# IN SEARCH OF AGRI-FOOD QUALITY FOR WINE: IS IT ENOUGH TO JOIN A GEOGRAPHICAL INDICATION?[a]

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## ABSTRACT

This study examines whether geographical indications (GIs) truly enhance producer quality, which is a main regulatory justification for the GIs' existence. We compare the quality of wine producers with and without GIs and test for the effectiveness of GIs based on (i) the strictness of GIs' production standards and (ii) GIs' organizational characteristics as a collective brand. We argue that GIs encourage producer quality because they attenuate free-riding problems, provide incentives to invest and facilitate knowledge sharing. Focusing on the Spanish wine industry, the results reveal that except for wineries with the lowest GI category (*i.e.*, protected geographical indication), GI wineries show higher quality than non-GI wineries. We also observe that more stringent categories increase quality but at a decreasing rate. Regarding the influence of organizational features, we found that collective action problems seem to be relevant. First, above a certain threshold, the number of producers affiliated with a GI decreases the wine producer's average quality (*i.e.*, it shows an inverted U-shaped relationship with quality). Second, GIs covering very large geographic areas are found to be less effective.

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## 1. Introduction

Geographical indications (GIs) constitute a central tool of EU quality policies for the agri-food sector (Agostino and Trivieri, 2014; Josling, 2006). This aim is clearly and explicitly referred to by Article 1 of the European regulation on GIs: "The measures set out in this Regulation are intended to support agricultural and processing activities and the farming systems associated with *high quality products*, thereby contributing to the achievement of rural development policy objectives" (Regulation UE1151/2012, emphasis added).

Surprisingly, the economic and business literature has not studied whether GIs achieve their main objective, *i.e.,* to promote the production of high-quality products among firms. In other words, does belonging to a GI enhance the quality of the producers? This is not a trivial issue because guaranteeing the origin of a product does not necessarily guarantee high quality (Joslin, 2006). Nevertheless, this question has not often been the focus of research on GIs. Conversely, the economic debate about GIs has gone towards the appraisal of their collateral effects, focusing on their potential restrictive effects on international trade (*e.g.,* Frantz, 2016; Meloni and Swinnen, 2018) as non-tariff barriers that serve the protectionist interests of domestic agri-food industries (*e.g.,* Landi and Stefani, 2015). The GIs' stimulation of local development (Cei, Defrancesco and Stefani*,* 2018; Kneafsey *et al.,* 2013) and their role as efficient quality certification instruments capable of diminishing information asymmetries and promoting value and differentiation in agri-food markets have also been extensively studied (Adinolfi, De Rosa and Trabalzi, 2011; Moschini, Menapace and Pick 2008; Sorgho and Larue, 2014). However, from a theoretical perspective, the reduction of the information asymmetry between buyers and sellers justifies the signalling and trade-enhancing role of geographical brands but does not explain why and how the existence of a GI contributes to improving producer quality.

Empirically, the results of recent literature reviews are inconclusive, both among papers that study the role of agri-food quality standards (including GIs) in hampering trade and economic development (*e.g.,* Beghin, Maertens and Swinnen*,* 2015) and among studies that address their value creation and market differentiation (*e.g.,* Grunert and Aachmann, 2016). In particular, studies that analyse GIs as valuable signals of quality, for which consumers are willing to pay a premium (see Deselnicu, Costanigro, Souza-Monteirsbo and McFadden*,* 2013, and Leufkens, 2018 for a review), are not conclusive, with some authors reporting null or negative market values for GIs (Carbone, Cacchiarelli and Sabbatini*,* 2018; Hayes, Lence and Stoppa*,* 2004; Herrmann and Teuber, 2011). Moreover, the willingness to pay depends on a complex variety of factors other than quality (Oczkowski and Doucouliagos, 2015). Finally, although several studies have investigated the effects of GIs on producers' welfare (Moschini *et al.*, 2008) and different measures of firm performance, such as reputation (*e.g.,* Castriota and Delmastro, 2012), efficiency (*e.g.,* Sellers and Mas, 2015) or exports (*e.g.,* Agostino and Trivieri, 2014), these studies have not examined their effects on the producers' quality.

Consequently, this study addresses a key but still unanswered question, namely, whether GIs can promote quality in wine producers. In particular, the first aim of this study is to compare the quality of producers with and without GIs. Furthermore, since GIs differ both in their category (stringency) and in their organizational characteristics, as well as in their location and terroir features, we address two additional aspects. On the one hand, given that European (No 1308/2013) and national (*e.g.,* Spanish Ley 6/2015) regulations define different GI categories according to the stringency of their requirements, our second aim is to assess how these categories may influence quality. On the other hand, our third objective is to explore whether the effectiveness of GIs in improving quality varies with their structural and organizational dimensions (*e.g.,* number of producers and geographical extent).

To achieve these aims, this study draws on the literature on organizational economics (Dorobantu, Kaul and Zelner, 2017; Kim and Mahoney, 2005; Williamson, 2000) and collective reputation (Tirole, 1996; Winfree and McCluskey, 2005). Organizational economics has proven to be a particularly useful tool to explain the need for horizontal and vertical coordination in agribusiness (Bonanno, 2018; Ménard, 2018; Ménard and Valceschini, 2005) and, particularly, to explain the rationality of GIs as a public governance device for a collective brand name. In this sense, Fernández-Barcala, González-Díaz and Raynaud (2017) argue that since they are capable of solving coordination and incentive problems that might not be solved if private mechanisms work alone, GIs complement the private mechanism of governance along the supply chain. However, this case study paper does not empirically test its theoretical proposition and calls for further research on this topic. Relatedly, López-Bayón, González-Díaz, Solís-Rodríguez and Fernández-Barcala (2018) argue that GIs facilitate the exchange of knowledge among their members, acting as a broad knowledge transfer system capable of improving the quality of products and processes. Finally, the literature on collective reputation argues that GIs can also act as a shared reputation indicator, capable of amplifying the incentive of their members to invest in quality (Fishman, Finkelstein, Simhon and Yacouel, 2018).

The Spanish wine industry has been chosen as the empirical setting of the study because of the economic relevance and long tradition of GIs in this field. Wine alone accounts for 54% of all agro-food geographical indications registered in the EU (see e-Ambrosia and DOOR EU databases). Furthermore, Spain stands out as the country with the largest area of vineyards in the world and is the third-largest wine producer and GI wine marketer worldwide (OIV, 2019; Chever *et al.,* 2012).

