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Abstract

Food safety and agricultural health standards have become a mayor challenge for food exports from developing countries in the past few years (Jaffe & Henson, 2005; OECD, 2003; Josling, Roberts & Orden, 2004; Maskus & Wilson, 2001). As tariff rates were negotiated down in the context of the World Trade Organization (WTO) and in regional and bilateral trade agreements, international trade in agro-food products increased substantially and so did concerns over food safety and agricultural health in food importing countries. Several countries, including the U.S, started to pay closer attention to their food safety and agricultural health standards both domestically and for food imports. In the U.S., the tightening of standards was in part related to heightened concerns about bioterrorism (Jaffe & Henson, 2005). Increased consumer awareness of agro-food quality and agricultural health issues also played an important role, as indicated by the large number and strictness of private technical standards (Jaffe & Henson, 2005).

Although there is an extensive literature describing the general issues of food-safety and its potential effects on international trade, few studies have looked at the empirical question of what are the actual trade costs of an increase in the number, strictness and enforcement of food safety regulations. This document contributes to the literature by providing an innovative estimation of the effects of U.S. food safety and agricultural health standards in the agro-food exports of Latin America and the Caribbean, using the number of refusals at the U.S. border as a proxy for trade costs associated with tighter food safety standards and regulations. The analysis focuses on agro-food exports from Latin American countries to the U.S. market to estimate a gravity model with panel data for the years spanning from 1997 to 2009.

The main results are that technical standards and regulations are not significant determinants of Latin America and Caribbean agro-food exports to the U.S. Rather the size of the countries or their market potential in the food sector, as measured by the agricultural GDP, is the main determinant. Time specific factors such as oil prices and global economic conditions as well as population of the exporting country also play a role. This is consistent with the results obtained by Novy (2009), that the majority of U.S. trade growth over the period 1970-2000 was explained by income growth rather than by a decline in bilateral trade barriers. In addition, we found that using GDP as a measure of market potential in the agro-food sector is inadequate, because GDP includes services, most of which are non-tradables, and the value added of products other than those whose trade is relevant for our analysis. As a result, using GDP overestimates trade costs in the agro-food sector and underestimates the role of income as a determinant of trade (Novy, 2009).

Introduction

Food safety and agricultural health standards have become a major challenge for food exports from developing countries in the past few years (Jaffe & Henson, 2005; OECD, 2003; Josling, Roberts & Orden, 2004; Maskus & Wilson, 2001). As tariff rates were negotiated down in the context of the World Trade Organization (WTO) and in regional and bilateral trade agreements, international trade in agro-food products increased substantially and so did concerns over food safety and agricultural health in food importing countries. Several countries, including the U.S, started to pay closer attention to their food safety and agricultural health standards both domestically and for food imports. In the U.S., the tightening of standards was in part related to heightened concerns about bioterrorism (Jaffe & Henson, 2005). Increased consumer awareness of agro-food quality and health issues also played an important role, as indicated by the large number and strictness of private technical standards (Jaffe & Henson, 2005).

The increasing number and strictness of public and private technical standards implies rising compliance costs for agricultural producers, agro-food and drug and cosmetics industries. As a result, technical standards and regulations for food and drug related imports have been increasingly perceived as non-tariff barriers to trade (Otsuki et al., 2001). However, these standards could also open niches of opportunities, enhancing trade among concerned foreign consumers that are willing to pay the additional cost of healthier and safer food and other related products (Jaffe & Henson, 2005; Moenius, 2004).

Although there is an extensive literature describing the general issues of food-safety and its potential effects on international trade, few studies have looked at the empirical question of what are the actual trade costs of an increase in the number, strictness and enforcement of food safety regulations. Quantification of the effects of sanitary and phytosanitary (SPS) and other technical standards will help inform governments of the end result of their regulations and assist in the design of the most efficient ones.

This research contributes to the literature by providing an alternative estimation of the effects of U.S. food safety and agricultural health standards on the agro-food exports of Latin America and the Caribbean, using the number of refusals at the U.S. border as a proxy for trade costs associated with tighter food safety standards and regulations. Previous studies (Otsuki et al., 2001; Krissoff, et al., 1997) have looked at the effect on trade flows of one particular standard in the market of one particular product. We focus on the agro-food sector as a whole, and technical standards and regulations are interpreted as one component of trade costs as those goods are traded internationally.

The focus on agro-food exports from Latin American countries to the U.S. market is motivated by three main considerations. First, there has been a significant surge in U.S. agro-food imports, in particular for products coming from Latin American and Caribbean countries. Second, quality standards as well as health and safety regulations have been growing strongly in the U.S., particularly since 2001, and affect specifically food imports coming from developing countries. And third, a better understanding of the determinants and trends of bilateral agro-food trade can help Latin American exporters to better exploit the potential of this growing market.

