Balancing the Spirit of Innovation and Love for Traditional in Agrifood Territories of Origin

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Abstract

The Geographical Indications (GIs) scheme implemented by the European Union ensures the safeguarding of exceptional traditional agri-food products that originate from specific demarcated regions. While this protection preserves the essence of tradition, it may also impede the adoption of innovative practices, which are considered crucial for bolstering competitiveness, sustainability, and resilience of the agri-food sector. The paper examines the influence of the GI scheme on innovation in the agrifood technological field at the territorial level by using Propensity Score and a dynamic staggered Difference-in-Differences model. The time dimension of such effect is therefore the main focus of this paper. The analysis is conducted at the Italian municipalities level over the 1999-2020 period and distinguishes between agricultural and food processing stages along the supply chain. Results show an overall positive effect, which is mainly driven by the agricultural technological field and the effects in the long run.

Keywords: Innovation, Patents, Economic Development, Geographical Indications

JEL Code: Q16; C23; Q55

1. Introduction

From the first monks observing grapevine cycles and adjusting their practices accordingly, to smart developments in fining and storage, science and innovation has always been the bedrock of winemaking. Innovations are considered crucial for bolstering competitiveness, sustainability, and resilience in the agri-food sectors and, nowadays, they are changing the world of winemaking. The EU Common Agricultural Policy (CAP) incentives and support the adoption of innovations recognising "*fostering knowledge and innovation*" as one of the ten key objectives of the 2023-2027 programming period.

However, at the same time, also "*improve the response of EU agriculture to societal demands on food and health, including high-quality […] food*" has been listed as a key objective. Over the last decade, producers and consumers have become more and more sensible to agri-food quality. As reported by Reg. (EU) No. 1151/2012., "*Citizens and consumers in the Union increasingly demand quality as well as traditional products. […]. This generates a demand for agricultural products or foodstuffs with identifiable specific characteristics, in particular those linked to their geographical origin".*[1]Alongside the focus on product attributes, there has been, in fact, a growing emphasis on the attributes of the process by which the product is made. In this context, the socio-cultural traditions of the geographical origin have been enhanced as key drivers of quality resulting in the establishment of the European Geographical Indications (GIs) quality scheme (Resce and Vaquero-Piñeiro, 2022). Nowadays, the Geographical Indication (GI) scheme is the main pillar of the EU quality policy for the agri-food sector. Its aim is to preserve the name of high-quality traditional productions - food, wine and spirits – whose production is essentially (Protected Geographical Indications - PGI) or exclusively (Protected Designation of Origin - PDO) linked to specific territories. The distinctive features of these products are the results of all the contextual environmental, human, historical characteristics, and cultural habits of their region of origin. Born in the early 30s in the French wine sector and followed in the 60s by the Italian national regulation for the wine sector, the GI scheme was officially expected to food products and to all the EU countries in the early 90s.[2] Literature demonstrated that the adoption of this scheme has generated higher positive socio-economic spill overs at the national and international level, in comparison to standardised agri-food productions (Crescenzi et al., 2023; Crescenzi et al., 2022; Cei et al., 2021 and 2018).

Looking at the two CAP objectives cited above, as well as the diffusion of the GI quality scheme as the key agri-food EU policy, a tricky question remains opened (FAO, 2018): how the traditional dimension of GIs can fit with innovation diffusion? As stated by Moerland (2019, p.1), in fact, "geographical indications and innovation do not seem to fit well together". Being a traditional knowledge-based activities, the "traditional" nature of GIs may limit the development of new products or the adoption of new technologies. At the same time, however, innovators can be attracted to a GI area to participate in producing agri-food products with a high-quality reputation that are managed by specific regulations, i.e., Product Specifications (PSs).[3] If on the one hand, PSs may limit

[1] REGULATION (EU) No 1151/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 November 2012 on quality schemes for agricultural products and foodstuffs. Quality can be defined as the sum of intrinsic and extrinsic, tangible, and intangible characteristics, both material and immaterial, of a product. The term "traditional" refers to the diffusion of a product on the national market for a period of time that allows knowledge to be passed down from one generation to another (at least 30 years, art.3, Reg (UE) N. 1151/2012).

[2] Regulation 2081/92, modified by Regulation 510/2006 and 1151/2012.

[3] Who want to acknowledge the products with the GI label must indeed follow the product specification specific for that product. This document reports, for each product included in the GI scheme, the detailed information on the types of productions, the year of GI acknowledgement, the territorial area of production plus other information on the production process, the technology allowed and the historical value. Even after the GI registration, PS might therefore require

the free access to innovation adoption, establishing some requirements through the PS may induce producers to innovate. For instance, if the PSs fixes more stringent environmental efficient requirements, actors could be more incentivised to innovate to fit this requirement. Ruitz et al. (2018) find that the amendment of PSs with the inclusion of new standards could be particularly relevant for the oldest GIs, whose code of practice has been written several years ago. From this standpoint therefore, GIs may be linked with innovation because, by aiming at offering more sustainable and efficient productions, they also ensure innovation demand to innovators. At the same time, investors may be attracted by the fertile socio-economic condition based on cooperation and territorial identity that over the years has been established within GI areas. Territorial identity expresses itself in common working experiences and cultural practices that require similar capabilities, skills and technologies (Capello, 2018).

