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RESEARCH PAPER

Do Territories with Geographical Indications Trade Better?

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Abstract
Do Geographical Indications (GIs) have an impact on local export dynamics? This paper uses a panel geo-referenced dataset and a quasi-experimental approach based on Propensity Score Matching and Difference in Differences methods. Specifically, the study focuses on the impact of the European GI scheme on the wine sector export dynamics of Italian municipalities. Findings suggest that GIs positively impact wine export performance. Additionally, the positive impact of GIs spills over to the overall agri-food sector: taking similar non-GI municipalities as a benchmark, GI municipalities saw a higher increase in the value, volume, and unit value of export both in the wine and the overall agri-food sector. The positive impact involves both extra- and intra-EU trade flows and it is confirmed for rural areas as well for municipalities belonging to regions with weak institutions.

Keywords Geographical indications · Trade · Local internationalization · Exports

JEL Classification Q17 · C32 · O13 · P25

Penicillin cures, but wine makes people happy - Alexander Fleming

1 Introduction

This paper aims to analyse the impact of Geographical Indications (GI), the main quality scheme for agri-food products of the European Union (EU), on export dynamics at the local level, with a focus on the Italian wine sector.[1]

[1] Regulations: EEC No 2081/92; The revised and current regulations are EU Reg. No.2012/1151, food; EU Reg. No.2013/1308, wine; EU Reg. No.2019/787, spirit; EU Reg. No.2014/251, aromatized wines.

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Born in the early'30s in France, the GI scheme was formally adopted in Italy in the early '60s and in the EU in the early 90s to preserve high-quality local productions from standardised and industrial competitors.[2] The GI scheme defends the holistic combination of soil, climate, and topography as the key part of agri-food product authenticity and quality (recalled by the French notion of *terroir*) (Haeck et al. 2019; Josling 2006).[3] The GI sign is associated with high-quality agri-food products to acknowledge the fact that their uniqueness (characteristics, reputation and quality) is essentially (Protected Geographical Indications—PGI) or exclusively (Protected Designation of Origin—PDO) resulting from the specific environmental and human characteristics of the territory in which they are produced, the region of origin (Resce and Vaquero-Piñeiro 2022; Mantino 2021).

At the global level, due to their clear association to a strictly demarcated area of production, GI may represent a valid opportunity for reducing information asymmetry (consumers), increasing international returns (sellers) and working in the agri-food markets without encountering the risk of displacement and off-shoring strategies (workers) (Menapace and Moschini 2012; Bonanno et al. 2019; EC 2021; Huysmans 2020).[4] In recent years, the export effects of GI labels have been extensively studied, and a consensus on the positive impact of GIs in increasing exports has been reached (Curzi and Olper 2012; Sorgho and Larue 2014; Duvaleix-Treguer et al. 2018; Sorgho and Larue 2018; Raimondi et al. 2020; De Filippis et al. 2022). However, existing studies mainly look at the average effects of GIs on trade at the aggregated (national) level. In contrast, studies evaluating the impact of GIs at the disaggregated territorial level are scant. This is an important limitation for two reasons: firstly, the recognition of productions as GIs takes place locally, and it is inaccurate to account for the GI presence by looking at regions or countries as a whole. Secondly, the trade performance of territories and the territorial impact of GIs might significantly vary at the local level: the presence of a GI can either compensate for or complement the other drivers of international openness at the local level. In addition, its impact can lead territories to the sectorial re-composition of local production systems and export dynamics. Being a region of origin of a GI is not per se a guarantee of trading better after the certification (Chambolle and Giraud-Heraud 2005; Goebel and Groeschl 2014; Duvaleix-Treguer et al. 2018).

While the existing literature suggests that having a GI positively affects exports, the main research questions we address here are: what is the trade impact of GIs at the territorial level? Is the trade impact of GIs protection uniform across areas?

To test this hypothesis, we ensured that GIs were accounted for at the municipality level. Then, we investigate whether the trade territorial performance changes after the acknowledgement of a GI by looking at (i) exports' values, (ii) exports' volumes,

[2] France introduced a national regulation as early as the 1920s for cheese and in the 1930s for wines with the concept of *Appellation d'Origine Contrôlée (AOC)*. In Italy, the protection of high-quality wines goes back in history to the 60s when the Designation of Controlled Origin (DOC) concept was introduced.

[3] The word has been coined to express that the collective knowledge of the interactions between the identifiable physical and biological environment and applied agricultural practices, providing distinctive characteristics for the products from this area (Resolution OIV/Viti 333/2010 OIV).

[4] According to the UNCTAD (2019) classification, GIs are included within the Non-Tariff Measures (NTMs) category.

(iii) exports' unit values and (iv) exports' shares. We answer our question in the context of Italy by exploiting municipality-year variation of wine GIs combined with data on intra- and extra-EU exports over time. The analysis uses a novel dataset that reconstructs the time–space variability of GIs (source: e-Ambrosia, European Commission) at the local administrative level (i.e. *Comuni* in Italy), which is the geographical level to which GIs' region of origin refers, from 2004 to 2018, the most prolonged period available (Crescenzi et al. 2023).[5]

The Italian context allows for a good test of the question proposed in this study. Italy has the highest number of certified agri-food products (845, 526 of which are wines) (Huysmans and Swinnen (2019)), but with an uneven spatial distribution of these products and their economic returns across territories (Vaquero-Piñeiro 2021). The wine sector has established itself as a leader in the Italian agri-food industry and in the GI market, allowing Italy to claim a top spot among producer and exporting countries. The Italian wine supply chain has become a strategic asset for the agri-food sector, both in terms of profitability and high-quality reputation in domestic and international markets. In 2021, 57% of Italian wine production is certified as GI, accounting for 87% of the value of the wine sector. Apulia, Sicily and Veneto are the regions with the highest number of wine farmers and Utilised Agricultural Area (UAA). Veneto is also the region accounting for the highest number of farmers specialised in PDO productions (both for UAA and number of farms), the highest volume and economic value of PDO and one of the regions with the highest number of GI wines together with Piedmont and Tuscany.[6]

Among wine GIs, in this paper, we focus on PDOs. They are the GIs whose entire production process must be located within the region of origin and mainly influence trade flows (Kuenzel 2023). According to Italian official statistics, the majority of GI wines are PDOs (408 PDOs vs 118 PGIs, up to 2022) and the majority of exported GI wines are PDOs.

Operationally, we use Propensity-Score-Matching and Difference-in-Differences methodologies to compare the export dynamics of Italian municipalities entitled to PDOs with the correspondent trends experienced by a counterfactual group of similar municipalities that have never (or not yet) been entitled to a PDO.

Findings support that municipalities with a GI status are more likely to be involved in export activities. There is a significant increasing effect on wine exports' value, volumes, and unit value. Such an effect is driven by the performance of existing exporters (intensive margin) rather than the appearance of new ones in terms of the number of exporters (extensive margin). Regarding trade destinations, the effects are always significant for both extra- and intra-EU trade. Results also unveil the positive spill-over effects on the exports of the overall agri-food sector, by increasing the agri-food export more than proportionally than the sole wine export. This leads to a negative impact of GIs on the share of the export of wine over the export of the overall agri-food.

[5] Such database is the first geo-referenced inventory for all the EU GI at the Local Administrative Units (LAU) level obtained thanks to the re-organisation in a machine-readable format of information downloaded by eAmbrosia website. To extract the list of LAUs from the section titled "*Concise Definition of Geographical Area*", "*Demarcated geographical area*", or a section labelled similarly (there is not a harmonized title or section number, indeed) we use text-miner tools.

[6] Apulia is the region accounting for the highest value and volumes of PGI wines.

The results are confirmed for both intra- and extra-EU trade. Among municipalities playing as region of origin, the territorial context matters. The effect of GIs is always positive and significant for rural areas, while in the case of non-rural area, it is significant only for export values. Furthermore, it is confirmed independently from the quality of institutions.

This paper adds to the existing literature in three main ways.

First, it contributes to the literature on the trade effect of GIs, which has followed a perspective of analysis that neglects the local dimension of GIs (acknowledged at the very local level) and their impacts (that can vary across territories).

By adopting a micro-territorial level approach, the paper contributes to the recent but growing literature on the indirect effects of GIs on socio-economic development (e.g., Torok et al. 2020; Crescenzi et al. 2022, 2023). The positive impact of GIs on shaping quality trade can be considered, in fact, as one of the mechanisms through which this quality scheme can support territorial development and international competitiveness.

Finally, the paper contributes to the current policy debate on the future GI reform regulation (approved at the end of 2023). Our results support the relevance of investing in the competitiveness of local agri-food sectors in the global economy without losing local identity. By relying on a multi-level governance system, the general regulative framework of GIs, which is the same for all EU Member States and products, is adopted for each specific production through the Product Specifications. In this way, the scheme succeeds in valorising the heterogeneity of geographical, historical and socio-economic features of the territory where the policy will be implemented without losing the shared nature of this scheme (Huguenot-Noël and Vaquero-Piñeiro 2022; Belletti et al. 2017a). This is crucial evidence for the redefinition of the role of GIs in a global context.[7]

The rest of the paper is structured as follows. Section 2 introduces the Italian wine industry and discusses the role of GIs at the global level, while Sect. 3 describes the empirical setting, data and methodology. Results are presented in Sect. 4, while the analysis of the heterogeneous impact is presented in Sect. 5. We draw final remarks and lay out some policy implications in the conclusion.

