# Estimating the Impact of Organic Equivalency Agreements on U.S. Agricultural Trade

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**Abstract:**

This study uses new organic import/export data to test the hypothesis that a 2012 organic certification equivalency agreement between the European Union and the United States positively influenced U.S. trade of organic agricultural commodities. Using a difference-in-difference approach, we find that the likelihood of exporting any level of organic products to a particular E.U. country increased due to the agreement, as did the share of organic exports to the E.U. We intend to estimate the effect on organic imports from the E.U. in a similar way.

**Keywords:** organic equivalency agreement, organic export, organic import

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## I. INTRODUCTION

The organic industry in the U.S. is the fastest growing sector of the food system. The Organic Trade Association reports that since 2010 the growth rate of organic food sales has averaged almost 10 percent every year, which is more than three times the average annual growth of total food sales during that same period. However, according to some USDA-Economic Research Service reports, domestic organic production is not keeping pace with organic demand. As a result, many food retailers are turning to imported organic food products to make up the difference.

Recently, a number of trade-related policies have been adopted that are designed to make organic trade easier. In 2014, the United States signed an organic equivalence arrangement with Japan and South Korea, and now certified organic products can move freely between these countries. In 2009, Taiwan also recognized the U.S. National Organic Program, which allows USDA organic products to be sold as organic in Taiwan. The first organic equivalence arrangement, between the U.S. and Canada, was signed in 2009, and one between the U.S. and the European Union followed in 2012. Under these bilateral equivalency agreements, food certified as organic in one country can immediately be called organic by the agreement partner. Without an equivalency agreement, organic food imported into the U.S. has to follow the USDA organic regulations and it has to be certified by an agency approved by the USDA.

While it makes logical sense that the new organic equivalency agreements have had and will have a positive effect on organic trade, demonstrating this impact has been difficult because of the lack of trade data that specifically identifies organic food. In April 2015, the European Commission reviewed the E.U.-U.S. organic equivalency agreement and claimed that it had been instrumental in “increasing market access for producers, expanding consumer choices, and facilitating regulatory cooperation”. Our goal is to found if this strong statement can be backed up with rigorous quantitative analysis.

## II. LITERATURE REVIEW

This work builds on a preliminary analysis of USDA's organic trade patterns that showed strong growth in organic exports as well as for some import product categories (Jaenicke and Demko, 2015). During the 2011-2014 period, Jaenicke and Demko (2015) find that 17 out of 22 organic export products show statistically significant, positive annual growth rates that range from 41% for organic apples to 6% for carrots.

More generally, 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 include limits on the distances product can travel (Sawyer et al., 2009). Meeting the growing concerns about the integrity of organic imports, the USDA's National Organic Program has announced the surprise visits to organic farming and processing operations in China in order to check the records of several of the USDA-accredited certifiers operating there (Blobaum, 2010).

To our knowledge, only two other studies have attempted to investigate the impact of organic agreements or policies on trade. Canavari and Cantore (2010) use a gravity model to analyze trade between Italy and other non-E.U. countries using the equivalence of the organic standards to approximate affinity of countries. During the time span of their analysis, the E.U. had organic equivalency agreements with eight countries: Australia, Argentina, Costa Rica, Hungary, New Zealand, Czech Republic, Switzerland and Israel. However, Canavari and Cantore (2010) were not able to distinguish the effects specifically on organic trade because the dataset used did not track organic and nonorganic food separately. Kristiansen (2014) gathered newly available data on U.S. organic imports and estimated a gravity model for organic corn, wheat and soybeans, but did not find any effect of the agreement.

Our study investigates the impact of the organic equivalency agreement between the European Union and the United States. Because the data are available at the monthly level starting in 2011, and because the E.U.-U.S. agreement was signed afterwards in February 2012, we use a difference-in-difference (DD) approach to estimate the impact of the agreement on exports by comparing the change in exports to the policy-affected E.U. countries to the change in exports to a set of countries that serve as a control group. When necessary, we exclude exports to Canada, Taiwan, Japan, and South Korea from the control group to isolate the effect of the E.U. equivalency agreement from other "treated" countries. Our study focuses on the top eight organic export products and uses monthly USDA data from January 2011 to March 2015 available from the USDA-Foreign Agricultural Service's Global Agricultural Trade System (GATS). We also collect data on these products' non-organic export counterparts.[1] We construct two trade-related variables of interest: the organic share of total organic and non-organic exports to investigate the intensive margin of organic trade, and the probability of exporting organic to investigate the extensive margin of organic trade. Preliminary results do in fact suggest a strong positive impact on U.S. organic exports. We find that the organic equivalency policy the U.S. has with the E.U. strongly affects both the share of organic exports relative to total exports and the likelihood of exporting any level of organic products to a particular country. We also find that the agreement causes a slight decrease in organic export price and increase in organic import price. To investigate the effect of the agreement further, we intend to analyze the intensive and extensive margin of organic imports to the U.S.

