Impacts of TTIP on Processed Food Trade under Monopolistic Competition and Firm Heterogeneity

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Abstract

Food processing firms vary in size, exhibit productivity differences, engage in monopolisitic competition, and produce highly differentiated products. As the TTIP negotiation is gaining momentum and trade in processed food is becoming more important, it is worth analyzing the impact of this potential trade liberalization on the US and EU processed food markets. This study develops a three-region (United States, European Union, and ROW) monopolistic competition trade model with heterogeneous firms to analyze the effects of US-EU bilateral tariff elimination and non-tariff barrier harmonization on prices, domestic production, consumption, bilateral trade, cutoff productivity levels, and aggregate productivity in the processed food sector. The empirical results show that this trade liberalization expands cross hauling, with US exports to the European Union increasing by 113.58% and EU exports to the United States rising by 96.19%. This increased cross hauling displaces exports from ROW to the United States and European Union by 47.26% and 16.10%, respectively. US and EU processed food production increases by 4.89% and 3.91%, respectively. Consequently, aggregate utility expands in all three regions.

Keywords: Cross hauling, Heterogeneous firms, Imperfect competition, Non-tariff barriers, Processed food trade, Tariffs, TTIP
JEL: F12, F13, F15

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Processed food exports have experienced substantial growth from $37 billion in 1998 to $104 billion in 2012, an increase of 178% (BEA, 2015). Furthermore, food processing firms engage in monopolistic competition, produce highly differentiated food products, and differ in size, which are unique characteristics of this industry and important determinants of whether firms operate only domestically or also export (Francois et al., 2013). The United States is actively negotiating the Transatlantic Trade and Investment Partnership (TTIP) with the European Union. This comprehensive trade agreement will call for the phasing out of trade restrictions and harmonization of NTBs, which will enhance market access to value-added food products in both countries.

The European Union-28 and the United States are key players in the world processed food market, accounting for almost a third of global trade in this market. In 2013, the European Union was the world's largest processed food exporter with $97 billion worth of exports, which was almost twice the value of US exports of $51 billion, but EU imports of $67 billions were only slightly more than US imports of $61 billions (UNComtrade, 2015). The United States and European Union are also the largest bilateral trade partners in value-added food products (FAS/USDA, 2014; Olper et al., 2014) because of similar tastes and preferences of their consumers and traditional trade links. In 2013, EU exports to the United States were valued at $16.5 billion, while imports from the United States were worth only $5.1 billion. The lower EU imports from the United States are due to processed food trade restrictions, particularly tariffs; the EU trade weighted import tariff is 14.6% and, in contrast, the US trade weighted import tariff is 3.3% (Francois et al., 2013). In particular, US dairy, tobacco, and sugar products face high EU tariffs.

Both the European Union and the United States protect their processed food sector more than any other manufacturing sector through significant non-tariff barriers (NTBs) because of Sanitary and Phytosanitary measures and disparate regulations (Arita et al., 2014). In fact, NTBs[1] have become more prominent and are considerably more egregious than tariffs (USTR, 2013). Consequently, NTBs severely hamper processed food trade between the two countries. Berden et al. (2009) estimate, because of cross border NTB trade restrictions, the European Union imposes a 56.8% additional cost to US processed food exports, and the United States levies a 73.3% additional cost to EU exports. As a result, bilateral food exports in these growing markets are heavily restricted by NTBs. For instance, Berden et al. (2013) report that if both the United States and the European Union could agree to eliminate the *actionable* regulatory measures (i.e., rules, policies, and regulations that impose artificial burdens on trade but could be removed if the United States and European Union reach an agreement) which account for about half of the total NTB costs, then EU and US NTBs will be reduced to 27% and 35%, respectively.

Food processing firms differ considerable in size. For instance, Berden et al. (2009) observe large food processing firms constitute only 1% of the total number of companies but account for about 52% of total sales, whereas small and medium sized enterprises comprise of 99% of the total number of companies, but their sales amount to only about 48%. These size differences and product differentiation are root causes for firms in this industry to operate under imperfect competition.

A series of Economic Research Service papers highlight the importance of the US processed food industry by studying US trade patterns and cross-hauling (Neff et al., 1996), the complementarity and substitutability of foreign direct investment versus trade (Malanoski et al., 1996), technological advancements in communication and transportation (MacDonald, 1996), interrelationships between trade and domestic policies in global food marketing (Neff, 1996; Neff and Malanoski, 1996), environmental quality and implications for food production and trade (Gray et al., 1996), and intellectual property rights of food product firms in the global market (Henderson, 1996). Though these studies covered various aspects of the processed food industry, they did not quantify the impacts of any trade liberalization on processed food market and also did not focus on the differences in firm sizes which are important characteristics of this industry.

