Policy Impacts from U.S. Organic Equivalency with the European Union

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Abstract:

This study uses the synthetic control method to investigate the impact of the 2012 bilateral organic equivalency arrangement between the European Union and the United States, the two largest organic markets in the world. Employing the newly available USDA Global Agricultural Trade System (GATS) data on organic trade, we collectively analyze 23 products of U.S. organic exports, representing fresh produce, coffee, and tomato sauce, at the quarterly level during the 2011-2014 period. We find that the policy generates an increase of $149,100, or 9.3%, in the organic exports of these products to the European Union each quarter.

Keywords: organic equivalency arrangement, synthetic control method

I. Introduction

The organic industry is the fastest growing sector of the U.S. food system. The Organic Trade Association reports that since 2010 the growth rate of organic food sales has averaged almost 10% every year, which is more than three times the average annual growth of total food sales during that same period. However, 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 (OTA, 2015).

Recently, a number of trade-related policies have been adopted to make organic trade between the U.S. and partners easier. In 2007, Canada and the U.S. began a discussion of the bilateral equivalence arrangement to promote trade of organic products under new Canadian organic laws.

In June 2009, as a new Canadian organic certification became effective, an organic equivalency arrangement between Canada and the U.S. was implemented. Global Organic Market Access (GOMA) reports that Canada is one of the most important markets for the U.S. organic exports with a share of organic products imported from the U.S. reaching 60% (GOMA, 2013). Under the equivalence arrangement, Canadian producers can access both markets while being certified to the domestic system only. Equally, U.S. organic producers do not need extra certification to enter Canadian organic market.

Other organic equivalency arrangements soon followed the Canadian arrangement. In 2009, Taiwan declared a unilateral recognition of USDA-certified exports. In June 2012, an organic equivalency arrangement between the E.U. and the U.S. became effective after rounds of unsuccessful discussions during 2000-2005 (Bendz et al., 2012). In 2014, the U.S. also signed a bilateral organic equivalency with Japan (effective beginning January 2014) and South Korea (effective beginning July 2014). In 2015, the U.S. National Organic Program entered into a bilateral organic equivalency with Switzerland, its fifth organic equivalency arrangement. Bilateral equivalence arrangements suggest a trend towards negotiations in which export and import outcomes play role. However, multilateral equivalency arrangements present opportunity to strengthen organic agricultural trade and enhance the integrity of organic production systems even further (GOMA, 2013).

This study focuses on the bilateral organic equivalency between the two world's major global traders: the E.U. and the U.S. In fact, the E.U. is the largest economy in the world, representing 25.1% of world GDP and 17.0% of world trade and the U.S. is the second largest economy accounting for 21.6% of world GDP and 13.4% of world trade. The bilateral trade relationship is very important for both partners. In 2011, the E.U. was the largest trading partner of the U.S. with

17.6% of trade in goods, while the U.S. was the second largest trading partner of the E.U. with 13.9% share of the E.U.'s trade in goods (European Commission, 2013).

At the same time, both the E.U. and the U.S. represent the two largest certified organic markets in the world. In 2013, global sales of organic food products reached $72 billion with organic retail sales in the U.S. accounting for 37% of the market ($26.6 billion) and sales in the E.U. amounting for $24.3 billion or 34%. China was in the third position with a relatively small share, 4% or $2.6 billion in sales. Canada's share was 3% with organic retail sales worth $2.5 billion (McCarthy, 2015; Willer and Lernoud, 2015). While organic sales are concentrated in Europe and North America, organic production is global and equivalency arrangements at all levels establish integrity of the domestic and global organic market.

Although the U.S. organic regulations share many similarities with the E.U. organic laws, they have some differences. In the U.S., the legislation is based on the list of methods that are not allowed, while in the E.U., the legislation lists what is allowed. The E.U. regulates organic food products including seafood, USDA has only been in the process of setting rules for organic aquaculture production. At the same time, the E.U. laws do not regulate products of personal care. In the U.S., products with the 70-95% of organic ingredients may be labeled as "made with organic", while this is not an option in the E.U.

Organic equivalency arrangements are designed to promote organic trade by reducing the cost of trade. Although most of organic standards are quite similar, certification costs can be an obstacle especially for small producers. UNEP-UNCTAD reports that the cost of certification can reach 4% of products value and higher (CBTF, 2008). In the U.S., for example, organic certification usually costs midsize farms from $700 to $1,000 in application fees. Typically, there is an application fee, annual renewal fee, assessment on annual production or sales, and inspection fees. Direct reduction in costs comes from savings on extra certification for the E.U. which Weise (2012) reports to be about $250. After a recent required review of the E.U.-U.S. organic equivalency arrangement, the European Commission confirmed its fundamental role in the reducing trade barriers for producers (European Commission, 2015).

While it makes logical sense that the equivalency policies 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 the E.U., a group of institutions is attempting to develop a European Information System for Organic Markets, but the system of specific Harmonized System (HS) codes to analyze organic trade has not yet been introduced (Bendz et al., 2012). In the U.S., the HS codes for selected sets of exported and imported organic products has been in use since 2011. Although they do not yet represent all existing organic trade to the E.U., they provide a unique and consistent source of information about certain product categories.

In this study, we attempt to quantify the impact of the bilateral organic equivalency arrangement between the U.S. and E.U. on the value of organic exports to the E.U. using the new HS codes obtained from the USDA Global Agricultural Trade System (GATS) at the quarterly level. Because of the incomplete data on organic imports, we analyze organic exports only for products available in the dataset. The change in organic trading policy between the U.S. and the E.U. can be considered a quasi-experiment, which allows us to use a difference-in-difference approach to identify the effect of the change.