We estimate a gravity model with panel data to examine the determinants of U.S. food imports from thirty-two Latin American and Caribbean countries for the years spanning from 1997 to 2009. The model is estimated for eight agro-food sectors using a two-way fixed effects model that includes country-specific dummies as well as time-specific dummies (Cheng & Wall, 2004; Baldwin & Taglioni, 2006). All time-invariant country-pair specific determinants of trade flows are absorbed by the country dummies. Time varying exogenous macroeconomic variables related to the US-economy and global macroeconomic shocks are captured by the time dummies.

The main results are that technical standards and regulations are not significant determinants of trade flows. Rather the size of the exporting countries or their market potential in the food sector, as measured by the agricultural GDP, is the main determinant of food exports from Latin America and the Caribbean to the United States. Time specific factors such as oil prices and global economic conditions as well as the population of the exporting country also play a role. This is consistent with the results obtained by Novy (2009), that the majority of U.S. trade growth over the period 1970-2000 was explained by income growth rather than by a decline in bilateral trade barriers. In addition, we found that using GDP as a measure of market potential in the agro-food sector is inadequate, because GDP includes services, most of which are non-tradable, and the value added of products other than those whose trade is relevant for our analysis. As a result, using GDP overestimates trade costs in the agro-food sector and underestimates the role of income as a determinant of trade (Novy, 2009).

I. Food safety and agricultural health standards and the agro-food exports

A rough indication of the effects that food safety and agricultural health standards have had on food exports is in the number of border rejections of shipment of exports from food exporting countries.

In the United States, tens of thousands of foreign products are refused entry every year (see table I.1). Over 70% of all the refusals that occurred between 2006 and 2008 corresponded to shipments arriving from Asia and Europe. Almost half of all customs rejections involved products from Asia, followed by Europe, which accounts for 24% of refusals, and by Latin America and the Caribbean, with 18%. The interception of products from lower-income regions such as Africa is minimal.

A handful of countries are responsible for most refusals. Among developing countries, most refusals are from China (7,151), India (8,433) and Mexico (6,052). 45% of refusals from Latin America and the Caribbean are for products from Mexico, which is natural given that this country is the third main supplier of foreign products to the United States, and the main supplier from Latin America and the Caribbean.

Around 20% of all refusals recorded between 2006 and 2008 were concentrated on a few industries: fish and seafood, fruit and vegetables, sweets, non-alcoholic beverages, cosmetics and food supplements such as vitamins and proteins and other dietary products. In the case of Latin America and the Caribbean the top five agro-food industries in the number of refusals are vegetables and vegetable products, vitamins, minerals, proteins and other food supplements, non-chocolate candy, fruits and fruit products, and fish and seafood.

In terms of sub-regions of Latin America and the Caribbean, the most affected industries in Central America (including Mexico) were fruit, vegetables, and non-alcoholic beverages. As for the Caribbean, the most seriously affected categories were sea products, fruits, and vegetables, while most refusals from South America corresponded to fish and seafood, specific medications, and cosmetics.

TABLE I.1
SHARE OF THE TOTAL NUMBER OF CUSTOMS REFUSALS BY REGION
(2006-2008)

	Number	Share of world total *(Percentage)*
North America	6 050	8.2
Latin America & Caribbean	13 445	18.1
Africa	1 717	2.3
Asia	33 968	46.0
Europe	17 845	24.1
Oceania	891	1.2
Total	73 916	100

Source: ECLAC, based on data from OASIS.

TABLE I.2
LATIN AMERICA AND THE CARIBBEAN: SHARE OF SUBREGIONS IN TOTAL REFUSALS
(2006-2008)

	Number	Share *(Percentage)*	Exports to the U.S. *(US$ millions)*
South America	2 871	21.4	62 650.5
Caribbean	2 149	16.0	5 335.7
Central America (inc. Mexico)	8 425	62.6	220 180.9
México	6 052	45.0	216 834.1
Total	13 445	100	288 167.1

Source: ECLAC, based on data from OASIS.

A large percentage of refusals of products from Asia and Latin America and the Caribbean involve deficiencies relating to health and hygiene requirements. In the case of Latin America and the Caribbean, one third of refusals are due to the presence of pesticides in higher quantities than those considered harmless for human health, the presence of salmonella or filth/decomposition of a product. (see table I.3).

The rest of the regions show a pattern more similar to the overall trend, with a prevalence of products detained because they have not been approved, do not list all ingredients or other labeling deficiencies.

TABLE I.3
LATIN AMERICA AGRIFOOD EXPORTS:
MOST COMMON REASONS FOR REFUSAL BY UNITED STATES CUSTOMS
(2006-2008)