Actors operating in GI territories are, in fact, used to cooperate due to the bottom-up nature of the GI system, the management organisation in Consortia and the coordination in economic activities (e.g., co-marketing).[4] The coordination that lies beyond the GI system management, therefore, might also improve cooperation in innovation. Firstly, existing literature demonstrates, in fact, that improvement in the organisation of economic activities through more coordinated forms of transactions, such as consortia or cooperatives (Russo et al., 2000; Stranieri et al., 2017) can foster flow of knowledge, R&D cooperation and innovation. Secondly, the structure on innovation activities in the EU is based on the Agricultural Knowledge and Innovation Systems (AKIS) which is characterized by the interaction of a huge number of different entities and governance levels (including Universities and Educational Institutions). Innovation processes have been developed thanks to the cross fertilisation of producers' networks, R&D activities and policy programmes (i.e., European Innovation Partnership for Agriculture).

In the literature, there is no clear evidence about which are the effects of GIs on innovation. Stranieri et al. (2023) is the first paper that attempts to empirically investigates this issue by looking at agri-food patent diffusion in EU regions. They conclude that the diffusion of GIs affects innovative activities, but the effect is mediated by the region's distance from the technological frontier: GIs slightly reduces innovation and growth in regions close to the technological frontier but spurs them on in laggard regions. However, they conduct the analysis at a quite huge territorial aggregations (NUTS2), limit it to agricultural and food manufacturing patents, without considering the patent registered in the wine and beer sector, and do not look at the time dimension of innovation. Against this background, it is still not fully clear whether GIs exert a significant impact on innovation, and whether and to what extent this impact depends on the stage of the agrifood supply chain as well as on the time passed from the registration. The relevance of distinguishing in which part of the supply-chain innovations are implemented has been recently stressed by Mancini et al. (2019). By discussing about the case of Parmigiano Reggiano PDO, they concluded that the adoption of innovation is related to the chain stages, organisations, and networks, which can mediate the diffusion of traditional

amendments to update the rules in response to external dynamics (e.g., socio-cultural trends, environmental crises). Amendments and updates of PSs can be proposed by Consortia or by a significant group of producers to be approved by the EC.

[4] The GI certification process is initiated by a group of producers (they should account for 2/3 of the production) and local actors that submit their expression of interest with a preliminary draft of the Product Specification to the Regional authority. In the case of a positive response, the application is sent to national authorities designed by Member States for scrutiny and, then, to the European Commission (EC). Even if it is not mandatory for the EU, the majority of GI are organised in Consortia which are involved in several different activities.

knowledge among producers. With this paper, we attempt to provide evidence on what is the impact of GIs on innovation in the agrifood technological fields.

To answer to the research question, this paper conducts the analysis at the municipality level over the 1999-2020 period in Italy by using a novel panel dataset from different sources of data. Methodologically, we implement Propensity Score Matching to clean the sample and Difference-in-Differences (DiD) models to estimate the impact. In particular, we use: (i) two-stages DiD to estimate the overall effect, (ii) dynamic DiD to estimate the time needed to become effective and (iii) staggered DiD to investigate the heterogeneity effect among municipalities with variation in treatment timing. The staggered version of the DiD model is the foremost approach to estimate the casual effect of multiple time period treatments that arrive at different points in time (Roth et al., 2023; Sun et al., 2021; Callaway and Sant'Anna, 2021).

Among GIs, we look at wine PDOs, which, following existing literature (Crescenzi et al., 2022), are the best empirical setting to test of the issue proposed in this study. Italy has the highest number of certified agri-food products (Qualivita, 2023), whose majority is wines PDOs. Among GIs, PDOs are the most linked to the region of origin, as they are the only ones for which the entire production process must be located within the region of origin. For instance, in the case of wine, this means that 100 per cent of grapes comes from that area. Wine PDOs are also the most routed in traditional know-how (Resce and Vaquero-Piñeiro, 2022). In addition, the wine sector it is also one of the most performant in terms of innovation and the Italian context accounts for an outstanding performance: more than 50% of wine technologies in wineries all over the world are Italian (Pomarici et al., 2021).

Results show that GIs generates an overall increase in innovation. Time however matters as, when we implement the dynamic model, we find that positive and significant impacts emerge after some years from the acknowledgement. In the short run, in fact, there is not a significant effect of GIs on innovation. The positive effect is mainly driven by the agricultural technological field.

This paper adds to the existing literature by providing the first estimation of the effects of GIs on innovation over time at a micro territorial level (municipality), considering the entire set of agri-food patents (including wine and beer sectors) and disentangling the heterogeneity of the effect along the supply chain (agriculture *vs* food processing). Methodologically, it is the first contribution that relies on quasi experimental techniques.

This paper contributes therefore firstly to the existing literature about GIs, which has followed a perspective of analysis that neglects the supply chain, the local territorial dimension and the time dynamics. Secondly, the paper contributes to the economic literature about innovation, which has never discussed about the potential impact of agri-food quality scheme. Lastly, we inform the current policy debate on the new Common Agricultural Policy (2023-2024 programming period) and on the future GI reform (scheduled for the next years) by providing a welcome basis for discussing how these two main conceptual pillars of the current agri-food policy interventions, tradition vs innovation, can be addressed together. Findings show, in fact, the relevance of supporting the innovation dynamics of the agri-food sector without losing local identity.

The rest of the paper is organised as follows. Section 2 frames the contextual background by referring to the existing literature. Section 3 presents the empirical setting with information on data, sample and methodology. Results are reported and discussed in Section 4, together with some robustness checks and heterogeneity analysis. Final remarks and some policy advice are provided in the Conclusion.