Although countries in the E.U. may have their own national organic standards, the E.U. organic regulations define rules common for the whole union. This paper considers the E.U. as one group of countries with a single policy because the E.U.-U.S. arrangement recognized the equivalency to the common E.U. organic standards. However, as the treatment affects a large group of countries, it is difficult to find a single unexposed country that can closely approximate the E.U.'s organic export demand before the arrangement and serve as a control in a difference-in-difference analysis.

As the reliability of the conclusions depends on the choice of control group, we apply a method developed by Abadie and Gardeazabal (2003) and Abadie, Diamond, and Haimueller (2010, 2015) to construct a comparable control region to the E.U. referred to as a "synthetic control group". Countries that the U.S. exports organic goods to comprise a "donor pool" and a synthetic control group is defined as a weighted average of the countries in the donor pool. The synthetic control group is meant to reproduce the values of organic exports to the E.U. that would have been observed in the absence of the policy. We employ insights of the gravity model of trade and the pre-treatment values of organic exports to identify optimal weights for the donor pool countries to match the levels of organic exports to the E.U. Using this synthetic control group of countries as a comparison to the E.U., we find that the E.U.-U.S. organic equivalency policy increases quarterly organic exports to the E.U. by $149,100, or 9.3%, for products covered in the USDA GATS data.

II. Previous Research

It is not easy to monitor the development of organic sector until organic data is included to the publicly available agricultural statistics. Prior to the implementation of the new HS codes, research on organic exports and imports relied on survey data. For example, Jaenicke, Dimitri and Oberholtzer (2011) develop a survey of U.S. retailers to explore the relationship between organic imports and private labeling. However, the new HS-coded data allow a more systematic analysis of U.S. organic trade. As of October 2015, there exists 34 export and 40 import HS codes to analyze organic trade in the U.S. Jaenicke and Demko (2015a) present analysis of monthly export and import growth rates of organic products with HS codes for the 2011-2014 period.

Using a gravity model applied to organic imports, Kristiansen (2014) was the first to analyze the organic equivalency arrangements with the USDA GATS data. However, her study was restricted to the Canadian and the E.U. policies because only 2011-2013 data were then available. Moreover, for the three products of organic imports (corn, soy and wheat) covered in her study, organic import data was reported from just two E.U. countries, Romania and the Netherlands. As a result, the Poisson estimation of the gravity model failed to identify any effect of the equivalency arrangements.

Jaenicke and Demko (2015b) also employ a gravity model to examine the impact of five organic equivalency arrangements (with Canada, Taiwan, the E.U., Japan, and South Korea) on both U.S. organic exports and imports for a wider range of products. Using annual data from 2011 to 2014, they generally find that the arrangements, examined both collectively as a single policy or as individual policies, have a positive impact on organic exports. The 2012 GAIN report on the E.U.-U.S. organic equivalency cooperation also refers to the USDA GATS data and brings some insights on the opportunities that the equivalency opens up for U.S. exporters (Bendz et al., 2012). However, when examining the effect of the E.U.-U.S. organic equivalency arrangement only, Jaenicke and Demko (2015b) show that it had virtually no effect on annual organic exports.

In this study, we use quarterly level data instead of annual and achieve a better identification of the effect using a difference-in-difference method where adoption of the organic equivalency arrangement between the E.U. and the U.S. is considered a quasi-experiment and the policy variable of interest might be validly treated as exogenous. Finally, by employing the synthetic control group approach, we construct comparable treatment and control groups with similar pre-treatment characteristics and trends, thereby allowing the difference-in-difference approach to be convincing as possible.

III. Data

Beginning January 2011, the USDA GATS added separate HS trade codes for a selected number of fresh and processed organic food products. When organic products first appeared with Harmonized Tariff Schedule codes in 2011, the USDA GATS data contained 23 HS codes for different organic export products and 20 HS codes for organic import products. With the addition of the new codes in subsequent years, there are 34 export and 40 import HS codes as of October 2015. In this study, we choose 23 unique products of U.S. organic exports that were available in the data from the very beginning and analyze them collectively. Twenty-one of these codes are for fresh produce, one code is for roasted non-decaffeinated coffee, and one is for tomato sauce.

In 2014, organic exports to the E.U. totaled over $12.3 million for HS-coded products. The top eight products (grapes, apples, strawberries, coffee, carrots, tomato sauce, and blueberries) have reported data for all four years and cover $12.15 million (99%) in organic exports to the E.U. in 2014. The United Kingdom demonstrates a robust growth in organic demand: its share in the total E.U. consumption of organic exports from the U.S. has grown from 33% in 2011 to 77% in 2014 and is valued four times more in 2014 than in 2011, an increase from $2.3 million to $9.5 million. The United Kingdom along with the Netherlands and Belgium are the most important port of entry for U.S. organics (Lohr, 1998; Bendz et al., 2012). Thus, this increase may be linked to an increase in the demand on organic products in the E.U.

The market for organic imports to the U.S. is even larger than the export market, but organic imports form the E.U. are not strongly represented in the HS code. Data for only four organic products (coffee, tea, bell peppers and rice) from the E.U. have non-zero import values each year from 2011 to 2014. While in 2011 these four products represent 99% of the value of organic imports from the E.U., they only cover 5% and 7% of imports in 2013 and in 2014 correspondingly. This noticeable difference stems mostly from the type of HS codes added to the data in 2013. These newly added HS import codes include those for olive oil and wine, two products with a strong E.U. presence. Because the E.U. does not specialize in the production of coffee, tea or rice, one may misrepresent organic imports flows from the E.U. using HS codes consistently available from 2001-2014. Therefore, in what follows we assess the impact of the E.U.-U.S. organic equivalency on organic exports but not imports.