[1] Appendix C (Table C.1 and C.2) includes Organic and Non-Organic Export/Import Code Correspondences found in the USDA GATS data

## III. DATA

The U.S. International Trade Commission publishes and maintains the U.S. Harmonized Tariff Schedule, which serves as the statistical reference for trade data. Organic products first appeared with Harmonized Tariff Schedule codes in 2011, and new codes were added in subsequent years. In 2011, the USDA GATS contained export data for 23 different organic products and import data for 10 different aggregated organic products with HS codes.[2]

Note that the organic export and import figures do not capture all international trade for organic products. Instead, the data presented here represent only the portion of trade recorded by the U.S. government through the Harmonized Tariff Schedule System. An application must be submitted to the Office of Tariff Affairs and Trade Agreements of the U.S. International Trade Commission to grant a new code; it also requires $1 million in annual U.S. trade and multiple trading partners. As a matter of fact, the USDA GATS data mostly track organic export products representing fresh produce while most of the organic import products represent processed goods.

### III.1. Organic Export to the E.U. and Rest of the World

The USDA GATS data cover organic products representing over $550 million in exports from the United States for 2014. This figure compares to more than $5.9 billion in non-organic exports for the same 26 products. More generally, the USDA reports that all agricultural exports were valued at $150.5 billion in 2014. In dollar value, organic apples ($116 million in 2014), lettuce ($73 million in 2014), grapes ($64 million in 2014) are the top three organic exports.

The USDA GATS data represent over $12.3 million in exports to the E.U. for 2014. This figure compares to $54.6 million in non-organic exports for the same set of products. In dollar value, organic grapes, apples and strawberries are the top three organic exports to the E.U. In fact, organic exports to Europe cover only about 2% of total U.S. organic exports, with Canada and Mexico together representing almost 80%.

The share of organic exports relative to total (organic plus non-organic) exports was high in 2014 – 18%; and it has grown from 9% in 2011, increasing by almost 10% throughout the four-year

[2] In this study, a number of the products are so closely related that it makes sense to aggregate them to a single product. For example, red, white, and sparkling wine imports can be aggregated to a single "wine" category.

period. The share of organic exports to other countries (excluding the E.U. countries) was 8%, and has seen only a 1% increase since 2011.

### III.2. Organic Exports by Product

As of January 2015, there are 38 export and 38 import HS codes. However, in 2011, only 13 of 23 available different organic products were traded with the E.U. We analyze export products that have all four years of reported data: grapes, apples, strawberries, coffee, carrots, tomato sauce, and blueberries. These products together cover $12.15 million (99%) in organic exports to the E.U. in 2014, $7.2 million (84%) in 2013, $5.6 million (93%) in 2012, and $3.8 million (55%) in 2011. Lower representation in 2011 is attributable to an incidence of unusually high organic cherry export in 2011, i.e., $3 million or43% of total organic export that year. After 2011, organic cherries were not traded at all with the E.U. in 2012 and 2014, and only $44 thousand of organic cherry were exported in 2013. Organic exports to the E.U. almost doubled during the 2011 to 2014 period: from $7.0 million in 2011 to $12.3 in 2014; while organic exports to all other destinations (excluding the E.U. countries) increased by 34%. Excluding organic cherry exports from total export, organic exports to the E.U. increased by a factor of three during the 2011 to 2014 period, from $4.0 million to $12.3 million; and by 40% to other countries but the European Union.

From 2011 to 2014, all (eight) organic export products except for coffee showed a very strong increase in the values of export. Organic blueberries and organic carrot exports rose dramatically there was a 21-fold increase for blueberries (from $12 thousand to $421 thousand), and a 15-fold increase for carrots (from $59 thousand to $853 thousand). Organic exports of the top products have risen seven fold for strawberries ($2 million in 2014); six fold for grapes ($4.7 million in 2014); and four=fold for apples ($2 million in 2014).

### III.3. Organic Imports from the Rest of World and from the E.U.

Organic products in the USDA GATS data represent over $1.2 billion in imports for 2014. This figure compares to more than $18 billion in non-organic imports for the same 21 products.  More generally, the USDA reports that all agricultural imports were valued at $111.7 billion in 2014. Organic coffee ($332.5 million in 2014), soybeans ($183.6 million in 2014), olive oil ($156.3 million in 2014), bananas ($121.6 million in 2014), and wine ($121.3 million in 2014) are the top organic imports.

The USDA GATS data cover organic products representing over $300 million in imports from the E.U. in 2014. As with organic exports, our empirical analysis discussed in the subsequent section will consider only products that have all four years of reported data. Thus, organic import analysis will cover four aggregated product categories: coffee, tea, rice and bell peppers.

For these products, the share of organic imports relative to total (organic plus non-organic) imports from the E.U. was 6% in 2014 and did not change much over 2011-2014 period. On the other hand, the organic share from origins other than the E.U. has fallen from 7% in 2011 to 5% in 2014.

### III.4. Organic Imports by Product

Organic imports of coffee, tea, rice and bell peppers together were valued at $17.5 million (and had a 6% organic share) in 2014, $14.8 million (4%) in 2013, $14.2 million (93%) in 2012, and $21.0 million (100%) in 2011. Data collection on such highly valued organic imports as wine and olive oil began in 2013, and a very low representation in the last two years echoes this fact. Imports of organic coffee from the E.U., like tea, have fallen. Organic coffee imports dropped from $13.3 million in 2011 to $7 million in 2014 for coffee, and from $5.5 million in 2011 to $4.6 million in 2014 for tea.