2 Italian Wine Industry and Geographical Indications

In Italy, the wine sector is deeply rooted in a long history that spans several centuries and that established the country as a worldwide player.

The development of the wine sector has been essentially a bottom-up process supported by local actors and a system of public investiments, and dedicated to preserving local high-quality productions (Pomarici and Sardone 2020). Territorial and cultural features are so relevant for the Italian wine industry that this sector was the first one for which Italy introduced a national scheme aimed at protecting high-quality local production (Resce and Vaquero-Piñeiro 2022). The Italian wine industry is fragmented from different perspectives.

[7] Among the proposals, there is the aim of increasing the international role and protection of GIs by moving almost all the international governance of GIs from the general EU DG-AGRI to a specific office of the EUIPO agency.

First of all, in terms of production, given the differentiated supply offered by a grape-growing system, it covers virtually all regions and includes a high number of local grape varieties. Italian viticulture is, in fact, more based on local traditional varieties (e.g. Sangiovese, Glera, Montepulciano) than international ones (e.g. Pinot Grigio). In 2020, in Italy, vineyards for wine production covers 657,708 ha of the national land, the national production accounts for 49,066,000 hl, and there are 310,428 farmers operating.[8]

The average vineyard size is smaller than the EU ones (2,1 ha), decreasing from the North to the South. In terms of turnover, the sector is polarised between many very small units accounting for a small share of production, and the few large companies covering most of it (Corsi et al. 2019). On the one hand, this may represent a weakness for the sector that cannot exploit economies of scale; on the other, as stressed by Corsi et al. (2019), the "*numerous networks, some of which are formal and others informal*" established among firms within local production systems is one of the strengths of the Italian wine sector (i.e. *Consortia*). Overall, the Italian wine industry is therefore characterised by a low degree of concentration, with a key role of cooperatives, while a few foreign multinationals are involved.

The wine industry can be considered fragmented also from the winemaking perspective, due to the high number of actors involved in the supply chain. In 2020, in Italy, there were 45,631 winemaking firms (agricultural phase) and 1807 industrial farmers (industrial operators and cooperatives) involved. Tuscany is the region with the highest number of winemaking operators. In the chain analysis, it is relevant also to stress the presence of operators working in the intermediate grape markets, external (grapes sold by grape-growers to winemakers) and internal (grape self-processed). Bottling and distribution phases are maybe the most heterogeneous and articulated given the high number of different sell strategies and actors involved (see Corsi et al. 2019 for details). Both integrated and de-integrated supply-chain organizations are present and relevant in the national market.[9]

In 2020, 40.80% of the national wine production was exported, while only 7.10% of consumed wine was imported, confirming Italy as one of the top export players in the wine trade. Wine exports account for 13.90% of the total agri-food exports and are made up of a wide range of products mainly composed by bottles (Anderson and Pinilla 2018). Veneto, Piedmont and Tuscany are the regions more relevant regarding wine export values, while the USA, Germany and the United Kingdom are the main destinations accounting for around 50% of the Italian exports.

Over the years, the Italian wine sector has been able to sustain the competition of the standardised and homogenous wines coming from the New World producers, as well as of the premium quality of the French industry, by investing in traditional peculiarities and medium-range high-quality products. The result was an increase in the wine export of 56% in the last decade.

[8] All the data cited in the paragraph come from ISMEA Mercati (https://www.ismeamercati.it/vino). Exceptions report their specific reference.

[9] Vertically integrated supply chains imply that all activities (grape-growing, winemaking, bottling/packing) are carried out by a single unit, while de-integrated supply chains are characterised by a key company that purchases grapes or wine as inputs and operates on intermediate and final distribution with bottled/packed wine.

The strengthening of the EU GI system for the wine sector before, and for the entire agri-food sector since the 1990s, has to be seen in connection with global integration processes (Schober et al. 2023). In response to this threat, in fact, the EU proposed the GI quality scheme as a viable alternative to protect the names of specific products and promote their unique characteristics linked to their geographical origin in the international market.

The GI scheme's main aim is to preserve high-quality local productions against imitation, introducing consumer guarantees and bringing mutual trade benefits among producers that should better reach international markets (Pomarici et al. 2021; Giovannucci et al. 2010; Moschini et al. 2008; Romano et al. 2021). The reasons why wines are certified vary from avoiding fraud competition and "*Italian sounding*", particularly true for very well-known products, to sustain competitiveness within the international agri-food chains.[10] To guarantee that wine GIs are recognized internationally, additional protection for Geographical Indications for wines is provided by the Article 23 of the Trade-Related Aspects of Intellectual Property Rights Agreement (TRIPS). In addition, specific wines, as well as other GI products, started to be explicitly included in multilateral and bilateral trade agreements (e.g., World Intellectual Property Organization (WIPO), World Trade Organization (WTO) and Free Trade Agreements (FTAs)). For instance, the 2021 EU-China agreement recognizes 200 GIs from the EU and China, among which there are 15 Italian GI wines.[11] In 2021, wine GI export towards extra-EU countries increased by 13.8% reaching the 63% of the entire GI wine export (Qualivita 2022). The majority of exported GI wines are PDOs, which overall account for 11,512 thousand of hl, 4685 mln and 4.07 euro per litre. The USA, Germany and the United Kingdom are confirmed as the main export destinations for the GI market. This evidence suggests that the peculiarity of differentiated wine supply based on the specific territorial features, *terroir*, is shared not only with other EU countries but also with extra-EU ones, especially with those one that are involved in wine production (e.g., the USA).[12]

2.1 Trading Geographical Indications in a Globalised Word

From the theoretical perspective, the GI label is considered a quality shifter for some consumers (increasing the demand for GI varieties) but also, due to production constraints, as a marginal cost shifter for producers (increasing price and thus reducing demand). Thus, the GI labels could have an ambiguous effect on trade. The literature on the GI impacts on trade is extensive. Several studies provide evidence about the positive ex-post effects of GIs on trade performances (Huysmans 2020; Josling 2006): GIs allow for premium pricing (Duvaleix-Treguer et al. 2021), increasing volumes (Sorgho and Larue 2018) and additional export value and new trade routes (extensive

[10] For very well-known products, the need of linking the product to a specific demarcated area relies mainly on avoiding counterfeiting. In the case of wines, for example, this means avoiding blending with not authorised wines, while in the case of food it can avoid the mix with false products during processing stages (slicing for cured meat).

[11] Agreement between the European Union and the Government of the People's Republic of China on cooperation and protection of, geographical indications. OJL 408I, 4.12.2020, p. 3–43.

[12] The relevance of the concept of terroir for extra-EU countries is not the case also for other food products.

margin) (Agostino and Trivieri 2014). Even if the GI certification is insufficient to reach internationalisation goals (Morrison and Rabellotti 2017; Belletti et al. 2009), international GI protection can decrease the cost of exporting firms. This reduction can be assumed as a consequence of collective management (i.e. *Consortia*) and public support granted to GI productions (e.g., Common Market Organization wine policy). Raimondi et al. (2020) find, in fact, evidence of the positive effects of GIs on both extensive and intensive margins. In this direction, Duvaleix-Treguer et al. (2021) provide evidence of the crucial role of GIs for better market access, especially in the case of countries with similar policies for agri-food quality. Some papers investigate how the protection of GIs in Free Trade Agreements generates additional trade benefits (Matthews 2016; Engelhardt 2015). Curzi and Huysmans (2022) concluded that, in the cheese sector, higher legal protection in destination markets has positive effects only for higher quality products with higher market share, while Emlinger and Latouche (2022) look at the French agri-food sector and find that the protection of GIs in European Regional Trade Agreements has a positive impact on trade. Most recently, De Filippis et al. (2022) have reviewed the existing literature on the effects of GIs on trade and conducted a meta-analysis to summarise the main results provided. Despite the vast literature on the GIs trade effects, limited attention has been paid to investigating the trade consequences of obtaining a GI at the sub-national level (De Filippis et al. 2022). Reisman (2022) is one of the few exceptions. By looking at the Spanish almond-based PGI turron, the paper conceptually debates the fact that GIs are designed to reduce intensive production and accelerate export expansion, generating a form of growth which may ultimately undermine the benefit at the local scale. Empirical evidence is, however, not provided.

More generally, the literature investigating the relationship between quality and trade is also a reference for this paper. The baseline strand of this empirical literature assesses the impact of different trade costs on trade performances according to the quality of the products, using either country-level (Schott 2004; Hummels and Klenow 2005; Baldwin and Harrigan 2011; Fiankor and Santeramo 2023) or firm-level data (Bastos and Silva 2010). Hummels and Skiba (2004) find that average free-on-board (FOB) export prices rise with freight costs to a destination market. They interpret this as confirming the Alchian–Allen (1964) effect (Alchian and Allen 1964). The Alchian-Allen effect, also known as "shipping the good apples out", arises when freight costs depend on weight rather than being proportional to value as per iceberg assumption (Borcherding 1978; Umbeck 1980; Bauman 2004). An increase in freight costs lowers relative delivered prices and raises the relative attractiveness of high-quality goods for distant consumers. Except for Crozet et al. (2012), who use quality ranking by experts, and Curzi and Olper (2012), who used R&D and innovation as a proxy for quality, most of these studies have used trade unit values as a proxy for the quality of the product. Over the last few years, GIs have assumed a more and more relevant role in this literature, given their nature as a good proxy of high-quality productions.

