Assessing the Impacts of Equivalency Agreements in International Organic Trade

Siqi Zhang*

Dec 1st, 2019

ABSTRACT

This study investigates the effects of Organic Equivalency Agreements (OEAs) on the imports of organic food products into the United States (U.S.) and Denmark using organic trade flow data from 2011-2016. OEAs exist to confirm that another country's control system and standards are in line with domestic requirements in order to allow the organic products certified in that country to be sold in the domestic market. The BLP method (Berry, Levinsohn, and Pakes, 1995) is used to estimate market share elasticities with respect to the establishment of OEAs. Using these results, the value of exports between a new OEA signatory and Demark or the U.S. are predicted. The results indicate that both the current and potential OEAs have a positive effect on the value of exports and market share for most exporting countries exporting to the two markets. Based on this model it is predicted that a new U.S. OEA would result in additional imports of $205 million, reflecting a 650% increase from an average trading partner in 2016. For Denmark, organic food imports would have increased by an average of $7 million (350% increase) by signing a new OEA. Further, the findings suggest that market share increases for an exporter in a newly established come at the expense of the decreased market shares of other OEA and non-OEA exporting countries. The sensitivity of the remaining exporting countries to the reduction of trade costs from a newly established OEA depends on the extent to which the organic food products sold by these competitive exporting countries are close substitutes. These findings offer new and unique insights into the broader and indirect impacts an importer's decision to enter a bilateral trade agreement can have on countries not-party to the agreement.

Keywords: international trade, organic trade agreements, non-tariff barrier

JEL Codes: F13, Q17, Q18

*Department of Economics, North Carolina State University. E-mail address: szhang31@ncsu.edu

1 Introduction

Growing consumer demand for organic food products has led to a quickly evolving global organic industry (OTA, 2017). In 2011, the global organic market totaled $62.9 billion, with 1.8 million producers and 162 countries engaging in organic activities (Willer et al., 2013). Between 2011 and 2016, the global organic market increased by 42.6%, amounting to $89.7 billion in 2016, with 2.7 million producers and 178 countries involved in organic activities (Willer et al., 2018). While the worldwide demand for organic food products has increased, organic production has lagged behind (Barrett et al., 2002; Martinez and Banados, 2004; Seufert et al., 2017). Although organic agricultural land increased by 55.4% between 2011-2016 and reached 57.8 million hectares in 2016, the average organic share of total agricultural land among 178 countries was only 1.2% (Willer et al., 2013; Willer et al., 2018). The gap between supply and demand for organic food products has augmented international organic trade (Demko and Jaenicke, 2017; Pekdemir, 2018), especially between the emerging countries which occupied one-third of organic farmland with 80% of organic producers getting involved and the developed countries such as the United States and the European Union whose organic sales accounted for 90% of global organic sales in 2016 (Oberholtzer et al., 2013).

Organic production is an overall system of farm management and food production that integrates cultural, biological and mechanical practices as well as high-level production and animal welfare standards to foster cycling of resources, promote ecological balance and conserve biodiversity (the European Union (EU) Regulation 2018/848; e-CFR, Title 7, PART 205, Subpart A). Although the definitions of organic and organic production were clarified in both EU and U.S. organic regulations nowadays, the lack of a standard definition in early 20th century drew attention by organic farmers due to fraudulent claims and unfair competition (Grolink, 2012). The Soil Association in the United Kingdom published the first private organic standards in 1967 and established a certification system in 1973 (Soil Association, 2012). A similar pattern was found in the U.S., where California Certified Organic Farmers (CCOF) started to produce organic standards and operate certification systems in the early 1970s (Arcuri, 2015). As a result, a great many certification bodies published their own organic standards in the 1970s and 1980s in order to provide organic farmers with technical assessment and assure the integrity of organic production systems (Grolink, 2012). The EU Council Regulation EEC 2092/91, published in 1991 and came into force in January 1993, was the first legal regulation in the world and was motivated by protecting consumers rather than organic farmers (Mikkelsen and Schlüter, 2009). The organic regulations established by the EU and other countries in the world do not necessarily drive out the private standards set by the third certification bodies and private organizations, because private standards are conducive to the enforcement of organic standards (Arcuri, 2015) and are more adaptive to local ecosystems and culture (Grolink, 2012). The coexistence of public standards published by governments and private standards set by private organizations prevents organic producers from accessing international markets and leads to two central concepts in organic agriculture, certification and regulation (Seufert et al., 2017).

Organic Equivalency Agreements (henceforth, OEAs) contribute to reducing costs in organic certification and indirectly influencing organic regulation in most countries. Bilateral OEAs exist to confirm that another country's control system and standards are in line with domestic requirements in order to allow the products certified in that country to be sold in the domestic market. The establishment of OEAs facilitates trade by allowing organic food products certified to an internal standard to gain access to the market in the partner country without further documentation, therefore lowering administrative costs otherwise required (Barrett et al., 2002). On the other hand, considering that organic producers pay certification costs, lower cost of certification bodies resulted from obtaining fewer accreditations to various target markets further reduces transaction costs related to organic trade and thus alleviates the burden of organic producers (Bowen and Hoffman, 2013). The effects of the establishment of OEAs on organic trade by lowering certification costs are even more salient for manufacturers whose products are composed of organic ingredients. Bowen and Hoffman (2015) mentioned the so-called "chocolate problem" under the circumstances when U.S. signed OEA with EU while not with Switzerland, Swiss organic chocolate producers could not source certified milk powder and cocoa competitively from the U.S. recognized ingredient suppliers and were eventually excluded from the U.S. market.[1]

Considering the many differences between the organic standards of different countries, particularly in the degree to which fertilizers and animal feed were defined as organic (Padel et al., 2009), the Codex Alimentarius Commission (Codex)[2] founded in 1961 and the International Federation of Organic Agriculture Movement (IFOAM) founded in 1972 have made an effort to

[1]EU signed bilateral OEA with the U.S. in June 2012, and Switzerland signed bilateral OEA with the U.S. in July 2015.

[2]The Codex Alimentarius Commission is an intergovernmental body established by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO).

harmonize organic standards (Mutersbaugh, 2005). The IFOAM published the IFOAM Basic Standards (IBS) in 1980, and the Codex developed and approved the Guidelines for the Production, Processing, Labeling and Marketing of Organically Produced Foods (Codex Guidelines) in 1999. Whilst the guidelines published by Codex and IFOAM aimed to reach a consensus on the definitions of organic practices across countries and facilitate trade by harmonizing organic requirements (Codex Alimentarius, 2007; Bowen and Hoffman, 2013), few countries in the world officially claimed that their organic regulations were affected by the IBS and Codex Guidelines (Katto and Bowen, 2012).[3] Notably, the EU and the U.S. organic regulations were not affected by the IBS (Bowen and Hoffman, 2013) or the Codex Guidelines (Katto and Bowen, 2012). The reasons why international organizations can hardly influence the development of organic regulations in most countries are two-fold. First, harmonization is often restricted by differences between countries such as culture, technical development, and governance constructs (Bowen and Hoffman, 2015). For example, countries whose organically produced livestock are in their infancy would prefer more basic standards related to animal welfare than other countries. Second, consumers' concern and understanding of organically produced food play an essential role in the development of organic regulation. For example, Indian consumers care more about biodiversity, while Australian regulation focuses on water issues (Seufert et al., 2017).

When compared to the process of developing a multilateral harmonized standard, OEAs are more comfortable to implement because this form of agreement allows each country to retain their own production and certifying systems, and agree to acknowledge another country's organic standard and technical regulations as equal in its effectiveness on environmental and health protection (Vogl et al., 2005; Pekdemir, 2018). Some argue that equivalency negotiations could be lengthy and costly (International Task Force, 2003). Despite this, the number of bilateral OEAs has increased from seven to thirty from 2011 to 2019 (IFOAM-Organic Equivalency Tracker, 2019).

In addition, trade agreements have the capacity to reshape public and private quality control systems in the international framework (Henson and Caswell, 1999). Gandal and Shy (2001) pointed out that each country would mutually recognize organic standards when network effects overwhelmed conversion costs.[4] Up to this point, 87 countries have organic legislation,

[3]India and Uganda claimed that they adopt IBS (Seufert et al., 2017), and Japan adopted the Codex Guidelines (Katto and Bowen, 2012). However, Japan introduced "grading" of organic products throughout the production and distribution chain to the Japanese Agricultural Standard (JAS).

[4]Gandal and Shy (2001) note that conversion costs are required when governments do not recognize foreign standards, foreign firms must incur a standard conversion cost in order to adhere to the local specification and

18 countries are in the process of drafting legislation, and 33 countries have national organic standards without national legislations (Willer et al., 2018).[5] International trade agreements such as OEAs could contribute to creating a policy environment in which network effects outstrip conversion costs and guide the drafting of organic legislation. “Ultimately, organic is about a way of life,” said Franz Fischler, the former Agriculture Commissioner of the European Union (GOMA, 2012, p.12). As a representative of a new style of life, Consumers’ awareness of health and environmental protection in developed countries induced more stringent definitions of organic farming and conformity assessment in organic regulations, which created more significant gaps between developed and developing countries in terms of organic standards. The establishment of OEAs gives developing countries more incentive to update organic regulations, especially when the developed countries are ideal markets they would like to access, and eventually facilitates harmonization.

This study focused on OEAs between exporting countries and two major organic markets: the U.S. and Denmark. The U.S. organic market is the largest in the world, accounting for 47% of the global sales of organic food products and amounting to $43 billion in organic food sales in 2016. The European Union (EU) is the second-largest organic market in the world, holding 37% of the global organic market and amounting $35 billion in organic retail sales in 2016 (Willer et al., 2018). Denmark is the second-largest member country in the E.U. in terms of per-capita consumption of organic food products. In Denmark, the consumption of organic food products is approximately 244 Euros per person in 2016, and organic products comprise nearly 10% of Denmark’s total food sales (Willer et al., 2018, p.147).

Two recent studies have highlighted concern about the effect of OEAs on the international trade of organic products.[6] Demko and Jaenicke (2017) used the synthetic control method to explore the impacts of the OEA between the U.S. and the EU. This study found that the policy generated a 9.1% increase in quarterly exports of U.S. organic food products to the EU. Demko and Jaenicke (2015) used 2011-2014 trade flow data to predict that the impact of OEAs between U.S.-Canada and U.S.-Japan on U.S. organic exports at 454.6% and 219.7%, respectively. They also predicted that U.S. imports of organic food products from Canada and Japan would

be permitted to sell in the domestic country.

[5]Such organic standards do not necessarily lead to national inspection and certification system which would be supervised by the government, they only provide a national definition of organic products and are a reference point for certification activities (Willer et al., 2018). For example, Laos, Nepal, Vietnam, and South Africa.

[6]This study only considers two markets due to data availability; only the U.S. and Denmark collect trade value data for organic food products with each partner country. Data availability also limits variables used in this study, in specific, product-level data related to organic land in exporting countries.

increase by 371% and 267%, respectively, using 2013-2014 trade flow data.

Whether or not OEAs create trade depends on: (i) agroecological characteristics and technological productivity in the exporting country; (ii) whether the organic food products originating from the remaining exporters in the importing country are close substitutes for those originating from the exporting country; and (iii) trade costs between the exporting and importing country. The results of Demko and Jaenicke (2015; 2017) should be carefully interpreted. Not all bilateral OEAs necessarily cause "trade creation,"[7] indicating that within-bloc trade increases and imports from non-member countries remain unchanged (Carrere, 2006; Sun and Reed, 2010). If organic food exporters produce and sell different products to a given importing country, then the trade benefits of entering an OEA are less clear. Further, focusing on OEAs between developed countries and organic market leaders might give policymakers a misleading impression that the establishment of OEAs ensures "trade creation."

