Impacts from Organic Equivalency Policies:
A Gravity Trade Model Analysis

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EXECUTIVE SUMMARY

The purpose of this report is to quantify the impact that organic equivalency arrangements have on U.S. annual organic exports and imports. In short, this report answers the question of whether or not these policies are working as intended.

Organic equivalency is a mutual recognition in the form of bilateral arrangements between key trading partners that allows for successful trade by reducing trade barriers and supporting the strengthening of the supply chain. Organic equivalency recognizes two systems as comparable and verifiable, although not necessarily identical. When it comes to the development of standards, it is recognized that technical requirements will differ by jurisdiction or region. Ultimately what is more important is that the parties agree that they are meeting the same objectives without compromising the integrity that has come to be expected from the organic designation in the respective markets. This leads to numerous benefits such as reduced costs of doing business.

The United States signed the first organic equivalency arrangement in the world with Canada in 2009. Since then, the United States has established organic equivalency arrangements with the European Union (2012), Japan (2014), South Korea (2014), and Switzerland (2015). The United States has a one-way equivalency arrangement with Taiwan (2009).

The USDA tracks imports and exports for products assigned a "harmonized tariff schedule" code, and these codes were first issued to organic products in 2011. The study was conducted using product-specific annual data from 2011 to 2014 except for the case of organic imports, where a second data set covering 2013 and 2014 only, with an expanded set of codes, is also used. Note: the Korean and Swiss policies are excluded from this analysis because the effective date is very late in the study period, and not enough data are available.

To determine the policy impacts from the organic equivalency arrangements, organic export and import activities were estimated and predicted using a "gravity" trade model. The model is called a gravity model because the general assumption is that trade is likely to be larger between countries with large economic mass, and likely to be smaller the farther apart two countries are. Policy-type variables are then added to the model to reflect factors that might make international transactions less or more burdensome, and therefore more or less likely. The organic equivalency arrangements that exist between the U.S. and Canada, the E.U., Japan, and Taiwan, designed to make organic trade less burdensome, are coded into variables and added to the model. The model is then estimated using econometric techniques that generate the best prediction on the measurable effect of the policy variables.

The authors generally find that organic equivalency arrangements, examined both collectively as a single policy or as individual policies, have a positive impact on organic exports. The effect of the equivalency arrangements on U.S. imports, however, appears to be sensitive to the data used in the quantitative analysis.

When examined as individual policies the Canadian equivalency policy generates a 455 percent predicted increase in annual organic exports. The Japanese equivalency policy generates a 220 percent predicted increase in annual organic exports. The Taiwanese equivalency policy generates a 211 percent predicted increase in annual organic exports. The E.U. equivalency policy suggests little change on annual organic exports despite US exports to the EU in recent years. In fact, export totals are on the rise in all equivalency partner markets.

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IN BRIEF: The Issue

Beginning in 2009, the U.S. has entered into organic equivalency arrangements with a number of individual countries or country groups that are designed to promote organic trade by allowing organic products certified in one country to be labeled and sold as organic in another country without additional inspections or paperwork. For example, the 2009 arrangement was between the U.S. Department of Agriculture (USDA) and its Canadian counterpart. In 2012, the U.S. entered one with the European Union (E.U.), and in 2014, the U.S. entered ones (separately) with Japan and South Korea. The purpose of this report is to quantify the impact that these organic equivalency arrangements have on U.S. annual organic exports and imports. In short, this report answers the question of whether or not these policies are working as intended.

IN BRIEF: Methods

USDA tracks imports and exports for products receiving a special "harmonized" code. These codes were first issued to organic products in 2011. This study was conducted using product-specific annual data from 2011 to 2014 except for the case of organic imports, where a second data set covering 2013 and 2014 only, with an expanded set of codes, is also used. To determine the policy impacts from the organic equivalency arrangements, organic export and import activities were estimated and predicted using a "gravity" trade model. The model is called a gravity model because of the general assumption is that trade is likely to be larger between countries with large economic mass, and likely to be smaller the farther apart two countries are. Policy-type variables are then added to the model to reflect factors that might make international transactions less or more burdensome, and therefore more or less likely. The organic equivalency arrangements that exist between the U.S. and Canada, the E.U., Japan, and Taiwan, designed to make organic trade less burdensome, are coded into variables and added to the model. Note that we exclude the Korean policy from this analysis because the effective date is very late in our study period. The model is then estimated using econometric techniques that generate the best fit, and the impact of the policy variables can be predicted with the estimated results.

IN BRIEF: Findings

Effect of a General Equivalency Policy on U.S. Organic Exports:

- We generally find that the organic equivalency arrangements, examined collectively as a single policy, have a positive impact on U.S. organic exports.
- All policies collectively increase annual organic exports by 58 percent over a hypothetical non-policy baseline.

Effect of a General Equivalency Policy on U.S. Organic Imports:

- Alternatively, the predicted impact of the equivalency arrangements on U.S. imports is sensitive to the data used in the quantitative analysis.
- Using a 2011-2014 dataset composed of organic imports receiving harmonized trade codes in 2011, the impact of all organic equivalency arrangements together is negative, i.e., we find a 45 percent predicted decrease in annual imports.
- On the other hand, predicted impacts using a 2013-2014 dataset composed of organic imports with 2013-based product are strongly positive, i.e., we find a 110 percent predicted increase in annual imports.

Effect of Individual Equivalency Policies:

Canada:

- *Exports:* The Canadian equivalency policy generates a 455 percent predicted increase in annual organic exports.
- *Imports:* The Canadian policy generates either a 65 or a 371 percent predicted increase in annual organic imports depending on whether the model is estimated using 2011-2014 data with 2011 product codes or the 2013-2014 data with 2013 product codes.

European Union:

- *Exports:* The E.U. equivalency policy had virtually no effect on annual organic exports.
- *Imports:* The E.U. policy generates either a 61 percent predicted decrease or a 91 percent predicted increase in annual organic imports, depending on whether the model is estimated using 2011-2014 data with 2011 product codes or the 2013-2014 data with 2013 product codes.