More recently, based on the firm heterogeneity and monopolistic competition framework of Melitz (2003), studies develop econometric frameworks to test if trade liberalization and import penetration impact total factor productivity. Ruan and Gopinath (2008) find that global trade liberalization increases average productivity in the food processing sector and benefits countries with higher productivity growth. Vancauteren and de Frahan (2011) conclude that harmonization of the Dutch and EU food processing industry augments total factor productivity of firms due to competitive pressure. Kugler and Verhoogen (2012) extend Melitz's (2003) model to incorporate input choice and its impact on the quality of food output and show that larger plants not only charge more for outputs but also pay a premium on production inputs. Olper et al. (2014) conclude that an increase in import penetration positively influences productivity growth for nine food industries in 25 European countries. Thus, these studies stress the prevalence of firm heterogeneity in the processed food industry.

Several studies model the food processing industry in a general equilibrium framework. Rae and Josling (2003) and Burfisher et al. (2014) analyze the effects of trade liberalization using the GTAP (Global Trade Analysis Project) model. While Rae and Josling (2003) study the effects of trade liberalization on developing countries' food sector, Burfisher et al. (2014) examine the impacts of the Trans-Pacific Partnership (TPP) on several agricultural sectors under perfect competition. Beckman et al. (2015) employ the GTAP model to evaluate US and EU trade liberalization under TTIP, with a particular focus on tariff-rate quotas in several agricultural sectors. Their results reveal a substantial increases in US-EU trade from the removal of tariffs, an increase in the tariff-rate quotas, and harmonization of the NTBs. Disdier et al. (2015) use the MIRAGE (Modeling International Relationships in Applied General Equilibrium) CGE model and show that tariff reduction and NTB harmonization from the TTIP and TPP agreements would potentially provide the largest benefits to the US agri-food sectors, only modest benefits to their trading partners, and some sectors may lose. The above studies do not capture important features of the processed food industry such as imperfect competition and heterogeneity of firms. Tseng and Sheldon (2015) develop a theoretical framework to include the quality of intermediate inputs in a heterogeneous-firms model and conclude that larger and exporting firms produce higher quality goods and charge higher prices. However, their analysis does not examine the effects of TTIP trade agreements.

We contribute to the literature on trade agreements by analyzing the impacts of tariff reduction and NTB harmonization on US and EU food trade by capturing imperfect competition and productivity differences among firms in the food processing sector. In doing so, our study captures the cross hauling observed in processed food trade. The specific objectives of this study are to develop a multi-regional trade model with monopolistic competition, heterogeneous firms, and endogenous entry and exit; calibrate the model to the US and EU processed food sectors; and simulate the effects of tariff removal and NTB harmonization under TTIP on prices, consumption, production, and productivity.

Model

To accurately capture real-world phenomena observed in processed food production, consumption, and trade, we formulate a three-region model (United States, European Union, and rest of the world (ROW)) based on Krugman's (1980) monopolistic competition and Melitz's (2003) firm-heterogeneity studies.[2] In addition, our model accounts for differences in preferences across countries, firm-level production technologies, regional sizes, and trade policies by incorporating NTBs in addition to tariffs. A representative consumer optimizes utility over a continuum of domestic and imported processed food items. Heterogeneous firms that produce processed food engage in monopolistic competition and make endogenous entry, operating, and exit decisions for both the domestic and export markets. All three regions impose bilateral tariff and non-tariff barriers on imports of processed food.

Consumers' Problem

A representative consumer in region i derives utility C_i from consumption of domestic and imported processed foods. We consider a constant elasticity of substitution (CES) utility function postulated by Dixit and Stiglitz (1977). The consumer maximizes

$$C_i = \max_{c_{ii},c_{ji},c_{ki}} \left(\sum_m n_m \int_{\bar{z}_{mi}} c_{mi}(z)^{\rho_i} \, dG_m(z) \right)^{\frac{1}{\rho_i}} \tag{1}$$

subject to the budget constraint

$$\sum_m n_m \int_{\bar{z}_{mi}} p_{mi}(z)\, c_{mi}(z)\, dG_m(z) \le I_i, \tag{2}$$

where n_m is the measure of firms in region m (= i, j, and k which are alias indexing US, EU, ROW), $\bar{z}_{mi}$ is the cutoff productivity of the marginal firm that produces in m and sells in i and earns zero profits, $c_{mi}(z)$ is processed food produced by a firm with productivity z in region m and consumed in region i,$\rho_i \in (0,1)$ is the CES parameter with elasticity of substitution $\sigma_i = \frac{1}{1-\rho_i} > 1$, $p_{mi}(z)$ is the price of $c_{mi}(z)$, $G_m(z)$ represents the cumulative distribution function of the productivity random variable z, and I_i is income spent on processed food.

