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Geographical Indications of Origin as an Indirect Barrier for Agri-Food Trade: An Empirical Assessment

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Abstract

The paper evaluates the impact of the European Union's policy on Geographical Indications of Origin [GIs] on trade in agri-food products by employing a PPML gravity methodology on highly disaggregated data. The results show a negative elasticity of trade with respect to GI protection of about 29% when only the importing country in a bilateral trade observation applies the policy to a specific product line. The results are not estimated to be significantly different in the case of intra- or extra-EU trade and when the importers are the countries that most often apply GIs, but larger coefficients are estimated in the HS2 sectors where the policy is less frequently applied. The composition (quality) of imported goods does not appear to change as a consequence of the policy, as measured by the estimation on Unit Values.

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1. Introduction

Geographical Indications of Origin [GIs] are intellectual property instruments consisting of signs applied to consumer products in the food and beverage industry to certify production occurring in a specific area and employing related traditional or specific inputs and techniques (WIPO, 2020). At the international level, GIs are defined by the World Trade Organization under the TRIPS Agreement (Art. 22-24), but there are considerable differences regarding how countries implement these instruments in their legislation. This contemptuous issue is also among those preventing the closing of the WTO Doha round of negotiations, as multilateral negotiations have failed to result in an agreement regarding two GI issues included in the Doha mandate: the creation of a multilateral register for wines and spirits, and the extension of a higher level of protection to products other than wines and spirits (WTO, 2008).

Among the most important causes for this lack of international agreement on the issue is the different approach taken by the European Union and the United States in the protection of agri-food products whose quality is linked to their geographical origin[1]. In particular, U.S. legislation does not define GIs as a separate intellectual property category, but allows for the protection of geography-based labels through more general instruments: Trademarks (owned by firms), Certification marks (used by other parties such as government bodies), and Collective marks (managed by groups of producers). In the EU, instead, GIs are a public policy instrument that comprise a uniform recognizable label to be applied to all registered food products. Third countries can generally be classified to be adopting one of the two approaches.

The protection of agri-food products whose quality is linked to a specific geographical origin and to the employment of traditional production methods has a long history in the present-day European Union, with the first attempts at regulation appearing as early as 1883 (Josling, 2006). Many of the earlier policies focused in particular on rules regarding the production and commercialization of wines, and this is reflected in the different rules and wider international protection of GIs applied to this type of product.

[1] The two policies and their trade implications are thoroughly described in Josling (2006). Based on this work, I here provide a summary of the most important characteristics and differences between the two systems.

Regarding foodstuffs, the EU policy is mostly included in EEC Regulation No. 2081/92, which defines the two main GI implementations: Protected Designation of Origin [PDO] and Protected Geographical Indication [PGI]. The main difference between the two lies in the amount of local content requirements: PDOs are granted to products for which every step of production, processing and preparation occurs in a clearly defined geographical area, whereas PGIs only require one stage of production occurring in the origin region (European Commission, 2020b). Registered goods produced under these regulations are have to report on the packaging the respective PDO or PGI label, which acts as the signal to consumers of the origin of the product and is mandatory for all products except wines and spirits.

GIs are therefore used by producers of traditional agri-food products as a quality signal that is observed, in many cases, to lead to higher prices of the products (Raimondi et al., 2020) and to a larger volume of exports (Agostino and Trivieri, 2014; Raimondi et al., 2020). Together with these trade-enhancing effects for countries and possible advantages for firms who produce under these labels, however, there is also the possibility of a trade-diverting effect of these policies, if the countries that implement it develop a preference towards locally produced goods because of the label or it the registration creates entry barriers for foreign producers of similar products. The main purpose of this research would therefore be to investigate whether the protection of GIs in the European Union reduces imports of similar products. The expectation is to find a negative association between the number of registered PDOs and PGIs and the import volumes of closely related products by the implementing countries.

In order to perform this empirical assessment, I employ a unique dataset matching all GIs registered under the EU with HS6 product codes. The number of GIs implemented in a specific product line by a country for each year of my sample (1996-2018) forms my GI policy variable, which is then used as a control in a regression on the trade volume or Unit Values of closely comparable products according to the Harmonized System [HS] classification. The estimation is performed employing a PPML methodology such as the one proposed by Santos Silva and Tenreyro (2006); the results show a negative impact of GI policy implementation on the import quantity of comparable goods, but no significant effect on Unit Values, which are interpreted as a proxy for quality. These effects are not estimated to be different in the cases of intra- or extra-EU trade, or for the seven countries that most

frequently adopt the policy. The estimated anticompetitive effect, however, appears to be significantly larger in sectors where GIs are less frequently applied.

In detailing out the various steps of my empirical analysis, the rest of the paper will be organized as follows: Section 2 reviews the related literature in the field, Section 3 discusses the available data that can be used for my analysis, Section 4 outlines the chosen empirical methodologies, Section 5 elaborates on the estimated results, and Section 6 concludes with a summary of the most important findings and with policy and research suggestions.

2. Literature Review

Geographical Indications are intellectual property instruments that are of interest to economists for their role as signals of product quality and for their relatively uniform protection in some jurisdictions, which allows for easier evaluations of their effects on agri-food markets. Accordingly, the economic literature regarding GIs can be divided between studies focusing on its role as a measure of quality, and empirical assessments of the impact of the policy itself. Additionally, the possible welfare effect of this policy has been theoretically assessed in a number of studies.

2.1 Quality and Trade

The relationship between quality and trade has been investigated numerous times and with diverse approaches in the international trade literature. For example, some studies have shown that higher-income countries tend to both export (Schott, 2004; Hummels & Klenow, 2005) and import (Hallak, 2006) higher-quality goods. Interpreting the firm productivity term that is at the at the center of the international trade with firm heterogeneity model developed by Melitz (2003) as an indicator of the quality of firms' products also provides theoretical foundations for some of these findings: the model predicts that firms producing higher-quality outputs will expand and produce more under free international trade, and that average quality will increase as a consequence of a decrease

in trade costs. Empirical observations by Verhoogen (2008) and Crozet et al. (2012), among others, appear to be in line with these predictions: they found, respectively, that exporters from developing countries produce higher-quality goods for developed export markets than they do for their own domestic market, and that in the champagne market higher quality is associated not only to higher prices and export values, but to higher probability of exporting.

One of the issues with these analyses lies in the unavailability of an appropriate and widely recognized measure of quality. Many of the studies in this field, including the above-mentioned works by Schott (2004), Hummels & Klenow (2005), and Hallak (2006), proxied for quality using Unit Values [UVs] and other indexes constructed from them. Despite UVs being one of the most readily-available possible indicators of quality of traded goods, Hallak & Schott (2011) listed a number of shortfalls of this measure, including the fact that UVs may not only reflect quality but may be influenced by other factors such as exchange rate fluctuations, cost, and measurement error. Khandelwal (2010) found that Unit Values are more strongly correlated with actual quality in markets with larger possibilities for quality differentiation, and proposed a new measure of quality that can be constructed taking into account both prices and market shares when this is not the case. The employment of Geographical Indications, which are an institutionalized and publicly certified signal for quality, allows instead for more direct identification of otherwise unobserved product characteristics.

2.2 Welfare Effects of Geographical Indications

Acting as quality signals, GIs are expected to have a two-sided effect on agri-food markets: they may solve the information asymmetry issues of consumers that have been acknowledged in the literature since the development of the famous "market for lemons" model by Akerlof (1970); at the same time, however, quality certifications may have an anticompetitive effect as they increase the fixed costs of entering a market, thus increasing market concentration (Marette et al., 2008). In an international trade context, this latter effect could result in an indirect trade barrier for foreign producers of goods that are similar to those protected by the GI (Chambolle & Giraud-Héraud, 2005); in some cases, the fixed costs associated to the certifications could even be significantly larger for foreign producers, as claimed by the United States in WTO dispute n. 174 (WTO, 2006) regarding the European

Union's system for the protection of GIs. The present paper, by focusing on the impact of GI protection on the implementing country's imports, will empirically assess the possibility of an anticompetitive impact of GIs on international markets.