Japan:

- *Exports:* The Japanese equivalency policy generates a 220 percent predicted increase in annual organic exports.
- *Imports:* The Japanese policy generates either a 196 or a 267 percent predicted increase in annual organic imports, depending on whether the model is estimated using 2011-2014 data with 2011 product codes or the 2013-2014 data with 2013 product codes.

Taiwan:

- *Exports:* The Taiwanese equivalency policy generates a 211 percent predicted increase in annual organic exports.

INTRODUCTION

While industry reports continue to depict double-digit annual growth in the U.S. organic food sector (Daniells, 2014; OTA, 2015a), the outlook on organic trade is not as clear. Based on four years of trade data, a preliminary analysis shows that that U.S organic exports exhibit strong growth in the 2011 to 2014 period while organic import growth is mixed (Jaenicke and Demko, 2015). The Jaenicke and Demko (2015) report is preliminary, however, for a number of reasons. First, the ability to systematically quantify organic trade is relatively new, with U.S. organic export and import data becoming available only since 2011. Second, the number of traded products receiving a "harmonized" trade code, which allows for systematic tracking, has increased since 2011, particularly for imports. This increase can make it more difficult to accurately quantify organic trade growth because apparent growth can come from two sources: an increase in product-specific exports or imports, or an increase in the number of product categories available in the data. Third, policies that promote imports and exports organic trade policies are evolving. For example, in 2009, the U.S. entered into an organic equivalency arrangements with Canada. In 2012, the U.S. entered one with the European Union (E.U.), and in 2014, the U.S. entered one (separately) with Japan and Korea. These arrangements, designed to promote organic trade, allow organic food certified in one country to be labeled and sold as organic in another country without additional inspections or paperwork. In April 2015, the European Commission reaffirmed its commitment to the equivalency arrangement after stating that the 2012 arrangement has been "instrumental in increasing market access for producers, expanding consumer choices, and facilitating regulatory cooperation." (European Commission, 2015). Because both the policies and the data are relatively new, impacts from these organic equivalency arrangements have not been thoroughly established or documented. A 2015 survey of U.S. organic industry participants suggests that most equivalency policies--Canada excepted--are having minimal impact on U.S. organic trade (OTA 2015b). In that survey, participants in the U.S. organic industry were asked to if their exports increased, stayed even, or declined since the implementation of various organic equivalency policies. For the E.U. and Japan arrangements, only 13 percent of survey respondents say the equivalency arrangements increased exports, whereas 87 percent say that that exports either stayed even or that they do not export to the Europe or Japan (OTA 2015b). On the other hand, 43 percent of respondents say that exports to Canada increased. The incompleteness of reports on the policies' impact, coupled with the notion that U.S. domestic supply of organic products is not necessarily keeping pace with strong market growth, suggest that a deeper investigation into organic trade is warranted. In this report, we attempt to quantify the impact of the organic equivalency arrangements on U.S. organic exports and imports using the well-known gravity model of international trade. We generally find that the organic equivalency arrangements, examined collectively as a single policy, have a positive impact on organic exports. However, most of these positive impacts are accruing to the Canada, Japan, and Taiwan arrangements. The E.U. arrangement does not appear to increase U.S. organic exports. The effect of the equivalency arrangements on U.S. imports, however, appears to be sensitive to the data used in the quantitative analysis. Using a 2011-2014 dataset composed of organic imports receiving harmonized codes in 2011, the impact of the E.U. equivalency arrangement is shown to be negative. On the other hand, analysis of a 2013-2014 dataset composed of organic imports with 2013-based product codes shows that the E.U. equivalency arrangements, as well as the Canada and Japan arrangements, have a positive impact on imports. Anecdotally, the impact of Korean arrangement also appears to be strongly positive; however, our estimation results to not include Korea because the equivalency arrangement became effective near the end of our study period. We discuss our findings in more detail below, following some more thorough information about the organic policies, gravity model, and data.

BACKGROUND ON ORGANIC TRADE POLICIES, PATTERNS, AND ANALYSIS

In 2002, regulations originally authorized under the Organic Foods Production Act of 1990 became fully effective, and USDA began implementing a unified set of organic standards that include a USDA Organic seal and labeling requirements. Seven years later, in 2009, the U.S. and Canada signed the first bilateral organic equivalency arrangement. The arrangement means that USDA-accredited products are not required to meet the separate set of Canadian organic standards before being exported to Canada. Similarly, Canadian-certified organic products can be exported to the U.S. without a separate USDA accreditation. Essentially, the equivalency arrangement implies that the two sets of standards are equivalent despite some small differences. After the Canada arrangement, other equivalency arrangements followed. Also, in 2009, Taiwan agreed to treat USDA-certified organic exports as organic in Taiwan without additional certification. This arrangement is not reciprocal, however, meaning that Taiwanese-certified organic projects cannot be imported into the U.S. as organic unless they are also USDA-certified. In February 2012, an equivalency arrangement was signed between the U.S. and E.U., the two largest organic-producers in the world, and became effective on June 1, 2012. The announcement noted that the arrangement would benefit the growing organic industry and support jobs and businesses on a global scale. Product labeling must state the name of the U.S. or E.U. certifying agent, and may use the USDA Organic seal or the E.U. organic logo. Finally, in 2014, the U.S. entered into separate reciprocal organic equivalencies with both Japan and Korea.Systematic data collection on U.S. organic trade began in 2011 after harmonized system trade codes were added for some organic products. The U.S. International Trade Commission publishes and maintains the U.S. Harmonized Tariff Schedule, which serves as the statistical reference point for trade data. The structure of the tariff schedule is based on the international Harmonized Commodity Description and Coding System (HS), administered by the World Customs Organization in Brussels. New code requests can be submitted to the Office of Tariff Affairs and Trade Agreements of the U.S. International Trade Commission. However, the granting of a new code generally requires $1 million in annual U.S. trade and multiple trading partners.As of August 2015, there are 34 export and 40 import HS codes. In 2011, however, the USDA GATS contained export data for only 23 different organic products and import data for 20 organic products with HS codes. Table 1 lists these products. In dollar value, organic apples, lettuce, grapes, spinach and strawberries are the top five organic exports; organic coffee and soybeans are the top organic imports. The full set of USDA-GATS HS-coded export data covers organic products representing over $550 million in exports for 2014. Because very few export codes have been added since 2011, this figure is quite close to the $412 million in organic exports represented by the original 23 organic codes from 2011. On the other hand, the full set of USDA-GATS import data represents over $1.3 billion in imports for 2014 and covers 40 organic HS codes. This figure is much larger than the $668 million in organic imports corresponding to the 20 original organic HS codes from 2011.Organic trade analysts therefore face a dilemma when investigating organic imports: one could use the full set of HS codes, including newly added codes, thus covering many more products, or one could use the set of codes available in 2011 and investigate a static set of products. While the first option leads to a much larger set of observations on organic imports, it may generate the appearance in trade growth that is actually due to a growth in HS codes. This “false growth” problem might, in fact, be exacerbated if the newly added HS codes reflect products more likely to be traded by countries that have organic equivalency arrangements. In other words, if the newer HS codes correspond to products more intensively traded by Canada, the E.U., Japan, and/or Korean, then it might appear that the organic equivalency policies are generating growth in organic trade when, in fact, the apparent growth would be due (mostly) to the addition of new codes.