2. Literature and contextual background

2.1 Geographical Indications: between tradition and innovation

We are in the golden age of the GI quality scheme. Over the years, the objective of this scheme went beyond the preservation of high-quality productions and assumed a key role for supporting the competitiveness of the agri-food sector, especially in the Mediterranean countries which account for seven times more food GIs per capita than in other EU countries (Huysmans and Swinnen, 2019). In lead Italy, France and Spain, both in terms of numbers and revenues (EC, 2020). Italy is one of the pioneers of the wine GI scheme introducing the regulation already in the early ‘60s. Nowadays, Italy is the country with the highest number of GIs registered (Qualivita, 2023) whose more than 500 are wines.

Explanations for the increasing relevance of this policy scheme relate mainly to its socio-economic effects. First of all, GIs operate as (i) a vertical differentiation tool, generating premium pricing and higher added value for the certified productions and, at the same time, (ii) a strategic tool to reduce information asymmetry along the entire supply chain, between producers and consumers along the supply chain (Stranieri et al., 2017). The number of papers about the territorial socio-economic effects of GIs has constantly increased over the last decades. Several are the spill-overs effects that literature demonstrated to be linked with the spread of GIs across territories, such as population growth and employment rate (Crescenzi et al., 2022), sector added value (Cei et al., 2018), and tourism attractiveness (De Simone et al., 2023). Some preliminary studies have stressed the potential role of GIs in promoting more sustainable (Gocci and Luetge, 2011) and healthier (Galli et al., 2020) food systems, even if there is not a clear-cutting edge empirical evidence about that. At the global level, the term GI was introduced for the first time referring to the wine GIs in the WTO Agreement on Trade Related Aspects of IPRs (TRIPS) and afterwards in several bilateral and multilateral trade agreements.[5] Working as a sort of Non-Tariff Measure (NTM), GIs guarantee the protection from misleading competition and frauds resulting in a concrete leave for export and international activities (Curzi and Huysmans, 2022; De Filippis et al., 2022) and the attraction of FDI (Crescenzi et al., 2023).

A quite huge gap remains however in the GI literature that has not clear provided evidence to what extents the traditional knowledge-based orientation of GI production affects the innovation adoption. The existing papers about this issue mainly analysed it from a theoretical perspective, without providing empirical evidence. Josling (2006) and Kuhne and Gellynck (2009) introduced in their studies the idea the traditional culture of production of GIs may not fit well with innovation. The importance of striking a proper balance between innovation and traditional production methods (preserved by GIs) was also supported by the case study analysis conducted by Bowen and Zapata (2009) in the case of Mexican tequila, which is one of the extra-EU GIs included within the EU scheme. By using textual analysis and a focus group approach, Guerrere et al. (2009) demonstrated that, from the consumers’ point of view, the application of innovations may damage the traditional character of traditional food products but only in some cases. In the same line, Ruits et al. (2018) looked at the case of four GI cheeses and find that GIs’ traditional methods can, for these products, be effective to promote competitiveness if combined with innovation.[6] Looking at the non-agrifood Banarasi Sari production, Basole (2015) conclude that

[5] Art. (22.1) [GIs] identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin. (TRIPS Article 22.1).

[6] Pecorino Toscano DOP (Italy), Bitto DOP (Italy), Langres PDO (France), Reblochon PDO (France).

GI will discourage innovation and allow mal-distribution of value.[7] More recently, this argument has been recalled by Moereland (2019) that provide a detailed conceptual analysis about the capacity of GIs to foster, or rather to hamper, innovation, but also in this case there is not empirical evidence in support of the thesis discussed. In 2023, Stranieri et al. published the first contribution that investigates the extent to which the diffusion of GIs across EU regions affects technological innovation. They use data on the number of GIs and of agri-food patents in 265 EU regions over the period 1996–2014 and find that the adoption of innovation is supported by the presence of GIs only in those regions that are far from the technological frontier. These findings corroborate in part the controversial evidence provided by previous literature, even if only theoretically or by means of qualitative analysis. In Italy, literature and stylised facts stress that many obstacles exist for the adoption and diffusion of agrifood innovation due to the structural characteristics of the Italian sector, mainly composed by small and medium firms, and the traditional producer nature of this country (Santoro et al., 2017). In this context, the traditional dimension of GIs might be an additional obstacle to the diffusion of innovation. Accordingly, we formulated the first research question of this paper:

- does the diffusion of GIs spur, or conversely reduce, innovation in the agrifood technological field? (RQ1)

Several factors can however influence the choices of technological domain for innovation. In the agri-food sectors, innovators usually target domain not exclusively linked to the agricultural and food sector. The majority of registered patent has in fact more than one domain and are not exclusively linked to the agricultural activities. An illustrative example is the Ferrero group, that is the assignee of several patents related to cutting or slicing machines or devises adapted for baked articles or containers, packaging elements for contents presenting particular transport or storage problems (e.g., Kinder Surprise Egg).

In the wine and viticulture innovation, an example is the leader Italian company Vivai Cooperativi di Rausced, the largest firm in the world and leader in the diffusion of new rootstocks resistant to abiotic stress and of new hybrids resistant to powdery mildew and downy mildew. Italy has become the world leader alsoin eno-technologies and machinery. The 2023 Uiv-Vinitaly Wine Observatory's survey reports that the turnover of these activities' accounts for around 40% of the indirect made in Italy wine supply chain's turnover ("planting and nursery", 470 million euros, "protection and fertilisers", 800 million euros and "mechanization", 730 million euros).

