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The Cases of the US and Canada

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By Bo Xiong and John Beghin *

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Stringent Maximum Residue Limits, Protectionism, and Competitiveness:

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Running head: Stringent MRLs, Protectionism, and Competitiveness in Canada and the US

Abstract: Maximum Residue Limits (MRLs) on pesticides and veterinary drugs in plant and animal products are established to promote food safety and animal and plant health. In practice, however, they are often accused of creating unnecessary trade barriers. The controversy is more prominent when a given MRL is stricter than the corresponding international standard developed by Codex. Using the score indices constructed by Li and Beghin (2012), we empirically assess the implications of stringency in MRLs in plant and animal products, relative to Codex levels, for Canadian and U.S. trade performance. We find little evidence that U.S. imports are influenced by domestic stringency or those imposed by its trading partners. However, U.S. exports are negatively affected by stringency in destination markets. Canada's stringent MRLs facilitate its exports of plant and animal products and these exports do not seem to be impeded by MRL stringency in destination markets. Canada's imports do not appear to be systematically influenced by either its own or its trading partners' MRL stringency. We draw implications for the potential harmonization of MRLs between the two countries.

Keywords: Maximum Residue Limit, MRL, standard, protectionism, non-tariff measures, non-tariff barriers, competitiveness, gravity, US, Canada

JEL Codes: Q17, Q18, F13

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Introduction

Maximum Residue Limits (MRLs) are widely used to regulate the application of pesticides in plant products and veterinary drugs in animal products. For example, the United States sets 10 parts per billion (ppb) as the maximum allowable level for the use of O-phenylphenol pesticide on lemon trees (USDA). While lower tolerance levels reduce the health and environmental hazards, the associated compliance costs borne by growers, both at home and abroad, can significantly affect the relevant industry. As import tariffs are progressively constrained by multilateral agreements under the World Trade Organization (WTO) and a myriad of regional trade agreements, more attention is being given to various forms of non-tariff measures (NTMs) and barriers (NTBs), including MRLs, which may constitute new protectionism. Such trend is evidenced by the growing number of WTO trade disputes and concerns citing the sanitary and phytosanitary (SPS) agreement and the Technical Barriers to Trade (TBT) agreement (e.g., DS430, DS406, and DS389; see Disdier and van Tongeren (2010) for SPS concerns). The two WTO agreements allow member countries to set their own standards but require that the regulations should be science-based, non-discriminative (applicable to similar products of all origins) and least trade distorting.

To minimize the possible trade distortion implied by food safety standards, WTO agreements recommend using science-based international standards whenever possible. The Codex Alimentarius committee, established by the Food and Agriculture Organization of the United Nations and the World Health Organization, has been developing such international standards and practice codes based on currently available science. Nevertheless, Codex standards are voluntary in nature and only a fraction of member countries have fully deferred their MRLs to Codex levels as of March 2012 (Li and Beghin, 2012).

One may speculate that a food safety standard that is more stringent than its Codex counterpart is more likely to distort trade, and thus warrants further scrutiny. Several conceptual models in the literature have addressed such protectionist suspicion on the stringency of a standard addressing a market imperfection. Fisher and Serra (2000) showed that a social planner maximizing domestic welfare sets standards that are too stringent from the viewpoint of a global social planner maximizing global welfare (domestic welfare and foreign firms' profit). More recently, Marette and Beghin (2010) further point out that a policy-maker would adopt excessively stringent standards to correct externalities when its domestic producers have a comparative advantage in complying with the regulations but would do the opposite if their producers are much less efficient than foreign competitors in meeting the standards. Swinnen and Vandemoortele (2011) underscore the political considerations in the design of food standards. Berti and Falvey (2011) looked at the interface between trade and stringency of standards in a political economy model à la Grossman and Helpman. However, empirical studies assessing the trade effects of excessive standards are lacking, possibly due to the following two obstacles.[1] First, it is difficult to measure the stringency of standards because of the complexity and vagueness in legislative documents, commodity classifications, regulatory procedures, and other logistic reasons.[2] Second, globally optimal standards (which presumably maximize the sum of consumers' welfare, domestic producers' welfare, and foreign producers' welfare net of external effects) are unknown and hard to estimate. The latter problem means that it is difficult to distinguish a standard with legitimate public objectives from one driven by protectionism,