We solve the first-order conditions of the above utility maximization problem to obtain demand functions for $c_{mi}(z)$:

$$c_{mi}(z) = \frac{I_i}{P_i}\left(\frac{p_{mi}(z)}{P_i}\right)^{-\sigma_i}, \tag{3}$$

where P_i is the aggregate price index

$$P_i = \left(\sum_m n_m \int_{\bar{z}_{mi}} \left(p_{mi}(z)\right)^{\frac{-\rho_i}{1-\rho_i}} dG_m(\zeta)\right)^{-\frac{1-\rho_i}{\rho_i}} \tag{4}$$

derived using the relationship $P_i = \frac{I_i}{C_i}$.

Firm's Problem

Consider a continuum of firms each producing a different variety indexed by the productivity parameter z, which has a one-to-one correspondence with varieties consumed; this relationship explicitly captures the market clearing conditions defined below in equation (10). The profit function for a firm producing in i selling in m with productivity z is

$$\pi_{im}(z) = p_{im}(z)\, y_{im}(z) - w_i l_{im}(z) - w_i f_{im}, \tag{5}$$

where $y_{im}(z)$ is firm-level output, $l_{im}(z)$ is a composite input comprised of intermediate inputs, labor, and capital, and f_{im} is the fixed cost. The production technology is

$$y_{im}(z) = \frac{z l_{im}(z)}{\tau_{im}}, \tag{6}$$

where $\tau_{im} = 1 + t_{im} + \phi_{im} + \eta_{im}$ is the per-unit trade cost consisting of transport costs (t_{im}), tariffs (ϕ_{im}), and ad valorem equivalent of NTBs (η_{im}).

Invert the demand function (3) to express price as a function of quantity, substitute for $p_{im}(z)$ in the profit function (5), and maximize profits to obtain the pricing rule

$$p_{im}(z) = \frac{w_i \tau_{im}}{z \rho_m}, \tag{7}$$

which differs from the competitive pricing rule as evident from the markup $\frac{1}{\rho_m}$ due to product differentiation.

Next we discuss the entry and operating decisions of a firm. A food processing firm decides to enter if expected profit equals the fixed cost of entry $w_i f_{ei}$:

$$\sum_m \int_{\bar{z}_{im}} \pi_{im}(z)\, dG_i(z) = w_i f_{ei}. \tag{8}$$

We characterize the productivity differences using the Pareto distribution $\left(G_i(z) = \left(1 - \frac{\mu_i}{z}\right)^{\alpha_i}\right)$, where the location parameter μ_i is such that $0 < \mu_i \leqslant z$ and the shape parameter satisfies $\alpha_i > 1$. The Pareto distribution is commonly used in the firm heterogeneity literature because it lends itself for analytical solutions, and, more importantly, is consistent with size distribution of firm-level data where only a small proportion of firms are large and highly productive (Melitz and Ottaviano, 2008).

Once a firm enters, whether or not it stays in business depends on its profitability, i.e., a firm operates if it earns nonnegative profits and otherwise it exits. The minimum (cutoff) productivity level $\bar{z}_{im}$, at which a firm is willing to operate, satisfies

$$\pi_{im}(\bar{z}_{im}) = 0. \tag{9}$$

This equation implies that the marginal food manufacturing firm earns zero profits, while firms with productivity greater than $\bar{z}$ earn positive profits.

Market Clearing

The market clearing condition for each food item is

$$c_{im}(z) = y_{im}(z), \tag{10}$$

where consumption of each variety is equal to its production. Market clearing for the composite input in each region is

$$\gamma_i w_i^{\varepsilon_i} = n_i f_{ei} + n_i \sum_m \int_{\bar{z}_{im}} f_{im} dG_i(z) + n_i \sum_m \int_{\bar{z}_{im}} l_{im}(z)\, dG_i(z), \tag{11}$$

where the term on the left-hand side is the input supply function with γ_i and ε_i representing scale and elasticity of supply parameters, the first term on the right-hand side is composite input used for the fixed entry fee, the second term is composite input used for fixed operating costs, and the third term is composite input used for variable cost in production.

