TTIP and agricultural trade: The case of tariff elimination and pesticide policy cooperation

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Abstract

A possible Trans-Atlantic Trade and Investment Partnership (TTIP) agreement will further integrate agricultural markets between the United States and the European Union. The elimination of tariffs and cooperation on Sanitary and Phytosanitary measures will promote cross-Atlantic trade. We empirically estimate the impacts of tariffs and Maximum Residue Limits (MRLs) on trade in plant products between the two partners. Furthermore, we simulate trade expansions under plausible negotiation outcomes. We find that a TTIP agreement promotes cross-Atlantic trade in plant products, in both directions, by over 60% if tariffs are removed and MRLs are mutually recognized or harmonized to Codex levels.

Keywords: Trans-Atlantic Trade and Investment Partnership, TTIP, maximum residue limit, MRL, sanitary and phytosanitary measures, tariff, trade agreement, NTM

JEL: Q17, F15

1. Introduction

The first round of the proposed Trans-Atlantic Trade and Investment Partnership (TTIP) negotiations was launched in July, 2013, with the aim to improve market access, regulatory coherence, and modes of cooperation between the United States (US) and the European Union (EU) (European Commission, 2015a). Although the TTIP negotiations are ongoing, official press releases suggest that the removal of tariffs and the minimization of the impacts of Sanitary and Phytosanitary (SPS) measures are top priorities. For example, an EU position paper outlines that one of EU's goals is to "remove nearly all customs duties on EU-US trade" (European Commission, 2015b). In addition, both sides strive for a SPS chapter in the potential TTIP agreement that "builds upon the key principles of the SPS Agreement of the World Trade Organization (WTO)" (European Commission, 2013).

Average customs duties are generally low between the US and the EU. Nevertheless, tariffs are higher for agricultural products than for manufactured goods (Josling and Tangermann, 2015). Non-tariff measures including the SPS measures tend to be more stringent in the EU than in the US. For instance, the EU enforces tougher food safety standards for aflatoxin residues in food items (Xiong and Beghin, 2012), pesticide residues in food products (Li and Beghin, 2014), and growth additives in livestock industries such as hormones and ractopamine (Bureau, Marette, and Schiavina, 1998; Alemanno and Capodieci, 2012). In addition, the EU adopts stricter regulations on emerging biotechnologies such as genetically modified crops (Moschini, 2008).

Several studies in the literature have assessed the economic impacts of a forthcoming TTIP agreement, with emphasis on different products and policy reforms. In a report for the European Parliament, Bureau et al. (2014) project that the removal of tariffs and the 25% reduction in non-tariff measures will raise EU's agri-food export to the US by 60% and import

from the US by 120%. Beghin, Bureau, and Gohin (2014) find that the removal of tariffs and tariff-rate quotas in the biofuel and feedstock markets will boost the ethanol and biodiesel sector in the US and the sugar and isoglucose sector in the EU. Using a computational general equilibrium model, Cororaton and Orden (2016) report modest gains in agricultural exports in both economies if the TTIP agreement does not substantially reduce non-tariff barriers. In an econometric analysis, Arita, Mitchell, and Beckman (2015) find that non-tariff measures are highly restrictive for agri-food exporters from both the US and the EU. Akgul, Hertel and Villoria (2016) examine the possible removal of EU's ban on hormone-treated beef within a GTAP model accounting for productivity difference among beef processors. They find that beef trade across the Atlantic would increase by over $400 million a year.

In this article, we focus on two sets of policy reforms that can result from a potential TTIP agreement: the elimination of tariffs and the cooperation on Maximum Residue Limits (MRLs) that govern pesticide residue concentrations in plant products. First, we deploy an econometric model to estimate the impacts of tariffs and MRLs on the bilateral trade in plant products between the two trade partners. Second, we simulate the economic gains to US and EU exporters under two plausible TTIP negotiation outcomes: (1) the removal of tariffs and the mutual recognition of MRLs; (2) the removal of tariffs and the compliance to Codex MRLs as recommended by the WTO.