[1] Related to the issue of excessive stringency, Czubala, Shepherd, and Wilson (2009) show that harmonized standards are less trade-impeding or even trade-promoting in textile and clothing sectors. Winchester et al. (2012) measure the relative stringency of non-tariff measures between bilateral trading partners and their impact on trade.
[2] The World Trade Report 2012 (WTO) acknowledges those inefficiencies and identifies WTO's role in promoting transparency and conformity in the regulation of non-tariff measures.

especially in presence of external effects. The standard itself is not in question, but its optimal level is. When it comes to empirical analysis, the first hurdle challenges the quantification of standards in general, and the second one hinders the measurement of their excessiveness. In the context of MRLs on pesticides and veterinary drugs in plant and animal products, however, the above problems are less hindering because MRLs are quantitative in nature, and Codex MRLs constitute science-based international standards that are presumably "not far" from globally optimal standards, at least as far as science is concerned. Our premise and that of Li and Beghin (2012) are that systematic deviations from international standards is an indication of excessive stringency in a WTO sense as it contradicts the WTO's prescription of adopting such international standards. Our investigation explores the trade effects of departures from these MRL international standards on trade patterns in plant and animal products for the US and Canada.

It has been gradually recognized that the implication of food safety regulations on international trade goes beyond mere protectionism of a domestic industry. First, a quality-like standard does not necessarily hurt imports. Unlike traditional trade measures (such as import tariffs and quotas) that simply tax foreign producers, many food safety standards also address information asymmetry or consumption externalities, potentially leading to an enhanced demand for imports and trade. For instance, Jaffee and Henson (2005) showed that Kenyan fresh vegetable growers were able to expand their exports to EU after successfully upgrading the supply chain and meeting EU' sanitary standards. Xiong and Beghin (2012) show that intra-OECD agricultural trade is facilitated by technical measures because the regulations enhance the import demand more than they penalize foreign suppliers meeting this import demand, through higher costs.

By symmetry of the latter argument, not only food safety standards affect a country's inward trade flows (imports), but also its own competitiveness and outward trade flows (exports). According to the SPS and TBT agreements, both foreign and domestic producers ought to comply with the food safety standards and other technical measures. A priori, the own-export effect of a domestic standard can be either positive or negative, depending on whether the domestic industry has a comparative advantage in meeting the regulations, and how consumers in destination markets perceive the enhanced safety or quality. For example, Blind and Jungmittag (2005) identified the trade-fostering effect of international standards in the case of trade between Germany and United Kingdom. More recently, Blind, Mangelsdorf, and Wilson (2012) find that countries' certification with ISO standards tends to expand their own exports. Several other investigations have also looked at heterogeneity in food safety standards across countries and how this heterogeneity affects bilateral trade (e.g. .Winchester et al. (2012), Drogué and DeMaria (2012)).

We empirically examine the implications of stringency of MRLs in pesticides and veterinary drugs for the trade performance of the US and Canada. The case of the US and Canada is of particular interest given the fact that the two countries' economies are deeply integrated, but have been keeping and implementing different MRL policies. Our investigation uses the protectionist score indices developed by Beghin and Li (2012) (discussed in more detail below) to measure the restrictiveness of MRLs relative to the Codex levels, which are science-based international standards. Using a gravity equation approach to trade, we investigate the impacts of the score indices on the trade performance of the US and Canada in plant and animal products. We find that, U.S. MRLs, which are no systematically stricter than Codex, do not significantly impede its imports from the rest of the world, but that U.S. exports are constrained by MRL regulations abroad. As a country using stricter-than-Codex tolerance levels in many plant and animal products, Canada has gained further competitiveness in the world market, without systematically driving foreign competitors out of its own market because of its stringent MRLs.