Table 1: Organic Export and Imports with HS Codes

ORGANIC EXPORTS (2011 PRODUCTS)	ORGANIC IMPORTS (2011 PRODUCTS)	ORGANIC IMPORTS (2013 PRODUCTS)
1. Apples	1. Apples >22Cents/Kg	1. Almonds
2. Broccoli	2. Avocado, Hass-like	2. Apples
3. Carrots	3. Bell Peppers Other	3. Avocado-Hass-like
4. Cauliflower	4. Bell Peppers Greenhouse	4. Bananas
5. Celery	5. Black Tea Ferm Bag<3Kg	5. Bell Peppers Other
6. Cherries	6. Coffee Arabica	6. Bell Peppers Greenhouse
7. Cherry Tomato	7. Coffee Not Roasted Decaf	7. Black Tea Ferm Bag<3Kg
8. Coffee Roast Not Decaf	8. Coffee Not Roasted Not Decaf Other	8. Coffee Arabica Not Roasted Not Decaf
9. Cult Blueberries	9. Coffee Roasted Decaf <2kg	9. Coffee Not Roasted Decaf
10. Grapes	10. Coffee Roasted Not Decaf <2kg	10. Coffee Not Roasted Not Decaf Other
11. Head Lettuce	11. Coffee Roasted Not Decaf Other	11. Coffee Roasted Decaf <2K
12. Lemons	12.Cultivated Blueberries	12. Coffee Roasted Not Decaf <2Kg
13. Lettuce Not Head	13. Durum Wheat Not Seed	13. Coffee Roasted Not Decaf Other
14. Onion Sets	14. Green Tea Flavored<3K	14. Cultivated Blueberries
15. Oranges	15. Green Tea Not Flavored Other	15. Durum Wheat Not Seed
16. Pears	16. Green Tea Not Flavored<3K	16. Extra Virgin Olive Oil, <18Kg
17. Peppers	17. Pears, 4/1-6/30	17. Extra Virgin Olive Oil, >=18Kg
18. Potatoes	18. Pears, Other Time	18. Flaxseed
19. Roma Plum Tomato	19. Rice	19. Garlic
20. Spinach	20. Soybeans Except Seed	20. Ginger
21. Strawberries		21. Green Tea Flavored<3K
22. Tomato Other		22. Green Tea Not Flavored Other
23. Tomato Sauce		23. Green Tea Not Flavored<3K
		24. Honey
		25. Mangoes Fresh 6/1-8/31
		26. Mangoes Fresh 9/1-5/31
		27. Olive Oil, 18Kg Or Over
		28. Olive Oil, Under 18Kg
		29. Pears Fresh 4/1-6/30
		30. Pears Fresh Other Time
		31. Quinces Fresh 4/1-6/30
		32. Quinces Fresh 7/1-3/3
		33. Rice Semi/Whole Milled
		34. Soybeans Except Seed
		35. Virgin Olive Oil, <18Kg
		36. Virgin Olive Oil, >=18Kg
		37. Wine, Red; >$1.05/L; <14%; <2L
		38. Wine, Sparkling; >$1.59/L
		39. Wine, White; >$1.50/L; <14%; <2L
		40. Yellow Dent Corn, Except Seed

In this report, we construct the data to ensure that measured policy impacts are actually from the policies and not an artifact of the data collection. For organic exports where the HS codes do not change much after 2011, we use data corresponding to the 23 product codes that are present in 2011. For organic imports, however, the situation is drastically different because of the substantial addition of HS codes in 2013. Therefore, for imports, we undertake two separate analyses: The first one only uses data corresponding to the 20 HS codes that were available from 2011 on, and we use four years of these data. The second analysis uses data corresponding to the 40 HS codes that were available from 2013 on, but we use data only from 2013 and 2014.

Before the data based on the HS codes are presented, one very important caveat needs to be made clear. U.S. organic trade data with HS codes represent only a fraction of all organic trade. In other words, just because a product does not have an HS code does not mean there is no organic trade in that product. Furthermore, when the discussion below refers to small or no increases in organic imports, it refers to small or no increases in organic imports that have HS codes. Lastly, a particular product may not have a code for several reasons, including but not limited to the following: (i) trade in that product may fall under a $1 million threshold, (ii) the number of exporters or importers may be sufficiently small that HS codes are withheld for confidentiality concerns, or (iii) no one has yet gone through the complicated process of petitioning for a HS code in a particular product.