We find that the tariffs significantly constrain cross-Atlantic trade in plant products. Moreover, we find that the MRLs in both markets raise costs borne by foreign suppliers on the one hand and sustain import demand on the other. The simulation results suggest that the elimination of tariffs boosts US import of plant products from the EU by 49%, or $300 million a year, and US export of plant products to the EU by 38%, or $940 million a year. Finally, the

mutual recognition of cross-Atlantic MRLs boosts US import of plant products from the EU by 13%, or $79 million a year, and US export of plant products to the EU by 25%, or $635 million a year. The alignment of each country's MRLs on Codex MRLs expands across-Atlantic trade even more. Overall, the gain in export revenue is over 60% for both the US and the EU.

The remainder of the article is organized as follows. Section 2 reviews the current markets and policy instruments pertaining to plant products in the US and the EU. Section 3 uses an econometric model to quantify the impact of tariffs and MRLs on the bilateral trade between US, EU, and other trading partners. We describe data sources and present the estimation results in Section 4. We project the economic gains from a potential TTIP agreement under different policy scenarios in Section 5. Section 6 concludes the article and suggests directions for future research.

2. An overview of trade in plant products and regulatory regimes across the Atlantic

Cross-Atlantic trade in plant products is worth more than $3 billion.[1] In 2012, US import value of plant products from the EU was $620 million, while US export of plant products to the EU totaled $2.5 billion. The customs duties are generally low in either market. Specifically, the simple average tariff for plant products is about 4% in the US and 10% in the EU. However, sanitary and phytosanitary measures diverge significantly across the Atlantic (Bureau et al., 2014; Josling and Tangermann, 2015).

In particular, the regulatory regime governing pesticide residues differs substantially between the two markets. The primary policy instrument is the Maximum Residue Limit, which sets the maximum permissible rate of concentration for a specific chemical residue in a specific product. The Codex Alimentarius, a body under the United Nations Food and Agriculture Organization and the World Health Organization, develops international MRLs based on science.

[1] See Appendix A provides for the coverage of products.

However, the Codex standards are voluntary in nature, as the WTO acknowledges member countries' sovereign right in setting their own standards. Nevertheless, The SPS Agreement of the WTO encourages its members to use CODEX MRLs whenever they are available.

Neither the US nor the EU is currently in compliance with the Codex standards. In particular, Li and Beghin (2014) find that the MRLs in the US do not exactly follow Codex recommendations, but on aggregate are pretty close to them. However, the MRLs implemented in the EU are considerably more restrictive than the Codex counterparts (see the data section below for summary values).

3. An econometric analysis of the US-EU trade in plant products

3.1. The econometric specification

In this section, we provide an econometric model to characterize the cross-Atlantic trade in plant products. Specifically, we extend the model developed by Xiong and Beghin (2014) with emphasis on the US-EU partnership. In the original model, Xiong and Beghin (2014) use the MRL stringency index of Li and Beghin (2014) to measure the restrictiveness of MRLs by product and by nation. In particular, the MRL stringency index is averaged across MRLs targeting all pesticides and chemicals applicable to a specific product. A higher MRL stringency index indicates a more restrictive MRL policy. If a country defers its MRLs to Codex, the stringency index takes the value of one.

More importantly, the model in Xiong and Beghin (2014) accounts for the impacts of MRLs on both the supply side and the demand side of the market. They find empirical evidence that a more stringent MRL imposes extra costs on foreign suppliers on one hand, and stimulates additional demand via quality assurance or information disclosure on the other. With focus on the US-EU partnership, we extend the model by allowing MRLs in the EU and the US to have

different impacts than the MRLs adopted by other developed nations.

Specifically, the econometric model is as follows:

$$\begin{aligned}\ln(T_{sijt}) = {} & (\beta_1 + \beta_2 I\{i = EU\} + \beta_3 I\{i = US\} + \beta_4 I\{j = EU\} + \beta_5 I\{j = US\}) \cdot \ln(1 + tar_{sij}) + \\ & (\beta_6 + \beta_7 I\{i = EU\} + \beta_8 I\{i = US\} + \beta_9 I\{i = EU\} + \beta_{10} I\{i = US\}) \cdot \max\{MRL_{sjt} - MRL_{sit}, 0\} + \\ & (\beta_{11} + \beta_{12} I\{i = EU\} + \beta_{13} I\{i = US\} + \beta_{14} I\{i = EU\} + \beta_{15} I\{i = US\}) \cdot MRL_{sjt} + \\ & \beta_{16} Q_{sit} + \beta_{17} \ln(1 + dist_{ij}) + \beta_{18} Lang_{ij} + \beta_{19} Bord_{ij} + \beta_{20} Col_{ij} + fe_{jt} + fe_{hit} + \varepsilon_{sijt},\end{aligned}$$