The rest of the paper is organized as follows. Section 2 introduces the data and the empirical methodology. Section 3 presents the regression results and economic interpretations. Conclusions and policy implications on harmonization are drawn in Section 4.

Data and methodology

Data and the scores of excessive MRLs

The global MRL database developed by USDA compiles MRLs on pesticides in plant products and veterinary drugs in animal products for a large set of countries. These MRLs are presented by pesticide type (or drug type), by commodity, and by country, including the international Codex MRL whenever defined (USDA). Overall, the database covers MRLs set by 83 individual countries as well as Codex, in 345 pesticides and 87 veterinary drugs, for 340 plant and animal products.[3]

To measure the excessiveness of a country's MRLs applied to a given product, Beghin and Li (2012) define the following score index:

(1) $$S_{jk} = \left(\sum_{n_{(k)}=1}^{N_{(k)}} \exp\left(\frac{MRL_{codex,kn_{(k)}} - MRL_{jkn_{(k)}}}{MRL_{codex,kn_{(k)}}}\right)\right) \Big/ N_{(k)}$$

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[3] The database is limited in a few aspects, such as the omission of pesticides and veterinary drugs not used in the United States. See Beghin and Li (2012) for a thorough discussion of the database.

where $MRL_{jkn_{(k)}}$ is maximum residue limit adopted by Country j, for product k, and targeting pesticide or veterinary drug $n_{(k)}$; and $MRL_{codex,kn_{(k)}}$ is the MRL recommended by Codex for the same product and pesticide or veterinary drug type; and $N_{(k)}$ is the total number of pesticides or veterinary drugs applied to product k.

The score index defined by Equation (1) measures the stringency (in reference to Codex) of a country's MRL regulations toward a given product.[4] The higher the score is, the more stringent the country's MRLs are towards the product. In particular, the score reduces to one for a country that defers to Codex completely. A score above one indicates that, averaging over all applicable pesticides or veterinary drugs, the country adopts stricter-than-Codex standards to regulate the product of concern.

The above MRL stringency score is appealing in several aspects as explained in Li and Beghin (2012). First, it is invariant to units of measurement of MRLs. As an illustration, the same score emerges if MRLs were measured in parts per million rather than in parts per billion. Second, the score is increasing and convex in MRLs set by individual countries; this assumes that lowering (i.e. tightening the standard) a MRL is increasingly difficult. Last, by averaging across all types of pesticides or veterinary drugs, the score avoids assigning higher scores to certain commodities simply because a greater variety of pesticides or drugs are commonly applied to those products.

By virtue of the above-defined score indices, our empirical analysis focuses on the MRLs implemented in the US and Canada and their impacts on the trade performance of the two

[4] The score index differs from the heterogeneity index suggested by Winchester et al. (2012) in that the score index measures the discrepancy between domestic MRLs and Codex MRLs as opposed to the difference in MRLs between two trading partners.

countries respectively. The Canadian and U.S. cases are of particular interest for the following reason. From the viewpoint of a third-country exporter, The US and Canada are "close-substitute" destination markets in terms of geography proximity, consumer preferences, and internal tariff structure from NAFTA. Therefore, the differential trade costs implied by MRL policies could play an important role in a third country's choice of export destination. In addition, despite the deep integration of the U.S. and Canadian markets, the two countries have kept considerably different MRL policies and it is interesting to see how these differences in standards have influenced their own exports to the rest of the world.

