

Geographical Indications' territories 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 in the overall agri-food sector. The positive impacts are more pronounced for extra-EU trade flows and territories where the GI scheme compensates for rural structural difficulties and weak institutions.

Keywords: Geographical Indications, trade, local internationalization, exports.

JEL Code: Q17, C32, O13, P25

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

Born in the early '30s in France, the GI scheme was formally adopted in the EU in the early 1990s 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).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;

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.

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 develops, providing distinctive characteristics for the products from this area (Resolution OIV/Viti 333/2010 OIV).

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

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 not precise 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 in the most precise way possible (i.e., 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, (iii) exports' unit values and (iv) exports' shares. We answer this 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.⁵

⁵ Such database is the first geo-referenced inventory for all the EU GI at the LAU level obtained thanks to the re-organised in a machine-readable format of information download by eAmbrosia website. To extract the list of LAUs from the section titled "*Concise Definition of Geographical Area*", "*Demarcated*

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, whose 526 are wines), but with an uneven spatial distribution of these products and their economic returns across territories (Vaquero-Piñeiro, 2021). Most wine GIs come from the rural areas of the Northern and Central regions. As a matter of fact, Piedmont, Tuscany, and Veneto are the regions with the highest number of certified wines, around 50 each. These regions are also the most economically performant and have the longest wine trade tradition (certified and non-certified wines).

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

Findings support that municipalities with a GI status are more likely to be involved in successful export activities. There is a significantly increasing effect on wine exports' value, volumes, and unit value. Among margins at which trade can evolve, such an effect is driven by the intensive margin and higher for extra-EU destinations.⁶ Results also unveil the positive spill-over effects on the exports of the overall agri-food sector, 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.

Among municipalities playing as the region of origin, the territorial context matters. The effect of GIs is more significant for exporter municipalities that are rural and/or characterized by a lower level of institutional quality.

geographical area", or a section labelled similarly (there is not a harmonized title or section number, indeed) we use text-miner tools. This dataset is partially available under request.

⁶ Intensive margins refer to a bilateral trading relationship that already exists and that may increase through time. But trade may also increase in terms of extensive margins if a trading bilateral relationship is newly established between countries that have not traded with each other in the past.

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 of its 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. 2018; Crescenzi et al. 2022). 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 (scheduled for the end of 2023). Our results support the relevance of supporting 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., 2017). Our findings support the importance of defining policy interventions with a certain degree of tailoring. 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 discusses the role of GIs at the global level and the related trade effects, while Section 3 describes the empirical setting, data and methodology. Results are presented in Section 4, while the analysis of territorial differences is presented by Section 5. We draw final remarks and lay out some policy reflections in the conclusion.

2. Trading Geographical Indications in a globalised world

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.

The strengthening of the EU GI system since the 1990s has to be seen in connection with global integration processes. Despite being globally known as foreign agri-food excellence, over the decades, traditional local, high-quality productions have been compromised by the competition of standardised productions (Schober et al., 2023). In response to this threat, 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 literature demonstrates that the territorial concentration of quality agri-food products is not merely the consequence of environmental conditions; instead, human and cultural factors are the main determinants (Resce and Vaquero-Piñeiro 2022; Huysmans and Swinnen, 2019).

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). The reasons products 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.⁸ To guarantee that GIs are recognized at the international level, these 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 100 GIs each from the EU (e.g., Champagne, Feta and Prosciutto di Parma) and China (e.g., Panjin rice, Anji White Tea and Baise Mango).⁹ As a result, around 270 non-EU GIs are currently protected within the EU, and thousands of EU GIs are protected in partner countries. However, not all the GI seems to have the same opportunity of being included: Huysmans (2020) shows that the GIs more likely to be protected by trade agreements are those with the highest share values.

⁸ 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).

⁹ 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.