Even though organic bell peppers and organic rice import almost tripled, the total value of the four considered products has fallen by 17% ($2.5 million), from $21 million in 2011 to $17.5 million in 2014. At 24%, the drop in the value of non-organic imports was even more larger. While the drop in non-organic tea and coffee correspond to a drop in organic tea and coffee imports, organic bell peppers and rice imports rise and may be substituting non-organic.

To summarize, during 2011-2014 period, the total value of exports to the European Union increased in more than three times for all (eight) organic export products tracked since 2011, while it dropped by 17% for the four organic import products.

## IV. MODELS

### IV.1. Organic and Non-Organic Prices

The USDA GATS data contains monthly information on the total value of imported/exported products along with a unit value and quantity of a traded commodity. The data allow measuring quantity of different products in kilograms representing price of a product as a value of one kilogram of that product. Sometimes, when the unit value information is missing but the reported total value is non-zero, we recover prices by dividing total value by quantity. Prices calculated in this way is comparable but not always identical to those directly available from the USDA GATS data website. We choose to present the results using both calculated and directly available prices for now.

The average non-organic price of export is lower than organic by $0.67 or 14% ($4.89 versus $5.56). The same holds for the average non-organic price of import: $13.85 for non-organic and $16.04 for organic ($2.19 difference or 16%). More details are found in Appendix A. Because coffee and tea are some of the top imports, and because they have a high value per kilogram, the overall prices for imports are higher than exports.

A simple but naïve way to assess the impact of the E.U. equivalency policy would be a "before and after" approach. Based on 51 months (January 2011-March 2015) of export data for eight products, Table 1 compares organic price summary statistics for before-policy and after-policy periods for the top eight organic export products.

**Table 1: Organic Export Price Summary Statistics, $/kg**

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Organic Price Calculated Before Policy | 53 | 5.95 | 5.43 | 0.84 | 25 |
| Organic Price Calculated After Policy | 211 | 5.46 | 6.03 | 0.79 | 29.09 |
| Organic Price Downloaded Before Policy | 53 | 5.94 | 5.43 | 0.8 | 25 |
| Organic Price Downloaded After Policy | 211 | 5.47 | 6.04 | 0.8 | 29.1 |

The E.U.-U.S. agreement was signed in February 2012. The average price of a kilogram of organic exports after this agreement dropped by $0.49 (from $5.95 to $5.46). The agreement makes it easier for foreign organic products to access domestic market, and implies higher competition. Thus, we should expect prices of organic go down. However, this is not true for organic import price. Table 2 summarizes organic import prices for 13 products[3] (6 types of coffee, 4 types of teas, 2 types of bell peppers and 1 type of rice).

**Table 2: Organic Import Price Summary Statistics, $/kg**

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Organic Price Calculated Before Policy | 183 | 14.01 | 11.32 | 0.68 | 60.30 |
| Organic Price Calculated After Policy | 386 | 17.00 | 15.28 | 0.61 | 120.38 |
| Organic Price Downloaded Before Policy | 183 | 14.01 | 11.32 | 0.7 | 60.3 |
| Organic Price Downloaded After Policy | 386 | 17.00 | 15.28 | 0.6 | 120.4 |

After the agreement, the average organic price went up by almost $3, which may be explained with rising domestic demand for organic. Change in trading policy shows different effect on organic prices when assessed in a naïve way. Other non-policy factors could influence the change in organic price. For instance, seasonality, evident in many organic export products (Jaenicke and Demko, 2015), may have an impact. Likewise, organic exports/imports could also be growing even without the policy.

Instead, a more accurate and less naïve policy impact assessment would control for these other factors. Because the data are available at the monthly level starting in 2011, and because the E.U.-U.S. agreement was signed in February 2012, we can use a difference-in-difference (DD) approach. In other words, we can start with (i) a difference measurement based on before- and after-policy prices of U.S. exports/imports to the European Union, but then (ii) subtract out the effect of organic versus non-organic exports/imports prices. Accounting for (i) and (ii), leads to a difference-in-difference (DD) model.

The treatment effect on organic export prices from a DD model can be found with the help of simple regression model:

$$Y_{ijt} = \alpha + \beta_1 DAfter_t + \beta_2 DOrganic_{ij} + \gamma DAfter_t * DOrganic_{ij} + \varepsilon_{ijt} \quad (1)$$

[3] To avoid averaging prices, we use disaggregated products here. In the rest of the paper, two types of bell peppers aggregated to a single “bell peppers” category, four different types of tea - to a single “tea” category and six different types of coffee codes - to a single “coffee” category.

where $Y_{ijt}$ is the price of product $i$ exported from the U.S. to one an E.U. country $j$ in month $t$. $DAfter$ is a dummy variable for the time period $t$ after the E.U. organic equivalency policy was signed (February, 2012) or became effective (June, 2012). $DOrganic$ represents a dummy for organic products; and $\varepsilon$ is a white noise error term.