The contribution of the study is threefold. First, to the best of our knowledge, this is the first work that evaluates the quality advantages that the membership in a GI generates for producers. Specifically, we focus on the average quality of the products marketed by GI

wineries versus non-GI wineries. This paper not only fills this gap but also sheds light on the substantial debate generated regarding the utility of GI regulation as an agricultural policy tool. Furthermore, once the GI has been adopted, we extend the appraisal of the differential impact of the GIs' categories on the producers' quality. Although some papers have studied the influence of GIs on firm performance, none of them considers the effects of the complete array of GI varieties. Castriota and Delmastro (2012) and López-Bayón *et al*. (2018) come close to addressing this issue, but they examine only the choice between two categories. Therefore, this study provides a more detailed view of the relative effectiveness of GI types by comparing all existing categories in the wine sector. This issue is important because the ability to influence producers' quality varies by the GI type.

Finally, from the organizational economics perspective, our work joins a small set of studies that emphasize GIs as quality governance mechanisms that shape incentives and coordination in agri-food supply chains (Fernández-Barcala *et al.,* 2017; López-Bayón *et al.,* 2018; Ménard and Klein, 2004; Ménard and Valceschini, 2005). We go a step further and determine whether the GIs' effectiveness is affected by several organizational and structural characteristics that may alter their ability to govern quality. In this sense, no empirical work has yet assessed the impact of such characteristics on the quality of producers. Only Sellers and Mas (2015) and Castriota and Delmastro (2014) consider some GI characteristics in the evaluation of GI effectiveness, but rather than focusing on a firm's quality performance, they focus on firm efficiency and the collective reputation of the geographical brand. In this regard, this study adds new insights into the factors that determine the success of GIs as effective mechanisms for quality governance.

The remainder of the paper is organized as follows. The next section presents the conceptual framework and research hypotheses. The following sections describe the research

design and the empirical results. The final section discusses the results and offers policy implications, limitations and topics for future research.

## 2. Theoretical foundation

### 2.1. Quality implications of GI membership

From an economic point of view, geographical brands, such as GIs, can be seen as common resources subject to free-riding problems (Arfini, Cozzi, Mancini, Ferrer and Gil, 2019; Ostrom, 2010; Winfree and McCluskey, 2005). Thus, the quality and reputation attributable to GIs depend not only on the unique and "exogenous" characteristics attributable to the terroir (*e.g.*, soil quality, climate, superior inputs) but also on how their mechanisms of governance attenuate the free-riding problems and foster investment efforts by their members (Fernández-Barcala *et al.,* 2017; Fishman, *et al.,* 2018)[1]. Specifically, since the production of higher quality products entails higher costs, GI members might have the incentive to take advantage of the collective reputation of the GI and sell low-quality products at the high prices achieved through the efforts of high-quality producers in the past. This free-riding problem is readily acknowledged by GI members, discouraging individual investments in quality and ultimately deteriorating the common reputation of the GI (Castriota and Delmastro, 2014). Therefore, the challenge for GIs is the preservation of the territorial link and traditional production methods while ensuring internal compliance with quality standards and quality development.

GIs consequently adopt governance and organizational devices that shape the incentives of their members to enhance GIs' effectiveness in promoting high quality. Specifically, GIs are organized as a collective decision-making body, the governing body, which implements several

[1] Note that in principle, GI product specifications by themselves ensure more traditional or original products (authenticity) but not necessarily the superior attributes (organoleptic, nutritional or commercial) of top-quality goods (Ponte, 2009).

devices to mitigate free-riding problems and promote quality enhancement (Fernández-Barcala *et al.,* 2017). The governing body sets the minimum quality standards (specifications) for all products sold under the geographical brand, makes membership decisions, and ensures compliance with the specifications[2]. The governing body also takes legal actions against any member who does not meet the quality specifications, with the possibility of exclusion in the case of serious infringements. The threat of exclusion acts as a credible penalty that imposes real economic losses on defaulters who, in the case of expulsion, may lose the value of their specific GI investments (Rokkan, Heide and Wathne*,* 2003) and the price premium added by the GI (Delsenicu *et al.,* 2013; Leufkens, 2018). Different authors agree that the introduction of these standards, with their corresponding control systems, helps coordinate the entire supply chain, reduce information asymmetries and avoid quality problems (Banterle and Stranieri, 2008; Ciliberti, Groot, de Haan and Pontrandolfo*,* 2009; Pilbeam, Álvarez and Wilson*,* 2012; Wever, Wognum, Trienekens and Omta*,* 2010).

GIs also stimulate technological upgrades in agri-food chains (Swinnen and Kuijpers, 2019) because GI members can make additional efforts to improve quality above the GI standards (*e.g*., by investing in more stringent quality controls) and by doing so, differentiate their products (private brands) within the GI (Dentoni, Menozzi and Capelli, 2012). Firms are interested in making such extra efforts because they are the residual claimants of their returns (*i.e*., they are expected to increase the price premium of their private brands). However, although these extra efforts initially improve only the quality and differentiation of the private

[2] In Spain, it is common for the competent administration (Ministry for Agriculture, Fisheries and Food or Governments of the Autonomous Communities) to delegate official certification and control tasks to the GI governing body (*i.e.,* to an internal and specific control body that is duly accredited and independent of its management body). Therefore, unlike how this delegation is carried out in other countries such as France (*e.g.,* Marie-Vivien *et al*., 2017), these tasks do not need to be performed by third parties (*i.e.,* external certification bodies).

brand, in the long run, they will also benefit the rest of the GI's producers in terms of both shared reputation and quality.

