Trade effects of MRL harmonization

Liliana Foletti[1] and Anirudh Shingal[2]

16 August 2013

PRELIMINARY VERSION, PLEASE DO NOT QUOTE

Abstract

Combining data on Maximum Residue Levels (MRLs) in pesticides with bilateral trade and standard gravity variables over 2005-11, this paper identifies the effect of the complete harmonization of MRLs across EU member states on inter- and intra-EU agri-food trade. We make an empirical contribution to the impact assessment of standards literature by identifying the trade effects of three different harmonization dynamics in health-related standards: complete harmonization of domestic and foreign regulation (intra-EU members), harmonization of standards between a large number of foreign markets (non EU-members), harmonization of standards towards international levels (non EU-members). Significantly, we find that the harmonization of MRL standards may have led to greater trade at both margins for all different sub-samples, even those including developing country exporters. Our results also suggest that having different MRL regulations is mostly costly at the extensive margin; this is found to be especially true for intra-EU15 agri-trade.

JEL classification: F13 (Trade Policy)

Key words: Standards, pesticide MRLs, harmonization, EU, regulatory heterogeneity

[1] University of Geneva (liliana.foletti@unige.ch)
[2] World Trade Institute, University of Bern (anirudh.shingal@wti.org)

1. Introduction

This paper aims to identify the effect of (the complete) harmonization of Maximum Residue Levels (MRL) across EU member states on inter- and intra-EU agri-food trade. Regulation (EC) No 396/2005 contains a list of MRLs that came into effect on September 2008 and effectively repealed national MRL regulation from there onwards. Thus, before 1 September 2008, a mixed system was in place with harmonised Community MRLs for *ca*. 250 active substances and national MRLs for the remaining substances. After this date, harmonised MRLs became applicable for all active substances used in plant protection products that have the potential to enter the food chain.

The removal of heterogeneity in MRL regulation across EU member states is likely to be an advantage to exporters targeting the EU market since they now need to comply with a single set of regulations as opposed to multiple sets in the past, thus reducing the extent of "regulatory protectionism" (Baldwin et.al., 2000). The same reasoning is expected to apply to trade between EU member states since food regulations of the "foreign" markets coincide perfectly with domestic regulations.

Our empirical approach is embedded in Melitz's (2003) heterogeneous firms approach, wherein a firm's decision to export depends on the level of fixed cost in a given market and the ability to meet sanitary and phyto-sanitary standards (SPS) such as MRLs constitutes an important element of such fixed costs. A harmonization of MRLs thus leads to a reduction in fixed costs for all exporters to the harmonized market, given that a representative firm is now making a joint entry decision for all markets in the harmonizing region. Empirically, we use a two-stage estimation structure, where the first stage consists of a Probit gravity estimation yielding a proxy for the extensive margin. This is then used to correct for the heterogeneity-bias in the second stage of the estimation.

The analysis is conducted at the sectoral level, focusing on HS Chapters 7 to 12, which are the agriculture and processed food sectors where pesticide MRLs are relevant. It is found that the harmonization of MRL regulation may have led to greater trade in these products at both margins for both EU and non-EU exporters including from developing countries, which is a significant finding, hitherto unobserved in the impact-assessment of standards literature. In general, regulatory heterogeneity was found to affect the probability to export more adversely and this result was found to be especially true for intra-EU15 trade.

2. Heterogeneous Standards as Trade Barriers

While SPS measures integrate the markets of members participating in the harmonization of such measures, they can also act as barriers to those who are excluded from such harmonization. Country-specific standards effectively create additional costs for foreign producers by forcing them to adjust their product and production process so as to meet individual national standards. Further costs emanate from the need for subsequent conformity assessment with these standards (World Bank TBT Survey, 2004; Baldwin, 2000; Chen and Mattoo, 2004; Wilson, Chen and Otsuki, 2006).

Heterogeneity in standards creates two negative side effects. Firstly, foreign producers are hurt by increased production costs, which may even be prohibitive and especially burdensome for developing countries trying to get access to industrialized countries' markets. Secondly, by creating artificial entry barriers to national markets, country-specific standards have a negative effect on efficiency by preventing firms forced to meet different standards for different markets from being able to take advantage of economies of scale, thus dampening productive efficiency. When markets remain segmented by such barriers, firms are further able to raise prices over marginal costs, implying less allocative efficiency than could be reached with integrated markets.

Additionally, Baldwin (2000) points to a "magnification effect of globalization": the greater the freeness of trade, the greater the effect of any remaining barriers especially from an economic geography point of view. In other words, a reduction in distortion arising from tariff barriers, will lead to an increased impact of regulatory differences on the location of production.

3. Literature review

The main strand of the standards-literature has generally been more concerned with the link between standards and innovation and standards and growth[3].

However, firm level surveys have also been conducted to estimate the direct impact of standards and technical regulations on firms' production costs and export performance. For instance, Wilson and Otsuki (2004) looked at 689 firms in over 20 industries in 17 developing countries in a World Bank TBT survey and found 70% of them reporting facing technical regulations in their export markets, especially the EU and the US. The authors also show that testing procedures and lengthy inspection reduce exports of developing countries to these markets by 9% and 3% respectively while standards reduce the likelihood of exporting to more than three markets by 7%. The study also showed that the firms needed to make significant investments[4] to meet these standards or had to lay off workers instead to keep the costs down.

