This is a pre print version of the following article:

Trade effects of geographical indication policy: The EU case / Raimondi, V.; Falco, C.; Curzi, D.; Olper, A.. - In: JOURNAL OF AGRICULTURAL ECONOMICS. - ISSN 0021-857X. - 71:2(2020), pp. 330-356. [10.1111/1477-9552.12349]

Terms of use:

The terms and conditions for the reuse of this version of the manuscript are specified in the publishing policy. For all terms of use and more information see the publisher's website.

05/05/2026 19:08

(Article begins on next page)

Article type : Original Article

Trade Effects of Geographical Indication Policy: The EU Case

Valentina Raimondi, Chiara Falco, Daniele Curzi and Alessandro Olper [1]
(Original submitted October 2018, revision received March 2019, accepted May 2019.)

Abstract

Using a new detailed dataset on country-product information on European Union (EU) Geographical Indications (GIs), we study the impact of this food quality policy on trade margins over the 1996–2014 period. We consider the effect of GIs on both intra- and extra-EU trade margins (extensive and intensive), as well as on export (and import) unit values. Our main results show that GIs affect trade flows differently depending on whether GIs are produced by the exporter or importer country. The presence of GIs in the exporter country systematically exerts a positive trade effect on both the extensive and intensive trade margin. When registered only in the importer country, GIs seem to act weakly as a trade-reducing measure, at least at the intensive trade margin. In addition, GIs positively affect export prices, consistent with the idea that GI products are perceived by consumers as higher quality goods. Importantly, extra-EU trade margins react similarly to those on intra-EU trade. These results have clear and interesting implications concerning the EU strategy of promoting the protection of GIs worldwide.

Keywords: *EU geographical indications; trade margins; export unit values; food quality.*

JEL classifications: *F12, F14, Q18.*

[1] Alessandro Olper Valentina Raimondi, Chiara Falco, Daniele Curzi are all in the Department of Environmental Science and Policy, University of Milano, Italy. E-mail: alessandro.olper@unimi.it for correspondence. Alessandro Olper is also with LICOS – Centre for institutions and Economic performance, KU Leuven, Belgium. This study has received funding from the European Union's Horizon 2020 research and innovation programme 'Strength2Food' under grant agreement No. 678024.

1. Introduction

In recent decades, few topics have been so controversial in international trade talks as the intellectual property rights (IPR) protection of geographical indications (GIs).[2] Countries worldwide continue to quarrel on the nature, the scope, and the enforcement of GI protection nationally and internationally (Calboli and Wee Loon, 2017). This conflict has been the subject of bilateral and multilateral talks for more than 20 years, as well as of trade disputes within the World Trade Organization (WTO).

GIs have a long history in Europe, beginning in 1883 with the convention of Paris for the protection of industrial property (Josling, 2006). In 1992 the European Union adopted the first Regulation (EEC) No 2081/92, defining the conditions for registration of GI agricultural products and foodstuffs as protected.[3] The European Union (EU) policy on 'quality schemes for agricultural products and foodstuffs' aims to protect, both domestically and internationally, the name of specific products, in order to promote 'their unique characteristics, linked to their geographical origin as well as traditional know-how'.[4] Therefore products can be classified as GIs if they can be linked to the place where they are made.[5]

At the international level, failure to reach an agreement on multilateral trading rules within the WTO Doha Development Round triggered a new wave of international trade arrangements

[2] The adoption of Trade Related Aspects of Intellectual Property (TRIPs) in 1994, together with the Uruguay Round Agreement on Agriculture, did not resolve the disagreement between the European Union and 'Anglo-American' countries. In short, while the TRIPS established a strong intellectual property rights (IPR) protection for wines and spirits in Art. 23, the IPR protection for other products including agricultural products and foodstuffs, defined in Art. 22, is significantly weaker.

[3] This framework was repealed in 2006 by the Regulation (EC) No. 510/2006 and then in 2013, by the Regulation (EU) No. 1151/2012 of the European Parliament on 'quality schemes for agricultural products and foodstuffs'.

[4] EU Commission website: https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/ certification/ quality-labels/quality-schemes-explained_en

[5] In particular, a distinction between Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) can be made according to the extent to which they have to comply with the required origin-quality link. In the PGI case, it is sufficient that one stage of the production process is carried out in a specific geographical area, while in the case of PDO all production stages must take place in the same geographical area. As a consequence, for PDO products the agricultural raw materials have to be obtained within a specific geographical area. In the case of PGI products, the agricultural raw material can be sourced anywhere, and can also come from abroad.

negotiated on a bilateral basis, where both the European Union (EU) and the United States (US), have had some success in extending their particular view concerning the protection system of GIs. The free trade agreements (FTAs) of the EU concluded with South Korea, Singapore, Vietnam and Japan, and the 'Comprehensive Economic and Trade Agreement' (CETA) with Canada, are important examples where, for the first time, specific GI provisions have been formally included in the EU FTAs. At the same time, the US in its FTA with Asian countries, the so called 'Trans-Pacific Partnership' (TPP), promoted its trademark system view on how GIs should be protected, a view that contrasts with that of the EU (Matthews, 2016).[6]

From an economic point of view, the nature of the Transatlantic disagreement over GIs can be attributed to their possible pro- or anti-competitive effect (Chambolle and Giraud-Heraud, 2005; Josling, 2006; Marette *et al.*, 2008). This is because, on the one hand, the idea of including the geographic origin of the product on a label is a crucial element for correcting consumer information asymmetries (Marette and Crespi, 2003). Hence, using a GI label as a proxy for information for the consumer about the attributes of a good may have some economic justification (Lance *et al.*, 2007; Moschini and Menapace, 2014). On the other hand, as discussed in Josling (2006, p. 339) 'if linking quality to land merely provides a rent to those who own the land, and reduces competition by newcomers who could otherwise find ways to reproduce the land-based attributes through other means, then such linkage would be less obviously beneficial'.

This tension between more information for consumers and less competition (Marette and Crespi, 2003; Zago and Pick, 2004) may raise problems at both national and international levels (Josling, 2006; Marette *et al.*, 2008). In fact, GI labels may entail trade distortions or impede the entry of producers who cannot comply with specific requirements. As stressed by Josling (2006), the asymmetric information argument and the extent to which GIs induced a pro- and/or anti-competitive effect is difficult to establish *a priori*, and should be investigated and addressed empirically. The present contribution, by investigating if there exists an export-promoting and/or import-reducing effect of the European Union GIs, is a move in that direction.

More specifically we contribute to a better understanding of the international trade dimension of EU GI policy extending previous evidence in several directions. In particular, we

[6] Note that, countries such as Mexico, South Korea, Japan and Vietnam, are both signatories of the TPP with the US, and free trade agreements with the EU. Because the provisions of GI protection included in these FTAs reflect, alternatively, the rather different US and EU perspectives, this raises potential problems and confusion about the protection of GIs in these countries (see Matthews, 2016).

try to answer the following research questions: does the EU GI policy contribute to improving export performance of agri-food products in international markets? To what extent does the diffusion of GIs in importing countries represent a protection device against import competition? Does the GI trade policy affect intra- vs. extra-EU trade flows differently? Is there any GI effect on export (and import) prices?

To answer these questions our analysis builds on the few early published works investigating empirically the relationship between GIs and trade (Agostino and Trivieri, 2014; Sorgho and Larue, 2014, 2018), and provides three main novelties. First, we test our research questions by building a new dataset on the EU quality policy through a careful classification of *all* the EU GI products at the Harmonized System (henceforth HS) 6-digit level, over the 1996–2014 period. This new dataset allows us to exploit the within country-sector variation in the number of GIs, to identify their trade effects. Thus, our empirical exercise is robust to endogeneity bias that normally plagues this kind of analysis, such as omitted variables bias, and is close in spirit to a differences-in-differences research design. In addition, we also control for endogeneity bias due to reverse causality between trade and GIs, by adopting an instrumental variables (IV) approach. Second, we focus our analysis separately on intra-EU and extra-EU trade. Such a distinction is necessary as these trade patterns are based on different presumptions in terms of tariff and non-tariff barriers, and, perhaps more importantly, because the GI policy is set at the EU level, and is rarely recognised by extra-EU countries. However, both cases are equally interesting to study as they may provide important policy implications on different grounds. Our paper is the first to take into account all these important differences. Finally, unlike previous papers, we consider a direct measure of trade margins, based on the theoretically-founded decomposition of overall trade into extensive and intensive margins. This computation, originally proposed by Feenstra (1995) and further developed by Hummels and Klenow (2005) and Feenstra and Kee (2008), presents the main advantage of accounting for the economic weight of traded products, as discussed in more depth in the data section below.

The remainder of the paper is organised as follows. Section 2 discusses the relevant literature on the economics of GIs, with a special focus on trade issues. Section 3 presents our data and defines the sample we use for the empirical analysis. Section 4 proposes an empirical strategy based on the decomposition of trade flows into their respective intensive and extensive margins that is consistent with firm-level trade models that emphasise heterogeneity in product quality. Section 5 discusses the results, and section 6 concludes.

2. Related Literature

In the last decades, the economics of GIs has attracted growing interest. A large part of the literature investigated the extent to which, and under which specific market arrangements, certification and labelling tools can address market failures due to asymmetric information (e.g. Langinier and Babcock, 2008; Marette and Crespi, 2003; Moschini *et al*., 2008; Zago and Pick, 2004), the related consumers' and producers' welfare effect under different market arrangements (e.g. Desquilbet and Monier-Dilhan, 2015; Lence et al., 2007; Menapace and Moschini, 2012; Mérel and Sexton, 2012; Yu and Bouamra-Mechemache, 2016), and the economics and politics of GI regulations (e.g. Deconinck and Swinnen, 2014; Deconinck *et al*., 2015; Landi and Stefani 2015).

An issue stressed, especially in the early literature, is the extent to which the signaling effect of GI – due to more consumer information on the origin and quality of products – more than compensates the collusion effect of the GI policy – due to the potential loss in competition induced by the market restriction of the GI protection policy (see, e.g. Lance *et al*., 2007; Marette and Crespi, 2003; Mérel, 2012; Zago and Pick, 2004). Other contributions, instead, by recognising that GIs are essentially public goods and are used by many firms simultaneously, investigate their welfare consequences in a competitive setting (see Menapace and Moschini, 2012, 2014; Mèrel and Sexton, 2012; Moschini *et al*., 2008).[7]

From an analytical point of view, which assumption is more pertinent for modelling GIs is a choice complicated by the fact that in the EU similar GI rules are applied to different products operating in different countries with different market structures, rendering generalisations somewhat problematic. In addition, the large majority of the contributions on the economics of GIs do not consider *directly* the potential implications stemming from a situation where the level of competition in the domestic market is also affected by international competition due to trade liberalisation.