The coefficient of interest, $\gamma$, measures changes in prices for the treated group (organic export/import) relative to the control group (non-organic export/import). Because the USDA GATS data records different sets of export and import products, we estimate a DD model for import prices separately. We also include controls for country-specific, product-specific, and time (year and quarter) fixed effects.

Table 3 shows estimation results for Model (1) using OLS. The data used is a panel of organic export prices for eight products to fourteen countries over 51 months (from January 2011 through March 2015) matched with non-organic price of the same product to the same country and in the same month. Only matched observations were used in the estimation (not matched observation were dropped for the estimation part).[4]

**Table 3: Policy Impacts from DD Model (1) - Examining Organic Export Prices**

| Coefficients of Interest | Variation 1 – Agreement Signed February 2012 | Variation 2 – Agreement Effective June 2012 | Variation 3 – Dropping 2012 | Variation 4 – Effect over Time |
|---|---|---|---|---|
| | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) |
| γ | - 0.810 (0.682) | 0.116 (0.865) | - 0.071 (0.660) | - |
| γ*year_2012 | - | - | - | - 1.360 (0.966) |
| γ*year_2013 | - | - | - | 0.2441 (0.887) |
| γ*year_2014 | - | - | - | - 0.865 (0.788) |
| γ*year_2015 | - | - | - | - 3.931 (1.185) *** |
| Country Fixed Effects | Y | Y | Y | Y |
| Product Fixed Effects | Y | Y | Y | Y |

[4] Because Price Calculated almost perfectly resembles Price Downloaded (Table 1 and 2), we will report estimation using Price Calculated only; results for Price Downloaded available upon request.

| | | | | |
|---|---|---|---|---|
| Year Fixed Effects | Y | Y | Y | Y |
| Quarter Fixed Effect | Y | Y | Y | Y |
| Number of obs | 528 | 528 | 418 | 528 |
| $R^2$ | 0.60 | 0.60 | 0.62 | 0.60 |

Note: * when p < 0.05, ** when p < 0.01, *** when p < 0.001

We try four variations: Variation (1) looks for policy impacts starting February 2012, the month the agreement was signed; Variation (2) looks for impacts starting June 2012, the month the agreement became effective; in Variation (3) we exclude 2012 as a transition year and in Variation (4) we explore how the effect of the policy changes over time.

The effect of the agreement between the E.U. and U.S. on organic export prices was not statistically different from zero in Variations (1) – (3). Variation (4) shows negative and statistically significant effect only in 2015.

Table 4 shows estimation results for Model (1) applied to import prices using OLS. The data used are a panel of organic import prices for ten disaggregated import products (6 types of coffees, 3 types of teas, and 1 types of bell pepper), from sixteen countries over 51 months from January 2011 through March 2015. We match these organic prices with non-organic prices for the same products from the same country and in the same month. Only matched observations were used in the estimation (not matched observation were dropped for the estimation part).

**Table 4: Policy Impacts from DD Model (1) - Examining Organic Import Price**

| Coefficients of Interest | Variation 1 – Agreement Signed February 2012 | Variation 2 – Agreement Effective June 2012 | Variation 3 – Dropping 2012 | Variation 4 – Effect over Time |
|---|---|---|---|---|
| | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) |
| γ | 3.056 (2.261) | 3.422 (2.031)[#] | 4.094 (2.476)[#] | - |
| γ*year_2012 | - | - | - | 0.339 (3.010) |
| γ*year_2013 | - | - | - | 2.245 (2.464) |
| γ*year_2014 | - | - | - | 6.072 (2.600) ** |
| γ*year_2015 | - | - | - | 4.175 (4.067) |

| | | | | |
|---|---|---|---|---|
| Country Fixed Effects | Y | Y | Y | Y |
| Product Fixed Effects | Y | Y | Y | Y |
| Year Fixed Effects | Y | Y | Y | Y |
| Quarter Fixed Effects | Y | Y | Y | Y |
| Number of obs | 1138 | 1138 | 886 | 1138 |
| $R^2$ | 0.28 | 0.28 | 0.29 | 0.28 |

Notes: * when p < 0.05, ** when p < 0.01, *** when p < 0.001; # - when p $\in$ (0.05-0.1)

We find that the effect of the agreement was positive and statistically significant using Variation (4), which may be explained by a strong reputation for the quality of E.U. organic produce in the United States.

To summarize, using our DD model for export and import prices shows some significant policy impacts resulting from the E.U-U.S. organic equivalency agreement: we have evidence organic export prices decreased while organic import prices increased.

### IV.2. Extensive Margin: Probability of Exporting Organic

We also hypothesize that the probability of exporting organic products to the European Union increased as a result of the equivalency agreement, and we construct a second DD model to investigate this hypothesis. This second model specifies a DD model to investigate this probability by setting up a different control group comparison, a non-E.U. control group. Our Model (2), therefore, is specified in the following manner:

$$P_{ijt} = \alpha + \beta_1 DAfter_t + \beta_2 DEU_{ij} + \gamma DAfter_t * DEU_{ij} + \varepsilon_{ijt} \qquad (2)$$

where $P_{ijt}$ is the observed probability of exporting organic product $i$ from the United States to country $j$ in month $t$. $DAfter$ is a dummy variable for the time period $t$ after the E.U. organic equivalency policy was signed (February, 2012) or became effective (June, 2012). $DEU$ represents a dummy if the destination country is in the E.U.