where T_{sijt} is the trade value of product *s* in year *t* from the exporting nation *i* to the importing nation *j*; the function $I\{\}$ generates an indicator variable that equals one if the bilateral trade involves EU or US as the importer or the exporter and zero otherwise; and tar_{sij} is the ad valorem tariff rate imposed by country *j* on product *s* from country *i*. Note that the additional slopes assigned to the tariffs and MRLs implemented by the US and the EU allow us to focus on cross-Atlantic policies and outcomes.

On the second line of the above equation, the variable $\max\{MRL_{sjt} - MRL_{sit}, 0\}$ captures the trade-cost effect of MRLs. That is, exporters overcome additional costs when selling to countries where the MRLs are more stringent than the counterparts at home. Note that the bilateral trade is not disrupted when the MRLs are harmonized between the trading partners.[2] As for the tariff variable, we separately identify the trade-cost effects of MRLs when the EU or the US is involved as the exporter or the importer.

The variable MRL_{sjt} on the third line of the equation can be interpreted as the demand-enhancing effect of the MRL policy for product *s* in the importing country *j*. Specifically, a more restrictive MRL regime stimulates or sustains demand by ensuring quality or addressing asymmetric information in the agri-food markets (Thilmany and Barrett, 1997). On the last line of the regression equation, we control for the supply capacity of sector *s* in the exporting country

[2] In the model, the mutual recognition of MRLs would have the same cost-reducing effect as harmonization, as the divergence in MRLs no longer hinders trade between trading partners.

i (Q_{sit}), the distance between the two trading partners ($dist_{ij}$), whether the two nations use the same official language ($Lang_{ij}$), whether the countries are adjacent ($Bord_{ij}$) or have colonial tie in history (Col_{ij}). Finally, we include time-varying importers' fixed effects (fe_{jt}) and time-varying and chapter-specific exporters' fixed effects (fe_{hit}) to account for the multilateral trade resistance terms (Anderson and van Wincoop, 2003).[3]

3.2. Data features and the estimation procedure

We utilize the data set in Xiong and Beghin (2014). Specifically, the data covers bilateral trade records of disaggregated plant products from 61 nations to 20 high-income nations in the year 2007-2008 and 2011-2012.[4] The effectively applied tariffs are retrieved from the MacMap database. The MRL data as of 2008 is sourced from the Homologa database provided by the Department of Environment, Food and Rural Affairs in the United Kingdom. The MRL data as of 2012 originates from the GlobalMRLs databank of Bryant Christie Inc. Other bilateral variables are retrieved from the CEPII database. The 2007 and 2008 trade series are matched with MRL stringency indices in 2008 by product and by nation. Similarly, the 2011 and 2012 trade flows are aligned with the MRL stringency measurements as of 2012.

Table 1 shows the summary statistics of the MRL stringency indices in the importing markets. The MRLs enforced by the EU are highly restrictive. Specifically, the EU MRL index is 1.53 in 2008 and 1.39 in 2012. Since the stringency index of Codex MRLs is one by default, the MRL regime in the EU is nearly 40% tougher than the international recommendations. The MRL stringency index in the US is slightly below one in both periods, suggesting that the regulatory regime in the US is almost equivalent to Codex levels. The MRL polices implemented by other

[3] The chapters are defined at the HS-2 levels, whereas the plant products of interest are defined at either HS-4 or HS-6 levels.
[4] See Appendix A for the coverage of products and Appendix B for the coverage of nations.

importing markets are less restrictive than the EU but tougher than the US or Codex. Although the MRL information is frequently updated by regulatory bodies across the world, the overall stringency did not vary substantially from 2008 to 2012.