The distinctive shared reputation of collective brands is based on the average quality achieved by the group in the past (Castriota and Delmastro, 2014; Tirole, 1996; Winfree and McCluskey, 2005). It is therefore expected that quality improvements by a member may improve the perceptions of the entire GI's quality (Menapace and Moschini, 2012). Moreover, all the members of the GI can gradually adopt and benefit from the quality improvements achieved by individual producers. In this sense, GIs not only serve as a mechanism for supporting minimum quality standards but could also function as a broad knowledge-sharing network (*e.g.,* Dyer and Nobeoka, 2000; Heide, Kumar and Wathne, 2014; Powell, Koput and Smith-Doerr*,* 1996) able to create superior quality by efficiently identifying and combining the diversity of knowledge residing inside the GI (Denolf, Trienekens, Van Der Vorst and Omta*,* 2015; Lewis, Byrom and Grimmer*,* 2015; López-Bayón *et al.,* 2018; Sanz and Macías, 2005). This knowledge sharing is enabled through the governing body, which acts not only as a supervisory authority that aims to identify and avoid opportunistic behaviour but also as a third-party supply chain coordinator (Masten and Kim, 2015). Relatedly, GIs make it possible to introduce official amendments that facilitate the dissemination of knowledge and key technological improvements in the sector and even make them compulsory to all certified producers (Quiñones *et al.,* 2018). Moreover, functioning as a firm network, GIs can also facilitate scope and scale economies (*e.g.,* in promotional activities) that are capable of improving not only efficiency (Sellers and Más, 2015) but also quality by facilitating joint investment in new technologies and services that only the largest firms can afford individually (Sanz and Macías, 2005).

Finally, GIs can also facilitate the creation of a reputation effect that is capable of improving quality by increasing the individual incentives of the GI members to invest in quality

(Sellers and Más, 2015; Fishman *et al.,* 2018). While many GIs have a common reputation that is widely recognized in the market, buyers are often much less informed about the individual reputation and past performance of many of their members (especially if the members are numerous and small relative to the industry). Thus, compared to the private reputation of (small) independent firms with limited market presence, the GI brand can provide its individual members with greater reputational capital that is capable of increasing their visibility and the likelihood of a good return on their investments. Ultimately, the likelihood of higher returns will provide companies with a greater incentive to invest in maintaining and improving quality. As a result, collective brands are expected to lead to higher quality than that achievable by individual members operating in isolation (*i.e.,* without a collective brand) in the market.

Overall, given the advantages of GIs in avoiding free-riding while incentivizing investments in quality and the development of technological and commercial knowledge among their members, we expect higher quality levels among GI wineries than among non-GI producers:

*H1. The quality of wine of GI producers will be higher than that of non-GI producers.*

### 2.2. The effectiveness of GIs in supporting high quality

The effectiveness of GIs in supporting high quality can vary considerably from one to another; therefore, there is a need to examine the determinants of such effectiveness. First, we focus on the standardization function of GIs and their quality standards as key drivers of their ability to enhance the producers' quality (Castriota and Delmastro, 2014; Winfree and McCluskey, 2005).

European Regulation (EU) No 1308/2013 identifies different types of GI schemes based on the stringency and complexity of their quality standards. The regulation defines two categories for the wine sector: the least demanding, protected geographical indications (PGI),

and the most demanding, protected designations of origin (PDO). Compared with PGIs, PDOs are characterized by stronger traceability, stronger connections to the region of origin and less freedom in production rules and in the blending of grape varieties (Deselnicu *et al.,* 2013; Cacchiarelli, Carbone, Laureti and Sorrentino*,* 2016). Within each GI category, country-specific laws may differentiate further levels. Thus, the three worldwide wine production leaders, Italy, France, and Spain (OIV, 2019), have added extra GI levels to the general European scheme. Specifically, the Spanish regulation distinguishes among five categories that differ with regard to the strictness of their accreditation and their monitoring processes. From the lowest to the highest level of stringency, these five categories are Regional Wine, Quality Wine, Designation of Origin, Qualified Designation of Origin, and Single-Estate Wine (see Table 1 for their correspondence with the PDO/PGI European levels).

**----------TABLE 1----------**

Based on those typologies, previous research has revealed that most stringent GIs may entail higher investments and production costs to meet their quality standards (*e.g.,* Belletti, Burgassi, Marescotti and Scaramuzzi*,* 2007; Bouamra-Mechemache and Chaanban, 2010). Additionally, more restrictive technical and production rules could undermine the innovation and strategic flexibility of firms belonging to the most demanding GIs[3]. However, in exchange, higher-tier GIs may be effective tools to strengthen the link between quality production and territory and to leverage the GI value (Costanigro, Scozzafava and Casini*,* 2019; Scozzafava, Gerini, Dominici, Contini and Casini*,* 2018). Stricter standards can drive greater variance

[3] For example, in the wine sector, non-GI producers could take advantage of their greater flexibility in terms of grape varieties and agricultural and oenological restrictions, to better adapt to changes in technology, competition or consumer preferences (Cacchiarelli *et al.,* 2016).

reduction (in agricultural and industrial practices) and increased process control, which not only reinforces the image of a more reliable and unique product (Cacchiarelli *et al.,* 2016; Castriota and Delmastro, 2014; Deselnicu *et al.,* 2013; Leufkens*,* 2018) but also enhances coordination and knowledge sharing throughout the supply chain, reinforcing the GI role as a quality enhancer (López-Bayón *et al*., 2018). Therefore,

*H2. Belonging to a more demanding GI category is positively related to the producers' quality performance.*

The effect of belonging to a GI on the producers' quality lies not only in the introduction of minimum quality standards but also in the enforcing of these standards. These standards would be useless if supply chain members did not respect them. Therefore, the success of the GI in promoting quality among producers critically depends on the effectiveness of its certification, supervision and knowledge management functions. In this sense, the organizational and structural characteristics of the GI (such as group size and geographical extension) have been identified as the main determinants of internal conflicts and relative GI effectiveness in governing quality (Castriota and Delmastro, 2014; Fishman *et al.,* 2018; Saak, 2012).

First, group size has been identified as one of the most important organizational attributes influencing collective performance. Apart from its examination in the GI literature (Castriota and Delmastro 2014; Fishman *et al.*, 2018; Sellers and Mas, 2015), group size has been considered extensively in the provision of public goods (Olson, 1965, Isaac and Walker, 1988) and in umbrella branding such as franchising (Shane, 2001). Applying these arguments to GIs, the relationship between the GIs' size and the producers' quality is likely non-linear because of the existence of opposing effects.