The impacts of quality on trade have also been investigated by papers focusing on the consumers' attitude toward an indication of source (UNIDO 2010).[13] They

[13] In the context of agri-food productions, generic terms are names which, although they denote the place from where a product originates, have become the term customary for such a product. At the same time,

provide numerous and varying evidence on the relative importance of this extrinsic attribute as compared to other product characteristics (Chamorro et al. 2015). Territorial imagery is, in fact, increasingly being recognised as having a commercial value for agri-food products, and it provides a subjective source of quality differentiation (Henchion and Mcintyre 2000; Marcoz et al. 2016). Even though countries operate within an increasingly globalised context, the indication of the source of agri-food products still appears to be a relevant cue for consumers, producers, or marketers (Pucci et al. 2017). For producers and marketers, the indication of the geographical sources allows them to charge prices above marginal cost, thus achieving market power, thanks to the consumers' association between product and territorial image (Bruwer et al. 2012). Indeed, the strategic advantage of regional branding is that an agri-food product can be differentiated based on geographic origin, a unique attribute difficult to reproduce and presumed to be a quality cue for the product (van Ittersum et al. 2007). The existing literature on the consumers' attitude towards an indication of source provides numerous and varying evidence on the relative importance of this extrinsic attribute as compared to other product characteristics (Carbone et al. 2018). However, a recent study by Santeramo et al. (2020) finds that the region of origin is an effective differentiation instrument in the agri-food markets, but only if supported by GI labels.

3 Research Design: Data, Sample and Methodology

To explore whether the recognition of GIs changes the international openness of local areas, this paper uses counterfactual techniques and relies on a rich dataset covering the total GIs spatial–temporal variability and trade flows at the municipality level.

3.1 Data and Sample

Data comes from different sources, and several steps are involved in data collection.

Starting from the updated list of Italian municipalities, we identify which and since when are granted with GIs. This information has been collected from a more extended database in which they reconstructed the time and space variability of GIs at the municipality level for all of the EU since the'60s (Crescenzi et al. 2023). Given the rule of assignment of GIs, using such disaggregated data is, in fact, crucial since the so-called region of origin refers to an area of specific neighbouring municipalities, which is significantly smaller and distinct in comparison with regions or countries.

The dataset has been augmented by data on trade reconstructed from firm-level 8-digit data (Combined Nomenclature 8) (source: Italian National Institute of Statistics,

Footnote 13 continued
an indication of source can be defined as an indication referring to a place as being the area of origin of a product. However, the indication of source only require that the product originate in a certain geographical area, but it does not imply the presence of any special quality, reputation, or characteristic of the product linked to its place of origin.

ISTAT) and socio-economic contextual characteristics. Exporting firms are located within municipalities according to their head office.[14]

Our final database is a balanced panel of 8071 municipalities, with 72% of Italian municipalities being acknowledged with at least one wine PDO in 2018 and the majority of them also with food PDOs as depicted by Fig. 1 (municipalities with only wine PDO in green, while municipalities with both wine and food PDO in blue).[15]

Over the years under analysis, the overall values and volumes of wine exported by Italian municipalities have increased, despite fluctuating trends (Fig. 2). All Italian regions are involved in the wine trade (Table 8), with some municipalities accounting for outstanding performances (Table 9). In our sample, 2859 municipalities are involved in wine export in at least one year from 2004 to 2018. According to a preliminary mean comparison test, there is a significant difference in the wine export values between municipalities with and without PDOs.[16]

3.2 Methodology

Empirically, the aim is to estimate the effect of GIs on export dynamics by isolating the causal impact from other potentially confounding factors.

As a first step, we exploit a Propensity Score Matching (PSM) strategy to construct the control group for the treated units (Rosenbaum and Rubin 1983).[17] Treated municipalities are those that are registered under PDO for the first time and at least once during the period under analysis, while untreated ones are municipalities with no GI. Municipalities registered under wine PDO before 2004 are not included in the sample.

Thanks to the PSM, we remove from the sample those municipalities that, based on observable contextual socio-economic and topography characteristics, are non-comparable with any treated ones. In this way, any significant difference between PDO and non-PDO municipalities in terms of these characteristics is ruled out. To match control and treated municipalities, we use socio-economic structural characteristics of the municipalities, such as population density and employment rate (Table 10 for the entire list), measured in the year before the wine PDO treatment. Conversely,

[14] The firm-level sample includes information for 11,730 firms exporting agri-food products (manufactured tabacco firms excluded). Firms are localized in the municipality of their head office. To obtain this information, we merge the ISTAT trade database (that includes information on trade flows by referring to the fiscal code of the head office of exporting firms) with the Italian statistical register of active enterprises (ASIA-Imprese), that reports the address of the same head office. Therefore, due to data limitations, we do not have information to identify trade flows from multi-plants firms. The merging resulted in a slight loss of information, equal to about 10% of the imported/exported value of the agri-food sector. The loss of information is mainly due to non-resident firms (e.g., firms with registered offices abroad), included in the trade dataset but not in the ASIA-Imprese register.Using the head office could induce bias in our estimations, but this is the most detailed and precise data that we can have. However, in Italy the geographical distribution of export values extensively reflects the distribution of PDOs (Figs. 3, 4 in the Appendix).

[15] In details, 48.8% of municipalities are acknowledged only by a PDO food, 1.4% only by a PDO wine, and 49.8% by both food and wine PDOs.

[16] We perform *ttest* for the export value of the entire wine sector, including both GI and non-GI products.

[17] We implement k-nearest neighbour matching (k = 10) one-to-one with replacement. Among the different matching algorithms proposed by the literature (Caliendo 2008), we select the k-nearest neighbour matching with replacement as it decreases bias in comparison with radius matching and kernel matching, as well as one neighbour matching.

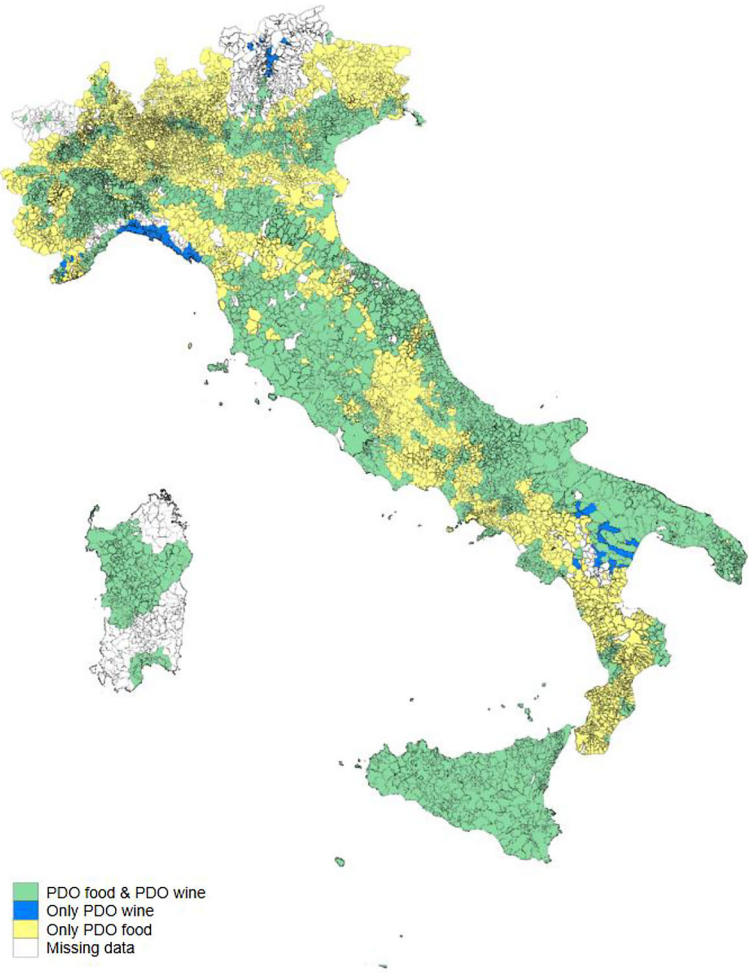

Fig. 1 Map of food and wine PDO municipalities in Italy, 2018. *Source*: Authors' elaboration on data collected from Geographical Indication codes of practice (source*: eAmbrosia*). Missing data are for municipalities whose jurisdiction has been merged or divided during the period under analysis and for which data are unavailable

variables accounting for relevant characteristics of the wine production and the GI scheme have been then included as controls in the Difference-in-Differences model (Model 1). Table 11 and Fig. 5, reporting the balancing after the PSM, confirm that no significant differences are observed between treated (PDO) and non-treated (non-PDO) matched observations (municipalities) for the majority of control variables. Those that remain unbalanced will be included in the DiD model as controls. Starting from 8071 municipalities, we eliminate municipalities whose jurisdiction has been merged or divided during the period under analysis and for which data are unavailable, obtaining a sample of 7960 municipalities from which we excluded those that have