Treated Group

Overall, the U.S. exports HS-coded organic products to 98 separate countries. Eighteen of these countries are members of the E.U., and collectively these countries comprise the treatment group. Note that not all of the 28 sovereign states constituting the E.U. have trading relations with the U.S. for the HS-coded organic products. Although the E.U. member states can have their national organic standards, the European organic certification is recognized by all the E.U. member countries. The 2012 E.U.-U.S. arrangement recognizes the E.U. certification as an equivalent to the USDA organic certification. For this reason, all E.U. members are treated together as one group of countries with a single policy.

Donor Pool

For the rest of the 75 countries receiving HS-coded organic exports from the U.S., our goal is to construct the best comparison group for the E.U. Canada, Taiwan, Japan, South Korea, and

Switzerland are excluded in order to isolate the effect of the E.U. equivalency arrangement from similar arrangements. We also discard islands nations (Netherlands Antilles, Cayman, French Pacific, Leeward-Windward, and Turks and Caicos Islands) that do not have a consistent data on their GDP as this variable is used to construct the synthetic control group. To make sure that the composition of the countries in the donor pool is unchanged over time, we choose countries that have all four years of reported data for the top eight products in the dataset. Following this criteria, 42 countries remain in the donor pool.

Finally, we discard Mexico as an outlier from the donor pool because Mexico's large average annual share in the donor pool of 42 countries (72%) may reflect the effect of another big trade agreement – the North American Free Trade Agreement (NAFTA). Also, the Organic Trade Association (OTA) acknowledges that the U.S. has been in talks with Mexico over an equivalency arrangement for organic products. Hence, the final donor pool includes the remaining 41 countries.

Examined collectively, these 41 countries are not a particularly good comparison group for the E.U. While the total annual value of organic exports to the E.U. increased by 76% during the 2011 to 2014 period, from $6.96 million to $12.3 million, organic exports to the donor pool countries collectively declined by 17% (from $69.4 million to $57.3 million). Moreover, the average quarterly value of organic exports to the donor group of 41 countries is six time higher than to the E.U.: $12.7 million versus $2.1 million. Table 1 summarizes organic exports to the E.U. and the entire donor group for the pre- and post-treatment periods, where the pre-treatment period reflects the first six quarters of the 2011-2014 and the post-treatment period reflects the remaining quarters. During the pre-treatment period, the average organic exports to the E.U. were valued at $1.6 million each quarter. After the establishment of the policy, the average value of exports increased by almost 50%, to $2.4 million per quarter. The organic exports to the countries in the donor group decreased by 11% (from $13.6 million to $12.1 million per quarter) after the treatment.

Table 1: Quarterly Average Value of Organic Exports, $1,000s

	Treated Group (E.U.)	Donor Group (41 countries)
Before Treatment	1,644.7 (368.7)	13,639.5 (4,895.4)
After Treatment	2,397.4 (431.8)	12,104.8 (1,517.1)

Note: std. errors in parentheses; t-tests show no stat. significant difference in means for the treated and donor groups before ($n = 6$) and after the treatment ($n = 10$)

The comparison in Table 1 suggests that organic exports to the 41 donor group countries do not resemble organic exports to the E.U. in the pre-treatment period. Moreover, because of the size of the E.U., a single country would likewise not lead to a good match. On the other hand, a weighted average of all countries in the donor group (using optimally assigned weights), could be constructed to mimic the E.U. in the pre-treatment period. Once the weights are optimally assigned, the weighted average should mimic the E.U. in the pre-treatment period.

IV. Methods

To assess the impact of the policy, the key question is how organic exports would have evolved to the E.U. after May 2012 in the absence of the arrangement. We employ a synthetic control method (Abadie and Gardeazabal, 2003; Abadie, Diamond, and Hainmueller, 2010, 2015) to construct a weighted average of the donor pool and estimate this counterfactual. The method involves constructing a valid comparison group of countries to the E.U. with a good fit in the pretreatment trends. It has been employed to answer many policy questions including trade (Hosny, 2012; Billmeier and Nannicini, 2013; Bohn, Lofstrom, and Raphael, 2014; Heilmann, 2015), environmental (Barone and Mocetti, 2014; Munasib and Rickman, 2015), and health-related issues

(Wang, 2015; Qian et al., 2015). To examine trade-related policies, Bohn, Lofstrom and Raphael (2014) use the synthetic control method to select a comparable state to Arizona and investigate the impact of the Legal Arizona Workers Act (LAWA) on the state's demographics. Billmeier and Nannicini (2013) undertake the analysis of a worldwide panel of economies over the 1963-2005 period to see the impact of economic liberalization on the real GDP per capita. Hosny (2012) draws attention to the effect of remaining outside a trade agreement (GAFTA) on Algeria's trade with member countries, while Heilmann (2015) estimates the effects of international conflicts (boycotts) on trade.

The synthetic control group method works as follows. Suppose that there is a sample of $\mathrm{J}+1$ countries and only the first country is exposed to the treatment. Then, J constitute a set of potential controls or a "donor pool". The difference between the pre-treatment characteristics of a treated country and a synthetic control group is given by a vector $X_1 - X_0W$ where X_1 is a $k \times 1$ vector of pre-treatment characteristics of a treated country, X_0 is a $k \times \mathrm{J}$ matrix of the values of the same variables for the countries in the donor pool, and $W = (w_2,\ldots, w_{J+1})'$ is a $J \times 1$ vector of non-negative weights that form a convex combination of unexposed to the treatment countries.

The optimal synthetic control weights $W^* = (w_2^*,\ldots, w_{J+1}^*)'$ minimize the discrepancy between X_1 and X_0W:

$$||X_1 - X_0W|| \tag{1}$$

subject to $0 \leq w_j \leq 1$ for $\mathrm{j} = 2, \ldots, \mathrm{J}$ and $w_2 + \cdots + w_{J+1} = 1.$ [1]

[1] Weights assigned to each country may only take non-negative values and should sum up to one, which prevents extrapolation outside the data support. In contrast, one may extrapolate outside the data support using regression weights as they may fall outside the $[0,1]$ interval (Abadie, Diamond, and Hainmueller, 2015).

Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010) propose to minimize (1) using:

$$\|X_1 - X_0W\| = \sqrt{(X_1 - X_0W)'V(X_1 - X_0W)} \tag{2}$$

where V is a positive semidefinite $k \times k$ matrix. The choice of V influences the mean squared error of the estimator. The optimal V assigns weights to characteristics in X_0 and X_1 that minimize the root mean squared prediction error. The weights of V are normalized to sum to one with those matching variables that are strong predictors of the outcome variable receiving more weight. Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010) choose V such that the synthetic control approximates the pre-treatment path of the outcome variable. Abadie, Diamond, and Hainmueller (2015) suggest an alternative for large pre-treatment periods. They choose V to minimize the lack of fit (the root mean square prediction error) between the path of the outcome variable for the synthetic control and any particular country over a validation period using an earlier training period.

Note that the synthetic control method focuses on small rather than large samples. It is not a randomization-based approach and the probability of being exposed to each treatment is not employed to sample units. Thus, formal statistical inference for treatment effect cannot be drawn (Abadie, Diamond, and Hainmueller, 2015; Rubin, 1990). Researchers rely on "placebo" tests to evaluate the statistical significance of the synthetic control estimates. In the placebo test, members of the donor pool one by one replace the target country as if they were treated. After procedure is iteratively applied to each member of the donor pool shifting the treated unit to the donor pool, one compares how different the distribution of these placebo runs with the one estimated for the treated. Synthetic control estimates are significant when they are not similar to the results found for the countries artificially assigned to the treatment.

Any characteristics unaffected by the treatment are valid predictors under the synthetic control method. At the same time, the matching variables in X_0 and X_1 should include some linear combination of pre-treatment outcomes to ensure unbiasedness of the synthetic control estimator, and to control for the unobservables as well as for the heterogeneity of the effect of the observed and unobserved factors on the outcome (Abadie, Diamond, and Hainmueller, 2010, 2015; Dube and Zipperer, 2014).

In this study, we match the levels of organic exports from the U.S. to the E.U. using seven variables. The first five variables are the levels of organic exports in each quarter of 2011 and the second quarter of 2012. Note that among all countries in the donor pool, the E.U. had the highest levels of organic exports in the first quarter of 2012. Therefore, no combination of countries can reproduce the levels of organic exports to the E.U. in this quarter. Using well-established insights of the gravity trade model, we include the logged annual values of destination countries' GDPs and the logged distance between their capitals and Washington, DC to explain trade flows. Thus, logged GDP and logged distance comprise the sixth and seventh variables used in the matching algorithm that estimates the weights for the synthetic control group.

It is not uncommon to match values of the outcome variables based on its pre-intervention values only. In Bohn, Lofstrom, and Raphael (2014) all pre-treatment population values are used in the matching to study the effect of the Arizona state immigration law on population movement. In the robustness check section, we probe the E.U.-U.S. policy effect when only the pre-treatment values of the dependent variables are used in the match. The effect of the policy is estimated to be 0.6% lower (an 8.6% increase compared to a 9.1% increase) compared to our preferred model (Table 4).

In the traditional difference-in-difference model, equal weights are assigned to the countries selected in the donor pool. By contrast, the synthetic control approach assigns its own weight based on the pre-treatment fit to the treated group. A principal estimate of the E.U.-U.S. organic equivalency effect on exports uses countries' synthetic weights to estimate a difference-in-difference model as follows:

$$Org\_Exp_{it} = \alpha + \beta_1 DPolicy_t + \beta_2 DEU_i + \beta_3 DPolicy_t * DEU_i + \beta_F \boldsymbol{X}_{it} + \varepsilon_{it} \qquad (3)$$

where the dependent variable represents the levels of organic exports to country i in quarter t; $DPolicy$ is a dummy variable for quarters after the E.U. organic equivalency policy became effective (i.e., June 2012); DEU represents a dummy if the destination country is in the E.U.; $\boldsymbol{X}_{it}$ denotes interaction of country and year fixed effects to control for the unobservables including prices. Finally, the coefficient of interest, β_3, measures the change in organic exports to the E.U. relative to the synthetic control group before and after the policy.

The effect is estimated for the levels of organic exports to incorporate large amount of zeros (17% of all observations) typically present in trade data, which also allows a straightforward comparison between estimations of (3) for the donor and synthetic control groups.

V. Identification

The synthetic control group method aids identification of the policy impact by creating an appropriate comparison group. One may argue that an increase in organic exports to the E.U. can be related to generally increasing trends in organic markets. However, a synthetic approach already accounts for that by comparing trends in the E.U. to other countries (Bohn, Lofstrom, and Raphael, 2014), as does the inclusion of a whole suite of fixed effects in (3). These country-year fixed effects capture all temporal and product-related trends.

Identification of the policy impact still requires that the policy target was not chosen strategically to maximize the policy's impact and that the enactment of the 2012 E.U.-U.S. organic equivalency can be represented as an exogenous shock to the international organic market. As the E.U. and the U.S. have the largest bilateral trade relationship, one may think that they will be more likely to enter into some kind of trade agreement. However, a number of other forces drive international trade of organics. For example, in 2014 the value of organic goods exported into Mexico from the U.S. was 13 times higher than the value exported to the E.U., but Mexico and the U.S. never entered into an organic equivalency, mainly, due to the infancy of organic regulatory framework in Mexico (Rosmann, 2013). At the same time, long established organic food regulations do not necessarily lead to organic equivalencies with other countries. For example, the E.U. members acquired comprehensive organic legislation in 1992, the same year that Argentina established its norms for organic production. In 1997, Argentina was recognized by the E.U. for the purpose of equivalency. However, the U.S. does not have an equivalency with Argentina, nor with Colombia and Brazil, countries that have established legal framework for organic foods since 1995 and 1999 correspondingly.[2]

It is also questionable that more developed countries are more likely to have the most comprehensive organic legislation and recognize each other's standards as equivalent. For example, Norway has a strictly enforced market of organic products and no organic equivalency with the U.S. Size of the local market is also not a good policy predictor. In the case of China, the third largest organic market in the world and the world's biggest market of organic dairy, equivalencies with other countries are not allowed. Therefore, recognition of organic standards

[2] In the U.S., the final rule of the National Organic Program was published in 2000, and final regulations were implemented in 2002.

between two countries depends on many factors and in the case of the U.S. it is hard to foresee who may become the next equivalency partner and when.