On the one hand, GI size, which reflects the number of producers, can increase free-riding problems with regard to quality. The argument is that producers in collective brands with many participants may be less willing to cooperate in improving the quality of products than producers in small groups because producers in these large groups see less individual benefit from such a cooperation (Olson, 1965). The reason might be twofold. First, the public goods literature suggests that because individual contributions to large groups can be very small, producers in large groups are much less worried about contributing than are producers in small groups, where individual contributions are more relevant and visible (Isaac and Walker, 1988). Second, the literature on franchising suggests that as brands with many participants tend to be more visible and valuable, the individual incentives for free-riding are also greater (Shane, 2001). Moreover, collective brand and reputation models (*e.g.,* Winfree and McCluskey 2005, Castriota and Delmastro 2014, Fishman *et al.,* 2018) predict that internal conflicts increase with group size, at least up to a threshold. On the other hand, the incorporation of additional producers into associations facilitates the accumulation and development of resources to overcome the technological and commercial constraints experienced by less prominent producers. Additionally, an increase in size broadens the buyer base, improves brand visibility and incentivizes higher investments in quality (Castriota and Delmastro 2014; Fishman *et al.*, 2018; Sellers and Mas, 2015).

Therefore, there are two conflicting forces that lead to an inverted U-shaped relationship between GI size (producers) and the quality efforts of producers. The optimal size should be large enough to facilitate resource accumulation and the attainment of enough visibility but small enough to deter free-riding. If GIs become too large, free-rider incentives could override the GIs' advantages and damage quality to the point that consumers again rely more on private brands as credible signs of quality. On this basis, we pose the following hypothesis:

*H3a. The number of GI producers has a non-linear (inverted U-shaped) relationship with the producers' quality.*

A second antecedent of the effectiveness of a GI is the geographical area to be controlled. A traditional argument in franchising, where the franchisor has to control the behaviour of many scattered franchisees, is that monitoring costs are directly related with the distance or with the size of the area to control (Lafontaine, 1992). In this same vein, the monitoring costs of the GI will probably increase with the size of the area; this can lead to a less effective control of the standards and could end up making the GI less effective. Furthermore, in the particular case of the wine industry, due to the emergence of differences in the "terroir" and the loss of "authenticity" associated with an oversized area, the expansion of the GI area can also negatively affect quality (Deconinck and Swinnen, 2014). Moreover, increased extension and land differences cause increased heterogeneity among producers, which in turn results in higher supervision costs and more disputes. In this line, Yu, Bouamra and Zago (2017) argue that in addition to group size, heterogeneity has a role in explaining internal conflicts. For instance, a heterogeneous group in which both high- and low-quality producers coexist might be more conflict-prone than a numerous but homogeneous group. For high-quality producers in a heterogeneous group, a collective brand (with a modest reputation) could become unprofitable; thus, these producers would prefer to invest in promoting their private brands[4]. This result could lead to excessive differentiation and fragmentation within the GI, which ultimately would damage the information and the quality advantages associated with the collective brand. In this regard, we expect that the extension of the GI (geographic area) will increase the heterogeneity of the terroir and the GI members and, thus, its level of internal conflict. Accordingly, the following is expected:

[4] In particular, this will happen when high-quality producers lack the necessary bargaining power to translate their high-quality standards into GI specifications.

*H3b. The geographic area of the GI is negatively related to the quality performance of its producers.*

## 3. Research design

### 3.1. Data collection and sample

The empirical setting of the study is the Spanish wine industry because of the special relevance of GIs in this sector. The first GIs were for wines (Meloni and Swinnen, 2018), and wine is the most common product protected by a GI (Bonn, Cho and Um, 2018). Furthermore, we focus on Spain because it has the greatest land area of vineyards in the EU and is the third-largest worldwide producer of wine (OIV, 2019). We combined four datasets to test our hypotheses. The main data source was a Spanish professional wine guide, Peñín Spanish Wine Guide (Peñín, 2015), which provides the most comprehensive list of the wineries that produce bottled wine in Spain. The guide offers general data about the wineries, their associated GIs, and annual information regarding the professional quality scores of their wines. The second dataset comes from Alimarket, the main generator of sectorial economic information in Spain, which provides information about wine sector companies, such as hectares of vineyards held and storage capacity. The third dataset comes from SABI, a product of Bureau van Dijk, which contains comprehensive information about companies (wineries included) in Spain. We used this dataset to obtain information about the firms, such as their legal form and age. The wineries' websites and specialized wine websites were also used to complete the Alimarket and SABI information. Finally, the official statistical data on wine GIs available on the Spanish Ministry for Agriculture, Fisheries and Food website were used to collect information about the GIs' organizational and structural characteristics.

By combining all these datasets, we obtained 805 complete observations of GI (740) and non-GI (65) wineries. This result represents 20% of the total population (4,025 wineries in

2015 according to MAPA, 2018a). We departed from the 2,489 Spanish wineries contained in the 2015 Peñín Spanish Wine Guide, but we had to rule out many observations because we could not complete them with our datasets.

We compared the main structural variables available in the Spanish official statistics for the wine industry between the population and our sample of wineries to demonstrate its representativeness and the absence of relevant bias. First, Table 2 compares the distribution of the legal form of the wine firms between the population and the sample. There are no substantial differences except for sole proprietors, which are underrepresented. However, the economic relevance of this group is small, and they are frequently very small wineries that go unnoticed by professional wine guides and databases. Second, when comparing the sample and the population by type of GI (Table 3), the weight of each GI category is also similar in the sample and in the population. Note that although there are no available data for non-GI wineries because they are not officially listed in any specific open-access register, we can obtain some indirect references. On the one hand, we know that according to MAPA (2018b), the extent of vineyards devoted to non-GI wine was 4.4% of the total extent of Spanish vineyards. However, the fact that only 4.4% of the vineyards are not linked to any GI does not guarantee that more non-GI wine can be produced, particularly in bulk. Many grape growers join a GI to have the right—but not the obligation—to sell to GI wineries, which is always an advantage because it broadens the range of potential buyers. However, part of that grape initially qualified as GI could end up being processed by non-GI wineries, which would reflect a real greater weight of the non-GI grapes. On the other hand, using the Peñín Spanish Wine Guide as source, the weight in our sample of non-GI wineries is 8.1% (see Table 5), with a total of 65 observations. This guide is purported to be the most exhaustive guide on Spanish wineries, and, in fact, no other source has more information regarding wines in Spain