With few notable exceptions (see Chambolle and Giraud-Heraud, 2005; Josling, 2006; Marette *et al.,* 2008), the analysis of the GI trade effect has been mainly focused on the legal issues of intellectual property rights protection (e.g. Biénabe and Marie-Vivien, 2017; Calboli and Wee Loon, 2017; Gangjee, 2017; Kireeva and O'Connor, 2010; O'Connor, 2014; Matthews, 2016). However, more recently a few contributions investigate empirically the

[7] The relevance of collusion effects and the idea of GIs as 'agricultural production clubs', appear to be inconsistent with the institutional setup of GIs in the EU. This is because any producer who abides by the code of rules for a GI, within the given geographical area, can produce the GI, i.e. there is free entry (see Menapace and Moschini, 2012, p. 544).

extent to which GIs affect trade flows (Agostino and Trivieri, 2014; Duvaleix-Treguer *et al*., 2018; Sorgho and Larue, 2014, 2018).

A good starting point is represented by the analysis of Marette *et al.* (2008). These authors argued that the globalisation wave of the last decades increased the need for quality signals because consumers are now progressively less aware of the origin and quality of products in the marketplace. They also stressed that as an effect of international competition, if the fixed costs of quality certification and innovation are particularly high, this can lead to an increase in market concentration and a reduction of the varieties sold into the domestic market. They quoted the model of Shaked and Sutton (1987) that predicts how the increase in market size due to trade liberalisation translates into an increase in concentration, and a subsequent reduction in the number of product varieties. This consideration is important because it raises the issue of the GI trade effect, not just on the export side, but also on their effects on the import side trade margins, i.e. the number of imported varieties and their import intensity.

Chambolle and Giraud-Heraud (2005) highlighted the possible import restriction effect of GIs, by arguing that this EU policy incorporated both quantity restrictions and a quality costs subsidy. They used a model of strategic trade policy, with two firms (home and foreign) competing in the Home market, where a domestic firm, as an effect of the GI certification, positions itself as a higher quality producer. A similar import reducing effect of GIs can be found in simple extensions of firm-heterogeneity trade model *a la* Melitz (2003). For example, Abel-Koch (2013) developed a trade model where quality standards and certification requirements, such as GIs, raise fixed costs of market access for both domestic producers and foreign exporters. The model predicts that the implementation of anti-competitive regulations (as in the case of GIs) can never be a social optimum, because the positive effect of a certification on the aggregate profits of home firms is always dominated by the loss in the home number of available varieties.[8] Yet, this result could be reversed when the certification of origin is implemented to reduce a consumption externality – i.e. information asymmetry – when the increase in the consumers surplus attributable to the externality reduction more than compensates the decrease in the number of home varieties.

To sum up, following the discussion in Josling (2006), the trade impacts of GIs are mainly a direct consequence of the potential suitability of the domestic regulatory framework to

[8] In this setting, certification costs force the least efficient firms to exit and shift profits to the most efficient firms. Thus certification requirements work similarly to non-tariff barriers to trade by shifting profits both within and across countries.

provide the appropriate level of protection and information. If consumers are over-protected, the level of imports in the domestic market will be lower than the optimal level, and exports from domestic producers will be too high. On the other hand, if consumers will be under-protected by the GI policy, the level of imports of low quality goods will be too high domestically, but the level of export from domestic producers too low, because the lack of information will adversely hit sales of the product with the geographically linked quality attribute (Josling, 2006, p. 343). Because these factors tend to be country and sector/product specific, on average, the actual trade effect of GIs is an empirical question.

The empirical evidence on the GI trade effect to date is limited. A few papers quantitatively investigate the extent to which the EU GI policy affects international trade and, more importantly, only one published paper focuses simultaneously on both the export and import side, though at the aggregate level and considering intra-EU trade flows only.

The first contribution that evaluated the trade effect of GI by Sorgho and Larue (2014) applied the odd ratio gravity specification of Head and Mayer (2000) that normalises bilateral flows by trade with self. Using a cross-section of 27 EU countries and aggregated agri-food trade, the authors showed that GIs promote trade only when both the importing and exporting EU countries are GI producers, an effect mainly attributed to consumer information. A potential limitation of the result lies in the aggregation level of the analysis. Indeed, considering only the overall agri-food trade, many sectoral information and heterogeneity effects are lost.

A step forward has been provided by Agostino and Trivieri (2014), using a theory-driven gravity equation in a panel data context (Baier and Bergstrand, 2009). Focusing on wine exports from France, Italy and Spain, they were able to show that high quality wines produced in specific regions (GI wine) have better performance abroad, both through the extensive (probability to trade) and the intensive (trade volume) trade margins. However, by focusing only on wine, the results are less informative about the GI international trade issue, because this product (like spirits) are within the few GIs that receive special protection in international markets.

Sorgho and Larue (2018) extended their 2014 paper by emphasising heterogeneity in consumer preferences over GIs. Using disaggregated trade data within the EU, they showed that GI-products have ambiguous effects on intra-EU trade, a finding attributed to the heterogeneity of consumer preferences, and the reputation of the product. While reputation is clearly an important driver of the export success of many GIs, by working on *all* the GIs produced in the EU, irrespective of their market relevance, the results of Sorgho and Larue (2018) are somewhat pre-determined. Indeed, they also included in the analysis several products that are commercialised and known by only local (or regional) consumers, and that are not really relevant in international markets.[9]

Finally, using French custom data matched with firm-level data of PDO cheese producers, Duvaleix-Treguer *et al.* (2018) were able to show that GI certification increases firms' exports at both the extensive and intensive trade margins, but not export unit values.[10] All these results appear to hold for the EU markets, but less so for extra-EU markets. While there are several advantages in using firm-level trade, particularly to better identify mechanisms, the source of variability exploited by Duvaleix-Treguer *et al.* (2018) is cross-sectional, rendering the identification of the GI trade effect prone to potential omitted variables bias.

We extend this early empirical literature in several directions. First, we build a new database where all the EU GIs are classified at the HS 6-digit level. This allows us to work with a broader coverage of products and for a longer time period than previous works. Second, we investigate both intra- and extra-EU trade flows providing an overall view of the trade effect of the GI policy. Third, the reliability of our results stems first from the use of a more rigorous empirical approach based on panel data econometrics, which better accounts for different endogeneity issues. Second, the use of trade margins that are computed based on a theoretically founded approach and that account for the economic weight of traded products provides further credence to our results.

Our paper is also related to the emerging literature on quality and trade. Starting from the seminal contributions of Linder (1961), Falvey and Kierzkowski (1987) and Flam and Helpman (1987), a growing literature investigated the influence of product quality on international trade in firm-heterogeneity models (Bernard, 2003; Melitz, 2003), showing that heterogeneity in product quality is a key driver of firms' export success (see Baldwin and Harrigan, 2011; Crozet

[9] It is important to emphasise that, as showed by AND-International (2012), the overall sales value of EU certified GIs (excluding wine) in 2010, was equal to around €15.8 billion, of which, 78% sold in the domestic market, 16% exported within the EU market, and only 6% exported in the extra-EU market (mainly US, Switzerland, Canada and Japan). Because in 2010 the external EU food trade was equal to about €57 billion, this means that GIs, overall, represented just 2% of the total value of extra-EU food exports.

[10] Interestingly, Duvaleix-Treguer *et al.* (2018) by comparing GI certified firms to non-certified ones, showed that the former have better performance than the latter for their non-labelled products in the EU market, suggesting that firms producing GIs gain in reputation also with respect to other (non-GI) products.

et al., 2012; Crinò and Epifani, 2012; Curzi and Olper, 2012; Hallack and Sivadasan, 2011; Kugler and Verhoogen, 2012).

Two important elements of this trade literature are relevant when considering the case of GIs. First, the extent to which the EU GI regulatory policy effectively induces a process of product quality upgrading generates quite clear predictions about its trade effects. That is, firms adopting a GI quality policy, and thus producing higher quality goods, on average, should export more through both the extensive and intensive trade margins. In addition, because export price is increasing in the marginal cost and thus in the quality of the exported goods, we expect that firms exporting GIs will charge, on average, higher export unit values.

Second, an overwhelming difficulty of this literature is how to measure the unobserved product quality. Early contributions have used several variables as proxy for quality: unit values from trade or firm level data (Baldwin and Harrigan, 2011; Manova and Zhang, 2012), standard certification such as ISO 9000 (Hallak and Sivadasan, 2011), quality rating from wine guides (Crozet et al. 2012), firms' characteristics linked to product and process innovations (Crinò and Epifani, 2012; Curzi and Olper, 2012). Our approach, and contribution, is to exploit an important quality policy (GI) that institutionalised food quality standards (and labels) at the EU level, in order to characterise the quality of traded products.

3. Data and Variables

Our analysis focuses both on intra-EU and extra-EU agri-food trade. The two analyses share the same objective, but they are based on slightly different assumptions. When considering the EU internal market rules, firms face neither tariff nor non-tariff measures when deciding to export in a given EU destination market. Thus, when working with only intra-EU trade our strategy delivers a 'clean' test of the potential GI trade effect, ruling out other potential confounding factors. Similarly, to avoid potential bias determined by the progressive EU enlargements from 2004 to 2013, and the subsequent abolition of intra-EU tariffs (and NTMs), we focus on the EU-15 old member states.

When considering extra-EU trade, we focus on import and export flows of EU-15 countries. In order to properly identify the GI trade effect in this context we need to account for the possible overlapping effect of trade policy. Specifically, we account for the presence of non-tariff measures, particularly sanitary and phytosanitary standards (SPS), by relying on a new dataset that provides information on WTO notifications of this important source of (possible) trade barriers. This is important because several SPS measures can have trade effects similar to GIs. In addition, we control for *ad valorem* bilateral tariffs using data from the UNCTAD-

Trains database. This analysis allows us to assess, from the export side, whether the supposed higher quality of EU GI products is recognised outside the EU market, irrespective of whether these markets have their own GI policy or not. Considering the import side, our analysis is aimed at better understanding if the presence of GIs in the EU market represents a trade hurdle for extra-EU exporting firms, due to the higher quality competition induced by the EU GI policy.

It is important to keep in mind that when working on external EU trade, the analysis raises some questions about the cross-country comparability of the GI measure, given the current impossibility of constructing a GI variable, accounting also for information at sectoral/product level for the extra-EU trade partners. However, it is important to highlight that this limitation only affects the comparability of (intra-EU vs extra-EU) results, when both trading partners are GI producers. In other words, the estimated GI effect when *only* the exporter or the importer are GI producers, *ceteris paribus*, are comparable in the two analyses, and, thus, potentially informative and interesting.