Reason code	Total refusals *(Percentage)*	Description of reason
PESTICIDE	20.9	The article appears to be a raw agricultural commodity that bears or contains a pesticide chemical which is unsafe within the meaning of Section 408(a).
FILTHY	19.6	The article appears to consist in whole or in part of a filthy, putrid, or decomposed substance or be otherwise unfit for food.
UNSAFE COL	9.9	The article appears to be a color additive for the purposes of coloring only in or on drugs or devices, and is unsafe within the meaning of Section 721(a).
NO ENGLISH	7.2	Required label or labeling appears to not be in English in violation of 21 C.F.R. 801.15(c)(1)
SALMONELLA	6.5	The article appears to contain Salmonella, a poisonous and deleterious substance which may render it injurious to health.
NUTRIT LBL	5.5	Required label or labeling appears to not be in English in violation of 21 C.F.R. 801.15(c)(1)
NO PROCESS	4.7	It appears that the manufacturer has not filed information on its scheduled process as required by 21 CFR 108.25(c)(2) or 108.35(c)(2).
NEEDS FCE	3.1	It appears the manufacturer is not registered as a low acid canned food or acidified food manufacturer pursuant to 21 CFR 108.25(c)(1) or 108.35(c)(1).
LIST INGRE	2.4	It appears the food is fabricated from two or more ingredients and the label does not list the common or usual name of each ingredient.
INGRED FIL	2.3	The article appears to be an ingredient in a dietary supplement and may have been prepared packed or held under unsanitary conditions whereby it may have become contaminated with filth or rendered injurious to health.

Source: ECLAC, based on data from OASIS.

II. Methodology

This study makes use of a gravity model to estimate the effects of technical standards on trade flows of selected agro-food sectors. The focus of the study is on Latin American exports to the U.S. market.

The gravity model has been widely used as a baseline model for estimating the impact of a variety of trade policy issues on trade flows, including regional trading groups, currency unions, and trade distortions. This method explains international trade flows as a function of the trading countries' sizes and the trade costs in a very broad sense of the word (Head, 2000; Anderson & van Wincoop, 2004; Feenstra, 2004; Olper & Raimondi, 2009). Several studies have already used this method to quantify the effects of technical standards on trade flows (Moenius, 2004; Otsuki, Wilson & Sewadeh, 2001a; Otsuki, Wilson & Sewadeh, 2001b; Wilson & Otsuki, 2001; Gebrehiwet, Ngquang & Kirsten, 2007).

We use the number of refusals at U.S. ports of entry from each country/sector per volume of imports per year as an indicator of the tightness of technical standards and regulations in the agro-food sector. An increase in said ratio would indicate at least one of the following scenarios: there has been an increase in the number of standards, the existing standards have been made stricter, and/or there has been more enforcement of the set standards. For short term projections we could then argue, that an increase in the stringency of U.S. technical standards could be represented by an increase of that variable because in the short term, the Latin American firms do not have sufficient time to adapt to those changing standards.

In our model, we use the ratio of the number of refusals (Det) for that product category (k), coming from country (i) in a particular year (t) to the U.S. imports in constant prices of 2000 (X) for that product category (k) coming from country (i) in year (t) multiplied by 1000. This is described in expression (1) below:

$$(1) \qquad \frac{Det_{i,t,k}}{X_{i,t,k}} * 1000$$

We estimate the following panel gravity model for the time period 1997-2009:

$$(2) \qquad \ln(M_{i,t,k}) = \alpha_0 + \alpha_t + \alpha_{i,U.S.} + \beta_{1,i,t,k} \ln(GDP_{i,t}) + \beta_{2,i,t,k} \left(1000 * \frac{Det_{i,t,k}}{X_{i,t,k}}\right) + \beta_{3,i,t,k} \ln(Z_{i,t,k}) + \varepsilon_{i,t,k}$$

where Mi,t,k is the c.i.f. value of U.S. imports of product k from country i in year t in current thousand U.S. dollar. $GDP_{i,t}$ is nominal agricultural GDP or nominal GDP, depending on the specification of the model, of country i in year t in current million U.S. dollars.[1] α_i,US denotes the fixed effect specific for country i that is the same across the years, α_t is the fixed effect specific to year t and common to all countries, α_0 is the intercept that is common to all years and countries. $Z_{i,t,k}$ represents the vector of other variables included in the estimation. Depending on the specification, it could be nominal exchange rate, population and/or per capita GDP. $\varepsilon_{i,t,k}$ is the error term assumed to be normally distributed with zero mean and constant variance for all observations. It is also assumed that the disturbances are pair wise uncorrelated.

Equation (2) does not refer to bilateral trade among country pairs; rather it looks at one-way trade from certain Latin American and Caribbean countries to the United States. The exogenous variables are the time variation in the policy variables such as technical standards and regulations, economic size or market potential, population or GDP p.c. of the exporting country as well as the nominal exchange rate. Our model specification includes the multilateral resistance terms derived in Anderson and Wincoop, 2003 (see Cheng & Wall, 2004, and Baldwin & Taglioni, 2006).

We use three different specifications of the model. First, we estimate the regression for our 8 disaggregated food sectors using GDP as independent variable (see Otsuki, Wilson & Sewadeh, 2001a; Otsuki, Wilson & Sewadeh, 2001b; Wilson & Otsuki, 2001; Gebrehiwet, Ngquang & Kirsten, 2007). Second, we use agricultural value added, instead of GDP, as the independent variable to try to better capture the market potential of agro-food products of the exporting country (Olper & Raimondi, 2009).[2] Third, we aggregate all 8 food sectors and estimate the model using agricultural value added as independent variable. For each specification we estimate a compact gravity model and three different versions of the expanded gravity equation.