[3] General overviews of this literature are available in Farrell and Saloner (1987), David and Greenstein (1990), Katz and Shapiro (1994) and Matutes and Regibeau (1996); trade-related aspects of this literature are discussed by Matutes and Regibeau (1996), Kende (1992), Gandal and Shy (1996), Wallner (1998), Jeanneret and Verdier (1996) and DIN (Deutsches Institut für Normung, 1999); e.g. Blind and Jungmittag (2004), Jungmittag, Blind and Grupp (1999).

[4] These included investments in additional plant or equipment, one-time product redesign, product redesign for each export market, additional labor for production, additional labor for testing and certification.

The empirical literature has also evolved to estimate the trade effects of diverging standards directly from the number or costs of standards: for instance see Moenius (1999), Swann, Temple and Shurmer (1996), Vancauteren and Weiserbs (2003) Mantovani & Vancauteren (2003).

On the other hand, theoretical literature on this subject remains scant. Ganslandt & Markusen (2001) have modeled TBTs formally (though not their liberalization). Baldwin (2000) and Mattoo and Chen (2004) have modeled both TBTs and their liberalization, cautioning against the discriminatory effects that the latter may entail. Mattoo and Chen (2004) also found harmonization in the EU to raise both intra-regional trade as well as trade with excluded developed countries, though their results also indicate that such harmonization diverts trade away from developing countries.

In more recent work, Moenius (2006) estimates the effects of national and internationally harmonized standards on trade between Canada and its major trading partners in electricity-dependent products over 1980-1995 for 471 four-digit SITC industries. His results suggest that while both national and international harmonization has positive effects on trade in electricity-dependent products, the former dominates the latter. Moreover, country size matters: smaller countries benefit more from international harmonization.

Baller (2007) investigates trade effects of the regional liberalization of TBTs in the form of harmonization and mutual recognition agreements (MRAs) for testing procedures in telecoms and medical devices. While she finds MRAs to have a strong positive influence on both export probabilities and trade volumes for partner countries, she finds the impact of harmonization on members and excluded developing countries to be negligible. However, this impact is found to be large and positive on excluded OECD countries. In all cases, she finds harmonization to have a stronger impact at the extensive margin compared to the intensive margin of trade.

Shepherd (2007) uses a new database of EU product standards in the textiles, clothing and footwear sectors to show that international standards harmonization is associated with increased partner country export variety. Specifically, a 10 percentage point increase in the proportion of internationally harmonized standards is associated with a 0.2 percent increase in partner country export variety. The harmonization elasticity is also found to be around 50 percent higher for low income countries, which suggests that they may be particularly constrained in adapting products to meet multiple standards. These findings are also consistent with a heterogeneous firms model of trade in which harmonization is beneficial at the extensive margin provided that any increases in compliance costs are not too large.

De Frahan and Vancauteren (2006) study the trade effects of harmonization of food regulation in the EU on intra-EU trade over 1990-2001 and find this harmonization to have a large and positive trade effect both at the aggregate level and for individual food sectors.

In more closely related research, Achterbosch et.al. (2009) studied the impact of differences in pesticide MRLs on Chilean fruits[5] exports to the EU15 over 1996-2007 and found a 5% reduction in the EU's regulatory tolerance levels for MRLs to lead to a 14.8% decline in export volumes, with grapes being twice as sensitive as the other fruits.

Foletti (2013) uses data on MRL regulation for 20 countries over 2005-2010 to find that these MRLs fostered trade in the 117 agricultural goods in the sample, thus emphasizing the informative and trade creating feature of such SPS measures.

However, the paper closest to ours is Winchester et.al. (2012) that studies the impact of regulatory heterogeneity on the EU's agri-food trade in the year 2009-10 by using the NTM[6]-Impact database that was assembled under a European research framework programme. Their results indicate that differences in most regulations weakly reduce trade, but that stricter MRLs for plant products in one country relative to others reduces exports to that country. Unlike Winchester et.al. (2012), we only focus on MRLs in pesticides in our paper but this enables us to include more products and trading partners and also give a panel dimension to our analysis.

4. Empirics

4.1. Measures of MRL regulation heterogeneity

We construct the following heterogeneity index of MRLs:

$$f_{ijpkt} = \frac{MRL_{jpkt} - min(MRL_{jpkt}, MRL_{ipkt})}{MRL_{jpkt} + MRL_{ipkt}}$$

The index, f, measures the degree of heterogeneity of MRL regulation between importer i and exporter j, regarding the maximum residue level of pesticide k allowed to be remain on product p. The value of the index ranges between 0 and 1, where $f = 0$ indicates that for the same pesticide and crop, the importer and exporter have equal MRLs and there is therefore no heterogeneity. Because we assume that differences in MRLs will affect trade though increase in trade costs due to the presence of compliance costs, we are not interested in cases in which the exporting country has stricter MRL regulations than the importing country. Compliance costs for the exporting country arise only if the importing country has stricter MRLs and therefore the numerator of f measures the difference between the exporter's MRL and the importer's MRL only if the latter is smaller. If the importer's MRL is larger, the heterogeneity of MRLs between the countries becomes superfluous to trade. As f approaches 1, the greater is the difference between the importer and exporter MRL regulation.