Based on a structural model, this study sought to solve the previously discussed issues to some degree and to answer the following empirical question: How large are the effects of current and potential OEAs on the value of exports for countries exporting to the U.S. and Denmark? This study focuses on the period of 2011-2016, during which the U.S. signed four out of five bilateral OEAs, and Denmark expanded bilateral OEA partners from two to five. Following Eaton and Kortum (2002), it is assumed that the exporting country that offers the lowest price for a given product in the importing country dominates the market. Further, price is a function of agroecological characteristics, technological productivity of the exporting country, and bilateral trade costs between exporting and importing countries. Therefore, the effects of OEAs on trade flows are constrained by productive factors. In addition, this study assumed that increases in market shares of exporting countries were at the expense of other exporting competitors. It was especially true for competitors with similar land and climate endowments that compete head-to-head for specific organic food products in the destination market. This structural model followed the work of Heerman et al. (2015), which first applied the BLP method (Berry, Levinsohn and Pakes, 1995) in agricultural trade literature and identified the elasticity of bilateral trade flow with respect to trade costs by relaxing the assumption of IIE (independence of irrelevant exporters)[8], thus offering the likelihood of disproportionate elastic-

[7]Carrere (2006) defines pure trade creation that trade flow increases among member countries within regional trade agreements, and trade flow between importer and non-member countries remains unchanged. Sun and Reed (2010) support trade creation if within-bloc trade increases and imports from non-member countries decrease, but the decrease in imports from non-member countries is lower than within-bloc trade increase.

[8]IIE property is equivalent to IIA(independence of irrelevant alternatives) property in discrete choice literature. Heerman et al. (2015) define IIE as the following: "changes to a third country's trade costs are 'irrelevant' to

ities to trade costs. As a result, the simulation on the predictive trade patterns between the importing country and each active exporter gives policymakers a broader view of OEAs.

This study has three primary contributions. First, the findings are reliable to the extent that the effects of OEAs are based on technological productivity and agroecological endowments in exporting countries. The findings suggest that OEAs lead to growing trade volumes for most exporters in the market of the U.S. and Denmark, which gives policymakers a global view of OEAs. Second, since the focus was on the effects of exports to the Danish market rather than imports from Denmark, unilateral OEAs in which the Danish market were grantors were treated as similarly "effective" as bilateral OEAs. The inclusion of unilateral OEAs is novel, as it has not been addressed previously. Therefore, the findings shed light on how unilateral OEAs benefit exporters, especially for export-oriented exporters such as Argentina, Chile and Peru.[9] Third, although the establishment of an OEA depends on the extent to which two countries trust each other's organic production and quality control systems (Bowen and Hoffman, 2015; Pekdemir, 2018), this study offers a more realistic prediction of trade pattern based on comparative advantage of agroecological characteristics in exporting countries rather than political willing. The findings with respect to how each exporting country would have repositioned under possible organic equivalency agreements not only allow competitive developing exporting countries enter the vision field of developed importers, but also reinforce the influence of importing countries on development of organic regulations in exporting countries who have a comparative advantage in producing organic food products of interest.

The findings indicate that exporters that have an OEA with the importer enjoy higher market shares relative to those that do not have an OEA with the importer. If the U.S. had signed an OEA with one of its non-OEA exporting partners in 2016, the value of export of organic food products to the U.S. would have averaged \$205 million, 650% higher than the actual value in 2016. If Denmark had established an OEA with one of its exporting partners in 2016, the export value would have increased by 350% and reached \$9 million on average. However, some OEAs (e.g., between U.S.-Tunisia, U.S.-Turkey) would have negatively impacted the export value of organic food products to the corresponding markets in 2016.

The remainder of this paper is structured as follows. In Section 2, background information

the ratio of any other two competitors' market share in a given import market."

[9] Examples of export-oriented countries come from a blog written by Joelle Katto Andrighetto, head of policy and guarantee, IFOAM-Organics International, https://www.organicwithoutboundaries.bio/2018/08/15/data-collection-promote-organic/

on the organic policy and OEAs is provided. Section 3 provides an overview of literature related to organic standards/agreements and internationa trade. In Section 4, the structural model is proposed, and the data set is introduced. Section 5 presents estimation results and discusses counterfactual analyses, and Section 6 offers conclusions.

2 Background: Organic Food and Relevant Global Market

2.1 Organic and Organic Regulations in the U.S. and EU

The term “organic” originates from the Greek word “bios,” meaning life or way of living. The Codex Alimentarius Commission defines organic as a “labeling term that denotes products that have been produced in accordance with organic production standards and certified by a duly constituted certification body or authority” (Codex Alimentarius, 2007). Green Earth Organics provides an alternative definition of organic food products, “organic foods are minimally processed to maintain the integrity of the food without artificial ingredients, preservatives or irradiation” (Essoussi and Zahaf, 2008). The International Federation of Organic Agricultural Movement (IFOAM) defines organic agriculture as a production system that relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects, such as synthetic chemical fertilizers, pesticides and pharmaceuticals (Raynolds, 2004; IFOAM Norms, 2014).

Initially promulgated by third-party certification bodies and private organizations, organic standards, inspections, and certifications are increasingly regulated by government authorities. European governments established laws regulating organic certification and labeling in the 1980s (Michelsen, 2001). In 1991, the European Union published EU Council Regulation (EEC 2092/91) on organic production of agricultural products, and EEC 2092/91 came into force on January 1st, 1993. The EU Council adopted a new Council Regulation EC 834/2007 on organic production and labeling of organic products in July 2007, which came into force on January 1st, 2009. At the same time, two sets of implementing rules came into force under EC 834/2007: EC 889/2008 on detailed production rules for plants, livestock and processed products including yeast, and their labeling and control; EC 1235/2008 on detailed rules for imports from third countries. The latest version of the EU Council Regulation on organic production and labeling of organic products is EC 2018/848, which was published in May 2018 and would not be effective until January 1st, 2021.

In the United States, California was one of the first states to regulate organic products. In 1979, California passed the Organic Food Act into law, which defined the term "organic" (CCOF, 2015). In 1990, the Organic Foods Production Act (OFPA), enacted under the 1990 Farm Bill, authorized the U.S. Department of Agriculture (USDA) to establish the National Organic Program (NOP). NOP set regulations and guidance on certification, production, and labeling of organic products and finalized the national organic standards in 2001. By 2002, operations with gross agricultural income from organic sales of more than $5,000 must be certified organic by an accredited certification agent (ACA) and complied with the national organic standards.

2.2 Organic Equivalency Agreements

United States

In 2009, the U.S. established the first bilateral OEA with Canada. As a result, producers and processors who are certified by a USDA accredited certifying agent following U.S. National Organic Program (NOP) standards do not have to be certified by the Canada Organic Product Regulation (COPR) standards in order for their products to be represented as organic in Canada. Likewise, Canadian products certified under COPR standards may be sold or labeled in the United States as organically produced. In June 2012, the U.S. and the EU recognized one another's organic standards and control systems as equivalent. There are some notable exceptions to the U.S.-EU agreement, which require additional specifications and verifications. Some examples are agricultural products derived from animals treated with antibiotics from the EU, apples, and pears produced with antibiotics from the U.S. In addition, aquaculture products are not yet included in this agreement. An OEA between the U.S. and Japan went into effect in January 2014, and later, in July 2014, an OEA was established between the U.S. and South Korea. Finally, in July 2015, a bilateral OEA between the U.S. and Switzerland was established, marking its fifth organic equivalency arrangement.

European Union

The EU currently recognizes thirteen countries as being equivalent to the EU's organic standards and control systems; therefore, products assessed in conformity with organic standards in these thirteen countries are authorized to export to the EU labeled as organically produced products. These thirteen countries are listed in Annex III to EC 1235/2008, an implementation rule under EC834/2007 (known as the Third Country List). Chile is the newest member of the third country list with the organic agreement established between the EU and Chile in 2017. The other twelve countries and the year the EU OEA was established are as follows: Australia (1996), Argentina (1997), Israel (1997), Switzerland (1997), New Zealand (2002), Costa Rica (2003), India (2006), Tunisia (2009), Japan (2010), Canada (2011), United States (2012), and South Korea (2015). According to the IFOAM-Organic Equivalency Tracker (2019) and the best of my knowledge, only six countries in this third country list also accepted EU's organic standards and conformity assessment and thus constituted bilateral OEAs. They are Switzerland (1997), Japan (2010), Canada (2011), U.S. (2012), South Korea (2015), and Chile (2017). The OEAs between the EU and the other seven countries in the third country list can be treated as unilateral OEAs where the EU is the grantor.

Table 1 details the OEAs between exporters and two import markets from 2011 to 2016. In the U.S. market, notice that Croatia joined the EU in 2013; thus, Croatia was excluded from the US OEA partners in 2012 but included in 2013. Table 1 displayed thirteen countries which were recognized by the EU, including the EU-Chile OEA. However, notice that the EU-Chile OEA was established in 2017 and was out of range of sample period 2011-2016.

[Insert Table 1 here.]

3 Literature Review

Previous literature has a long-time debate on useful methods to reduce organic certification costs and how to codify organic regulations in order to facilitate international trade. Vogl et al. (2005) confirm that farmers and consumers pay for multiple certifications and accreditations, and Barrett et al. (2002) suggest that more efficient and affordable certification process should be made to facilitate organic trade to Europe, such as local inspection bodies. Arcuri (2015) studies the effects of the process of publicization and finds that public regulation allows private actors to maintain private standards and expand in new directions, on the other hand, the process of publicization might have reduced the regulatory capabilities of private regulators committed to core organic values. Padel et al. (2009) and Seufert et al. (2017) advocate the establishment of public regulations on organic products, but they both suggest that public regulations should focus more on the organic values and environmental practices rather than specific rules. Padel et al. (2009) compare the discrepancies of core organic values between private principles (IFOAM) and public regulations (EEC 2092/91), they suggest that concern of organic regulation should focus on harmonization of ethical values and principles rather than rules in order to protect the integrity of organic farming. Seufert et al. (2017) employ a scoring approach to assess how organic principles vary with organic regulations in countries. They find that substances that are allowed (or not) as inputs are codified in regulations while environmental best practices such as diversified crop rotations are less emphasized.

To be consistent with the organic principles and values in developed countries, scholars investigate the possibilities of developing multilateral agreements on organic products. Gandal and Shy (2001) develop a three-country and three-variety world economy model, they assume that each government decides whether or not to recognize foreign standards against with conversion costs in the first stage, and each firm sets prices to maximize profits and consumers make purchases in the second stage. They find that the likelihood of standardization unions would be higher if conversion costs overwhelm network effects, countries will choose to mutually recognize all standards with positive network effects and no conversion costs. Pekdemir (2018) introduces the development of regional organic standards established in the EU, Africa, Central America, the Pacific, Asia and concludes that inter-regional equivalence and multilateral agreements contribute to the reduction of regulatory complexity in organic regulation systems.

Several works of literature shed light on the international trade of organic products. Demko and Jaenicke (2017) obtain data from USDA GATS system, they use quarterly level data on 23 categories of the U.S. organic food products during 2011-2014 period and find that the Organic Equivalency Agreement between the U.S. and the EU established in 2012 brings about 9.1% increase in organic food export from the U.S. to the EU market. They minimize the distance between pre-treatment characteristics of a treated country and those of a country from comparison group to construct the optimal weight of the comparison group and then use the difference-in-difference method to assess the impacts of the U.S.-EU OEA. Oberholtzer et al. (2013) employ the Heckman model to explore organic handler's decision to import and how much of the organic product to import using a survey of organic handlers in 2007 administered by Washington State University. They find that larger organic firms are more likely to import organic products, while smaller firms are less likely to import, smaller firms would import a more considerable share once deciding to import.