Table 1. Summary statistics of the MRL stringency indices

MRL stringency index:	2008		2012	
	Mean	Std. Dev.	Mean	Std. Dev.
EU	1.53	0.37	1.39	0.48
US	0.94	0.40	0.97	0.33
Other high-income OECD nations	1.12	0.48	1.29	0.50
All importing nations	1.15	0.49	1.27	0.49

Note: Appendix B provides the list of importing markets. Codex MRLs have a stringency index of one.

A prominent feature of bilateral trade records at disaggregated product levels is that zero trade flows are pervasive. In the dataset, more than 80% of the 315,397 observations correspond to the absence of trade. To account for the large portion of missing trade, we use the two-step Heckman procedure to estimate the regression equation. Following Xiong and Beghin (2014), we choose the common religion variable as the excluded variable to facilitate the identification of the Heckman procedure. Furthermore, to allow heterogeneity in the self-selection process across different agricultural sectors, we also include the interaction terms of the excluded variable and the fixed effects at the HS-2 chapter level.

4. Results and discussions

4.1. Estimation results and marginal effects

We focus on the marginal effects of the tariffs and MRLs in this section, while leaving the estimated coefficients to Appendix C.[5] Specifically, Table 2 shows the marginal effects of tariffs and MRLs along the *intensive margin of trade*. That is, the impacts on the trade volumes given that bilateral trade already takes place. We later define the marginal effects of tariffs and

[5] One can verify from Appendix C that the estimated coefficients of other trade costs bear the expected signs, except for the effect of common border on the probability of trade partnership.

MRLs along the extensive margin.

Table 2. Marginal effects of tariffs and MRLs along the intensive margin

	US as exporter		EU as exporter		3rd country exporter	
US as importer						
Tariff			-7.846***	(1.107)	-7.476***	(1.090)
MRL: demand enhancement	n.a.		1.682***	(0.179)	1.543***	(0.159)
MRL: trade cost			-1.274***	(0.261)	-0.599**	(0.235)
EU as importer						
Tariff	-2.408***	(0.367)			-2.489***	(0.207)
MRL: demand enhancement	0.379*	(0.199)	n.a.		0.697***	(0.066)
MRL: trade cost	-0.670***	(0.208)			-0.347***	(0.073)
3rd country importer						
Tariff	-0.846**	(0.338)	-1.296***	(0.256)	-0.926***	(0.138)
MRL: demand enhancement	-0.086	(0.215)	0.370***	(0.125)	0.232**	(0.105)
MRL: trade cost	0.626***	(0.236)	0.275*	(0.165)	0.950***	(0.128)

Note: The marginal effects correspond to the estimated coefficients with correction for self-selection to trade. Standard errors are in parentheses. The notations *, **, and *** represent the 10%, 5%, and 1% levels of significance respectively.

As shown in Table 2, tariffs significantly impede agricultural trade cross the Atlantic. The tariff elasticity of US import from the EU is over -7, and the tariff elasticity of US export to the EU is -2.4. In an earlier study, Bureau et al. (2014) also find that the tariff elasticity of cross-Atlantic agricultural trade is well above one. With US-EU trade flows excluded, the marginal effect of tariffs on trade volumes among third countries is nearly one.

Next, we attend to the marginal effects of MRLs in Table 2. We find that the MRL policies in either the US or the EU exhibit dual effects. That is, the MRLs impose extra costs on foreign suppliers as well as sustain demand for imports via information disclosure or quality assurance. In particular, the MRLs in the US affect market participants more profoundly than the MRLs in the EU. The plausible reason is that the harmonization of MRLs among EU member states has reduced the disruptions of MRLs within the common market. In addition, we find that the MRLs adopted by other high-income nations generally promote imports of plant products.

However, the positive trade-cost effects of MRLs implemented by third nations are unexpected. One possible explanation is that these MRLs impose more costs onto domestic producers than foreign suppliers. As a result, a more stringent MRL regime further diminishes the competitiveness of the agricultural sectors.[6]

As a complement to Table 2, Table 3 presents the marginal effects of tariffs and MRLs along the *extensive margin of trade*. That is, the impacts on the likelihood of trade partnership. The effects along the extensive margin are of particular interest when certain policies impose substantial costs on foreign suppliers and therefore drive vulnerable exporters out of the market altogether. The reduction or removal of these prohibitive measures expands the variety of products traded in the world market or the number of nations participating in international trade.