In some cases, investors are explicitly linked with GI products. This is the case of *Consorzio of Parmigiano Reggiano DOP* that registered a patent for marking cheese with an agricultural technological field. [8]

Based on this line, we formulate the second research question:

- does the GI effect change among supply chain stages? (RQ2)

Lastly, the effect of formal regulations can be shaped by time the time dimension: how many years from the acknowledgement and the specific year in which observations participate to the treatment. In the second one we are therefore interested in studying the group-time average treatment effects (Callaway and Sant'Anna, 2021).

[7] Banarasi Sari is a hand-woven silk fabric with intricate woven embroidery worn by women.

[8] Ferrero: https://patents.google.com/patent/EP0814033A1/de?oq=EP19970109539; https://patents.google.com/patent/EP0968653A1/de?oq=EP19980111954. Consorzio Parmigiano Reggiano PDO: https://patents.google.com/patent/EP0685154A1/de?oq=EP19950201232

In the case of recent GIs, whose product specifications are presumably more innovation oriented in comparison with historical GI, farmers may need time to adapt their production process to the product specification requirements and create the cooperative framework that can attract and stimulate innovation spillovers. We therefore may capture the spillover innovation diffusion effect only after some years. In the case of historical GIs established several years ago, the supply chain organisation is well rooted in consolidate schemes and practices meaning that actors may be less prone to innovate.

To investigate this heterogeneity, we develop the following research questions to investigate whether time matters:

- is there a time and a cohort-specific average treatment effect?

3. **Empirical setting**

To compare the innovation performance of the Italian municipalities with and without GI productions, the paper uses a panel geo-referenced dataset and quasi-experimental models. The focus is the Italian wine PDOs. Italy is the first country for the number of GIs certified, and the wine sector is the leader of the GI economy for both number of GIs and their economic value. At the same time, the socio-cultural and informal factors have been demonstrated to be the most relevant for the probability of been certified as a GI (Resce and Vaquero-Piñeiro, 2022).

3.1 Data and sample

The analysis is conducted at the municipality level over the 1999-2020 period.

Data on GIs have been reconstructed at the municipality level starting from the Product Specification of each GI (source: eAmbrosia, European Commission) and following the rule of assignment of GIs. The so-called region of origin refers, in fact, to an area of specific neighbouring municipalities, which can be significantly smaller than administrative regions (NUTS2 – NUTS3) or countries (NUTS1). As far as GI treatment concerned, in this paper we consider only PDO wines.[9] This choice has been made for several reasons, associated to both the importance of the link with territories of PDO productions, the diffusion of this phenomenon in Italy, and the role of innovation in this sector. Among GIs, PDOs are the only ones that are completely processed within the region of origin and 100% of the grapes must come from the region.

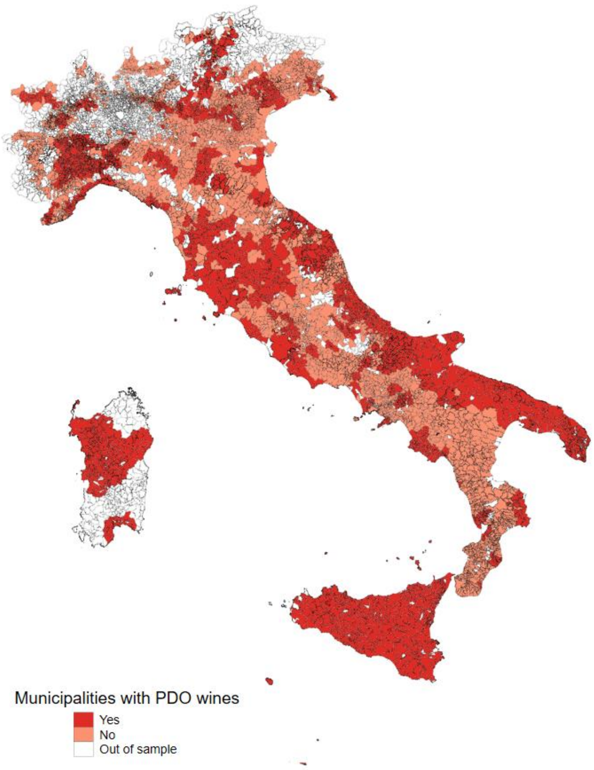
Data on innovation are patent data from REGPAT and OECD Patent Quality Dataset (Squicciarini et al., 2013). Among technological field we select those related to the agricultural sector as well as those related to foodstuffs (food processing), at which we add the beer and wine industry (Table A1, in the Appendix). The diffusion of these patent across municipalities is depicted by Figure 2 which, at least partially, suggests a preliminary relation with the geographical pattern of PDOs (Figure 1).

From the entire list of Italian municipalities (8071), we drop municipalities whose jurisdiction has been merged or divided during the period under analysis and for which data are unavailable remaining with 5645 municipalities. In 2020 in Italy, 3535 municipalities are involved in PDO production and 2691 have already a PDO in 1999 (Figure 1). The majority of them (1160) are

[9] PGI wines, PDO food and PGI food are used as control variables.