Empirical models have been employed in emerging literatures to investigate the impacts of trade agreements on trade flow and trade pattern. Baier and Bergstrand (2007) use panel data for 96 potential trading partners in eight five-year intervals during 1960-2000 period to estimate the effects of Free Trade Agreements (FTAs) on member's trade, they find that FTAs will on average increase two member countries' trade about 100% after ten years. Baier and Bergstrand (2009) use nonparametric matching econometrics to estimate the long-run effects of Free Trade Agreements (FTAs) on members' trade, they find that the long-run effects of membership in the European Economic Community (EEC) and Central American Common Market (CACM) between 1960 and 2000 are 100%, not far away from gravity results. Egger and Larch (2008) employ spatial econometrics to revisit the effects of Preferential Trade Agreements (PTAs) using data for 145 countries during 1955-2005. They find that pre-existing PTAs have a positive impact on the probability of non-members to participate in existing PTAs, and this impact is more substantial for the pairs of countries which are geographically close to member countries of the pre-existing PTAs. Hertel et al. (2007) use Computable General Equilibrium (CGE) model to estimate elasticities of imports from different countries, and they find that nine of thirteen Free Trade Area of the Americas (FTAA) region experience a welfare gain.

This paper employs Berry, Levinsohn, and Pakes (1995) method, not only because of the development of BLP method in estimating demand parameters but also considering the similarities between BLP model and trade theory derived from Eaton and Kortum (2002). Berry, Levinsohn, and Pakes (1995) firstly provide a structural model to estimate demand and cost parameters in the U.S. automobile industry using only aggregate consumer-level and product-level data. Nevo (2001) extends the BLP method and employs a random coefficients logit model to estimate price-cost margins in the ready-to-eat cereal industry. He finds that product differentiation and multi-product firm pricing explain most of the observed price-cost margins. In Nevo's guide for practitioners (Nevo, 2000), he clearly points out three advantages of using BLP method: first, the model can be estimated using only market-level data such as price and quantity; second, it deals with the endogeneity of prices using instrument variables; third, it produces a more realistic demand elasticities pattern, in that, cross-price elasticities are larger for products that are closer substitutes. As noted by Eaton and Kortum (2002), "our model of trade bears resemblance to discrete-choice models of market shares, popular in industrial organization" (footnote 19). Heerman et al. (2015) use 2006 production and trade data on the 134 agricultural items to investigate bilateral trade patterns due to Asia-Pacific integration. They find that exporters would have occupied higher market shares if the United States was excluded from Asia-Pacific integration. If China was excluded, then the increase in the market shares of exporters would have been lower relative to U.S. exclusion. Compared with the U.S., fewer exporters produced close substitutes for agricultural products originated from China and were, therefore, less sensitive to the change of trade costs.

4 Methods and Data

Suppose there are I exporters and an *outside exporter* engaging in international trade. In this model, it is assumed that importers may decide not to purchase a specific product from any of the I exporters; in this case, the exporter from which they choose to purchase products is defined as the *outside exporter*. Exporters are indexed by $i \in \{0, 1, 2, \ldots\ldots I\}$, where $i = 0$ represents the *outside exporter*. Importers are indexed by n, and products are indexed by j. This analysis uses as a basis for the Eaton and Kortum model (2002). To this, specific land productivity and other aspects of the production function used by Heerman et al. (2015) are added, and add production is assumed to follow:

$$q_{ij} = z_{ij}(N_i^{\beta_i}(a_{ij}L_i)^{1-\beta_i})^{\alpha_i} Q_i^{1-\alpha_i} \tag{1}$$

where q_{ij} is the output of product j in exporter i, z_{ij} represents product j-specific technological productivity in exporter i, N_i, L_i, and Q_i refers to input of labor, land, and intermediate inputs, respectively. The newly added measure of product-specific land productivity, a_{ij}, reflects the overall suitability of exporter i's environment for producing product j.

Following Eaton and Kortum (2002), it is assumed that exporter i's technological productivity follows a Frechet distribution (also called the Type II extreme value distribution):

$$F_i(z) = e^{-T_i z^{-\theta}} \tag{2}$$

where $T_i > 0$ and $\theta > 1$. The country-specific scale parameter T_i governs the location of the distribution; a higher value of T_i implies that it is more likely to draw a high productivity for any product j in country i. The shape parameter θ reflects the amount of variation within the distribution, and a larger θ implies less variability in productivity across products.

With perfect competition, the price offered by exporter i in market n for product j is equivalent to the unit production cost multiplied by the cost of trading product j between countries i and n:

$$p_{nij} = \frac{a_{ij}^{-\alpha_i(1-\beta_i)} c_i \tau_{nij}}{z_{ij}} \tag{3}$$

where p_{nij} represents the price offered by exporter i in market n for product j; where c_i is the cost of an agriculture input bundle in exporter i. The product-specific cost of land input in exporter is reflected by $a_{ij}^{-\alpha_i(1-\beta_i)}$, and the power $\alpha_i(1-\beta_i)$ is derived from measures of the responsiveness of output to a change in the productivity of land used in production. The trade cost of delivering product j from exporter i to market n is denoted as τ_{nij}. The Samuelson iceberg assumption is adopted, which implies that delivering one unit of product j to country n requires shipping $\tau_{nij} > 1$ units for $n \neq i$ from country i since a portion of goods are disappeared during the delivery. If there is no cross-border delivery, trade costs within each country are assumed negligible, then $\tau_{iij} = 1$. Cross-border arbitrage forces effective geographic barriers to obey the triangle inequality[10]: for any three countries, i, k, n, $\tau_{inj} \leqslant \tau_{ikj}\tau_{knj}$.

The method developed by Eaton and Kortum (2002) is used to obtain the probability that exporter i offers the lowest price for product j in market n (See Appendix A).

Denoting the exporter's product-specific cost of land input $a_{ij}^{-\alpha_i(1-\beta_i)}$ as $\tilde{a_{ij}}$, then the probability that exporter i offers the lowest price for product j in market n is:

$$\pi_{nij} = \frac{T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}{\sum_{i=0}^{I} T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}} \tag{4}$$

where π_{nij} represents the probability that price of product j offered by exporter i is equal to or lower than the price offered by any other exporter in market n; where T_i is scale parameter for exporter i's technological productivity distribution.

Rearranging equation (4) to express market share in the form of a logit formula:

[10]Triangle inequality implies that trade cost of delivering product j from country i to country n always costs less than or equal to trade cost of delivering from country i to country n thorugh country k rather than straightforward delivery from country i to country n.

$$
\begin{aligned}
\pi_{nij} = e^{ln(\pi_{nij})} &= e^{ln(\frac{T_i(\widetilde{a_{ij}}c_i\tau_{nij})^{-\theta}}{\sum_{i=0}^{I} T_i(\widetilde{a_{ij}}c_i\tau_{nij})^{-\theta}})} \\
&= e^{ln(T_i(\widetilde{a_{ij}}c_i\tau_{nij})^{-\theta})-ln(\sum_{i=0}^{I} T_i(\widetilde{a_{ij}}c_i\tau_{nij})^{-\theta})} \\
&= \frac{e^{ln[T_i(\widetilde{a_{ij}}c_i\tau_{nij})^{-\theta}]}}{e^{ln[\sum_{i=0}^{I} T_i(\widetilde{a_{ij}}c_i\tau_{nij})^{-\theta}]}} \\
&= \frac{e^{lnT_i-\theta lnc_i+\theta\alpha_i(1-\beta_i)lna_{ij}-\theta ln\tau_{nij}}}{\sum_{k=0}^{I} e^{lnT_k-\theta lnc_k+\theta\alpha_k(1-\beta_k)lna_{kj}-\theta ln\tau_{nkj}}}
\end{aligned} \tag{5}
$$

We denote V_{ij}^E, V_{nij}^t, and ν_{nij} as random variables drawn from distribution of unobserved product j-specific agro-ecological characteristics in exporter i, unobserved product j-specific trade cost between exporter i and market n, and unobserved product j-specific standard deviation from the mean effect of OEA respectively. Integration with respect to the product-related random variables is used to identify the market share specific to exporter i and market n. We also normalize the mean effect of *outside exporters'* characteristics on trade flow to zero. The random coefficients logit model can thus be written as:

$$
\pi_{ni} = \int \frac{exp(lnT_i - \theta lnc_i + \theta\alpha_i(1-\beta_i)lna_{ij}(V_{ij}^E) - \theta ln\tau_{nij}(V_{nij}^t, \nu_{nij}))}{1 + \sum_{k=1}^{I} exp(lnT_k - \theta lnc_k + \theta\alpha_k(1-\beta_k)lna_{kj}(V_{kj}^E) - \theta ln\tau_{nkj}(V_{nkj}^t, \nu_{nkj}))} dV_{ij}^E dV_{nij}^t d\nu_{nij} \tag{6}
$$

The definition of a market determines the set of available exporters, and we define a market as an importer-year combination. That is, each importer (U.S. or Denmark) combined with each year (from 2011 to 2016) is defined as a new "market". Overall, this definition results in 12 markets, encompassing two import markets and six years. The random coefficients logit model which describes the organic food market share of exporter i in market n at time t can thus be rewritten as the following:

$$
\pi_{nit} = \int \frac{exp(lnT_{it} - \theta lnc_{it} + \theta\alpha_i(1-\beta_i)lna_{ijt}(V_{ijt}^E) - \theta ln\tau_{nijt}(V_{nijt}^t, \nu_{nijt}))}{1 + \sum_{k=1}^{I} exp(lnT_{kt} - \theta lnc_{kt} + \theta\alpha_k(1-\beta_k)lna_{kjt}(V_{kjt}^E) - \theta ln\tau_{nkjt}(V_{nkjt}^t, \nu_{nkjt}))} dV_{ijt}^E dV_{nijt}^t d\nu_{nijt} \tag{7}
$$

Following Eaton and Kortum (2002) and Heerman et al. (2015), $S_{it} = lnT_{it} - \theta lnc_{it}$, S_{it} represents exporter i's "competitiveness" at time t, its state of technology adjusted for its intermediate input costs. Then we simplify the random coefficients logit model as:

$$\pi_{nit} = \int \frac{exp(S_{it} + \theta\alpha_i(1-\beta_i)lna_{ijt}(V^E_{ijt}) - \theta ln\tau_{nijt}(V^t_{nijt}, \nu_{nijt}))}{1 + \sum_{k=1}^{I} exp(S_{kt} + \theta\alpha_k(1-\beta_k)lna_{kjt}(V^E_{kjt}) - \theta ln\tau_{nkjt}(V^t_{nkjt}, \nu_{nkjt}))} dV^E_{ijt} dV^t_{nijt} d\nu_{nijt} \tag{8}$$

where V^E_{ijt} and V^t_{nijt} follows the standard multivariate normal distribution, and ν_{nijt} is random variable drawn from the standard normal distribution.

Next, we specify $S_{it} + \theta\alpha_i(1-\beta_i)lna_{ijt}$ as a function of exporter agro-ecological characteristics, product agro-ecological characteristics, exporter, and time fixed effects.

$$S_{it} + \theta\alpha_i(1-\beta_i)lna_{ijt} = X_{it}\varphi + X_{it}\Sigma_E V^E_{ijt} + \lambda_i + \lambda_t \tag{9}$$

where S_{it} represents exporter i's "competitiveness" at time t, defined as $X_{it}\varphi + \lambda_i + \lambda_t$; where X_{it} is a $1 * g$ vector of variables describing exporter i's agro-ecological characteristics at time t; φ is a $g * 1$ vector of coefficients; λ_i is exporter fixed effects, and λ_t is time fixed effects;

We define X_{it} as:

$$X_{it} = f(orgland_{it}, \quad orgshare_{it}, \quad temp_i) \tag{10}$$

where $orgland_{it}$ is the log of organic arable land in exporter i at time t, $orgshare_{it}$ is the organic arable land share of total farmland in exporter i at time t, and $temp_i$ represents the share of total arable land area in temperate climate zones in exporter i.

$$\theta\alpha_i(1-\beta_i)lna_{ijt} = X_{it}\Sigma_E V^E_{ijt} \tag{11}$$

where a_{ijt} represents organic product j-specific land productivity in exporter i at time t, which reflects the overall suitability of exporter i's environment for product j at time t; where V^E_{ijt} is a $g * 1$ vector that captures the effect of unobservable product j-specific agro-ecological characteristics in exporter i at time t with diagonal scaling matrix Σ_E $(g * g)$.