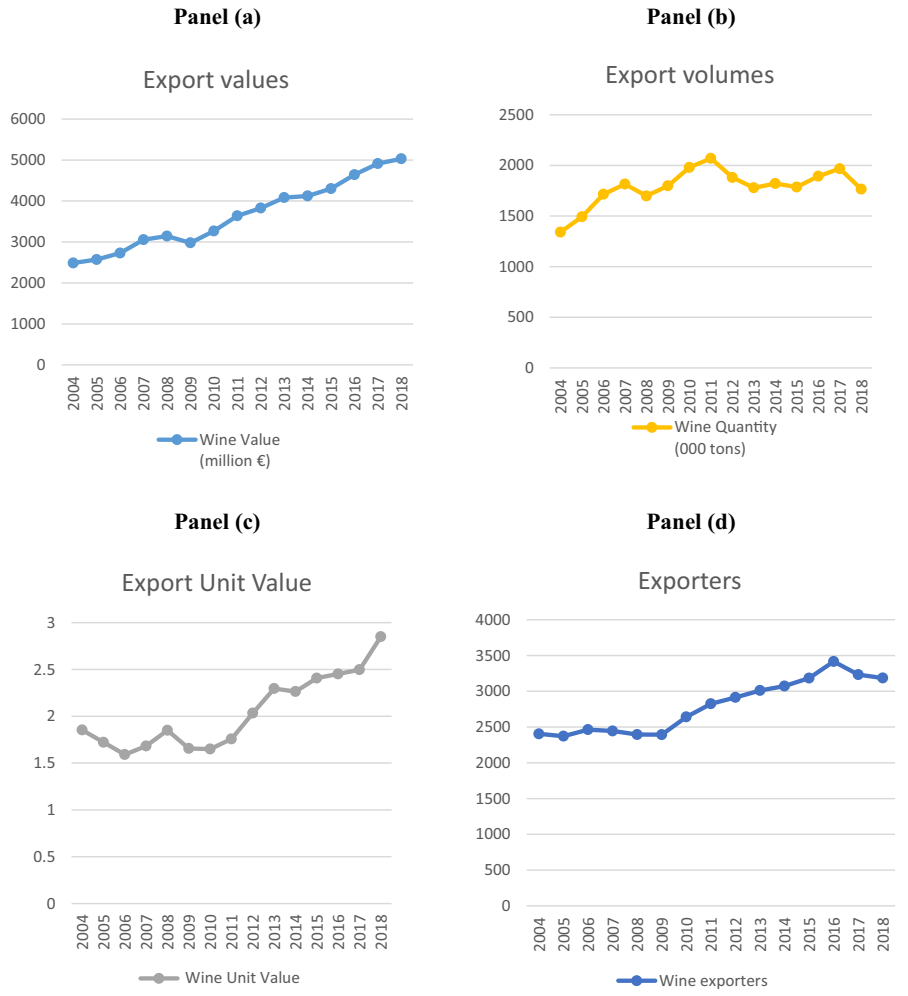

Fig. 2 Wine exports and exporters trends. *Notes*: Authors' elaboration on data collected from Italian National Institute of Statistics (ISTAT) data. We use tons as the unit of volume export for comparability with the export volume of the total agrifood sector. In addition, comparing the percentage variations in kg and litres over the analysed years, these are almost identical. Therefore, the choice of the unit of measurement does not affect the estimates

been always treated (with a PDO before 2004). Thereafter, to the remaining 4395 municipalities we run the PSM and exclude off-supported ones. The final sample is therefore composed of 4068 municipalities, of whose 377 are treated.

For the sub-group of matched municipalities, we estimate a two-periods (pre- and post-treatment) Difference-in-Differences model comparing the export performance of municipalities with and without GIs before and after the acknowledgement (Bertrand

Table 1 GIs effects on wine trade performance

	Export value (1)	Export volume (2)	Unit value (3)
Post*PDOs	0.872*** (0.401)	0.669* (0.360)	0.252*** (0.113)
Registration year	✓	✓	✓
GI controls	✓	✓	✓
Number of wine exporters	✓	✓	✓
Number of agri-food exporters	✓	✓	✓
Treated	✓	✓	✓
Post	✓	✓	✓
Pre-trends	✓	✓	✓
Unbalanced covariates	✓	✓	✓
Contextual controls	✓	✓	✓
Spatial lags	✓	✓	✓
Observations	7289	7289	7289
R2	0.55	0.57	0.30

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; Wine export value and volume are expressed as log transformations of absolute values. The unit value is the total value divided by the quantities and expressed as a log transformation. Values are expressed in millions, while volume is in tons

Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: employment rate; Spatial lags include a variable accounting for spatial lagged wine value and volume; and a variable accounting for the spatial lagged presence of wine PDO

Clustered standard errors in parentheses (municipalities)

et al. 2004), with clustered standard errors (Abadie et al. 2017):[18]

$$ExportPerformance_{i,t} = \alpha + \beta_1 PDOs_{it} + \beta_2 Post_{it} + \beta_3 (Post_{it} * PDOs_{it}) + GI\_Controls_{it} + Contextual\_Controls_{it} + \varepsilon_{it} \quad (1)$$

where i is the municipality, and t is the post-treatment period of reference. *ExportPerformance* is measured by (1) the log transformation of the absolute value and volume of wine exports; (2) the log transformation of the unit value, which is a proxy for price; (3) the share of the wine exports on the overall agri-food export and (4) the log transformation of the absolute value and volume of agri-food exports.

PDOs is a dummy variable that takes the value of 1 if the municipality *i* has acknowledged the status of PDO for one or more wines; *Post* is a dummy taking the value of 1 for the post-treatment period, while *Post*PDOs* is the interaction of the two variables being the key variable in the model. β_3 coefficient captures the impact of PDO in

[18] The two-period approach allows us to control for any time-invariant difference between the treated and the control groups and for any time-variant aspect varying similarly across them (Bertrand et al. 2004). Compared with the multi-year panel structure, the collapse of data in pre-post periods avoids correlation and generates consistent standard errors.

Table 2 GIs effects on wine trade performance: exports' share

	Share of export value (1)	Share of export volume (2)	Share of export value—country wine trade (3)	Share of export volume—country wine trade (4)
Post*PDOs	− 0.006	0.009	− 0.066***	− 0.065***
	(0.026)	(0.026)	(0.026)	(0.026)
Registration year	✓	✓	✓	✓
GI controls	✓	✓	✓	✓
Treated	✓	✓	✓	✓
Post	✓	✓	✓	✓
Pre-trends	✓	✓	✓	✓
Unbalanced covariates	✓	✓	✓	✓
Contextual controls	✓	✓	✓	✓
Spatial lags	✓	✓	✓	✓
Observations	7289	7289	7289	7289
R2	0.84	0.57	0.86	0.84

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; Wine export value and volume are expressed as log transformations of absolute values. The unit value is the total value divided by the quantities and expressed as a log transformation. Values are expressed in millions, while volume is in tons

Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: employment rate; Spatial lags include a variable accounting for spatial lagged wine value and volume; and a variable accounting for the spatial lagged presence of wine PDO

Clustered standard errors in parentheses (municipalities)

municipality i on the trade performance of municipality i at time t. As additional variables, we first consider a control matrix including GI-related variables ($GI\_Controls$) and one accounting for territorial contextual variables ($Contextual\_Controls$). In particular, the model is augmented with the GI control matrix to control for relevant aspects that can affect the relation between GIs and trade: (1) the presence of PGI wines, in addition to wine PDOs as a proxy of territorial reputation and specialisation towards high-quality wines, (2) the spatial lagged wine PDOs, to account for PDOs territorial concentration; (3) the volumes of wine exports of neighbourhood municipalities as a proxy of the relevance of the GI market; (4) dummies accounting for the years to have a proxy of the "age" of the GI market; (5) the number of wine exporters located within the municipality to control for the size of the GI market in terms of local actors. In addition, as a municipality can be entitled to food and spirit GIs, when we estimate the effect of the wine PDOs on the agri-food export, we control also the presence of food PDOs, food PGIs and spirit GIs (binary dummies).[19] Lastly, the model includes pre-treatment trends in the outcomes and the covariate that remained

[19] Unfortunately, we do not have data to control for reputation. However, our empirical strategy allows us to minimise the potential bias generated by the reputation of both product and territory. First of all, the DiDs approach eliminates those units that have always been treated under the period of analysis. If we look at the GI excluded, they are the most historical ones that tend to be those with the better reputation. PDOs such

Table 3 GIs effects on trade firms: number and average performance

	Number of wine trade firms (1)	Export value per firms (2)	Export volumes per firms (3)
Post*PDOs	0.001 (0.021)	1.106*** (0.458)	0.805*** (0.404)
Registration year	✓	✓	✓
GI controls	✓	✓	✓
Treated	✓	✓	✓
Post	✓	✓	✓
Pre-trends	✓	✓	✓
Unbalanced covariates	✓	✓	✓
Contextual controls	✓	✓	✓
Spatial lags	✓	✓	✓
Observations	7289	7289	7289
R2	0.86	0.47	0.49

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; Wine export value and volume are expressed as log transformations of absolute values. The unit value is the total value divided by the quantities and expressed as a log transformation. Values are expressed in millions, while volume is in tons

Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: employment rate; Spatial lags include a variable accounting for spatial lagged wine value and volume; and a variable accounting for the spatial lagged presence of wine PDO

Clustered standard errors in parentheses (municipalities)

unbalanced in the matched group of municipalities as identified by the Propensity Score analysis (i.e. employment rate).[20] Table 12 presents definitions and sources for all the controls.

