (2003) framework increases welfare considerably.

Table 6: Changes in welfare and trade balance [Billion USD]

Regions	Welfare Changes		Current account balance	
	Scenario 1	**Scenario 2**	**Scenario 1**	**Scenario 2**
World	5.56	22.36	0	0
EU	2.79	13.83	-0.37	0.35
Other Northern Europe	-0.23	0.08	0.01	-0.05
US	4.98	7.75	2.07	-1.82
Canada	-0.11	-0.08	-0.23	0.03
Mercosur	-0.14	-0.1	-0.19	0.14
China	0.02	0.62	0.01	0.17
ASEAN 10	-0.16	-0.07	0.18	0.29
Other OECD	-0.67	-0.24	-0.82	0.44
EU Mediterranean Partners	-0.2	0.19	-0.21	0.14
Low Income	-0.06	0.08	-0.05	0.04
Rest of World	-0.66	0.3	-0.41	0.27

Source: Simulation results

Firm-level impact of policy shocks in processing food sectors

Table 7 shows the changes for the variables related to the average firm in the Melitz model (as shown in rows) associated with the production and sale of “processed food” sector in the EU on different bilateral trade markets. The first column refers to the domestic market, the second column denotes the intra-EU trade, the third and fourth columns show the EU trade with the US and other regions not included in the transatlantic trade block (hereafter referred as nonTTIP). The last column relates to overall industry performance.

The EU-US trade link for the first scenario shows one typical reaction of a Melitz model: the tariff removal reduces the average c.i.f. price in the US at unchanged per unit cost, and thus allows also new, however less productive firms to operate on that trade link. That increases the number of varieties available in the US market and thus benefits the consumer. Particularly, the number of firms and thus varieties on the EU–US link increases by 52%. However, in average lower productivity lets variable per unit costs increase by about 9.5% which is by definition equal to the change in the average f.o.b. price before export taxation. The average firm after these changes is not only less productive, but also smaller, average output quantity per firm drops by about -9% such that the increase in traded quantity is about 40%. That allows reducing per unit fix costs which drop by about -28%, a change which also reflect that the average firm operating on that trade link is now less productive. Increasing the number of operating firms decreases the average productivity of the firms operating on that trade link (-35%), which implies that the average per unit variable costs (+17%) and thus f.o.b. prices increase. At the same, the average size of these firms also drops, as average output per firms decreases by about the same percentage. Together, these changes constitute a new equilibrium with zero profits for the firms operating on that trade link while monopolistic prices charged are equal to the willingness to pay for the specific quality delivered on that trade link given the number of varieties available.

The impacts of the second scenario on the EU-US trade link are more pronounced: besides the removal of tariffs plus now decreases in policy induced rents, we also directly reduce variable and fix cost related to NTMs on that specific trade link. That amplifies the effect compared to the first scenario, as now all firms not only face a higher willingness to pay on that trade link, but also experience cost savings before supply and demand adjust. That allows far less efficient firms to operate on that link and let the number of operating firms increase by 666% while average productivity (-35)% and firm size (-35%) drop. The combined effect of the assumed reduction in costs and the endogenous adjustments are increases in average per unit variable costs of around 18% which are translated into a change in the average firm price, while total output sold on that link almost quadruples. The fix cost of the industry operating on that link decreases overall by -24%, reflecting firstly our assumption of reduced costs of trade (see table 1). However, that original reduction is partly offset by a loss in average productivity, but at the same time distributed to a much higher output quantity. The combined impact let per unit fix costs on that link drop by around -85%. The finding is in line with the literature emphasizing the importance of the extensive margin of trade (see Hummel and Klenow, 2005; Chenny, 2008; among others). Moreover, no significant changes of the variables on the EU-nonTTIP link are observed, such that overall changes in trade basically only reflect the discussed changes on the EU-US link.