3.1. GI policy indicator

An important effort of this paper has been devoted to the GIs classification in accordance with the Harmonized System (HS) codes at the 6-digit level. Starting from the European DOOR database (Database of Origin and Registration), which collects official information on all the registered EU geographical indications, we selected all PDO/PGIs registered from 1996 to 2014. Since the DOOR database does not classify products with any official (trade) classification, we manually matched each of the registered GIs with the corresponding HS classification at the 6-digit level. In addition, with the aim of minimising measurement errors in the classification, because GIs are only labelled on goods for final consumption, we considered only HS product lines defined by the Broad Economic Categories (BEC) for final use. Thus we excluded those GIs classified as intermediate goods.[11]

Overall, the DOOR dataset at the time of the data extraction (2016), included 1,281 registered GI products, 52.7% PGI and 47.3% PDO. The classification methodology does not produce an exact correspondence for only 51 of these GI products, which have been consequently excluded from the analysis. The number of GIs registered by the EU-15 countries is 1,036, corresponding to 81% of total observations in the DOOR, with more than half being

[11] Not surprisingly, more than 88% of the GIs resulted classified in the BEC category for final consumption.

PDO products (530).[12] Figure 1 shows a representation of the number of new PDO and PGI products registered each year, and the cumulative number of GIs over the 1996–2014.[13] Overall, two patterns emerge: a strong yearly variation in the number of new registered GIs and the steady increase of the total number of GIs over the observed period.[14]

Insert Figure 1 here

The cross-country distribution of GIs is quite concentrated. More than 80% of GIs is produced in only five countries: Italy, France, Spain, Portugal and Greece (see Table A1 in the online Appendix). Considering the HS 2-digit sectors, six of them (Dairy, Meat, Vegetables, Fruit, Oils and Meat & Fish preparations) represent 86% of total GIs, 92% of PDOs, and 79% of PGIs (see Table 1).[15] In addition, the GI product lines associated with these six HS 2-digit sectors account for a relevant trade share, representing more than 25% of total intra-EU agri-food trade.[16] By contrast, in the other residual HS 2-digit sectors, trade associated to product lines with GIs is, on average, below 4% of intra-EU trade in these product lines. Thus, in the empirical analysis, we focused our attention on six HS 2-digit sectors.

[12] It is worth noting that any change in the GI regulation or any amendment introduced in all the registered GIs does not lead to a replacement of an 'old' GI product with a new and upgraded one. Once a new GI is registered, the DOOR database keeps track of these kind of changes, which are then shown within the relevant documentation in each GIs own web page. As a consequence, a new GI appears in the list of registered GI products only once. Therefore, a double counting in our GI variable is not possible.

[13] Note that, for illustrative purposes, to better highlight the yearly variability, we omit the first year of policy implementation (i.e. 1996), as there was a massive introduction of GIs (i.e. 328 GIs, of which 214 are PDOs and 114 are PGIs).

[14] It is worth noting that the time span between the date where an application gets the certification and the date when the GI is then registered, varies case by case. This difference is mainly based on bureaucratic issues (e.g. imperfect documentation) or for instance on complaints raised by other EU member countries.

[15] Note that, although official numbers do not exist, it is conventional wisdom that the total share of the value of production and trade of these products over all the EU GIs is well above these numbers. This is because the percentages presented above are computed considering solely the number of GIs, rather than the value of their production or export.

[16] The lines that are represented by GIs are 25% of the 263 lines reported on these six sectors. Within each HS 2-digit sector the percentage ranges from 43% (HS-07) to 2% (HS-15) of product lines.

Our final GI variable used in the empirical analysis is the total number of GIs of a country in a specific HS 6-digit product line, obtained by summing all the GI products that are present in the country in that specific product line in year *t*.

Because in the last decade a few non-EU countries have progressively implemented GI food quality policies, we also collected information to classify the GI products of EU trading partners, accordingly.[17] However, we encountered difficulty in collecting this information at the product line level. Thus, when working with external EU trade we classify non-EU countries either as GI producers or not using a simple 0/1 dummy, losing the product line information. As a matter of fact, this data limitation renders the comparability of the intra-EU vs. extra-EU trade analysis less than perfect but still informative as discussed above.

Table A2 in the online Appendix lists the countries with a GI policy 'comparable' to the EU, and the respective year when the first GI product was registered.[18] Sources of this information are single country reports on the GI and are taken from the World Intellectual Property Right (WIPO) reports on Geographical Indications.

3.2 Trade data and other measures

The overall sample contains information at the HS 6-digit level on intra-EU-15 and extra-EU-15 bilateral trade flows from 1996 (the first year of GI registration under the EU regulatory system) until 2014.[19] Trade data come from the BACI database (Base pour l'Analyse du Commerce International) of CEPII (Centre d'Etudes Prospectives et d'Informations Internationales). These data offer the advantage to correct, with a rigorous procedure, the potential discrepancies between import values, expressed as CIF, and export values, expressed as FOB (Gaulier and Zignago, 2010). Although this problem is not severe when we consider trade between European countries, the database improves the quality of the results when we measure the extensive and intensive trade margins, where exports from all the world countries are used (see online Appendix B).

---

[17] More specifically, in the construction of the dataset on extra-EU GIs we used the World Intellectual Property Organization (WIPO) statistics, integrated with other information searched at single country level. Here two examples: i) the Japan GI policy (www.maff.go.jp/e/policies/intel/gi_act/) that entered into force in 2015; ii) Café de Colombia (www.cafedecolombia.com) that entered into force in 2007.

[18] Note, out of 40 extra-EU trading partners used in the analysis, only 8 have a GI policy (see Tables A2 and A3 in the online Appendix).

[19] Non-European countries included in the extra-EU analysis account globally the 80% of extra-EU trade. The 40 extra-EU countries are listed in the online Appendix, Table A3.

Recently, a number of papers have used a direct approach to decompose the impact of policies on extensive and intensive trade margins, such as the number of products exported within a certain industry/category or exports concentration indexes (see Cadot *et al*., 2011; Dennis and Shepherd, 2011; Persson and Wilhelmsson, 2013). The simple count of the product number, although transparent, is flawed by the assumption that products have the same economic weight, which is generally not the case. To overcome this limitation, we follow Feenstra and Kee (2004) who proposed a theoretically-founded decomposition of trade into two margins, taking into account the economic weight of the products. This measure is very similar to a count of the exported varieties within a certain industry, but is weighted by comparisons with other reference countries, such as the rest of the world or the world as a whole. For an application of these decomposition to agro-food trade, see Scoppola *et al.* (2018); Appendix B (online) presents the derivation and computation of these trade margins.

In addition to the variable described above, as already mentioned, the extra-EU analysis considers also ad-valorem bilateral tariffs, taken from the Unctad-Trains dataset, and a proxy for NTMs, based on the WTO notifications of SPS measures. The SPS data, that do not have a bilateral dimension, are based on the WTO I-TIP database which reports countries' NTMs notified at the WTO, and accounts in our analysis for the number of SPS measures at the HS 4-digit level in each importing country.

Finally, to reduce the large number of zero observations in the data obtained after squaring the bilateral trade matrix, we used the average value of production for the years 2008–2010 to drop those zeros that are relative to countries which appear as neither producer nor exporter of the goods, based on FAOSTAT and EUROSTAT Prodcom data.[20]

Figure 2 reports the average values of trade margins computed as in equations (B1) and (B2) reported in Appendix B (online), for both intra-EU (top panel) and extra-EU (bottom panel) trade, averaged over the agri-food sectors considered. Intra-EU countries producing GIs increase systematically the number of exported varieties (extensive margin) from 30% in 1996 to about 50% in 2014 of the overall varieties imported by the considered countries. In contrast, countries that are non-GI producers reduced the level of extensive margin in the observed period. Both groups of countries have increased their intensive margin, but with a different pattern: for GI exporter countries the intensive margin of trade increases more than three times.

[20] After this procedure, the percentage of zero trade flows at HS 6-digit level is 70%, while at HS 2-digit level is 18%. Moreover, for extra-EU analysis only, we limit the dataset to non-EU countries that globally account for the 80% of food trade with the EU countries.

When considering extra-EU trade a similar pattern emerges, although now the difference between the growth rate of the extensive and intensive trade margins for GI- versus non-GI producers is less remarkable than the one highlighted in the case of intra-EU trade.

Insert Figure 2 here

This preliminary look at the raw trade data seems to suggest a strong trade promoting effect of GIs on both the extensive and intensive trade margin. However, these are simple correlations and trends. The next section investigates more formally the role played by the GIs on trade flows.

4. Empirical Model and Identification

Our empirical strategy tests the trade effects of the EU GI policy, both on the intra-EU and extra-EU markets, through a decomposition of country-product trade data to their respective extensive and intensive trade margins, also considering export prices (expressed as f.o.b. unit values). As shown by Helpman *et al.* (2008) and Santos Silva *et al*. (2014), predictions coming from a firm-level trade model can be properly estimated using such a decomposition of trade flows, because when firms produce differentiated products, these *firm-level* margins translate into *product-level* margins.

Our benchmark specification, when considering intra-EU trade, can be written as:

$$lnX_{od,ht} = \beta_0 + \beta_1 GI_{o,ht} + \beta_2 GI_{d,ht} + \beta_3 GI_{od,ht} + $$
$$+ \epsilon_{d,t} + \epsilon_{o,t} + \epsilon_{od} + \epsilon_{ht} + \epsilon_t + \varepsilon_{od,ht} \quad (1)$$

with the dependent variable, $X_{od,ht}$ being, alternately, one of our variables of interest (i.e. overall trade, intensive/extensive margins, export price) from the origin o to the destination country d, in the h product line at time t.[21] β_1, β_2 and β_3 are the coefficients to be estimated

[21] Note that we have defined the product h as a generic product category, although it will present two different levels of aggregation. Specifically, h will be defined as a HS 2-digit product line in the intensive margin, the extensive margin, and the overall trade (defined as combination of the two margins) equations. By contrast, h will be defined as a HS 6-digit product level in the trade and price equations.

on the 'quality' variables $GI_{o,ht}$, $GI_{d,ht}$ and $GI_{od,ht}$, respectively.[22] $GI_{o,ht}$ represents the number of GIs in the exporting country in a given product line, and accounts for a situation where only the exporter has GIs in that product line. $GI_{d,ht}$ accounts for the opposite scenario, representing the number of GIs of the importing country in a given product line, when only the importer (and not the exporter) has GIs in that product line. Finally, $GI_{od,ht}$ represents the sum of the number of GIs of exporter and importer in a given product line, and accounts for a scenario where both countries have GIs in that product line.[23]

In the equation (1), the terms $\epsilon_{d,t}$ and $\epsilon_{o,t}$ are the importer- and exporter-time fixed effects (FE); ϵ_{od} are the country-pair fixed effects; ϵ_{ht} and ϵ_{t} are the product-time and year fixed effects, respectively. Finally, $\varepsilon_{od,ht}$ is the error term. It is important to note that the inclusion of origin and destination time FE, product-time FE and bilateral FE, leads the β_1, β_2 and β_3 coefficients on the GI variables to identify the trade effects exploiting the within country-pair product line variation in the number of GIs (relative to non-GI product lines), accounting for any unobserved heterogeneity at the country, bilateral, sector/product and time level. Thus, our research design is close to a difference-in-difference identification strategy.