By using the observed values of $P_{ijt}$, either 0 or 1, for the dependent variable in Model (2), $\gamma$ will measure change in the probability of exporting organic in the E.U. for the treated group (the European Union) relative to the control group (other destinations outside the E.U.). To isolate the effect of the E.U. equivalency agreement from other related agreements, we exclude exports to Canada, Taiwan, Japan, and South Korea from the control group. As in Model (1), Model (2) includes controls for country-specific, product-specific, and time (year and quarter) fixed effects.

Table 5 shows estimation results for Model (2) using a Probit regresison for a panel of 141 countries, 25 of which are members of the European Union.[5] The dependent variable (Probability of Exporting Organic) was set to one when the U.S. exported a positive (non-zero) value of organic and/or a positive (non-zero) value of non-organic goods. The dependent variable equals to zero when (i) the United States exported a zero value of organic goods and a positive (non-zero) value of non-organic goods in a specific month and to a specific country, and (ii) when the U.S. did not export anything organic or non-organic to country $j$ in month $t$. Note that the panel excludes observations when, during the whole *year*, the U.S. did not export anything organic and/or non-organic to country $j$.

**Table 5: Policy Impacts from DD Model (2) - Examining the Probability of Exporting Organic**

| Coefficients of Interest | Variation 1 – Agreement Signed February 2012 | Variation 2 – Agreement Effective June 2012 | Variation 3 – Dropping 2012 | Variation 4 – Effect over Time |
|---|---|---|---|---|
| | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) |
| γ | 0.254 (0.103) * | 0.256 (0.097) ** | 0.396 (0.117) ** | |
| γ*year_2012 | - | - | - | 0.089 (0.137) |
| γ*year_2013 | - | - | - | 0.232 (0.126) # |
| γ*year_2014 | - | - | - | 0.441 (0.124) *** |
| γ*year_2015 | - | - | - | 0.009 (0.224) |
| Country Fixed Effects | Y | Y | Y | Y |

[5] 28 countries have accessed the European Union; however, not all of them have trade relations with the U.S.

| | | | | |
|---|---|---|---|---|
| Product Fixed Effects | Y | Y | Y | Y |
| Year Fixed Effects | Y | Y | Y | Y |
| Quarter Fixed Effect | Y | Y | Y | Y |
| Number of obs | 18005 | 18005 | 18005 | 18005 |
| Pseudo $R^2$ | 0.18 | 0.18 | 0.18 | 0.18 |

Note: * when p < 0.05, ** when p < 0.01, *** when p < 0.001; # - when p $\in$ (0.05-0.1)

All four variations of Model (2) show a positive and statistically significant effect of the equivalency agreement on the probability of exporting to the E.U.

### IV.3. Intensive Margin: Shares of Organic Exports

Our third model investigates how the equivalency policy affects the intensity of organic trade by examining the share of organic exports to individual countries relative to the total organic and non-organic exports to the same country. We construct Model (3) similarly to Model (2):

$$Share\_of\_Organic_{ijt} = \alpha + \beta_1 DAfter_t + \beta_2 DEU_{ij} + \gamma DAfter_t * DEU_{ij} + \varepsilon_{ijt} \qquad (3)$$

where the dependent variable (Share of Organic) equals to one when the U.S. has positive value of organic exports and zero value of non-organic exports of product $i$ to country $j$ in month $t$. It is zero when the U.S. has positive value of non-organic exports and zero value of organic export; and it belongs to (0,1) interval when the U.S. has positive value of both organic and non-organic exports.

Members of the E.U. that have trade relationships with the U.S. belong to the treated group, while other destination countries belong to the control group (excluding Canada, Taiwan, Japan, and South Korea). Practically, we use the same dataset to estimate the model as in the previous section, but with fewer observations because the Share of Organic variable cannot be defined where the U.S. did not export anything organic and non-organic to country $j$ in month $t$. Still, the panel exhibits a substantial fraction of zeros (77%), and we use Tobit regression with left-censoring at zero to estimate Model 3). Table 6 presents the results from the Tobit estimation:

**Table 6: Policy Impacts from DD Model (3) - Examining Share of Organic Export**

| Coefficients of Interest | Variation 1 – Agreement Signed February 2012 | Variation 2 – Agreement Effective June 2012 | Variation 3 – Dropping 2012 | Variation 4 – Effect over Time |
|---|---|---|---|---|
| | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) | Coef. (Robust Std. Err.) |
| γ | 0.154 (0.058)** | 0.149 (0.054)** | 0.233 (0.064) *** | - |
| γ*year_2012 | - | - | - | 0.084 (0.075) |
| γ*year_2013 | - | - | - | 0.145 (0.069)* |
| γ*year_2014 | - | - | - | 0.235 (0.069)** |
| γ*year_2015 | - | - | - | - 0.002 (0.121) |
| Country Fixed Effects | Y | Y | Y | Y |
| Product Fixed Effects | Y | Y | Y | Y |
| Year Fixed Effects | Y | Y | Y | Y |
| Quarter Fixed Effects | Y | Y | Y | Y |
| Number of obs: | 11791 | 11791 | 9042 | 11791 |
| Left-censored | 9078 | 9078 | 6940 | 9078 |
| Uncensored | 2713 | 2713 | 2102 | 2713 |
| Pseudo $R^2$ | 0.15 | 0.15 | 0.15 | 0.15 |

Note: * when $p < 0.05$, ** when $p < 0.01$, *** when $p < 0.001$

All four variations of Model (3) confirm that share of organic export to the E.U. was positively affected by the organic equivalency agreement.