Table 7: Average firm results for EU domestic sales and exports of processed food [% change]

	Scenario 1					Scenario 2				
	Domestic sales	EU	US	nonTTIP	Total sale	Domestic sales	EU	US	nonTTIP	Total sale
Firm price	-0.23	-0.09	9.52	0.00	0.83	-0.94	-0.89	17.60	0.00	1.33
Number of operating firms	-0.57	0.07	52.66	0.00	4.33	-2.92	-2.69	666.54	0.89	55.75
Avg. output per firm	0.22	0.08	-8.70	0.09	0.13	1.04	0.98	-35.53	0.13	0.76
Avg. productivity per firm	0.10	-0.04	-8.81	0.00	-0.86	0.70	0.65	-35.74	0.00	-2.87
Industry Fix costs	-0.01	-0.01	-0.01	0.00	-0.01	0.09	0.09	-24.18	0.00	-0.07
Fix costs per unit	0.34	-0.16	-28.26	0.00	-2.08	2.03	1.85	-84.66	0.00	-7.29
Industry Variable costs	-0.63	0.06	52.65	0.00	-0.24	-3.00	-2.60	481.20	1.24	-0.37
Variable costs per unit	-0.28	-0.09	9.52	0.00	0.75	-1.11	-0.89	17.60	0.00	1.18
Total output sold	-0.36	0.15	39.38	0.11	0.00	-1.91	-1.73	394.22	1.27	0.69

Source: Simulation results

The expansion in exports combined with in average less productive firms involved in trade increases the overall input demand in the economy which in turn bids up factor and other intermediate prices. As a first order impact, production costs increase and let profits on other trade links decline. In the EU domestic market, that induces some low productive firms to exit, the number of operating firms drops by -0.6% and -2.9% in the first and second scenario. As firms with low productivity exit such that output and production factors are reallocated towards higher-productivity and larger firms, average productivity of firms operating in the domestic market rises by 0.1% and 0.7%. That in turn leads to an ultimate drop in variable costs per unit of -0.3% and -1.1%. These changes result in an increase in average output per firm of 0.2% and 1%. However, the increase in average firm output does not compensate for the decrease in the number of firms operating in the domestic market. Consequently, domestic sales decline by -0.4% and -1.9%, along with lower offer prices of -0.1% and -1.7%, reflecting the increasing competition with US imports at lower border protection and the reduced export costs to the U.S.

The magnitude of the impacts on the EU “beverages and tobacco” sector is comparable with that of “processed food” (see. table 8). Removal of non-tariff measures increase the overall number of varieties exported to the US by 4.3% in the first and 55.7% in the second scenario, while the output sold on this link increases by 6% and 250%, respectively. Higher EU exports to the US as well as to nonTTIP drive up input for the domestic firms which in combination with increased import competition reduces the number of domestically operating firms, but increases their average productivity and firm output which almost compensates for the reduction in the number of firms. As a result, domestic EU sales in the first scenario decrease very slightly, while they even marginally increase in the second scenario. The total output of beverages and tobacco products in EU is expected to rise significantly in the second scenario (6.74%), mainly due to a higher number of operating firms (34.6%).

Table 8: Average firm results for EU domestic sales and exports of beverages and tobacco products [% change]

	Scenario 1					Scenario 2				
	Domestic sales	EU	US	nonTTIP	Total sale	Domestic sales	EU	US	nonTTIP	Total sale
Firm price	-0.14	-0.11	1.29	0.00	0.08	-1.67	-1.70	4.23	0.11	0.08
Number of operating firms	-0.13	-0.01	6.60	0.11	0.67	-1.70	-1.81	362.43	6.33	34.58
Avg. output per firm	0.12	0.09	-1.29	0.00	0.07	1.76	1.79	-27.32	0.00	0.89
Avg. productivity per firm	0.05	0.02	-1.36	0.00	0.00	1.55	1.57	-27.48	0.00	-2.30
Industry Fix costs	-0.02	-0.02	-0.02	0.00	-0.03	0.06	0.06	-24.25	0.00	-0.64
Fix costs per unit	-0.01	-0.11	-4.99	0.00	0.00	0.02	0.11	-77.46	-1.39	-7.29
Industry Variable costs	-0.16	-0.03	6.58	0.00	0.05	-1.64	-1.75	250.31	6.45	5.56
Variable costs per unit	-0.14	-0.11	1.29	0.00	0.11	-1.67	-1.70	4.23	0.00	0.11
Total output sold	-0.02	0.08	5.22	0.12	0.14	0.03	-0.06	236.08	6.46	6.74