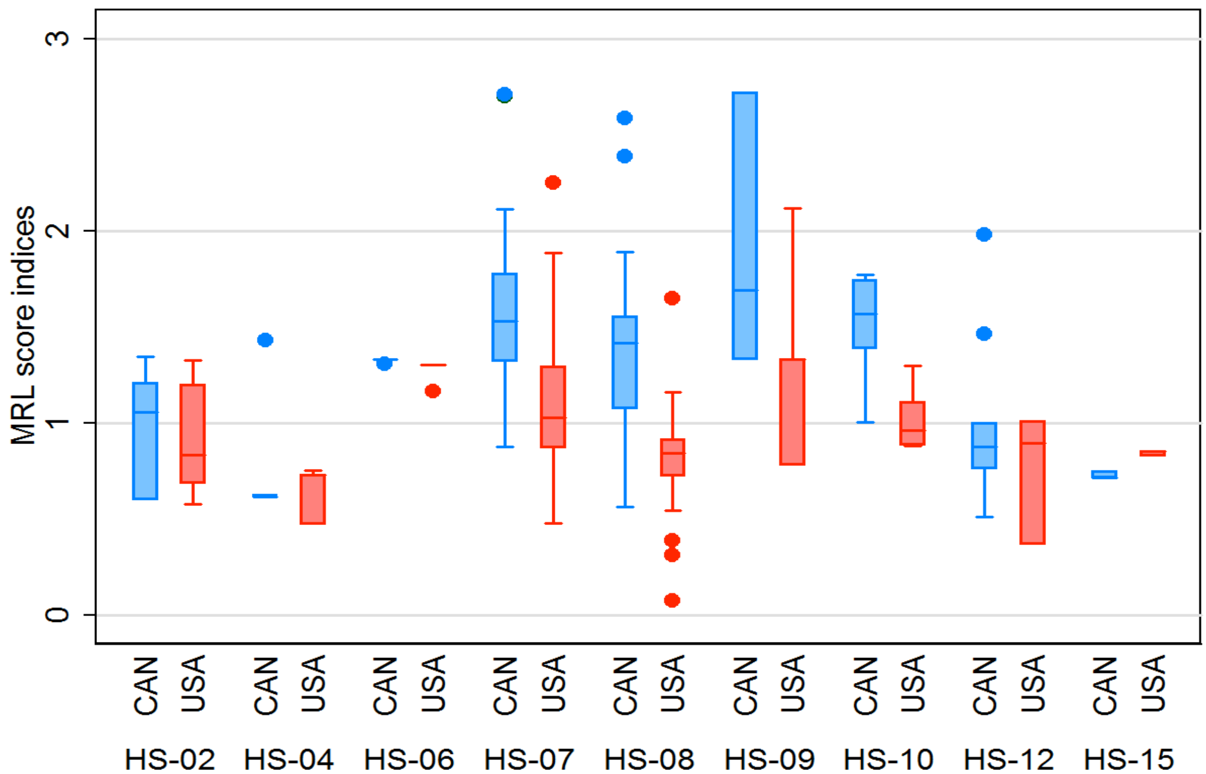
To illustrate the MRL stringency differentials between the US and Canada, we compare their score indices by HS chapters in Figure 1. Two interesting features are worth noting in the boxplot. First, Canadian average scores are higher than U.S. average scores in several sectors: meat products (HS-02), edible vegetables (HS-07), edible fruits and nuts (HS-08), coffee, tea and spices (HS-09), and cereals/grains (HS-10) in particular. Second, Canadian mean scores are well above one (which is the score for a country deferring to Codex) in several sectors, while U.S. mean scores are fairly close to one in almost all sectors.

To complement the score indices with bilateral trade records, we extract trade series in plant and animal products in the year 2010 from the database COMTRADE-United Nations. We focus on the cross-section for 2010 because the global MRL database is frequently updated and without archives, which means that the MRL data can be only mapped with recent trade flows. The 2010 trade series are the latest complete data in COMTRADE.[5] Finally, we merge the MRL

[5] Although the 2011 import series are available in COMTRADE, it contains many missing entries for several countries, for which the corresponding 2010 trade entries were not systematically missing.

score indices and trade series by country and by commodity.[6] In summary, we have 60 countries trading or potentially trading with the US or Canada in 135 plant and animal products (HS-4 or HS-6 produce lines) classified into 9 sectors (HS-2 chapters).