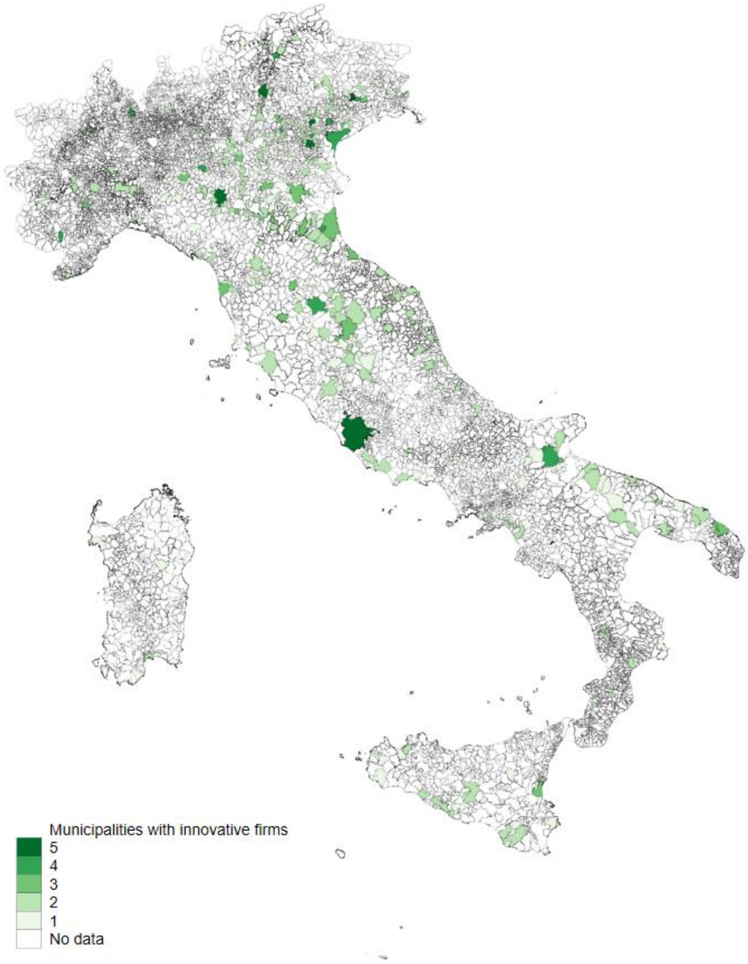
acknowledge by a unique PDO. Only 7 municipalities region account for the highest number of accreditations (11 PDO wines). Given that in our sample treated municipalities are those that are registered under PDO for the first time and at least once during the period under analysis, we eliminate those municipalities that have always been treated (with a PDO before than 1999). Our final database is a balanced panel of 2954 municipalities followed from 1999 to 2020. 297 of them are involved in innovation activities, among them 83 are PDO territories.

Figure 1: Municipalities with PDOs, 2020



Notes: Yes are municipalities with at least one wine PDO; No are those municipalities with no PDOs; Out of sample are those municipalities whose jurisdiction has been merged or divided during the period under analysis and for which data are unavailable.
Source: Authors elaboration from Product Specifications, eAmbrosia register

Figure 2: Municipalities with innovation activities, 2020



Notes: No data are those municipalities whose jurisdiction has been merged or divided during the period under analysis and for which data are unavailable.
Source: Authors elaboration from OECD dataset

3.2 Methodology: innovation probability

Methodologically, this study is the first one that proposes a quasi-experimental framework to investigate the effect of GIs on innovation. The paper adopts a Propensity Score Matching (PSM) to clean the sample and Difference in Differences models (DiD) to estimate the before-after treatment effect. As anticipated, the treatment is the condition of been acknowledged as a wine PDO during the period under analysis (binary variable).

Starting from the entire sample of 2954 municipalities, to isolate the causal impact of PDOs from other potentially confounding factors we implement *one to one k-nearest* PSM with replacement to construct the control group for the treated units (Rosenbaum and Rubin, 1983). The aim is to rule out any difference between PDO and non-PDO municipalities in terms of a set of observable characteristics related to the wine industry structure and the territorial characteristics that potentially affect the probability of being treated. Controls are considered at t-1 and the list is the following: population density, elderly rate, remote housing, high-education rate, employment rate, distance from major cities, Utilised Agricultural Area, winegrowing farms density, winegrowing farms' physical size, family farms, Utilised Agricultural Area diffusion, spatial lagged wine PDO, spatial lagged agri-food patent, altitude. After the PSM, the sample is composed by 796 treated municipalities. For the sub-group of matched municipalities, we firstly exploit the following two-periods DiD model:

$$Innovation_{it} = \alpha + \beta_1 Treated_{it} + \beta_2 Post_{it} + \beta_3 (Treated_{it} * Post_{it}) + Controls_{it} + \varepsilon_{it}$$

where i is the municipality and t is the pre-post period. $Treated$ is a dummy variable that takes value 1 if municipalities have been acknowledge with PDO status; *Post* is a dummy taking value 1 for the post-treatment period; the interaction term $Treated*Post$ captures the effect of the presence of a PDO wine *ceteris paribus*. As controls, we include a dummy variable accounting for the presence of PGI wines and PDO foods. Standard errors are clustered at the municipality level (Abadie et al., 2017).
Innovation is declined as the log transformation of a binary variable + 1 accounting for the probability of having at least one patent referring to:

(i) at least one agribusiness technological fields
(ii) at least one agricultural technological field
(iii) at least one food processing technological fields
(iv) only agricultural technological field
(v) only food processing technological field

In order to exploit the time variation, we run the following model specified in a panel setting with staggered treatment:

(2)

$$Innovation_{it} = \alpha + \beta_1 Treated_{it} + \beta_2 PSMweight_{it} + Controls_{it-1} + \gamma_i + \mu_t + \lambda_{it} + \varepsilon_{it}$$

where i is the municipality and t the year. Here *Treated* is a dummy variable that that takes the value of 1 from the year *t* in which the municipality *i* has acknowledged the status of PDO for one or more wines during the period under analysis. As controls, we include a dummy variable accounting for the presence of PGI wines, the PSM weights and NUTS3-year, year and NUTS3 fixed effects. Standard errors are clustered at the municipality level (Abadie et al., 2017). The outcome variable *Innovation* is declined with the same variables of model (1) and we estimate the model with 5 years pre and post period.