Source: Simulation results

In addition, the impact on export flows of processed food from the US to the EU is presented in tables 9 and 10. Note first the impact on the US-EU link: following the reduction in border protection and trade cost, less productive firms find it profitable to enter. Thus, the number of operating firm on the US-EU link increase by factor 1.7 in first scenario and 14 in the second scenario. That in turn lowers the average productivity on that link, such that the average firm price and output increase. Still, US exports to the EU increase considerably by factor 1.2 and 7.4, which reflects removal of tariffs plus increased willingness to pay due to a higher number of varieties. The second scenario amplifies the effect by additional removals of rents and direct reduction of bilateral trade cost. Export expansion ultimately negatively affects the output sold in the domestic market by -0.3% and -3%. Accordingly, the total industry sale of the US of processed food increases only significantly in the second scenario (1.3%).

Similarly, in the beverage and tobacco sector, the firms' price in the domestic market drops, the number of firms operating on the domestic link is reduced and average productivity and output per firm goes up. In opposite to that, the average firm price of exports to the EU increase, by 5% in the first scenario and 14% in the second scenario, as tariff and rents related to NTMs are removed. That lets the number of operating firms on that link increase by factor 0.3 and 5, while average productivity and quantities drop. Still, as a result of these effects, export increase considerably by factor 2.7 and 3.5, respectively. As expected, the impact on the total industry is far larger in the second scenario, where the number of firms increase (36%), industry productivity goes down (-5.6%), and total industry output decreases by -15.4%.

Table 9: Average firm results for US domestic sales and exports of processed food [% change]

	Scenario 1				Scenario 2			
	Domestic sales	EU	nonTTIP	Total sale	Domestic sales	EU	nonTTIP	Total sale
Firm price	-0.12	24.58	0.00	2.27	-1.97	35.61	0.00	3.09
Number of operating firms	-0.55	174.85	-0.89	15.09	-4.95	1421.02	4.00	132.00
Avg. output per firm	0.27	-19.62	0.26	0.16	1.92	-44.22	0.03	1.56
Avg. productivity per firm	0.20	-19.67	0.00	-1.88	1.38	-44.52	0.00	-4.08
Industry Fix costs	0.14	0.14	0.00	0.13	-0.09	-24.36	0.00	-0.22
Fix costs per unit	0.43	-54.67	0.00	-4.55	3.13	-91.08	0.00	-7.95
Industry Variable costs	-0.42	175.24	-0.42	0.35	-5.51	1050.54	3.57	-0.37
Variable costs per unit	-0.13	24.58	0.00	2.23	-2.46	35.61	0.00	2.93
Total output sold	-0.29	120.94	-0.32	0.35	-3.12	748.45	3.69	1.31

Source: Simulation results

Table 10: Average firm results for US domestic sales and exports of beverages and tobacco products [% change]

	Scenario 1				Scenario 2			
	Domestic sales	EU	nonTTIP	Total sale	Domestic sales	EU	nonTTIP	Total sale
Firm price	-0.01	5.55	0.00	0.55	-3.00	14.14	0.11	1.09
Number of operating firms	-0.53	27.56	-0.89	1.73	-20.94	501.02	-8.78	36.45
Avg. output per firm	0.15	-5.12	0.24	0.10	2.98	-33.74	-0.24	2.56
Avg. productivity per firm	0.05	-5.22	0.00	-0.31	1.00	-35.01	-3.07	-5.64
Industry Fix costs	0.14	0.14	0.00	0.09	-0.11	-24.37	0.00	-0.27
Fix costs per unit	0.53	-17.25	0.00	-1.14	22.69	-81.01	12.50	5.68
Industry Variable costs	-0.39	27.74	-0.95	-0.15	-21.02	354.55	-7.91	-17.31
Variable costs per unit	-0.01	5.55	0.00	0.48	-3.00	14.14	0.00	1.08
Total output sold	-0.38	21.02	-0.96	-0.21	-18.58	298.23	-8.43	-15.48