Table 3. Marginal effects of tariffs and MRLs along the extensive margin

	US as exporter		**EU as exporter**		**3rd country exporter**	
US as importer						
Tariff			-4.527***	(0.555)	-4.861***	(0.547)
MRL: demand enhancement	n.a.		1.069***	(0.102)	1.097***	(0.094)
MRL: trade cost			-0.850***	(0.152)	-0.569***	(0.138)
EU as importer						
Tariff	-1.541***	(0.235)			-1.852***	(0.112)
MRL: demand enhancement	-0.039	(0.127)	n.a.		0.291***	(0.037)
MRL: trade cost	-0.157	(0.130)			0.025	(0.042)
3rd country importer						
Tariff	-0.237	(0.222)	-0.214*	(0.125)	-0.548***	(0.079)
MRL: demand enhancement	-0.249*	(0.141)	0.053	(0.072)	0.081	(0.062)
MRL: trade cost	0.382**	(0.147)	0.283***	(0.095)	0.564***	(0.075)

Note: The marginal effects correspond to the changes in the log-likelihood of trade partnership in response to changes in the explanatory variables. Standard errors are in parentheses. The notations *, **, and *** represent the 10%, 5%, and 1% levels of significance respectively.

As shown in Table 3, tariffs lower the likelihood of the occurrence of trade across the Atlantic. The result suggests that the elimination of tariffs will expand the variety of plant

[6] See Marette and Beghin (2010) for a conceptual model capturing the impacts of standards on comparative advantages.

products traded between the US and the EU. Moreover, the increase in variety will be more substantial in the US market than in the EU market, probably because the diversity of EU imports is more constrained by non-tariff measures in the EU. We also find that the MRLs in the US affect the propensity of both US importers and EU exporters. In contrast, the MRLs in the EU do not affect EU-US partnership and even make EU's sourcing from third countries more likely.[7] As in Table 2, we find no evidence that the MRLs enforced by third nations suppress the probability of trade.

In summary, the marginal effects in Table 2 and Table 3 provide a quantitative assessment of the impacts of tariffs and MRLs on the across-Atlantic trade in plant products. The overall effects of trade liberalization can be derived by combining the marginal effects along both margins of trade. In the next subsection, we simulate the potential gains to agricultural exporters in the US and the EU, under possible policy environments implied by a forthcoming TTIP agreement.

4.2. Simulation results and policy implications

The gradual removal of all import duties and the cooperation on non-tariff measures are high priorities in the ongoing TTIP negotiations. Although a duty-free market across the Atlantic is a preferred outcome by both sides, the risk perceptions and assessments of other public policies such as the SPS measures differ greatly between the US and the EU markets. We consider two plausible policy scenarios resulting from the TTIP negations. In the first scenario, tariffs are eliminated and the both markets consider the MRLs effective in the other market equivalent to the domestic standards (i.e., mutual recognition). In the second scenario implied by the TTIP agreement, cross-Atlantic tariffs are removed and both the US and the EU defer their

[7] The finding lends support to the idea that non-tariff measures addressing market imperfections can be trade catalysts rather than impediments. See the 2012 World Trade Report of the WTO for a survey of non-tariff measures and multilateral trade issues. https://www.wto.org/english/res_e/publications_e/wtr12_e.htm

MRLs to the Codex counterparts. Under this negotiation outcome, the TTIP agreement would be consistent with the SPS Agreement and Technical Barriers to Trade Agreement of the WTO. Table 4 shows the simulated trade expansions due to a TTIP agreement in both scenarios.

Table 4. Expansions in across-Atlantic trade in plant products

	TTIP outcome 1: mutual recognition	TTIP outcome 2: Harmonization to Codex MRLs
Gains to US exporters		
From tariff elimination	38%	38%
From MRL changes	25%	26%
Gains to EU exporters		
From tariff elimination	49%	49%
From MRL changes	13%	21%

Note: The trade expansions account for the increase in trade volumes (or the intensive margin) and the increase in trade likelihood (or the extensive margin).

As shown in Table 4, the elimination of tariffs promotes US export to the EU by 38%, or $940 million a year based on the trade record as of 2012. Similarly, the tariff removal boosts US import from the EU by 49%, or $300 million a year. Note that the simulated trade expansions do not incorporate potential feedback effects from field crops to processed food items such as meat and dairy products along the supply chain.