The two-way fixed effect models allow for country-specific fixed effects as well as time- specific fixed effects but restrict the slope coefficients in the rest of the independent variables to be constant across countries and times and, in our example, product groups.[3] That is $\beta1_{,i,t,k}= \beta1$, $\beta2_{,i,t,k}= \beta2$, and $\beta3_{,i,t,k}= \beta3$. In this specification, there is no need to introduce country specific time invariant variables such as distance to the U.S., common language, historical ties, ethnic similarities, geographic factors,

1 We follow Baldwin &Taglioni (2006) in using nominal GDP and year dummies to control for the residual conversion factor. For the same reason, we include the nominal exchange rate, and not the real exchange rate, in our model.

2 We were not able to use sectoral output data from the World Bank Trade, Production and Protection Database (Nicita & Olarreaga, 2006), as Olper and Raimondi (2009) did, because its coverage was too sparse. We used the agricultural value added data from the World Bank Development Indicators, instead.

3 We tried to estimate the coefficients for separate food sectors, but there were not enough observations to estimate the model properly.

etc. because they are all included in the country-specific fixed effects (Cheng & Wall, 2004; Baldwin & Taglioni, 2006). The size of the U.S. economy, U.S. population and U.S. GDP p.c. as well as other time variant, trade influencing variables related to the U.S. economy and global macroeconomic shocks are included in the time fixed effects. Additional to our measurement of the strictness of U.S. standards, we include the following country-time varying variables that influence trade: population (or per capita GDP) and nominal exchange rate. The equation is estimated for 32 countries and 13 years, the dummy variable for 1997 is omitted to avoid perfect multicollinearity and therefore αt measure the difference in the intercept as compared to that of 1997.

III. Data

The c.i.f. value of U.S. imports at current prices for the three-digit industry level SITC (Standard International Trade Classification) come from the U.S. International Trade Commission. Nominal GDP, GDP p. c. and population data come from the International Monetary Fund, World Economic Outlook (WEO) database. Nominal exchange rate figures and the data on agricultural value added are from the World Development Indicators from the World Bank.[4]

The Observatory of Customs Controls for United States imports: technical standards (OCAI by its initials in Spanish) developed by ECLAC (2009) contains information on the number of refusals of imports at the U.S. borders for the years 1997-2009. The FDA inspects about 1% of all food and drug related imports entering any port in the U.S. and reports the number of refusals at U.S. port of entry, the country of origin and the reason for rejection of the product that is gathered together in OCAI.

Eight product categories are included in the study. The five groups of products from Latin America and Caribbean countries that were most frequently refused in the period considered: vegetables, confectionary sugar, fish and fisheries, fruits and nuts, alcoholic and non-alcoholic beverages plus other three groups of products that are important U.S. import products from the region but that do not have high refusal numbers. Not surprisingly, the five most frequently detained products are also the most relevant U.S. import products from the region. Because the FDA uses different product codes than the SITC, we had to develop the correspondence between them. The food sectors and the correspondence between the codes are presented in annex 1.

4 Sectoral production data from the Trade, Production and Protection data base (Nicita & Olarreaga, 2006) does not cover enough years in the period 1997-2009 to estimate the model properly for Latin American countries.

All Latin American and Caribbean countries that trade with the U.S. are included in the sample,[5] even if they have very few or none refusals in the period. The reasoning behind this is that they might provide important information regarding potential "good compliers". We assume that if the FDA does not report any refusals for a certain country, product and year, this country complied with the technical standards for the product in that year. The complete list of countries included can be found in annex 2.

To compute real imports from the nominal value reported by ITC, we use the import price indices from the U.S. Bureau of Labor Statistics (BLS) with the base year 2000 (see annex 3 for more details).[6]

5 Those countries for which GDP data was not available were excluded form the regression. We only include the observation for country i in year t and product k, if the exports to the US were greater than 0. We excluded 916 out of 4160 observations because they reported zero trade flows (in the case of the 8 disaggregated sectors). For the regression with aggregated food sectors we only excluded 1 out of 345 observations.

6 We could not use the import price indices based on the SITC classification because the BLS did not report data for this classification from 2006-2009.

IV. Results

We estimate three sets of models. The first one includes logarithm of GDP of the exporting country as an exogenous variable and is estimated as a pooled regression for 8 disaggregated sectors. The results are presented in table 1. The first column presents the results for the compact gravity equations that includes, in addition to the country and time dummy variables, the logarithm of nominal GDP of the exporting country and the (refusals/imports)*1000 as the variable of interest. The last three columns include different versions of the expanded gravity model where either population, as indicator for supply side effects (Brun et al., 2002; Cheng & Wall, 2004), or per capita GDP, to control for the average level of development (Olper & Raimondi, 2009), are included, as well as the nominal exchange rate as a determinant of trade flows.[7] The number of observations corresponds to 32 countries over 13 years for 8 sectors, for the compact equation. For the others, the number of observations is smaller because in the WDI database there is no data for the year 2009 for the nominal exchange rate.