It is worth noting that we do not have information on the share of trade attributable to GIs in any of the considered HS 6-digit product lines, and, thus, we are not able to disentangle the GI vs. non-GI effect within the same product line. However, it is reasonable to assume that a higher number of GIs in a product line will tend to be positively correlated with the share of GI trade in this line. From this perspective, one may argue that our dependent variables are measured with errors.[24] However, when the measurement error occurs in the dependent variable, and it is statistically independent from the explanatory variables, this causes a higher

[22] As the log of zero is undefined, we use the GI variable in level and the estimated coefficients (β_1, β_2 and β_3) can be interpreted as semi-elasticities.

[23] Note that by using the number of GIs in a given country-product line, rather than a dummy variable approach as in Sorgho and Larue (2014), we are able to capture the effect of the introduction of an additional GI in a given product-line, significantly increasing the time variation in our variable of interest, an important property of our identification strategy.

[24] There might be the case that a GI is not exported or internationally traded. It is worth noting that the occurrence of this situation does not lead to a measurement error in our explanatory variable. This is because our GI variable does not proxy for the number of GIs that are internationally traded and we do not make any assumption on this issue. We observed and measured the number of new GIs that a country registered in each tariff line – irrespective of whether these GIs are exported or not – leaving it to the data to speak about their possible trade effect.

asymptotic variance and lower t-statistics, with respect to the case where it would not have been measured (Wooldridge, 2009, pp. 316–318). As a consequence any measurement error in our dependent variables would lead to an attenuation bias in our estimates.[25]

When focusing on extra-EU trade, our empirical model is slightly different:

$$lnX_{od,ht} = \beta_0 + \beta_4 GI_{o,ht} + \beta_5 GI_{d,ht} + \beta_6 GI_{o,ht} * dGI_{d,t} + \beta_7 GI_{d,ht} * dGI_{o,t} + \\ +\gamma\, T_{od,ht} + \epsilon_{d,t} + \epsilon_{o,t} + \epsilon_{od} + \epsilon_{ht} + \epsilon_t + \varepsilon_{od,ht}\,. \qquad (2)$$

In particular, the variable $GI_{o,ht}$ ($GI_{d,ht}$) now represents the number of GIs in the exporting (importing) EU country-product line, while $dGI_{d,t}$ ($dGI_{o,t}$) is a dummy equal to 1 if the extra-EU importing (exporting) country has a GI policy in place at time t, and zero otherwise.[26] The interaction of these two variables allows us to distinguish the GI effect on EU trade flows whether the extra-EU importer (exporter) country produces GIs or not.[27] Finally, the term $T_{od,ht}$ in equation (2) includes policy related trade costs, i.e. bilateral tariffs and NTMs as discussed above.

Given the well-known problem of many zeros in bilateral trade and the panel structure of our datasets, both equations (1) and (2) are estimated by using the Poisson Pseudo Maximum Likelihood (PPML) estimator, to avoid the incidental parameter problem of the first stage (Probit) Heckman selection model in a panel fixed effects context. Santos Silva and Tenreyro (2006, 2011) showed that this estimator is robust to different patterns of heteroscedasticity and measurement errors, and it is particularly suitable in the presence of many zeros. Standard errors

[25] Note in addition that the actual structure of trade data allows us to test a difference-in-difference model, by comparing our trade outcomes pre- and post-introduction of a new GI. If GIs had their own code, it would be not possible to estimate such an empirical model.

[26] Note that we do not have information on which products are produced by extra-EU countries under the GI policy. Our dummy variable allows us to distinguish only between countries that have introduced their own GI policy in the considered period, and those that do not have any GI policy. The non-EU countries with a GI policy in place, and the year of implementation, are reported in Table A2 in the online Appendix.

[27] The $dGI_{o,t}$ ($dGI_{d,t}$) term is omitted from the equation as it is already accounted for by the exporting (importing) country-time dummy.

are always clustered by country pair-product at HS 6-digit (or HS 2-digit) level.[28] In addition, as a robustness check, we also perform instrumental variable (IV) regressions to control for potential endogeneity bias due to reverse causality. As discussed below, in the IV regressions the number of GIs is instrumented by the (average) number of GIs in adjacent industries.

5. Econometric Results

All regressions are estimated through the PPML approach considering two sets of specifications that differ for the level of product aggregation. First of all, we present our results testing the GI trade effect on intra-EU trade. Second, we present a similar analysis considering extra-EU trade.

5.1. The effect of GIs on intra-EU trade

Table 2 summarises our main results when considering overall intra-EU-15 trade, by pooling data across all the HS 2-digit sectors considered in the analysis.[29] Column (1) reports the results for the extensive margin of trade. The effect of a new GI in the exporting country is positive and significant (p-value<0.01) when the importer does not produce any GI. Instead, the GI effect is negative when only the importer or both countries are GI producers, although the effect is insignificant in the latter case. Quantitatively, a new GI in the exporting countries increases the extensive margin by about 0.27% points. As we consider the extensive margin at the HS 2-digit level, it is worth noting that the addition of new GIs may also induce an increase in the exports of other non-GI products within the same product category. In this respect, the presence of GIs in a given country-product line may foster a quality-reputation effect (see Menapace and Moschini, 2014), which is also beneficial for non-GI products.

Overall, this result suggests the existence of a positive GI trade effect driven by the extensive margin, i.e. the creation of new trade routes. This result is consistent with results from Agostino and Trivieri (2014) for wines and from Duvaleix-Tréguer *et al.* (2018) for French cheese, with the important qualification that this effect holds true, *on average*, for all the main sectors characterised by GIs.

[28] Note that when clustering the standard errors at country pairs level we obtain similar results.

[29] Because the model is, *de facto*, a bilateral gravity equation, bilateral variables such as distance, contiguity, language etc. could be included in the model in place of the country-pair fixed effects. When running the model with these variables included (and so omitting pair fixed effects) we obtain similar results that however overstate the coefficients magnitude of our GI variables of interest, due to the insignificance effect of these bilateral variables in the context of intra-EU trade.

Considering the impact of GIs on the intensive margin of trade (column (2)), the EU quality policy appears to act as a trade-reducing measure when only the importer produces GIs, and as a trade enhancing measure when GIs are produced by the exporter, or by both countries. Quantitatively, the magnitude of the estimated effects suggests that a new GI produced in the importing country, when the exporting country does not produce any GI, reduces the intensive margin by about 1.4 percentage points. When only the exporting country produces GIs, the intensive margin increases by about 1 percentage point. Finally, when both countries produce GIs, one additional certified product increases the intensive margin by 0.3 percentage points. All these effects are significant at the 1% level. Finally, column (3) presents the results relative to overall trade, here defined as the product of the extensive and intensive trade margins.[30] The overall pattern and magnitude of the effects are similar to those detected for the intensive trade margin.

Until now we worked at the HS 2-digit level, a level of aggregation imposed by the necessity to measure the two margins of trade. This level of aggregation when working with the overall trade could induce aggregation bias. For this reason, in column (4) we report results by estimating the GI effect on overall intra-EU trade at the HS 6-digit level. Confirming our expectation, although pointing in the same direction, the results are quantitatively different, with a magnitude of the estimated effect (in absolute terms) significantly greater. Now, a new GI in the exporting country HS 6-digit tariff line, induced a trade increase of about 3.9 percentage points (p-value<0.01) in comparison to HS 6-digit tariff lines without GIs.[31] From an economic point of view, this it is not an irrelevant effect. As before, the adoption of a new GI enhances trade when both countries produce GIs (+ 1.8%), but it acts as a trade reducing

[30] As shown by equation B3 in online Appendix B, the product of the two margins equals bilateral trade, when country and sectoral fixed effects are included in the equation.

[31] We also estimate the GI effect on overall trade separately for each of the HS 2-digit sectors considered in the analysis. The results are presented in the Table A4 in the online Appendix. It is worth noting that while the trade promoting effect is largely confirmed in all the considered sectors, the effects when only the importing countries present GIs are more heterogeneous. Note in addition that the magnitude of the results is not strictly comparable across sectors, although the sectoral specification does not constrain country-pair fixed effects to be equal across sectors.

measure when GIs exist only in the importer country (–5.2%), *ceteris paribus*.[32] All these effects are estimated with high precision (p-value<0.01).

Insert Table 2 here

Column (5) of Table 2 presents the results concerning the GIs effect on exports' unit values. This focus represents an important element of the analysis, as it may provide some additional insights, in particular relative to the effect of the EU GI policy on countries' pricing and quality export strategies. Our results suggest that when GIs are produced by the exporter country only, or by both countries, the EU quality policy induces a statistically significant increase in the export unit values, with a semi-elasticity of 0.72 and 0.44 percentage points, respectively.[33] In contrast, the presence of GIs in the importer countries only is associated with a significant reduction of countries' export unit values (–0.32%). It is worth noting that the last result cannot be rationalised by any theoretical model. However, a possible interpretation is that countries exporting non-GI products in country-sectors characterised by the presence of GIs, where the quality competition is fiercer, may opt for a price competition, rather than to compete on quality.[34]

These results have relevant implications, as they suggest that the adoption of the EU quality policy allows a clear process of quality upgrading. Indeed, as showed by Khandelwal (2010), the price of a product may present itself as a good proxy for quality, when products are vertically differentiated. Since the scope of the GI policy is to promote (country of origin) quality differentiation, these results seem to confirm the effectiveness of the EU GI policy in this respect. In addition, the negative effect exerted by the presence of GIs in the importer country when the exporter country does not produce any GIs, may also have relevant implications. In

[32] We also check whether, when both countries produce GIs, the GI trade effect is mainly driven by new GIs in the importer or exporter country. Results show very similar effects (see Table 2.bis in the online Appendix). Thus, the $GI_{od,t}$ positive effect on trade occurs independently of its origin.