Observed shares reported in Table 7 echo the results of the Model 3 estimation: share of organic exports to the E.U. increased dramatically over the four-year period. The average share across eight products grew from 10% in 2011 to 33% in 2014. In 2014, organic products constitutes more than half of the total exports to the E.U. for three of the eight products: carrots (with a 73% organic share), peppers (56%) and blueberries (46%). Appendix B shows the same table for organic imports from the E.U., where average share across four aggregated products increased from 9% in 2011 to 13% in 2014. In 2014, the share of organic imported tea from the E.U. was 24%, bell peppers – 18%, rice – 6%, and coffee – 3%.

**Table 7: Organic Exports' Share of Total Exports, %**

| Product | | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|
| 1. | Grapes Fresh | 13% | 4% | 1% | 25% |
| 2. | Apples | 3% | 12% | 16% | 16% |
| 3. | Strawberries | 4% | 17% | 23% | 27% |
| 4. | Coffee Roast (Not Decaf) | 10% | 13% | 6% | 9% |
| 5. | Carrots | 2% | 9% | 18% | 73% |
| 6. | Tomato Sauce | 5% | 1% | 2% | 15% |
| 7. | Cult Blueberries | 16% | 18% | 10% | 46% |
| 8. | Peppers | 24% | 87% | 78% | 56% |
| **Average share across 8 products** | | **10%** | **20%** | **19%** | **33%** |

## V. CONCLUSIONS AND NEXT STEPS

Our results from several difference-in-difference models provide evidence that the E.U.-U.S. organic equivalency agreement has affected organic prices, the probability of organic trade with E.U. countries, and the share of organic exports to E.U. countries (relative to total exports). In other words, the policy is having its intended effect, and we can confirm April 2015's evaluation of the agreement by the European Commission.

Our next step is to estimate the intensive margin of trade using the levels of organic exports/imports as the dependent variable. One additional factor that complicates the estimation of the DD model is the potential abundance of "zeros", meaning there might be a number of months where the U.S. exported/imported zero organic products. Most actual trade datasets exhibit substantial fractions of zeros, and the problem is even more apparent in datasets disaggregated by month and/or country (as in this study). To accommodate these zeros econometrically, we have applied a negative binomial model that classifies each $1,000 in monthly exports/imports as a count of 1. For example, this treatment implies that $1,500 of monthly exports/imports would have a count of 1.5. Head and Mayer (2013) provide a detailed exposition of some other estimators that could be employed with zero trade flows between the countries. After exploring a variety of methods, we will estimate the effect of the equivalency agreement on the levels of exports and imports. We will also estimate the effect of the E.U.-U.S. organic equivalency agreement on the likelihood of importing organic products to the U.S. along with the share of organic imports using Models (2) and (3) presented here.

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## APPENDIX A

**Table A.1: Export Prices Summary Statistics over 51 months (January 2011-March 2015), $/kg**

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Organic Calculated Export Price | 264 | 5.56 | 5.91 | 0.79 | 29.09 |
| Organic Downloaded Export Price | 264 | 5.55 | 5.91 | 0.8 | 29.1 |
| Non-Organic Calculated Export Price | 264 | 4.89 | 4.68 | 0.85 | 30.54 |
| Non-Organic Downloaded Export Price | 264 | 4.89 | 4.68 | 0.9 | 30.5 |

**Table A.2: Import Prices Summary Statistics over 51 months (January 2011-March 2015), $/kg**

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Organic Calculated Import Price | 569 | 16.04 | 14.19 | 0.61 | 120.38 |
| Organic Downloaded Import Price | 569 | 16.04 | 14.19 | 0.6 | 120.4 |
| Non-Organic Calculated Import Price | 569 | 13.85 | 21.14 | 0.59 | 373.47 |
| Non-Organic Downloaded Import Price | 569 | 13.85 | 21.14 | 0.6 | 373.5 |

**APPENDIX B**

**Table B.1: Organic Imports' Share of Total Imports, %**

| **Product** | | **2011** | **2012** | **2013** | **2014** |
|---|---|---|---|---|---|
| 1. | Coffee | 4% | 3% | 2% | 3% |
| 2. | Bell Peppers | 4% | 8% | 15% | 18% |
| 3. | Tea | 26% | 24% | 25% | 24% |
| 4. | Rice | 2% | 3% | 4% | 6% |
| **Average share across 4 products** | | **9%** | **10%** | **12%** | **13%** |