The econometric approach proposed in this paper relies on the parallel trend assumption. To provide a formal analysis of this issue, we use the test proposed by Angrist and Pischke (2009) that consists of running a model with the same outcome variables of the baseline model 1 (i.e. export values, volumes and unit values) and the treatment dummies, the time dummy variables and the interactions between them and the treatment variable (Angrist and Pischke 2009). As the coefficient of the interaction terms in the pre-treatment years is statistically equal to zero, we can hold that the parallel trend assumption is satisfied (Table 13).

Footnote 19 continued
as Chianti and Chianti Classico, which were officially certified in 1973 and 2004 respectively, are therefore not included in the sample.

[20] As reported by Table 11, the only unbalanced covariate is the employment rate.

Table 4 Estimation results for the agri-food sector

	Agri-food export value (1)	Agri-food export volume (2)	Agri-food unit value (3)
Post*PDOs	1.180* (0.651)	1.197** (0.606)	0.086 (0.114)
PDO registration year	✓	✓	✓
GI controls	✓	✓	✓
Treated	✓	✓	✓
Post	✓	✓	✓
Pre-trends	✓	✓	✓
Unbalanced covariates	✓	✓	✓
Contextual controls	✓	✓	✓
Spatial lags	✓	✓	✓
Observations	7289	7289	7289
R2	0.44	0.45	0.23

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; Wine export value and volume are expressed as log transformations of absolute values. The unit value is the total value divided by the quantities and expressed as a log transformation. Values are expressed in millions, while volume is in tons

Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: employment rate; Spatial lags include a variable accounting for spatial lagged wine value and volume; and a variable accounting for the spatial lagged presence of wine PDO

Clustered standard errors in parentheses (municipalities)

4 Results

Findings reported in Table 1 highlight a positive impact of GI on exports. In comparison with the non-treated observations, the presence of GIs generates an increase of values by 139% (column 1), 95% for volumes (column 2) and 28% in terms of unit values (column 3).[21] These are large values showing that a relevant share of the large increase observed in the data (Table 8) is due to the GI acknowledgement.

By increasing reputation and certifying high-quality productions, GIs generate a positive effect on trade not only in terms of export value but also in terms of quantity. The positive impact on the unit value is in line with the hypothesis of trade literature, according to which producers could be more prone to export higher values rather than lower ones to minimise fixed costs. The positive effect of GIs on trade unit value also

[21] The dependent variable is log-transformed and, therefore, to obtain the percent increase in the response for every one- unit increase in the independent variable we exponentiate the coefficient, subtract one from this number, and multiply by 100. Example: the coefficient is 0.872. (exp(0.872) − 1) * 100 = 139. The change in the independent variable (from 0 to 1), the dependent variable increases by about 139% of the general pre-treatment values.

Table 5 The heterogeneous effects of wine GIs on exports—quality of institutions (IQ)

	Export value (1)		Export volume (2)		Unit value (3)	
	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ
Post*PDOs	0.655*** (0.253)	0.674* (0.413)	0.476*** (0.105)	0.533 (0.362)	0.265*** (0.096)	0.225* (0.123)
Registration year	✓	✓	✓	✓	✓	✓
GI controls	✓	✓	✓	✓	✓	✓
Treated	✓	✓	✓	✓	✓	✓
Post	✓	✓	✓	✓	✓	✓
Pre-trends	✓	✓	✓	✓	✓	✓
Unbalanced covariates	✓	✓	✓	✓	✓	✓
Contextual controls	✓	✓	✓	✓	✓	✓
Spatial lags	✓	✓	✓	✓	✓	✓
Observations	2583	5646	2583	5646	2254	5035
R2	0.66	0.55	0.67	0.57	0.40	0.27

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; Wine export value and volume are expressed as log transformations of absolute values. The unit value is the total value divided by the quantities and expressed as a log transformation. Values are expressed in millions, while volume is in tons

Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: employment rate; Spatial lags include a variable accounting for spatial lagged wine value and volume; a variable accounting for the spatial lagged presence of wine PDO

Clustered standard errors in parentheses (municipalities)

captures the role of these products in increasing the economic importance of exports thanks to their intangible territorial characteristics in terms of their environmental, social and institutional components (Mantino 2021; Dal Bianco et al. 2016).

Looking at the share of wine exports (value and volume) on the whole agri-food flows worldwide, we do not find a significant impact of GIs (columns 1 and 2, Table 2). However, if we restrict the focus to those countries towards which Italian municipalities export wine, the effects become significant and negative. This evidence suggests two extensions of the analysis.

Firstly, the increase in terms of export values and volumes leads us to question about the nature of this effect and whether an intensive or extensive margin mainly drives it in terms of trade firms. We test this aspect by using the number of firms involved in the wine trade and find that the positive effect of GIs is significant and positive only if we look at the average performance per firm (Table 3).

Secondly, after the certification, the wine relative market share, compared to other agri-food products, decreases (columns 3 and 4, Table 2). Such a result suggests potential positive spillovers toward the whole local agri-food sector of the region of origin. Therefore, we estimate the extent to which these positive effects affect the overall trade patterns by focusing on the absolute values for the overall agri-food sector. Table 4 shows a positive and significant impact of GIs for export values and volumes but a not significant one for unit values. These results, in line with what

Table 6 The heterogeneous effects of wine GIs on exports—rural areas

	Export value (1)		Export volume (2)		Unit value (3)	
	Rural areas	Non-rural areas	Rural areas	Non-rural areas	Rural areas	Non-rural areas
Post*PDOs	0.696* (0.386)	1.30* (0.784)	0.508* (0.337)	0.558 (0.523)	0.285*** (0.117)	0.805 (0.506)
Registration year	✓	✓	✓	✓	✓	✓
GI controls	✓	✓	✓	✓	✓	✓
Treated	✓	✓	✓	✓	✓	✓
Post	✓	✓	✓	✓	✓	✓
Pre-trends	✓	✓	✓	✓	✓	✓
Unbalanced covariates	✓	✓	✓	✓	✓	✓
Contextual controls	✓	✓	✓	✓	✓	✓
Spatial lags	✓	✓	✓	✓	✓	✓
Observations	6974	1210	6974	1210	6974	1210
R2	0.63	0.55	0.65	0.57	0.35	0.52

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; Wine export value and volume are expressed as log transformations of absolute values. The unit value is the total value divided by the quantities and expressed as a log transformation. Values are expressed in millions, while volume is in tons

Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: employment rate; Spatial lags include a variable accounting for spatial lagged wine value and volume; and a variable accounting for the spatial lagged presence of wine PDO

Clustered standard errors in parentheses (municipalities)

existing literature has found for other sectors (see Duvaleix-Treguer et al. (2021), for the French cheese sector), mean that the acknowledgement of a GI in a specific sector (wine in this paper) generates benefits for the entire agri-food one.

The legal recognition of a specific GI keeps the door open for different initiatives supported by outside public and economic actors, which can lead to the successful engagement of local actors in other agri-food markets, thus resulting in positive impacts yielded at the level of the overall agri-food sector. Belletti et al. (2017b) state that the notoriety gained by a product through the GI supports the valorisation of other agri-food products.

In the case of wine in Italy, several promotion initiatives and fairs targeted to GI wines guarantee market access to other agri-food products. For instance, the initiative "Superiore Match" organised by the Consortium of Conegliano Valdobbiadene Prosecco Superiore DOCG in partnership with Eataly store in London where they organised a specific corner in the store in London to reproduce some seasonal traditional recipes to eat in conjunction with their wine. Another is the "Grande Langhe" event yearly

organised by the Consortium of Piedmont wines (Consorzio di Tutela Barolo Barbaresco Alba Langhe e Dogliani e dal Consorzio Tutela Roero), during which wine tasting and pairing are open to national and international chefs, restaurants and buyers.

4.1 Robustness

We implemented some standard robustness checks to corroborate the results presented so far. First, our identification strategy must account for potential endogeneity issues, given that GIs are not randomly assigned, and our treatment variable could correlate with our trade outcomes generating simultaneous causality. Curzi and Huysmans (2022) and Raimondi et al. (2020) suggest that reverse causality may arise if the request for a GI certification is advanced for products exhibiting a particular trade pattern before the certification. To address these issues, we test the ex-ante correlation between treatment and outcomes variables to eliminate the potential endogeneity driven by the fact that the achievement of GI status could be due to ex-ante trade conditions (Table 14).