A number of studies have tried to model the overall welfare effects of these policies and evaluate the optimal protection mechanisms that would maximize consumers' and producers' welfare. Among these, the theoretical analysis by Lence et al. (2007) concluded that the collusive effect of GIs could end up having positive impact on societal welfare by incentivizing investment in innovation, leading to increases in welfare from consuming high-quality goods that outweigh the losses from less-than-perfect competition. Similarly, Moschini et al. (2008) found in their model that although the GI system underprovides the high-quality good, some welfare benefits of these protections are present, and they are mainly reaped by consumers. Regarding the optimal level of protection, Menapace & Moschini (2014) derived that full protection benefits mostly the producers of the GI good, while consumers and producers of substitute goods are likely to benefit from intermediate levels of protection.

Within the debate regarding the optimal policies to protect quality agri-food products based on their geographical origin, an important role is played by the comparison between the two different approaches taken by the United States and the European Union. In this respect, Lence et al. (2007) claimed that the EU system, which is more strongly based on geography and on government protection, weakly dominates the U.S. system, whose protection is comparable to that accorded to trademarks. This is true both in terms of producer surplus and of social surplus for the GIs that were created after the implementation of the EU-wide system in 1992. Also according to Menapace & Moschini (2012), the U.S. certification marks are less preferable, as regards their welfare impact, than GIs of the type used in the EU. The main determinant of this difference, as derived from their model, is that the U.S. labels provide less information about the technology used in production, and thus about the quality of the product.

2.3 Empirical Assessments of GI Policy

As Josling (2006) stressed, however, the impact of GIs on information asymmetry and competition in agri-food markets needs to be evaluated empirically. One channel that is

useful in order to evaluate these aspects is the analysis of the impact that GIs have on international trade. In this respect, the EU system of indications and protections provides an additional advantage: the relatively uniform method of recognition of GI products across member and non-member countries allows for comparison and empirical assessment of the impact of these policies in different markets. The most important studies that have tried to evaluate the impact of GIs on trade, in fact, have done so employing in various forms data on the protections implemented in Europe.

To my knowledge, Sorgho & Larue (2014) were the first to empirically estimate the effect of GI protection on international trade flows. They employed the "border effects" gravity model as formulated by Head & Mayer (2000) on aggregate agricultural trade flows between the 27 EU Member States in the years 1999, 2004, and 2009. In order to measure the extent of GI protection, for each bilateral trade-year observation they included in the specification the overall number of GI products registered in the importing and exporting countries. The results showed that GI protection enhances trade when both trading partners have registered GIs, but also reflected the possibility of a trade-diverting effect when only the exporter protects certain agricultural products based on their geographical origin. This paper thus constitutes initial evidence that GIs may in fact have a significant impact on trade flows, but the employment of aggregated data on intra-EU trade flows exclusively constitutes an evident limitation of the study. In fact, subsequent studies employing more disaggregated data reached very different conclusions on the relationship between GIs and trade.

Agostino & Trivieri (2014) focused instead on the wine market, including in their sample exports from the three largest European producers (France, Italy and Spain) for the years 1995 to 2009. The GI indicators are based on data about quality that are specific to wine products, and the estimation strategy involves an adjusted formulation of the Anderson & Van Wincoop (2003) gravity specification. They found an export-enhancing effect for quality wines originating from specific regions, both in terms of values and of volumes to high-income destinations, mainly through the extensive margin of trade. The peculiarities of the wine market, however, regarding both international protection of their designations and classifications of quality and origin, make these important results difficult to extend or generalize to other contexts within the agri-food sector.

Finally, Raimondi et al. (2020) performed their analysis on all agricultural products protected under the EU GI policy at a very disaggregate level. Considering intra- and extra-EU trade flows for the 1996-2014 period, and constructing a novel GI indicator based on the number of products protected by each country at the HS6 disaggregation level, they were able to estimate the effects of GI policy on both exports and imports. Adopting a fixed effects methodology, they found that GI protection in the exporting country results in higher exports, but that when the Indications are only used in the importing countries, trade flows are reduced. One limitation of this study, that is of particular importance when trying to evaluate the possibility of GIs constituting an unfair disadvantage for foreign producers of similar products, is the focus on EU-15 countries and the incomparability of the intra- versus extra-EU estimations. By exploiting different methodological assumptions and the recognition by the EU GI registry of products originating from external countries, the present paper will attempt to overcome these limitations.

2.4 Contribution

The present study will therefore contribute to the existing literature by empirically investigating, at a highly disaggregate level, the impact that the protection of GIs by the EU may have on import flows of European and non-European countries that have at least one product registered under these classifications. More specifically, this study will constitute the first thorough gravity analysis at the product level of the effect that GI protection can have on agri-food import flows. Additionally, by focusing on imports and on GIs registered in the EU by EU Member and Non-Member States, in contrast with the previous literature I am able to directly evaluate and compare the impact of this policy on both sets of countries.

While providing additional evidence on the role of quality signals on international trade, this analysis also indirectly sheds further light on the effect of GIs on competition in agri-food markets or on their possible role as an indirect trade barrier. Furthermore, the investigation of possibly heterogeneous effects of GIs on different product or country markets could help understand more about the effectiveness of a uniform EU GI policy for a diverse sector such as agriculture.

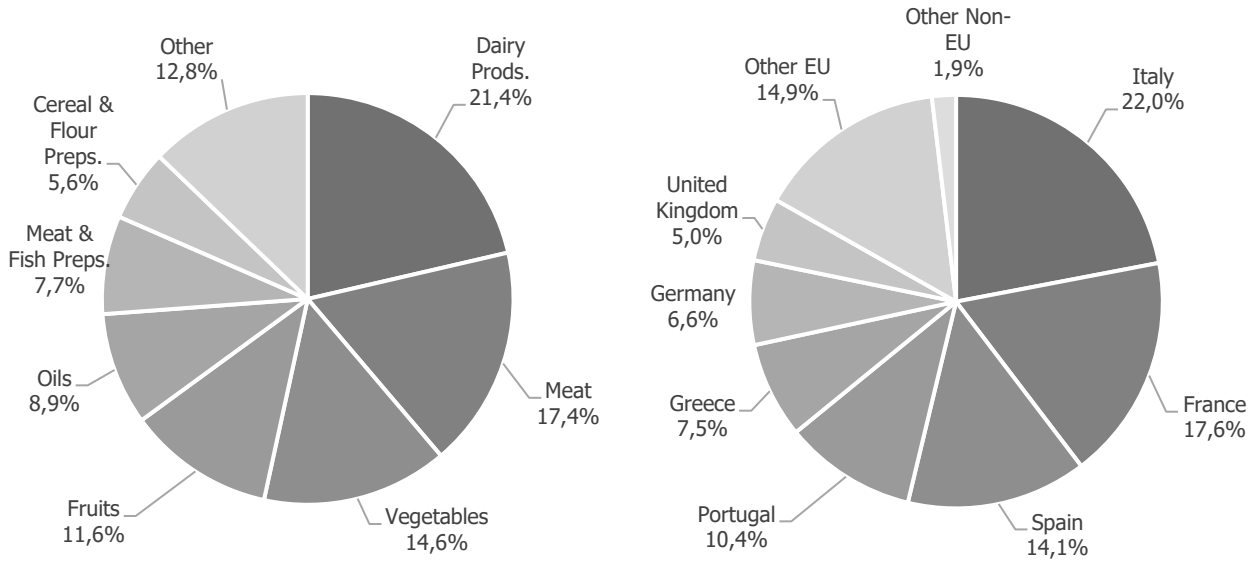
3. Data and Sources

3.1 Data on Geographical Indications

In order to evaluate the impact of GI protection on import flows at the product, I first need to construct an indicator providing information about the extent of application of these policies at the country-product-year level. The European Commission's official register of Geographical indications, eAmbrosia (European Commission, 2019), provides basic information for all agri-food products protected under the EU's GI policy, but no indications that allow to directly match its entries with trade data. I therefore make use of the dataset matching products from this register with HS codes at the 6-digit level compiled by Raimondi et al. (2020)[2]. The dataset was updated with products that were registered for the first time between 2016 and 2018 using additional information on the newly protected GIs provided by Fondazione Qualivita (2015).