Aggregation and Productivity

We define aggregate variables for real income, production, input use, and productivity. Real income is the utility in equation (1):

$$C_i = \left(\sum_m n_m \int_{\bar{z}_{mi}} c_{mi}(z)^{\rho_i} \, dG_m(z) \right)^{\frac{1}{\rho_i}}.$$

Total domestic production of all firms in region i and exports from region i to regions j and k are

$$Y_{im} = n_i \int_{\bar{z}_{im}} y_{im}(z) \, dG_i(z).$$

Total production in region i, including exports to regions j and k, is

$$Y_i = \sum_m Y_{im}.$$

Average composite input used in the production of processed food for domestic sales in region i and exports from region i to regions j and k are

$$L_{im} = \int_{\bar{z}_{im}} l_{im}(z) \, dG_i(z).$$

With the measures of firms that choose to operate in region i and export to regions j and k given by

$$\bar{n}_{im} = n_i(1 - G_i(\bar{z}_{im})), \tag{12}$$

total domestic sales in region i and exports from region i to regions j and k can be expressed as

$$Y_{im} = \frac{Z_{im} L_{im} \bar{n}_{im}}{\tau_{im}}, \tag{13}$$

where

$$Z_{im} = \frac{\int_{\bar{z}_{im}}^{\infty} z_{im} dG_i(z)}{1 - G_i(\bar{z}_{im})} \tag{14}$$

is a weighted average of operating firms' productivities. The aggregate productivity (Z_i) in country i is the weighted average of Z_{im}:

$$Z_i = \frac{\sum_m Z_{im}\bar{n}_{im}}{\sum_m \bar{n}_{im}}. \tag{15}$$

System of Equations

Equations (3)-(11) define a system of 63 equations in 63 variables $c_{im}(z)$, P_i, $\pi_{im}(z)$, $y_{im}(z)$, $p_{im}(z)$, n_i, $\bar{z}_{im}$, $l_{im}(z)$, and w_i.[3] To avoid multiple corner solutions in the empirical analysis of the above asymmetric three-region model, we abstract from entry and exit decisions of firms.[4] This implies that the fixed entry fee f_e is zero, equation (8) is dropped from the model, and the measure of total entrants n_i is exogenous. The zero-profit (9) and labor clearing (11) conditions can be simplified using the demand function (3), profit equation (5), production technology (6), pricing rule (7), and output market clearing condition (10):

$$\pi_{im}(\bar{z}_{im}) = \frac{1}{\sigma_m - 1}\frac{I_m}{\rho_m^{-\sigma_m}}\left(\frac{w_i\tau_{im}}{\bar{z}_{im}P_m}\right)^{1-\sigma_m} - w_i f_{im} = 0 \tag{16}$$

$$\gamma_i w_i^{\varepsilon_i} = n_i\left(\sum_m \int_{\bar{z}_{im}} f_{im} dG_i(z)\right) + n_i\left(\sum_m \int_{\bar{z}_{im}} I_m\left(\frac{w_i}{\rho_m}\right)^{-\sigma_m}\left(\frac{\tau_{im}}{zP_m}\right)^{1-\sigma_m} dG_i(z)\right). \tag{17}$$

Similarly, substituting the pricing rule (7) into the price index equation (4) yields

$$P_i = \left(\sum_m n_m \int_{\bar{z}_{mi}} \left(\frac{w_m\tau_{mi}}{z\rho_i}\right)^{\frac{-\rho_i}{1-\rho_i}} dG_m(z)\right)^{-\frac{1-\rho_i}{\rho_i}}. \tag{18}$$

Equations (16)-(18) represent a reduced system of 15 equations which can be solved for the 15 endogenous variables $\bar{z}_{im}$, w_i, and P_i.

Quantitative Analysis

This section contains a description of data, sources, and calibration; simulation of baseline and alternate scenarios; and results and discussion.

Data and Calibration

We use aggregate processed food (code numbers 19-26 corresponding to sectors CMT, OMT, VOL, MIL, PCR, SGR, OFD, and B_T)[5] data for 2011 from the GTAP 9 Data Base. We collect data for the value of domestic production, inputs, imports, and exports, and transport costs and tariffs. Because the GTAP database contains only value data, we calculate quantity data by dividing values by the unit price. The unit price is computed by dividing the value of US imports by the quantity of imports from the European Union, which comes from FAS (2015). The purchasing power parity index collected from OECD (2015) is used to convert the US unit price into the EU and ROW unit price. We obtain bilateral NTB data from Berden et al. (2009) and Dean et al. (2009).