We specify product-specific trade cost $-\theta ln\tau_{nijt}$ as the following:

$$-\theta ln\tau_{nijt} = t_{nit}\eta + t_{nit}\Sigma_t V^t_{nijt} + \gamma OEA_{nit} + \sigma\nu_{nijt} OEA_{nit} + \lambda_n + \xi_{nit} \tag{12}$$

where t_{nit} is a $1 * h$ vector describing the relationship between exporter i and market n at time t; η is a $h * 1$ vector of parameters;

We define t_{nit} as:

$$t_{nit} = f(border_{ni}, \quad language_{ni}, \quad rta_{nit}, \quad d_{ni}, \quad exgdp_{it}, \quad imgdp_{nt}) \tag{13}$$

where equal to one if the two countries share a common border ($border_{ni}$), language ($language_{ni}$), or are members of a common regional free trade agreement at time t (rta_{nit}). The log values of the gross domestic product measured in 2010 constant dollars in exporter i at time t and importer n at time t are denoted by $exgdp_{it}$ and $imgdp_{nt}$ respectively. The population-weighted average distances between the largest cities in each trading country pair are separated into five categories and denoted as d_{ni}.
where V^t_{nijt} is a $h * 1$ vector that captures the effect of unobservable product j-specific trade costs between exporter i and market n at time t with diagonal scaling matrix Σ_t $(h * h)$;
where OEA_{nit} would equal to one if exporter i and market n signed bilateral organic equivalency agreement or unilateral organic equivalency agreement where the market n is the grantor at time t. The coefficient of OEA_{nit} follows a normal distribution with mean γ and standard deviation σ; where ν_{nijt} is a random variable drawn from standard normal distribution.
A market-specific trade cost captured by a fixed effect λ_n, and ξ_{nit} captures unobservable or unquantifiable bilateral trade costs that are common across products and orthogonal to the regressors at time t (For detailed estimation procedures, see Appendix B);

4.1 Instrumental Variable Construction

OEA_{nit} is considered an endogenous variable because the importing countries may observe and consider exporting countries' characteristics which are unobserved or unquantified by researcher, when deciding whether signing OEA with exporters. For example, China signed OEA with New Zealand in 2016 because Chinese consumers lost confidence in dairy products resulted from Melamine milk powder incident in 2008.[11]

Due to the endogeneity of OEAs, an instrumental variable (IV) is devoted to a consistent estimation. The IV should be correlated with the endogenous explanatory variable (indicator for the establishment of OEAs), conditional on the other covariates. If, for example, charac-

[11]Yin et al. (2018) found that consumers were willing to pay 6.679 US dollars higher for infant milk powder with country of origin label from New Zealand compared with label from China by conducting a choice experiment survey.

teristics of exporters who already signed organic equivalency agreement with market n at time t were similar to a potential OEA signatory, then there may be a higher probability of this country pair signing a new OEA. Here the IV is defined as the absolute value of the difference between the average number of organic farmers in exporting countries who already signed OEA with market n at time t and the number of organic farmers in exporter i at time t.[12]

Use of the number of organic farmers as the IV informs how similar (or remote) exporter i is to other OEA exporters to market n rather than similarity to market n itself. Therefore, this IV is not correlated with unobservable and unquantified variables which affect the trade flow between exporter i and market n at time t. Thus this IV is unrelated to the econometric error term in the model (ξ_{nit}).

4.2 Data

The dependent variable is defined as the market share of exporter i in market n at time t. The market share (π_{nit}) is computed as the ratio of the imported value of organic food products from exporter i to value of organic food products imported from all sources at time t.

The value of organic agri-food trade between exporters and the two import markets of focus, the U.S. and Denmark are obtained from the USDA Foreign Agricultural Service's Global Agricultural Trade System (GATS) and Statistics Denmark, respectively. Due to the identification strategy, an observation was dropped if the market share equaled zero[13]; as such, the set of available exporters to each market varied over time. Table 2 shows that the combined market share of all exporter to the U.S. market (n=82) included in this analysis. These countries reflected 98.8% of organic food exports to the U.S., and 96.5% of exports Denmark during the period of study of 2011-2016.

[12]The intuition of IV comes from Baier and Bergstrand (2002), who used the absolute value of the difference between free trade agreements (FTAs) member countries' capital-labor ratio with respect to the rest of the world?s (ROW's) average capital-labor ratio as IV to solve the endogeneity of indicator for FTAs. They found that the smaller the relative factor-endowment differences (capital-labor ratio) with the ROW, the more likelihood of signing an FTA. Apart from the IV we selected, we also made an effort on several alternative IVs. For example, the RTA indicator, the aggregate bilateral trade value on agricultural products, the same IV in this study but removing the absolute value. However, they are not valid since they are negatively related to the indicator for OEAs and result in a negative mean effect of OEAs on the value of export.

[13]The selection of organic exporters included in this analysis is limited by the availability of data for the number of organic producers (needed for the IV construction). An observation was dropped if the market share was equal to zero; 267 observations were eliminated for this reason. Observations with zero market share are excluded due to the identification strategy, in specific, the contraction mapping (fixed-point iteration) clarified in Appendix B-step 3. To estimate the mean effect, we simulated the market share and then minimized the difference between observed and predicted market share. An estimate of the mean effect could not be generated if the observed market share were equal to zero.

Data concerning the organic arable land and the share of organic arable land to total farmland in exporter i at time t are obtained from the Research Institute of Organic Agriculture (FiBL) statistics (Willer, 2018).[14]

The average log value of organic arable land was 11.58 during the sample period, amounting to approximately 106,940 hectares. Organic arable land accounted for an average of 3 percent of total farmland over the period of study.

Data for total arable land in tropical, temperate, and boreal climate zones in exporter i were collected from the Development of the GTAP land use database (Avetisyan, Baldos, and Hertel, 2011). It was assumed that the total arable land in the above three climate zones in exporter i did not vary over time.[15] In this dataset, arable agriculture land is sorted into 18 agroecological zones (AEZ). AEZ 1-6 represents a tropical land area, AEZ 7-12 represents a temperate land area, and AEZ 13-18 represents a boreal land area. The sum of the arable land in each climate zones was calculated, and the ratio of arable land in each climate zones to all the three climate zones was computed. Table 2 shows that the average share of arable land in temperate zones was 63 percent, which is higher than average shares of arable land in tropical climate zones (around 34 percent) and boreal climate zones (around 3 percent).

[Insert Table 2 here.]

Standard gravity variables, such as a dummy variable indicating whether countries share a common border, a common language, and whether they are both members of a given Regional Trade Agreement, were obtained from the Centre d'Études Prospectives et d'Informations Internationales (CEPII, Head et al., 2010). The real Gross Domestic Product (GDP) of exporters and importers during the sample period were obtained from the World Bank Development Indicators.[16] Population-weighted average distances between the largest cities in each trading country pair were obtained from CEPII and separated into five distance categories following Eaton and Kortum (2002). Eaton and Kortum (2002) explained that the advantage of using

[14] "FiBL is an independent and non-profit organization and is considered to be one of the world's leading organic farming information and research centers. In conjunction with the International Federation of Organic Agricultural Movments (IFOAM), FiBL annually conducts a global survey and report 'The World Organic Agriculture' (Willer et al., 2018)."

[15] The GTAP land use database reports production data every 3-4 years; data later than 2011 are not available. The data availability limits our research to time-invariant effects of climate characteristics in exporting countries. The GTAP Research Memorandum No. 30 reports the latest version of GTAP land use and land cover database; it can be accessed at https://www.gtap.agecon.purdue.edu/resources/download/8800.pdf.

[16] World Bank Development Indicators Data can be accessed at https://databank.worldbank.org/reports.aspx?source=2&series=NY.GDP.MKTP.KD&country=#

distance intervals rather than continuous distance measures was imposing little structure on how geographic barriers vary with distance. As presented in Table 2, 69 percent of country pairs were located greater than 6,000 miles apart, 16 percent of country pairs had relatively far trading distance (1,500 - 6,000 miles), 9 percent had a median trading distance (750 - 1,500 miles), and 5 percent relatively short trading distance (0 - 750 miles).

The OEA dummy variable indicated that, on average, 40 percent of country pairs were OEA partners in the study period. The instrument variable for OEA endogenous variable, defined as the absolute value of the difference between the number of organic producers in exporter i and the average number of organic farmers in all countries who are OEA partners of market n at time t, was an average of 33,170 during the sample period.

5 Results

In this section, we report the results of the random coefficients logit model (Table 3) and the exporter fixed effects model (Table 4). Then we conduct counterfactual analysis to predict the imported value of organic food products if the U.S. and Denmark signed an OEA with another organic food exporter in 2016 (Table 5). The response of non-OEA exporters to the creation of a new OEA with either the U.S. and Denmark in 2016, is then explored (Table 6, 7, respectively). Another a second type of counterfactual analysis, which predicts the impact on organic food imports by the U.S. and Denmark if one of these countries withdrew from an OEA, is also presented (Table 8).

Columns 4-7 in Table 3 show estimates of mean effects and unobserved product-specific deviations in the random coefficients logit model. A positive mean effect of covariate implies that exporting country occupies a higher market share on average, and the unobserved deviations of covariate capture the heterogeneity in effects across products. Columns 4 and 5 show the parameters and coefficients of mean values of explanatory variables, and columns 6 and 7 report the parameters and coefficients of product-specific deviations of covariates.

The mean effect of the OEA indicator (OEA_{nit}) is 2.65 and statistically significant, indicating that exporters that are OEA partners of the importer occupy a higher share in this market relative to non-OEA partners. The product-specific deviation of OEA indicator (OEA_{nit}) is positive and statistically significant, which implies that the effect of OEA on trade flow varies with products, while the magnitude of deviation is relatively small compared to standard deviations of other explanatory variables.

The mean effect of organic arable land ($orgland_{it}$) is shown in column 5 and denoted by parameter $\varphi^{orgland}$. It results in a coefficient (0.05) that is positive and statistically significant, implying that market share is increasing for organic land-intensive exporters. The product-specific deviation of organic arable land ($orgland_{it}$) is shown in column 7 and denoted by parameter $\Sigma_E^{orgland}$. The positive and significant coefficient (0.03) indicates that market share is increasing for organic land-intensive products. The mean effect of the organic land share of total farmland ($orgshare_{it}$) is 0.04 but not significant, denoted by parameter $\varphi^{orgshare}$. The product-specific deviation of the organic land share of total farmland ($orgshare_{it}$) is shown in column 7 and denoted by parameter $\Sigma_E^{orgshare}$. It results in a coefficient (-0.02) that is negative and statistically significant. This finding is reasonable considering the norm of exporters with large amounts of organic land but a small share of total farmland. The mean effect of arable land in temperate climate zones ($temp_i$) is 14.96 and significant, denoted by parameter φ^{temp}. It suggests that the market share is relatively high for exporters with more temperate-climate-intensive farmland, compared to those exporters with more tropical or boreal-climate-intensive farmland.

[Insert Table 3 here.]

The mean effects of trade cost-related variables, such as the dummy variables for common border ($border_{ni}$) and common language ($language_{ni}$) between country pairs are shown in column 5 (denoted by parameters η^{border} and $\eta^{language}$). The negative and statistically significant coefficients (-0.97 and -0.30) indicate that market shares are lower for exporters that share a common border and common language with the importer relative to exporters without sharing a common border or common language. It seems inconsistent with results of other gravity models, however, considering that only 3 percent of country pairs in the sample shared a common border, and 14 percent shared a common language, the result is consistent with structure of data used in this study. Besides, neighboring countries are likely to share similar agro-ecological characteristics and therefore produce similar products with domestic farmers, resulting in a lower market share (Heerman et al., 2015).