Up to 2018, 2,982 PDO and PGI products were registered in the eAmbrosia database, of which 1,599 wines and 1,383 food items. Wines are not included in the final sample for two main reasons: the HS6 classification provides for a small number of varieties within the "wine" category, which compared to the number of products protected under the GI system would result in a figure for wine protections in some countries that would appear as an outlier compared to other products; secondly, the rules regarding the international protection of intellectual property rights regarding wine denominations are different from those regarding other food categories (Josling, 2006; Agostino & Trivieri, 2014). In particular, the EU rules make it optional for wine producers to include on the final packaging the PDO or PGI label that is compulsory for all other product categories (European Commission, 2020), so the signal effect to consumers is likely to be different. Raimondi et al. (2020) do not find a perfect correspondence in HS6 categories for 51 products, resulting in the final number of matched GI goods being 1,332, representing 156 different HS6 products.

[2] I would like to thank Professor Valentina Raimondi and Professor Alessandro Olper of the University of Milan for their kind willingness to share their dataset with me for the purpose of this research.



Panel A: Distribution by HS2 **Panel B: Distribution by Country**

Figure 1: Distribution of the EU GIs by HS2 Product Category and by Protecting Country

Source: Matching of registered GIs from the eAmbrosia database (European Commission, 2019) with HS codes at the 2 and 6-digit level performed by Raimondi et al. (2020) and myself.

The distribution in the number of protections across countries and products is not uniform: as **Figure 1** shows, over 81% of the denominations are concentrated in only 6 of the 19 HS2 product categories for which at least one good is protected. Furthermore, the seven EU nations that use the GI policy the most registered over 86% of the total number of food products contained in the eAmbrosia database, while extra-European countries produced less than 2% of the indications. Detailed lists of GI-protecting countries and of product codes to which the denominations pertain, together with the frequency of application of GIs in each category, are provided in Appendix A. Given this concentrated usage of GI protection in certain countries and sectors, I expect higher relevance and significance of the quality signals that are at the center of my analysis in the contexts in which they are most used, and I will empirically test for this hypothesis.

For the purpose of the overall estimation, the GI policy indicator will consist of a count of the number of GI protections applied by each country in each HS6 product line for each year. The sample period is chosen to go from 1996, the year in which Geographical Indications were first officially registered and recognized at the EU level, to 2018, the last year for which disaggregated trade data is available at the time of writing. Including years

prior to 1996 would not provide additional variation in the GI policy that would help identify its effect, since most of the entries that were included in the EU registry in 1996 reflected products that were already protected under national regulations which acted as forerunners to the subsequent EU policy (Barham, 2003). These previous regulations are therefore likely to have had a significant impact on trade flows, and especially on imports, before 1996, but no uniform data is available regarding their protection. This justifies the exclusion from the sample of the years prior to 1996.

3.2 Trade and Gravity Data

My analysis of the impact of GIs on imports requires the econometric modeling of international trade flows. For this purpose, I require first import data at the disaggregated product level for the 35 countries that protect at least one good through GIs: this is available through the BACI database of CEPII (Gaulier & Zignago, 2010). Secondly, additional information relative to country pairs that is useful to estimate gravity models such as distance, GDP, cultural links and the presence of trade agreements are also provided CEPII through the Gravity dataset (Head et al., 2010). Since the Gravity dataset only includes information up to 2015, the variables of interest are updated using data from the World Development Indicators (World Bank, 2019) and, for the case of Taiwan, from National Statistics (2019). The choice to only include as importers of a good the countries that adopt a EU GI policy for that HS6 product, together with the employment of country time-varying fixed effects, helps me isolate the effect of the policy itself, disregarding possible cultural and historical demand-side preferences for certain products in the countries that implement the policy.

The matching of GI information with data regarding bilateral trade flows between the GI protecting countries and 50 important trading partners for the HS6 products where protections are present leaves me with 148,925 positive-trade country-pair-product-year observations. For each product for which a country pair shows at least one positive trade flow during the sample period, I square the data matrix by adding zero-flow observations for all the years for which trade data is missing, resulting in an overall sample of 334,121 observations. To check whether missing observations are likely to reflect actual zero flows, I use a dataset again constructed by Gaulier & Zignago (2010) and provided by CEPII. The

results show a high probability of the missing values representing no trade between the countries for over 98% of the missing-trade observations. Zero-flows constitute over 55% of my sample, a reasonable proportion given the high level of disaggregation of the data, which however still implies the need to adopt adequate estimation procedures that account for observations for which the trade value is equal to zero.

Partners are chosen to be the countries which existed as sovereign entities throughout the entire sample period and for which the largest number of importer-product-year positive trade observations are available for importing countries and products in which GIs are present. This allows me to identify the exporting economies that most often find themselves competing in foreign markets against GI-protected products. The list of these partner countries is provided in Appendix B.

4. Methodology

4.1 The Gravity Model

The gravity model is one of the most successful and widely used instruments for the empirical estimation of international trade flows. First formulated by Tinbergen (1962) and inspired by the laws of physics, its intuitive features made it highly attractive for its applicability to the empirical analysis of international trade, but at the same time left many skeptical about its theoretical foundations. It was only years later that various theoretical trade models were linked to a rigorous derivation of the gravity predictions (Anderson, 1979; Krugman, 1980; Helpman, 1987; Eaton & Kortum, 2002; Chaney, 2008).

More recently, the gravity equation has been subject to review with respect to its empirical implementation, in particular regarding two issues: the large number of zeros in trade data, which is increasing in the level of disaggregation, and the need to control for so-called "multilateral resistance terms". The latter problem was highlighted by Anderson & van Wincoop (2003), who showed that a theoretically founded gravity specification requires the inclusion of such resistance terms, which take into account of a country's trade impediments against all other regions of the world. Exclusion of these variables, they claimed, would result in Omitted Variable Bias, and they proposed a complex nonlinear least

squares procedure to solve the issue. Baier and Bergstrand (2009) also developed a method to account for multilateral resistance terms using a Taylor expansion. To Anderson & van Wincoop's (2003) own admission, however, the inclusion of country fixed effects could also allow researchers to avoid bias, while maintaining a simpler specification. Several studies employing gravity specifications adopt this latter method and find consistent results (Rose and van Wincoop, 2001; Feenstra, 2002).

The problem of many zeros in bilateral trade data is of particular relevance for my analysis, which employs data at a very disaggregated level. As Helpman et al. (2008) underline, zero trade flows are also determined by gravity explanatory variables such as distance, and as such they should not be disregarding when estimating the model. The solution they propose is to employ a two-stage estimation procedure that first calculates with a Probit methodology the probability of trade occurring between two countries, and then proceeds to perform the regression on trade volumes. Santos Silva & Tenreyro (2006) also tackle the issue of zero flows, proposing a Poisson Pseudo-Maximum-Likelihood [PPML] estimator that also improves on the issues of heteroskedastic residuals and of bias deriving from logarithmic specifications of the OLS regression variables. As shown in Santos Silva & Tenreyro (2011), the PPML estimator is also particularly suitable for situations in which the proportion of zeros is large, as in the present study. My baseline estimation will therefore employ the PPML method, while a two-stage regression will be performed as a robustness check.

4.2 Specifications

The benchmark specification used to evaluate the impact of GIs on imports of the implementing countries could therefore be as follows:

$$IM_{jikt} = \beta_0 + \beta_1 gi^{IM}{}_{jikt} + \beta_2 gi^{EX}{}_{jikt} + \beta_3 gi^{IM-EX}{}_{jikt} + \beta_4 gdp_{jt} + \beta_5 gdp_{it} +$$

$$+ \beta_6 dist_{ji} + \beta_7 CONTIG_{ji} + \beta_8 LANG_{ji} + \beta_9 COLONY_{ji} + \beta_{10} EU_{jit} + \alpha_{jt} + \alpha_{it} + \varepsilon_{jikt}$$

Where *IM* stands for imports of GI-imposing country *j* from partner country *i* of HS6 product *k* in year *t*. Coefficients α_j and α_i represent importer and exporter country time-varying fixed effects, which are included with the purpose of controlling for multilateral resistance and other country-specific import trends. A description of the other control

variables, including some that will be added in further specifications that check for robustness of the results to different specifications, is provided by **Table 1**. Variables that in the above equation are indicated in lower case characters (all non-dummy variables) enter the equation in logarithms, in line with the requirements of the PPML estimator[3].