Next, we discuss the expansions of trade induced by cross-Atlantic cooperation on MRL policies. Under the first negotiation outcome, the US and the EU mutually recognize the MRLs adopted in the other market. The equivalence of MRLs exempts exporters from incurring additional costs in order to penetrate the other market. We expect that US exporters benefit more from mutual recognition than EU exporters because the current MRL regime is tougher in the EU than in the US (recall Table 1). At the same time, the mutual recognition might lead EU consumers to perceive US imports as inferior. Such changes of risk or quality perceptions in the EU are likely to weaken the demand for US imports. As shown in Table 4, the mutual recognition of MRLs raises US export to the EU by 25%, or $635 million a year, and US import

from the EU by 13%, or $79 million a year.

Under the second TTIP negotiation outcome, both the US and the EU endorse the Codex MRLs. This implies a substantial relaxation of MRLs in the EU and a slight strengthening of MRLs in the US (recall Table 1). The adherence to a common set of MRLs spares exporters from overcoming extra hurdles when selling across the Atlantic. As in the case of mutual recognition, we expect US exporters to gain more than EU exporters because a more stringent regulatory regime is currently effective in the EU. In addition, the relaxation of MRLs in the EU suppresses EU demand, as European consumers adjust their risk and quality perceptions. Similarly, the strengthening of MRLs in the US is likely to enhance the demand for plant products in the US. According to Table 4, US export to the EU increases by 26%, slightly higher than in the case of mutual recognition. The reason is that European consumers perceive US imports as less inferior when the US strengths its MRLs to meet Codex recommendations. Finally, we find that US import from the EU rises by 21%, higher than13% under mutual recognition. The reason is that the US compliance with Codex enhances US demand for plant products. Overall, the cross-Atlantic trade in plant products expands by more than 60%, in either direction, in response to a comprehensive TTIP agreement that addresses both tariffs and non-tariff measures.[8]

5. Conclusions

The ongoing TTIP negotiations between the US and the EU are expected to bring forth a broad-based trade agreement that further integrates the two markets. The proposed cooperation ranges from the gradual removal of bilateral customs duties to the convergence of regulatory regimes across the Atlantic. The agricultural sectors on both sides will be profoundly affected by a TTIP agreement as policies affecting the agri-food industries diverge substantially between the two

[8] Jean and Bureau (2016) report that currently effective regional trade agreements have promoted world trade in food products by 30% to 40%. Our simulation results suggest that the TTIP agreement would stimulate more trade than previous regional trade pacts.

markets.

We investigate the impact of a potential TTIP agreement on the cross-Atlantic trade in plant products, with emphasis on the elimination of tariffs and the convergence of MRLs that regulate pesticide residues. Deploying a state-of-the-art econometric model, we find that the elimination of tariffs boosts US import of plant products from the EU by $300 million a year and US export of plant products to the EU $940 million a year. Furthermore, the mutual recognition of MRLs raises US import of plant products from the EU by $79 million or $130 million a year, and US export of plant products to the EU by $635 million or $661 million a year. The endorsement of Codex MRLs by the US and the EU has the potential to release even more trade opportunities.

We foresee several extensions to the current research. First, the proposed model can be used to evaluate other policies interfering with agricultural trade across the Atlantic. For example, one could consider the reconciliation of SPS measures governing food and feed additives and antibiotic residues in animal products. Second, the possible trade-diversion effects of a TTIP agreement are of great interest to stakeholders and policy makers beyond the US and the EU. In particular, it is worth exploring whether the expansion of cross-Atlantic trade is at the expense of diminished export opportunities faced by less developed nations. In addition, future research could go beyond trade growths and investigate the welfare implications of the TTIP agreement.

Reference

Alemanno, A., & Capodieci, G. (2012). Testing the limits of global food governance: the case of ractopamine. *European Journal of Risk Regulation*, *3*.

Anderson, J. and van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review* 93: 170-192.

Akgul, Z. T.H. Hertel and N.B. Villoria. (2016). Heterogeneous Firms, Non-tariff Measures, and US Beef Trade. Mimeo, April.