[33] Note that, as before, the estimated coefficient of the price equation captures the variation in average unit value after a new GI is introduced, in a certain product line, in comparison to the average unit value of non-GI product lines.

[34] Similarly to the case of overall trade, in the case of unit value we also test the GI effect separately for each of the HS 2-digit sectors considered in the analysis. The results are shown in the online Appendix Table A5. The above patterns obtained on the pooled sample are often confirmed, with the main exception of the significant and negative effect for fruits in the first row of column (4).

fact, since exporters cannot compete on the level of quality set by the importer (GI producer), they resort to a sort of *race to the bottom* in terms of quality, by competing on price. This finding may have clear welfare implications for the EU consumers, as they may perceive imported non-GI products as a cheaper alternative of domestic GI products.

A comparison of our results with previous findings is not easy, as, to the best of our knowledge, there are no published papers in the literature working on such a large scale sample of products (and time) and detailed level of disaggregation. At the empirical level, we could only compare our results with those of Sorgho and Larue (2014), who measured the effect of GI products on the EU countries' border effect (i.e. the external to internal trade ratio), at the aggregated agri-food level. The authors find evidence of a trade promoting effect of the EU quality policy only when considering the case of both exporting and importing countries as GI producers. When the exporter (importer) is the only GI producer, they find a weak negative (positive) trade effect, thus exactly the opposite of our results. Differences in the data used (aggregated vs disaggregated), and the econometric approach (cross-sectional vs panel data) are probably the causes of these differences in results.

5.2. GI effects on extra-EU trade

Table 3 summarises our main findings considering the effect of the diffusion of GIs on the intensive and extensive (extra-EU) trade margins (measured at HS-2 digit level), as well as on total trade and export unit values (as before considered at the HS 6-digit level). The key difference of extra-EU regressions is that now we include controls for trade policy, namely tariffs and SPS standards. In addition, as explained in the specification section, when working with external-EU trade we are forced to measure the presence of GIs in the non-EU destination countries, with a country 0/1 dummy, and this clearly reduces the comparability of the two analyses, at least from this perspective.

Starting with the additional controls included in these extra-EU trade regressions, as can be seen at the bottom of Table 3, both tariffs and SPSs systematically exert a negative effect on both trade margins (columns (1) and (2)), and on overall trade (columns (3) and (4)). In addition, the effect on export unit value of both tariffs and SPS variables are positive, as expected, but only the SPS estimated coefficient is statistically significant.

Insert Table 3 here

Similarly to intra-EU trade, the results on the extensive trade margin confirm that a new GI in the EU exporting country, on average, increases the number of (extra-EU) exported varieties (see column (1)). The magnitude of these effects suggests that a new GI induces an increase of around 0.6[35] or 0.2 percentage points of the extensive margin, depending on whether the importer country recognises GIs or not, respectively. Interesting, the size of these effects are of the same order of magnitude as the result obtained for intra-EU trade and is qualitatively similar to results reported in Duvaleix-Treguer *et al*. (2018).[36] In contrast, the effect of a new GI in the EU-importer country reduces the extensive margin of the third countries' exports to the EU by a larger amount (between −1.6 and –2.9 percentage points), with the largest reduction detected when the non-EU exporting country produces GIs.[37]

Column (2) reports the impact of GIs on the intensive margin of trade. The results partially confirm the export-creation and import-reducing effect of EU-GIs. However, the positive impact of a new GI on the volume of products already exported by the EU is not affected by the presence of GIs in the importing (non-EU) countries. Instead, the negative impact on EU imports is significant only when goods come from an extra-EU country producing GIs. The last result is somewhat counterintuitive in comparison to what we find at the EU level. However, it is important to bear in mind that when working at the extra-EU level, the extent to which non-EU countries are GI producers can only be measured at the country, instead of country-product, level rendering the comparison problematic.

The impact of GIs on overall trade, as defined in column (3) by combining the extensive and intensive margins, confirms these findings. The addition of a new GI increases EU countries exports' by 2.9% (2.0%), and reduces European imports of 3.5% (1.6%), depending on whether (or not) extra-EU countries have their own GI policy, respectively. Note that the export-increasing effect is explained by the increase in both the intensive and extensive margins, while the import-reducing effect is mainly the result of the extensive margin of trade. Thus, the production of GIs for an average EU country induces an increase in both the probability of

[35] This result is obtained by adding to the coefficient relative to GIs-EU-exporter (0.018), the one concerning the GIs-EU-exp. * $dGI_{d,t}$, namely when the non-EU importing countries produce GIs (0.041).

[36] To test if the use of the extensive margin measured with the Feenstra and Kee (2008) approach drives previous results, we also estimate the export probability using a linear probability model (LPM) with the dependent variable equal to 1 when trade flows are positive, and zero otherwise. The results confirm the sign of the GI variables over export probability (see Table 3.bis in the online Appendix).

[37] Numerically: 0.0163+0.0125=0.0288.

exporting to extra-EU destinations, as well as an increase in the volume of products already traded. In contrast, the negative GI effect on the import side is largely attributable to the extensive margin. The last finding may suggest that for an extra-EU firm, sending a product into the EU market where GIs are present, implies additional fixed costs of exporting, such as specific marketing and promotion costs, to contrast the higher vertical competition in the EU destination.

Column (4) of Table 3 presents the results of running the regression on overall trade at HS 6-digit. A new GI in the EU exporting country significantly increases the external trade by about 7.1 percentage points (p-value<0.01), irrespective of whether the destination country produces GIs. When considering the EU as importer, the results suggest a negative and significant effect when extra-EU countries do not produce GIs, and, thus, in line with the results obtained for the intensive trade margin. This negative effect is strongly reduced when the extra-EU exporters produce GIs,[38] a result that once again confirms the presence of aggregation bias when working at HS 2-digit level.[39]

Finally, the effects of GIs on extra-EU export unit values are reported in column (5) of Table 3. In line with the results obtained for the intra-EU trade analysis, when GIs are produced by the exporter country, there is a statistically significant increase in the export unit value, that ranges from an average increase of the EU exporter unit value of about 0.5%, when the importer country does not produce GIs, to an increase of 0.2%, when the importer produces GIs. In contrast, the presence of GIs in EU-importer country does not seem to be associated with any significant variation in import unit value.[40]

---

[38] Numerically: –0.2105+0.2058=–0.0047

[39] We run the same estimation, as in column (4), separately for each of the considered HS 2-digit sectors. The results are shown in the online Appendix, Table A6, and confirm a positive GI trade effect in all the considered sectors; by contrast, the import side negative (and significant) effect of GIs is detected only for dairy, fruits and preparation of fish sectors. Note that, due to convergence problems, we run these sectoral equations using an OLS estimator and positive trade flows (log(trade)).

[40] The results obtained considering each sector separately are presented in Table A7 in the online Appendix. Overall they confirm the above findings when we consider the (positive) effects over EU-export unit value, with the only exception being the fruits sector where we find a significant and negative effect (the same result has been obtained in intra-EU trade analysis). In contrast, the effect of GIs on EU import unit value presents more heterogeneous results among the six sectors. As for Table A6 we run these equations using an OLS estimator.

5.3. Robustness check: IV regressions

Our results presented so far are based on econometric specifications that use country-pair, country- and sectoral-time fixed effects. As is well known from the empirical trade literature (see Baier and Bergstrand, 2007) this specification strongly reduces the risk of endogeneity bias due to selection and omitted variables. However, the interpretation of our findings as causal is still problematic if endogeneity bias is due to reverse causality. This problem may be induced, for example, in situations where the decision to create and join a particular GI certification is also the consequence of the *past* level of market share and of the reputation gained by the exporting firms producing a particular product. Indeed, though many EU GIs are of relatively recent origin, in some circumstances GIs have ancestral origins that predate the enactment of the EU regulatory system (Lence *et al*., 2007).[41] This mechanism may lead to biased results symmetrically on both the exporter and importer side.

Addressing this source of endogeneity bias is challenging, because finding good instruments for the diffusion of the number of GIs to run an instrumental variable (IV) regression is difficult. Following Chen and Mattoo (2008) and Fontagnè *et al*. (2015), the strategy we propose is to instrument the number of GIs in each HS 6-digit product, by using the (average) number of GIs in adjacent industries, i.e. industries classified in the same HS 2-digit sector, excluding the number of GIs of the instrumented HS 6-digit product line. The intuition is that if there is a GI in a certain product line, it is likely that a GI will also be present in products that are similar, i.e. products in the same HS 2-digit.

As discussed by Chen and Mattoo (2008), this is a plausible instrument for two main reasons. First, agri-food sectors classified in the same HS 2-digit industry – such as cheese and butter, or apples and pears – are likely to have similar characteristics, some of which may influence the diffusion of GIs. Second, the number of GIs in an adjacent industry should not be *directly* correlated with the trade volume in another particular industry. Of course, there can be also reasons why the instrument is not fully exogenous. First, because pre-existing trade can cause GIs at the 2-digit level,[42] and secondly because the high level of GI concentration in a

---

[41] Consider the case of a GI in the exporting country. The addition of a GI in a very competitive country-product line may indeed lead to reverse causality since the estimated increase in exports may be due either to an actual increase in that product due to the adoption of the policy, or because the GI has been introduced in a country-product line already competitive in the past.

[42] We account for this potential additional issue following the suggestion by Wooldridge (2002) and implemented by Baier and Bergstrand (2007). Specifically, we regress our dependent variables on

few countries increases the probability of finding a GI in adjacent industries in those countries, raising potential problems for our instrument. However, we note that even in this case, namely when the instrument is not fully exogenous, our IV strategy can be at least informative and help understand the direction of the endogeneity bias in OLS regressions, i.e. whether our previous results are over- or under-estimating the true GI effect.

The very high number of fixed effects included in our specification forced us to run the IV regressions using a least squares estimator, instead of PPML, due to convergence problems.[43] In columns (1) and (3) of Table 4 (Table 5), we show the results obtained from the estimation of our main equation through OLS for intra-EU (extra-EU) trade. These results suggest that a change in the estimation procedure (from PPML to OLS) induces only minor changes in the parameters previously estimated and reported in columns (4) and (5) of Table 2 (Table 3), rendering our IV strategy informative.

The first-stage of the IV regressions suggests that our instruments explain a relevant variation of the number of GIs in contiguous sectors (see Appendix C online). The first-stage F-statistic is indeed systematically higher than the critical value of 10, rejecting the risk of weak instruments (Stock and Yogo, 2005). Considering intra-EU trade, the second-stage IV results for the overall trade reported in Table 4 (column (2)) strongly confirm our findings when GIs are produced by the exporters only, or when both countries produce GIs. The magnitude of the IV estimated effect shows that previous results tend be biased downwards, if at all, namely the *true* GI export-promotion effect is probably larger in magnitude when simultaneity bias is controlled for. However, when GIs are produced by only the importing country, our previous findings appear to be less robust. In fact, the estimated effect turns from negative to positive in the IV regression, although this effect is not statistically different from zero. Thus, the import-reducing effect of GIs appears to be sensitive to the estimation method, suggesting that we cannot derive clear conclusions from this side.