It is important to note that the GI policy enters the equation through three separate variables: the number of protections implemented by the importer in case the exporter does not have any EU GIs for that product in year t, the number for the exporter in the opposite case, and the sum of the protections in case both trading countries apply the policy to that product. The inclusion of all three variables is needed to separate the impact of protection on imports and on exports. The main coefficient of interest is β_1, which measures the effect of GI protection in the importing country on the quantity of total imports of comparable non-protected products, measured at the HS6 level.

Table 1: Description of the Main Control Variables Used in the Empirical Specifications

Variable	Description	Units
GI^{IM}	Number of GIs pertaining to a HS6 product line protected by the importer country, for the case in which the exporter country does not protect the product under the EU GI policy.	Integer Count
GI^{EX}	Number of GIs pertaining to a HS6 product line protected by the exporter country, for the case in which the exporter country does not protect the product under the EU GI policy.	Integer Count
$GI^{IM\text{-}EX}$	Sum of the number of GIs pertaining to a HS6 product line protected by the importer and exporter countries, for the case in which both countries protect the product under the EU GI policy.	Integer Count
DIST	Population-weighted distance between two countries	Kilometers
CONTIG	Indicates whether two countries share a common border	0 or 1
LANG	Indicates whether two countries share a common official or primary language	0 or 1
COLONY	Indicates whether two countries were ever in a colonial relationship	0 or 1
EU	Indicates whether two countries are both EU Member States	0 or 1
GICountry	Indicates whether a country protects an above-average number of GIs	0 or 1
GISector	Indicates whether an HS6 product line pertains to an HS2 sector in which an above-average number of GIs is protected	0 or 1
PDO	Indicates whether at least one of the Importer's GIs is a Protected Designation of Origin	0 or 1

[3] Given the large number of zero observations for GI policy, the GI variables are logarithmically transformed according to the following formula: gi = log (1 + GI)

As Santos Silva and Tenreyro (2006) showed, estimating such a gravity equation by OLS could lead to inconsistent estimates due to the likely heteroskedasticity of the error terms. The PPML estimator is therefore proposed as a solution to this problem, leading to consistent results while adopting relatively simple underlying assumptions: in particular, for the estimator to be consistent, I only need to assume correct specification of the conditional mean, which is a plausible assumption given the long history and wide usage of the gravity specification. Furthermore, the appropriateness of the employed specification can be tested through the Ramsey (1969) RESET test. In line with the literature, standard errors are clustered at the country-pair level.

The previous specification can also be simplified by transforming it into a fixed effects regression comparable to the ones performed by Raimondi et al. (2020), who use a dataset similar to mine. As Raimondi et al. (2020) claim, a fixed effects specification would be equivalent to a bilateral gravity equation where gravity variables such as distance, contiguity, and language are accounted for by country-pair dummies. This type of regression is also claimed to be similar in spirit to a difference-in-difference design, and in my analysis will take the following form:

$$IM_{jikt} = \beta_0 + \beta_1 gi^{IM}{}_{jikt} + \beta_2 gi^{EX}{}_{jikt} + \beta_3 gi^{IM-EX}{}_{jikt} + \beta_4 EU_{jit} + \\ + \alpha_{ji} + \alpha_{jt} + \alpha_{it} + \alpha_{kt} + \varepsilon_{jikt}$$

Where the subscripts *j*, *i*, *k*, and *t*, have the same meaning as before, variables relative to GI protection and EU membership are as described in Table 1, and the dependent variable is defined as for the first specification. α_{ji} represents country-pair fixed effects, α_{jt} and α_{it} stand for importer and exporter time-varying fixed effects, respectively, and product time-varying dummies are symbolized by α_{kt}. Raimondi et al. (2020) separate their analysis between intra-EU (only considering as such the 15 countries that were already Members of the European Union prior to 1996) and extra-EU trade and control for various international policy implementations of GIs. I instead focus exclusively on the Indications protected by the European Union and exploit the fact that some extra-EU countries have products registered under this policy to analyze all trade in product lines with GI protection in aggregate.

The different nature of international trade relationships within the EU and the 2004, 2007, and 2013 enlargements of the Union justify the addition of the EU control. The PPML

estimator is also applied to this regression, and standard errors are clustered at the country-pair-product level. A similar specification will also be used to look at the impact of GI policy on the quality of traded goods through the employment of Unit Values as the dependent variable.

5. Econometric Results

5.1 Effects of GI Policy on Import Quantities

Table 2 reports estimation results for the impact of the EU GI policy on trade quantities of the countries and products in my sample, comparing different estimation techniques. The basic, "intuitive" gravity model specification is reported in *Column I*: the log of measured international trade flows is modeled employing Ordinary Least Squares [OLS] and controlling for traditional gravity variables such as geographical distance and contiguity, together with my variables of interest related to GI protections. As evident from the number of observations included in the estimation, the OLS methodology disregards zero-trade flows, which is likely to lead to bias of the estimates. Importer and Exporter fixed effects control for economic size of the countries in the trade relationship and for additional country-specific characteristics.

The results show coefficients that are in line with the theory for most of the gravity variables, with positive coefficients associated to geographical, cultural, and institutional proximity, and a negative strongly significant coefficient for geographical distance. The estimation results related to the GI policy also go in the direction of theoretical predictions for the case of exporter-only GIs and when both countries protect similar products, as the coefficients are positive and strongly significant. The coefficient associated to importer GIs is however unexpectedly estimated to be positive and significant. As previously underlined the OLS estimation is likely to lead to biased estimates due to the elimination of zero-trade observations and other estimation issues such as heteroskedasticity. Additionally, the very small p-value of the Ramsey RESET test points to a problem of misspecification of the functional form, and further highlight the need for a more reliable estimation method.

Table 2: Baseline Results on Quantities – Comparison of Estimation Methods

Depend. Var.:	**Log Quantity of Imports**			**Q of Imports**
	(I)	**(II)**		**(III)**
Model:	**OLS**	**Heckman 2-Stage**		**PPML-FE**
		1st stage	**2nd stage**	
Log Importer GIs	0.072**	0.015	0.056	-0.286**
	(0.03)	*(0.01)*	*(0.04)*	*(0.11)*
Log Exporter GIs	0.230***	0.216***	0.350***	0.209
	(0.07)	*(0.04)*	*(0.07)*	*(0.13)*
Log Im.+Ex. GIs	0.656***	0.366***	0.805***	0.174
	(0.04)	*(0.02)*	*(0.05)*	*(0.14)*
Log Distance	-1.181***	-0.442***	-1.585***	
	(0.07)	*(0.03)*	*(0.09)*	
Contiguity	0.885***	0.435***	1.001***	
	(0.11)	*(0.07)*	*(0.11)*	
Comm. Language	0.388**	0.020	0.442**	
	(0.13)	*(0.06)*	*(0.17)*	
Colonial Links	-0.040	0.211***	0.151	
	(0.13)	*(0.06)*	*(0.15)*	
EU Membership	0.296***	0.424***	0.534***	0.740***
	(0.07)	*(0.04)*	*(0.11)*	*(0.21)*
Log Entry Costs		0.027***		
		(0.01)		
Log Entry Time		-0.014***		
		(0.01)		
Constant	7.748***	1.719***	10.290***	8.998***
	(0.68)	*(0.23)*	*(0.62)*	*(0.20)*
Included Fixed Effects:	Importer Exporter Year	Importer Exporter Year		Importer-Year Exporter-Year Imp.-Exp. Product-Year
N° of Obs.	148,926	185,051	87,582	331,178
(Pseudo) R^2	0.24	0.18		0.74
RESET test p-val.	0.00	0.58	0.15	0.73

Note: robust standard errors clustered at the country-pair level are reported in parentheses.
* stands for significance at the 10% confidence level, ** at the 5% level, and *** at the 1% level.