Source: Simulation results

Table 11 summarizes the total impact on firm variables for the industry as a whole, i.e. the sum of the domestic and all export markets, together for the "processed food" and "beverages and tobacco" sectors. Results hence reflect total sale columns in tables 7 through 10. As indicated in the table, at industry level, no significant changes in average firm level variables are found in the EU or US under both scenarios. We observe only slight changes in the number of varieties while average output per firm increases, average firm productivity decreases and total output sold changes only slightly.

Table 11: Overall industry impact (total sale) in processing food sector, [change]

	EU		US	
	Scenario 1	**Scenario 2**	**Scenario 1**	**Scenario 2**
Firm price	0.00	0.01	0.01	0.02
Number of operating firms	0.03	0.45	0.08	0.84
Avg. output per firm	0.00	0.01	0.00	0.02
Avg. productivity per firm	0.00	-0.03	-0.01	-0.05
Fix costs	0.00	0.00	0.00	0.00
Fix costs per unit	-0.01	-0.07	-0.03	-0.01
Variable costs	0.00	0.01	0.00	-0.03
Variable costs per unit	0.00	0.01	0.01	0.02
Total output sold	0.00	0.02	0.00	-0.02

Source: Simulation results

5. Conclusion

Based on data on bi-lateral import tariffs and existing empirical studies which estimate expected changes in trade cost reductions under TTIP due to changes in NTMs, this study employs a CGE model (Van der Mensbrugghe and Britz, 2015) to simulate impacts of a potential TTIP agreement on the EU, US and third countries. A newly developed extension depicts all manufacturing sectors by heterogeneous firms under monopolistic competition on specific trade links based on Melitz (2003) which traces impacts on the intensive and extensive margin of trade as well as on firm productivity. The implementation builds to a large extent on Balistreri et al. (2011) and Akgul (2016). The extended model allows explicitly considering bi-lateral supply shifting effects of non-tariff measures, estimated at 60%, while rent generating impacts of NTMs are captured by import and export taxation (2:1 of the remaining 40% of the total AVE of NTMs). Using as the benchmark an accordingly projected GTAP 8 database which thus captures the between the United States and the EU, we simulate the impact of (i) the removal of all bilateral tariff and export subsidies currently in place between the EU and the US; and (ii), an additional removal of non-tariff measures in processed food sectors. Dismantling bilateral import tariff and export subsidies shows moderate impacts on bi-lateral trade volumes below +10%, combined with limited trade diversion effects, and rather limited welfare changes of +2.79 billion USD in the EU and +4.98 billion USD in the US. These translate in minuscule changes in yearly real GDP of 0.02% in the EU and 0.04% and the US. As the empirical estimates of the AVE of bilateral NTMs in food processing sectors are considerable with up to 70%, the second scenario which partially removes these shows some more pronounced impacts for these sectors. Still, the overall impact on real GDP remains small, EU welfare increases by +13.8 billion USD. The larger increases in simulated export volumes in food processing sector are almost entirely attributed to the extensive margin of trade which underlines the importance of the Melitz model in the analysis. However, increased exports are offset by lower domestic sales in both regions such that overall industry output is more or less unchanged. Our study could only draw on rather aggregate estimates of the AVEs related to NTMs in the food processing sector. However, that sector is highly heterogeneous, also with regard to NTMs applied. Better and especially more dis-aggregated estimates of costs related to NTMs and their composition (rents in importer and exporter country, variable or fixed cost of trade, demand shifting etc.) would clearly not only improve our analysis of a potential TTIP agreement, but more generally economic impact assessment of FTAs and multi-lateral trade liberalization.

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References

Akgul, Z., Villoria, N.B., and T.W. Hertel (2016): GTAP-HET: Introducing firm heterogeneity into the GTAP model, *Journal of Global Economic Analysis*, 1 (1): 111-180.