---

lagged and forward values of our instruments, to see whether pre-existing trade causes GIs at the 2-digit level. The results confirm that the forward GI at t+1, is never statistically significant, i.e. GI changes are strictly exogenous to trade flows changes (see Table 4.bis in the online Appendix).

[43] Specifically we use the STATA command *reghdfe* (high dimensionality fixed effects) that in its PPML version does not yet include the IV option. Note that, using the IV estimator we run the trade regression including only positive trade flows as the dependent variable is now transformed in log (trade) and the log of zero is indefinite. Clearly, this is not the case for the export unit value equations, where zeros are not present.

The results of the IV regression for the export unit value (column (4)) show robust GI price effects when GIs are produced by both countries. In contrast, when only exporters produce GIs the results show a barely-significant price effect and this effect is mainly driven by the fruit sector.[44] In fact, by removing from the IV regression the HS 08 sector, the estimated GI effect on export unit value turns out to be significant at the 1% level (column (5)).

Insert Table 4 here

The second-stage IV results for extra-EU GIs impact are presented in Table 5. Overall when the GI effect is measured considering EU exports, IV results are totally consistent with the OLS results. Importantly, as in the intra-EU case, the magnitude of the IV effect suggests that the direction of the bias of our baseline regressions, if any, tends to be downward. Thus, the positive effect of a new GI on extra-EU exports and unit value appears to be robust to potential endogeneity concerns. By contrast, the results are only partially confirmed when we consider the EU import effect of GIs. Here, an additional GI in an HS 6-digit line seems to lead to an increase in European imports from the extra-EU countries producing no GIs and, at the same time, to a reduction of the import unit value.[45] Thus, on the import side, overall, the IV results suggest that our findings are less robust for both intra and extra-EU trade.

Insert Table 5 here

6. Concluding Remarks

We analyse the relationship between Geographical Indications and international trade within EU-15 countries and between EU-15 and extra-EU countries. We exploit an original dataset on GI products classified at HS 6-digit level, to investigate their effects on trade margins (extensive and intensive), and on import and export prices. Econometrically, the GI effect is identified through a difference-in-difference research design, and also using an instrumental variables approach.

[44] Indeed, as discussed above, in the fruits sector the presence of GIs in the exporter country shows an unexpected negative and significant effect on the export unit value (see column (4), Table A5 online).

[45] Similar to intra-EU trade, this finding could suggest that, due to the increasing quality of products in the EU importing countries, extra-EU countries producing no GIs progressively decide to opt for a price competition, as they cannot compete on quality.

With reference to the research questions proposed in the introduction, our main findings can be summarised as follows: (i) the EU GI policy does promote exports of agri-food products; (ii) On the import side, the EU quality policy may result in some *weak* trade reducing elements; (iii) our results show a positive GI effect on the price of exported agri-food products; (iv) the EU GI policy has similar effects on both intra-EU and extra-EU trade, although with some caveats on the comparability of the two sets of results.

Two main economic implications can be drawn from these econometric results. First, the significant GI export-promotion effect revealed by our analysis appears fully consistent with firm-heterogeneity trade models that emphasise heterogeneity in product quality as main drivers of export performance. In fact, our findings show that country-sectors producing more GIs have higher export unit values, namely they export higher quality goods, and export more at both the extensive and intensive trade margins, consistent with the predictions of quality sorting models (e.g. Crozet *et al*., 2012). Second, our results do not clearly support an anti-competitive trade effect of GIs on the import side. Baseline regressions do show that the diffusion of GIs in the importing countries seems to act as a non-tariff measure. However, this finding is not supported by instrumental variable regressions for both intra-EU and extra-EU trade flows. The nuanced effect of GIs on the import side is also reinforced by the weak effect on import unit values, that switch from negative to positive or to insignificant between the PPML and the IV specifications.

The present analysis has several caveats, mainly related to the difficulty of tracing whether traded products are GIs or not in the available data. This forces researchers with the objective of capturing the GI trade effect, to use a proxy for GI relevance, such as their number as in the present study. However, this approach may overlook important economic dimensions related to the GI weight and potential for international trade. This is a fundamental problem with current production and trade statistics that can only be solved at an institutional level. From this perspective, a key direction for future research on the GI trade effect should be to exploit (custom) micro-data matched with GI certified firm-level information. A movement in this direction may significantly improve our understanding of the mechanisms governing the GI trade effects.

Supporting Information

Additional supporting information may be found in the online version of this article available at the publishers website:

Appendix A

Appendix B

Appendix C

References

Abel-Koch, J. *Endogenous Trade Policy with Heterogeneous Firms.* Working Paper No. 1306 (Gutenberg School of Management and Economics, Johannes Gutenberg-Universität Mainz, 2013).

AND-International. Value of production of agricultural products and foodstuffs, wines, aromatized wines and spirits protected by a geographical indication. Study Commissioned by the European Commission, 2012. Available online at: https://ec.europa.eu/agriculture/sites/agriculture/files/external-studies/2012/value-gi/final-report_en.pdf.

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

Amiti, M. and Khandelwal, A.K. 'Import competition and quality upgrading', *The Review of Economics and Statistics*, Vol. 95(2), (2013) pp. 476–490.

Baier, S.L. and Bergstrand, J.H. 'Do Free Trade Agreements Actually Increase Members' International Trade?', *Journal of International Economics,* Vol. 71(1), (2007) pp. 72–95.

Baldwin, R. and Harrigan, J. 'Zeros, Quality, and Space: Trade Theory and Trade Evidence', *American Economic Journal: Microeconomics*, Vol. 3(2), (2011) pp. 60–88.

Bektasoglu, B., Engelbert, T. and Brockmeier, M. 'The Effect of Aggregation Bias: An NTB-modelling Analysis of Turkey's Agro-food Trade with the EU', *The World Economy*, Vol. 40, (2017) pp. 2255-2276.

Bernard, A.B., Eaton, J., Bradford J. and Kortum, S. ‘Plants and Productivity in International Trade’, *American Economic Review*, Vol. 93(4), (2003)pp. 1268-1290.

Biénabe, E. and Marie-Vivien, D. ‘Institutionalizing Geographical Indications in Southern Countries: Lessons Learned from Basmati and Rooibos’, *World Development*, Vol. 98(C), (2017) pp. 58-67.

Bureau, J.C., Marette, S. and Schiavina, A. ‘Non-tariff Trade Barriers and Consumers' Information: The Case of the EU-US Trade Dispute over Beef’, *European Review of Agricultural Economics,* Vol. 25(4), (1998) pp. 437-62.

Cadot, O., Carrère, C. and Strauss-Kahn V. ‘Export Diversification: What’s behind the Hump?’, *The Review of Economics and Statistics,* Vol. 93(2), (2011) pp. 590-605.

Calboli, I. and Wee Loon, N. *Geographical Indications at the Crossroads of Trade, Development and Culture* (Cambridge University Press, 2017).

Caswell, J. A. and Mojduszka, E. M. ‘Using Informational Labeling to Influence the Market for Quality in Food Products’, *American Journal of Agricultural Economics*, Vol. 78(5), (1996) pp. 1248–1253.

Chambolle, C. and Giraud-Heraud, E. ‘Certification of origin as a non-tariff barrier’, *Review of International Economics*, Vol. 13(3), (2005) pp. 461–471.

Chen, M. X. and Mattoo, A. ‘Regionalism in standards: good or bad for trade?’, *Canadian Journal of Economics*, Vol. 41(3), (2008) pp. 838–863.

Crinò, R. and Epifani, P. ‘Productivity, Quality and Export Behavior’, *Economic Journal*, Vol. 122(565), (2012) pp. 1206–1243.

Crozet, M., Head, K., and Mayer, T. ‘Quality Sorting and Trade: Firm-level Evidence for French Wine’, *Review of Economic Studies,* Vol. 79(2), (2012) pp. 609–644.

Curzi, D. and Olper, A. ‘Export behavior of Italian food firms: Does product quality matter?’, *Food Policy*, Vol. 37(5), (2012) pp. 493−503.

Deconinck, K. and Swinnen, J. ‘The economics of planting rights in wine production’, *European Review of Agricultural Economics*, Vol. 42(3), (2014) pp. 419-440.

Deconinck, K., Huysmans, M. and Swinnen, J. *The Political Economy of Geographical Indications*, Discussion Paper No. 372/215 (LICOS Centre for Institutions and Economic Performance: Leuven, 2015). .

Dennis, A. and Shepherd, B. ‘Trade Facilitation and Export Diversification’, *The Word Economy*, Vol. 34(1), (2011) pp. 101-22.

Desquilbet, M. and Monier-Dilhan, S. ‘Are geographical indications a worthy quality label? A framework with endogenous quality choice’, *European Review of Agricultural Economics*, Vol. 42(1), (2015) pp. 129-150.

Duvaleix-Treguer, S., Emlinger, C., Gaigne, C., and Latouche, K. *Quality and export performance evidence from cheese industry*, (145th EAAE Seminar: Parma, Italy, 2018)..

European Union. Regulation on quality schemes for agricultural products and foodstuffs. *Official Journal of the European Union*, Vol. 1151/2012, (2012) L 343/1–L 343/29.

Fajgelbaum, P., Grossman, G. G. M. and Helpman, E. 'Income Distribution, Product Quality, and International Trade', *Journal of Political Economy*, Vol. 119(4), (2011) pp. 721-765.

Falvey, R. E. and Kierzkowski H. 'Product Quality, Intra-Industry Trade and (lm)Perfect Competition', In H. Kierzkowski (ed.), *Protection and Competition in International Trade: Essays in Honour of W. M. Corden* (Oxford, England: Basil Blackwell, 1987)..

Feenstra, R. C. and Kee, H. L. 'On the Measurement of Product Variety in Trade', *American Economic Review,* Vol. 94(2), (2004) pp. 145–149.

Feenstra, R.C. and Kee, H. L. 'Export Variety and Country Productivity: Estimating the Monopolistic Competition Model with Endogenous Productivity', *Journal of International Economics,* Vol. 74(2), (2008) pp. 500-514.

Feenstra, R. C. 'Estimating the effects of trade policy', Ch. 30 in Grossman, G. M. and Rogoff, K. (Eds). *Handbook of International Economics*, Vol. 3, (1995) pp. 1553–1595.