Conclusions should therefore not be drawn from these preliminary results, and more accurate estimation procedures will be employed in order to obtain more consistent results.

A step forward is provided by the estimation shown in *Column II*, in which I follow Helpman et al. (2008) in estimating trade flows through a two-stage procedure based on Heckman (1979). The probability of positive trade flows between two countries in a certain product line is therefore first estimated through a Probit regression, and then the effect of my included variables on the quantity of trade flows is estimated in the second stage. In order to avoid taking rebuttable assumptions, the procedure requires the inclusion in the first stage of additional variables that only affect the probability of trade and not directly the quantity of traded goods. I therefore construct the same variables that Helpman et al. (2008) used to control for the costs of accessing a new trade destination: for each country-pair in which both countries are high-cost destinations (i.e. have above-median entry costs or entry time and procedures), the two variables Entry Costs and Entry Time are constructed as the sum of the amount of costs or number of days and procedures that are above the median in the two countries. For all other cases, the variables take value zero.

The two-stage estimation has the further advantage of allowing for an interpretation in terms of the extensive and intensive margins of trade, although only at the country level. The first stage therefore evaluates the impact of my control variables on the probability of trade, i.e. on the country extensive margin, while the second stage represents the effect on the amount of trade, the intensive margin. Gravity variables again have the expected signs and are mostly significant for both stages of the regression; furthermore, the coefficients associated to the GIs applied by exporters only and by both importers and exporters at the same time on very similar products are again positive and significant, with no substantial differences between the intensive and extensive margin: most coefficients are estimated to be larger on the extensive margin, but no differences in signs or significance are retrieved.

The estimated coefficients associated to the number of GIs in countries importing from partners that do not have parallel quality protections are again positive, although not statistically significant. The OLS regression, as mentioned, had a number of limitations, and the two-stage regression, while providing and intuitive solution of the zero-trade flows issue, still provides unreliable results, most importantly due to the probable presence of

heteroskedasticity in the logarithmically transformed dependent variable when a large number of zero observations is present.

To overcome the shortcomings of these methodologies, I turn next to the PPML estimator developed by Santos Silva and Tenreyro (2006), showing the results of this regression in *Column III*. In this case not only country fixed effects control for economic size of the trading partners and for multilateral resistance terms, but also country-pair characteristics such as distance and common language are absorbed by dummies and I additionally control for HS6 product time-varying characteristics.

These regression result in coefficients associated to exporter GIs and GIs applied in both countries that are positive, similarly to the previous specifications, but are in this case not statistically significant. The hypothesized presence of bias in the previous two specifications appears to be particularly evident from the coefficient associated to importer-only GIs, which becomes negative and significant. The result of the RESET test, showing a very large p-value when testing for the significance of an alternative quadratic specification, does not prompt me to reject the hypothesis of correct functional form, giving me additional confidence in the interpretation of these results as reflecting the true effect of the policy.

A PPML fixed effects regression with the inclusion of country-pair fixed effects in addition to country and product time-varying fixed effects thus appears to be an appropriate specification to evaluate the impact of GI policy on disaggregated bilateral trade flows. The fact that the coefficient associated to exporter GIs is nonsignificant is not a matter of concern and does not contradict previous results in the literature of an export-enhancing effects of GIs. This result is instead probably due to my sample construction focused on importers, which leaves a very small number of observations for exporter-only protections, representing (European) partner countries that implemented the GI on a specific product before the importer of interest did. The positive effect on trade of GIs when both importers and exporters implement them also emerges from my data, although with a nonsignificant coefficient.

Since I am employing a PPML methodology, I can interpret my coefficients on logged regressors as elasticities, despite my dependent variable (quantity of trade) being in levels. The overall effect on imports of GI protection is therefore estimated to be negative, implying a 29% decrease in imports of a specific HS6 product when a country increases by 100% its

number of protections in that product line. The robustness of this result to slightly different specifications, together with possibly different effects in the various markets and sectors, is investigated in the following section. These initial results appear to have confirmed a strong anticompetitive impact of GIs in international trade, which can however completely be offset by producers if they are able to protect similar products through GIs, as suggested by the positive (nonsignificant) coefficients associated to the sum of importer and exporter GIs.

5.2 Additional Specifications and Decomposition

The estimation results of my PPML Gravity estimation with slightly modified specifications are shown in **Table 3**, the difference in specification consisting of the inclusion of country-pair-product fixed effects in place of the country-pair controls of the previous regression. Comparing the estimates provided in *Column I* with those of *Table 2, Column III*, my main coefficient of interest, that associated to Importer GIs, is much smaller in absolute size and nonsignificant, despite maintaining the negative sign. The results of the RESET test, however, imply strong rejection of the hypothesis of correct functional form, implying that the basic assumptions of the PPML estimation procedure are likely to not hold. As a consequence, my conclusions on the effect of GI policy on imports remain those based on the results shown in *Table 2*, *Column III*, and further estimations will employ similar controls.

I therefore proceed by performing a breakdown of the analysis for different product and country groups, which could shed further light on the different areas from which the estimated negative effect could originate. Results are again shown in **Table 3**. *Column II* allows me to analyze the effect of GIs on intra-EU and extra-EU trade relationships, by interacting the dummy indicating EU membership of both trading countries with my GI policy variables. The estimated results do not imply a significant difference in the impact of the policy on the two types of trade relationships. The effect on extra-EU trade is negative and significant at the 10% level, and that on trade between EU countries, which can be evaluated by summing the coefficient associated to importer GIs and the interaction term regarding importer-only protection, is very similar, being the estimate related to the interaction term nonsignificant.

Table 3: PPML Fixed Effects Estimation Results on Quantities - Decomposition

Dependent Variable:	**Quantity of Imports**				
Model:	**PPML - FE**				
Interaction Variable:	**(I)**	**(I) EU Memb.**	**(III) GI Country**	**(IV) GI Sector**	**(V) PDO**
Log Importer GIs	-0.005	-0.246*	-0.482**	-0.616***	-0.292*
	(0.05)	*(0.14)*	*(0.21)*	*(0.24)*	*(0.17)*
Log Exporter GIs	-0.095	-0.300	-0.146	-0.105	0.186
	(0.07)	*(0.19)*	*(0.15)*	*(0.22)*	*(0.13)*
Log Imp. + Exp. GIs	-0.040	0.132	0.034	-0.108	0.157
	(0.06)	*(0.34)*	*(0.14)*	*(0.22)*	*(0.14)*
*Log Im. GIs * Inter. Var.*		-0.059	0.204	0.420*	0.263
		(0.15)	*(0.20)*	*(0.23)*	*(0.24)*
*Log Ex. GIs * Inter. Var.*		0.560***	0.549**	0.389*	
		(0.16)	*(0.16)*	*(0.23)*	
Log Im.+Ex. GIs Int. Var.*		0.040	0.142	0.343*	
		(0.34)	*(0.10)*	*(0.20)*	
EU Membership	0.752***	0.491**	0.675***	0.763***	0.738***
	(0.21)	*(0.21)*	*(0.20)*	*(0.21)*	*(0.20)*
PDO					-0.606**
					(0.28)
N° of Obs.	331,054	331,178	331,178	331,178	331,178
Pseudo R^2	0.96	0.74	0.74	0.74	0.74
RESET Test p-value	0.00	0.12	0.98	0.08	0.39

Note: robust standard errors clustered at the country-pair level are reported in parentheses. Importer-Year, Exporter-Year, Product-Year, and Country-Pair fixed effects are included in all regressions. In Column I, Country-Pair fixed effects are replaced by Country-Pair-Product fixed effects. * stands for significance at the 10% confidence level, ** at the 5% level, and *** at the 1% level.