The literature on the GI impacts on trade is extensive. 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. With some exceptions (De Filippis et al., 2022), several studies provide evidence about the positive ex-post effects of GIs on trade performances (Huysman, 2020; Josling, 2006): GIs allows for premium pricing (Duvaleix et al., 2021), increasing volumes (Sorgho and Larue, 2018) and additional export value and new trade routes (extensive 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 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 the extent to which the protection of GIs in FTAs 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 Emliger and Latouche (2022) looks at the French agri-food sector and find that the protection of GIs in European RTA has a positive impact on trade. Although the vast literature on the GIs trade effects, limited attention has been however paid to investigating the trade consequences of obtaining a GI at disaggregated territorial levels, such as regions or local administrative units (De Filippis et al., 2022). Reisman (2022) is one of the few exceptions. By looking at the Spanish almond-based PGI turrón, 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 Santermano, 2023) or firm-level data (Bastos and Silva, 2010; Martin, 2012). 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 the more generic indication of sources, the so-called indication of source (UNIDO, 2010).¹⁰ They 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

¹⁰ 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, 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.

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., 2014). 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 acknowledged with GIs. This information has been collected from a more extended database in which we reconstructed the time and space variability of GIs at the municipality level for all of the EU since the '60s. 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 data for 1-24 of Harmonized System (HS) (source: Italian National Institute of Statistics, ISTAT) and on socio-economic contextual characteristics.¹¹ Our final database is a balanced panel of 8071 municipalities with 2859 involved in wine export in at least one year from 2004 to 2018.¹²

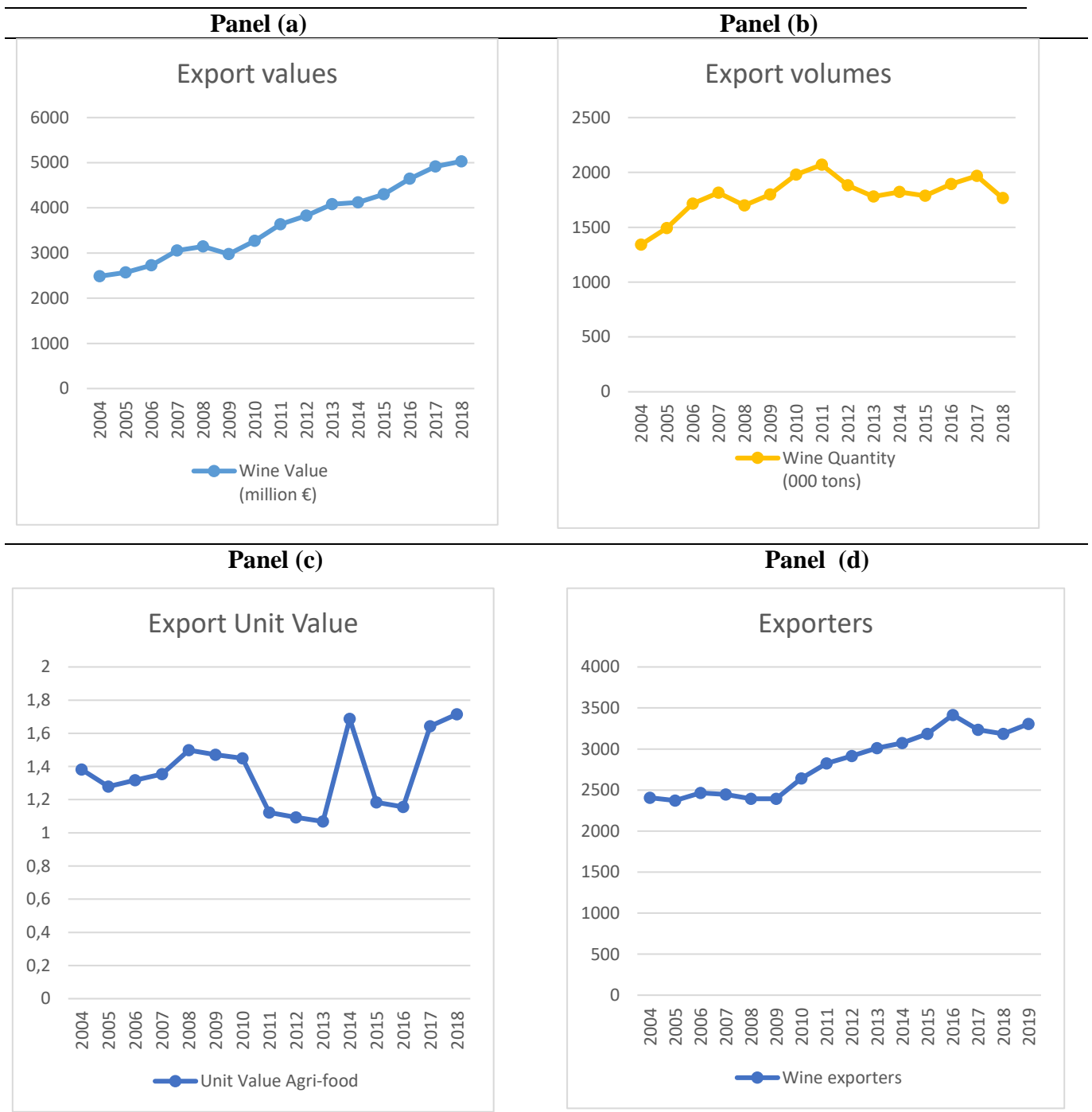
Over the years under analysis, the overall values and volumes of wine exported by Italian municipalities have increased, despite some fluctuating trends (Figure 1). All Italian regions are involved in the wine trade (Table A1), with some municipalities accounting for outstanding performances (Table A2). Between 2004 and 2018, around 6400 over 8071 municipalities registered a new PDO wine resulting in 72 per cent of Italian municipalities being acknowledged with at least one wine PDO (Figure 2). According to a preliminary mean comparison test, there is a significant difference in the wine export values between municipalities with and without PDOs.¹³