[7] GDP p.c. and Population can not both be included in the model together with GDP, because that would cause multicollinearity.

TABLE IV.1
REGRESSION RESULTS FOR MODELS USING 8 DISAGGREGATED SECTORS[8]
(dependent variable = LN of imports)

	Fixed effects model			
	Compact Equation	Expanded Model 1	Expanded Model 2	Expanded Model 3
ln GDP	-0.331 (-1.21)	-0.434 (-1.48)	0.51 (0.51)	-0.473 (-1.59)
Standards	-0.009*** (-6.98)	-0.009*** (-10.11)	-0.009*** (-10.08)	-0.009*** (-10.08)
ln Nominal exchange rate	-	-0.046 (-0.79)	-0.05 (-0.86)	-0.05 (-0.86)
ln GDP p.c.	-	-	-1.234 (-0.57)	-
ln Population	-	-	-	1.234 (0.82)
Intercept	11.19*** (4.35)	12.268*** (4.38)	10.879*** (2.51)	10.879*** (3.32)
1998	0.003 (0.02)	0.010 (0.05)	-0.008 (-0.82)	-0.008 (-0.04)
1999	-0.024 (-0.11)	-0.012 (-0.06)	-0.045 (-0.20)	0.045 (-0.20)
2000	-0.021 (-0.10)	-0.022 (-0.10)	-0.074 (-0.32)	-0.074 (-0.32)
2001	0.046 (0.21)	0.05 (0.22)	0.015 (-0.06)	-0.015 (-0.06)
2002	0.161 (0.74)	0.167 (0.77)	0.082 (0.34)	0.082 (0.34)
2003	0.196 (0.90)	0.213 (0.98)	0.112 (0.45)	0.112 (0.45)
2004	0.445** (1.98)	0.474** (2.09)	0.364 (1.37)	0.364 (1.37)
2005	0.496** (2.10)	0.537** (2.24)	0.413 (1.46)	0.413 (1.46)
2006	0.793*** (3.16)	0.849*** (3.30)	0.714** (2.35)	0.714** (2.35)
2007	0.892*** (3.28)	0.961*** (3.42)	0.815** (2.45)	0.815** (2.45)
2008	0.916*** (3.09)	0.999*** (3.23)	0.842** (2.32)	0.842** (2.32)
2009	0.826*** (2.83)	-	-	-
Observations	2648	2449	2449	2449
Parameters	47	47	48	48
F	10.62	9.86	9.25	9.25
Adjusted -R^2	0.515	0.513	0.513	0.513

Source: Estimates by the authors.

The coefficient of the ln GDP is not significant in any of the specifications of this model. The coefficient on the standards indicator, on the other hand, is significant at the 1% level in all the cases and with the expected negative sign, and the size of the effect is quite large: an increase of 0.001 in the number of refusals per volume of imports would reduce the exports of a country, whose exports amount to US$100 million per year and product in the base year, by US$ 0.9 million. What is perplexing, however, is that a well established result in the literature, that the most significant determinant of bilateral trade is the size of the trading economies, becomes unimportant in this model.

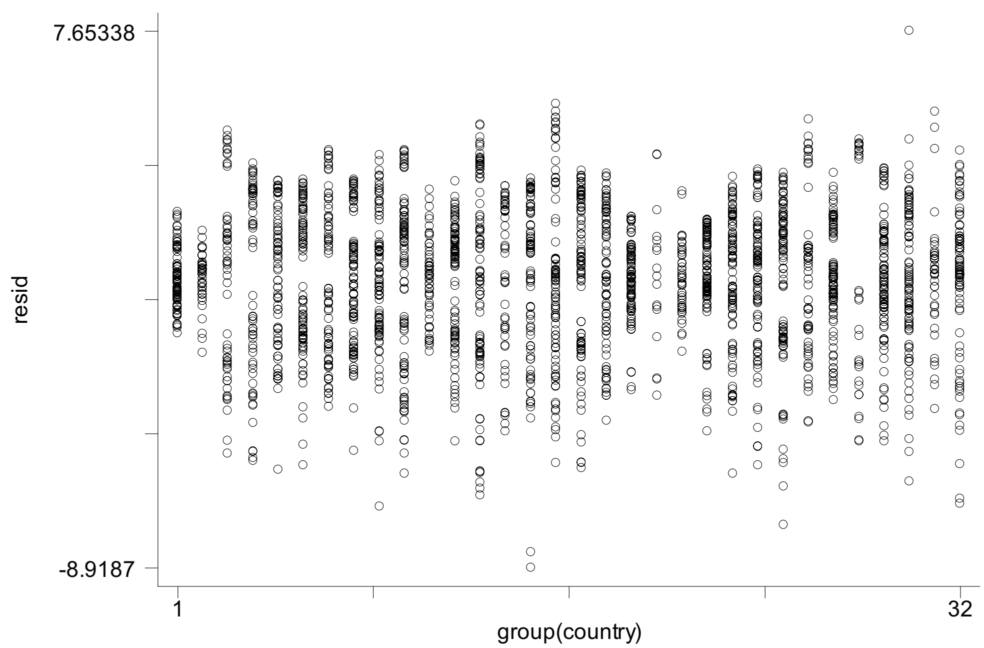
One possible explanation is that GDP is not a good indicator of a countries export potential of agro-food products and its use as a regressor introduces a bias in the estimation. GDP includes the value