We normalize the measure of firms to one in all three regions. To account for the differences in preference across regions, we consider different values of the elasticity of substitution (σ_i). Since the literature does not have specific estimates of the elasticity of substitution for processed foods, we consider σ_i of 2.3 for the United States, 2.2 for the European Union, and 1.4 for ROW. We use a parameter value of 0.5 for the elasticity of supply (ε_i) for the composite input. The food processing industry is characterized by a small number of firms with high productivity and a large number of firms with low productivity levels. The Pareto distribution depicts this feature of the food processing industry with shape and scale parameters. We consider a shape parameter of 3 for the United States, 3.6 for the European Union, and 6 for ROW. We calibrate the scale parameters using the processed food data. Because of the similar tastes and preferences between the United States and European Union and considerable history of bilateral trade between the two regions, a significant percentage of firms engage in exports. We assume that in the United States and European Union, 90% of firms operate domestically and 20% of these firms also export.[6] However, because of limited trade between ROW vis-a-vis the United States and ROW vis-a-vis the European Union in processed food, we consider 90% of the ROW firms operate domestically, but only 10% of these firms engage in exports. We calibrate the remaining parameters—fixed operating and export costs f_{im}, scale parameter for the Pareto distribution μ_i, and the scale parameter for the supply functions γ_i—to match domestic sales and exports y_{im}, composite input L_i, and expenditure on processed food I_i data.

Simulation Analysis

This section presents the simulation analysis of the baseline and three alternate scenarios. Based on the above calibration, the baseline simulation replicates the GTAP 9 data. To simulate the effect of a potential TTIP agreement, the first alternate scenario eliminates bilateral US-EU tariffs and reduces the bilateral US-EU NTBs by 50%. We consider complete elimination of tariffs because tariffs are easier to negotiate and phase out compared to NTBs. In contrast, we consider only a 50% cut in NTBs because of complex regulations and restrictions that cannot be readily harmonized, and elimination of some NTBs are not possible due to sanitary and phytosanitary reasons. Consequently, total elimination of NTBs is not realistic, which is also confirmed by Berden et al. (2009) who estimate that bilateral US-EU NTBs in the processed food sector could potentially be reduced by no more than about 50%.

We also quantify the effects of tariff elimination and NTB reduction separately. The second alternate scenario examines complete removal of bilateral US-EU tariffs while leaving NTBs unchanged. The third alternate scenario analyzes a 50% reduction in bilateral US-EU NTBs while keeping tariffs unaltered. A comparison of these three alternate scenarios to the baseline quantifies the impacts of the trade liberalization on the aggregate price index, domestic production, bilateral trade, aggregate consumption, measure of operating firms, cutoff productivity levels, and aggregate productivity in all three regions. Table 1 reports the simulation results for all three alternate scenarios.

Reduction of Bilateral US-EU Tariffs and NTBs

In this scenario, we examine the impacts of the removal of the US-EU bilateral tariffs and a 50% cut in US-EU bilateral NTBs on the processed food market, while maintaining the current US-ROW and EU-ROW bilateral tariffs and NTBs. This trade liberalization reduces the cost of exporting and expands US-EU bilateral trade. EU tariffs (NTBs) of 14.2% (56.8%) on imports from the United States are higher (smaller) than US (NTBs) tariffs of 3.3% (73.3%) on imports from the European Union. Reduction of these bilateral tariffs and NTBs augments cross hauling, leading to an increase in US exports to the European Union of 113.58%, while EU exports to the United States expand by only 96.19%.

Expansion in US-EU bilateral trade displaces exports from the ROW to the United States by 47.26% and to the European Union by 16.10%; thus, trade is diverted from ROW to the United States and the European Union.[7] However, a rise in US imports creates additional competition for US firms selling only domestically, reducing their domestic sales by 14.66%. Similarly, higher EU imports bring more competition for the EU firms selling domestically, curtailing their domestic sales by 9.53%. The higher US-EU trade offsets the decline in domestic production/sales and imports from ROW, leading to higher consumption and an increase in utility (real income) in the United States of 5.38% and in the European Union of 2.04%. The elimination of tariffs and a reduction in NTBs lower the aggregate price index in the United States by 7.54% and in the European Union by 4.21%.

Because US-EU trade liberalization displaces ROW exports to these regions, sales within ROW expand by 1.31%. As a result of the bilateral US-EU trade liberalization, both US and EU export firms find it more profitable to sell in each other's market, and consequently, divert their exports from ROW. Thus, US and EU exports to ROW decline by 2.80% and 1.69%, respectively. Higher domestic sales, despite the decline in US and EU exports to ROW, cause total ROW consumption and thus utility (real income) to rise by 2.00%, leading to a fall in the aggregate price index by 1.23%.