Akhtar, S.I. and V.C. Jones (2013): Proposed Transatlantic Trade and Investment Partnership (TTIP): in brief. Congressional Research Services No. (7-5700). 2013. Available at: https://www.fas.org/sgp/crs/row/R43158.pdf (accessed 15 November 2016).

Andriamananjara, S., Ferrantino, M., and M. Tsigas (2003): Alternative approaches in estimating the economic effects of non-tariff measures: Results from newly quantified measures (International Trade Commission Working Paper, December 2003) 12-C, U.S., Office of Economics, 2003. Available at: https://www.usitc.gov/publications/332/ec200312c.pdf (accessed 15 November 2016).

Arita, S., Beckman, J., Kuberka, L., and A. Melton (2014): Sanitary and phytosanitary measures and tariff-rate quotas for U.S. meat exports to the European Union (United States Department of Agriculture, December 2014). Available at: http://www.ers.usda.gov/publications/pub-details/?pubid=37588 (accessed 15 November 2016).

Balistreri, E.J., Hillberry, R.H., and T.F. Rutherford (2011): Structural estimation and solution of international trade models with heterogeneous firms, *Journal of International Economics*, 83(2):95–108.

Balistreri, E.J. and T.F. Rutherford (2013): Computing general equilibrium theories of monopolistic competition and heterogeneous firms, *Handbook of Computable General Equilibrium Modeling*, 1B: 1513-1570.

Beckman, J., Arita, S., and L. Mitchell (2015): The Transatlantic Trade and Investment Partnership and agriculture: A quantitative analysis (Agricultural & Applied Economics Association Conference Paper, July 2015). Available at: http://ageconsearch.umn.edu/bitstream/205056/2/AAEA%20Paper%20rev.pdf (accessed 15 November 2016).

Berden, K.G., Francois, J., Thelle, M., Wymenga, P., and S. Tamminen (2009): Non-tariff measures in EU-US trade and investment – An economic analysis (ECORYS report prepared for the European Commission, December 2009). Available at: http://trade.ec.europa.eu/doclib/docs/2009/december/tradoc_145613.pdf (accessed 15 November 2016).

Bernard, A.B., Jensen, J.B., Redding, S. J., and P.K. Schott (2007): Firms in international trade, *Journal of Economic Perspectives*, 21(3):105–130.

Bridges Network (2015): TTIP negotiations push for trade deal before Obama presidency ends (Bridges, October 2015). Available At: Accessed at: http://www.ictsd.org/bridges-news/bridges/news/ttip-negotiators-push-for-trade-deal-before-obama-presidency-ends (accessed 15 November 2016).

Britz, W., Drud, A. and D. Van der Mensbrugghe (2016): Reducing unwanted consequences of aggregation in large-scale economic models- a systematic empirical evaluation with the GTAP model, *Economic modelling*, 59: 463-472.

Chaney, T. (2008): Distorted gravity: the intensive and extensive margins of international trade, *American Economic Review*, 98 (4) :1707–1721.

Disdier, A.C., Emlinger, C., and J. Fouré (2015): Atlantic versus Pacific agreement in agri-food sectors: Does the winner take it all? (CEPII Working Papers, 2015). Available at: http://www.cepii.fr/PDF_PUB/wp/2015/wp2015-10.pdf (accessed 15 November 2016).

Dür, A., Baccini, L., and M. Elsig (2014): The design of international trade agreements: Introducing a new database, *Review of International Organizations*, 9:353-375.

Egger, P., Francois, J. Manchin M., and D. Nelson (2015): Non-tariff barriers, integration and the transatlantic economy', *Economic Policy*, 30 (83): 539-584.

Egger, P. and M. Larch (2011): An assessment of the Europe agreements' effects on bilateral trade, GDP, and welfare, *European Economic Review*, 55(2):263–79.

Egger, P., Larch, M., Staub, K.E. and R. Winkelmann (2011): The trade effects of endogenous preferential trade agreements, *American Economic Journal: Economic Policy*, 3(3): 113–43.

FAS/USDA (2015): Global Agricultural Trade System (United State Department of Agriculture, Foreign Agricultural Service, 2015). Available at: http://apps.fas.usda.gov/gats/ (accessed 15 November 2016).