¹¹ The firm-level sample includes information for 11730 firms exporting agri-food products. To obtain information about in which municipality firms are located, we merge ISTAT trade database with the Italian statistical register of active enterprises (ASIA). ASIA reports the address of the head office of exporting 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), that are included in the trade dataset but not in the ASIA register. We exclude manufactured tobaccos.

¹² We exclude municipalities for which we cannot observe at least 1 year of pre- treatment period. For treated municipalities, we exclude from sample municipalities that have always been treated.

¹³ We perform *ttest* for the exports value of the entire wine sector including both GI and non-GI products.

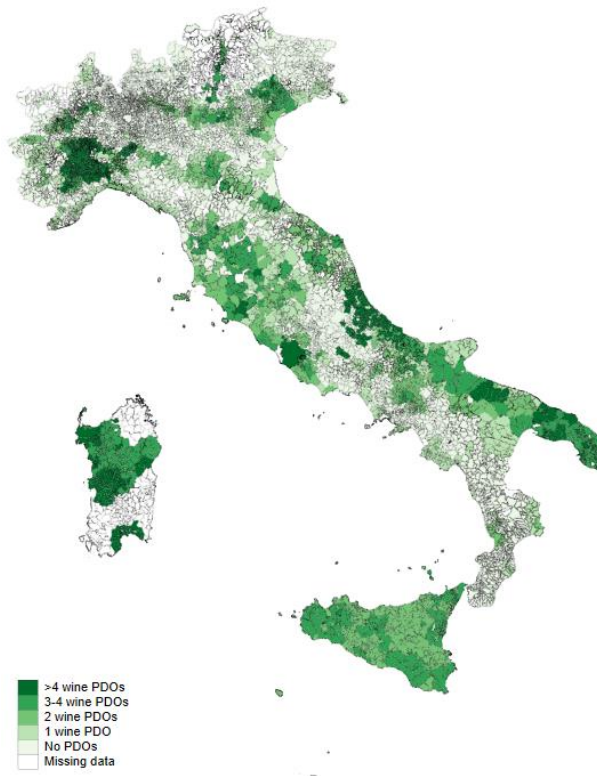
Figure 1: Wine exports and exporters trends



Notes: Authors' elaboration on data collected Italian National Institute of Statistics (ISTAT) data.