Flam, H. and Helpman, E. 'Vertical Product Differentiation and North-South Trade', *American Economic Review*, Vol. 77(5), (1987) pp. 810-22.

Fontagné, L., Orefice, G., Piermartini, R. and Rocha, N. 'Product standards and margins of trade: Firm-level evidence', *Journal of International Economics*, Vol. 97(1), (2015) pp. 29-44.

Gangjee, D.S. 'Proving Provenance? Geographical Indications Certification and its Ambiguities' *World Development*, Vol. 98, (2017) pp. 12–24.

Gaulier, G. and Zignago, S. *Baci: International trade database at the product-level. The 1994–2007 version*, Working Paper No. 23 (CEPII Research Center: Paris, 2010)..

Grunert, K. G. 'Food quality and safety: consumer perception and demand', *European Review of Agricultural Economics*, Vol. 32(3), (2005) pp. 369–391.

Hallak J. C. and Sivadasan, J. *Firms' Exporting Behavior Under Quality Constraints*, Working Papers No. 628 (Research Seminar in International Economics: University of Michigan, 2011).

Head, K. and Mayer, T. 'Non-Europe: the magnitude and causes of market fragmentation in the EU', *Review of World Economics*, Vol. 136 (2), (2000) pp. 284–314.

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

Hummels, D. *Toward a Geography of Trade Costs*, GTAP Working Papers No. 1162 (Center for Global Trade Analysis, Department of Agricultural Economics: Purdue University, 2001).

Hummels, D. and Klenow, P.J. 'The variety and quality of a nation's exports', *American Economics Review*, Vol. 95(3), (2005) pp. 704–723.

Josling, T. 'The war on terroir: Geographical indications as a transatlantic trade conflict', *Journal of Agricultural Economics*, Vol. 57(3), (2006) pp. 337–363.

Khandelwal, A. 'The Long and Short (of) Quality Ladders', *Review of Economic Studies*, Vol. 77(4), (2010) pp. 1450-1476.

Kireeva, I. and O'Connor, B. 'Geographical Indications and the TRIPS Agreement: What Protection Is Provided to Geographical Indications in WTO Members?', *The Journal of World Intellectual Property*, Vol. 13(2), (2010) pp. 275-303.

Kugler, M. and Verhoogen, E. 'Prices, Plant Size, and Product Quality', *Review of Economic Studies*, Vol. 79(1), (2012) pp. 307–339.

Landi, C. and Stefani, G**.** 'Rent Seeking and Political Economy of Geographical Indication Foods', *Agribusiness,* Vol. 31(4), (2015) pp. 543–563.

Langinier, C. and Babcock, B. A. 'Agricultural Production Clubs: Viability and Welfare Implications', *Journal of Agricultural & Food Industrial Organization*, Vol. 6(1), (2008) pp. 1-31.

Lence, S., Marette, S., Hayes, D. and Foster, W. 'Collective marketing arrangements for geographically differentiated agricultural products: welfare impacts and policy implications', *American Journal of Agricultural Economics*, Vol. 89, (2007) pp. 947–963.

Linder, S. B. *An Essay on Trade and Transformation* (Wiley and Sons: New York, 1961)

Manova K. and Zhang Z. 'Export Prices Across Firms and Destinations', *The Quarterly Journal of Economics*, Vol. 127(1), (2012) pp. 379-436.

Marette, S., Clemens, R. and Babcock, B. 'Recent international and regulatory decisions about geographical indications', *Agribusiness*, Vol. 24, (2008) pp. 453-472.

Marette, S. and Crespi, J.M. 'Can quality certification lead to stable cartels?', *Review of Industrial Organization*, Vol. 23(1), pp. 43-64.

Marette, S. 'Non-Tariff Measures When Alternative Regulatory Tools Can Be Chosen', *Journal of Agricultural & Food Industrial Organization*, Vol. 14(1), (2015) pp. 1-17.

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

Menapace, L. and Moschini, G. 'Quality certification by Geographical Indications: Trademarks and Firm Reputation', *European Review of Agricultural Economics*, Vol. 39(4), (2012) pp. 539-566.

Menapace, L. and Moschini, G. 'Strength of Protection for Geographical Indications: Promotion Incentives and Welfare Effects', *American Journal of Agricultural Economics*, Vol. 96(4), (2014) pp. 1030-1048.

Mérel, P. and Sexton R. J. 'Will Geographical Indications Supply Excessive Quality?', *European Review of Agricultural Economics,* Vol. 39(4), (2012) pp. 567–587.

Matthews, A. 'What Outcome to Expect on Geographical Indications in the TTIP Free Trade Agreement Negotiations with the United States?', In Arfini, F., Mancini, M.C., Veneziani,

M. and Donati, M. (Eds.). *Intellectual Property Rights for Geographical Indications: What is at Stake in the TTIP?* (Cambridge Scholars Publishing: Newcastle, UK, 2016).

Matthews, A. *Geographical indications (GIs) in the US-EU TTIP negotiations*, CAPReform.EU, 2014. Available online at: http://capreform.eu/geographical-indications-gis-in-the-us-eu-ttip-negotiations/.

Moir, H. *Geographical indications: EU policy at home and abroad,* Working Paper ("IP Statistics for Decision Makers (IPSDM) conference": Sydney, Australia, 2016).

Moschini, G. C., Menapace, L. and Pick, D. 'Geographical indications and the provision of quality', *American Journal of Agricultural Economics,* Vol. 90(3), (2008) pp. 794–812.

O'Connor, B. 'The European Union and the United States: Conflicting Agendas on Geographical Indications - What's Happening in Asia?', *Global Trade and Customs Journal,* Vol. 9 (2), (2014) pp. 66–69.

Olper, A. 'The political economy of trade-related regulatory policy: environment and global value chain', *Bio-based and Applied Economics,* Vol. 5(3), (2017) pp. 287-324.

Persson, M. and Wilhelmsson, F. *EU Trade Preferences and Export Diversification*, IFN Working Paper 991 (Research Institute of Industrial Economics: Stockholm, 2013).

Santos Silva, J. and Tenreyro, S. 'The Log of Gravity', *The Review of Economics and Statistics*, Vol. 88(4), (2006) pp. 641–658.

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

Santos Silva, J., Tenreyro, S. and Wei, K. 'Estimating the extensive margin of trade', *Journal of International Economics*, Vol. 93(1), (2014) pp. 67–75.

Scoppola, M., Raimondi, V. and Olper, A. 'The impact of EU trade preferences on the extensive and intensive margins of agricultural and food products', *Agricultural Economics*, Vol. 49(2), (2018) pp. 251-263.

Shaked, A., and Sutton, J. 'Product Differentiation and Industrial Structure', *The Journal of Industrial Economics*, Vol. 36(2), (1987) pp. 131-146.

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

Sorgho, Z. and Larue, B. 'Do Geographical Indications Really Increase Trade? A Conceptual Framework and Empirics', *Journal of Agricultural & Food Industrial Organization*, Vol. 16(1), pp. 1-18.

Stock, J. and Yogo, M. Testing for Weak Instruments in Linear IV Regression, In: Andrews D.W.K. (Ed.) *Identification and Inference for Econometric Models* (Cambridge University Press: New York, 2005) pp. 80-108.

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

Wooldridge, J. M. *Introductory Econometrics: a Modern Approach* (Mason, Ohio: South-Western Cengage Learning, 2009).

Wooldridge, J. M. *Econometric Analysis of Cross-section and Panel Data* (Cambridge, MA: MIT Press, 2002).

Yu, J. and Bouamra-Mechemache, Z. 'Production standards, competition and vertical relationship' *European Review of Agricultural Economics,* Vol. 43(1), (2016) pp. 79–111

Zago, M. A. and Pick, D. 'Labeling policies in food markets: private incentives, public intervention, and welfare effects', *Journal of Agricultural and Resource Economics,* Vol. 29(1), (2004) pp. 150–165.

Figures

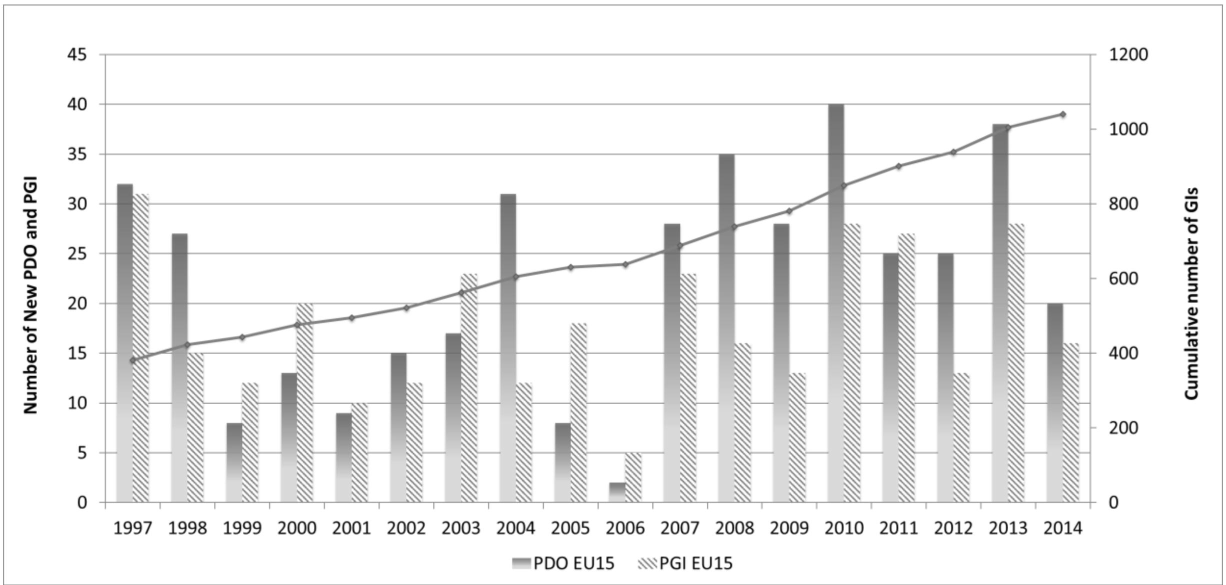

Figure 1. Distribution of GIs by year of registration

Source: Authors' analysis based on data described in the text. The grey line represents the cumulative representation of GIs over the analysed period, while bars graphically represent the yearly number of new PDOs and PGIs introduced. The first year of the policy implementation has been not included for illustrative purposes, as a massive number of GIs have been introduced (i.e. 328 GIs, of which 214 are PDOs and 114 PGIs).