**----------TABLE 2----------**

**----------TABLE 3----------**

### 3.2. Variables and measures

*Dependent variable*

The assessment of wine quality was obtained from the Peñín Spanish Wine Guide, which uses a 50- to 100-point scale. These wine ratings range from "unacceptable" (those nearer to 50) to "extraordinary" (those closer to 100). This type of information is frequently used in the literature to rate quality (*e.g.,* Benjamin and Podolny, 1999; Cacchiarelli *et al.,* 2016; Castriota and Delmastro, 2012; Costanigro, McCluskey and Goemans, 2010; Frick, 2004; Landon and Smith, 1998; López-Bayón *et al.,* 2018; Pennerstorfer and Weiss, 2013; Schamel and Anderson, 2003; Scott-Morton and Podolny, 2002). The advantage of this type of information is that professional guides employ experts to rate wines and force them to follow highly systematized procedures and rigorous standards of evaluation. As a result, these ratings show high convergent validity across independent evaluations. Following the methodology of other empirical papers, López-Bayón *et al*. (2018, p.5) checked the reliability of the Peñín Spanish Wine Guide by comparing the correlation of scores for a set of wines with those published by The Wine Advocate (by Robert Parker), which is perhaps the most famous wine guide at the international level. The authors report that both rankings are reasonably correlated and seem to agree in their scores.

We define the dependent variable, *Quality*, as the average quality ratings of all the wines reported for each winery. Table 4 provides the definition of the variables used in the model. The descriptive statistics for all the variables are shown in Table 5, and their correlations are in Table 6.

**----------TABLE 4----------**

**----------TABLE 5----------**

**----------TABLE 6----------**

*Independent variables*

We implemented two different variables to measure the adoption of a GI: *GI* and *GI category*. The first reflects whether the winery belongs to a GI; it takes the value of "0" if the winery is non-GI and "1" otherwise. Furthermore, the Spanish regulation is more detailed than the European regulation and contains five GI levels based on GI requirements or stringency (see Table 1). Accordingly, the second independent variable referred to, *GI category*, takes the following values: "0" if the winery is non-GI; "1" for a PGI; "2" for a PDO (including the Spanish traditional terms "Quality Wine" and "Designation of Origin"); "3" for a Qualified Designation of Origin (QDOs); and "4" for a Single-Estate Wine (SEW). Additionally, we used two GI-related variables to test Hypothesis 3. *Participants* indicate the number of wineries in each GI, and *Area* measures the geographical extent of the GI in hectares.

*Control variables*

We use four other independent variables to control for different effects. *Legal* is a categorical variable that takes the value of "0" if the winery's owner is an investor-owned firm, "1" if the winery belongs to a cooperative, and "2" when the owner is a sole proprietor. The economic literature has argued that the lack of ownership specialization and the governance principles of agricultural cooperatives increase their vulnerability to collective action problems (*e.g.,* Cook, 1995; Fulton, 1995; Nilsson, Svendsen and Svendsen, 2012; Rey and Tirole, 2007) that are capable of hindering quality investments and quality performance (*e.g.,* Castriota and Delmastro, 2012; López-Bayón *et al*., 2018; Pennerstorfer and Weiss, 2013; Saitone and Sexton, 2009). Similarly, capital constraints and the lack of the small sole-proprietors'

ownership specialization (Fama and Jensen 1985, 1983a, b; Quazi and Padibjo, 1998) could also act as obstacles to the implementation of effective quality management practices.

*Producer size* is controlled through the amount of wine produced by the winery per year (in millions of litres). Several studies on the wine sector propose a positive correlation between small businesses and their orientation towards high-quality production. In particular, they suggest that small wineries tend to specialize more in high-end exclusive and expensive wines in order to compete with larger and more efficient producers (*e.g.,* Oczkowski, 1994; Scott-Morton and Podolny, 2002). The variable *Experience* indicates the number of years since the winery's foundation. The producers' age not only favours the consumers' learning about the company (and so its reputation building) (*e.g.*, Castriota and Delmastro, 2012) but also promotes experimental-learning and knowledge accumulation within firms capable of improving their performance (*e.g.,* Argote, 1999). In this regard, both general previous studies on quality management (*e.g.,* Zhang, Linderman and Schroeder, 2012) and those focused on the wine industry (*e.g.*, López-Bayón *et al.*, 2018) have observed significant relationships between the producers' experience and their quality performance. We also expect a non-linear effect of the *Experience* variable, reflecting that it takes time to achieve significant knowledge accumulation and experimental-learning. Therefore, we introduced in the model a squared term ($Experience^2$) along with its linear effect. Finally, belonging to a wine corporate group could facilitate access to resources and capabilities that are difficult to access for small or inexperienced producers operating independently. To control for this possibility, we use *Winery group,* a categorical variable that takes the value of "0" if the winery does not belong to a winery group and "1" otherwise.

## 4. Analysis and results

### 4.1. Description of the model

We tested the first two hypotheses by using a regression model of the form

$$Quality_i = \beta_0 + \beta_1 GI_i + \beta_2 Legal_i + \beta_3 Producer\ size_i + \beta_4 Experience_i + \beta_5 Experience_i^2 + \beta_6 Winery\ group_i + \varepsilon_i. \quad [1]$$

where $\beta_m$ are the estimates for "m" independent variables and $\mu_i$ is a random error. We used two different definitions for the variable *GI* in [1]. First, we used the variable *GI,* which is a dummy that takes a value of 0 for non-GI wineries and 1 otherwise, regardless of the category of the GI adopted. This variable directly tests Hypothesis 1. Second, we re-estimate [1] considering *GI category* instead of *GI*. The variable *GI category* is a categorical variable that takes different values based on the GI types (Table 4). The results are shown in Table 7. Furthermore, to better test the second hypothesis, we re-estimate the model [1] by changing the reference category of *GI category*. Table 8 shows these results. Finally, because testing Hypotheses 3a and 3b requires the consideration of different GI features, we introduced two GI variables in [1], which is the model:

$$Quality_i = \beta_0 + \beta_1 GIcategory_i + \beta_2 Legal_i + \beta_3 Producer\ size_i + \beta_4 Experience_i + \beta_5 Experience_i^2 + \beta_6 Winery\ group_i + \beta_7 Participants_j + \beta_8 Participants_j^2 + \beta_9 Area_j + \varepsilon_i, \quad [2]$$

where $\varepsilon_i$ is again a random error term and the subscript "j" refers to the specific GI to which the producer belongs (we have 81 different GIs). The results are shown in Table 9.