The results are also robust to a standard placebo test where we replicate the analysis by considering a'fake' treatment group unaffected by the program. Starting from the

Table 7 The effects of wine GIs on intra-EU *vs* extra-EU exports

	Export value (1)		Export volume (2)		Unit value (3)	
	Intra-EU	Extra-EU	Intra-EU	Extra-EU	Intra-EU	Extra-EU
Post*PDOs	0.705*** (0.3012)	0.865*** (0.436)	0.576*** (0.283)	0.722** (0.380)	0.185*** (0.089)	0.213*** (0.073)
Registration year	✓	✓	✓	✓	✓	✓
GI controls	✓	✓	✓	✓	✓	✓
Treated	✓	✓	✓	✓	✓	✓
Post	✓	✓	✓	✓	✓	✓
Nuts3 dummies	✓	✓	✓	✓	✓	✓
Pre-trends	✓	✓	✓	✓	✓	✓
Unbalanced covariates	✓	✓	✓	✓	✓	✓
Contextual controls	✓	✓	✓	✓	✓	✓
Spatial lags	✓	✓	✓	✓	✓	✓
Observations	7289	7289	7289	7289	7289	7289
R2	0.48	0.52	0.49	0.54	0.26	0.21

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; Wine export value and volume are expressed as log transformations of absolute values. The unit value is the total value divided by the quantities and expressed as a log transformation. Values are expressed in millions, while volume is in tons

Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: employment rate; Spatial lags include a variable accounting for spatial lagged wine value and volume; a variable accounting for the spatial lagged presence of wine PDO

Clustered standard errors in parentheses (municipalities)

municipalities that have never been granted PDO areas, we randomly assigned the treatment to half of them to create a sub-sample of fake treatment municipalities. We find no significant impacts confirming the validity our main results (Table 15).

5 Impact Heterogeneity Across Places of Origin and Destinations

We now move to investigate how the trade impacts of GIs vary according to different sources of heterogeneity characterizing treated units and trade destination areas. We focused on the heterogeneity in terms of (i) the local institutions of the GI areas, (ii) the rurality of the GI areas and (iii) the intra-EU vs extra-EU destination of the export.

5.1 Institutional Context

A fertile socio-economic and institutional context is key for supporting local development and internationalisation (Rodríguez-Pose 2020). Efficient juridical systems, contract enforcement, market competition, and high-quality public goods provision may create a favourable entrepreneurial ecosystem with greater stability and lower uncertainty and transaction costs. To the best of our knowledge, literature explicitly focusing on the link between the quality of the institutional context and the export performance at the local level does not exist. However, building on the several papers studying how institutions affect local development, we hypothesise that areas with better (formal and informal) institutions can also be favoured in terms of export performances (Lasagni et al. 2015; Rodríguez-Pose and Ganau 2022). Here, we want to check if the capability of GIs to deliver positive impacts in terms of trade performance works in local areas characterized by low-quality institutions (Crescenzi et al. 2023).

To test this, we split municipalities according to the quality of institutions of the regions to which they belong.[22] We find that the effect is always significant for municipalities located in weak-institutions regions, whereas, in the case of territories with high levels of quality institutions, it is significant only in the case of absolute and unit volumes (Table 5). This evidence suggests that GIs support international trade also when regional institutions are weaker. In this case, GIs can play a crucial role in strengthening the tie between local and global contexts, mainly thanks to the role of local producer groups (Arfini et al. 2011). Local producer groups foster the territorial-wide collaboration needed to guarantee that the establishment of a GI delivers positive effects (UNIDO 2010). In the Italian wine sector, this collective nature of GIs is particularly evident given that most GIs' producers have organised themselves in *Consortia,* each

[22] To split the sample, we used the mean value of the European Quality of Government Index (EQI) of the region to which municipalities belong (Charron et al. 2014). The index relies on four indicators (equal weighting) accounting for: control of corruption; government effectiveness; rule of law; and voice and accountability, and it combines the four into one composite index.Regions with low-quality institutions: Abruzzo, Basilicata, Calabria, Campania, Lazio, Liguria, Molise, Apulia, Sardinia and Sicily.Regions with high-quality institutions: Emilia-Romagna, Friuli-Venezia Giulia, Lombardy, Marche, Piedmont, Tuscany, Trentino South-Tyrol, Umbria, Aosta Valley and Veneto.

for specific GIs.[23] Also, in this case, the wine sector is the agri-food sector with the highest number of *Consortia* recognised by the Government and, therefore, autonomous in several activities (updated in June 2023: 130–304).[24] Among others, *Consortia* have the functions of safeguarding, promoting, enhancing, informing consumers, and generally caring for the interests related to GIs. In the case of internationalisation they can provide technical assistance for producers, the organisation of training sessions for cellars' export managers and fostering knowledge exchanges. A recent study on the role of GI *Consortia* in Italy reveals that they have substantially enhanced the support provided to producers in collective marketing for foreign buyers, online sales and training programmes (Qualivita 2022).[25]

The active role of *Consortia* in collectively promoting activities in support of producers can be particularly relevant in areas where formal institutions are weak. This is likely to be the reason why GIs work also in municipalities belonging to regions with institutional weaknesses (Table 5).

5.2 Rural Versus Non-rural Areas

Here we want to investigate the impact of GIs changes on rural vs non-rural municipalities, testing whether rural areas struggle more to reach international markets.[26] With this aim, we use the classification proposed by the Italian Rural Development Programme. Results unveil that in rural areas, the effects of GIs on export performance are always positive and significant (Table 6), while in the case of non-rural areas it is significant only for export values.

As it was for the case of low-quality institution areas, the GI scheme seems to be more effective in those territories that needed it the most: being capable of compensating local structural weaknesses, such as remoteness or scarce social and transport infrastructure endowment, GIs help rural areas to exploit the economic potential of typical products to activate virtuous trajectories of internationalisation.

[23] For the EU regulation, the establishment of a Consortium is not mandatory for certifying a GI.

[24] In Italy, Consortia are distinguished between Consortia included or not within the official list of Consortia recognized by the Government (art. 14, c. 15, Legge 526/99). The main difference is that while in the former case, the official regulative duties are managed directly by the Consortium, in the latter one, they are managed by the Government's office (Ministero, in Italy).The Consortia officially recognized by the Government is available at: https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/4923.

[25] The study has been published by Qualivita, but conducted by Origin Italia, the Italian Organization for an International Geographical Indications Network.

[26] Rete Rurale Nazionale, Zonizzazione delle aree rurali nel Psn. More information available at: https://www.reterurale.it/areeruraliThe choice of use this classification in the heterogeneity analysis, rather than the SNAI classification used in the PSM, is that the Rete Rurale Nazionale one accounts for agricultural and altitude factors that are particularly relevant for wine production. Conversely, the SNAI classification of municipalities is based only on spatial inequalities and the different level of accessibility to basic public services and infrastructures (e.g., hospital, secondary school, railway station), of which we wanted to account for when identifying observable characteristics along which matching treated and untreated municipalities.

5.3 Intra-EU Versus Extra-EU

The information asymmetry highlighted by Akerlof (1970) could have a different impact according to the regulatory and institutional backgrounds of the destination markets. Accordingly, we test whether the scheme's impact differs when trading GI wines toward EU destinations *vs* non-EU destinations.

The replication of the analysis distinguishing the outcome variables for intra and extra-EU destinations shows significant results for both extra- and intra-EU trade (Table 7). More importantly, the impact is similar, with only a small difference in terms of significance for export volumes (column 2).

In the case of Italian wine exports, the geographical, institutional and cultural proximity of the EU markets does not make the GI labels more or less effective in terms of trade facilitation. These results are partly different from the evidence available for other countries. In the case of the French wine industry, for instance, Mérel et al. (2021) find that welfare losses from asymmetric information are particularly significant in extra-EU destinations. In the same vein, Macedo et al. (2020) show that in Portugal Douro wine's marketability increases in more mature wine markets or countries speaking Portuguese.

6 Conclusions

Over the years, GIs have been recognized as signs of the link between agri-food products, quality and territories. Several socio-economic benefits are ascribed to the GIs from both producers' and territorial perspectives. At the international level, by recognising and protecting the given designation of an agri-food product that has a strong link to territories, GIs solve cases of fraud or misleading linkages with the region of origin.

In this paper, we examine the causal link between GIs and export performance at the local level. In particular, we focused on the case of the Italian wine sector, analysing how GIs shaped export performance at the municipality level. Contrary to what the literature has done so far, this is the first estimation of GIs' trade impacts that capture territorial differences, also considering not only the specific sector under analysis (wine) but also the spill-over dynamics for the entire agri-food sector.

Our analysis confirms previous studies finding a general positive relationship between GIs and export performance, with GIs being captured at the territorial level at which they are granted (LAUs). Results show a positive effect on wine exports due to the presence of a wine GI. At the same time, the acknowledgement of a GI induces positive spill-overs affecting the entire agri-food trade. As a result, there is no evidence of trade specialisation towards the specific sector of the GI (wine). The effects of GIs are significant for both intra- and extra-EU destinations.

In addition, our evidence adds novel insights on the specific types of areas gaining the most from GI protection. Looking at the impacts in different territorial conditions, we find that the positive role of GIs is relevant also in rural areas and territories characterised by lower quality levels of institutions. This suggests that even when formal

institutional support is weaker, there is the opportunity to count on existing capabilities and local peculiarities to exploit the opportunities offered by global economic integration.

In terms of policy implications, our results suggest that the GI scheme can deliver positive effects on export performances and that it is particularly effective in those cases where the policy support is needed the most: fragile areas left aside the internationalization flows (e.g., low-quality institutions and rural areas) and global scenarios where cultural proximity is low, and market regulations are heterogeneous (extra-EU destinations).