Figure 1: MRL score indices in selected chapters, US and Canada



Data source: Li and Beghin (2012)

Empirical strategy

The gravity equation approach is widely used to evaluate the impacts of various policies and trade costs on bilateral international trade flows. The gravity equation at the sectoral level is based on an equilibrium condition between export supply from the country where the good is

[6] COMTRADE and the global MRL database use different country names and product classifications. We borrow the conversion defined in Li and Beghin (2012).

produced and import demands in destination countries (see de Frahan and Vancauteren (2006) for such specification). It explains bilateral trade flows by plausible trade determinants such as the income level of the importing country, the production capacity of the exporting country, and factors that could affect the costs of trade between countries (e.g., geographic distance, colonial relationship, contingency condition, official language type, and preferential trade agreements). For our purpose, we focus on the following two plausible trade determinants in a given sector: the stringency MRL scores of the importing country and the corresponding MRL scores of the exporting country. The estimated coefficient of the importer's score sheds light on the impact of MRL stringency on the country's imports. Presumably, a negative and statistically significant estimate suggests that the stringency adversely affects foreign competitors and potentially should be further scrutinized for possible protectionism. Equally important, we include the stringency MRL score of the exporting country as an additional explanatory variable of the bilateral trade flow to investigate the impact of a country's own stringency standards on its export performance. A priori, stringent standards at home can either promote or hinder the export performance of the domestic industry, depending on whether domestic producers have a comparative advantage in complying with the regulations and to what extent the enhanced safety or improved quality is appreciated by consumers in destination markets. In the case of MRLs on pesticide and veterinary drug residues, the presumption is that such own export effect is positive as countries adopting stringency in excess of Codex are overwhelmingly from the developed world (Beghin and Li, 2012).

Following Anderson and van Wincoop (2003) and others, we specify the following gravity equation to characterize the bilateral trade in food and animal products:

(2) $E(y_{ijk}) = \exp\{\alpha_0 + \alpha_1 score_{jk} + \alpha_2 score_{ik} + \sum_n \phi_n \mathrm{I}_n + \sum_m \varphi_m E_m + \sum_l \gamma_l S_l\},$

where y_{ijk} is country j's value of import of product k from country i, $score_{jk}$ is the importing country's score in product k, $score_{ik}$ is the exporting country's score in product k, I_n is a dummy variable that equals one if country n is the importing country, E_m is a dummy variable that equals one if country m is the exporting country, and S_l is a dummy variable that equals one if product k belongs to sector l. The country-level dummy variables account for the multilateral trade resistance terms (Anderson and van Wincoop, 2003), and the sector-level dummy variables control for the heterogeneity across sectors. Noticeably, the conventional trade cost terms such as distance, tariff rates, colonial tie, and free trade agreements are omitted in (2) because trading partners' dummy variables fully absorb those effects when only one exporter or one importer is considered in each regression.

We conduct two sets of regressions. In the first set, we run four different individual regressions based on (2): (i) U.S. imports from the rest of the world ($j = USA$ and $i = 1, 2, ..., I$); (ii) U.S. exports to the rest of the world ($j = 1, 2, ..., J$ and $i = USA$); (iii) Canadian imports from the rest of the world ($j = CAN$ and $i = 1, 2, ..., I$); and (iv) Canadian exports to the rest of the world ($j = 1, 2, ..., J$ and $i = CAN$). The number of observations in each regression is 8100 (60 trading partners and 135 products). In the second set, we analyze the full sample with all 60 countries as importers and exporters, and allow the US and Canada to have different MRL responses. Besides evaluating the impacts of MRLs on U.S. and Canadian specific trade flows, this approach makes possible inference on other trade costs as in a conventional gravity analysis. In addition, the pooling of all countries avoids the sample selection issue.