Figure 2: Maps of wine PDOs in Italy, 2018

Wine PDOs



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.

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 Propensity Score Matching (PSM) strategy to construct the control group for the treated units (Rosenbaum and Rubin, 1983).¹⁴

Thanks to the PSM, we identify 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 are ruled out. Table A3 reports the variables used for the PSM, which are measured in a pre-treatment period (10 years lagged). Table A4 and

¹⁴ We implement k-nearest neighbours matching (k = 10) one-to-one without replacement.

Figure A1, reporting the balancing after the PSM, confirm no significant differences observed between treated (PDO) and non-treated (non-PDO) matched observations (municipalities) that can be used as counterfactual.

For the sub-group of balanced municipalities (number), we estimate a two-periods (pre and post) Difference-in-Differences model comparing the export performance of municipalities with and without GIs before and after the acknowledgement (Bertrand et al., 2004) with clustered standard errors (Abadie et al., 2017):¹⁵

$$ExportPerformance_{i,t} = \alpha + \beta_1 GIs_{it} + \beta_2 Post_{it} + \beta_3 (Post_{it} * GIs_{it}) + GI_Controls_{it} + Contextual_Controls_{it} + \varepsilon_{it}$$

where i is the municipality, and t is the year of reference. *ExportPerformance* is measured by (1) the absolute value and volume of wine exports; (2) 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 absolute value and volume of agri-food exports.

GIs 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*GIs* is the interaction of the two variables being the key variable in the model. β_3 coefficient captures the impact of GI in year t in 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_{it}*). The Table A5 presents definitions and sources.

The model also includes NUTS3 dummies, pre-treatment trends in the outcomes, spatial lags to control for spatial endogeneity and covariates that remained unbalanced in the sub-group of municipalities identified by the Propensity Score analysis.

¹⁵ 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.

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 in running a model with 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 A6).

4. Results

Findings reported in Table 1 highlight a positive impact of GI on exports. The presence of GIs generates an increase of values by around 280% (column 1), 190% for volumes (column 2) and 41% in terms of unit values (column 3).

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 lowers ones to minimise fixed costs. The positive effect of GIs on trade unit value also 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, 2022; 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.

Table 1: GIs effects on wine trade performance: absolute values

	Export value (1)	Export volume (2)	Unit value (3)
PDO (treatment)	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	✓	✓	✓
Nuts3 dummies	✓	✓	✓
Pre-trends	✓	✓	✓
Unbalanced covariates	✓	✓	✓
Contextual controls	✓	✓	✓
Spatial lags	✓	✓	✓
Observations	7289	7289	7289
R2	0.55	0.57	0.30

Note: ***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. Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: a municipality-year varying variable accounting for mountain classification; a municipality-year varying variable accounting for employment rate; Spatial lags include: a municipality-year varying variable accounting for spatial lagged wine value and volume; a municipality-year dummy variable accounting for the spatial lagged presence of wine PDO. Clustered standard errors in parentheses (municipalities).

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)
PDO (treatment)	-0.006 (0.026)	0.009 (0.026)	-0.066*** (0.026)	-0.065*** (0.026)
Registration year	✓	✓	✓	✓
GI controls	✓	✓	✓	✓
Treated	✓	✓	✓	✓
Post	✓	✓	✓	✓
Nuts3 dummies	✓	✓	✓	✓
Pre-trends	✓	✓	✓	✓
Unbalanced covariates	✓	✓	✓	✓
Contextual controls	✓	✓	✓	✓
Spatial lags	✓	✓	✓	✓
Observations	7289	7289	7289	7289
R2	0.84	0.57	0.86	0.84

Note: ***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. Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: a municipality-year varying variable accounting for mountain classification; a municipality-year varying variable accounting for employment rate; Spatial lags include: a municipality-year varying variable accounting for spatial lagged wine value and volume; a municipality-year dummy variable accounting for the spatial lagged presence of wine PDO. Clustered standard errors in parentheses (municipalities).