The product-specific deviations of dummy variables for a common border ($border_{ni}$) and common language ($language_{ni}$) are shown in column 5 (denoted by parameters Σ_t^{border} and $\Sigma_t^{language}$). The coefficients are both 0.01 and smaller than the corresponding mean effects, indicating a small heterogeneity in effects of contiguous border and common language across products. The mean value of the RTA indicator (rta_{nit}) is denoted by parameter η^{rta}, resulting in a positive and significant coefficient (0.10). It implies that there is an increasing market share for exporters who are party to the same regional trade agreements as the importer.

As for the mean effects of distance indicators shown in column 5, a smaller value indicates that the market shares contract more for exporters that are farther away from importers relative to the smallest distance range (0-750 miles). For example, the mean effect of $distance2_{ni}$ is -2.25, indicating that the market shares of country pairs in the median trading distance range (750 - 1,500 miles) are smaller than the market shares of country pairs in the smallest trading distance range (0 - 750 miles). The mean effects of $distance3_{ni}$, $distance4_{ni}$, and $distance5_{ni}$ are -4.94, -4.85, and -6.33, showing that the effect of distance on market share is increasing. The product-specific deviation of $distance5_{ni}$ results in a negative and statistically significant coefficient (-0.03), implying that products are even more sensitive to the larger distance.

The mean effect of real GDP of exporters ($exgdp_{it}$) is negative but not significant (-2.24), while the mean effect of real GDP of importers ($imgdp_{nt}$) is positive and statistically significant (1.89), indicating that exporters incline to export more organic products to larger economies. The year fixed effect estimates imply that organic trade was more active in 2015 and 2016, but less active in the first four years.

Exporter fixed effect captures the unobserved heterogeneity that are constant for a given exporter across importers and time. Table 4 shows the results for the exporter fixed effects. Indonesia had the largest exporter fixed effect (15.89), followed by Thailand (15.39), and Brazil (15.02). The smallest exporter fixed effect was Albania (-15.52), followed by Latvia (-14.85), and Slovenia (-13.49). Further, the exporter fixed effect values of the top three exporters by volume of exports in 2016, the US, Italy, and China, were all positive.

[Insert Table 4 here.]

Two counterfactual analyses were conducted based on estimates and equation (6). One analysis investigated what would happen if the market signed an OEA with a non-OEA partner in 2016. The other analysis explored what would happen if the importer removed an OEA with an exporter it had an OEA with in 2016. Each of these counterfactual analyses was conducted for the U.S. and Denmark. Table 5 shows the simulated results pertinent to the response of the exporter that newly established OEA with the market in 2016. Table 6 and Table 7 show the results with respect to the response of the remaining exporters with the status of the OEA unchanged. Notice that the total import value on organic food in each market was kept constant when conducting the counterfactual analysis. For example, in 2016, the total import value on organic food from all exporters, including outside exporters, was \$1.69 billion in the U.S., and \$0.48 billion in Denmark. The market share for active exporters in the sample was simulated and then multiplied by the total import value of organic food for both the U.S. and Denmark in 2016. Therefore, Table 5, Table 6, and Table 7 should be jointly examined to explain the results of this simulation.

[Insert Table 5 here.]

From Table 5, the average actual export values from non-OEA exporters to the U.S. and Denmark in 2016 were \$27 million and \$2 million, respectively. If the U.S. had signed an OEA with one of the non-OEA exporting partners in 2016, then the simulated average value of export to the U.S. in 2016 would have averaged \$205 million, 650% higher than the actual value. If Denmark had established an OEA with one of its non-OEA exporting partners in 2016, the export value would have increased by 350% and reached an average of \$9 million.

[Insert Table 6 here.]

Case A in Table 5 shows that the Philippines would have experienced the highest growth rate in the U.S. market under the establishment of an OEA with the U.S. in 2016. At the same time, market shares of other exporters in the U.S. market would have decreased. Combining results from Table 5 and information from Table 6, 32.9% of remaining active exporters ($n - 1 = 70$), including six OEA exporting partners and seventeen non-OEA exporting partners, would have experienced drop in market shares in response to the establishment of an OEA between the Philippines and the U.S. in 2016. Romania, an OEA exporter, and Tunisia, a non-OEA exporter, suffered most in the Philippines experiment. In this model, Romania contracted to only 23% of its actual value of export to the U.S. in 2016, and Tunisia shrunk to only 6% of its actual value of export to the U.S. in 2016. According to data from the FiBL Survey regarding land use for organic food products, the predictive trade pattern seems consistent with the proposed theory. The Philippines produces and sells organic banana, organic coconut, organic rice, organic sugarcane, organic tropical and subtropical fruits to consumers worldwide. U.S. consumers treat organic rice originating from Romania and organic tropical and subtropical fruits sold by Tunisia as close substitutes for such products from the Philippines. Therefore, Romania and Tunisia were sensitive to the reduction of trade costs between the Philippines and the U.S., leading to a dramatic drop in their market shares in 2016.

The findings also indicate that several exporters would not have benefitted from signing an OEA with the U.S. in 2016. For example, the rates of change in Tunisia, Turkey, and Ukraine were negative. Combined with Table 6, this negative change could be explained by exploring the responses of the remaining exporters. In the case of Tunisia, the model resulted in increased U.S. market shares relative to actual U.S. market shares in 2016 for 75% of the remaining OEA exporters and 65.2% of the remaining non-OEA exporters. It indicates that more than half of U.S. exporting partners produce and sell organic food products that are regarded as fewer substitutes for those originating from Tunisia, making them less sensitive to the reduction of trade costs between Tunisia and the U.S. and squeezing out Tunisia. The same trade patterns are found in the cases of Turkey and Ukraine.

[Insert Table 7 here.]

From Case B in Table 5, Indonesia would have benefitted most by establishing an OEA with Denmark in 2016, followed by Chile and Ethiopia. Taking into consideration the progress made by Chile and the E.U. by initiating a bilateral agreement on trade in organic products in December 2017, the discussion of findings related to predictive trade pattern is focused on the Chile case. If Denmark and Chile had signed an OEA in 2016, the export of organic food products from Chile to Denmark would have increased from $39,000$ to \$15 million, more than 300 times the actual value of export in 2016. Combined with information found in Table 7, at the same time, 61.8% of remaining active exporters ($n - 1 = 55$) in the Danish market would have experienced a drop in market share, including eighteen OEA exporting partners and sixteen non-OEA exporting partners. Bulgaria, an OEA exporter, and the Philippines, a non-OEA exporter, would have experienced the most significant decreases in market shares from the Chile experiment. To be specific, Bulgaria contracted to only 4% of its actual value of export to the Denmark in 2016, and the Philippines shrunk to only 2% of its actual value of export to Denmark in 2016. This trade patterns indicated that Bulgaria and the Philippines produced and sold organic food products that were close substitutes to those originating from Chile in 2016 and thus were most sensitive to the reduction of trade costs between Chile and Denmark. According to data from the FiBL Survey related to land use for organic food products, such trade pattern can be explained as the following scenario: consumers in Denmark treated organic apples and strawberries sold by Bulgaria as close substitutes for those originating from Chile and organic tropical and subtropical fruits originating from Chile and the Philippines as close substitutes.

Similar to the U.S. case, several countries, including the Philippines, Cambodia, and Pakistan, seemed to benefit from a change in OEA status with Denmark hardly. An interesting finding is that the Philippines would not have received benefits from the establishment of OEA with Denmark in 2016, while it was predicted to experience the highest export growth from the establishment of OEA with the U.S. in 2016. If the Philippines had signed an OEA with Denmark in 2016, the simulated value of export to Denmark would have dropped from $194,000 to $66,000, accounting for 34% of its actual export value. Based on the simulated results, the Philippines was positioned at opposite extremes in the U.S. and Denmark organic markets in 2016.

Comparing the trade pattern experienced by the same country in two markets was similar to naturally controlling for the agroecological characteristics and technological productivity in the exporting country. Thus, the opposite extremes reflected by the model might reflect the actual extreme situations that the Philippines faced in two markets. Namely, factors that influence bilateral trade costs, such as distance and whether the remaining exporters in the market produce and sell close substitutes to those originating from the Philippines or not. Therefore, the scenarios can be explained by the following: organic food products sold by the Philippines were treated as close substitutes to those originating from other exporters in the U.S., and exporters in the U.S. market were sensitive to the change of trade costs between the Philippines and the U.S.; while Danish consumers treated organic food products sold by the Philippines as fewer substitutes to those originating from other exporters in Denmark, and exporters in the Danish market were less sensitive to the change of trade costs between the Philippines and Denmark. Considering that Denmark is a member country of the E.U., the other exporting countries, especially the remaining member countries of the E.U., might have a comparative advantage in terms of distance and consumer trust in food safety. Combining results from Table 5 with information collected from Table 7, 43.8% of the OEA exporters and 34.8% of the non-OEA exporters in the Danish market would have experienced higher market shares relative to their actual market shares, in response to the simulation under which the Philippines signed an OEA with Denmark in 2016.

Table 8 shows the results for the second counterfactual analysis. If the U.S. had withdrawn from the organic equivalency agreement with an existing OEA partner in 2016, the simulated export volume would have averaged $1.5 million, 9% of the actual export volume. If Denmark had withdrawn from the organic equivalency agreement with an existing OEA partner in 2016, the simulated value of export from OEA exporting partners to Denmark would have dropped to an average of $1.25 million, 9% of the actual export value. Table 8 shows that withdrawing from the organic equivalency agreement with existing OEA partners would have induced decreased market shares of the OEA partner in the market of the U.S. and Denmark in 2016. Exceptions to this were Sweden in the U.S. market and Argentina and Costa Rica in the Danish market. Consumers in the U.S. market seem to treat organic coffee originated from Sweden as unique food products and organic coffee originating from other exporting countries as less close substitutes; consumers in Danish market prefer organic soybeans, organic wheat and organic oilseeds sold by Argentina and treat organic bananas, organic pineapples produced in exporting countries other than Costa Rica as less close substitutes for those originated from Costa Rica. Therefore, withdrawing from the organic equivalency agreement with the U.S. and Denmark does not affect the comparative advantage of organic food products originated from these exporting countries.

[Insert Table 8 here.]

6 Conclusion

This study estimated the effects of Organic Equivalency Agreements (OEAs) on the value of exports of organic food products from exporting countries to the markets of the U.S. and Denmark. Unobserved product-specific agroecological characteristics in exporting countries and product-specific bilateral trade costs between exporting and importing countries were simulated to estimate the parameters, and then predict the value of exports for each active exporter in the two markets in 2016. The adoption of the BLP method is superior to the OLS in the gravity model analysis for two reasons. First, it provides a broader view of OEAs by observing the effects on all active exporters, allowing policymakers from both exporting and importing countries to get acquainted with how each exporter responds to the establishment of each possible OEA. Second, the dynamic model contributes to a more comprehensive and objective understanding of OEAs. That is, not all OEAs necessarily cause positive effects on the value of exports to the market. This point of view is crucial for the organic industry which relies on resource endowments and consumer trust in food safety.

In this model, OEAs had positive effects on the export values of most exporting countries to the markets of the U.S. and Denmark. Additionally, withdrawing from OEAs would cause adverse effects on trade volumes from most exporting countries. On average, exporting countries that share an OEA with the importing country would occupy higher market shares relative to those who are non-OEA partners. Given that OEAs facilitate the harmonization of organic standards worldwide and act as stepping stones towards the construction of an organic standards union and upgrades to organic standards regulations, it is vital to understand the effects of OEAs on international trade. The first-time inclusion of unilateral OEAs makes this study more meaningful for export-oriented countries, such as Argentina, Chile, and Peru; and several high-value importing countries who desire stringent standards for organic food products, such as Australia, the E.U., Japan, New Zealand, and Switzerland.

Based on the comparative advantage of exporting countries rather than political willing, this study allows competitive developing countries to enter the vision field of developed importers. For example, the results indicate that Philippines would have experienced the highest growth rate of export if the Philippines signed OEA with the U.S. in 2016; and Indonesia would have obtained the largest benefit from the establishment of OEA with Denmark in 2016. Meanwhile, the policymakers in the importing countries (the U.S. and Denmark) are able to identify how the remaining exporting partners would have repositioned under the possible establishment of new OEAs. Therefore, this study offers a comprehensive prediction of the OEA "map."