Based on data generated with the original 2011 HS codes and with the above caveat firmly in mind, Figures 1 and 2 present organic export and import data, respectively, for world regions and some individual countries that have particular trade or organic equivalency policies. Figure 1 shows that Canada and Mexico, the U.S.'s two NAFTA partners, dominate organic exports from the U.S. It also shows that exports to these two NAFTA partners increased from 2011 to 2014, Mexico in particular. For countries with organic equivalency arrangements, organic exports increased to Canada, the E.U., and Korea, but decreased to Japan and Taiwan between 2011 and 2014. Figure 2 shows that Asia and South America are the two primary originating regions for U.S. organic imports. No country with an organic equivalency arrangement saw an increase in organic imports with HS codes from 2011 to 2014. Imports from Canada, the E.U., and Japan decreased, while imports from Korea were zero both years. Figure 3, which is generated using 40 HS codes and 2013-2014 data, presents a different picture of U.S. organic imports than Figure 2. In Figure 3, imports from the E.U. make up a much larger portion of total imports. This noticeable difference stems mostly from the type of HS codes added in 2013. Newly added HS import codes include those for olive oil and wine, two general products with a strong E.U. presence.The data in Figures 1 and 2 (or 3) provide a fairly naïve examination of how the organic equivalency arrangements affected U.S. organic exports and imports. A more systematic and thorough analysis would do a better job accounting for the timing of the organic equivalency

Figure 1: Destination Countries and U.S. Organic Exports, 2011 Product Codes (Millions of Dollars)

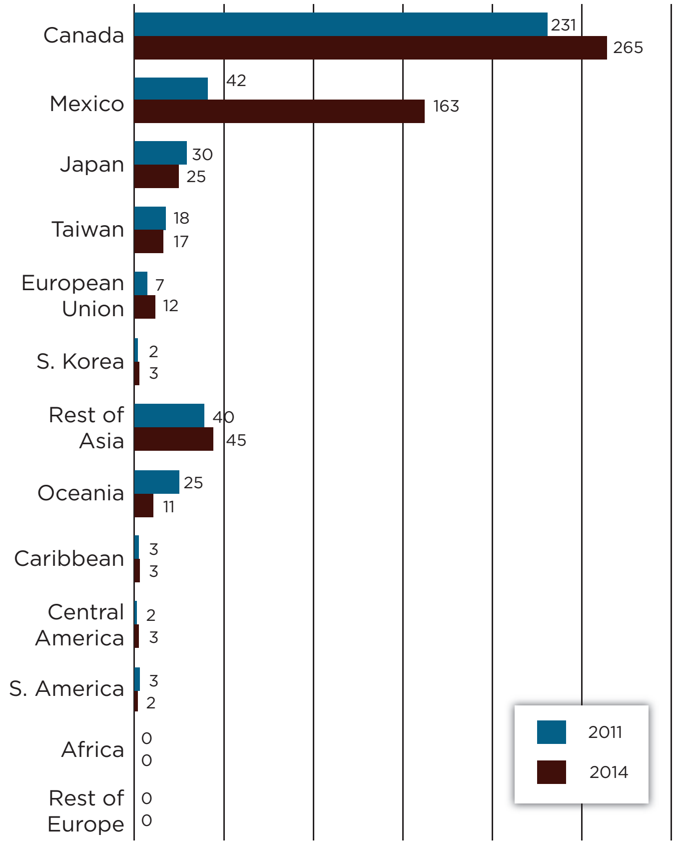


Figure 2: Countries of Origin and U.S. Organic Imports, 2011 Product Codes (Millions of Dollars)

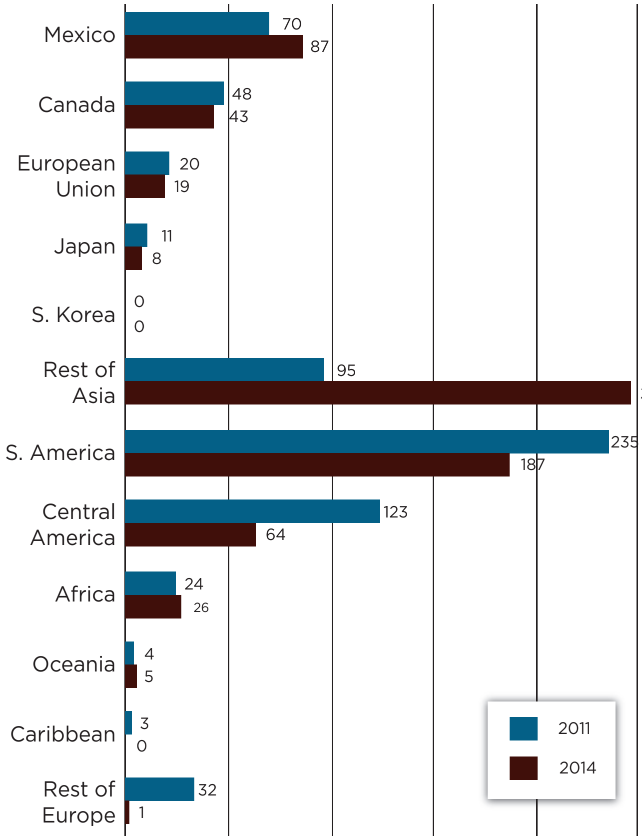
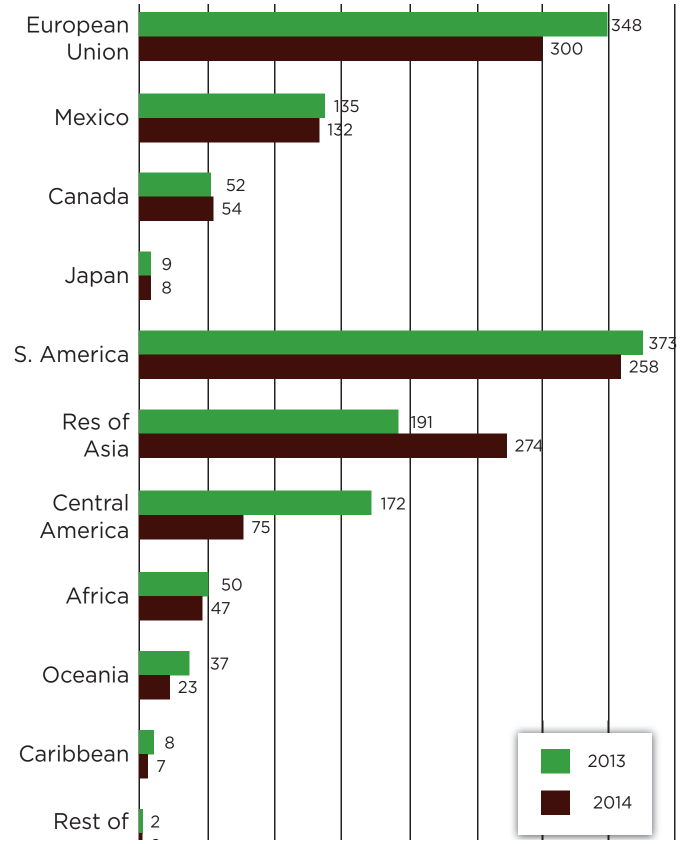