Regarding GI policies applied by exporters only, the estimation results in a negative nonsignificant coefficient for extra-EU trade, which is instead positive and statistically and economically significant for the case of intra-EU flows. Having highlighted that the exporter-only protections in my sample represent GIs applied on a product line that was subsequently protected also by the importer, it appears that EU producers of GI products are able to reap a benefit from protecting their good and exporting it to a country that is already producing similar products with traditional and geography-based methodologies. This is however not

the case when one of the two trading partners is not a EU Member State. When importers and exporters are both observed to be applying the policy to the same product, similarly to the previous specifications positive but nonsignificant effects are retrieved. In both country-pair groups, exporters still appear to be able to offset the negative impact on imports that the protection of GIs by the importer implies by registering their own products.

My estimation thus does not provide evidence of a substantially different effect of GI policy on imports when looking at intra- versus extra-EU trade; as the next step, I analyze whether the effect of the policy is stronger in the countries that are most active countries in the protection of GIs (all EU Member States throughout the entire sample period). Estimating my PPML specification equation with the inclusion of interaction terms between GI policy indicators and a dummy indicating whether the importer is a country protecting an above-average number of GIs, I obtain the results shown in *Column III*. The "GI Countries" are, according to my data: France, Germany, Greece, Italy, Portugal, Spain, and the United Kingdom.

The results again do not imply a significantly different effect of GI policy on imports when comparing these group of countries, as shown by the nonsignificant coefficient associated to the interaction term between Importer GIs and the country dummy, which is however quite large and positive. The other GI variables and interaction terms are less economically meaningful given the import-side definition of the country dummy. What they imply is that additional GI implementation by exporters has a positive but nonsignificant effect on trade flows when the importer is not one of the GI countries, but a positive impact on exports to the countries that are more likely to protect their agri-food products, for goods that have not yet received protection by the importer. This is probably due to a higher rate of recognition and higher value given by consumers to the GI label in the countries when this quality sign is applied to many well-known local products. The coefficients for the case in which both countries implement the policy are both nonsignificant.

Having analyzed the differential effects of GI policy on two different groups of countries, I now look at the possible differences between product markets, by creating a dummy variable indicating with the value one the HS2 sectors in which an above-average number of GIs is protected by the EU policy. The estimation results of my specification with the inclusion of this variable's interaction terms are provided in *Column IV*. In this case,

there is evidence of a strong import-reducing effect of GIs in sectors where not many of these protections are implemented, as the coefficient associated to Importer GIs is large, negative, and strongly significant. This effect is estimated to be much smaller in the seven GI-intensive HS2 sectors. For the case of exporter-only protection, the already observed positive effect appears to be stronger for the sector in which fewer GIs are protected. The weaker effect of GI policy on imports in GI-intensive sectors is also translated in a significant trade-enhancing effect of the policy when both trading countries apply it to a specific product line: the interaction term is estimated to be positive and marginally significant.

Lastly, I empirically assess for differential impact of the two possible applications of the EU GI policy, namely the Protected Geographical Indication [PGI] and Protected Designation of Origin [PDO] labels. In order to perform this analysis, I create a PDO dummy that indicates whether at least one of the products registered as GIs that pertain to a certain HS6 category is protected through the PDO label, which implies stricter local content requirements. The estimated coefficients can be interpreted as follows: the presence of PDO registered products in the importing country for a certain product line results in trade flows that are over 45%[4] smaller. The effect of additional registrations, however, is not significantly different if these are PDO or PGI, since the coefficient associated to the interaction between the number of GIs and PDO presence is nonsignificant.

The available data does not allow me to reach further conclusions on the effect of these two variations of the EU GI policy on trade for the case of exporter-only GIs or when both countries protect similar products. The PDO label thus could be acting as a stronger trade deterrent than the comparable PGI label, but employment of more detailed data on the application of the two protections would help shed further light on this issue. This analysis is however beyond the scope of my study.

Having observed the significant effects of GI policy on trade volumes, and in particular on import flows, in the next section I turn to the possible impacts of these protections on the quality of traded goods, by employing the imperfect, but still useful, measure provided by Unit Values.

[4]The coefficients associated to regressors not in logarithmic form in a PPML estimation can be used to compute a semielasticity according to the following formula: $S = (e^{\beta} - 1)*100\%$ (Santos Silva and Tenreyro, 2006)

5.3 Effects of GI Policy on Import Unit Values

The fixed effects specification described in Section 4.2 and employed in Sections 5.1 and 5.2 has the additional advantage of providing a more general framework for the modeling of international trade flows that abstracts from traditional gravity controls such as geographical distance and economic country size. This allows the fixed effects methodology to more flexibly be adapted to not only estimate the impact of a policy of interest on trade quantities, but also on the approximate measure of quality of traded goods that is represented by Unit Values. In this section, I therefore evaluate whether the increased in protection of GI policy determines a change in import compositions towards higher-quality goods.

The results of five different fixed effects estimations on Unit Values are provided by **Table 4**. Here, no evidence emerges of a tendency to import higher-quality goods as a consequence of the implementation of GIs from the coefficient associated to Importer GIs, which is negative and nonsignificant: the coefficients associated to Importer GIs are mostly negative and never statistically significant. The presence of PDOs, however, seems to determine higher Unit Values of traded goods, with a marginally significant estimate. Also Exporter-only GIs and EU Membership have positive significant coefficients: GIs appear to benefit exporters through higher prices they are able to impose on foreign markets, with an estimated increase in Unit Values after a 100% increase in the number of protections of about 28%.

The breakdown of the effects on different country groups through the employment of interaction variables (*Columns II* and *III*) points to the same conclusion, with nonsignificant differences in UVs when looking at intra- or extra-EU trade and at imports from GI-intensive countries. The already observed advantage in terms of prices and quality for exporters selling in countries that are not (yet) protecting similar products is estimated to be larger for the case of extra-EU trade. The estimates involving the interaction between the GI policy variables and the GI-intensive sectors (*Column IV*) show evidence of a substantial increase in UVs in the sectors in which GI policy is relatively less frequently applied when both the importer and the exporter apply the policy. No other significant effect of GI implementation on trade Unit Values in the two sector categories is retrieved. The estimation including interactions with the presence of PDOs also does not lead to significant differences in the

Table 4: PPML Fixed Effects Estimation Results on Unit Values

Dependent Variable	**Unit Values**				
Model:	**PPML – Fixed Effects**				
Interaction Variable:	**(I)**	**(II) EU Memb.**	**(III) GI Country**	**(IV) GI Sector**	**(V) PDO**
Log Importer GIs	-0.131	-0.185	-0.065	0.036	-0.101
	(0.10)	*(0.12)*	*(0.14)*	*(0.25)*	*(0.13)*
Log Exporter GIs	0.284***	0.504***	0.330***	0.315	0.287***
	(0.07)	*(0.09)*	*(0.06)*	*(0.35)*	*(0.07)*
Log Imp. + Exp. GIs	0.066	-0.071	0.167***	0.593**	0.071
	(0.07)	*(0.16)*	*(0.06)*	*(0.28)*	*(0.07)*
*Log Im. GIs * Inter. Var.*		0.119	-0.071	-0.219	-0.058
		(0.11)	*(0.13)*	*(0.27)*	*(0.15)*
*Log Ex. GIs * Inter. Var.*		-0.281***	-0.075	-0.057	
		(0.09)	*(0.14)*	*(0.35)*	
*Log Im.+Ex. GIs*Int. Var.*		0.148	-0.121*	-0.611**	
		(0.15)	*(0.07)*	*(0.29)*	
EU Membership	0.311*	0.432***	0.292*	0.343**	0.313*
	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)
PDO	0.355*	0.349*	0.349*	0.407**	0.409*
	(0.19)	*(0.19)*	*(0.19)*	*(0.15)*	*(0.25)*
N° of Obs.	331,178	331,178	331,178	331,178	331,178
Pseudo R^2	0.72	0.72	0.72	0.72	0.72
RESET Test p-value	0.53	0.80	0.70	0.61	0.47

Note: robust standard errors clustered at the country-pair level are reported in parentheses. Importer-Year, Exporter-Year, Product-Year, and Country-Pair fixed effects are included in all specifications.
* stands for significance at the 10% confidence level, ** at the 5% level, and *** at the 1% level.

results for the two groups of observations (*Column V*). The presence of PDOs themselves in the importing country is consistently estimated to be associated to a strong positive increase in trade Unit Values of over 40%, but the amount of protection applied to product lines does not significantly change the results, if not in the already case of exporter-only protection.