On the other hand, this study enables the policymakers in the importing countries (the U.S. and Denmark) to make decisions on accelerating the development of organic regulations in selected exporting countries by signing new OEAs. As mentioned in the previous section, eighteen countries are in the process of drafting organic legislation. In this case, the establishment of OEAs contributes to building trust on signatories? organic production and quality control systems and facilitating organic trade between importer and exporting countries with comparative advantage of producing products of interest.

This study focused on only two organic markets, the U.S. and Denmark; thus, the results are limited to these two markets and should be carefully interpreted. Internationally, organic markets vary with many respects, including GDP, per-capita consumption of organic food products, and remoteness from the rest of the world. Future work should be extended to more markets across the world to understand the impact fully. Although this work predicted a more realistic trade pattern for organic food products compared to previously published studies, the counterfactual analysis was implemented on active exporting countries with positive trade volume in the markets due to identification strategy. As a result, future work should be extended to exporting countries with zero trade flow in the markets. For example, if the importing country signed OEAs with neighboring countries of the zero-trade-value exporting country, or with exporting countries who produced and sold close substitutes for those originated from the zero-trade-value exporting country, then whether the zero-trade-value exporting country would have decided to enter the market or not. This study only investigated the effects of signing bilateral/unilateral OEAs to be consistent with the reality; future research can be extended to the effects of multilateral organic agreements or predicted trade pattern under regional organic standards union.

The approach used in this study is suggested to be applied to two kinds of work in international trade literature. First, this study fully considers the endogeneity of trade agreements and fills the blank suggested by Baier and Bergstrand (2007) who claimed that effects of Free Trade Agreements (FTAs) were likely to differ and left this research question to future research (Baier and Bergstrand, 2007, p.92). If researchers believe that the trade agreements such as FTAs and RTAs (Regional Trade Agreements) have different impacts on trading country pairs, either depending on the economic size, per capita incomes and distance suggested by Baier and Bergstrand (2007), or relying on product-specific agro-ecological characteristics in exporting countries, product-specific trade costs between exporting and importing countries suggested by this work, this study offers an intuitive example. Second, this study also provides researchers with an innovative approach if the researchers are interested in the impacts of trade policy or food standards on the trade value, assuming that comparative advantage plays an essential role rather than political willing.

Supplementary Information

The Supplementary Information (Appendix C) reports the response of the remaining exporters to one more OEA partner with U.S. and Denmark in 2016 under each possible establishment of OEA. Appendix C is available on my website: www.siqizh.weebly.com

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TABLE 1: OEA TRADING PARTNERS OF IMPORT MARKETS

Import Market	OEA Partner	Effective Year
U.S.	Canada	2009
	EU	2012
	Japan	2014
	Republic of Korea	2014
	Switzerland	2015
Denmark	Australia	1996
	Argentina	1997
	Israel	1997
	Switzerland	1997
	New Zealand	2002
	Costa Rica	2003
	India	2006
	Tunisia	2009
	Japan	2010
	Canada	2011
	U.S.	2012
	Republic of Korea	2015
	Chile	2017

Notes: More OEA fact sheet can be retrieved from IFOAM organics international website. https://www.ifoam.bio/en/organic-equivalence-tracker

TABLE 2: SUMMARY STATISTICS

Variable	Description	Mean	Standard Deviation	Minimum Value	Maximum Value
π_{nit}	Dependent variable, market share of exporter i in market n at time t	0.02	0.04	0.00000065	0.25
$orgland_{it}$	Log of organic arable land in exporter i at time t, hectare	11.58	2.05	5.52	17.12
$orgshare_{it}$	Organic arable land share of total farmland in exporter i at time t	0.03	0.04	0.01	0.22
$temp_i$	Share of total arable land area in temperate climate zones in exporter i	0.63	0.43	0	1
trp_i	Share of total arable land area in tropical climate zones in exporter i	0.34	0.44	0	1
bor_i	Share of total arable land area in boreal climate zones in exporter i	0.03	0.09	0	0.65
$border_{ni}$	Dummy variable, whether exporter i and market n share common border	0.03	0.16	0	1
$language_{ni}$	Dummy variable, whether exporter i and market n share common language	0.14	0.34	0	1
rta_{nit}	Dummy variable, whether exporter i and market n are RTA partners at time t	0.37	0.48	0	1
$distance1_{ni}$	Distance between exporter i and market n is between [0,750) miles	0.05	0.22	0	1
$distance2_{ni}$	Distance between exporter i and market n is between [750,1500) miles	0.09	0.29	0	1
$distance3_{ni}$	Distance between exporter i and market n is between [1500,3000) miles	0.08	0.27	0	1
$distance4_{ni}$	Distance between exporter i and market n is between [3000,6000) miles	0.08	0.28	0	1
$distance5_{ni}$	Distance between exporter i and market n is between [6000,maximum) miles	0.69	0.46	0	1
OEA_{nit}	Dummy variable, whether exporter i and market n are OEA partners at time t	0.40	0.49	0	1
IV_{nit}	IV: Absolute value of the difference between number of organic producers in exporter i and average number of organic producers in all countries who are OEA partners of market n at time t, in 1,000s	33.17	86.75	0	824.98
$exgdp_{it}$	Log of GDP in exporter i at time t, in constant 2010 US dollars	26.13	1.78	21.47	30.46
$imgdp_{nt}$	Log of GDP in market n at time t, in constant 2010 US dollars	28.73	1.92	26.51	30.46
I_t^{US}	Number of active exporters in U.S. market at time t	67.50	4.85	60	72
I_t^{DNK}	Number of active exporters in Danish market at time t	52	3.90	47	57
π_t^{US}	Market share of all active exporters in U.S. market at time t	0.9877	0.0035	0.9818	0.9911
$outshr_t^{US}$	Outside market share in U.S. market at time t	0.0123	0.0035	0.0089	0.0182
π_t^{DNK}	Market share of all active exporters in Danish market at time t	0.9647	0.0248	0.9369	0.9896
$outshr_t^{DNK}$	Outside market share in Danish market at time t	0.0353	0.0248	0.0104	0.0631
n_obs	Number of observations	717			
n_exp	Number of exporting countries in each market	82			

Notes: Values are computed within sample data across sample period (2011-2016).

TABLE 3: RANDOM COEFFICIENTS LOGIT MODEL RESULTS

	Linear Model	Homogeneous Logit Model	Ramdom Coefficients Logit Model			
	OLS	2SLS	Mean Effect		Unobserved Deviation	
OEA_{nit}	-0.9111^{***}	2.6908	γ	2.6545^{***}	σ	0.0019^{***}
	(0.2703)	(8.0844)		(0)		(0)
			X_{it}			
$orgland_{it}$	0.0831	0.0708	$\varphi^{orgland}$	0.0528^{***}	$\Sigma_E^{orgland}$	0.0287^{***}
	(0.1945)	(0.2190)		(0)		(0)
$orgshare_{it}$	0.0876	0.0408	$\varphi^{orgshare}$	0.0436	$\Sigma_E^{orgshare}$	-0.0154^{***}
	(0.1183)	(0.1688)		(10.8051)		(0)
$temp_i$	30.6867^{***}	14.1681	φ^{temp}	14.9590^{***}	Σ_E^{temp}	0.0173^{***}
	(5.9322)	(37.6376)		(0)		(0)
			t_{nit}			
$border_{ni}$	-0.6384	-1.0129	η^{border}	-0.9684^{***}	Σ_t^{border}	0.0040
	(0.5914)	(1.0687)		(0)		(1,843.8)
$language_{ni}$	-1.0358^{***}	-0.3189	$\eta^{language}$	-0.3030^{***}	$\Sigma_t^{language}$	0.0106^{***}
	(0.3362)	(1.6512)		(0)		(0)
rta_{nit}	-0.4429	0.0490	η^{rta}	0.1017^{***}	Σ_t^{rta}	0.0230^{***}
	(0.3207)	(1.1600)		(0)		(0)
$diatance2_{ni}$	-2.2674^{***}	-2.2496^{***}	$\eta^{distance2}$	-2.2526	$\Sigma_t^{distance2}$	-0.0064^{***}
	(0.4850)	(0.5432)		(64.2495)		(0)
$distance3_{ni}$	-4.4657^{***}	-4.8890^{***}	$\eta^{distance3}$	-4.9360^{*}	$\Sigma_t^{distance3}$	0.0373
	(0.4825)	(0.6057)		(2.5495)		(241.5947)
$distance4_{ni}$	-5.1538^{***}	-4.8768^{***}	$\eta^{distance4}$	-4.8505	$\Sigma_t^{distance4}$	-0.0095
	(0.6597)	(0.9640)		(25.3772)		(690.5997)
$distance5_{ni}$	-6.8668^{***}	-6.3666^{***}	$\eta^{distance5}$	-6.3255	$\Sigma_t^{distance5}$	-0.0296^{***}
	(0.5728)	(1.2915)		(6.9282)		(0)
$exgdp_{it}$	-6.4024^{***}	-2.0534	η^{exgdp}	-2.2400	Σ_t^{exgdp}	0.0188
	(1.4818)	(9.8937)		(1.5207)		(5.3852)
$imgdp_{nt}$	5.5150^{***}	1.6568	η^{imgdp}	1.8906^{***}	Σ_t^{imgdp}	0.0729
	(1.2902)	(8.7728)		(0)		(2.4717)
Year Fixed Effect						
λ_t^{2012}	-0.4462^{**}	-1.0203	-1.0909^{***}			
	(0.2065)	(1.3083)	(0)			
λ_t^{2013}	-0.0398	-0.7054	-0.5286			
	(0.2118)	(1.5115)	(182.4281)			
λ_t^{2014}	0.0612	-0.7365	-0.7774^{***}			
	(0.2211)	(1.8063)	(0)			
λ_t^{2015}	0.7450^{***}	-0.1019	0.1495^{***}			
	(0.2337)	(1.9173)	(0)			
λ_t^{2016}	0.9156^{***}	0.0116	0.1283			
	(0.2569)	(2.0478)	(233.7862)			
Importer Fixed Effect						
$\lambda_n^{UnitedStates}$	-18.8886^{***}	-3.3875	-3.4609			
	(5.0117)	(35.2151)	(119.4655)			

Notes: Dependent variable is the market share of each exporter in markets of United States and Denmark from 2011 to 2016. Standard errors are in parentheses. $*p < 0.1, **p < 0.05 ***p < 0.01$

TABLE 4: EXPORTER FIXED EFFECTS ESTIMATES

Exporter	λ_i	Exporter	λ_i
Albania	−15.5233***	Israel	−0.8209***
United Arab Emirates	9.2740***	Italy	1.5160
Argentina	−0.6309	Jordan	−10.8174
Armenia	−9.2340***	Japan	2.9176
Australia	−1.3126	Kenya	6.5722***
Austria	−6.1061	Cambodia	4.5211***
Burundi	−1.5574***	Republic of Korea	−4.3449
Belgium	−5.1411	Lao People's Democratic Republic	−3.2938
Bangladesh	6.6088	Lebanon	−8.4180
Bulgaria	−11.3911	Sri Lanka	10.0965***
Bosnia and Herzegovina	−10.7515***	Lithuania	−12.7508
Bolivia (Plurinational State of)	1.1619***	Latvia	−14.8474***
Brazil	15.0219***	Madagascar	2.1247***
Canada	6.6506***	Mexico	10.6101
Switzerland	−3.5797***	Namibia	−13.4716
Chile	0.0103	Nigeria	11.1520***
China	9.1455	Nicaragua	5.2602***
Cameroon	3.2924	Netherlands	−2.2384***
Colombia	12.0526***	New Zealand	−3.3252
Costa Rica	6.8822***	Pakistan	−3.0399
Czech Republic	−12.4426	Panama	3.6449
Germany	0.9556	Peru	6.4592***
Denmark	−10.4665***	Philippines	8.9347
Dominican Republic	7.8174	Poland	−7.4689
Ecuador	7.1506	Portugal	−7.7909***
Spain	0.3611	Paraguay	−6.9710***
Ethiopia	4.5954	Romania	−6.7972***
Finland	1.3390	Russian Federation	2.9878***
France	0.5388	Rwanda	3.6231***
United Kingdom	0.4838***	Saudi Arabia	−0.4423***
Georgia	−8.5682	Slovenia	−13.4922***
Ghana	3.4537	Sweden	−5.8518
Greece	−5.5193***	Thailand	15.3856***
Guatemala	7.8401	Tunisia	−8.1174***
Honduras	7.5409	Turkey	1.4077***
Croatia	−11.3310	United Republic of Tanzania	5.7063
Hungary	−10.7497***	Uganda	7.7633***
Indonesia	15.8946***	Ukraine	−6.1942***
India	13.3840***	Uruguay	−9.1686
Ireland	−9.0196	United States	7.2163***
		Viet Nam	10.2271***