8 In all tables, *** denotes that the coefficient is significant at the 1% level of significance (** refers to the 5% level of significance and * to the 10% level). t-values are in parenthesis.

added of all the country's production not only agro-food products, including non-tradable goods. In fact, a country may have a large GDP but produce and export very little food products. Therefore, the intranational trade of food products is largely overstated in the equation leading to an overestimation of international trade costs (Novy, 2009). In our case, U.S. standards and regulations in the food industry, one of the components of trade costs, become highly significant.

The plot of the residuals for the 32 countries in our data set (figure IV.1), also indicates a problem in the model specification. If the model estimation were unbiased, there would be no discernable pattern in figure IV.1 because the average residual for each country would be zero. In our case, the residuals have large variances around the mean and the mean is not zero.

FIGURE IV.1
RESIDUALS OF MODEL 1



Source: Calculated by the authors.

The second set of models uses the agricultural GDP instead of the GDP, to take this factor into consideration. The assumption is that this would be closer to the sectors considered. The results are presented in table IV.2.

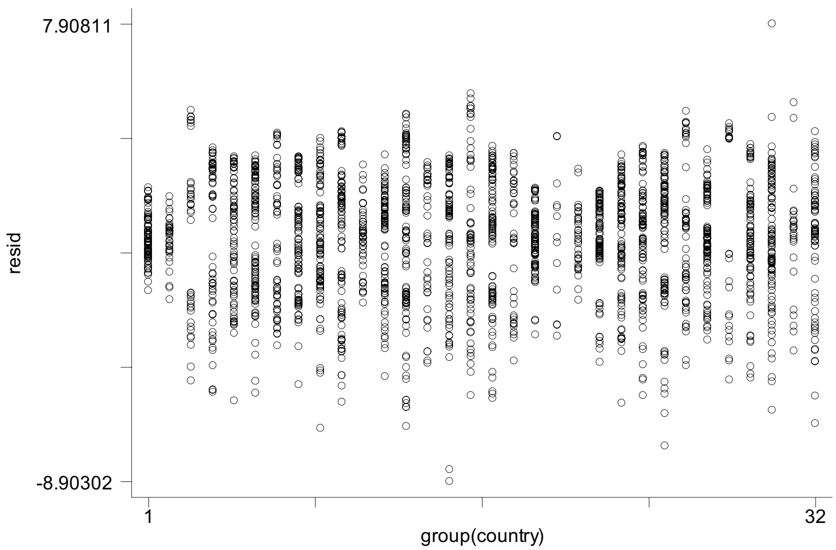
TABLE IV.2
REGRESSION RESULTS FOR MODELS USING LN OF AGRICULTURAL GDP AND 8 DISAGGREGATED AGRICULTURAL SECTORS
(dependent variable = ln of imports)

	Fixed effects model			
	Compact Equation	Expanded Model 1	Expanded Model 2	Expanded Model 3
ln GDPAgr	0.151 (0.46)	0.174 (0.53)	0.306 (0.90)	0.167 (0.50)
Standards	-0.009*** (-9.5)	-0.009*** (-9.50)	-0.009*** (9.57)	-0.009*** (-9.49)
ln Nominal exchange rate	-	-0.031 (-0.54)	-0.06 (-1.00)	-0.032 (-0.56)
ln GDP p.c.	-	-	-0.577* (-1.77)	-
ln Population	-	-	-	0.621 (0.37)
Intercept	6.112 (1.33)	5.859 (1.27)	8.686* (1.78)	5.01 (0.97)
1998	-0.016 (-0.07)	-0.014 (-0.07)	0.003 (0.01)	-0.024 (-0.11)
1999	-0.022 (-0.10)	-0.015 (-0.07)	-0.012 (-0.01)	-0.033 (-0.15)
2000	-0.039 (-0.18)	-0.042 (-0.19)	-0.018 (-0.08)	-0.070 (-0.30)
2001	0.035 (0.16)	0.034 (0.15)	0.066 (0.29)	-0.001 (-0.00)
2002	0.169 (0.76)	0.173 (0.78)	0.171 (0.77)	0.128 (0.51)
2003	0.193 (0.88)	0.199 (0.90)	0.206 (0.94)	0.146 (0.55)
2004	0.388* (1.73)	0.392* (1.75)	0.465** (2.04)	0.332 (1.20)
2005	0.369* (1.65)	0.371* (1.66)	0.497** (2.12)	0.303 (1.05)
2006	0.583** (2.46)	0.581** (2.45)	0.760*** (2.95)	0.503 (1.58)
2007	0.702*** (2.71)	0.697*** (2.69)	0.931*** (3.20)	0.609* (1.73)
2008	0.697** (1.33)	0.684** (2.16)	0.959*** (2.72)	0.584 (1.40)
Observations	2251	2251	2251	2251
Parameters	44	45	46	46
F	9.41	8.76	8.39	8.18
Adjusted -R^2	0.505	0.505	0.505	0.504

Source: Estimates by the authors.