[5] These included blueberries, kiwifruit, cherries, plums, grapes and apples.
[6] This includes measures such as product requirements/food safety limits, process requirements, presentation requirements, conformity assessment requirements and other country-specific requirements.

A few cases must be noted. Not all countries set MRLs for the same pesticide/crop combination, it can therefore be the case that the importer country sets an MRL for a *k,p* pair for which the exporting country has not set a limit. Some countries set default MRLs for any *k,p* combination that is not explicitly cited in their MRL regulation, such as the EU that sets an MRL of 0.01 ppm for any pesticide on any crop that is not listed in the MRL Directive . Thus, where pertinent, we have imputed default values for all *i-j-k-p* combinations. If a country does not have default MRLs we assume that they are not regulating and thus no compliance costs arise. In the absence of default MRLs, therefore, not having an MRL boils down to the partner country having a stricter MRL regulation and thus the index takes the value of 1 if the partner country is the importer and 0 if it is the exporter.

Our heterogeneity index is very similar to that in Achterbosh et. al. (2009), except that we do not consider heterogeneity when the exporter is stricter in setting standards (thus, their index ranges from (-1,1), where the lower bound refers to the exporter country having much stricter regulation that the importer country). Just as in Achterbosh et. al. (2009), we proceed to aggregating the index for each product by constructing the following:

$$F_{ijpt} = \frac{1}{K}\sum_{k=1}^{K} f_{ijpkt}$$

where K is the total number of pesticides for which there is an MRL on product *p*.

4.2. Empirical methodology

Our empirical analysis is conducted in the framework of the gravity model, which following Melitz (2003) additionally exploits the fact that not all countries trade with each other and if they do, those trade flows are not necessarily symmetric. These considerations give rise to a two-stage estimation procedure, as in Helpman et. al. (2008). In addition to correcting for the Heckman (1979) selection bias, Helpman et. al. (2008) use Melitz (2003) to argue that a correction for biases arising from asymmetries in trade flows is also necessary to obtain consistent results.

We therefore use the Heckman (1979) two-step estimator to control for the large number of zero trade flows between partners. Zero trade flows become increasingly probable as the level of disaggregation of products increase, which is also true for our data. The Heckman estimation also allows us to distinguish between the effect that MRL harmonization has at the intensive and extensive margins of trade. A strong negative effect at the extensive margin suggests that having dissimilar MRL regulations between countries is a fixed cost that producers have to overcome before being able to export. The same effect at the intensive margin suggests that the costs of complying with different MRL regulations is variable and increases with the value of exports. Literature suggests that harmonization initiatives affect both fixed and variable costs (Baldwin, 2000; Mattoo and Chen, 2004).

To examine the trade effects of the harmonization of MRL regulations, reflected by the index F, we include this index in the standard gravity equation, which is estimated using the Heckman (1979) two-step estimator. The Heckman two-step estimation involves running a first stage Probit that estimates the effect of explanatory variables on the probability of exporting. The second step comprises an MLE with the natural logarithm of exports as dependent variable on the same set of control variables as in step one with the exclusion of at least one variable that should affect trade only at the extensive margin[7]. Following Helpman et. al. (2008), we also use common religion between the trading partners as the selection variable.

The explanatory variables include the index of heterogeneity F, the preferential tariff of the importer country towards the exporter, a dummy variable identifying whether the country pair have are signatories of the same PTA at time *t*, and standard dyadic gravity control variables which are grouped into two vectors: $\Gamma_{ij}, \mathrm{Z}_{ij}$. The vector Γ_{ij} is made up of: the log of distance, common border, common language, colonial heritage[8], the natural logarithm of distance between trading partners, dummy variables taking the value of unity when the pair shares a border, if the pair had a colonial relationship, if they have a common language and whether the major religion is the same in both countries (only in step one).

Formally, we have the following baseline specifications:

Step one:

$$\Pr\left(X_{ijpt} > 0\right) = \Phi\left[\alpha_1 F_{ijpt} + \alpha_2\left(1 + \tau_{ijpt}\right) + \alpha_3 PTA_{ijt} + \alpha_4 \ln(GDP_{it} \cdot GDP_{jt}) + \alpha_5\left(POP_{it} \cdot POP_{jt}\right) + \alpha_n \Gamma_{ij} + \alpha_6 MR_{ijpt} + \mu_i + \mu_j + \mu_p + \mu_t + \epsilon_{ijpt}\right] \quad (1)$$

Step two:

$$\ln\left(X_{ijpt} | X_{ijpt} > 0\right) = \beta_1 F_{ijpt} + \beta_2\left(1 + \tau_{ijpt}\right) + \beta_3 PTA_{ijt} + \beta_4 \ln(GDP_{it} \cdot GDP_{jt}) + \beta_5\left(POP_{it} \cdot POP_{jt}\right) + \beta_n \mathrm{Z}_{ij} + \beta_6 MR_{ijpt} + \mu_i + \mu_j + \mu_p + \mu_t + \epsilon_{ijpt} \quad (2)$$