FAS/USDA (2014): Agricultural exports to the European Union: Opportunities and challenges. (United State Department of Agriculture, Foreign Agricultural Service, 2013). Available at: http://www.fas.usda.gov/data/agricultural-exports-european-union-opportunities-and-challenges (accessed 15 November 2016).

Fontagné, L., Gourdon, J. and S. Jean (2013): Transatlantic trade: Whither partnership, which economic consequences? (CEPII Policy Brief No. 1, September 2013). Available at: http://www.cepii.fr/PDF_PUB/pb/2013/pb2013-01.pdf (accessed 15 November 2016).

Francois, J., Manchin, M., Norberg, H., Pindyuk O., and P. Tomberger (2013): Reducing transatlantic barriers to trade and investment – an economic analysis (Report prepared for the European Commission, March December 2013). Available at:

http://trade.ec.europa.eu/doclib/docs/2013/march/tradoc_150737.pdf (accessed 15 November 2016).

Fugazza, M., and J. Maur (2008). Non-tariff barriers in CGE models: How useful for policy? *Journal of Policy Modelling*, 30(3):475-490.

Hertel, T.W., Walmsley, T.L., and K. Itakura (2001): Dynamic effects of the "new age" free trade agreement between Japan and Singapore, *Journal of Economic Integration*, 16 : 446–84.

Hummels, D., and P.J. Klenow (2005): The variety and quality of a nation's exports', *American Economic Review*, 95(3):704–723.

Junker, F., and T. Heckelei (2012): TRQ-complications: who gets the benefits when the EU liberalizes Mercosur's access to the beef markets? , *Agricultural Economics*, 43(2):215-231

Luckstead, J. and S. Devadoss (2016): Impacts of the transatlantic trade and investment partnership on processed food trade under monopolistic competition and firm heterogeneity, *Am. J. Agr. Econ*., doi: 10.1093/ajae/aaw058.

Melitz, M.J. (2003): The impact of trade on intra-industry reallocations and aggregate industry productivity', *Econometrica*, 71(6):1695–1725.

Narayanan, G.B., Angel Aguiar, A., and R. McDougall (2012): Global Trade, Assistance, and Production: *The GTAP 8 Data Base*, Center for Global Trade Analysis, 2012, Purdue University.

Olper, A., Curzi, D., and L. (2014): Trade, import competition and productivity growth in the food industry, *Food Policy*, 49(1):71 – 83.

UNComtrade (2015). UN Comtrade Database. Available at: http://comtrade.un.org/ (accessed 15 November 2016).

Van der Mensbrugghe, D. and W. Britz (2015): The GTAP Standard model in GAMS Version 6.2, *GTAP Technical Paper*, forthcoming

Walkenhorst, P., and T. Yasui (2005): Benefits of trade facilitation: a quantitative assessment. In: Dee, P. and Ferrantino, M. eds. Quantitative Measures for Assessing the Effect of Non-tariff Measures and Trade Facilitation (World Scientific Ltd. Singapore).

Appendix 1: Sectoral correspondence of GTAP 8 sector to new sectors

Number	**Code**	**Description**	**Pre model Aggregation**	**Post model aggregation**	**Market Structure**
1	PDR	Paddy rice	Paddy rice	Grains and Crops	PC
2	WHT	Wheat	Wheat	Grains and Crops	PC
3	GRO	Cereal grains nec	Cereal grains nec	Grains and Crops	PC
4	V_F	Vegetables, fruit, nuts	Vegetables, fruit, nuts	Grains and Crops	PC
5	OSD	Oil seeds	Oil seeds	Grains and Crops	PC
6	C_B	Sugar cane, sugar beet	Sugar cane, sugar beet	Grains and Crops	PC
7	PFB	Plant-based fibers	Plant-based fibers	Grains and Crops	PC
8	OCR	Crops nec	Crops nec	Grains and Crops	PC
9	CTL	Bovine cattle, sheep and goats, horses	Bovine cattle, sheep and goats, horses	Livestock	PC
10	OAP	Animal products nec	Animal products nec	Livestock	PC
11	RMK	Raw milk	Raw milk	Livestock	PC
12	WOL	Wool, silk-worm cocoons	Wool, silk-worm cocoons	Livestock	PC
13	FRS	Forestry	Forestry	Mining and Extraction	PC
14	FSH	Fishing	Fishing	Mining and Extraction	PC
15	COA	Coal	Coal	Mining and Extraction	PC
16	OIL	Oil	Oil	Mining and Extraction	PC
17	GAS	Gas	Gas	Mining and Extraction	PC
18	OMN	Minerals nec	Minerals nec	Mining and Extraction	PC
19	CMT	Bovine meat products	Processed food	Processed food	FH