In the first set, the advantage of individual regressions is that the associated results are robust to the omission of any bilateral trade costs, whose effects are fully captured by the trading partners' fixed effects. Nevertheless, the restriction to only one country (either the US or Canada) at a time means we lose some cross-country variation that could improve statistical inference. The second set of results accommodates such concerns but complicates the interpretation of results specific to the US and Canada. Specifically, we compile a balanced sample with all 60 countries trading or potentially trading with one another and collect usual bilateral trade cost variables such as distance, colonial relationship, common language, and common border from CEPII. We estimate (2) again using the balanced sample while allowing the scores of the US and Canada to have different slopes for score indices.

One common feature of the regressions and associated data is that zero trade records are prevalent. Specifically, in the first set of regression, the proportions of zeros in (i) through (iv) are 81 per cent, 55 per cent, 71 per cent, and 85 per cent respectively. In the second set the frequency of missing trade increases to 90 per cent. Accordingly in both sets of regressions, we estimate equation (2) via the Poisson Pseudo Maximum Likelihood (PPML) estimator (Silva and Tenreyro, 2006) and construct the heteroskedasticity-resistant standard errors as in White (1980). The PPML estimator accommodates zero outcomes (which are pervasive in our application) and has been shown to be robust to various heteroskedastic patterns (which are common in cross-sectional analysis).

A legitimate caveat in the analysis is that we abstract from the potential endogeneity of MRLs. Farnsworth (2012) reports that the levels of MRLs are attributable to public concerns about food safety, countries' development status, but less to industry's lobbying efforts, although no formal structural model is developed to rationalize these empirical findings. In contrast, Li

(2012) finds that MRL stringency and tariffs are jointly determined, which suggests that political decision-making might have a role in the design or implementation of MRL policies.

Results and discussions

Beginning with the first set of regression, we first focus on the U.S. trade performance for plant and animal products, or cases (i) and (ii) described above. Table 1 summarizes the regression results when we consider U.S. imports from and export to the rest of the world. It turns out that U.S. MRL stringency weakly impedes its imports but facilitates its export of plant and animal product. Neither of the effects is statistically significant, suggesting that U.S. MRLs do not systematically distort trade in these products. Interestingly, U.S. exports are significantly constrained by its trading partners' stringent regulations, indicating that U.S. producers face additional trade costs when exporting to markets where stringent standards apply. In addition, the estimated coefficient of the exporter's score can go either negative (as in the regression explaining U.S. imports) or positive (as in the regression explaining U.S. exports), which points to the ambiguity of the own export effect of home standards: they can either improve or disturb the export performance, depending on domestic producers' cost-effectiveness in compliance and the information conveyed to the destination markets. Again none of these effects is significant. The relatively low pseudo R-square statistics are typical for cross-sectional data.

Table 1: U.S. trade with the rest of the world[a, b]

U.S. imports			**U.S. exports**		
variable	Estimated coefficient	Robust std errors	variable	Estimated coefficient	Robust std errors
Importer's score	-0.44	0.60	Importer's score	-0.76**	0.37
Exporter's score	-0.38	0.28	Exporter's score	0.65	0.55
Pseudo R^2	0.40		Pseudo R^2	0.55	

Note: (a) both partners' fixed effects and sectors' fixed effects are included in the regression but omitted in the table. (b) ** denotes significance levels of 5%.

Next, we turn to the trade performance of Canada, or case (iii) and case (iv) described above. Table 2 reports the regression results when we investigate Canadian imports and exports. Canada's MRL stringency weakly reduces its imports from the rest of the world but systematically stimulates its exports of plant and animal products to the rest of the world. The latter effect is statistically significant, suggesting that Canadian producers might have gained further competitiveness after complying with the stringent regulations at home.