The use of fixed effects on Probit estimations has come under intense scrutiny since Heckman (1981) identified a bias due to incidental parameters. This methodology, however, continues to be very common in the trade literature, and the gravity[9] of the bias might not be as large as

[7] In order to correctly identify the selection equation of the Heckman estimation, the selection equation (first stage Probit) has to have additional explanatory variables than the outcome equation. These explanatory variables have to satisfy the criterion that they affect the probability of having positive exports (therefore setting up a trading relationship) but that once the relationship has been set, the volume of exports is not affected. Helpman et al (2008) propose a theoretically valid variable, which is the cost of regulatory entry into a market, but because such data is scarce and limits estimation samples considerably, they find that common religion between trading partners has the exclusion property.

[8] Four variables summarize the colonial heritage: whether or not the pair has ever been in a colonial relationship, whether the pair was part of the same colonial empire, whether the pair is still in a colonial relationship and finally, whether the pair had a common colonizer after 1945.

[9] Pun intended

initially believed. Greene (2004) shows that even with short panels the Tobit estimator is not inconsistent due to the incidental parameter problem, and since Tobit and Probit estimations share distribution functions this conclusion can be applied to both.

4.3. Data

We use data on MRL regulation over 2006 to 2011 for Argentina, Australia, Brazil, Canada, Switzerland, Chile, China, India, Israel Japan, Korea, Mexico, Malaysia, New Zealand, Russia, Singapore, Thailand, Turkey, Taiwan, USA and the EU-15 members[10]. The data on MRL regulation were acquired from a private company HOMOLOGA that updates MRL regulation from these countries on a monthly basis. The data are intended mainly for agricultural producers wishing to export their crops.

However, the richness of the data received from Homologa could not be fully exploited because of the large amount of crops which are too specific compared with HS6 level data[11]. To enable an empirical trade analysis of these MRLs, it becomes impossible to use these specific observations since they would introduce MRL variation within the HS code that cannot be matched by trade variables. We therefore only kept those crops specified in Homologa that were either a perfect match (e.g. avocados are listed separately in Homologa and have the HS code 080440), broader than the HS 6 category (e.g. Brassicas, for which we proceed to apply the MRL to all HS codes that have this description) and in very few cases, we took the average of no more than two crops listed within the HS code (e.g. plantains and bananas). These last exceptions were made considering the economic importance of these crops. Because we are considering MRLs, we concentrate on non-processed food products, and therefore include most of the HS6 codes under Chapters 7 through 12. The list of HS codes is reported in Table 8 at the end of the paper.

Export data come from the BACI database, which is constructed from UN COMTRADE trade data after reconciling exporter and importer declarations and thus expanding the availability of bilateral trade data. BACI is available at the HS6 level and records exports per USD thousands, in current prices. The bilateral variables distance, common border and colonial relationship are also taken from BACI. GDP and population data were sourced from the Penn World Tables, and the common religion variable comes from Elhanan Helpman’s and Xavier Sala-i-Martin's webpages, the latter being used to construct the binary variable for intra-EU countries, data which are not available in the former database. The PTA variable was compiled by Jose de Sousa, who makes it available through his website[12]. All data are summarized in Tables 4 through 7.

[10] India and Russia are missing data for 2006, while Singapore is missing data for 2006-2008.
[11] For instance, some of the crops included acerola, sour cherry, balsam apple, all of which do not have a corresponding HS6 level code.
[12] http://jdesousa.univ.free.fr/data.htm

We separate the panel into different samples in order to highlight the different magnitude of effect that heterogeneity of MRL regulation can have depending on the importer and exporters involved. Our first sample includes all countries for which MRL regulation was publicly available to foreign interested parties; the 35 countries listed above as importers, and 123 additional countries as exporters[13]. The second sample removes all exporting countries that do not have MRL regulations, and therefore we concentrate on bilateral trade between countries that are actively setting these sanitary measures. To exploit the total harmonization of EU standards, the third sample includes only EU 15 countries as importers with exports from around the globe, finalizing with a EU 15 only sample.

5. Results and analysis

Tables 1 and 2 report the results of the Heckman two-step estimations of our baseline specifications using four different samples All estimations are run with importer, exporter and time fixed effects. Product fixed effects are introduced at the HS4 level in order to limit the degrees of freedom lost due the significant number of dummy variables already being estimated. These sets of fixed effects control for unobserved heterogeneity at the importer, exporter and product level, separately. Gravity control variables are also included in all estimations as described in Section 4.2. We also include multilateral resistance terms *à la* Baier and Bergstrand (2009) to avoid having to estimate country-time fixed effects to correct for multilateral remoteness of countries. To do this we calculate multilateral resistance terms for all of the gravity controls states above and include them in the estimations.