Figure 3: Countries of Origin and U.S. Organic Imports, 2013 Product Codes (Millions of Dollars)



arrangements as well as accounting or controlling for some other facts that might have led to changes in trade levels. The so-called gravity model of trade provides one method for systematically investigating the role that trade policies play in influencing trade while simultaneously accounting for other economic factors.The gravity model was first introduced to empirical trade research by Tinbergen in 1962. For nearly a half century, it has been used to explain econometrically the post effects of trade-related policies. The gravity model postulates that the volume of trade between countries is proportional to their gross domestic product (GDP) and is inversely related to trade barriers between them. Anderson and Van Wincoop (2003) developed the most famous theoretically grounded gravity model in the applied literature. It captures the fact that changes in trade costs on one bilateral route can affect trade flows on all other routes because of relative price effects.

Contrary to the computable general equilibrium (CGE) models used in examining changes in trade policy prior to implementation, the gravity model provides a nice framework for considering the trade policy after it has taken place. It can be augmented with many different measures of trade harmonization such as the number of regulations in an industry, the number of printed pages of a regulation, export-weighted coverage ratio of regulations (Frahan and Vancauteren, 2006). In Otsuki et al. (2001), the maximum allowable aflatoxin levels were used as the measure of the severity of standards on trade flows of African groundnuts.

Frahan and Vancauteren (2006) show that harmonization of food regulations within the E.U. has increased trade between member countries, while Otsuki et al. (2001) emphasize the negative effect it had on the level of trade with non-members, mostly developing countries. Anders and Caswell (2009) and Tran et al. (2011) confirm the negative role of seafood safety regulations in the U.S. on exports, especially from developing countries. Interestingly, Peterson et al. (2013) show that the negative role of sanitary and phytosanitary regulations on international trade of fresh produce diminishes as exporters accumulate experience, and vanishes at a certain threshold.

Not many researchers have investigated organic imports or exports. Blobaum (2010) underlines that foods imported into the U.S. generally are products that cannot be grown in the country such as tea, coffee, cocoa, off-season fruits and vegetables, special products such as flavorings used as ingredients, products that have established good reputation, and products that are not grown in large enough quantities. Jaenicke et al. (2011) show that the levels of organic imports are interrelated with the expansion of retailers' organic private labels products, which can be explained by potentially lower prices of organic imports and the year-round availability of supplies. Imported organic products are cheaper but they move the environmental and the social benefits of organic production outside the U.S. borders (Blobaum, 2009). Even though foreign producers from developing countries face the cost and complexity of organic certification to enter the international market (Barrett et al., 2002; Xie et al., 2010), they may have comparative advantage in the U.S. market because of the lower farm labor costs and support from their governments (Greene et al., 2009; Behar, 2014).

Although global organic market growth is consumer led, some consumers argue that the act of importing organic food is counterintuitive to the intentions of organic production (Oberholtzer et al., 2012), and want the definition of organic to include limits on the distances product can travel (Sawyer et al., 2009). Bernzen and Braun (2014) emphasize the particular role of uncertainties faced by firms importing organic food from countries with different legal and regulatory systems. To meet organic integrity concerns both domestically and globally, USDA policy specifies that all certified organic farms could undergo a surprise audit each year and this happens regularly around the world and in the U.S.

Canavari and Cantore (2010) apply the gravity analysis to trade between Italy and other non-EU countries using the equivalence of the organic standards to approximate affinity of countries. During the time span of their analysis, the European Union had organic equivalency arrangements with eight countries: Australia, Argentina, Costa Rica, Hungary, New Zealand, Czech Republic, Switzerland and Israel. However, they were not able to distinguish the effects specifically on organic trade because the dataset used did not track organic and non-organic food separately.

Kristiansen (2014) presented the first and possibly only application of the gravity model using the USDA-GATS organic trade data. However, her analysis is limited to the import of organic corn, wheat and soybeans into the U.S., and did not show any effect of the organic equivalency arrangement on organic imports. Indeed, the binary variable for the equivalency arrangement captures a range of other country-pair-specific effects contemporaneous with equivalency policies as noted in Cardamone (2011).

AN ECONOMETRIC GRAVITY MODEL OF ORGANIC TRADE

Mimicking the law of gravity in basic physics, the gravity model of international trade says that trade flows between two counties are proportional to the product of the two counties' economic mass divided by the distance between the two countries. We translate economic mass empirically to nominal GDP per capita (GDP per cap) using current prices, and distance is measured in kilometers (km) from capital to capital. Goods do not move across borders without cost, however. In addition to distance, we include other trade-cost observables: (a) indicator variables for our two NAFTA partners, Canada and Mexico (NAFTA), (b) indicator variables for countries entirely in the southern hemisphere and therefore having opposite growing seasons (SouthernHem), and (c) indicator variables for countries that have English as their official language (English). The NAFTA variable is included to capture the ability of products to easily flow across North American boards; the SouthernHem variable is included to capture the impact of potential cost differences of exporting or importing out-of-season products between North and South rather than within the same hemisphere; and the English variable is included to capture potential lower costs of conducting trade between countries with the same official language. The focus of our investigation is the policy impacts of organic equivalency arrangements, so we also add indicator variables if trade occurs with a country having an organic equivalency arrangement within the effective time period (Policy). Because we use annual data, we have the E.U. policy being effective in 2013 and 2014, and the Japan policy effective in 2014. Finally, because our data represent trade with the U.S. we need only to include the GDP per capita of the target country, not the U.S.