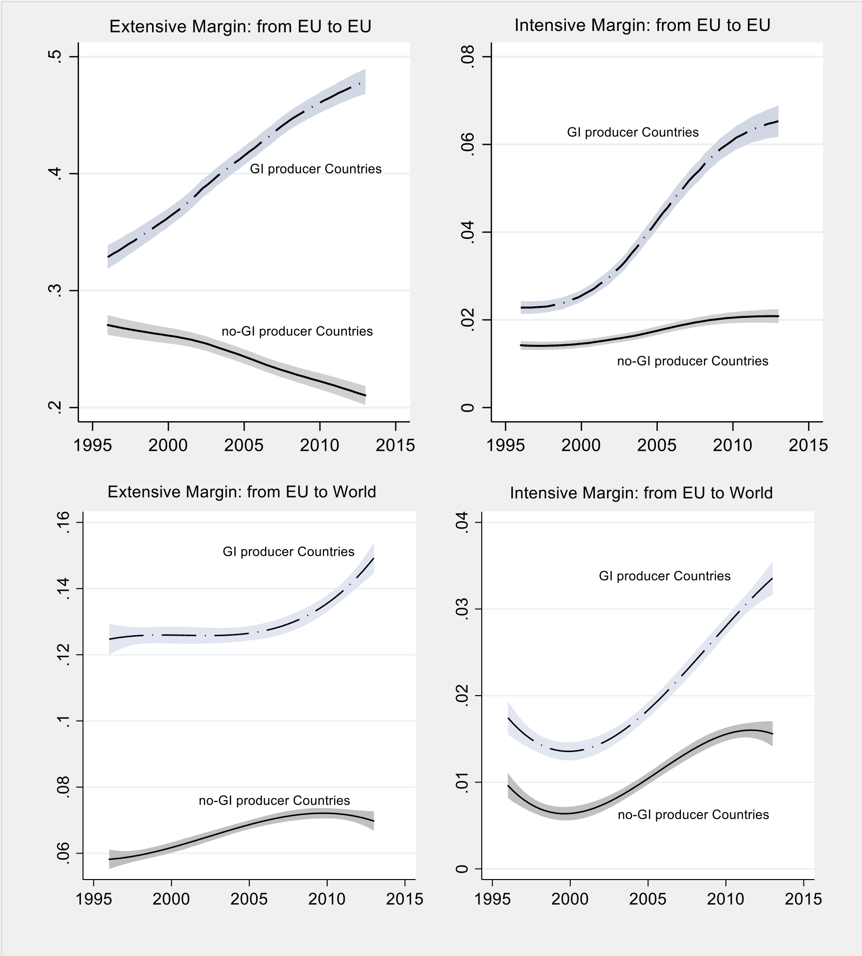

Figure 2. Extensive and intensive trade margins: GI vs non-GI producer countries

Notes: The figures show the evolution of the (smoothed) average extensive (intensive) margin, and their 95% confidence interval (computed using Stata's command for local polynomial smooth plots with CIs lpolyci), calculated across GI and no-GI producer countries both for intra-EU and extra-EU trade.

Source: Authors' analysis based on data described in the text.

Tables

Table 1

HS2 Classification	PDO	PGI	Total
04- Dairy produce; birds' eggs; natural honey; edible products of animal origin (…)	209	27	236
02- Meat & edible meat offal	60	134	194
07- Edible vegetables and certain roots and tubers	55	103	158
08- Edible fruit and nuts; peel of citrus fruit or melons	60	71	131
15- Animal or vegetable fats and oils and their cleavage products (…)	100	8	108
16- Preparations of meat, of fish or of crustaceans (…)	7	60	67
- Others (03, 09, 10, 11, 12, 17, 19, 20, 21, 22, 25, 51)	42	105	147

Number of GI products aggregated at HS2-digit level

Source: Authors' computation based on the DOOR dataset 1996–2014 (see text).

Table 2

Effects of GIs on intra-EU trade outcomes

Dependent variable:	Extensive Margin	Intensive Margin	Trade Ext*Int	Trade	Unit Value
				Main sectors	
	(1)	(2)	(3)	(4)	(5)
GIs – exporter	0.003***	0.012***	0.010***	0.039***	0.007***
	(0.000)	(0.001)	(0.001)	(0.003)	(0.001)
GIs – importer	-0.001**	-0.014***	-0.017***	-0.052***	-0.003***
	(0.000)	(0.002)	(0.002)	(0.012)	(0.001)
GIs – both	-0.000	0.004***	0.002***	0.018***	0.004***
	(0.000)	(0.001)	(0.001)	(0.003)	(0.000)
Dummy:					
Importer-year	yes	yes	yes	yes	yes
Exporter-year	yes	yes	yes	yes	yes
Importer-Exporter	yes	yes	yes	yes	yes
Product-year	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes
No. of obs.	88,550	88,550	88,550	917,566	452,446
Adj R^2	0.62	0.46	0.58	0.22	0.52

Notes: The table reports PPML regressions. Extensive and intensive margins are measured using the theoretically-founded decomposition of trade proposed by Feenstra and Kee (2008). All the regressions include data on the following sectors: HS 02, 04, 07, 08, 15, 16. Columns (1) to (3) use HS 2-digit sector data and report (in parentheses) robust standard errors clustered by country pairs-product HS 2-digit. Columns (4) and (5) use HS 6-digit product data and report robust standard errors clustered by country pairs-product HS 6-digit. Constant and fixed effects not reported.

*, **, *** indicate significance at 90%, 95% and 99% confidence levels, respectively.

Table 3

Effects of GIs on extra-EU trade outcomes

Dependent variable:	Extensive Margin	Intensive Margin	Trade HS 2-digit	Trade HS 6-digit	Unit Value HS 6-digit
	(1)	(2)	(3)	(4)	(5)
GIs–EU–exporter	0.002***	0.022***	0.020***	0.071***	0.005***
	(0.000)	(0.002)	(0.001)	(0.007)	(0.001)
GIs–EU–exp * $dGI_{d,t}$	0.004***	0.001	0.009***	-0.006	-0.003**
	(0.001)	(0.003)	(0.003)	(0.011)	(0.001)
GIs–EU–importer	-0.016***	0.001	-0.016***	-0.211**	0.001
	(0.001)	(0.002)	(0.002)	(0.091)	(0.004)
GIs–EU–imp * $dGI_{o,t}$	-0.013***	-0.023***	-0.019***	0.206**	-0.002
	(0.002)	(0.004)	(0.004)	(0.088)	(0.006)
log(1+tariff)	-0.774***	-0.561***	-0.531***	-0.916***	0.010
	(0.022)	(0.085)	(0.080)	(0.352)	(0.031)
Log(1+SPS)	-0.104***	-0.167***	-0.204***	-0.200**	0.042***
	(0.006)	(0.024)	(0.023)	(0.099)	(0.009)
Dummy:					
Importer-year	yes	yes	yes	yes	yes
Exporter-year	yes	yes	yes	yes	yes
Importer-Exporter	yes	yes	yes	yes	yes
Product-year	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes
No. of obs.	148,364	148,364	148,364	638,512	447,840
Adj R^2	0.62	0.46	0.55	0.21	0.49

Notes: The table reports PPML regressions. Extensive and intensive margins are measured using the theoretically-founded decomposition of trade proposed by Feenstra and Kee (2008). All the regressions include data on the following sectors: HS 02, 04, 07, 08, 15, 16. Columns (1) to (3) use HS 2-digit sector data and report (in parentheses) robust standard errors clustered by country pairs-product HS 2-digit. Columns (4) and (5) use HS 6-digit product data and report robust standard errors clustered by country pairs-product HS 6-digit.

*, **, *** indicate significance at 90%, 95% and 99% confidence levels, respectively.

Table 4

GI effects on intra-EU trade and export unit values: Instrumental variables (IV) regressions

Dep. variable:	Log(Trade Flow)		Log(Unit Value)		
	LSDV	IV	LSDV	IV	IV
	(1)	(2)	(3)	(4)	(5)
GIs - exporter	0.110***	0.238***	0.008***	0.009*	0.018***
	(0.010)	(0.037)	(0.001)	(0.005)	(0.005)
GIs - importer	-0.028***	0.009	-0.002*	0.007	0.007
	(0.007)	(0.036)	(0.001)	(0.005)	(0.005)
GIs - both	0.043***	0.082***	0.005***	0.014***	0.015***
	(0.007)	(0.022)	(0.001)	(0.003)	(0.003)
No. of obs.	452,446	452,446	452,446	452,446	358,702
Adj R^2	0.44	0.44	0.66	0.66	0.66

Notes: Robust standard errors clustered by country pairs-product HS 6-digit in parenthesis. In columns (1) and (3): Least Squares with Dummy Variables (LSDV) estimator; in columns (2), (4) and (5) instrumental variables regression (see text); in column (5) the regression omits the HS 08 sector. All regressions include importer/exporter-year FE, product-year FE and bilateral FE. Constant and fixed effects not reported.

*, **, *** indicate significance at 90%, 95% and 99% confidence levels, respectively.

Table 5

GI effects on extra-EU trade and export unit values: Instrumental variables (IV) regressions

Dep. variable:	Log(Trade Flow)		Log(Unit Value)	
	LSDV	IV	LSDV	IV
	(1)	(2)	(3)	(4)
GIs-EU-exporter	0.090***	0.132***	0.003***	0.023***
	(0.001)	(0.014)	(0.000)	(0.005)
GIs-EU-exp*$dGI_{d,t}$	-0.030***	-0.053**	-0.007***	-0.037***
	(0.003)	(0.0256)	(0.0001)	(0.009)
GIs-EU-importer	-0.026***	0.042**	0.006**	-0.040***
	(0.006)	(0.018)	(0.003)	(0.007)
GIs-EU-imp*$dGI_{o,t}$	0.023	-0.060	-0.002	0.044***
	(0.017)	(0.041)	(0.004)	(0.016)
log(1+tariff)	-0.700***	-0.714***	-0.011	-0.023
	(0.031)	(0.031)	(0.015)	(0.015)
Log(1+SPS)	-0.1998***	-0.199***	0.042***	0.045***
	(0.008)	(0.008)	(0.004)	(0.004)
No. of obs.	497,462	497,462	497,462	497,462
Adj R^2	0.21	0.21	0.39	0.39

Notes: robust standard errors clustered by country pairs-product HS 6-digit in parentheses. In columns (1) and (3): Least Squares with Dummy Variables (LSDV) estimator; in columns (2), (4) instrumental variables regression (see text). All regressions include importer/exporter-year FE, product-year FE and bilateral FE. Constant and fixed effects not reported.

*, **, *** indicate significance at 90%, 95% and 99% confidence levels, respectively.