VI. Results

The synthetic control group is computed using the Stata "Synth2" package. Table 2 displays the weights associated with each country contributing to the synthetic control. In this study, the synthetic control involves a convex combination of four countries, namely, Hong Kong, Dominican Republic, India, and China, with weights decreasing in this order. All other countries in the donor pool receive zero weight. Other studies that use the synthetic control group method often find that weights commonly come from small number of countries (Kleven, Landais, and Saez. 2010; Abadie, Diamond, and Hainmueller, 2010).

Table 2: Country Weights in the Synthetic Control Group

Country	Weight	Country	Weight
Australia	0	Israel	0
The Bahamas	0	Jamaica	0
Bahrain	0	Jordan	0
Barbados	0	Kuwait	0
Bermuda	0	Lebanon	0
Brazil	0	Malaysia	0
Cayman Islands	0	New Zealand	0
Chile	0	Nigeria	0
China	0.004	Panama	0
Colombia	0	Peru	0
Costa Rica	0	Philippines	0
Dominican Republic	0.352	Qatar	0

Ecuador	0	Russia	0
El Salvador	0	Saudi Arabia	0
Guatemala	0	Singapore	0
Haiti	0	Thailand	0
Honduras	0	Trinidad and Tobago	0
Hong Kong	0.452	United Arab Emirates	0
Iceland	0	Venezuela	0
India	0.191	Vietnam	0
Indonesia	0		

Table 3 shows how the pre-treatment characteristics of the E.U. match with that of the synthetic control (Column 2) and with the equally weighted average of 41 countries in the donor pool (Column 3). We argue that the average of the 41 countries receiving organic exports without an organic equivalency policy signed with the U.S. does not provide a suitable control group for the E.U. More specifically, the levels of organic exports to the average of the 41 donor countries are lower than to the E.U. in all five quarters. The difference in fit of the average of 41 countries and the synthetic control group is less striking for the logged GDP and distance variables.

In contrast, the synthetic control group provides almost a perfect fit in the third and fourth quarters of 2011 and very closely reproduces the values of organic exports to the E.U. in the first two quarters of 2011 and the second quarter of 2012. Higher discrepancy is associated with lower predicting power of the variables which can be assessed using matrix V. Diagonal elements of matrix V provide weights associated with each variable in Table 3. The resulting value of the organic exports in the second quarter of 2011 and of 2012 is virtually zero, and it is very small (0.007%) for the first quarter of 2011. We conclude that the characteristics of the synthetic control group coincide with those of the E.U. much better than the average of 41 countries in the donor group.

Table 3: Matching Variables for Construction of the Synthetic Control Group

Variables	Treated Group (E.U.)	Synthetic Control Group (4 countries)	Average of 41 Donor Countries
Organic Exports, Q1-2011	787	533	125
Organic Exports, Q2-2011	1116	1432	214
Organic Exports, Q3-2011	3266	3265	876
Organic Exports, Q4-2011	1791	1778	601
Organic Exports, Q2-2012	1041	1178	179
Log(GDP)	30.5	26.1	25.6
Log(Distance)	8.74	8.85	8.75

Note: GDP is the nominal annual GDP measured in billions of current U.S. dollars, World Bank; Distance is measured in kilometers.

The post-treatment period starts with the third quarter of 2012 as the E.U.-U.S. organic equivalency became effective in June 2012. Figure 1 displays organic exports to the E.U. and comparable trends to the synthetic control group. The dotted vertical line represents the beginning of the post-treatment period, i.e., the third quarter of 2012. Focusing first on the pre-treatment period, from the first quarter of 2011 through the second quarter of 2012, the figure reveals that export trends for the synthetic control group closely match corresponding export trends in the E.U. in all pre-treatment quarters except the first quarter of 2012. In this quarter, the E.U. received the highest levels of organic exports from the U.S. Thus, the values of organic exports to the E.U. fall far outside the convex hull of the data. No combination of countries in the donor pool can represent the levels of exports in that quarter because the synthetic control method does not allow extrapolation outside the support of the data.[3] In general, the match depicted in Figure 1 leads to a conclusion that the synthetic control group provides a good approximation to the organic exports to the E.U. that would have been evolved in the absence of the equivalency arrangement, and we proceed with the estimation of the size of the policy effect using a weighted difference-in-difference model described by (3).

[3] This sort of outliers occur more frequently in the monthly level data. For example, before the 2012 E.U.-U.S. arrangement, exports to the E.U. had the largest value among all countries in May 2011 and January through April 2012.