Two rationales justify such export-promoting effect. First, meeting strict regulations at home saves Canadian exporters from rejections and refusals at the customs of other nations. Second, lower tolerance levels in Canada could enhance Canadian exporters' reputation in foreign markets where food safety pays off in terms of either higher premium or repeated purchase.

The regressions results show that the exporter's score is positively associated with Canadian imports although such positive effect is statistically insignificant. Liu and Yue (2012) report a similar export-facilitating effect of catching up in terms of low tolerance levels in the destination markets for the case of trade in apples. In their case the effect is statistically significant.

Table 2: Canada' trade with the rest of the world[a, b]

Canadian imports			**Canadian exports**		
variable	Estimated coefficient	Robust std errors	variable	Estimated coefficient	Robust std errors
Importer's score	-0.26	0.25	Importer's score	-0.02	0.43
Exporter's score	0.05	0.50	Exporter's score	0.98**	0.48
Pseudo R^2	0.60		Pseudo R^2	0.52	

Note: (a) both partners' fixed effects and sectors' fixed effects are included in the regression but omitted in the table. (b) ** denotes significance levels of 5%.

Next we discuss the second set of results using the balanced sample of all 60 countries in the pooled regression. Table 3 summarizes the associated econometric results. Qualitatively, the implications that are specific to US and Canada, as elaborated below, are similar to those found in Table 1 and Table 2.

Table 3. Pooled regression with balanced sample[a, b]

Bilateral trade flows					
variable	Estimated coefficient	Robust std errors	variable	Estimated coefficient	Robust std errors
Importer's score	-0.29**	0.12	Exporter's score	0.31***	0.09
Importer's score ⊗to Canada	0.39*	0.22	Exporter's score ⊗from Canada	0.42**	0.16
Importer's score ⊗to US	-0.16	0.50	Exporter's score ⊗from US	0.13	0.30
Ln(distance)	-1.16***	0.05	Contiguity	0.30***	0.11
Language	0.35***	0.12	Colonial tie	-0.14	0.15
Pseudo R^2	0.47				

F-tests for the trade effects of US and Canadian scores	**P value**
H_0: Importer's score + importer's score⊗Canada dummy = 0	0.62
H_0: Importer's score + importer's score⊗US dummy = 0	0.38
H_0: Exporter's score + Exporter's score⊗Canada dummy = 0	0.00
H_0: Exporter's score + Exporter's score⊗US dummy = 0	0.13

Note: (a) the reference country is Bahamas, which complies with Codex MRLs completely; (b) "Importer's score⊗to Canada" represents the additional slope assigned to the Importer's score when the destination country is Canada; "Exporter's score⊗from Canada" represents the additional slope assigned to the Exporter's score when the source country is Canada; the interaction terms when US is involved are defined similarly.

Abstracting from the specific implications for Canada and the US, results in Table 3 show that the MRL stringency in an average importing country tends to affect its imports negatively, and that the MRL stringency in an average exporting country influences its exports positively. A glance at the U.S.-specific responses suggests that, relative to trade effects of the score indices, the US is no different from an average importer or exporter. Statistically, however, we fail to reject the hypothesis that the impact of U.S. MRL stringency on its imports (captured by the sum of the common effect and U.S.-specific effect of the importer's score) is zero. Similarly, we accept the hypothesis that the impact of U.S. MRL stringency on its exports (captured by the sum of the common effect and the U.S.-specific effect of the exporter's score) is null.[7] The above two results concerning the trade effects of the U.S. MRL stringency are consistent with the results reported in Table 1 based on the individual regressions.

Turning to Canada's specific responses to MRL stringency, we see that Canada's own slope is of opposite sign on an average importer's stringency variable, and the associated F test shows that we cannot reject the hypothesis that the sum of the common effect and the Canada specific effects is zero. That is, Canadian MRLs have not affected its imports significantly. On the export side, we find that Canada's own response reinforces the common export-enhancing effect found for an average exporter. The hypothesis that the sum of these two effects is equal to zero is strongly rejected. To sum up, Canadian exports to the rest of the world expand due to its own MRL stringency, but its imports are not significantly hurt by those MRLs. The above results are fully consistent with the results of Table 2 based on individual equations.