Arita, S., Mitchell, L., & Beckman, J. (2015). *Estimating the Effects of Selected Sanitary and Phytosanitary Measures and Technical Barriers to Trade on US-EU Agricultural Trade* (No. 212887). United States Department of Agriculture, Economic Research Service.

Beghin, J. C., Bureau, J. C., & Gohin, A. (2014). The impact of an EU-US Transatlantic Trade and Investment Partnership agreement on biofuel and feedstock markets. Center for Agricultural and Rural Development, Iowa State University. http://www.card.iastate.edu/publications/dbs/pdffiles/14wp552.pdf

Bureau, J. C., Marette, S., & Schiavina, A. (1998). Non-tariff trade barriers and consumers' information: The case of the EU-US trade dispute over beef. *European Review of Agricultural Economics*, *25*(4), 437-462.

Bureau, J.-C., Emlinger, C., Disdier, A.C., Felbermayr, G., Fontagné, L., Fouré, J., & Jean, S. (2014). The market opportunities for the EU agri-food sector in a possible EU-US trade agreement. Report for the European Parliament, 2014. http://www.europarl.europa.eu/RegData/etudes/STUD/2014/514007/AGRI_IPOL_STU(2014)514007_EN.pdf

Cororaton, C. B., & Orden, D. (2016). Potential Economic Effects of the Reduction in Trade Barriers in the Transatlantic Trade and Investment Partnership. GII Working Paper No. 2016-1, Global Issues Initiative, Institute for Society, Culture and Environment, Virginia Polytechnic Institute and State University.

European Commission, 2013. "EU-US Transatlantic Trade and Investment Partnership: Sanitary and phytosanitary issues". July 2013. http://trade.ec.europa.eu/doclib/docs/2013/july/tradoc_151625.pdf

European Commission, 2015a. "The Transatlantic Trade and Investment Partnership (TTIP) explained". March, 2015. http://trade.ec.europa.eu/doclib/docs/2014/may/tradoc_152462.pdf

European Commission, 2015b. "Trade in goods and customs duties in TTIP". January, 2015. http://trade.ec.europa.eu/doclib/docs/2015/january/tradoc_152998.1%20Trade%20in%20goods%20and%20customs%20tariffs.pdf

Jean, S., & Bureau, J. C. (2016). Do regional trade agreements really boost trade? Evidence from agricultural products. *Review of World Economics*, 1-23.

Josling, T. E., & Tangermann, S. (2015). *Transatlantic Food and Agricultural Trade Policy: 50 Years of Conflict and Convergence*. Edward Elgar Publishing.

Li, Y., & Beghin, J. C. (2014). Protectionism indices for non-tariff measures: An application to maximum residue levels. *Food Policy*, *45*, 57-68.

Marette, S., & Beghin, J. (2010). Are standards always protectionist? *Review of International Economics*, *18*(1), 179-192.

Moschini, GianCarlo. "Biotechnology and the development of food markets: retrospect and prospects." *European Review of Agricultural Economics* 35.3 (2008): 331-355.

Thilmany, D., and Barrett, C. (1997). Regulatory barriers in an integrating world food market. *Review of Agricultural Economics* 19: 91-107.

Xiong, B., & Beghin, J. (2012). Does European aflatoxin regulation hurt groundnut exporters from Africa? *European Review of Agricultural Economics*, *39*(4), 589-609.

Xiong, B., & Beghin, J. (2014). Disentangling Demand-Enhancing and Trade-Cost Effects of Maximum Residue Regulations. *Economic Inquiry*, *52*(3), 1190-1203.