For each organic product exported or imported, the basic gravity model can be written as follows:

$$\log(X_i) = \alpha + \beta_1 \log(GDP\ per\ cap_i) + \beta_2 \log(km_i) + \gamma\ Policy_i + \delta_1\ NAFTA_i + \delta_2\ English_i + \delta_3\ SouthernHem_i + \delta_4\ FE_i + \varepsilon_i$$

where X_i denotes U.S. exports of a particular product to (or imports from) country i, FEi represents year-specific and product-specific fixed effects, and **ε**i is a random error term.

For both U.S. organic exports and imports, we estimate several alternative versions of this model. One set of alternatives varies by how "zeros" are handled. If organic exports (or imports) to country i equal zero, note that the log of exports is undefined. One version simply drops observations with zeros and uses ordinary least squares (OLS); an alternative version uses a count-data model and estimates the gravity model, zeros included, as a negative binomial. Most academic studies that encounter the "zero problem" choose to include the zeros and estimate the model as a count-data model. In our case, as explained in the technical appendix, we use a negative binomial model to accommodate zeros. The main reason for this choice is that dropping time periods with zero exports (or imports) can bias the results, especially if the policy causes exports of a specific product to a particular country to rise from zero to some positive level. Therefore, estimation results from our negative binomial model version are preferred, though we include our OLS estimation for completeness.

A second set of alternatives varies by how Policy is specified. One version treats all organic equivalency arrangements identically and has a single policy variable for any arrangement in effect; an alternative version includes a separate policy variable for each effective organic equivalency arrangement.

Finally, for organic imports only, one last set of alternatives varies according to the dataset used. One version uses 2011-2014 data featuring the original 2011 HS organic import codes; an alternative version uses 2013-2014 data featuring HS organic codes available as of 2013. In all, four versions of the model are estimated for U.S. organic exports and eight versions are estimated for U.S. organic imports.

ORGANIC EQUIVALENCY POLICY IMPACTS AND OTHER RESULTS

The full set of estimation results from all versions of the gravity model of U.S. organic exports and imports are found in the technical appendix (see Tables A.1-3). However, in this section, we summarize the results related to policy impacts stemming from organic equivalency arrangements.

Exports: For annual organic exports, Table 2 presents the impact of the policy variable for the four versions of the gravity model. The percentage-change calculations are found by using the estimated model results and comparing the predicted annual exports with and without the policy variable in place.

Table 2: Predicted Change in Annual Organic Exports Due to Organic Equivalency Policies

	MODEL VERSION			
Policy variable:	(1) OLS zeros dropped	(2) Negative Binomial zeros included	(3) OLS zeros dropped	(4) Negative Binomial zeros included
Equiv Policy – Any	+138%	+57.5%		
E.U. Equiv Policy			+6.6%#	-0.3%#
Canada Equiv Policy			+1,102.2%	+454.6%
Japan Equiv Policy			+253.3%	+219.7%
Taiwan Export Policy			+237.1%	+211.1%

Note: # denotes that the estimated coefficient is not significantly different from zero.

The results presented in Table 2 lead to two strong conclusions:

- First, when examined collectively as a single policy, the organic equivalency arrangements do in fact have a strong positive impact on organic exports. The negative binomial model (Model 2) predicts a 58% increase in annual exports due to an equivalency policy as compared to a non-policy baseline.
- However, the second result, drawn from the last two columns of Table 2, is that the policy impact is not identical across all the particular organic equivalency arrangements. When each policy is included separately, the E.U. equivalency policy has almost no effect. On the other hand, the negative binomial model (Model 4) predicts that the Canadian, Japanese, and Taiwanese policies generate very strong impacts, ranging from 211 to 454 percent increases. The strongest impact comes from the Canada equivalency arrangement, the oldest of the policies.

Imports: For annual organic imports, we present two sets of results. As noted earlier, the number of HS-coded organic imports increased substantially in 2013. The first set of results uses all four years of data, but only products with HS codes going back to 2011. The second set of results uses data from 2013 and 2014, but products with the more expansive set of HS codes available in 2013. Table 3 presents both sets of results.

Table 3: Predicted Change in Annual Organic Imports Due to Organic Equivalency Policies

MODEL VERSION

2011 to 2014 data (2011 HS Codes) Policy variable:	(1) OLS zeros dropped	(2) Negative Binomial zeros included	(3) OLS zeros dropped	(4) Negative Binomial zeros included
Equiv Policy – Any	-3.2%#	-45.3%		
E.U. Equiv Policy			-4.9%#	-60.2%
Canada Equiv Policy			-25.7%#	+64.9%#
Japan Equiv Policy			+641.0%#	+196.4%

2013 to 2014 data (2013 HS Codes) Policy variable:	(1) OLS zeros dropped	(2) Negative Binomial zeros included	(3) OLS zeros dropped	(4) Negative Binomial zeros included
Equiv Policy – Any	+88.7%	+109.7%		
E.U. Equiv Policy			+89.9%	+91.3%
Canada Equiv Policy			+21.9%#	+370.6%
Japan Equiv Policy			+715.8%#	+267.5%

 # denotes that the estimated coefficient is not significantly different from zero.

The results presented in Table 2 lead to three strong conclusions:

- First, the choice of time periods and HS codes substantially affects the results.

  The estimated policy impacts are lower using the 2011-2014 data and the 2011 HS codes. Because the 2013 HS codes were added after the effective date of the E.U. policy (and the Canadian policy), this result suggests that the HS codes added in 2013 include organic products more likely imported from the E.U. and Canada. Using the 2011-2014 data, the negative binomial model (Model 2) predicts that a generic equivalency policy reduces organic imports by 45%. Alternatively, using the 2013-2014 data, the model predicts that a generic policy increases imports by 110%.

- Second, no matter which data are used, the negative binomial model (Model 4) always predicts that the Canadian and Japanese policies lead to large increases in organic annual imports.

  Use of the 2013-2014 data leads to the highest predictions: a 371% increase due to the Canadian policy, and a 267% increase due to the Japanese policy.

- Third, the predicted impact of the E.U. policy crucially depends on which data set is employed.