# APPENDIX C

## Table C.1. Organic and Non-Organic HS Export Code Correspondences

| Product | Codes (Organic) | Codes (Non-Organic) |
|---|---|---|
| **Apples** | 0808100010 - ORG APPLES FRESH | 0808100050 - APPLES FRESH |
| **Lettuce (Not Head)** | 0705190010 - ORG LETTUCE X HD | 0705190050 - LETTUCE X HD FR |
| **Grapes Fresh** | 0806100010 - ORG GRAPES FRESH | 0806100050 - GRAPES FRESH |
| **Spinach** | 0709700010 - ORG SPINACH FR/C | 0709700050 - SPINACH FR/CH |
| **Strawberries** | 0810100010 - ORG STRAWBERS FR | 0810100050 - STRAWBERRIES FR |
| **Carrots** | 0706103010 - ORG CARROTS FR/C | 0706103050 - CARROTS FR/CH |
| **Cauliflower** | 0704100010 - ORG CAULFLOWR FR | 0704100050 - CAULFLOWER FR/CH |
| **Coffee Roast (Not Decaf)** | 0901210010 - ORG COFFE RST ND | 0901210050 - COFFEE RST ND |
| **Tomato Sauce** | 2103204010 - ORG TMTO SAUC NE | 2103204050 - TMTO SAUCES NES |
| **Pears (and Quince)** | 0808300010 - ORG PEARS<br>0808200010 - ORG PEARS/QUINCE | 0808200050 - PEARS/QUINCE FR<br>0808300050 - PEARS, FRESH<br>0808400000- QUINCES, FRESH |
| **Cult Blueberries** | 0810400026 - ORG CULT BLUEBER | 0810400029 - CULT BLUEBERS FR |
| **Oranges** | 0805100045 - ORG ORANGES FR/D | 0805100065 - ORANGES NES FR/D |
| **Broccoli** | 0704904025 - ORG BROCCOLI FR | 0704904030 - BROCCOLI FR/CH |
| **Lemons** | 0805502010 - ORG LEMONS FR/D | 0805502050 - LEMONS FR/D |
| **Cherries** | 0809290010 - ORG CHER N/SR FR<br>0809200010 - ORG CHERRIES FR | 0809200050 - CHERRIES FR<br>0809290050 - CHER N/SR FR |
| **Onion Sets** | 0703100010 - ORG ONION SET FR | 0703100050 - ONION SETS FR/CH |
| **Celery** | 0709400010 - ORG CELERY FR/CH | 0709400050 - CELERY FR/CH |
| **Cherry Tomato** | 0702000015 - ORG CHERRY TOMAT | 0702000045 - CHERRY TOMATO |
| **Peppers** | 0709600010 - ORG PEPPERS FR/C | 0709600050 - PEPPERS FR/CH |
| **Tomato Other** | 0702000035 - ORG TOMATO OTHER | 0702000065 - TOMATOES OTHER |
| **Grapefruit** | 0805400010 - ORG GRAPEFRUIT | 0805400050 - GRAPEFRUIT,FRESH<br>0805400000 - GRAPEFRUIT,FRESH |
| **Potatoes** | 0701900070 - ORG POTATO XSD | 0701900080 - POTATO XSD NESOI |
| **Cabbage** | 0704902010 - ORG CABBAGE | 0704902050 - CABBAGE, FR/CH<br>0704902000 - CABBAGE, FR/CH |
| **Head Lettuce** | 0705110010 - ORG HD LETTUCE | 0705110050 - HD LETTUCE FR/CH |
| **Roma Plum Tomato** | 0702000025 - ORG ROMA PLM TOM | 0702000055 - ROMA PLUM TOMATO |
| **Cucumbers** | 0707000010 - ORG CUCMBERS | 0707000050 - CUCMBERS,FR/CH<br>0707000000 - CUCMBERS,FR/CH |