The higher US exports to the European Union (113.58%) offset the decline in production for domestic sales (-14.66%) and exports to the ROW (-2.80), leading to an increase in total US production by 4.89%. Similarly, the increase in EU exports to the United States (96.19%) exceeds the decline in EU production for domestic sales (-9.53%) and exports to ROW (-1.69%), resulting in a rise in total EU production of 3.91%.[8] However, the decline in ROW exports to the United States (47.26%) and European Union (16.10%) outweighs the increase in production for domestic sales (1.31%), leading to a decline in total ROW production of 1.82%.

Next, we discuss the impacts of tariff elimination and NTB reduction on the cutoff productivities and measures of operating firms. Trade liberalization reduces protection to domestic firms from foreign competition. As a result, domestic firms must compete with highly efficient foreign firms (as evident from the rise in US (EU) imports from the European Union (United States) by 96.19% (113.58%)), which causes less efficient firms to reduce their sales and become unprofitable. Because of this fierce competition, the minimum productivity needed for US and EU domestic firms to survive increases by 8.25% and 4.09%, respectively. As profits decline and only the more efficient firms remain in business, the measure of firms that produce for the US and EU domestic markets declines by 21.17% and 13.08%, respectively.

Trade liberalization reduces variable cost of exports, and consequently less efficient firms find it profitable to operate in the export market, which lowers the cutoff productivity for US firms exporting to the European Union by 21.20% and for EU firms exporting to the United States by 15.71%. As a result, more US firms export to the European Union (24.34%) and more EU firms export to the United States (81.91%).

Because both US and EU exporting firms gain by diverting exports from ROW, profitability in this market to declines, leading to an increase in the cutoff productivity of 1.43% and 0.68%, respectively. Consequently, less efficient US and EU exporting firms no long operate in the ROW market and the measure falls by 4.17% and 2.35%. Because of US-EU bilateral trade liberalization, ROW exporting firms face intense competition in the United States and European Union, their exports decline, and these firms become unprofitable. As a result, the minimum productivity needed for ROW firms exporting to the United States and European Union rises by 7.33% and 3.57%. Consequently, the measure of ROW firms exporting to the United States and the European Union falls by 34.60% and 19.00%. The lower US and EU exports to ROW are replaced by ROW firms' domestic sales, which increase domestic production and these firms become more profitable. Higher profits enable less efficient firms to survive, causing the cutoff productivity to fall by 0.26% and the measure of operating firms to rise by 1.57%.

As trade liberalization brings greater efficiency, aggregate productivity computed using equation (15) increases in the United States by 0.21%, European Union by 0.03%, and ROW by 2.24%. The small increases in the aggregate productivities of US and EU firms are due to a larger share of inefficient firms operating in the export markets. In contrast, the relatively large increase in the aggregate productivity of ROW firms is due to the large number of inefficient ROW exporting firms to the United States and European Union exiting the industry.

Elimination of Bilateral US-EU Tariffs

In this subsection, we highlight key results from alternate scenario 2 which considers only tariff elimination while leaving NTBs unchanged. Because tariffs account for a small portion of total variable trade costs (τ_{im}) relative to NTBs, the impacts resulting from tariff removal constitute a small portion of the total effects observed in scenario 1. Furthermore, EU tariff of 14.2% on imports from the United States is higher than the US tariff of 3.3% on imports from the European Union. Consequently, elimination of these tariffs expands cross hauling, with larger impacts for US firms exporting to the European Union compared to EU firms exporting to the United States. For instance, US firms' exports to the European Union increase by 24.63%, whereas EU firms' exports to the United States rise by only 7.28%.[9]

Interestingly, since the reduction of the EU tariff is larger than that of the US tariff, US firms divert their exports from ROW to the European Union because of enhanced profitability from selling in the EU processed food market. However, due to the removal of the small US tariff on EU food products and greater competition from US firms, EU firms reallocate their domestic sales to ROW. Thus, while simultaneous tariff elimination and NTB reduction result in EU firms exporting less to ROW in scenario 1, in isolation, tariff elimination causes EU firms to augment exports to ROW. This leads to a reversal in the sign of the cutoff productivity and measure of EU operating firms exporting to ROW, compared to those in scenario 1. Also, in contrast to the results in scenario 1, as US exports to the European Union expand, the fall in sales of EU firms operating in the domestic market is not offset by the increase in EU exports to the United State and ROW, and aggregate EU production declines by 0.34%.