Figure 1: Trends in Organic Exports to the E.U. and to the Synthetic Control Group (Synthetic E.U.), $1,000s

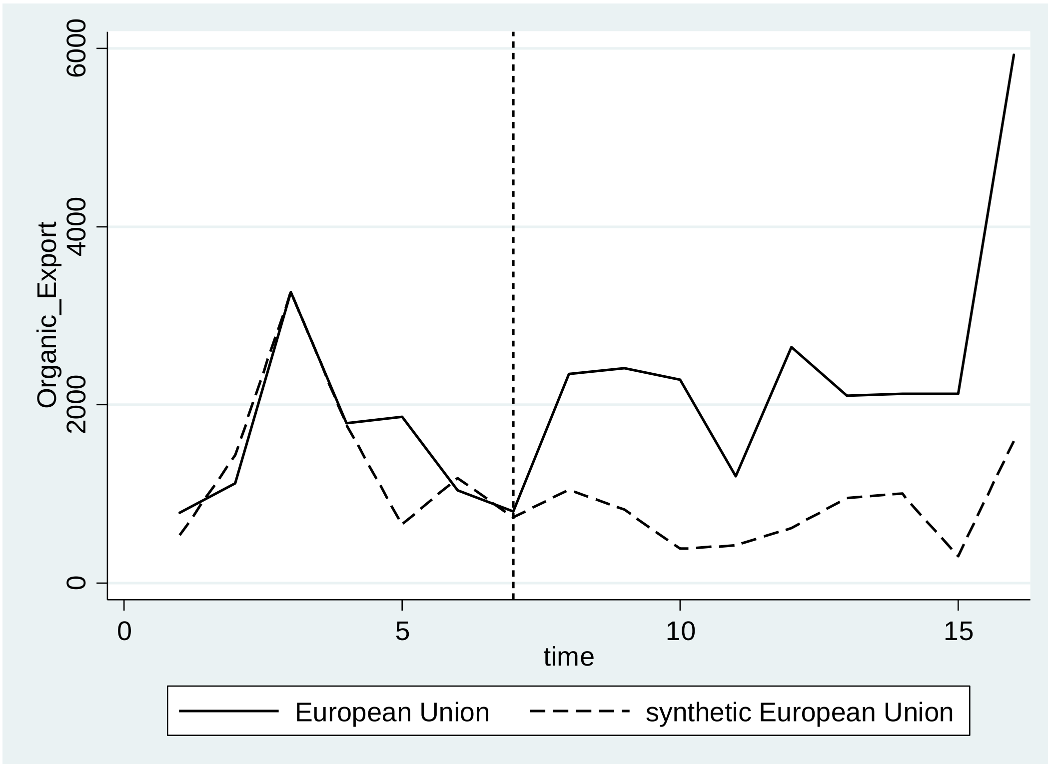


Table 4 presents the difference-in-difference results obtained by estimating (3) first with a donor pool of all 41 countries, equally weighted, and then with the synthetic control group using the optimally derived weights based on pre-treatment trends. These weights are then used as analytic weights in the OLS regression. The traditional donor pool model with equal weights shows virtually no effect of the policy while the second variation suggests that the policy generated a quarterly increase in the organic exports to the E.U. by $149,100.[4] Given that the average quarterly value of exports is equal to $1.6 million before treatment, this amount corresponds to a 9.3%

[4] Effect of the policy is substantially similar when the difference-in-difference model for a potential control group is estimated as a Negative Binomial or a Poisson regression employed as alternatives to incorporate zeros in trade data (Shepherd, 2013; Burger, van Oort, and Linders, 2009).

increase. The results in Table 4 clearly show that the traditional model and the synthetic control group model generate different policy impact estimates. We have argued that the synthetic control group model estimate is correct.

Table 4: Estimated Impact of the E.U.-U.S. Organic Equivalency from Model (3)

	Donor Pool (41 countries)		**Synthetic Control Group**	
	Coeff. (Robust St. Error)	p-value	Coeff. (Robust St. Error)	p-value
Policy Impact, $\widehat{\beta_3}$	-15.7 (94.6)	0.869	149.1**(48.6)	0.037
Country×Year F.E.	Yes		Yes	
Number of observations	672		80	
R^2	0.47		0.49	

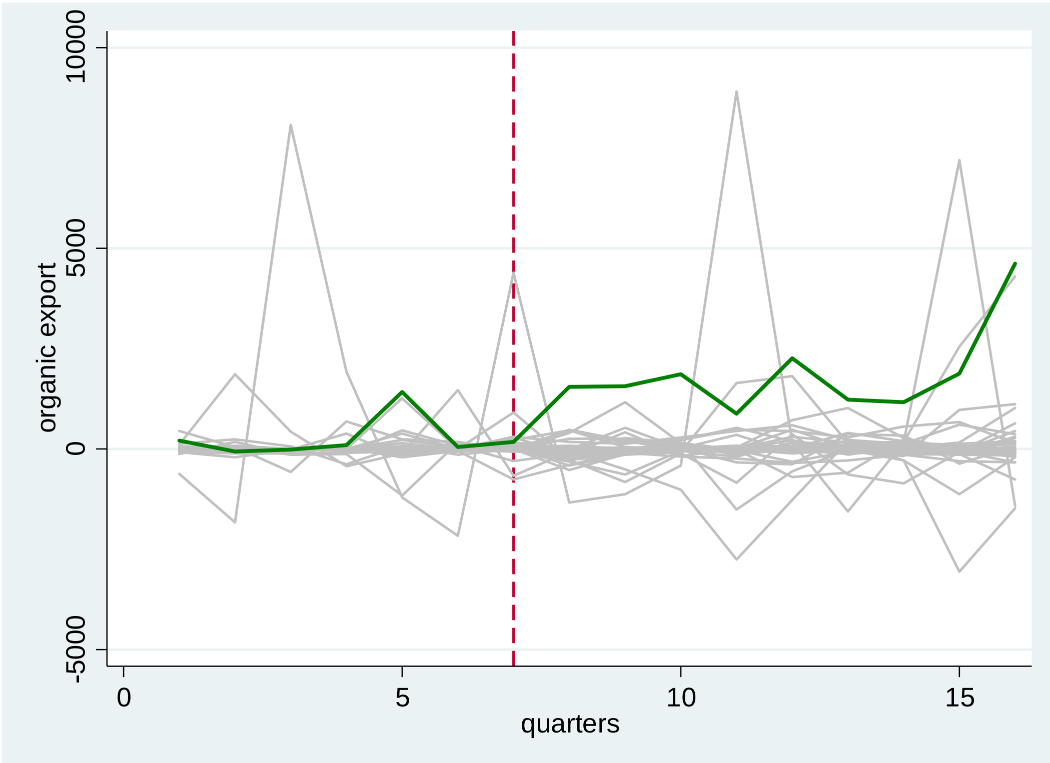
Note: std. errors clustered at the country level; ** when $p < 0.05$; results hold for both models when quarter fixed effects added to control for seasonality.