In order to correctly interpret the coefficients of the outcome and selection equation of the Heckman two-step, we calculate the marginal effects of each coefficient of interest. The marginal effects of the Probit are straightforward and the two-step framework does not modify how they are derived. In the case of the explanatory variables that appear in both the selection and outcome equation, in order to interpret their effect on the volume of trade, one must take into consideration their impact on both steps. Greene (2003) proposes the following equation to calculate these variables' marginal effects:

$$\frac{dE[X_{ijpt}|X_{ijpt}>0]}{dx} = \hat{\beta} - (\hat{\alpha} \cdot \hat{\rho} \cdot \hat{\sigma} \cdot \delta(\alpha)),$$

where $\hat{\beta}$ is the outcome coefficient, $\hat{\alpha}$ is the selection coefficient, $\hat{\rho}$ is the estimated correlation between the erros in the two equations, and $\hat{\sigma}$ is the error from the outcome equation, and $\delta(\alpha)$ is a function of the inverse mills ratio $\delta(\hat{\alpha}) = \hat{\lambda}(\hat{\lambda} + \hat{\alpha})$. Table 3 reports the marginal effects of the MRL regulation heterogeneity index on both equations, for four different samples.

5.1. Results for the full sample

[13] There are 158 exporters in total.

Column 1 of Table 1 reports the results from estimating equations (1) and (2) for the full sample. The coefficient of our MRL heterogeneity index is found to be negative and significant in explaining both the probability of trading and the volumes of exports. In column 1 of Table 3, we report the marginal effects of F on both the selection and the outcome equation. We find that an increase of 1 percentage point in the index leads to a 16 percentage point decrease in the probability of exporting, and an 8 percentage point decrease in the volume of exports. Since the index measures the degree of regulatory heterogeneity, a decline in the value of F i.e. harmonization of MRL standards, is associated with an increase in trade at both margins.

The coefficients on the gravity control variables are consistent with previous gravity estimates. Countries with common colonial heritage, or with common language or which are adjacent to each other have higher probabilities of exporting to each other, and export larger volumes. The same is true for countries that are similar in terms of population and GDP. Distance is found to reduce both the probability of trading and the volumes of trade between partners.

We also find that higher preferential tariffs reduce exports, both at the intensive and extensive margins, which is an expected result. A country-pair that is a member of the same PTA is also likely to trade more, again at both margins.

5.2. Results for the sub-sample of countries that set MRL regulations

The coefficient of our MRL heterogeneity index is again found to be negative and significant in explaining both the probability of trading and the volumes of exports. Column 2 of Table 1 reports the results from estimating equations (1) and (2) for the sub-sample of countries that set MRL regulations. In column 2 of Table 3, we report the marginal effects of F on both the selection and the outcome equation. We find that an increase of 1 percentage point in the index leads to a 34 percentage point decrease in the probability of exporting, and a 0.6 percentage point decrease in the volume of exports.

These results suggest that between these countries, having different MRL regulations is mostly costly at the extensive margin, rather than at the intensive. This result may reflect the fact that when countries set MRLs, they are based on good agricultural measures which are adapted to apply to domestic MRL regulation and therefore changing from one regulation to another might be more costly at the beginning than once the compliance costs are met. Countries that do not set MRL standards might see a large amount of heterogeneity within the country on how production is done since MRL regulations are not enforced.

The coefficients on the gravity control variables are consistent with previous gravity estimates and those reported for the full sample.

5.3. Results for the sub-sample of EU-15 reporters and intra-EU15 trade

Results for EU-15 importers and intra-EU15 trade reported in Columns 1 and 2 of Table 2, respectively, are qualitatively similar to those reported in Table 1 and suggest that harmonized

MRL regulation may have led to greater trade at both margins in both cases. The gravity control variables also retain their expected impacts in these results and distance continues to be positively correlated with the probability of exporting. This result is probably driven by two facts: importers in this sample are only within the EU, a relatively small area compared to the distances goods are shipped across meaning that relative to the general distance travelled, the extra distance from one EU country to the other is not defining. And secondly, because we have exporter fixed effects, and importers are so close geographically, the log of bilateral distance is capturing very little variability and between EU countries' relative distance to each other.

Marginal effects reported in Columns 3 and 4 of Table 3 show that an increase of 1 percentage point in the index leads to a 20.6 (80.1) percentage point decrease in the probability of exporting, and a 21 (12.1) percentage point decrease in the volume of exports for our sub-sample of EU-15 exporters (intra-EU15 trade).

These last results highlight the much more positive impact that harmonization of standards has had on the export of agri-products destined for EU-15 markets from both within and outside EU-15, including from the developing world, especially at the extensive margin.

6. Conclusion

This paper adds to the impact assessment of standards literature by examining the trade effects of the complete harmonization of pesticide MRLs across EU member states on inter- and intra-EU agri-food trade, following Regulation (EC) No 396/2005.

Our results, that are impervious to different sub-samples, suggest that this harmonization may have led to greater trade at both the intensive and extensive margin, though regulatory heterogeneity is found to be a greater impediment in the probability of exporting

The extensive margin impact is found to be especially strong in the case of intra-EU15 trade thereby suggesting that a harmonization of MRL regulation may have greatly fostered the decision to export within EU-15.

Finally, in a significant departure from previous literature (for instance Chen and Mattoo, 2004; Baller, 2007) we find that the harmonization of MRL standards seems to have fostered agri-trade into EU15 from developing country exporters as well.