Reduction of Bilateral US-EU NTBs

In this subsection, we discuss important results from alternate scenario 3 which examines a 50% cut in bilateral US-EU NTBs while keeping tariffs unchanged. Because NTBs are a large percentage of trade restrictions relative to tariffs, the impacts of a 50% NTB reduction account for a large portion of the total effects observed in scenario 1. Contrary to scenario 2, US NTBs of 73.3% on imports from the European Union are greater than the EU NTBs of 56.8% on imports from the United States. As a result, a 50% reduction in the US-EU bilateral NTBs increases cross hauling, with greater impacts for EU firms exporting to the United States than for US firms exporting to the European Union. For example, EU exports to the United States rise by 80.82%, while US exports to the European Union increase by only 67.37%.

Since in this scenario the relative size of US-EU NTB reductions is opposite of the relative size of US-EU tariffs reductions in scenario 2, the directions of US and EU exports to ROW in this scenario are opposite to that of scenario 2, i.e., US firms increase exports to ROW whereas EU firms reduce exports to ROW. As a result, EU firms redirect their exports from ROW to the United States due to greater profitability in the US market. However, because of the relatively smaller reduction of EU NTBs and enhanced competition from EU firms, US firms divert domestic sales to ROW. Thus, compared to trade liberalization of scenario 1, a 50% NTB reduction changes the sign of the direction of US firms exports to ROW. This causes the cutoff productivity to fall and the measure of operating firms to rise for US firms exporting to ROW compared to scenario 1. In contrast to scenario 2, but similar to scenario 1, the fall in sales of EU firms operating in the domestic market and exporting to ROW is offset by the increase in EU exports to the United State and aggregate EU production increases by 4.30%.

Conclusion and Discussion

In this paper, we develop a three-region (United States, European Union, and ROW) monopolistic competition trade model with heterogeneous firms to analyze the effects of potential trade liberalization in the processed food sector under the TTIP trade agreement on prices, domestic production, consumption, bilateral trade, cutoff productivity levels, and aggregate productivity. The model is calibrated to data for the processed food market and simulated to quantify the effects of three scenarios: a) a simultaneous US-EU bilateral tariff removal and a 50% NTB reduction, b) tariff removal, and c) a 50% NTB reduction.

Because of trade liberalization, the aggregate price index of the food products decreases and utility increases in all three regions. As the lowering of trade barriers brings more competition, aggregate productivities of processed food firms in all three regions rise, even though less efficient firms may enter in the export market because of the reduced trade costs arising from the trade liberalization. While consumption and utility increase, aggregate production does not necessarily rise as inefficient domestic firms are forced out by more efficient foreign firms which increase their exports. Since the trade liberalization is only between the United States and the European Union, bilateral trade flows between these two countries expand.

Since combined tariff elimination and NTB reduction are larger by the United States than by the European Union, US consumers gain more than EU consumers. As this trade liberalization augments US and EU processed food production, both countries expand their exports to ROW, which benefits the ROW consumers. The cutoff productivities decrease in the bilateral US-EU export markets because trade liberalization reduces the trade cost, which attracts inefficient firms to enter in these markets. However, in the US and EU domestic markets, cutoff productivities increase because of the intense competition arising from trade liberalization.

In the tariff elimination scenario, because the tariff reduction by the European Union is larger than that by the United States, this free trade benefits EU consumers more than US consumers. Furthermore, US aggregate production increases while EU aggregate production decreases. Consequently, US firms export more to the European Union and, because of this intense competition, EU firms divert their sales from the domestic market to ROW.

The NTB trade barriers in the processed food industry are very prominent, and thus the NTB reduction is of considerable importance to this industry. In this scenario, because US NTBs are larger than the EU NTBs, this trade liberalization brings greater gain to US consumers than to EU consumers. Since US NTB trade liberalization is more pronounced, EU firms expand their production and also divert their trade from ROW to the United States.

Finally, the theoretical model and empirical analysis of the processed food trade liberalization under TTIP are also applicable to other sectors, such as textiles, clothings, and electronics, which are characterized by heterogeneous firms with productivity differences and imperfect competition.

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Notes

[1]NTBs in processed food trade include Sanitary and Phytosanitary measures, genetically modified organism and food labeling requirements, certification, traceability, classifications, security related measures, geographical indications, and differences in trademark legislation (also see Josling (2014)).

[2]Also see Melitz and Ottaviano (2008) for a trade model with firm heterogeneity and nonconstant markups.