6. Conclusion

My PPML analysis on the impact of the protection of Geographical Indications of Origin on international trade flows has provided evidence of a significant trade-reducing effect of these registered products on imports from countries that do not protect goods in the same product line under the EU GI regulation. The estimated 29% negative elasticity of trade with respect to GI protection by the importing country reinforces the claim of an anticompetitive impact of the EU GI policy on international markets.

The fact that most estimates of the effect when two trading partners both apply the policy to the same product line are positive or nonsignificant, however, suggests that exporters are able to offset this disadvantage if they are able to register their own products. Wider availability of an international system of protection Geographical Indications could therefore allow producers to overcome entry barriers and maintain international competition on GI products, while still improving on the information asymmetries for consumers.

Additionally, despite my sample construction only including observations of countries exporting to markets where a GI would have been registered in subsequent periods in the same product line, I find strong advantages of GI implementation in these cases, in terms of Unit Values in virtually all cases and in terms of exported quantities for intra-EU trade and when exporting to GI-intensive countries. The logistical and technical difficulties in registering a GI product and the possibly higher costs for non-EU producers when trying to obtain the quality certification are not addressed in this study, but the presence of a GI label appears to be beneficial for exporters in terms of access to EU markets, opening the possibility of a positive return on the investment.

The estimates with interaction variables do not provide evidence of significantly different effects on intra- or extra-EU trade and when importers are the seven countries that most frequently adopt the policy. Sectoral decomposition however shows that the anticompetitive effect is much stronger in the HS2 products where the policy is less frequently applied, suggesting that GIs in these sectors constitute a stronger trade barrier. This finding could be of interest to policymakers shaping the future of the EU and international GI regulation, where the debate could shift to whether uniform protection schemes are appropriate for different agri-food products.

The estimation methods employed in this study allow me to avoid many sources of bias that could be present in baseline gravity specifications, but do not address the possibility of reverse causality. It could be the case that GI policy is implemented on some goods as a consequence of the preexistent volume of trade in that product line. This could undermine validity of my estimates, especially in the case of positive endogeneity bias, i.e. if a higher volume of trade in a certain product line incentivizes a country to register a specific good as a GI. An Instrumental Variable approach could allow me to collect evidence on the possible direction of this bias, but the difficulty in finding an appropriate such variable, which would need to only be correlated with GI implementation and not with volumes of trade, prevents me from doing so.

Among the limitations that this study shares with previous empirical assessments of the impact of GI policy is also the impossibility to measure the amount of measured trade flows that is represented by GI goods. A step further in our understanding of the relationships between GI protection and trade could thus be provided by the analysis of a more detailed dataset, optimally providing firm-level information on the amount of certified and noncertified goods that are traded. Firm-level data could also be used to verify whether the protection of GIs does in fact incentivize, through higher sales and unit values, investment in innovation, as Lence et al. (2007) theorized. Positive findings on this topic could mean that the trade-diverting effect of GIs observed in this paper would not necessarily have a welfare-reducing impact at the aggregate level.

7. Appendices

Appendix A: Lists of Countries and Product Codes [HS6] by Number of GIs Protected in the European Union up to 2018

Table A1: List of Countries by Number of GIs Protected in the European Union up to 2018

EU Member States				Non-Member States	
Country	***N°***	***Country***	***N°***	***Country***	***N°***
Italy	293	Belgium-Luxembourg*	13	China	10
France	235	The Netherlands	11	Thailand	4
Spain	188	Hungary	11	Turkey	3
Portugal	138	Denmark	7	Norway	2
Greece	100	Ireland	7	Andorra	1
Germany	88	Cyprus	5	Colombia	1
United Kingdom	66	Romania	5	Dominican Republic	1
Poland	31	Sweden	5	Indonesia	1
Czechia	27	Lithuania	4	India	1
Croatia	20	Finland	3	Cambodia	1
Slovenia	18	Latvia	3		
Austria	15	Bulgaria	1		
Slovakia	14				

*Since some countries do not distinguish between Belgium and Luxembourg in their trade declarations, trade data is only available as an aggregate of the two. I therefore also consider them jointly for GI data.
Source: eAmbrosia database (European Commission, 2019).

Table A2: List of HS2-HS6 Product Codes by Number of Protected GIs in the European Union up to 2018

HS2 Code	HS6 Codes with at least one GI	N°
[02] Meat and Edible Meat Offal	020110; 020311; 020410; 020421; 020430; 020441; 020450; 020711; 020724; 020751; 020760; 020910; 021011; 021012; 021019; 021020; 021099.	232
[03] Fish and Crustaceans, Molluscs and Other Aquatic Invertebrates	030211; 030213; 030214; 030219; 030241; 030242; 030243; 030244; 030251; 030252; 030273; 030274; 030279; 030452; 030520; 030541; 030544; 030617; 030711; 030721; 030731; 030791.	41
[04] Dairy Produce; Birds' Eggs; Natural Honey; Other Edible Products of Animal Origin	040410; 040510; 040520; 040610; 040640; 040690; 040711; 040729; 040900.	285

[07] Edible Vegetables and Certain Roots and Tubers	070110; 070190; 070200; 070310; 070320; 070390; 070410; 070490; 070519; 070529; 070610; 070690; 070700; 070810; 070820; 070920; 070930; 070940; 070951; 070960; 070991; 070992; 071190; 071320; 071333; 071340; 071350; 071420; 071440.	195
[08] Edible Fruits and Nuts; Peel of Citrus Fruit or Melons	080211; 080221; 080231; 080241; 080251; 080290; 080310; 080420; 080430; 080510; 080540; 080550; 080711; 080810; 080830; 080840; 080910; 080921; 080930; 080940; 081010; 081030; 081050; 081070; 081090; 081120; 081310; 081320.	153
[09] Coffee, Tea, Maté and Spices	090111; 090210; 090230; 090411; 090421; 090422; 090931; 091020; 091099.	21
[10] Cereals	100610.	11
[11] Products of the Milling Industry	110319; 110710; 110713.	5
[12] Oil Seeds and Oleaginous Fruits; Miscellaneous Grains, Seeds and Fruit	120400; 120791; 121010; 121190; 121221; 121291; 121490.	14
[15] Animal or Vegetable Fats and Oils	150910.	118
[16] Preparations of Meat, of Fish or of Crustaceans, Molluscs	160100; 160249; 160414; 160419.	103
[17] Sugars and Sugar Confectionery	170290; 170410; 170490.	14
[18] Cocoa and Cocoa Preparations	180632.	1
[19] Preparations of Cereals, Flour, Starch or Milk	190211; 190219; 190220; 190490; 190510; 190520; 190531; 190540; 190590.	75
[20] Preparations of Vegetables, Fruit, Nuts	200490; 200570; 200599; 200600; 200799; 200850; 200897; 200899.	11
[21] Miscellaneous Edible Preparations	210330; 210390.	3
[22] Beverages, Spirits and Vinegar	220300; 220600; 220900.	41
[25] Salt	250100.	8
[51] Wool	510111.	1

Source: Raimondi et al. (2020), own matching based on eAmbrosia database (European Commission, 2019).