Preliminary Results

Overall, findings suggest that it is not true that "geographical indications and innovation do not seem to fit well together" (Moerland, 2019, p.1). Table 1 reports the results for two-stages DiD (model 1) and shows that GIs have a positive and significant effect on innovation diffusion. The only not significant effect is registered for "pure" agrifood innovations (column 4 and 5).

Given the potential polarisation of the distribution of innovations along the supply-chain, we conduct the analysis separately from agriculture and food processing patents. In this sense, investigating which are the stages of the supply chain mainly involved in the innovation adaptation become relevant, especially in terms of policy advice.

Table 1: The impact of GIs on innovation probability

	Agrifood (1)	Agricolture (2)	Food Processing (3)	Only Food Processing (4)	Only Agricolture (5)
Treated*Post	0.055***	0.022***	0.016***	-0.0028	-0.023
	(0.013)	(0.0074)	(0.0054)	(0.0026)	(0.022)
PDO (*Treated*)	Yes	Yes	Yes	Yes	Yes
Post	Yes	Yes	Yes	Yes	Yes
PGI wine	Yes	Yes	Yes	Yes	Yes
PDO food	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
Observations	3,427	3,427	3,427	3,427	3,427
R-squared	0.015	0.008	0.007	0.002	0.009

Note: ***p < .01, **p < .05, *p < .1. Clustered standard errors in parentheses (municipality)

Moving to the dynamic analysis Table 2 show that the positive effect of GIs on innovation diffusion appears after some years from the acknowledgment. In particular, we select to evaluate the effect looking at 5 years after given that it is the long time available for data constraints.

Table 2: The impact of GIs on innovation probability over the years

	Agrifood (1)	Agricolture (2)	Food Processing (3)	Only Food Processing (4)	Only Agricolture (5)
_D_F5	-0.00024	-0.00072	0.00056	0.0093	0.00022
	(0.0043)	(0.0029)	(0.00078)	(0.0066)	(0.032)
_D_F4	-0.026	-0.0066	-0.011	-0.012	0.021
	(0.016)	(0.0066)	(0.0091)	(0.0078)	(0.073)
_D_F3	0.0065	-0.0067	0.011	0.0081	-0.013
	(0.024)	(0.014)	(0.0092)	(0.0055)	(0.069)
_D_F2	0.0081	0.013	-0.0070	0.0042	0.066
	(0.020)	(0.013)	(0.0045)	(0.0044)	(0.047)
_D_F1	0.0061	0.0063	-0.0021	0.0030	-0.0068
	(0.014)	(0.0059)	(0.0069)	(0.0036)	(0.047)
PDO (Treated)	0.0093	-0.000043	0.0065	-0.0024	-0.025
	(0.015)	(0.0078)	(0.0064)	(0.0034)	(0.031)
_D_L1	-0.0042	-0.0059	0.0030	-0.030	-0.18
	(0.0085)	(0.0052)	(0.0028)	(0.022)	(0.15)
_D_L2	0.0056	0.0040	-0.00010	0.030	0.19
	(0.0078)	(0.0040)	(0.0037)	(0.022)	(0.15)
_D_L3	-0.00039	0.0027	-0.0029	-0.018	-0.12
	(0.0088)	(0.0049)	(0.0037)	(0.012)	(0.080)
_D_L4	-0.0093	-0.0048	-0.0017	0.018	0.10
	(0.0077)	(0.0041)	(0.0034)	(0.012)	(0.081)
_D_L5	0.012***	0.0046***	0.0036	-0.00021	-0.00063
	(0.0044)	(0.0015)	(0.0027)	(0.00034)	(0.0039)

PGI wine	Yes	Yes	Yes	Yes	Yes
PDO food	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
Observations	21,648	21,648	21,648	21,648	21,648
No. municipalities	984	984	984	984	984
R-squared	0.228	0.070	0.326	0.342	0.346

Note: ***p < .01, **p < .05, *p < .1. Clustered standard errors in parentheses (municipality)

Conclusions

Is there a spirit of innovation in Geographical Indications' territories? This paper says yes. Preliminary results show, in fact, that there is an overall positive effect of GIs on innovation diffusion, contradicting the idea that tradition and innovation cannot coexist.

We understand how the impact of certification may vary according to the different segments of the supply chain. While on average the impact of GIs is positive and significant for both agricultural and food processing patents (Table 1), when we look at the effects over time, the impact is significant only when patents refer to at least one agricultural technological field. However, in the case of pure patents the effect seems to be no longer significant.

Existing literature on the effect of GIs on innovation is scarce, and mainly limited to discussion papers and policy reports. With the exemption to Stranieri et al. (2023), this paper is the first one that directs the attention to this issue by looking at two previously unexplored research inquiries: firstly, the effect along the supply chain (agriculture vs food processing) and secondly, the extents to which this effect suffers from time variation and is contingent upon the cohort of municipalities (i.e., the year when they achieve the GI). In addition, this is the first paper that provide causal evidence by using quasi-experimental techniques.

The comprehensive findings offer valuable insights for addressing the issue of supporting innovation in the agrifood sector while preserving local historical productions.

Preliminary results will be complemented by the estimation of the cohort effects to account for the multiple time period policy with a variation in treatment timing nature of the policy. GIs are, in fact, registered in different years and the impact can be therefore mediated by the time in which observations participate to the treatment.