An important issue related to the above equation is the possible endogeneity of the decision to belong to a GI. Wineries cannot decide *ex ante* the level of stringency of their GIs. The geographical location of wineries determines the specific GI with which they can associate

and the strictness of that GI is a structural (exogenous) characteristic that cannot be changed by the winery. However, provided that a winery is located in a geographical area with a GI—which is not always the case—the producer can choose between meeting its standards (certifying its wines) or producing a non-GI wine[5]. This situation could lead to a potential sample selection bias because this organizational decision (joining a GI) might be endogenous to its expected performance outcome (expected quality) (Hamilton and Nickerson, 2003). If such choices are made systematically and not randomly, standard ordinary least squares estimates could lead to biased coefficients. To address this potential problem, we used a two-step correction procedure based on Heckman (1979). Our results indicate that the bias selection is statistically insignificant and that Heckman's correction is not appropriate for our data. Actually, our estimations do not change when applying the correction for endogeneity[6].

### 4.2. Results

Table 7 shows the results of regressing *Quality* on a first set of independent variables. The Model Ia shows the results of the basic model when considering the independent variable *GI*, and the Model Ib shows the results with the variable *GI category*. As we used non-GI wineries (*i.e., GI*=0; *GI category*=0) as the reference group in the analysis, the coefficients of the other GI categories must be interpreted in relation to this control group. The Model Ia shows that wineries belonging to a GI obtain, on average, better quality wines ($\beta_1$=0.6287; p<0.1) than do non-GI wineries, other things being equal. The Model Ib shows that all the coefficients of the variable *GI category* are positive and statistically significant, except for the first level: PGI (*GI category* = 1). This result suggests that wineries belonging to a PDO ($\beta_{1,2}$=0.5858; p<0.1),

[5] The vast majority of non-GI wineries in our database (95.4%) locates in geographical areas endowed with geographical indications. So they could take advantage of their right to supply the GI product. Thus, 69.2% of non-GI wineries are within the limits of a PDO, 26.2% belong to territories with PGIs, and only three wineries (4.6%) locate their vineyards outside a GI area.

[6] For the sake of brevity, we omit here the corresponding estimations. Notwithstanding, complete results will be provided upon request.

QDO ($\beta_{1,3}$=1.1220; p<0.01) or to an SEW ($\beta_{1,4}$=2.4158; p<0.01) have a higher average quality than do non-GI wineries, ceteris paribus. However, there are no statistically significant differences between the average quality of PGI wineries and non-GI wineries. This result only partially supports H1 since not all GI types (PGI seems to be an exception) produce wines with a quality that is significantly enhanced over the quality of wine produced by non-GI wineries, as proposed.

**----------TABLE 7----------**

Testing the second hypothesis, H2, requires comparing the estimates for each GI category (Model Ib, Table 7). We coded such categories in ascending order in our variable *GI category*; 0 (non-GI) represents no requirement imposed above the mandatory wine regulation, and 4 represents the strictest category (SEW). H2 maintains that belonging to a more demanding GI is positively related to quality performance, which is what the *GI category* coefficients in Table 7 suggest. First, the strictest categories show positive and statistically significant differences with non-GI wineries (which are similar, on average, to PGI wineries), and second, these differences (estimated coefficients) are increasing; *i.e.,* the QDO coefficient ($\beta_{1,3}$= 1.1220) is smaller than the SEW coefficient ($\beta_{1,4}$= 2.4158) but larger than the PDO coefficient ($\beta_{1,2}$= 0.5858).

A more robust and visible way of testing H2 involves changing the control group so that the estimated parameters show the statistical differences between the categories we would like to compare. Table 7 shows that there is no difference between non-GI and PGI wineries, but the significance of the difference between PGI and the more stringent categories is unknown. We cannot evaluate the differences between PDO and QDO with SEW either. Table 8 resolves

this problem. The table presents these tests by re-estimating the model, excluding non-GI wineries and sequentially changing the reference group to PGI (Model IIa), PDO (Model IIb) and QDO (Model IIc). First, the results confirm that PGI wineries achieve a lower quality than do more stringent GIs because these differences are statistically significant and increase with the GI category ($\beta_{1,2}$=0.7526 < $\beta_{1,3}$=1.2847 < $\beta_{1,4}$=2.5812) (Model IIa, Table 8). Second, PDO wineries achieve a lower quality than do both QDO ($\beta_{1,3}$=0.5320) and SEW ($\beta_{1,4}$=1.8286) wineries (Model IIb, Table 8), with coefficients again increasing. Finally, when QDO is the reference group (Model IIc, Table 8), the (negative) coefficients of the less demanding GI categories show a deterioration in quality as the category declines. However, the coefficient of the most stringent category (*i.e.,* SEW) is not statistically significant. Therefore, the quality of wineries belonging to a QDO is not different from that achieved by a SEW. It is also interesting to note that the quality differences associated with the increase in GI category are positive but at a decreasing marginal rate (the increment associated with the upgrade from PGI to PDO (0.7526) is larger than that from PDO to QDO (0.5320) and from QDO to SEW (0)). In sum, these results only partially support our second hypothesis because one category (*i.e.,* SEW) does not show statistically significant differences over QDO.

**----------TABLE 8----------**

The third group of hypotheses (H3a and H3b) is tested in Table 9. Regressions in this table replicate those in Table 8, but they also include the main organizational features of each GI as regressors (*Participants* and *Area*). An underlying problem is the high correlation between these variables (see Table 6). A similar suspicion of multicollinearity is obtained through the analysis of the variance inflation factor (VIF). Although all this evidence is not

strong, we opted for a conservative approach and separately introduced each of these two variables. The two models of Table 9 collect each of these estimates. First, H3a maintains that as there is a non-linear relationship between the number of GI wineries (*Participants)* and quality, it is possible to find an *optimal* group size. To test for this relationship, we introduced the square of the number of GI wineries into the equation. The results confirm that the relationship is non-linear, with the coefficients for *Participants* ($\beta_7$=0.0062, p<0.01) and *Participants*$^2$ ($\beta_8$= $-7.70 \cdot 10^{-06}$, p<0.01) being positive and negative, respectively, and statistically significant, which supports Hypothesis 3a (Model IIIa, Table 9). The maximum quality level is reached for approximately 405 wineries, with decreasing quality values above that size. Second, the results for *Area* support Hypothesis 3b because its coefficient is negative and statistically significant ($\beta_9$= $-1.21 \cdot 10^{-5}$, p<0.01), as predicted by the hypothesis (Model IIIb, Table 9). Therefore, a larger expansion of the GI reduces the average quality of the wineries associated with that GI, other things being equal.