Fristly, the increase in terms of export values and volumes leads us to questioning 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).

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)
PDO (treatment)	0.001 (0.021)	1.106*** (0.458)	0.805*** (0.404)
Registration year	✓	✓	✓
GI controls	✓	✓	✓
Treated	✓	✓	✓
Post	✓	✓	✓
Nuts3 dummies	✓	✓	✓
Pre-trends	✓	✓	✓
Unbalanced covariates	✓	✓	✓
Contextual controls	✓	✓	✓
Spatial lags	✓	✓	✓
Observations	7289	7289	7289
R2	0.86	0.47	0.49

Note: ***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. Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: a municipality-year varying variable accounting for mountain classification; a municipality-year varying variable accounting for employment rate; Spatial lags include: a municipality-year varying variable accounting for spatial lagged wine value and volume; a municipality-year dummy variable accounting for the spatial lagged presence of wine PDO. Clustered standard errors in parentheses (municipalities).

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 what extent these positive effects affect the overall trade patterns by focusing on the absolute values for the overall agri-food sector. Table 3 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 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.

Table 3: Estimation results for the agri-food sector

	Agri-food export value (1)	Agri-food export volume (2)	Agri-food unit value (3)
PDO (treatment)	1.180* (0.651)	1.197** (0.606)	0.086 (0.114)
PDO registration year	✓	✓	✓
GI controls	✓	✓	✓
Treated	✓	✓	✓
Post	✓	✓	✓
Nuts3 dummies	✓	✓	✓
Pre-trends	✓	✓	✓
Unbalanced covariates	✓	✓	✓
Contextual controls	✓	✓	✓
Spatial lags	✓	✓	✓
Observations	7289	7289	7289
R2	0.44	0.45	0.23

Note: ***p<0.01, **p<0.05, *p<0.1; Agri-food export value and volume (outcome variables) are expressed as log transformation. The unit value is the total value divided by the quantities and expressed as log transformation. Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: a municipality-year varying variable accounting for mountain classification; a municipality-year varying variable accounting for employment rate; Spatial lags include: a municipality-year varying variable accounting for spatial lagged wine value and volume; a municipality-year dummy variable accounting for the spatial lagged presence of wine PDO. Clustered standard errors in parentheses (municipalities).

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. (2017) 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 initiatives that, although mainly targeted to support the wine GI sector, involve 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 Eataly store in London to reproduce some seasonal traditional recipes to eat in conjunction with their wine. Another is the

“Grande Laghe” event yearly organised by the Consortium of Piedmont wines (Consorzio di Tutela Barolo Barbaresco Alba Langhe e Dogliani e dal Consorzio Tutela Roero) during wines are presented not only by both wine and food experts. The event is 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 A7).¹⁶

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 municipalities that have never been acknowledged as 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 A8).

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, (the ii) the rurality of the GI areas and (iii) the intra-EU vs extra-EU destination of the export.

5.1 Institutional context

¹⁶ Results are available upon request.

A solid institutional context is key for supporting socio-economic 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; Che et al., 2017; Rodríguez-Pose et al., 2022). Here, we want to check if GIs can compensate for the lack of/lower institutional quality by delivering positive impacts in terms of trade performance also in local areas characterized by low quality institutions (Crescenzi et al., 2022).

By splitting municipalities according to the quality of institutions, we find that the effect of GIs is more significant where the quality is lower (Table 4).¹⁷ This evidence suggests that GIs operate as a sort of informal institutional plumbers in support of international trade when formal 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 for specific GIs.¹⁸ 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.¹⁹ Among others, *Consortia* have the functions of safeguarding,

¹⁷ 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.