The results are similar to those of the previous models. The number of observations differs from the previous model specification, because there was no data available for the agricultural GDP for the year 2009 and for some other observations from 1997-2008. The residuals show the same pattern as in the previous models.

FIGURE IV.2
RESIDUALS OF MODEL 2



Source: Calculated by the authors.

The third set of models aggregates the observations of all food sectors. The results, presented in table 3, are quite different. The coefficients on logarithm of agricultural GDP are significant at the 5% level, but standards become irrelevant. This is more consistent with previous results in the literature (Novy, 2009; Moenius, 2004) and also with economic intuition: the size of the economy, or its market potential, should matter more in determining bilateral trade flows than some of the obstacles presented by standards. Moreover, since there is no theoretical agreement as to what the effects of technical standards should be in trade flows because there are some positive benefits that might compensate for the negative ones, a coefficient that is not significantly different from zero would be consistent with this ambiguity (Moenius, 2004).

TABLE IV.3
REGRESSION RESULTS FOR MODELS USING LN OF AGRICULTURAL GDP AND AGRICULTURAL SECTORS 1-8 AGGREGATED
(dependent variable = ln of imports)

	Fixed effects model			
	Compact Equation	Expanded Model 1	Expanded Model 2	Expanded Model 3
ln GDPAgr	0.453** (2.58)	0.429** (2.43)	0.415** (2.28)	0.448** (2.54)
Standards	-0.023 (-0.17)	-0.032 (-0.24)	-0.032 (-024)	-0.028 (-0.22)
ln Nominal exchange rate	-	0.040 (1.19)	0.043 (1.23)	0.043 (1.28)
ln GDP p.c.	-	-	0.063 (0.34)	-
ln Population	-	-	-	-1.63* (1.84)
Intercept	4.973** (2.10)	5.197** (2.18)	4.88* (1.91)	6.65*** (2.66)

(continues)

Source: Estimates by the authors.

Table IV.3 (conclusion)

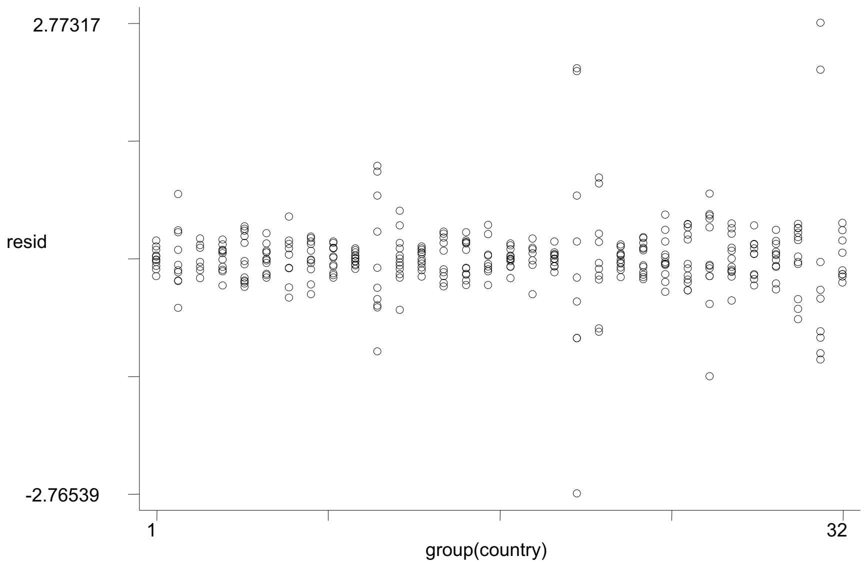
1998	-0.037	-0.039	-0.041	-0.017
	(-0.32)	(-0.33)	(-0.35)	(-0.14)
1999	-0.10	-0.107	-0.109	-0.061
	(-0.85)	(-0.91)	(-0.93)	(-0.51)
2000	-0.016	-0.014	-0.018	0.059
	(-0.14)	(-0.12)	(-0.15)	(-0.48)
2001	0.054	0.054	0.050	0.146
	(0.46)	(0.45)	(0.42)	(1.14)
2002	0.134	0.129	0.127	0.245*
	(1.13)	(1.09)	(1.08)	(1.83)
2003	0.061	0.053	0.05	0.191
	(0.52)	(0.45)	(0.43)	(1.38)
2004	-0.020	-0.025	-0.034	0.132
	(-0.16)	(-0.21)	(-0.27)	(0.89)
2005	0.078	0.075	0.06	0.253
	(0.65)	(0.62)	(0.47)	(1.64)
2006	0.133	0.132	0.112	0.340**
	(1.02)	(1.02)	(0.78)	(1.98)
2007	0.245*	0.249*	0.223	0.486**
	(1.68)	(1.71)	(1.36)	(2.50)
2008	0.270	0.283	0.252	0.550**
	(1.54)	(1.61)	(1.27)	(2.41)
Observations	344	344	344	344
Parameters	44	45	46	46
F	3.13	3.01	2.81	3.06
Adjusted -R^2	0.973	0.973	0.973	0.973

Source: Estimates by the authors.