Understanding the impact of the GIs is critical in enhancing informed policy decisions towards securing more geographical indicators for wines and other products.

Our results shed new light on the effectiveness of quality schemes such as GIs that, as stated by Huguenot-Noel and Vaquero-Piñeiro (2022, p. 17), "*… are a good example of a 'zero cost' power that plays a propulsive role in sustainable rural development thanks to a combination of local identity and global fame*". Local productions are, in fact, more and more under pressure from, on the one hand, lower-priced standardised productions and, on the other hand, from new technologies and more efficient production processes.

However, a question remains: how long will territorial peculiarities remain a sustainable driving force for differentiation and competitiveness? Food chains are sometimes so "*distant and opaque*" that it is hard to see "*the territory*". In this sense, ensuring transparency and uniformity across EU and extra-EU countries is necessary to provide information to consumers and those actors involved in the trade.

We believe that our results go beyond the case of the wine sector. Indeed, wine is interesting because the spread in unit values is very high and because production can be based on very different areas. In addition, collective reputation is well explained in the wine industry (Castriota and Delmastro 2015) but is common in many manufacturing sectors, such as ceramics or shoes. In other words, the wine sector epitomizes many other manufacturing sectors typical of developed countries, where quality and collective reputation are important, and production is allocated between different territories. Accordingly, the positive effect of the GI scheme at the international level, documented by this study, also opens the potential benefits of extending the GI scheme to non-agricultural products (EC 2019). Both these issues are part of our future research agenda, together with the extension of this study to other agri-food sectors and EU countries, upon data availability.

See Tables 8, 9, 10, 11, 12, 13, 14, 15and Figs. 3, 4, 5.

Table 8 Export value and quantity for wine sector, by region (mean 2004–2019). *Source*: Our Database on ISTAT data

Region	Value (million €)	Quantity (000 tons)	Quantity (000 hectoliters)
Piedmont	561.8	269.4	2.554.0
Valle d'Aosta	1.2	0.1	1.0
Lombardy	294.8	117.4	1139.2
Trentino-Alto Adige	435.8	189.9	1870.7
Veneto	1261.8	511.8	5140.9
Friuli-Venezia Giulia	49.1	17.1	171.5
Liguria	8.8	1.2	12.1
Emilia-Romagna	323.9	371.5	3714.7
Tuscany	433.2	100.4	994.4
Umbria	19.9	4.8	48.3
Marche	35.7	15.1	147.0
Lazio	35.5	14.8	148.9
Abruzzi	90.8	51.9	516.6
Molise	1.7	1.3	12.7
Campania	13.2	5.2	56.2
Apulia	89.9	82.3	815.3
Basilicata	0.9	0.2	1.6
Calabria	2.6	0.6	6.1
Sicily	71.5	37.0	365.1
Sardinia	14.1	3.5	32.2
Total	3746.3	1795.6	17,748.6

Table 9 First 15 municipalities by number of exporting firms

Municipality	Wine		
	2004	2010	2019
Milano	86	93	140
Roma	75	66	83
Firenze	39	37	61
Montalcino	17	27	41
Verona	19	21	33
Valdobbiadene	30	26	32
Marsala	32	32	29
Torino	16	20	28
Napoli	10	9	27
Montepulciano	5	7	25
Genova	23	29	23
Alba	16	22	23
Greve in Chianti	9	10	20
Modena	12	8	19
Castagneto Carducci	1	3	17

Authors elaboration on our Database on ISTAT data

Table 10 Description and source of Propensity Score variables. *Source*: Authors' elaboration

Variable	Definition	Source
Rurality	Categorical variable classifying municipalities into: poles, intermunicipal poles, belt areas, intermediate areas, peripheral areas, ultra-peripheral areas	SNAI, National Strategy for Inner Areas
Elderly rate	Share of people aged 65 years and over	National Census, ISTAT
Remote housing	Percentage of residents living in remote houses	National Census, ISTAT
High-education rate	Share of secondary and tertiary education	National Census, ISTAT
Employment rate	Share of residents working aged 15 years or over	National Census, ISTAT
Agricultural employment rate	Share of residents working in agriculture sector aged 15 years or over	ISTAT
Distance from major cities	Distance from the capital city of the Region, in minutes: distance from the centroided of each municipality and the city	Authors' elaboration–Geographical Information System

Table 10 (continued)

Variable	Definition	Source
Utilised Agricultural Area (UAA)	Total area taken up by arable land, permanent grassland, permanent crops and kitchen gardens used by the holding, regardless of the type of tenure or of whether it is used as a part of common land	Agriculture National Census, ISTAT

Table 11 Balancing test between treated and untreated municipalities after the PSM

	Mean		*t*-test		%reduct bias
	Treated	Control (matched)	T	$p > t$	
Rurality	0.235	0.233	0.17	0.846	93.9
Elderly rate	189.13	189.35	0.41	0.671	62.8
Remote housing	19.86	19.26	1.39	0.166	81.1
High-education rate	27.20	27.10	0.62	0.533	97.7
Employment rate	45.73	46.07	− 1.66	0.098*	87.5
Agricultural employment rate	7.49	7.30	1.08	0.279	93.2
Distance from major cities	3.85	3.85	0.50	0.616	96.0
Utilised Agricultural Area (UAA)	6.51	6.47	1.03	0.303	6.51

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; the *t*-test estimates the difference-in-means between treated and control after the matching to assess balance in the matched sample. Control variables used for the PSM refer to the year before the start of the treatment

Table 12 Description and source of DiDs controls. *Source*: Authors' elaboration

Variable	Definition	Source
Dependent variables		
Export value	Value of exports—EUR	Italian National Institute of Statistics, ISTAT
Export volume	Volume of exports—kg	Italian National Institute of Statistics, ISTAT
Export unit value	Value of exports—EUR/ Volume of exports—kg	Authors' elaboration from data of Italian National Institute of Statistics, ISTAT
Control variables		
PDO food	Dummy = 1 for PDO food municipalities	Authors' elaboration from codes of practice
PGI food	Dummy = 1 for PGI food municipalities	Authors' elaboration from codes of practice

Table 12 (continued)

Variable	Definition	Source
GI spirit	Dummy = 1 for GI spirit municipalities	Authors' elaboration from codes of practice
PGI wine	Dummy = 1 for PGI wine municipalities	Authors' elaboration from codes of practice
Successful PDO area	Dummy = 1 if municipality is within the production area of the most economically performant and well-known GI (Mozzarella di Bufala Campana PDO, Prosecco DOC, Prosecco Superiore Conegliano Valdobbiadene DOCG, Prosciutto di Parma DOP, Parmigiano Reggiano DOP, Gorgonzola DOP, Grana Padano DOP, Pecorino Romano DOP and Prosciutto San Daniele DOP)	Authors' elaboration from codes of practice
Certification year	Year of the first PDO wine	Authors' elaboration from codes of practice
Spatial lagged wine export value	Wine export value in neighbourhood municipalities	Nearest neighbour approach. Contiguity spatial weighting matrix with normalized spectral normalization for 1st-order neighbours
Spatial lagged wine export volume	Wine export volume in neighbourhood municipalities	Nearest neighbour approach. Contiguity spatial weighting matrix with normalized spectral normalization for 1st-order neighbours
Spatial lagged wine PDO	Dummy = 1 if the dummy PDO is = 1 in neighbourhood municipalities	Authors' elaboration from codes of practice
Airport	Dummy = 1 for GI municipalities with airport	Italian National Institute of Statistics, ISTAT
Train	Km of railways	Italian National Institute of Statistics, ISTAT
Altitude	Categorical variable classifying municipalities according to the level of altitude: low, moderate and high altitude	Italian National Institute of Statistics, ISTAT
Number of wine exporters	Number of wine exporters located within the municipality	Italian National Institute of Statistics, ISTAT
Number of agri-food exporters	Number of wine exporters located within the municipality	Italian National Institute of Statistics, ISTAT

Table 13 Parallel trend estimations

	Export value (1)	Export volume (2)	Unit value (3)
Treated*t − 1	− 0.023	− 0.007	− 0.015
	(0.160)	(0.142)	(0.037)
Treated*t − 2	− 0.066	− 0.056	− 0.008
	(0.146)	(0.129)	(0.038)
Treated *t − 3	0.158	0.109	0.065
	(0.167)	(0.143)	(0.048)
Treated *t − 4	0.271	0.220	0.067
	(0.189)	(0.163)	(0.051)
Treated*t − 5	0.500	0.403	0.123
	(0.191)	(0.165)	(0.049)
Treated*t − 6	0.116	0.077	0.038
	(0.181)	(0.156)	(0.046)
Treated*t − 7	0.011	− 0.103	0.106
	(0.474)	(0.383)	(0.143)
Treated*t − 8	0.321	0.264	0.098
	(0.473)	(0.417)	(0.118)
Treated*t − 9	− 0.081	0.454	0.062
	(0.455)	(0.456)	(0.130)
Treated*t − 10	− 0.099	− 0.123	0.021
	(0.414)	(0.366)	(0.111)
Treated dummy	✓	✓	✓
Year dummies	✓	✓	✓
Observations	57,725	57,725	57,725