¹⁸ For the EU regulation, the establishment of a Consortium is not mandatory for certifying a GI.

¹⁹ 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

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, 2021).²⁰ 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 and mainly in municipalities belonging to regions with low-quality Institutions (Table 4).

The heterogeneity among territories with different levels of institutions could capture other structural differences, such as infrastructure endowments or the distance from international airports and ports, which could be relevant in the case of Italy given the structural differences and socio-economic disparities among the Northern and Southern areas. We have controlled all models for Nuts3 dummies to avoid possible bias on the estimation results. The estimation in sub-samples (Table A9) also confirmed that the effect is significant not only for the Southern regions, which are those that in Italy are mainly characterised by lower levels of institutions.

Table 4: 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
PDO (treatment)	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	✓	✓	✓	✓	✓	✓

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>.

²⁰ The study has been published by Qualivita, but conducted by Origin Italia, the Italian Organization for an International Geographical Indications Network.

Treated	✓	✓	✓	✓	✓	✓
Post	✓	✓	✓	✓	✓	✓
Nuts3 dummies	✓	✓	✓	✓	✓	✓
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

Note: ***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. Share of wine export value and volume are expressed as the rate on the total agri-food exports value and volume.

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

Clustered standard errors in parentheses (municipalities).

5.2 Rural vs non-rural areas

Here we want to investigate the impact of GIs changes for rural vs non-rural municipalities, testing whether rural areas struggle more to reach international markets.²¹

With this aim, we use the classification proposed by the Italian Rural Development Programme. Results unveil that the effects of GIs on export value, volumes and unit value are higher in rural than in non-rural municipalities (Table 5). As it was for the case of low-quality institutions areas, the GI scheme is more effective in those territories that needed 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.

Table 5: 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

²¹ Rete Rurale Nazionale, Zonizzazione delle aree rurali nel Psn. More information available at: <https://www.reterurale.it/areerurali>

PDO (treatment)	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	✓	✓	✓	✓	✓	✓
Nuts3 dummies	✓	✓	✓	✓	✓	✓
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

Note: ***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. Share of wine export value and volume are expressed as the rate on the total agri-food exports value and volume.

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

Clustered standard errors in parentheses (municipalities).

5.3 Intra-EU vs Extra-EU

Finally, we want to check if the scheme's impact differs when trading GIs toward EU destinations vs non-EU destinations. Hence, we replicate the main analysis by distinguishing the outcome variables for intra and extra-EU destinations. Results show that, in absolute terms, the magnitude of the increasing effects generated by GIs in extra-EU trade volumes and values are higher than in the case of intra-EU trade. Conversely, the impact in intra and extra-EU markets is similar in terms of unit value (Table 6).

While the increasing effect in terms of values can be mainly explained by the intangible value generated after the certification, the increasing effect in terms of extra-EU volumes confirms the fact that exporters could be more incentivised to export higher values products toward countries with lower favourable trade characteristics to reduce the fixed costs' effect, mainly generated by trade distances. In addition, GIs may resolve “*the market for lemons*” information asymmetry (Akerlof, 1970), affecting actors operating in very different regulatory and institutional backgrounds. Merel et al. (2021) identify welfare losses from asymmetric information by looking at the French wine industry. This

effect is particularly significant in extra-EU destinations, whereas in the case of the EU, trade is already facilitated by a more general institutional and cultural proximity. For example, Macedo et al. (2020) show that in Portugal Douro wine's marketability increases in more mature wine markets or countries speaking Portuguese.

Table 6: 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
PDO (treatment)	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

Note: ***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. Share of wine export value and volume are expressed as the rate on the total agri-food exports value and volume.

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

Clustered standard errors in parentheses (municipalities).

Conclusions

Over the years, GIs turn to be 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 at such disaggregated territorial level considering not only the specific sector under analysis, 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 when GIs are captured at the disaggregated level at which they are acknowledged. Results show a positive effect on wine exports due to the presence of a wine GI. At the same time, the acknowledgment 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 especially significant for extra-EU destinations, where the information asymmetries issue is more pronounced. 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 much higher for 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 is able to deliver positive effects on the export performances and that it is particularly effective in those cases that 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.