VII. Placebo Test and Robustness Checks

Because the synthetic control group used as a comparison to the E.U. is an empirical rather than theoretical construct, and because the difference-in-difference equation (3) is a reduced-form model and not structural, we believe that a number of checks are necessary to have complete confidence in our results. More specifically, we conduct a total of five checks. The first, called a placebo test, ensures that the E.U.-U.S. equivalency policy is found to affect organic exports to the E.U. but no other countries. The next check is a robustness check that examines how sensitive the results are to changing the matching criteria for estimating the optimal weights in the synthetic control group. The last three robustness checks examine how sensitive the results are to changing the specification of equation (3), the difference-in-difference model. Results from the synthetic control group and our preferred model pass all these checks, which are discussed next.

For the first check, we conduct an intentionally false placebo test that provides a basis for inference. More specifically, for each 41 countries in the donor pool, we identify a synthetic control group and graph pre- and post-treatment levels of organic exports as if each country had signed an organic equivalency with the U.S. Figure 2 displays the distribution of these falsification exercises, i.e., placebos, for 41 countries in the donor pool plus the E.U. (displayed with thick green line). Next, one compares how different the distribution of the 41 placebo estimations are from the one estimated for the E.U. The effect of the policy is considered to be significant when the E.U. line is the most unusual one. Figure 2 clearly shows that the E.U. line stands out: it reflects relative increase in exports to the E.U. and is at the top of the distribution of placebo estimates across all countries, whereas the other 41 placebo estimations generally fluctuate around zero. Thus, the placebo test provides evidence that the synthetic control group approach is valid.

Figure 2: Placebo Analysis of Organic Exports to the E.U. and 41 Countries in the Donor Pool (E.U. Displayed with Thick Green Line)



Next, we explore how sensitive our Table 4 results are to the criteria used to find country-specific weights in the synthetic control group. Here, we investigate a change to the criteria: We eliminate logged GDP and logged distance from the matching criteria, thus reducing the variables used for match from seven to five. The only remaining variables for the match are thus the variable of interest, the five quarters of export data. To have confidence in our Table 4 results, we want new results to be insensitive to these changes. Results presented in Table 5 confirm this insensitivity. Estimated policy impacts in Table 5 from the difference-in-difference model based on the synthetic control group with different matching variables lead to results that are similar to those in Table 4. The new estimated increase in quarterly organic exports is $139,900, which is very close to the $149,100 found in Table 4.

Table 5: Robustness Check: Assessing Quality of the Synthetic Control Group Match

	Dropping GDP and Distance from the Match	
	Coeff. (Robust St. Error)	p-value
Policy Impact, $\widehat{\beta_3}$	139.9** (46.0)	0.042
Country×Year F.E.	Yes	
Number of observations	80	
R^2	0.50	

Note: std. errors clustered at the country level; ** when $p < 0.05$.

For our final three robustness checks, we return to our original matching criteria for the synthetic control group but alter the specification of equation (3). The first of these checks involves the post-treatment time period. For our Table 4 results, the post-treatment time period reflects ten quarters from the third quarter of 2012 through the fourth quarter of 2014. Because the difference-in-difference is a reduced-form model that reflects a shift from one equilibrium to another, we construct a robustness check that helps reduce the influence of other (non-policy) equilibrium forces from potentially affecting organic export levels and thus interfering with our measurement of the policy impacts. More specifically, we compress the post-treatment time period by eliminating all four quarters in 2014 from the data. In this way, a new estimation would measure the short-term direct impacts of the policy and avoid longer-term impacts that might reflect additional economic forces. One possible additional economic factor might be anticipatory effects from 2014 discussions about the Transatlantic Trade and Investment Partnership, proposed trade agreement between the U.S. and E.U. The first column of Table 6 shows that the estimated impact of the policy is an $149,100 increase in quarterly organic exports, which is identical to the results in Table 4. Thus, our results are robust to a shorter post-treatment period.

Table 6: Assessing Robustness in the Policy Impact

	Dropping 2014		Adding Ag Exports Unit Values Measured Quarterly		Alternative Policy Date and Same Matching Variables in the Synthetic Control Group	
	Coeff. (Robust St. Error)	p-value	Coeff. (Robust St. Error)	p-value	Coeff. (Robust St. Error)	p-value
Policy Impact, $\widehat{\beta_3}$	149.1** (48.8)	0.038	258.6** (83.7)	0.037	-136.4 (215.6)	0.572
Country×Year F.E.	Yes		Yes		Yes	
Ag Export Unit Value	-		Yes		-	
No. of Obs	60		80		64	
R^2	0.46		0.53		0.47	

Note: std. errors clustered at the country level; ** when p < 0.05, * when p < 0.10

The second of these specification checks involves additional covariates to equation (3) as a way of controlling for other economic forces. Here we add unit values, measured quarterly from 2011-2014, of agricultural exports for the countries in the synthetic control group, Hong Kong, Dominican Republic, India, and China. These unit values, which are found in the USDA GATS database, can loosely be interpreted as prices. Adding them to the difference-in-difference model given by (3) allows us to investigate if our organic exports to the E.U. are affected by prices, and if this potential influence affects our estimated policy in Table 4. The second column of Table 6 presents the results for this robustness check. There we see that the organic equivalency policy leads to an estimated $258,600 increase in quarterly organic exports. This increase is over 70% higher than the increase reported in Table 4, and therefore this robustness check does uncover some sensitivity to the inclusion of unit values. However, the main result is relatively unchanged, namely that the E.U.-U.S equivalency policy led to a significantly higher level of organic exports to the E.U.