Appendix

Table A1: List of technological fields included in the sample

AGRICULTURE; FORESTRY; ANIMAL HUSBANDRY; HUNTING; TRAPPING; FISHING	
A01B	SOIL WORKING IN AGRICULTURE OR FORESTRY; PARTS, DETAILS, OR ACCESSORIES OF AGRICULTURAL MACHINES OR IMPLEMENTS, IN GENERAL
A01C	PLANTING; SOWING; FERTILISING
A01D	HARVESTING; MOWING
A01F	THRESHING (combines A01D 41/00); BALING OF STRAW, HAY OR THE LIKE; STATIONARY APPARATUS OR HAND TOOLS FOR FORMING OR BINDING STRAW, HAY OR THE LIKE INTO BUNDLES; CUTTING OF STRAW, HAY OR THE LIKE; STORING AGRICULTURAL OR HORTICULTURAL PRODUCE
A01G	HORTICULTURE; CULTIVATION OF VEGETABLES, FLOWERS, RICE, FRUIT, VINES, HOPS OR SEAWEED; FORESTRY; WATERING (picking of fruits, vegetables, hops or the like A01D 46/00; propagating unicellular algae C12N 1/12)
A01H	NEW PLANTS OR PROCESSES FOR OBTAINING THEM; PLANT REPRODUCTION BY TISSUE CULTURE TECHNIQUES [5]
A01J	MANUFACTURE OF DAIRY PRODUCTS (for chemical matters, see subclass A23C)
A01K	ANIMAL HUSBANDRY; AVICULTURE; APICULTURE; PISCICULTURE; FISHING; REARING OR BREEDING ANIMALS, NOT OTHERWISE PROVIDED FOR; NEW BREEDS OF ANIMALS
A01L	SHOEING OF ANIMALS
A01M	CATCHING, TRAPPING OR SCARING OF ANIMALS (appliances for catching swarms or drone-catching A01K 57/00; fishing A01K 69/00-A01K 97/00; biocides, pest repellants or attractants A01N); APPARATUS FOR THE DESTRUCTION OF NOXIOUS ANIMALS OR NOXIOUS PLANTS
A01N	PRESERVATION OF BODIES OF HUMANS OR ANIMALS OR PLANTS OR PARTS THEREOF (preservation of food or foodstuff A23); BIOCIDES, e.g. AS DISINFECTANTS, AS PESTICIDES OR AS HERBICIDES (preparations for medical, dental or toiletry purposes which kill or prevent the growth or proliferation of unwanted organisms A61K); PEST REPELLANTS OR ATTRACTANTS; PLANT GROWTH REGULATORS
A01P	BIOCIDAL, PEST REPELLANT, PEST ATTRACTANT OR PLANT GROWTH REGULATORY ACTIVITY OF CHEMICAL COMPOUNDS OR PREPARATIONS [2006.01]

FOODSTUFFS	
A21B	BAKERS' OVENS; MACHINES OR EQUIPMENT FOR BAKING (domestic baking equipment A47J 37/00; combustion apparatus F23; domestic stoves or ranges being wholly or partly ovens F24B, F24C)
A21C	MACHINES OR EQUIPMENT FOR MAKING OR PROCESSING DOUGHS; HANDLING BAKED ARTICLES MADE FROM DOUGH
A21D	TREATMENT, e.g. PRESERVATION, OF FLOUR OR DOUGH FOR BAKING, e.g. BY ADDITION OF MATERIALS; BAKING; BAKERY PRODUCTS; PRESERVATION THEREOF [2006.01]
A22B	SLAUGHTERING
A22C	PROCESSING MEAT, POULTRY, OR FISH (preserving A23B; obtaining protein compositions for foodstuffs A23J 1/00; fish, meat or poultry preparations A23L; disintegrating, e.g. chopping meat, B02C 18/00; preparation of proteins C07K 1/00)
A23B	PRESERVING, e.g. BY CANNING, MEAT, FISH, EGGS, FRUIT, VEGETABLES, EDIBLE SEEDS; CHEMICAL RIPENING OF FRUIT OR VEGETABLES; THE PRESERVED, RIPENED, OR CANNED PRODUCTS
A23C	DAIRY PRODUCTS, e.g. MILK, BUTTER OR CHEESE; MILK OR CHEESE SUBSTITUTES; MAKING THEREOF (obtaining protein compositions for foodstuffs A23J 1/00)
A23D	EDIBLE OILS OR FATS, e.g. MARGARINES, SHORTENINGS, COOKING OILS (obtaining, refining, preserving C11B, C11C; hydrogenation C11C 3/12)
A23F	COFFEE; TEA; THEIR SUBSTITUTES; MANUFACTURE, PREPARATION, OR INFUSION THEREOF
A23G	COCOA; COCOA PRODUCTS, e.g. CHOCOLATE; SUBSTITUTES FOR COCOA OR COCOA PRODUCTS; CONFECTIONERY; CHEWING GUM; ICE-CREAM; PREPARATION THEREOF [2006.01]