## Table C.2. Organic and Non-Organic HS Import Code Correspondences

| Product | Codes (Organic) | Codes (Non-Organic) |
|---|---|---|
| **Coffee** | 0901110015 - ORG COFF AR ND<br>0901110045 - ORG COFFEE NR ND<br>0901120015 - ORG COFF DEC NR<br>0901210035 - ORG COF RS ND<2K<br>0901220035 - ORG COF RS DE<2K<br>0901210055 - ORG COFF RST ND | 0901110025 - COFF AR ND<br>0901110055 - COFFEE NR ND<br>0901120025 - COFF DEC NR<br>0901210045 - COFF RS ND<2K<br>0901220045 - COFF RS DEC<2K<br>0901210065 - COFF RST ND |
| **Soybeans** | 1201000045 - ORG SOYBEANS OTH (in 2011)<br>1201900010 - ORG SOYBEANS OTH (since 2012) | 1201000055 - SOYBEANS OTHER (in 2011)<br>1201900090 - SOYBEANS OTHER (since 2012) |
| **Bananas** | 0803900025 - BANANAS, ORGANIC | 0803900035 - BANANAS, FRESH<br>0803900045 - BANANAS, DRIED |
| **Olive Oil** | 1509102015 - OLV OL VRG<18ORG (only in 2013)<br>1509102030 - OLV OL XVR<18ORG<br>1509102040 - OLV OL VRG<18ORG<br>1509104030 - OLV OL XVR>18ORG<br>1509104040 - OLV OL VRG>18ORG<br>1509104015 - OLV OL VRG>18ORG (only in 2013) | 1509102025 - OLV OL VRG<18KCT (only in 2013)<br>1509102050 - OLV OL XVR<18KCT<br>1509102060 - OLV OL VRG<18KCT<br>1509104050 - OLVOL XVRG18K>CT<br>1509104060 - OLVOL VRG18K>CT<br>1509104025 - OLVOL VRG18K>CT (only in 2013) |
| **Wine** | 2204100065 - OSPK WIN>$1.59/L<br>2204215035 - ORED>1.05<14%<2L<br>2204215050 - OWWN>1.50<14%<2L | 2204100075 - SPK WIN>$1.59/L<br>2204215040 - RED>1.05<14%<2L<br>2204215055 - WWN>1.50<14%<2L |
| **Honey** | 0409000005 - BHONEY, ORGANIC | 0409000010 - CMB & NT HNY/RTL<br>0409000035 - WHT HONEY,NT/RT<br>0409000045 - HONEY,E/L AMBER<br>0409000056 - HONEY,NT/RET,LT<br>0409000065 - HONEY,NT/RET,OT |
| **Almonds** | 0802120005 - ALMONDS, SHL ORG | 0802120015 - ALMONDS,SHELLED |
| **Mangoes** | 0804504045 - MANGO, ORG IN<br>0804506045 - MANGO, ORG OUT | 0804504055 - MANGO, 9/1-5/31<br>0804506055 - MANGO, 6/1-8/31 |
| **Avocado** | 0804400020 - ORG AVOC-HSLIKE | 0804400040 - AVOC-HSLIKE |
| **Yellow Dent Corn** | 1005902015 - ORG CRN,YLW, X SD | 1005902025 - CORN, YLW, EX SD |
| **Tea** | 0902101015 - ORG GR TEA FL<3K<br>0902109015 - ORG GR TEA NF<3K<br>0902209015 - ORG GR TEA NF OT<br>0902300015 - ORG BL TEA F/BAG | 0902101050 - GR TEA FL<3K<br>0902109050 - GR TEA NF<3K<br>0902209050 - GR TEA NF OT<br>0902300050 - BL TEA F/BAG |
| **Apples** | 0808100045 - ORG APPL>22CN/KG | 0808100065 - APPLE FR>22CN/KG |
| **Rice** | 1006309015 - ORG RICE SMI/WHL | 1006309055 - LNG GRN RICE,MLD<br>1006309065 - MDM GRN RICE,MLD<br>1006309075 - SHT GRN RICE,MLD<br>1006309085 - RICE MIXED, MLD |
| **Bell Peppers** | 0709604015 - ORG BELL PEPP GH<br>0709604065 - ORG BL PEPPRS NE | 0709604025 - BELL PEPPERS GH<br>0709604085 - BELL PEPPERS NES |
| **Ginger** | 0910110010 - GINGER, ORGANIC | 0910110015 - GINGER,NT/GROUND |
| **Durum Wheat** | 1001100025 - ORG DURUM WHEAT (in 2011)<br>1001190025 - ORG DURUM WHEAT (since 2012) | 1001100061 - 1DURUM>84%DHV (in 2011)<br>1001100062 - 1DURUMUPTO84%DHV (in 2011)<br>1001100065 - 2DURUM>84%DHV (in 2011)<br>1001100066 - 2DURUMUPTO84%DHV (in 2011)<br>1001100069 - OTHER DURUM (in 2011)<br>1001190061 - 1DURUM>84%DHV (since 2012)<br>1001190062 - 1DURUMUPTO84%DHV (since 2012)<br>1001190065 - 2DURUM>84%DHV (since 2012)<br>1001190066 - 2DURUMUPTO84%DHV (since 2012)<br>1001190069 - OTHER DURUM (since 2012) |
| **Pears** | 0808202015 - ORG PEAR4/1-6/30 (in 2011)<br>0808204015 - ORG PEAR OTH TM (in 2011) | 0808202025 - PEAR FR 4/1-6/30 (in 2011)<br>0808204025 - PEAR OTH TM (in 2011)<br>0808302025 - PEAR FR 4/1-6/30 (since 2012)<br>0808304025 - PEAR7/1-3/31 (since 2012) |
| **Blueberries** | 0810400026 - ORG CULT BLUEBR | 0810400029 - CULT BLUEBR |

| | | |
|---|---|---|
| **Flaxseed** | 1204000025 - FLAXSEED, OIL ORG | 1204000035 - FLAXSEED, OIL STK |
| **Garlic** | 0703200005 - GARLIC, ORGANIC | 0703200015 - FRSH GARLIC BULB |
| **Quinces** | 0808402015 - ORG QNCE4/1-6/30<br>0808404015 - ORG QNCE7/1-3/31 | 0808404025 - QNCE7/1-3/31<br>0808402025 - QNCE FR 4/1-6/30 |