Appendix B: List of Exporting Countries and Regions with No GIs Registered under EEC Regulation No. 2081/92 included in the Sample

Albania	Israel	Philippines
Argentina	Japan	Republic of Korea
Australia	Jordan	Russian Federation
Bosnia Herzegovina	Kenya	Saudi Arabia
Brazil	Lebanon	Senegal
Canada	Madagascar	Singapore
Chile	Malaysia	Southern African Customs Union**
Costa Rica	Malta	Sri Lanka
Côte d'Ivoire	Mauritius	Switzerland, Liechtenstein***
Ecuador	Mexico	Syria
Egypt	Moldova	Tunisia
Estonia	Morocco	Ukraine
Ethiopia	New Zealand	United Arab Emirates
Ghana	North Macedonia	Uruguay
Guatemala	Other Asia [Taiwan]*	USA, Puerto Rico and US Virgin Islands***
Iceland	Pakistan	Viet Nam
Iran	Peru	

*The UN, and consequently the BACI database I employ, do not show statistics referring to Taiwan, but trade data for 'Asia, not elsewhere specified', is considered to be a good proxy for trade with Taiwan.
**SACU comprises Botswana, Eswatini, Lesotho, Namibia, and South Africa. Since some countries report their trade with the Union and not with the single countries, trade data is only available as an aggregate.
***Similarly to the case of SACU and Belgium-Luxembourg, trade with these groups of countries is reported in aggregate form.

8. References

Agostino, M., & Trivieri, F. (2014). Geographical indication and wine exports. An empirical investigation considering the major European producers. *Food Policy, 46*, 22-36.

Akerlof, G. A. (1970). The market for "lemons": quality uncertainty and the market mechanism. *Quarterly Journal of Economics, 84(3),* 488-500.

Anderson, J. E. (1979). A theoretical foundation for the gravity equation. *The American Economic Review, 69(1)*, 106-116.

Anderson, J. E., & Van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review, 93(1)*, 170-192.

Baier, S. L., & Bergstrand, J. H. (2009). Bonus vetus OLS: A simple method for approximating international trade-cost effects using the gravity equation*. Journal of International Economics, 77(1)*, 77-85.

Barham, E. (2003). Translating terroir: the global challenge of French AOC labeling. *Journal of Rural Studies, 19(1)*, 127-138.

Chambolle, C., & Giraud-Héraud, E. (2005). Certification of origin as a non-tariff barrier. *Review of International Economics, 13(3)*, 461-471.

Chaney, T. (2008). Distorted gravity: the intensive and extensive margins of international trade. *American Economic Review, 98(4)*, 1707-21.

Crozet, M., Head, K., & Mayer, T. (2012). Quality sorting and trade: Firm-level evidence for French wine. *The Review of Economic Studies, 79(2)*, 609-644.

Eaton, J., & Kortum, S. (2002). Technology, geography, and trade. *Econometrica, 70(5)*, 1741-1779.

European Commission (2019). *eAmbrosia – the EU geographical indications register* [Data Set]. https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/certification/quality-labels/geographical-indications-register/

European Commission (2020). *Quality schemes explained*. Retrieved May 15, 2020, from https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/certification/quality-labels/quality-schemes-explained_en

Feenstra, R. C. (2002). Border effects and the gravity equation: Consistent methods for estimation. *Scottish Journal of Political Economy, 49(5)*, 491-506.

Fondazione Qualivita (2015). *QUALIGEO.EU: The food, wine and spirits Geographical Indications database*. Retrieved May 4, 2020, from https://www.qualigeo.eu/en/

Gaulier, G., & Zignago, S. (2010). Baci: international trade database at the product-level (1994-2007 version).

Hallak, J. C. (2006). Product quality and the direction of trade. *Journal of International Economics, 68(1)*, 238-265.

Hallak, J. C., & Schott, P. K. (2011). Estimating cross-country differences in product quality. *The Quarterly Journal of Economics, 126(1)*, 417-474.

Head, K., & Mayer, T. (2000). Non-Europe: the magnitude and causes of market fragmentation in the EU. *Review of World Economics, 136(2)*, 284-314.

Head, K., Mayer, T., & Ries, J. (2010). The erosion of colonial trade linkages after independence. *Journal of International Economics, 81(1)*, 1-14.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica: Journal of the Econometric Society*, 153-161.

Helpman, E. (1987). Imperfect competition and international trade: Evidence from fourteen industrial countries. *Journal of the Japanese and International Economies, 1(1)*, 62-81.

Helpman, E., Melitz, M., & Rubinstein, Y. (2008). Estimating trade flows: Trading partners and trading volumes. *The Quarterly Journal of Economics, 123(2)*, 441-487.

Hummels, D., & Klenow, P. J. (2005). The variety and quality of a nation's exports. *American Economic Review, 95(3)*, 704-723.

Josling, T. (2006). The war on terroir: geographical indications as a transatlantic trade conflict. *Journal of Agricultural Economics, 57(3)*, 337-363.

Khandelwal, A. (2010). The long and short (of) quality ladders. *The Review of Economic Studies, 77(4),* 1450-1476.

Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. *The American Economic Review, 70(5)*, 950-959.

Lence, S. H., Marette, S., Hayes, D. J., & Foster, W. (2007). Collective marketing arrangements for geographically differentiated agricultural products: Welfare impacts and policy implications. *American Journal of Agricultural Economics, 89(4)*, 947-963.

Marette, S., Clemens, R., & Babcock, B. (2008). Recent international and regulatory decisions about geographical indications. *Agribusiness, 24(4)*, 453–453.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica, 71(6)*, 1695-1725.

Menapace, L., & Moschini, G. (2012). Quality certification by geographical indications, trademarks and firm reputation. *European Review of Agricultural Economics, 39(4)*, 539-566.

Menapace, L., & Moschini, G. C. (2014). Strength of protection for geographical indications: promotion incentives and welfare effects. *American Journal of Agricultural Economics, 96(4)*, 1030-1048.

Moschini, G., Menapace, L., & Pick, D. (2008). Geographical indications and the competitive provision of quality in agricultural markets. *American Journal of Agricultural Economics, 90(3)*, 794-812.

National Statistics Republic of China (Taiwan) (2019). *Statistical Tables. Principal Figures* [Data file]. Retrieved May 26, 2020 from https://eng.stat.gov.tw/ct.asp?xItem=37408&CtNode=5347&mp=5

Raimondi, V., Falco, C., Curzi, D., & Olper, A. (2020). Trade effects of geographical indication policy: The EU case. *Journal of Agricultural Economics, 71(2),* 330-356.

Ramsey, J. B. (1969). Tests for specification errors in classical linear least-squares regression analysis. *Journal of the Royal Statistical Society: Series B (Methodological), 31(2)*, 350-371.

Rose, A. K., & Van Wincoop, E. (2001). National money as a barrier to international trade: The real case for currency union. *American Economic Review, 91(2),* 386-390.

Santos Silva, J., & Tenreyro, S. (2006). The log of gravity. *The Review of Economics and Statistics, 88(4)*, 641-658.

Santos Silva, J., & Tenreyro, S. (2011). Further simulation evidence on the performance of the Poisson pseudo-maximum likelihood estimator. *Economics Letters, 112(2)*, 220-222.

Schott, P. K. (2004). Across-product versus within-product specialization in international trade. *The Quarterly Journal of Economics, 119(2)*, 647-678.

Sorgho, Z., & Larue, B. (2014). Geographical indication regulation and intra-trade in the European Union. *Agricultural Economics, 45(S1)*, 1-12.

Tinbergen, J. (1962). An analysis of world trade flows. *Shaping the World Economy, 3*, 1-117.

Verhoogen, E. A. (2008). Trade, quality upgrading, and wage inequality in the Mexican manufacturing sector. *The Quarterly Journal of Economics, 123(2)*, 489-530.

WIPO (2020). Geographical Indications. Retrieved from https://www.wipo.int/geo_indications/en/

World Bank (2019). *Databank | World Development Indicators*. Retrieved May 26, 2020 from https://databank-worldbank-org.eur.idm.oclc.org/source/world-development-indicators

WTO (2006). *DS 174: European Communities — Protection of Trademarks and Geographical Indications for Agricultural Products and Foodstuffs* https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds174_e.htm#

WTO (2008). TRIPS: Geographical Indications. Background and the current situation. Retrieved from: https://www.wto.org/english/tratop_e/trips_e/gi_background_e.htm