The plot of the residuals also seems to point to a much better fit of this model (figure 3), despite the presence of a few outliers. [9]

[9] The literature is not clear regarding the handling of outliers in empirical gravity models. However, we estimated the model without the two countries that presented the main outliers, St. Kitts and Nevis and St. Vincent. The results are similar to those presented in table IV.3.

FIGURE IV.3
RESIDUALS OF MODEL 3



Source: Calculated by the authors.

Robustness check

To check for sensitivity of the estimation, we estimate the model for all the countries for which there is U.S. customs refusal information, including Latin America and the Caribbean for the years 2006-2009. Because all countries are missing information on agricultural GDP for 2009, and for some countries even for other years there is a low coverage, we use population as a proxy for the size or the market potential of the exporting economy. In the document we only present the results for the aggregated sectors.[10] Table 5 reports the results for the compact gravity equation and the compact extended gravity equation.

TABLE IV.4
REGRESSION RESULTS FOR MODELS USING LN POPULATION AND AGRICULTURAL SECTORS 1-8 AGGREGATED WORLD DATA
(dependent variable = ln of imports)

	Fixed effects model	
	Compact Equation	Expanded Model 1
ln Population	3.983**	4.11*
	(2.36)	(1.71)
Standards	-0.006	-0.005
	(-1.08)	(-0.69)
ln Nominal exchange rate	-	-0.211
		(-1.31)
ln GDP p.c.	-	-
Intercept	2.178	0.044
	(0.69)	(0.69)

(comtinues)

10 Although the regressions have been estimated for both aggregated and disaggregated sectors.

Table IV.4 (conclusion)

2007	0.051 (0.80)	0.048 (0.56)
2008	0.031 (0.41)	0.048 (0.56)
2009	-0.104 (-1.16)	-
Observations	651	463
Parameters	168	164
F	2.48	2.64
Adjusted -R^2	0.973	0.978

Source: Estimates by the authors.

The results are similar to those of the regressions for Latin America using the agricultural GDP with aggregated sectors, that the main determinant of trade flows is the size of the economy with the level of standards and regulations playing a negligible part in explaining trade flows of food products.

V. Conclusion

This paper estimates the determinants of Latin American agro-food exports to the U.S. market using panel data and a novel indicator of quality standards and health and safety regulations. The results are consistent with the vast majority of the literature in what income is the main determinant of international trade flows.

Technical standards and regulations, as measured by the number of border refusals in the ports of entry of the United States, do not seem to be significantly affecting Latin America and Caribbean agro-food exports to the U.S. One explanation could be that while compliance with those standards significantly raises the cost of those products, making them less competitive internationally, it opens up a new market of more selected costumers that are willing to pay the higher price for the safety benefits, increasing the demand for those products and compensating for the loss of other segments of the market.

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Annexes

Annex 1

FDA code equivalency with 3-digit SITC code

Product	FDA code	3-digit SITC
Vegetables	24, 25	054, 056
Fruits, Nuts and Oilseeds	20-23	057,058,059, 222, 223
Fish and Fisheries	16	034-037
Confectionary Sugar, Sugar and Honey	33,36	061,062
Coffee, Tea, Cocoa, Species	28,31,34	071-075
Beverages	29,30,32	111,112
Cereal and Cereal Products	02-05	041-048
Diary Products	09,12-15	022-025

Source: Authors elaboration on the basis of OCAI and SITC.

Note: Bocados (07 FDA) are not included and neither are vegetable proteins (18 FDA).

Annex 2

List of countries included in the study

ATG	Antigua and Barbuda
ARG	Argentina
BHS	Bahamas, The
BRB	Barbados
BLZ	Belize
BOL	Bolivia
BRA	Brazil
CHL	Chile
COL	Colombia
CRI	Costa Rica
DMA	Dominica
DOM	Dominican Republic
ECU	Ecuador
SLV	El Salvador
GRD	Grenada
GTM	Guatemala
GUY	Guyana
HTI	Haiti
HND	Honduras
JAM	Jamaica
MEX	Mexico
NIC	Nicaragua
PAN	Panama
PRY	Paraguay
PER	Peru
KNA	St. Kitts and Nevis
LCA	St. Lucia
VCT	St. Vincent and the Grenadines
SUR	Suriname
TTO	Trinidad and Tobago
URY	Uruguay
VEN	Venezuela

Annex 3

Import price series by product category

Product	Import price series
Vegetables	EIUIR00130
Fruits, Nuts and Oilseeds	EIUIP08
Fish and Fisheries	EIUIP03
Confectionary Sugar, Sugar and Honey	EIUIR00160
Coffee, Tea, Cocoa, Species	EIUIP09
Beverages	EIUIP22
Cereal and Cereal Products	EIUIR00160
Diary Products	EIUIR001

Source: U.S. Bureau of Labor Statistics.

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