Appendix A

Table A. Names of plant products, based on the Harmonized System

Chapter	Description	Product names (HS 4 or 6 digits)
HS-06	live trees & other plants	canna, chufa, dasheen
HS-07	edible vegetables	artichoke, asparagus, bean*, broccoli, Brussels sprouts, bulb onion, cabbage, cassava(roots), celery, chickpea, chicory(tops), chrysanthemum, cucumber, eggplant, endive, garden beet(roots), garlic, green onion, lentil, lettuce(head), lettuce(leaf), mushroom, non-bell pepper, olive, pea*, potato, spinach, squash, sweet potato, tomato, turnip
HS-08	edible fruits & nuts, peel of citrus/melons	almond, apple*, apricot , avocado, blueberry, beechnut, Brazil nut, cantaloupe, cashew, cherry, chestnut, coconut, date, dry prune plum , fresh prune plum, grape, grapefruit, guava, hazelnut, kiwifruit, kumquat, loquat, nectarine, orange, papaya, peach, pear, pineapple, pistachios, plantain, raisin, strawberry*, tangelo, walnut, watermelon, youngberry*
HS-09	coffee, tea, mate & spices	ginger, pepper, summer savory
HS-10	Cereals	barley, corn, corn salad, lupin, millet*, oat, rice, sorghum, wheat
HS-12	oil seeds/ misc. grains/ med. plants/ straw	cotton seed, hop(dried cones), mustard spinach, peanut, sesame seed, sugar beet (roots)

Note: Products with * have multiple matches in the HS classifications.

Appendix B

Table B. List of importing and exporting countries

Importing countries		**Exporting countries**				
Australia	New Zealand	Algeria	Domini-can Rep.	Israel	Pakistan	Thailand
Belgium	Portugal	Argentina	Ecuador	Italy	Panama	Trinidad/ Tobago
Canada	Rep. of Korea	Australia	Egypt	Jamaica	Peru	Tunisia
Denmark	Spain	Bahamas	El Salvador	Japan	Philippine	Turkey
Finland	Sweden	Barbados	Finland	Jordan	Poland	United Arab Emirates
France	United Kingdoms	Belgium	France	Kenya	Portugal	United Kingdoms
Germany	United States	Brazil	Germany	Lebanon	Rep. of Korea	United States
Greece		Canada	Greece	Malaysia	Russia Federation	Venezuela
Ireland		Chile	Guatemala	Mexico	Singapore	Vietnam
Israel		China	Honduras	Morocco	South Africa	
Italy		Columbia	Hong Kong	Nether-lands	Spain	
Japan		Costa Rica	Indonesia	New Zealand	Sri Lanka	
Nether-lands		Denmark	Ireland	Nicaragua	Sweden	

Note: Importing countries are selected OECD members with nominal per-capita GDP over $20,000 as of 2012. Source: *International Monetary Fund*.

Appendix C

Table C. Estimated coefficients of high-income OECD' imports of plant products

Variables	Outcome equation		Selection equation	
	Coefficient	**Std. Err**	**Coefficient**	**Std. Err**
MRL: Demand enhancement	0.232**	0.105	0.039	0.030
⊗ EU as importer	0.466***	0.113	0.101***	0.032
⊗ EU as exporter	0.138	0.129	-0.014	0.035
⊗ US as importer	1.312***	0.176	0.489***	0.049
⊗ US as exporter	-0.318	0.121	-0.159**	0.064
MRL: Trade cost	0.950***	0.128	0.271***	0.036
⊗ EU as importer	-1.296***	0.134	-0.259***	0.038
⊗ EU as exporter	-0.674***	0.159	-0.135***	0.044
⊗ US as importer	-1.549***	0.254	-0.545***	0.072
⊗ US as exporter	-0.324	0.217	-0.087	0.065
ln(1+tariff)	-0.926***	0.138	-0.263***	0.038
⊗ EU as importer	-1.562***	0.234	-0.627***	0.063
⊗ EU as exporter	-0.370	0.263	0.161**	0.063
⊗ US as importer	-6.549***	1.094	-2.074***	0.265
⊗ US as exporter	0.080	0.342	0.149	0.108
ln(Production)	1.209***	0.016	0.229***	0.001
ln(Distance)	-2.262***	0.051	-0.617***	0.008
Border	0.488***	0.110	-0.251***	0.033
Colony	0.612***	0.057	0.129***	0.016
Language	0.984***	0.049	0.302***	0.012
Inverse Mills Ratio	3.608***	0.100	--	--
Number of obs.	58,603		315,397	

Note: The notation ⊗ represents the interaction with the following indicator variable. The year-specific importers' fixed effects and the year-specific and chapter-specific exporters' fixed effects are included in the regressions but omitted from the table for brevity. Chapter-specific common religion variables are used as the excluded variables in the Heckman two-step procedure. Notations **, and *** denote significance levels at 5% and 1% respectively.