References

Achterbosch, T. J., A. Engler, M. L. Rau, et R. Toledo. « Measure the measure: the impact of differences in pesticide MRLs on Chilean fruit exports to the EU ». In *International Association of Agricultural Economists Conference, Beijing, China*, 16–22, 2009.

Anderson, James E., and Eric van Wincoop. 2004. "Trade Costs." Journal of Economic Literature, 42(3): 691-751.

Baldwin, Richard E., John McLaren, and Arvind Panagariya. "Regulatory Protectionism, Developing Nations, and a Two-Tier World Trade System [with Comments and Discussion]." *Brookings Trade Forum* (January 1, 2000): 237–293. doi:10.2307/25063151.

Baller, Silja. « Trade effects of regional standards liberalization: A heterogeneous firms approach ». *World Bank policy research working paper* n° 4124 (2007). http://papers.ssrn.com/sol3/papers.cfm?abstract_id=960381.

Chen, Maggie Xiaoyang, et Aaditya Mattoo. « Regionalism in standards: good or bad for trade? » *Canadian Journal of Economics/Revue canadienne d'économique* 41, n° 3 (2008): 838–863.

Chen, Maggie Xiaoyang, Tsunehiro Otsuki, et John S. Wilson. « Do standards matter for export success? » *World Bank Policy Research Working Paper* n° 3809 (2006). http://papers.ssrn.com/sol3/papers.cfm?abstract_id=875656.

De Frahan, B. H., et M. Vancauteren. « Harmonisation of food regulations and trade in the Single Market: evidence from disaggregated data ». *European Review of Agricultural Economics* 33, n° 3 (2006): 337–360.

De Sousa, Jose. "The Currency Union Effect on Trade Is Decreasing over Time." Economics Letters (2012). http://www.sciencedirect.com/science/article/pii/S0165176512003941.

Ganslandt, Mattias & Markusen, James R., "National Standards and International Trade," Working Paper Series 547, Research Institute of Industrial Economics. (2001)

Greene, William. "Fixed Effects and Bias Due to the Incidental Parameters Problem in the Tobit Model." *Econometric Reviews* 23, no. 2 (2004): 125–147.

Helpman, Elhanan, Marc Melitz, et Yona Rubinstein. « Estimating trade flows: Trading partners and trading volumes ». *The Quarterly Journal of Economics* 123, n° 2 (2008): 441–487.

Heckman, J. The incidental parameters problem and the problem of initial conditions in estimating a discrete time – discrete data stochastic process. In: Manski, C., McFadden, D., eds. Structural Analysis of Discrete Data with Econometric Applications. Cambridge: MIT Press. (1981).

Mantovani, Andrea, et Mark Vancauteren. « The Harmonization of Technical Barriers to Trade, Innovation and Export Behavior: Theory with an application to EU Environmental Data. » (2003). http://amsacta.unibo.it/619/.

Maskus, Keith Eugene, Tsunehiro Otsuki, et John Sullivan Wilson. *The cost of compliance with product standards for firms in developing countries: An econometric study*. Vol. 3590. World Bank-free PDF, 2005.

Melitz, Marc J. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," Econometrica, Econometric Society, vol. 71(6), pages 1695-1725, (2003)

Moenius, Johannes. « The Good, the Bad and the Ambiguous: Standards and Trade in Agricultural Products ». In *IATRC Summer Symposium*, 28–30, 2006. http://bulldog2.redlands.edu/fac/johannes_moenius/content/moenius_agriculture_trade.pdf.

Shepherd, B. *Product Standards, Harmonization, and Trade: Evidence from the Extensive Margin*. Vol. 4390. World Bank Publications, 2007.

Swann, G. M. P. "International Standards and Trade." *A Review of the Empirical Literature', OECD Trade Policy Working Papers* no. 97 (2010). http://www.oecd.org/tad/benefitsoftradeliberalisation/45500791.pdf.

Vancauteren, Mark & Daniel Weiserbs, "Intra-European Trade of Manufacturing Goods: An Extension of the Gravity Model," Articles of International Econometric Review (IER), Econometric Research Association, vol. 3(1), pages 1-24, (2011)

Winchester, Niven, et al. « The Impact of Regulatory Heterogeneity on Agri-food Trade ». *The World Economy* 35, nº 8 (2012): 973–993.

Tables

Table 1 Heckman two-step estimation (1)