The approach proposed by Angrist and Pischke (2009) consists in dropping leads and lags from the model equation and augmenting it with the time trend variable and the interaction between t and the treatment variable, which should be not significant

Table 14 Endogeneity test for reverse causality

	PDO wine (1)
Export value t − 1	0.964
	(0.6.3)
Export volume t − 1	− 0.907
	(0.569)
Unit value t − 1	− 0.607
	(0.546)
Observations	4056

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; Wine export value and volume (outcome variables) are expressed as log transformation. Unit value is the total value divided by the quantities and expressed as log transformation

Table 15 Placebo test, fake treatment municipalities

	Export value (1)	Export volume (2)	Unit value (3)	Share of export value (4)	Share of export volume (5)	Share of export value—country wine trade (6)	Share of export volume—country wine trade (7)
Post*PDOs	− 0.075 (0.114)	− 0.065 (0.094)	− 0.022 (0.043)	0.002 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.006)
Registration year	✓	✓	✓	✓	✓	✓	✓
GI controls	✓	✓	✓	✓	✓	✓	✓
Treated	✓	✓	✓	✓	✓	✓	✓
Post	✓	✓	✓	✓	✓	✓	✓
Pre-trends	✓	✓	✓	✓	✓	✓	✓
Unbalanced covariates	✓	✓	✓	✓	✓	✓	✓
Contextual controls	✓	✓	✓	✓	✓	✓	✓
Spatial lags	✓	✓	✓	✓	✓	✓	✓
Observations	6356	6356	6356	6356	6356	6356	6356
R2	0.45	0.48	0.23	0.93	0.92	0.58	0.57

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; Wine export value and volume are expressed as log transformation of absolute values. The unit value is the total value divided by the quantities and expressed as log transformation. Values are expressed in millions, while volume is in tons

Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: employment rate; Spatial lags include a variable accounting for spatial lagged wine value and volume; a variable accounting for the spatial lagged presence of wine PDO

Clustered standard errors in parentheses (municipalities)

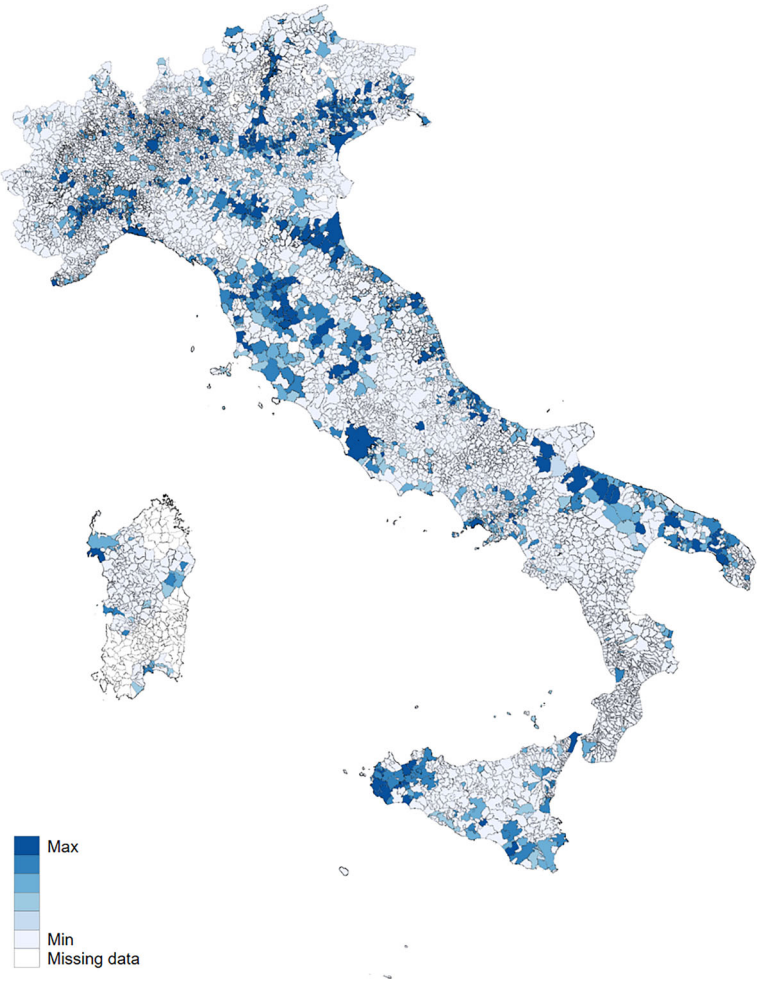

Fig. 3 Distribution index of wine exports, 2018. *Source*: Authors' elaboration on customs data

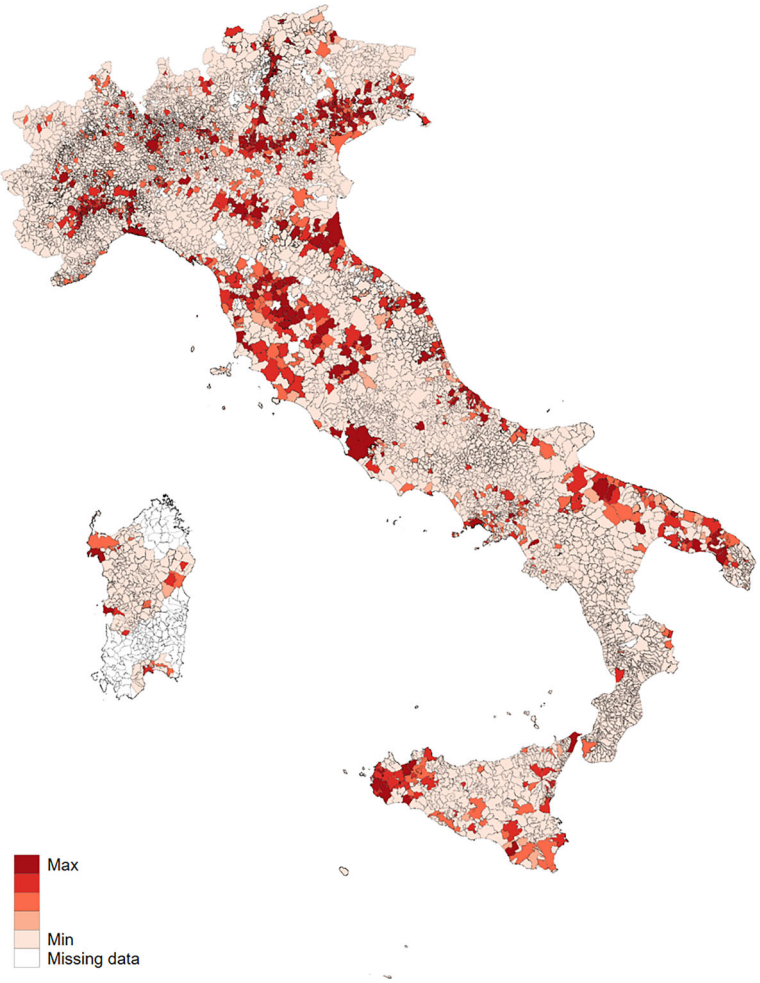

Fig. 4 Distribution index of PDO wine export, 2018. *Source*: Authors' elaboration on customs data

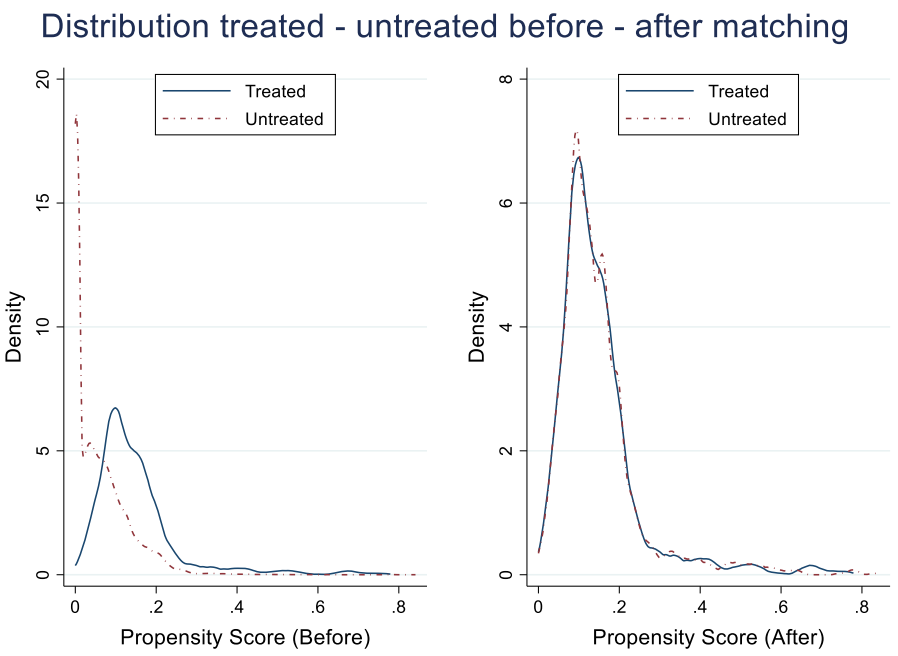

Fig. 5 Balancing graph before and after PSM. *Source*: Authors' elaboration

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Declarations

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