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Appendix

Table A1: Export value and quantity for wine sector, by region (mean 2004-2019)

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	1.139,2
Trentino-Alto Adige	435,8	189,9	1.870,7
Veneto	1.261,8	511,8	5.140,9
Friuli-Venezia Giulia	49,1	17,1	171,5
Liguria	8,8	1,2	12,1
Emilia-Romagna	323,9	371,5	3.714,7
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	3.746,3	1.795,6	17.748,6

Source: our Database on ISTAT data.

Table A2: 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

Notes: Authors elaboration on our Database on ISTAT data.

Table A3: Description and source of Propensity Score variables

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 centroid of each municipality and the city	Authors' elaboration– Geographical Information System
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	Agriculture National Census, ISTAT

Source: Authors' elaboration

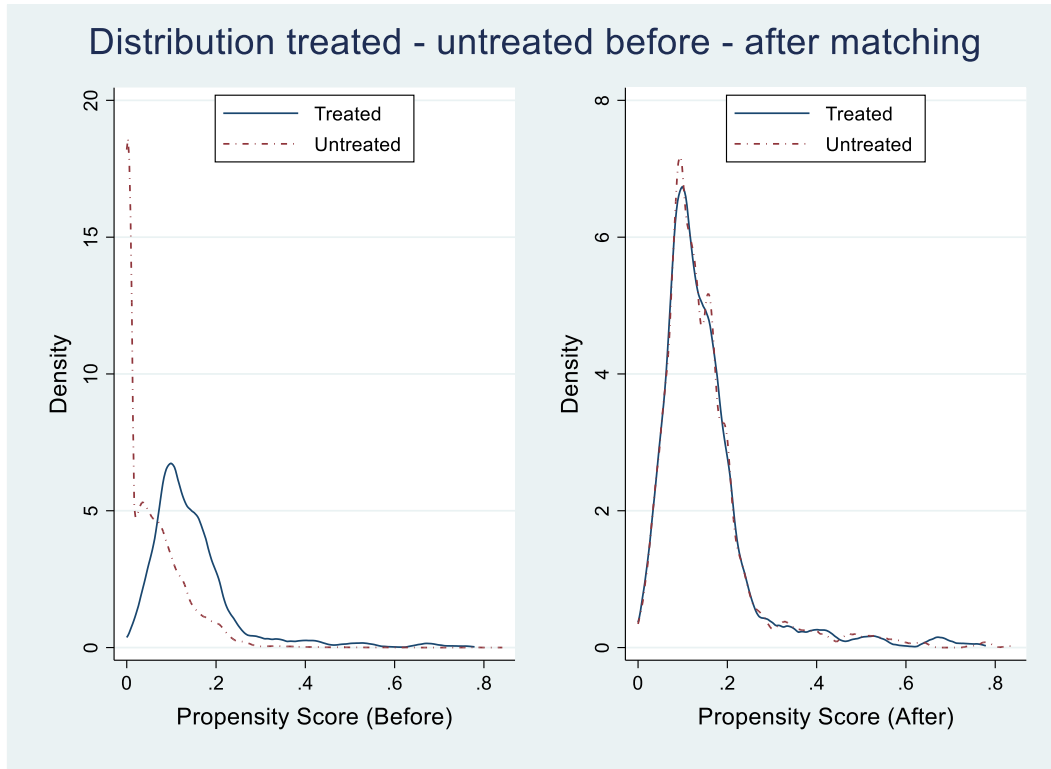
Table A4: Balancing test between treated and untreated municipalities after the PSM