**----------TABLE 9----------**

The control variables are statistically significant in all the estimations. First, *Legal* is a categorical variable that indicates the different legal forms of the wineries. The results suggest that there are statistically significant differences between the reference category (investor-owned firms) and cooperatives and, in most of the cases, also for sole proprietors. These differences are always negative, meaning that the legal category that enhances quality the most is investor-owned firms. Similarly, the estimates for *Producer size* are always statistically significant and negative. Therefore, the larger the amount of wine produced in a period is, the lower the quality. *Experience* presents a U-shaped relationship with the quality of the wine, so

it only positively affects quality performance after a threshold that ranges from 111 years (Model Ib) to 94 years (Model IIIb). Thus, it seems that it takes a long time for a winery to start enjoying any quality improvement due to its experience. Finally, the estimates for *Winery group* are always statistically significant and positive, meaning that belonging to a winery group promotes higher quality levels.

## 5. Discussion and conclusions

The above results show that wineries seem to achieve higher quality performance when they belong to a GI; in particular, the more stringent the GI is, the higher the average difference in quality with non-GI wineries. We argue that this result occurs because GIs fulfil a triple role—proposed by organizational economics and collective reputation literature—as devices that attenuate the free-riding problems, provide incentives to invest and facilitate knowledge sharing in agri-food supply chains. Although no statistically significant differences have been found between the quality of wineries with less demanding GIs (PGIs) and wineries without GIs, in three out of the four GI categories considered, belonging to a GI positively affects the quality of wineries. This result partially supports Hypothesis 1 and agrees with Banterle and Stranieri's (2008) argument referring to the assurance of quality as the main reason for introducing voluntary traceability systems in the food supply chain. In addition, assuming that consumers value quality, the results offer an explanation of why several authors found that consumers are willing to pay more for GI than for non-GI products (Deselnicu *et al.,* 2013; Leufkens, 2018). Moreover, the results point to GIs as quality enhancers and not merely as guarantors of traditional production methods linked to a territory.

Second, significant differences appear in quality performance among the different GI categories. On the one hand, the quality of QDO and SEW wineries is greater than the quality of PDO wineries, and the quality of the latter is greater than the quality of PGI wineries.

However, there are no significant differences between the two most stringent categories: QDO and SEW. This outcome could be because the regulation provides identical requirements for quality controls in both categories; their main difference is attributable to a far closer and deeper tie with the territory in the case of SEW wines. This result partially supports the second hypothesis and confirms and expands Castriota and Delmastro (2012) and López-Bayón *et al*. (2018): QDO wineries outperform PDO wineries. It is also consistent with the results of Costanigro *et al*. (2019) and Scozzafava *et al*. (2018), who show how more stringent GIs represent an effective strategy to leverage brand value and quality. Furthermore, this result is aligned with the prevailing view that consumers are willing to pay a higher premium for PDO versus PGI products.

Finally, the study considers that even *within* the same GI *category*, the effectiveness in promoting quality may differ considerably among GIs because their advantages also vary according to their ability to monitor the individual incentives and investment efforts of their members (Fishman *et al.,* 2018; Tirole, 1996). In this regard, we confirm that both the number of affiliate wineries and the size of the geographical area of the GI are important drivers of its effectiveness, capable of exerting a significant influence on the quality of wineries. First, the results support Castriota and Delmastro's (2014) outcomes; these authors observed a non-linear relationship between the number of producers and the collective reputation of GIs. Our study extends the analysis to the producing companies and their individual quality results, confirming a non-linear effect. Specifically, in our sample, above an optimal size of approximately 405 wineries, monitoring and incentive problems seem to prevail over the benefits of working together, diminishing the effectiveness of GIs as a tool to ensure higher quality and even damaging the quality of producers. This result points to the concentration of GI wineries as a structural factor capable of positively influencing their quality performance. Similarly, the geographic area of the GI negatively affects the quality performance of wineries, probably

because it aggravates the heterogeneity within the GI and thus internal conflicts and control costs (Yu *et al*., 2017). Ultimately, our results support that the structural and organizational characteristics of each GI system contribute to explaining their effectiveness in supporting the quality of their members' wine. It is noteworthy that differences in the GIs' market strategies and positioning may also explain different quality outcomes across GIs. The relative importance of these strategic variables in explaining the GIs' effectiveness constitutes a future line of research.

The results also point to several policy implications. First, empirical evidence supports the value of GIs as an instrument capable of facilitating higher quality levels for producers, at least those in the wine sector. This result suggests that the EU regulation has been successful in terms of reaching its main objective with the introduction of GIs: "support agricultural and processing activities […] associated with high quality products" (Regulation UE1151/2012). This result also endorses the utility of GIs as effective tools within European agri-food quality policies and sheds light on the debate that always arises when the EU tries to sign a new commercial agreement with, for example, the US or Mercosur.

A second policy implication is that extant EU regulations regarding GI wines (Regulation 1308/2013) seem too generic and that the EU variety of GI categories could be extended by one more category in the next common agricultural policy (CAP) review for the 2021-2027 period. Our work shows a situation in which the wine national regulation has extended the European regulation, distinguishing different levels of strictness within the EU category of PDO (see Table 1). The best result in terms of improving the average quality of wineries was obtained for QDO, which is a more stringent category than the regular PDO. This suggests that this additional category of GI might be better in certain situations and might help producers in countries where legislation is not as well developed or work as a reference in other industries where the use of GIs does not have as long a tradition as in the wine industry.

Third, policies encouraging the growth of producers could be appropriate for enhancing quality, particularly when the GI producers are numerous and small, because the effectiveness of GIs in supporting high quality critically depends on their organizational characteristics, such as the number of participants. The collective action problem that GIs attenuate worsens as the number of participants increases. We find that after a threshold, this free-riding problem negates the potential benefits of working together within the GIs (*e.g.*, access to superior resources and higher investment incentives), and can even impair the quality performance of affiliates. A concentration of producers would reduce the number of producers and facilitate the control of collective action; this in turn could help protect the quality and enhance the competitiveness of the producers, which seem to be two key aims of the new CAP regulation in progress (McEldowney and Kelly, 2018, p. 5).