[3]Note that any equation that has a left-hand side variable with subscripts im contains 9 equations, and any equation that has a left-hand side variable with a subscript i contains 3 equations. Similarly, any variable with subscripts im contains 9 variables, and a variable with a subscript i contains 3 variables.

[4]The multiple corner solutions problems is also pointed out by Chaney (2008).

[5]The description of processed food items corresponding to the code numbers and sectors is as follows. 19 CMT: meat from cattle, sheep, goats, and swine; 20 OMT: fresh and chilled fowl and turkey meat

and products; 21 VOL: Vegetable oils and fats; 22 MIL: Dairy products; 23 PCR: Processed rice; 24 SGR: Sugar; 25 OFD: Other food products such as flour, cocoa, processed fruit and vegetables, sea food products; 26 B_T: Beverages and tobacco products.

[6]Bernard et al. (2007) show that, in the United States, on average 18% of manufacturing firms export, while 12% and 23% of food manufacturing (NAICS Code 311) and beverage and tobacco product (NAICS Code 312) firms export, respectively.

[7]Disdier et al. (2015) show full tariff liberalization and a 25% reduction in NTBs for agri-food products (all products covered by the WTO Agreement on Agriculture plus fish and fish products) increase the value of US exports to the European Union by 34.9% and the value of EU exports to the United States by 11.6%. Beckman et al. (2015) find tariff removal for processed foods causes the value of US exports to the European Union to expand by 38.85% and EU export to the United States to rise by 1.40%. Their results also show the value of US exports (imports) to (from) ROW decreases by 0.90% (0.06%) and EU exports (imports) to (from) ROW rise (fall) by 0.10% (4.07%). Since these two studies have different magnitude of trade liberalization and report their impacts for *value* of exports and imports, their results cannot be directly compared to our results.

[8]Beckman et al. (2015) find that tariff and NTB removal causes US and EU processed food production to increase by 0.36% and 0.10%, respectively. Since our study incorporates imperfect competition, firm size and productivity differences, our production impacts are more pronounced than what is found in Beckman et al. (2015).

[9]Beckman et al. (2015) find tariff removal for processed foods leads to the value of US exports to the European Union to increase by 39.08% and EU export to the United States increase by 1.24. While the value of US exports (imports) to (from) ROW decreases by 0.72% (0.09%) and EU exports (imports) to (from) ROW decreases slightly by 0.01% (4.08%). Beckman et al. (2015) find that tariff removal results in US and EU processed food production to increase by 0.37% and 0.04%, respectively.

Table 1: Results of the Implementation of TTIP, Percent Changes

	Alternate Scenario 1			Alternate Scenario 2			Alternate Scenario 3		
	Bilateral Trade Flows								
y_{ij}	US	EU	ROW	US	EU	ROW	US	EU	ROW
US	-14.66	113.58	-2.80	-1.58	24.63	-2.64	-11.65	67.37	1.69
EU	96.19	-9.53	-1.69	7.28	1.82	1.90	80.82	-6.21	-4.83
ROW	-47.26	-16.10	1.31	-0.82	5.40	0.17	-44.10	-6.88	0.99
	Bilateral Cutoff Productivity								
$\overline{z}_{ij}$	US	EU	ROW	US	EU	ROW	US	EU	ROW
US	8.25	-21.20	1.43	0.80	-6.51	1.35	6.39	-15.47	-0.83
EU	-15.71	4.09	0.68	-2.06	0.74	-0.75	-13.71	2.60	2.00
ROW	7.33	3.57	-0.26	0.10	1.12	-0.03	6.74	1.44	-0.20
	Bilateral Measure of Operating Firms								
$\overline{n}_{ij}$	US	EU	ROW	US	EU	ROW	US	EU	ROW
US	-21.17	24.34	-4.17	-2.37	5.22	-3.94	-16.96	15.28	2.54
EU	81.91	-13.08	-2.35	7.55	-2.53	2.67	67.56	-8.59	-6.69
ROW	-34.60	-19.00	1.57	-0.62	-6.44	0.20	-32.37	-8.20	1.19
	Aggregate Price, Real Income, Production, and Productivity								
	US	EU	ROW	US	EU	ROW	US	EU	ROW
P_i	-7.54	-4.21	-1.23	-0.21	-1.21	-0.17	-6.85	-2.01	-0.95
C_i	5.38	2.04	2.00	0.25	0.56	0.28	4.64	0.88	1.50
Y_i	4.89	3.91	-1.82	1.96	-0.34	-0.23	1.17	4.30	-1.38
Z_i	0.21	0.03	2.24	0.04	0.01	0.26	0.14	0.02	1.68