	Mean		t-test	
	Treated	Control (matched)	t	p>t
Rurality	0.235	0.233	0.17	0.846
Elderly rate	189.13	189.35	0.41	0.671
Remote housing	19.86	19.26	1.39	0.166
High-education rate	27.20	27.10	0.62	0.533
Employment rate	45.73	46.07	-1.66	0.098*
Agricultural employment rate	7.49	7.30	1.08	0.279

Distance from major cities	3.85	3.85	0.50	0.616
Utilised Agricultural Area (UAA)	6.51	6.47	1.03	0.303

Note: ***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

Figure A1: Balancing graph before and after PSM



Source: Authors' elaboration

Table A5: Description and source of DiD controls

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 wine municipalities	Authors' elaboration from codes of practice
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

Source: Authors' elaboration

Table A6: Parallel trend estimations

	Export value (1)	Export volume (2)	Unit value (3)
Treated*t-1	-0.023 (0.160)	-0.007 (0.142)	-0.015 (0.037)
Treated*t-2	-0.066 (0.146)	-0.056 (0.129)	-0.008 (0.038)
Treated *t-3	0.158 (0.167)	0.109 (0.143)	0.065 (0.048)
Treated *t-4	0.271 (0.189)	0.220 (0.163)	0.067 (0.051)
Treated*t-5	0.500 (0.191)	0.403 (0.165)	0.123 (0.049)
Treated*t-6	0.116 (0.181)	0.077 (0.156)	0.038 (0.046)
Treated*t-7	0.011 (0.474)	-0.103 (0.383)	0.106 (0.143)
Treated*t-8	0.321 (0.473)	0.264 (0.417)	0.098 (0.118)
Treated*t-9	-0.081 (0.455)	0.454 (0.456)	0.062 (0.130)
Treated*t-10	-0.099 (0.414)	-0.123 (0.366)	0.021 (0.111)
Treated dummy	✓	✓	✓
Year dummies	✓	✓	✓
Observations	57725	57725	57725

Notes: 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 A7: 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

Note: ***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 A8: 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)
PDO (fake treatment)	-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	✓	✓	✓	✓	✓	✓	✓
Nuts3 dummies	✓	✓	✓	✓	✓	✓	✓
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

Note: ***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.

Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: a municipality-year varying variable accounting for mountain classification; a municipality-year varying variable accounting for employment rate; Spatial lags include: a municipality-year varying variable accounting for spatial lagged wine value and volume; a municipality-year dummy variable accounting for the spatial lagged presence of wine PDO. Clustered standard errors in parentheses (municipalities).

Table A9: The effects of wine GIs among macro-areas

	Export value (1)		
	North	Center	South
PDO (treatment)	0.954*** (0.424)	-0.011 (0.948)	0.682* (0.380)
Observations	5405	997	1782
R2	0.58	0.53	0.70

Export volume
(2)

	North	Center	South
PDO (treatment)	0.743** (0.373)	-0.015 (0.834)	0.384 (0.281)
Observations	5405	997	1782
R2	0.59	0.54	0.72
Unit value (3)			
	North	Center	South
PDO (treatment)	0.261*** (0.131)	0.009 (0.255)	0.375*** (0.150)
Observations	5405	997	1782
R2	0.288	0.34	0.43
Registration year	✓	✓	✓
GI controls	✓	✓	✓
Treated	✓	✓	✓
Post	✓	✓	✓
Nuts3 dummies	✓	✓	✓
Pre-trends	✓	✓	✓
Unbalanced covariates	✓	✓	✓
Contextual controls	✓	✓	✓
Spatial lags	✓	✓	✓

Note: ***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. Share of wine export value and volume are expressed as the rate on the total agri-food exports value and volume.

Pre-trends include pre-treatment of all the outcome variables; Unbalanced Covariates include: a municipality-year varying variable accounting for mountain classification; a municipality-year varying variable accounting for employment rate; Spatial lags include: a municipality-year varying variable accounting for spatial lagged wine value and volume; a municipality-year dummy variable accounting for the spatial lagged presence of wine PDO. Clustered standard errors in parentheses (municipalities).