The third and final check on specification involves the start date of the policy. Here, we construct an intentionally false scenario, i.e., one where the organic equivalency policy became effective in June 2013 rather than June 2012, and investigate the impact of this false policy on U.S. organic exports. In this case, we expect that this false policy will have no effect on exports. This test serves as a test against the possibility that organic exports to the E.U. just happened to increase (for some non-policy reason) sometime in the general time frame. As before, this test requires the similar steps, namely constructing a new synthetic control group and then re-estimating equation (3) with new effective date for the policy variable. The third column of Table 6 presents the results for this false policy and shows that the policy impact (is negative but) has no statistical significance. Thus, as expected, this false policy has no effect on exports.

Taken collectively, all these robustness checks provide ample assurance that the synthetic control method, the difference-in-difference model given by (3), and the HS-coded export data lead to the conclusion that it is the organic equivalency policy that caused a significant increase in quarterly organic exports to the E.U. and not some other factor.[5]

[5] We also looked at a check that ultimately proved infeasible. We considered using the difference-in-difference method combined with the propensity score matching sometimes used for the treatment effects models (Khandker, Koolwal, and Samad, 2010), but that method is econometrically infeasible when only one country unit (i.e., the E.U. in our case) is treated.

VIII. Conclusions, Policy Implications, and Next Steps

This study finds that the organic equivalency arrangement has stimulated U.S. organic exports of 23 agricultural products to the E.U. In other words, the policy is working as intended, with exports increasing by $149,100 or 9.3% each quarter as a result of the policy. We show that the policy has increased U.S. organic exports of fresh produce, coffee and tomato sauce to the E.U.

The methods employed to obtain this result are crucially important. A traditional difference-in-difference analysis that uses all non-policy affected countries receiving U.S. organic exports as the control group does not lead to the same results. However, we are confident in the policy we report for at least two reasons. First, we use a relatively new method to construct the most appropriate control group for the most accurate comparison with the E.U., the policy target. This method allows us to ask the question, how large would organic exports to E.U. be without the organic equivalency policy. Second, we conduct a large suite of robustness checks that, collectively, ensure that neither the synthetic control group method itself, nor the difference-in-difference model, nor the data are overly sensitive to alternate specifications.

Organic equivalency policies are a relatively new policy have not been rigorously studied. Thus, our results provide insight to policy makers and help resolve this open question. For example, the warm reception in the E.U. for U.S. organic products found in this research was not necessarily expected. First, while the E.U. organic standards apply to all E.U. member countries, "controlling bodies", which are the E.U. approved organic certifiers, can set standards that are stricter. Thus, despite the word equivalency in the policy arrangements, some European consumers and importers may have perceived U.S. organic exports to have different standards, perhaps lower. Second, given that many of the U.S.'s traditionally strong non-organic export crops, such as corn, soybeans, and cotton, are grown with genetically modified seeds, European consumers and importers may have conflated U.S. organic exports with general agricultural exports and placed them within the context of lively and ongoing GMO debate in Europe, perhaps making organic exports from the U.S. less welcome than expected.

Organic equivalency policies may end up being important for the U.S. organic sector to remain competitive globally. The E.U., for example, has a number of organic equivalency arrangements with other countries besides the U.S. Reciprocal equivalence arrangements with Switzerland have been in place since 1997, with New Zealand since 2002, with Canada since 2011 as well as with the members of the European Economic Area (Norway and Iceland). Organic products certified in Australia, Argentina, Israel, Costa Rica, India, Tunisia and Japan are recognized by the E.U. as well. However, these countries have not formally recognized the E.U. for the purpose of equivalence; e.g., special rules are in place for organic exports from the E.U. to Japan. Thus, the E.U.-U.S. policy appears to be a necessary step in preventing U.S. organic exports from suffering a competitive disadvantage in the European marketplace.

As the U.S. moves forward with organic equivalency arrangements with other countries, this research provides some reassurances that discussion and negotiations may be worth the trouble, at least if the E.U. arrangement serves as a guide. Likely candidates for new arrangement include Australia, New Zealand, other Asian countries, and non E.U. European countries. Mexico is an especially important candidate for an organic equivalency arrangement as it is still in the process of developing enforceable organic standards. If these new standards become fully enforceable without an organic equivalency arrangement in place, then current organic exports to Mexico may need additional certification. Unfortunately, the synthetic control group analysis used in this paper does not provide much insight into which of these potential policy partners may have the most success with an organic equivalency arrangement. Our analysis is data driven and backwards looking, and not based on a forward-looking structural model. Nonetheless, our results do suggest these policies do achieve the intended goal of lowering the certification burdens associated with organic exports (and imports).

Finally, future research may investigate other effects from the E.U.-U.S. arrangement or other bilateral equivalency arrangements. For instance, the E.U.-U.S. policy may affect the share of organic exports in total exports in addition to the value of organic exports. In 2014, 73% of all carrots, 56% of all peppers and 46% of all blueberries exported to the E.U. were organic; and the average share (equally weighted) across top eight products increased substantially throughout the four-year period: from 10% in 2011 to 33% in 2014. Jaenicke and Demko (2015a) document this increase, but do not investigate the causal effect of the equivalency policy. Future research may investigate these and similar findings more rigorously.

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