Notes:We have 83 exporters in total, but drop λ_i dummy variables for two exporters due to multicollinearity. They are South Africa and Zambia. $*p < 0.1, **p < 0.05 ***p < 0.01$

TABLE 5: COUNTERFACTUAL ANALYSIS:ADDING NEW OEA PARTNERS

Case A. If U.S. signed OEA with one of the following exporters in 2016				Case B. If Denmark signed OEA with one of the following exporters in 2016			
Exporter	Actual value of export to United States (in thousands of dollars)	Simulated value of export to United States (in thousands of dollars)	Rate of change	Exporter	Actual value of export to Denmark (in thousands of dollars)	Simulated value of export to Denmark (in thousands of dollars)	Rate of change
Albania	7	167	22.93	Bosnia and Herzegovina	286	11,580	39.49
United Arab Emirates	309	1,985	5.43	Bolivia	349	3,306	8.48
Argentina	100,076	271,585	1.71	Brazil	1,093	30,541	26.94
Australia	408	11,700	27.68	Chile	39	14,925	382.21
Bangladesh	54	861	14.94	China	26,787	42,598	0.59
Bosnia and Herzegovina	678	9,351	12.79	Colombia	88	2,109	22.92
Bolivia	2,322	157,603	66.87	Ethiopia	127	11,518	90.04
Brazil	95,065	877,049	8.23	Guatemala	80	2,925	35.44
Chile	47,226	553,090	10.71	Honduras	609	6,363	9.45
China	28,627	1,039,281	35.30	Indonesia	6	3,495	586.81
Colombia	65,027	378,983	4.83	Cambodia	945	358	-0.62
Costa Rica	6,034	93,530	14.50	Sri Lanka	1,458	3,779	1.59
Dominican Republic	2,760	141,848	50.39	Madagascar	63	173	1.72
Ecuador	102,405	460,135	3.49	Mexico	1,535	25,872	15.86
Ethiopia	25,730	97,840	2.80	Nicaragua	368	1,972	4.36
Georgia	65	4,651	70.56	Pakistan	4,324	1,871	-0.57
Guatemala	27,030	455,298	15.84	Peru	1,061	13,633	11.85
Honduras	35,340	806,005	21.81	Philippines	194	66	-0.66
Indonesia	37,019	166,363	3.49	Paraguay	805	1,325	0.65
India	73,667	76,454	0.04	Thailand	3,552	16,624	3.68
Israel	4,311	7,227	0.68	Turkey	2,263	18,681	7.25
Kenya	253	8,762	33.63	Uganda	644	3,910	5.07
Cambodia	422	18,281	42.32	Viet Nam	102	1,176	10.56
Lao People's Democratic Republic	578	10,098	16.47	South Africa	1,282	1,627	0.27
Lebanon	735	15,784	20.47				
Sri Lanka	3,560	178,237	49.07				
Madagascar	201	8,897	43.27				
Mexico	172,218	987,137	4.73				
Namibia	28	922	31.92				
Nigeria	269	7,003	25.03				
Nicaragua	14,437	358,104	23.80				
New Zealand	31,261	79,374	1.54				
Panama	33	4,397	132.25				
Peru	104,109	1,156,420	10.11				
Philippines	3	2,533	841.60				
Paraguay	6,904	66,365	8.61				
Russian Federation	4,057	15,137	2.73				
Rwanda	531	21,544	39.57				
Thailand	8,891	597,958	66.25				
Tunisia	26,247	21,945	-0.16				
Turkey	223,220	203,299	-0.09				
Uganda	5,825	139,491	22.95				
Ukraine	20,391	18,402	-0.10				
Uruguay	3,384	13,594	3.02				
Viet Nam	1,254	59,150	46.17				
South Africa	1,023	54,781	52.55				
Zambia	25	571	21.84				

Notes: In 2016, we only have 71 exporters which had positive market share with the United States and 56 exporters who traded organic food with Denmark. Rate of change equals to the the ratio of the difference between simulated value of export and the actual value of export to the actual value of export.

TABLE 6: RESPONSE OF THE REMAINING EXPORTERS TO ONE MORE OEA PARTNER WITH U.S. IN 2016

	OEA partners of United States		Non-OEA partners of United States	
Exporter under experiment	countries that shrink value of export	countries that expand value of export	countries that shrink value of export	countries that expand value of export
Philippines (841.60)	Greece (-0.01), Italy (-0.05), Spain (-0.20), France (-0.28), Netherlands (-0.51), Romania (-0.77)	Portugal (0.10), United Kingdom (0.29), Poland (0.55), Belgium (0.66), Japan (0.96), Denmark (1.06), Canada (1.43), Republic of Korea (1.63), Austria (3.28), Hungary (3.44), Lithuania (3.64), Germany (4.47), Croatia (4.79), Slovenia (5.42), Ireland (7.37), Bulgaria (9.95), Switzerland (10.66), Sweden (66.37)	Bosnia and Herzegovina (-0.03), Mexico (-0.12), Paraguay (-0.30), Colombia (-0.48), United Arab Emirates (-0.55), Ecuador (-0.58), Indonesia (-0.65), Ethiopia (-0.72), Uruguay (-0.72), Russian Federation (-0.74), Argentina (-0.78), New Zealand (-0.81), Israel (-0.88), India (-0.92), Turkey (-0.93), Ukraine (-0.94), Tunisia (-0.94)	Bangladesh (0.12), Costa Rica (0.15), Chile (0.19), Lao People's Democratic Republic (0.23), Brazil (0.26), Lebanon (0.52), Guatemala (0.58), Zambia (0.60), Albania (0.68), Uganda (0.82), Nigeria (0.84), Australia (1.03), Peru (1.15), Nicaragua (1.17), Namibia (1.31), Kenya (1.44), Rwanda (1.88), Honduras (1.89), Cambodia (2.07), Madagascar (2.12), Viet Nam (2.42), South Africa (2.88), Sri Lanka (2.90), Dominican Republic (2.92), Georgia (4.04), Bolivia (4.22), China (4.99), Thailand (6.05), Panama (8.38)
Tunisia (-0.16)	Greece (-0.02), Italy (-0.06), Spain (-0.21), France (-0.29), Netherlands (-0.51), Romania (-0.77)	Portugal (0.09), United Kingdom (0.28), Poland (0.53), Belgium (0.64), Japan (0.94), Denmark (1.03), Canada (1.41), Republic of Korea (1.61), Austria (3.24), Hungary (3.40), Lithuania (3.59), Germany (4.41), Croatia (4.73), Slovenia (5.35), Ireland (7.28), Bulgaria (9.83), Switzerland (10.54), Sweden (65.65)	Bosnia and Herzegovina (-0.04), Mexico (-0.13), Paraguay (-0.31), Colombia (-0.49), United Arab Emirates (-0.55), Ecuador (-0.58), Indonesia (-0.66), Ethiopia (-0.72), Uruguay (-0.72), Russian Federation (-0.74), Argentina (-0.78), New Zealand (-0.82), Israel (-0.88), India (-0.92), Turkey (-0.93), Ukraine (-0.94)	Bangladesh (0.11), Costa Rica (0.14), Chile (0.17), Lao People's Democratic Republic (0.22), Brazil (0.24), Lebanon (0.51), Guatemala (0.57), Zambia (0.59), Albania (0.66), Uganda (0.80), Nigeria (0.82), Australia (1.01), Peru (1.13), Nicaragua (1.15), Namibia (1.29), Kenya (1.42), Rwanda (1.85), Honduras (1.86), Cambodia (2.04), Madagascar (2.09), Viet Nam (2.39), South Africa (2.84), Sri Lanka (2.86), Dominican Republic (2.88), Georgia (3.98), Bolivia (4.17), China (4.92), Thailand (5.98), Panama (8.28), Philippines (57.63)

Notes: Values in parentheses are rate of change, the ratio of the difference between simulated value of export to U.S. and the actual value of export to U.S. to the actual value of export to U.S. in 2016.

TABLE 7: RESPONSE OF THE REMAINING EXPORTERS TO ONE MORE OEA PARTNER WITH DENMARK IN 2016

	OEA partners of Denmark		Non-OEA partners of Denmark	
Exporter under experiment	countries that shrink value of export	countries that expand value of export	countries that shrink value of export	countries that expand value of export
Chile (382.21)	Portugal (-0.04), New Zealand (-0.09), Germany (-0.35), Canada (-0.46), Poland (-0.48), Hungary (-0.59), Australia (-0.66), Greece (-0.70), Finland (-0.72), Lithuania (-0.73), Romania (-0.74), Sweden (-0.77), Slovenia (-0.79), Austria (-0.81), Spain (-0.81), Ireland (-0.82), Latvia (-0.83), Bulgaria (-0.96)	France (0.40), Netherlands (0.46), United Kingdom (0.51), Italy (0.71), United States of America (0.90), Belgium (1.05), Switzerland (1.23), Czech Republic (1.33), Croatia (2.13), Tunisia (5.20), India (5.24), Japan (9.46), Costa Rica (12.86), Argentina (28.51)	Peru (-0.10), Viet Nam (-0.21), Honduras (-0.28), Bolivia (-0.35), Turkey (-0.41), Uganda (-0.58), Nicaragua (-0.63), Thailand (-0.67), Madagascar (-0.81), Sri Lanka (-0.82), China (-0.88), Paraguay (-0.89), South Africa (-0.91), Cambodia (-0.97), Pakistan (-0.97), Philippines (-0.98)	Mexico (0.21), Colombia (0.64), Brazil (1.03), Guatemala (1.50), Bosnia and Herzegovina (1.83), Ethiopia (5.36), Indonesia (39.40)
Philippines (-0.66)	Portugal (-0.01), New Zealand (-0.07), Germany (-0.33), Canada (-0.44), Poland (-0.47), Hungary (-0.58), Australia (-0.65), Greece (-0.69), Finland (-0.71), Lithuania (-0.72), Romania (-0.73), Sweden (-0.76), Slovenia (-0.79), Austria (-0.80), Spain (-0.81), Ireland (-0.81), Latvia (-0.83), Bulgaria (-0.96)	France (0.44), Netherlands (0.51), United Kingdom (0.56), Italy (0.76), United States of America (0.96), Belgium (1.11), Switzerland (1.30), Czech Republic (1.40), Croatia (2.23), Tunisia (5.39), India (5.42), Japan (9.78), Costa Rica (13.29), Argentina (29.40)	Peru (-0.07), Viet Nam (-0.18), Honduras (-0.26), Bolivia (-0.33), Turkey (-0.40), Uganda (-0.57), Nicaragua (-0.62), Thailand (-0.66), Madagascar (-0.81), Sri Lanka (-0.82), China (-0.88), Paraguay (-0.88), South Africa (-0.91), Cambodia (-0.97), Pakistan (-0.97)	Mexico (0.25), Colombia (0.69), Brazil (1.09), Guatemala (1.58), Bosnia and Herzegovina (1.92), Ethiopia (5.55), Chile (26.78), Indonesia (40.63)

Notes: Values in parentheses are rate of change, the ratio of the difference between simulated value of export to Denmark and the actual value of export to Denmark to the actual value of export to Denmark in 2016.