  Using the 2011-2014 data with the 2011 HS codes, Model 4 predicts the E.U. policy decreases organic imports into the U.S. by 60%. On the other hand, using the 2013-2014 data with the 2013 HS codes, Model 4 predicts the E.U. policy increases organic imports into the U.S. by 91%.

The reason why this discrepancy appears to be so large for the E.U. is partially explained using a hypothetical scenario. Suppose the 2011 HS codes centered on products such as coffee or tea that were not commonly imported from Europe. An E.U. equivalency policy would not be expected to have much impact on the import of these types of products. On the other hand, suppose the 2013 HS codes included many more products such as wine and olive oil that were commonly imported from Europe. Now, an E.U. policy might be expected to have a much more positive effect on the import of these types of products. Finally, if one looks at the list of HS codes in Table 1 along with the organic import levels by country of origin in Tables 2 and 3, one sees that this hypothetical scenario is not so far-fetched.

CONCLUSIONS AND NEXT STEPS

To our knowledge, this gravity model-based research provides the first case of documented impacts by U.S.-partnered organic equivalency arrangements on the levels of U.S. organic exports and imports. After applying the gravity model of trade to new data on U.S. exports and imports of organic products, we draw five main conclusions:

(i) Results from gravity models of U.S. organic exports and imports often show that organic equivalency policies positively affect the level of trade.

(ii) These positive effects are found most consistently for U.S. organic exports.

(iii) The positive effects are often (but not always) found to be robust to how "zeros" are handled the data, where one option is to drop them and another option is to use a count-data model.

(iv) The Canada organic equivalency arrangement, the oldest of the equivalency arrangements, has the strongest effect on U.S. organic exports.

(v) Estimated policy impacts on U.S. organic imports are sensitive to choices of which HS product codes to focus on. In one case, a longer time period with fewer HS codes shows a negative policy impact on U.S. organic imports; alternatively, a shorter time period with many more HS codes generally shows a positive policy impact on U.S. organic imports.

Before the above conclusions can be considered definitive, a number of limitations and unanswered questions should be addressed with follow-up research. First, the gravity model's economic mass and distance variables sometimes but not always perform as expected, a result that suggests additional robustness checks on the choice of variables would be useful. It is possible that some unexplored variation or combination of GDP, population, and distance might perform better than specifying these as the log of GDP per capita and the log of kilometers between countries' capitals. Second, given conclusion (v) above, additional robustness checks on the inclusion or exclusion of particular HS codes and/or data years should be explored to better understand why some organic import models lead to positive estimated policy impacts while other models lead to negative estimated policy impacts.

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APPENDIX A: TECHNICAL DETAILS AND FULL ESTIMATION RESULTS FROM THE GRAVITY MODEL

Recall that the basic gravity model can be written as follows:

$$\log(X_i) = \alpha + \beta_1 \log(\text{GDP per cap}_i) + \beta_2 \log(km_i) + \gamma\ Policy_i$$
$$+ \delta_1\ NAFTA_i + \delta_2\ English_i + \delta_3\ SouthernHem_i + \delta_4\ FE_i + \varepsilon_i$$

where Xi denotes U.S. exports to (or imports from) country i, and all other terms are explained in the main section of this report. In addition to the variables identified above, the gravity model also includes FEi, a wide range of indicator variables to control for year-specific and product-specific effects. By including these "fixed effects," unexpected shocks of a temporal or product-specific nature will not be included in the predicted impacts of the policy variable. Tables A1 and A2 present the complete set of results for the gravity model estimated first with export data (Table A1) and then import data (Table A2).

A Note on Handling Observations with Zero Exports (Or Imports):

The prevalence of zeroes in trade data rises with the data disaggregated at the product level and presents an econometric issue. If organic exports (or imports) to country i equal zero, note that the log of exports is undefined. One version of the estimated model presented here simply drops observations with zeros and uses ordinary least squares (OLS). An organic export dataset used in this study contains 42% of zero observations, a 2011-2014 organic import dataset contains 36% of zeros, and a 2013-2014 organic import dataset has 32% zeros. These zeros arise mainly because the data are at the product level resulting in inactive trade flows between the U.S. and some countries. Because the OLS estimator does not account for the observations with values equal to zero and can produce biased estimates, it has been subject to criticism from an econometric point of view.

Santos Silva and Tenreyro (2006) accommodate zeros into the model using the Poisson maximum-likelihood estimator. Even though the Poisson is more commonly used as an estimator for count data models, it is appropriate to apply it far more generally to nonlinear models such as the gravity model. Sun and Reed (2010) analyze the impact of the most important free trade agreements on agricultural trade using a Poisson estimator.

In the presence of unobserved heterogeneity not taken into account by the Poisson regression model, the variation of the dependent variable (organic export/imports) is greater than that of a true Poisson. This extra variation is referred to as "overdispersion.". As emphasized by Burger et al. (2009), the Poisson models only account for observed heterogeneity. , and tTo correct for overdispersion, econometricians most frequently employ a negative binomial regression model (modified Poisson model) instead of a standard Poisson model.

A coefficient that measures overdispersion enters the negative binomial model separately, and it has shown to be statistically significant in each regression we estimated. Thus, we may conclude that the negative binomial model fits our data better than the Poisson.

One more alternative also used to accommodate zeros in the trade models is the sample selection correction introduced by Heckman (1979) where two decisions are modeled separately: at first, the decision to export/import organic, and at second, the choice of the level of exports/imports. Haq et al. (2013) uses Heckman selection to estimate bilateral trade flows for a big set of agrifood products. The main challenge in applying the Heckman selection is the need to find at least one variable that affects the probability that two countries engage in trade, but not the volume of such trade once it takes place (, Shepherd, (2013).

To summarize, dropping time periods with zero exports (or imports) can bias the results, especially if the policy causes exports of a specific product to a particular country to rise from zero to some positive level. Therefore, estimation results from our negative binomial model are preferred, though we include our OLS estimation for completeness.