	Full Sample		Sample of only MRl regulators	
	$\ln(X_{ijpt} \mid X_{ijpt} > 0)$	$\Pr(X_{ijpt} > 0)$	$\ln(X_{ijpt} \mid X_{ijpt} > 0)$	$\Pr(X_{ijpt} > 0)$
F	-0.433***	-0.167***	-0.471***	-0.341***
	(0.06)	(0.03)	(0.09)	(0.04)
$ln(1 + \tau_{ijpt})$	-0.301***	-0.069***	-0.338***	-0.093***
	(0.02)	(0.00)	(0.03)	(0.01)
PTA	0.775***	0.388***	0.798***	0.565***
	(0.12)	(0.03)	(0.15)	(0.06)
lndist	-0.776***	-0.174***	-0.625***	-0.084**
	(0.07)	(0.03)	(0.07)	(0.04)
contig	1.574***	0.678***	1.559***	0.817***
	(0.19)	(0.07)	(0.19)	(0.10)
comlang_off	0.498***	0.301***	0.358***	0.319***
	(0.10)	(0.03)	(0.12)	(0.05)
colony	0.156	0.062	0.037	-0.018
	(0.17)	(0.05)	(0.21)	(0.07)
curcol	-0.025	0.327		
	(0.36)	(0.27)		
col45	0.778***	0.353***	0.560*	0.274**
	(0.23)	(0.06)	(0.29)	(0.13)
comcol	0.407**	0.126*	0.312	0.241**
	(0.18)	(0.07)	(0.28)	(0.10)
smctry	-0.060	-0.049	0.125	0.081
	(0.26)	(0.11)	(0.25)	(0.23)
lngdp_x	0.357***	0.150***	0.517***	0.132**
	(0.11)	(0.03)	(0.15)	(0.06)
lnpop_x	1.233**	0.096	0.549	0.471
	(0.53)	(0.14)	(0.81)	(0.33)
commreligion		0.000		-0.036
		(0.03)		(0.05)
_cons	7.249	-3.173	-22.843	-10.783***
	(7.80)	(2.40)	(14.00)	(3.77)
Estimated rho	1.051***		0.792***	
	(0.12)		(0.12)	
Estimated lambda	1.124***		0.995***	
	(0.05)		(0.04)	
N	3574212		820015	
Importer FE	Yes		Yes	
Exporter FE	Yes		Yes	
HS4 FE	Yes		Yes	
Time FE	Yes		Yes	

Standard errors in parenthesis are robust, clustered by country-pair

Table 2 Heckman two-step estimation (2)

	EU 15 importers		Intra EU15 trade	
	$\ln(X_{ijpt} \| X_{ijpt} > 0)$	$\Pr(X_{ijpt} > 0)$	$\ln(X_{ijpt} \| X_{ijpt} > 0)$	$\Pr(X_{ijpt} > 0)$
F	-0.424*** (0.05)	-0.210*** (0.03)	-0.534*** (0.09)	-0.794*** (0.10)
$ln(1+\tau_{ijpt})$	-0.406*** (0.02)	-0.097*** (0.01)		
rta	-0.225*** (0.08)	0.033 (0.02)		
lndist	-0.393*** (0.12)	0.199** (0.10)	-0.534*** (0.16)	0.411*** (0.13)
contig	1.472*** (0.20)	1.004*** (0.14)	1.246*** (0.20)	1.246*** (0.21)
comlang_off	0.297** (0.12)	0.287*** (0.05)	0.594** (0.26)	0.307** (0.15)
colony	0.384** (0.19)	0.255*** (0.06)	0.661 (0.62)	0.823*** (0.32)
col45	-0.027 (0.19)	0.148** (0.07)		
smctry	0.042 (0.24)	0.375 (0.23)	0.016 (0.30)	-0.333 (0.26)
lngdp_x	0.149 (0.14)	0.146*** (0.04)	0.969*** (0.27)	0.472*** (0.17)
lnpop_x	1.063* (0.60)	0.143 (0.17)	-1.682 (1.33)	1.838* (1.07)
commreligion		0.015 (0.07)		0.133 (0.09)
_cons	-38.397*** (7.99)	-6.988*** (2.53)	-40.909** (19.95)	7.976 (16.16)
Estimated rho	0.534*** (0.09)		0.424*** (0.07)	
Estimated lambda	0.903*** (0.03)		0.762*** (0.02)	
N	1487066		154056	
Importer FE	Yes		Yes	
Exporter FE	Yes		Yes	
HS4 FE	Yes		Yes	
Time FE	Yes		Yes	
Standard errors in parenthesis are robust, clustered at country-pair level				

Table 3 Marginal effects of MRL heterogeneity

Marginal effects on selection equation $\Pr(X_{ijpt} > 0)$	Full Sample	MRL sample	EU 15 importers	Intra EU 15
F	-0.164*** (0.03)	-0.342*** (0.04)	-0.206*** (0.03)	-0.801*** (0.10)
Marginal effects on outcome equation $\ln(X_{ijpt} \mid X_{ijpt} > 0)$				
F	-0.084*** (0.000)	-0.006*** (0.000)	-0.210*** (0.000)	-0.121** (0.000)

4.4. Tables: summary statistics

Table 4 Summary Statistics of the full sample of countries

	Observations	Mean	Std.Dev.	Min.	Max.
$\ln(X_{ijpt})$	273933	4.317	2.676	0	16.221
F_{ijpt}	3574212	0.699	0.440	0	1
$\ln(1+\tau_{ijpt})$	3574212	1.196	1.459	0	6.686
RTA	3574212	0.188	0.391	0	1
$\ln(Dist_{ij})$	3574212	8.727	0.815	2.258	9.901
Contiguous	3574212	0.022	0.147	0	1
Common Language	3574212	0.111	0.314	0	1
Ever Colony	3574212	0.032	0.176	0	1
Current Colony	3574212	0.001	0.024	0	1
Colony in 1945	3574212	0.019	0.136	0	1
Common colonizer	3574212	0.021	0.145	0	1
Ever same country	3574212	0.003	0.058	0	1
Common Religion	3574212	0.126	0.331	0	1
$\ln(GDP_{it} \cdot GDP_{jt})$	3574212	24.384	2.463	17.053	32.823
$\ln(POP_{it} \cdot POP_{jt})$	3574212	5.531	2.378	-1.568	14.377