TABLE 8: COUNTERFACTUAL ANALYSIS: WITHDRAWING FROM THE ORGANIC EQUIVALENCY AGREEMENT WITH EXISTING OEA PARTNERS

Case A. If U.S. withdrew from the organic equivalency agreement with one of the following exporters in 2016				Case B. If Denmark withdrew from the organic equivalency agreement with one of the following exporters in 2016			
Exporter	Actual value of export to United States (in thousands of dollars)	Simulated value of export to United States (in thousands of dollars)	Rate of change	Exporter	Actual value of export to Denmark (in thousands of dollars)	Simulated value of export to Denmark (in thousands of dollars)	Rate of change
Austria	298	90	-0.70	Argentina	201	434	1.16
Belgium	1,515	177	-0.88	Australia	781	19	-0.98
Bulgaria	58	45	-0.23	Austria	7,993	112	-0.99
Canada	82,315	15,872	-0.81	Belgium	14,159	2,232	-0.84
Switzerland	162	133	-0.18	Bulgaria	1,289	4	-1.00
Germany	2,883	1,121	-0.61	Canada	5,564	219	-0.96
Denmark	16	2	-0.86	Switzerland	1,025	166	-0.84
Spain	99,078	5,821	-0.94	Costa Rica	31	31	0.01
France	25,258	1,294	-0.95	Czech Republic	72	12	-0.83
United Kingdom	5,390	493	-0.91	Germany	105,541	5,770	-0.95
Greece	9,354	653	-0.93	Spain	34,267	476	-0.99
Croatia	106	43	-0.59	Finland	2,819	57	-0.98
Hungary	33	10	-0.69	France	15,657	1,661	-0.89
Ireland	10	6	-0.41	United Kingdom	7,530	846	-0.89
Italy	115,776	8,302	-0.93	Greece	2,508	55	-0.98
Japan	9,302	1,300	-0.86	Croatia	238	54	-0.77
Republic of Korea	221	41	-0.81	Hungary	438	13	-0.97
Lithuania	70	23	-0.67	India	322	146	-0.55
Netherlands	22,885	802	-0.96	Ireland	747	10	-0.99
Poland	126	14	-0.89	Italy	77,535	13,228	-0.83
Portugal	1,058	82	-0.92	Japan	33	25	-0.24
Romania	14,005	232	-0.98	Lithuania	1,455	29	-0.98
Slovenia	4	2	-0.55	Latvia	1,122	13	-0.99
Sweden	13	62	3.75	Netherlands	89,271	12,899	-0.86
				New Zealand	2,320	153	-0.93
				Poland	4,333	163	-0.96
				Portugal	100	7	-0.93
				Romania	1,044	20	-0.98
				Slovenia	151	2	-0.99
				Sweden	43,137	744	-0.98
				Tunisia	296	133	-0.55
				United States	1,896	263	-0.86

Notes: In 2016, we only have 71 exporters which had positive market share with the United States and 56 exporters who traded organic food with Denmark. Rate of change equals to the the ratio of the difference between simulated value of export and the actual value of export to the actual value of export.

Appendix A

I denote the exporter's product-specific cost of land input $a_{ij}^{-\alpha_i(1-\beta_i)}$ as $\widetilde{a_{ij}}$, then the probability that price of exporter i's product j in market n is lower than p is:

$$
\begin{aligned}
G_{nij}(p) = Pr(P_{nij} \leqslant p) &= Pr(\frac{\widetilde{a_{ij}} c_i \tau_{nij}}{z_{ij}} \leqslant p) = Pr(z_{ij} \geqslant \frac{\widetilde{a_{ij}} c_i \tau_{nij}}{p}) \\
&= 1 - F_i(\frac{\widetilde{a_{ij}} c_i \tau_{nij}}{p}) = 1 - e^{-T_i(\frac{\widetilde{a_{ij}} c_i \tau_{nij}}{p})^{-\theta}} \\
&= 1 - e^{-p^\theta T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}
\end{aligned}
$$

The probability that country n actually buys product j is the probability that at least one exporter i's price of product j in market n is lower than p, so the distribution of price in market n is:

$$
\begin{aligned}
G_{nj}(p) &= 1 - \prod_{i=0}^{I} Pr(P_{nij} > p) = 1 - \prod_{i=0}^{I} [1 - G_{nij}(p)] \\
&= 1 - \prod_{i=0}^{I} \{1 - (1 - e^{-T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta} p^\theta})\} = 1 - \prod_{i=0}^{I} e^{-T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta} p^\theta} \\
&= 1 - e^{-p^\theta \sum_{i=0}^{I} T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}
\end{aligned}
$$

Therefore, the probability that exporter i offers the lowest price for product j in market n is:

$$
\begin{aligned}
\pi_{nij} &= Pr[P_{nij} \leqslant min\{P_{nsj}; s \neq i\}] \\
&= \int_0^\infty \prod_{s \neq i} [1 - G_{ns}(p)] dG_{ni}(p) \\
&= \int_0^\infty \frac{\prod_{i=0}^{I}(1 - G_{ni}(p))}{1 - G_{ni}(p)} dG_{ni}(p)
\end{aligned}
$$

Recall that $\prod_{i=0}^{I}(1 - G_{ni}(p)) = 1 - G_n(p) = e^{-p^\theta \sum_{i=0}^{I} T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}$;
and $1 - G_{ni}(p) = e^{-p^\theta T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}$; so I have:

$$
\begin{aligned}
\pi_{nij} &= \int_0^\infty \frac{e^{-p^\theta \sum_{i=0}^{I} T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}}{e^{-p^\theta T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}} d[1 - e^{-p^\theta T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}] \\
&= \int_0^\infty e^{-p^\theta \sum_{k \neq i}^{I} T_k(\widetilde{a_{kj}} c_k \tau_{nkj})^{-\theta}} \cdot -e^{-p^\theta T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}} \cdot -T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta} \cdot \theta p^{\theta-1} dp \\
&= \int_0^\infty e^{-p^\theta \sum_{i=0}^{I} T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}} \cdot T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta} \theta p^{\theta-1} dp \\
&= \frac{T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}{\sum_{i=0}^{I} T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}} \cdot \int_0^\infty \sum_{i=0}^{I} T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta} \cdot e^{-p^\theta \sum_{i=0}^{I} T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}} \theta p^{\theta-1} dp \\
&= \frac{T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}{\sum_{i=0}^{I} T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}} \cdot \int_0^\infty dG_n(p) \\
&= \frac{T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}{\sum_{i=0}^{I} T_i(\widetilde{a_{ij}} c_i \tau_{nij})^{-\theta}}
\end{aligned}
$$

Appendix B

Estimation procedures

I have linear parameters ϕ_1 and nonlinear parameters ϕ_2, where $\phi_1 = (\varphi, \eta, \gamma, \hat{\lambda_i}, \hat{\lambda_t}, \hat{\lambda_n})$; $\phi_2 = (\Sigma_E, \Sigma_t, \sigma)$. In equation (6), I specify that the random coefficients logit model is as the following:

$$\pi_{nit} = \int \frac{exp(S_{it} + \theta\alpha_i(1-\beta_i)lna_{ijt}(V_{ijt}^E) - \theta ln\tau_{nijt}(V_{nijt}^t, \nu_{nijt}))}{1 + \sum_{k=1}^{I} exp(S_{kt} + \theta\alpha_k(1-\beta_k)lna_{kjt}(V_{kjt}^E) - \theta ln\tau_{nkjt}(V_{nkjt}^t, \nu_{nkjt}))} dV_{ijt}^E dV_{nijt}^t d\nu_{nijt}$$

I denote that:

$\delta_{nit} = X_{it}\varphi + \lambda_i + \lambda_t + t_{nit}\eta + \gamma OEA_{nit} + \lambda_n + \xi_{nit}$

$\mu_{nijt} = X_{it}\Sigma_E V_{ijt}^E + t_{nit}\Sigma_t V_{nijt}^t + \sigma\nu_{nijt}OEA_{nit}$

I can rewrite the random coefficients logit model as the following:

$$\pi_{nit} = \int \frac{exp(\delta_{nit} + \mu_{nijt}(V_{ijt}^E, V_{nijt}^t, \nu_{nijt}; \phi_2))}{1 + \sum_{k=1}^{I} exp(\delta_{nkt} + \mu_{nkjt}(V_{kjt}^E, V_{nkjt}^t, \nu_{nkjt}; \phi_2))} dV_{ijt}^E dV_{nijt}^t d\nu_{nijt}$$

where δ_{nit} represents the mean effect of exporter i's characteristics on exporter i's market share in market n at time t;

where μ_{nijt} represents the product-specific deviation from the mean effect.

I illustrate the estimation procedure step by step.

Step 1 I draw V_{ijt}^E and V_{nijt}^t from standard multivariate normal distribution, and draw random variable ν_{nijt} from standard normal distribution.

Step 2 Compute market shares.

I give initial values to $\phi_2 = (\Sigma_E, \Sigma_t, \sigma)$, use V_{ijt}^E, V_{nijt}^t, ν_{nijt} collected from step 1, then I compute the predicted market share $\hat{\pi_{nit}}$ using the following estimator:

$$\pi_{nit} = \frac{1}{ns}\sum_{j=1}^{ns} \frac{exp(\delta_{nit} + \mu_{nijt}(V_{ijt}^E, V_{nijt}^t, \nu_{nijt}; \phi_2))}{1 + \sum_{k=1}^{I} exp(\delta_{nkt} + \mu_{nkjt}(V_{kjt}^E, V_{nkjt}^t, \nu_{nkjt}; \phi_2))}$$

where ns is the number of products in our sample data, set as 79. Because the number of HS code for organic food collected from GATS website in U.S. market is 32, and the number of HS code for organic food collected from Statistics Denmark in Danish market is 47, the total number of organic food in our sample data is 79.

Step 3 Contraction mapping (fixed-point iteration) to get mean effect δ_{nit}.

Given a guess of ϕ_2 and initial value of δ^0_{nit}, iterate on

$$\delta^{h+1}_{nit}(\phi_2) = \delta^h_{nit}(\phi_2) + ln(\pi_{nit}) - ln(\hat{\pi_{nit}})(\delta^h_{nit}, \phi_2)$$

where π_{nit} is the observed market share, $\hat{\pi_{nit}}$ is the predicted market share based on initial value of δ^h_{nit} and guess of ϕ_2. The process stops when $\|\delta^{h+1}_{nit} - \delta^h_{nit}\| \leqslant tolerance$. Then I obtain estimate of $\delta_{nit}(\phi_2)$.

Step 4

A. Given $\delta_{nit}(\phi_2)$, estimate ϕ_1 and compute ξ_{nit}. Recall that $\delta_{nit} = X_{it}\varphi + \lambda_i + \lambda_t + t_{nit}\eta + \gamma OEA_{nit} + \lambda_n + \xi_{nit}$, I simplify δ_{nit} as the following: $\delta_{nit} = X\phi_1 + \xi$, where X contains variables for $X_{it}, t_{nit}, \lambda_i, \lambda_t, \lambda_n, OEA_{nit}$, and Z are instrument variables. Then, $\hat{\phi_1} = (X'ZWZ'X)^{-1}(X'ZWZ'\delta)$, and $\xi_{nit}(\phi_2) = \delta_{nit} - X\hat{\phi_1}$.

B. Minimize the GMM objective: Min $\xi(\phi)'ZWZ'\xi(\phi)$, where W is the GMM weight matrix, $[E(Z'\xi(\phi)\xi(\phi)'Z)]^{-1}$. Start with $W = I$ to get initial estimates, use them to compute W, and minimize GMM objective function for new estimates. After minimizing GMM objective function, I get new ϕ_2, I use new estimates of ϕ_2 as initial guess and go back to step 1, get new $\delta_{nit}(\phi_2), \xi_{nit}(\phi_2)$ and minimize GMM again, and continue to move on until converge.