Exports: Table A.1 presents the estimation results from four versions of the gravity model of U.S. organic exports using 2011 to 2014 data. Columns (1) and (2) show results where organic equivalency arrangements are treated identically for each policy-affected country, while columns (3) and (4) show results where each organic equivalency policy is considered separately. Columns (1) and (3) show results from the ordinary least squares regression of the log of organic exports, thereby dropping any observation that has zero exports, while columns (2) and (4) show results from a negative binomial regression.

The main body of the report discusses predictions based on coefficient estimates for *Equiv Policy – Any* in Models 1 and 2, and for *E.U. Equiv Policy, Canada Equiv Policy, Japan Equiv Policy,* and *Taiwan Export Policy* in Models 3 and 4.

Table A1: Gravity Model Results – Organic Exports (2011–2014)

Dependent variable: Ln (Exports) Independent variable:	(1) OLS zeros dropped	(2) Negative Binomial zeros included	(3) OLS zeros dropped	(4) Negative Binomial zeros included
Ln (GDP per cap)	0.2077***	0.3969***	0.1619***	0.3756***
Ln (km)	0.66277***	0.9936***	0.7809***	1.0604***
Equiv Policy – Any	0.8681***	0.4540**		
E.U. Equiv Policy			0.0640	-0.0025
Canada Equiv Policy			2.4868***	1.7130***
Japan Equiv Policy			1.2621**	1.1622**
Taiwan Export Policy			1.2152***	1.1351***
NAFTA	4.4446***	5.7664***	3.8184***	5.1180***
English	0.3740***	0.3780**	0.2423**	0.3537***
Southern Hem	-0.0781	-0.5443***	-0.1111	-0.5778***
Constant	1.5963*	1.3755	0.0611	0.6012
2012	-0.03199	-0.0925	-0.0272	-0.0800
2013	-0.1028	-0.2080	0.0014	-0.1317
2014	-0.0326	0.0608	-0.081	0.0288
Product Fixed Effects	Yes	Yes	Yes	Yes
No. of Obs	1388	2372	1388	2372

Notes: Significance levels based on robust standard errors.

**** = statistically significant at 99% level; ** = 95%; * = 90%*

As shown in Table A1, all Ln (GNP per cap) coefficients are positive and significant. These results are in line with standard gravity model results that say more economic mass leads to more trade. The Ln(km) coefficients are unexpectedly positive, however. These results say that a greater distance between trading partners leads to more U.S. exports. These results might make economic sense for some specialized exports, which could be the case with our example of organic exports. The NAFTA coefficient is always positive and significant, meaning the NAFTA free trade agreement has a powerful positive effect on organic exports (to Canada and Mexico). The English language coefficient is also positive as expected. The Southern Hem coefficient is always negative and significant for the two negative binomial estimations in columns (2) and (4). This result implies that U.S. exports of organic agricultural products to the southern hemisphere are less likely than to countries in the northern hemisphere or countries that straddle the equator.

Imports: Table A.2 presents results from eight versions of the gravity model of U.S. organic imports. Columns (1) through (4) present results using 2011 to 2014 data, with products limited to only those that had a HS code in 2011. Alternatively columns (5) through (8) present results using 2013-2014 data with 2013 HS codes. Columns (1), (2), (5), and (6) show results where organic equivalency arrangements are treated identically for each policy-affected country, while columns (3), (4), (7), and (8) show results where each organic equivalency policy is considered separately. Finally, odd-numbered columns show results from the ordinary least squares (OLS), while even-numbered columns show results from a negative binomial regression.

Examining results from all eight columns, Ln(GDP per cap) performs as expected, positive and significant, only in columns (2) and (4), the negative binomial model using data based on 2011 HS codes. Distance, measured as Ln(km), never performs as expected. In this model, distance between countries has no statistical impact on U.S. organic imports. Results for the NAFTA variable shows the free trade agreement has a strong positive impact on U.S. organic imports, just as it did for exports. English, surprisingly, is found to have a negative impact on U.S. organic imports. No explanation from previous literature seems to explain this result. Results for the Southern Hem variable, however, do make economic sense: the U.S. imports more organic products from the southern hemisphere. The reason for the statistically significant negative sign is likely due to seasonality, or more accurately reverse seasonality, for imported agricultural products coming from the southern hemisphere.

Table A2: Gravity Model Results – Organic Imports

	2011-2014 Data Products with 2011 Codes				2013-2014 Data Products with 2013 Codes			
Dependent variable: Ln (Exports) Independent variable:	(1) OLS zeros dropped	(2) Negative Binomial zeros included	(3) OLS zeros dropped	(4) Negative Binomial zeros included	(5) OLS zeros dropped	(6) Negative Binomial zeros included	(7) OLS zeros dropped	(8) Negative Binomial zeros included
Ln (GDP per cap)	-0.0458	0.1981**	-0.04775	0.2095**	-0.2388	0.0148	-0.0263	0.0160
Ln (km)	-0.0832	0.0288	-0.1222	0.1173	0.1866	0.1391	0.1167	0.2326
Equiv Policy – Any	-0.0328	-0.6041**			0.6349***	0.7404***		
E.U. Equiv Policy			-0.0502	-0.9222***			0.6413***	0.6486**
Canada Equiv Policy			-0.2972	0.500			0.1984	1.5488**
Japan Equiv Policy			2.0028	1.0866*			2.0990	1.3016*
NAFTA	1.6645***	2.1895***	1.7420***	1.5698***	1.4021***	2.0352***	1.5116***	1.7169***
English	-0.8289***	-0.6789***	-0.7801***	-0.7575***	-0.9792***	-1.0022***	-0.9046***	-1.1050***
Southern Hem	1.0687***	0.7689***	1.0712***	0.7275***	1.3535***	0.9911***	1.3554***	0.9370***
Constant	7.0708***	9.5068***	7.4036***	8.8490***	5.5839***	7.4460***	6.1670***	6.7336***
2012	-0.2889	-0.4883	-0.2865	-0.4880				
2013	-0.0922	-0.2225	-0.0865	-0.1611				
2014	0.0356	-0.1832	0.0140	-0.1675	0.0620	-0.1302	0.0515	-0.1348
Product Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs	948	1485	948	1485	871	1279	871	1279

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