Table 5 Summary Statistics of those countries that have MRL regulations

	Observations	Mean	Std.Dev.	Min.	Max.
$\ln(X_{ijpt})$	190168	4.519	2.694	0.000	16.221
F_{ijpt}	820015	0.314	0.378	0.000	1.000
$\ln(1+\tau_{ijpt})$	820015	1.265	1.450	0.000	6.686
RTA	820015	0.405	0.491	0.000	1.000
$\ln(Dist_{ij})$	820015	8.496	1.140	2.258	9.883
Contiguous	820015	0.047	0.212	0.000	1.000
Common Language	820015	0.108	0.311	0.000	1.000
Ever Colony	820015	0.038	0.190	0.000	1.000
Current Colony	820015	0.000	0.000	0.000	0.000
Colony in 1945	820015	0.009	0.094	0.000	1.000
Common colonizer	820015	0.008	0.091	0.000	1.000
Ever same country	820015	0.005	0.069	0.000	1.000
Common Religion	820015	0.143	0.350	0.000	1.000
$\ln(GDP_{it} \cdot GDP_{jt})$	820015	26.996	1.654	23.178	32.823
$\ln(POP_{it} \cdot POP_{jt})$	820015	6.941	2.019	2.863	14.377

Table 6 Summary Statistics of bilateral pairs with only EU 15 members as importers

	Observations	Mean	Std.Dev.	Min.	Max.
$\ln(X_{ijpt})$	159174	4.486	2.680	0	14.315
F_{ijpt}	1487066	0.734	0.421	0	1
$\ln(1+\tau_{ijpt})$	1487066	0.598	1.124	0	5.338
RTA	1487066	0.290	0.454	0	1
$\ln(Dist_{ij})$	1487066	8.427	0.840	4.226	9.883
Contiguous	1487066	0.019	0.138	0	1
Common Language	1487066	0.084	0.277	0	1
Ever Colony	1487066	0.056	0.230	0	1
Colony in 1945	1487066	0.036	0.186	0	1
Ever same country	1487066	0.002	0.050	0	1
Common Religion	1487066	0.134	0.340	0	1
$\ln(GDP_{it} \cdot GDP_{jt})$	1487066	24.097	2.411	17.466	31.265
$\ln(POP_{it} \cdot POP_{jt})$	1487066	4.913	2.194	-1.558	11.597

Table 7 Summary Statistics of EU15 member states

	Observations	Mean	Std.Dev.	Min.	Max.
$\ln(X_{ijpt})$	71583	5.004	2.659	0	13.507
F_{ijpt}	154056	0.195	0.347	0	1
$\ln(Dist_{ij})$	154056	6.922	0.841	4.226	8.121
Contiguous	154056	0.133	0.339	0	1
Common Language	154056	0.071	0.258	0	1
Ever Colony	154056	0.020	0.141	0	1
Ever same country	154056	0.010	0.100	0	1
Common Religion	154056	0.459	0.498	0	1
$\ln(GDP_{it} \cdot GDP_{jt})$	154056	26.426	1.406	23.936	29.716
$\ln(POP_{it} \cdot POP_{jt})$	154056	5.680	1.434	2.883	8.826

Table 8 HS6 codes in the sample

70190, 70200, 70210, 70230, 70310, 70320, 70390, 70410, 70420, 70490, 70511, 70520, 70521, 70610, 70690, 70700, 70810, 70820, 70910, 70920, 70930, 70940, 70951, 70952, 70960, 70970, 70990, 71090, 71130, 71220, 71310, 71320, 71330, 71331, 71340, 71410, 71420, 80110, 80120, 80130, 80211, 80212, 80221, 80222, 80232, 80240, 80250, 80260, 80290, 80300, 80330, 80410, 80420, 80430, 80440, 80450, 80510, 80512, 80520, 80522, 80530, 80540, 80550, 80590, 80610, 80620, 80710, 80720, 80810, 80820, 80910, 80920, 80922, 80924, 80930, 80940, 81010, 81020, 81030, 81040, 81050, 81060, 81090, 81310, 81330, 81340, 90111, 90121, 90230, 90300, 90500, 90610, 90700, 90810, 90820, 90830, 90839, 90910, 90920, 90930, 90940, 90950, 91010, 91020, 91030, 91040, 91091, 100110, 100200, 100300, 100400, 100510, 100590, 100610, 100620, 100630, 100640, 100700, 100810, 100820, 100830, 100890, 110100, 110210, 110220, 110230, 110290, 120100, 120210, 120300, 120330, 120400, 120500, 120600, 120710, 120720, 120730, 120740, 120750, 120760, 120791, 120792, 120810, 120921, 120926, 121120, 121291