Appendix 1 : continued

Number	Code	Description	Pre model Aggregation	Post model aggregation	Market Structure
20	OMT	Meat products nec	Processed food	Processed food	FH
21	VOL	Vegetable oils and fats	Processed food	Processed food	FH
22	MIL	Dairy products	Processed food	Processed food	FH
23	PCR	Processed rice	Processed food	Processed food	FH
24	SGR	Sugar	Processed food	Processed food	FH
25	OFD	Food products nec	Processed food	Processed food	FH
26	B_T	Beverages and tobacco products	Beverages and tobacco products	Beverages and tobacco products	FH
27	TEX	Textiles	Textiles	Textile and clothing	FH
28	WAP	Wearing apparel	Wearing apparel	Textile and clothing	FH
29	LEA	Leather products	Leather products	Light Manufacturing	FH
30	LUM	Wood products	Wood products	Light Manufacturing	FH
31	PPP	Paper products, publishing	Paper products, publishing	Light Manufacturing	FH
32	P_C	Petroleum, coal products	Petroleum, coal products	Heavy Manufacturing	FH
33	CRP	Chemical, rubber, plastic products	Chemical, rubber, plastic products	Heavy Manufacturing	FH
34	NMM	Mineral products nec	Mineral products nec	Heavy Manufacturing	FH
35	I_S	Ferrous metals	Ferrous metals	Heavy Manufacturing	FH
36	NFM	Metals nec	Metals nec	Heavy Manufacturing	FH
37	FMP	Metal products	Metal products	Light Manufacturing	FH
38	MVH	Motor vehicles and parts	Motor vehicles and parts	Light Manufacturing	FH
39	OTN	Transport equipment nec	Transport equipment nec	Light Manufacturing	FH

Appendix 1 : continued

Number	Code	Description	Pre model Aggregation	Post model aggregation	Market Structure
40	ELE	Electronic equipment	Electronic equipment	Heavy Manufacturing	FH
41	OME	Machinery and equipment nec	Machinery and equipment nec	Heavy Manufacturing	FH
42	OMF	Manufactures nec	Manufactures nec	Light Manufacturing	FH
43	ELY	Electricity	Electricity	Utilities and Construction	PC
44	GDT	Gas manufacture, distribution	Gas manufacture, distribution	Utilities and Construction	PC
45	WTR	Water	Water	Utilities and Construction	PC
46	CNS	Construction	Construction	Utilities and Construction	PC
47	TRD	Trade	Trade	Transport and Communication	PC
48	OTP	Transport nec	Transport nec	Transport and Communication	PC
49	WTP	Water transport	Water transport	Transport and Communication	PC
50	ATP	Air transport	Air transport	Transport and Communication	PC
51	CMN	Communication	Communication	Transport and Communication	PC
52	OFI	Financial services nec	Financial services nec	Other Services	PC
53	ISR	Insurance	Insurance	Other Services	PC
54	OBS	Business services nec	Business services nec	Other Services	PC
55	ROS	Recreational and other services	Recreational and other services	Other Services	PC
56	OSG	Public Administration, Defense, Education, Health	Public Administration, Defense, Education, Health	Other Services	PC
57	DWE	Dwellings	Dwellings	Other Services	PC

Notes: FH: Firm heterogeneity, PC: Perfect Competition (Armington).