The remaining results in Table 3, concerning other trade costs, are in line with what one would expect in a gravity equation analysis. The trade-impeding effect of distance is well within the range of previous estimates (see Disdier and Head, 2008). Both a common language and a shared border facilitate bilateral trade significantly. Former colonial ties do not seem to have a significant effect on bilateral flows once the similarity in language is accounted for.

Diagnostic analysis and robustness checks

[7] The different inference one can draw based on T tests and F tests can be explained by the high standard error on the US-specific slopes in Table 3.

We check the robustness of the empirical results with a focus on the first set of regressions.[8] First, it is a common concern that the Poisson Pseudo Maximum Likelihood (PPML) estimator may deliver biased results when trade data exhibit a limited-dependency: the high frequency of zero trade flows may be caused by large fixed costs of trade (Martin and Pham, 2008). Therefore, we need to check whether equation (2) is correctly specified. To this end, we conduct Ramsey specification tests (Ramsey, 1969) for all four regressions in the first set. The tests results suggest that we should accept the null hypothesis that equation (2) is correctly specified for case (i) through (iii) but reject such null hypothesis for case (iv) at 5 per cent confidence level. Since case (iv) is also featured with the highest proportion of zeros (8 per cent), we speculate that the misspecification is attributable to the lack of appropriate separate treatment of zeros. With the root causes of zeros unknown, we delete all observations with zero trade records and re-estimate (2) using the truncated sample. The associated results show that the main finding in case (iv), that more stringent Canadian MRLs expand Canada's exports to the rest of world, is sustained.

Conclusions

Quality-like standards, such as SPS and TBT measures, can be effective policies tools to correct market imperfections, or can create unnecessary trade barriers in disguise. Although the distinction of the two cases is difficult to delineate in practice, we use data on MRLs in plant and animal products to investigate how stringency of MRLs above international standards impacts trade flows between Canada and the US with their respective trading partners. Based on Li and Beghin (2012), we use score indices of MRL stringency to measure countries' strictness in MRLs relative to the Codex levels for each product. Canada tends to have more stringent MRLs

[8] All results in this subsection are available from the authors upon request.

than the US does and sets many of these MRLs well above the Codex levels. In contrast, MRLs in the US gravitate around Codex values in most plant and animal products. In a gravity equation analysis of U.S. and Canadian trade flows with their trading partners in 2010, we find that, as a country that does not adopt MRLs systematically stricter than Codex, the US experiences little trade distortion either in terms of imports or exports of plant and animal products. On the other hand, as a country implementing MRLs more stringent than Codex in several sectors, Canada seems to have gained further international competitiveness with its lower tolerance levels in pesticides and veterinary drugs. In addition, the US sees its exports adversely affected by strict MRLs adopted by its trading partners.

We contribute to the analysis of non-tariff trade barriers by underscoring the importance of comparing the unilateral standards with the international standards. We also point out the role of quality-like standards in promoting international competiveness (or export performance) for the domestic industry, which complements the conventional analysis of protectionism (or import performance). Extensions could incorporate welfare implications of these findings.

Policy implications are immediate for the further integration of U.S. and Canadian food markets. With respect to the potential harmonization in non-tariff measures between the US and Canada, the results suggest that Canada may be reluctant to "harmonize downward" by relaxing its stringency to U.S. or Codex levels as mercantilist interests would oppose the loss of international competitiveness. On the other hand, the US has little incentive to "harmonize upward" and conform to the Canadian MRLs because setting standards systematically above Codex might unnecessarily compromise the domestic industry's competitiveness and risk losing the reputation of a free trader in the world market.

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