FOODSTUFFS	
A23J	PROTEIN COMPOSITIONS FOR FOODSTUFFS; WORKING-UP PROTEINS FOR FOODSTUFFS; PHOSPHATIDE COMPOSITIONS FOR FOODSTUFFS [4]
A23K	FEEDING-STUFFS SPECIALLY ADAPTED FOR ANIMALS; METHODS SPECIALLY ADAPTED FOR PRODUCTION THEREOF
A23L	FOODS, FOODSTUFFS, OR NON-ALCOHOLIC BEVERAGES, NOT COVERED BY SUBCLASSES A21D OR A23B-A23J; THEIR PREPARATION OR TREATMENT, e.g. COOKING, MODIFICATION OF NUTRITIVE QUALITIES, PHYSICAL TREATMENT (shaping or working, not fully covered by this subclass, A23P); PRESERVATION OF FOODS OR FOODSTUFFS, IN GENERAL [2006.01]

A23N	MACHINES OR APPARATUS FOR TREATING HARVESTED FRUIT, VEGETABLES, OR FLOWER BULBS IN BULK, NOT OTHERWISE PROVIDED FOR; PEELING VEGETABLES OR FRUIT IN BULK; APPARATUS FOR PREPARING ANIMAL FEEDING-STUFFS (machines for cutting straw or fodder A01F 29/00; disintegrating, e.g. shredding, B02C; severing, e.g. cutting, splitting, slicing, B26B, B26D)
A23P	SHAPING OR WORKING OF FOODSTUFFS, NOT FULLY COVERED BY A SINGLE OTHER SUBCLASS

CHEMISTRY – WINE and BEER	
C12C	BEER; PREPARATION OF BEER BY FERMENTATION (ageing or ripening by storing C12H 1/22; methods for reducing the alcohol content after fermentation C12H 3/00; methods for increasing the alcohol content after fermentation C12H 6/00; venting devices for casks, barrels or the like C12L 9/00); PREPARATION OF MALT FOR MAKING BEER; PREPARATION OF HOPS FOR MAKING BEER
C12F	RECOVERY OF BY-PRODUCTS OF FERMENTED SOLUTIONS (removal of yeast from wine or sparkling wine C12G 1/08); DENATURED ALCOHOL; PREPARATION THEREOF [6]
C12G	WINE; PREPARATION THEREOF; ALCOHOLIC BEVERAGES (beer C12C); PREPARATION OF ALCOHOLIC BEVERAGES NOT PROVIDED FOR IN SUBCLASSES C12C OR C12H
C12H	PASTEURISATION, STERILISATION, PRESERVATION, PURIFICATION, CLARIFICATION OR AGEING OF ALCOHOLIC BEVERAGES; METHODS FOR ALTERING THE ALCOHOL CONTENT OF FERMENTED SOLUTIONS OR ALCOHOLIC BEVERAGES (deacidification of wine C12G 1/10; preventing winestone precipitation C12G 1/12; simulation ageing by flavouring C12G 3/06) [6]
C12J	VINEGAR; PREPARATION OR PURIFICATION THEREOF

Table A2: Definition and sources of variables – PSM

Variable	Definition	Source
Outcome variables		
Agrifood patents	Number of patents that refer to at least one of the agrifood technological fields (see Table A1)	Authors' elaboration on REGPAT dataset

Agricultural patents	Number of patents that refer to at least one of the agricultural technological fields (see Table A1)	Authors' elaboration on REGPAT dataset
Food patents	Number of patents that refer to at least one of the food processing technological fields (see Table A1)	Authors' elaboration on REGPAT dataset
Agricultural patents - pure	Number of patents that refer to only agricultural technological fields (see Table A1)	Authors' elaboration on REGPAT dataset
Food patents - pure	Number of patents that refer to only food processing technological fields (see Table A1)	Authors' elaboration on REGPAT dataset

Control variables		
Population density	People km2	National Census, ISTAT
Elderly rate	Share of people aged 75 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
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
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	National Agricultural Census, ISTAT
Winegrowing farms density	Share of winegrowing farms	National Agricultural Census, ISTAT
Winegrowing farms' physical size	Utilized Agricultural Area for vines/number of farms specilised in winegrowing	National Agricultural Census, ISTAT
Family farms	Share of family employees	National Agricultural Census, ISTAT
Utilised Agricultural Area diffusion	UAA/municipality area	National Agricultural Census, ISTAT
Spatial lagged wine PDO	Dummy = 1 if the dummy PDO is = 1 in neighbourhood municipalities	Authors' elaboration from codes of practice
Spatial lagged agri-food patent	Dummy = 1 if the in neighbourhood municipalities there is at least one agrifood patent	Authors' elaboration from patent data
Altitude	Categorical variable classifying municipalities according to the level of altitude: low, moderate and high altitude	Italian National Institute of Statistics, ISTAT

Table A3: Descriptive statistics

Variable	Mean	Sd	Max	Min
Population density	260.58	581.63	3.5	15164.9
Elderly rate	178.09	120.49	14.7	2733.3
Remote housing	20.82	18.31	0	97.4
High-education rate	30.49	8.69	2.1	72.1
Employment rate	43.29	8.41	14.9	69.3
Distance from major cities	93933.88	52910.29	0	321224.2
Utilised Agricultural Area (UAA)	1623.48	2248.53	0	41421.88

Winegrowing farms density	2.91	4.26	0.004	69.29
Winegrowing farms' physical size	0.62	1.67	0.01	78.76
Family farms	0.87	0.14	0.016	1
Agricultural Utilised Area diffusion	43.35	28.93	0	295.51
Spatial lagged wine PDO	0.16	0.26	0	2.05
Spatial lagged agri-food patent	0.64	0.46	0	16.69
Altitude - 1	0.31	0.46	0	1
Altitude - 2	0.02	0.14	0	1
Altitude - 3	0.31	0.46	0	1
Altitude - 4	0.08	0.28	0	1
Altitude - 5	0.27	0.46	0	1