*Limitations and future research*

The study has certain limitations. First, focusing on a single country and a single industry may limit generalizability. Thus, future empirical research should explicitly address how the specificities of different industries may alter the results. Likewise, it is important to extend the study to other states to control for possible country-specific effects. Differences in their legal regimes (*e.g.*, Belletti, *et al*., 2017), the nature of the institutions responsible for the administration of the PDO/PGI schemes (see, EUIPO, 2017; Marie-Vivien, *et al.*, 2017), and their internal governance features may have an impact on the functioning and effectiveness of GIs. Second, regarding the reliability of our empirical results, we need to be cautious because, to assess the quality of producers, we have used only one source (the Peñín Spanish Wine Guide), whose scores are based on non-blind tastings. Although wine experts' ratings usually show high convergent validity across different professional guides (Benjamin and Podolny, 1999; López-Bayón *et al.,* 2018), tastings can incorporate a subjective bias in quality assessment that we cannot control for. Finally, even though quality is positively related to GI

stringency, only a limited number of Spanish GIs (*Priorat* and *Rioja*) have evolved into the more stringent category (QDO). It is therefore necessary to develop a more fine-grained analysis of GIs' drawbacks and limitations to explain why some GIs remain intentionally in lower categories, even though they meet the requirements for access to higher levels.

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## Tables and figures

### Table 1: PDO/PGI European and Spanish categories correspondence

| | European categories (Regulation (EU) No 1308/2013) | Spanish categories (Ley 6/2015) |
|---|---|---|
| **Less demanding (–)** | PGI<br>Protected Geographical Indication | Regional Wine |
| | PDO<br>Protected Denomination of Origin | Quality Wine |

| | | |
|---|---|---|
| (+) More demanding | | Designation of Origin |
| | | Qualified Designation of Origin |
| | | Single-Estate Wine (*Vino de Pago*) |

**Table 2: Population and sample distribution by legal form of the firm**

| Legal forms | Population[a] | Sample (n = 805) |
|---|---|---|
| **Sole proprietors** | 16.50 | 4.47 |
| **Investor-owned firms** | 65.00 | 75.90 |
| **Cooperatives** | 18.50 | 19.63 |
| **TOTAL** | 100 | 100 |

[a] MAPA (2018a)

**Table 3: Population and sample distribution of vineyard hectares by type of geographical indication**

| GI [(c)] | Population[(a)] | Sample |
|---|---|---|
| **PDO[(b)]** | 92.37% | 94.76% |
| **PGI** | 7.63% | 5.24% |

a) MAGRAMA (2015a, 2015b)
b) Includes Quality Wines, Designations of Origin, Qualified Designations of Origin and Single-Estate Wines because MAGRAMA does not breakdown this category.
c) Distributions for the sample and the population by each GI (81 GIs) show similar results; the results are available upon request.

## Table 4: Description of the variables

| Variable | Source | Description |
|---|---|---|
| *Dependent variables* | | |
| Quality | Peñín Spanish Wine Guide (2015) | The average quality ratings of all wines reported for each winery.<br>Range of variation: 50- to 100-point scale. |
| *Independent variables* | | |
| GI | Peñín Spanish Wine Guide (2015) | Categorical variable that takes the following value:<br>0 if the winery does not belong to any GI;<br>1 if the winery belongs to a GI; |
| GI category | Peñín Spanish Wine Guide (2015) | Categorical variable that takes the following value:<br>0 if the winery does not belong to any GI;<br>1 if the winery belongs to a PGI;<br>2 if the winery belongs to a PDO;<br>3 if the winery belongs to a QDO; and<br>4 if the winery belongs to an SEW. |
| Participants | MAPA (Spanish Ministry for Agriculture, Fisheries and Food) https://www.mapa.gob.es/es/alimentacion/temas/calidad-agroalimentaria/calidad-diferenciada/ | Number of wineries in each GI. |
| Area | MAPA (Spanish Ministry for Agriculture, Fisheries and Food) https://www.mapa.gob.es/es/alimentacion/temas/calidad-agroalimentaria/calidad-diferenciada/ | Geographical extent of the GI in hectares. |
| *Control variables* | | |
| Legal | SABI (https://www.bvdinfo.com/es-es/nuestros-productos/datos/nacional/sabi)<br>Wineries' websites | Categorical variable that takes the following value:<br>0 if the winery's owner is an investor-owned firm;<br>1 if the winery's owner is a cooperative; and<br>2 if the winery's owner is a sole proprietor. |
| Producer size | Alimarket (www.alimarket.es)<br>Wineries' websites | The amount of wine produced by period (millions of litres) by the winery. |
| Experience | Peñín Spanish Wine Guide (2015)<br>SABI (https://www.bvdinfo.com/es-es/nuestros-productos/datos/nacional/sabi)<br>Wineries websites | Number of years since the winery's foundation. |
| Winery group | Peñín Spanish Wine Guide (2015)<br>Wineries websites | Categorical variable that takes the following value:<br>0 if the winery does not belong to a winery group; and<br>1 if the winery belongs to a winery group. |

## Table 5: Descriptive statistics

| Variable | Observations | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|---|
| Quality | 805 | 87.90 | 2.61 | 80.00 | 95.67 |
| GI | 805 | 0.92 | 0.27 | 0 | 1 |
| GI category | 805 | 1.94 | 0.76 | 0 | 4 |
| Legal | 805 | 0.29 | 0.54 | 0 | 2 |
| Producer size | 805 | 5.72 | 17.31 | $3 \cdot 10^{-3}$ | 200 |
| Experience | 805 | 42.90 | 42.09 | 3 | 278 |
| Winery group | 805 | 0.21 | 0.41 | 0 | 1 |
| Participants | 740 | 223.72 | 263.07 | 1 | 804 |
| Area | 725 | 26,012.25 | 34,435.67 | 5 | 161,611 |

## Table 6: Correlation matrix

| | Quality | GI[(a)] | GI category | Legal | Producer size | Experience | Winery group | Participants | Area |
|---|---|---|---|---|---|---|---|---|---|
| Quality | 1 | | | | | | | | |
| GI | 0.0532 | 1 | | | | | | | |
| GI category | 0.1433* | 0.7525* | 1 | | | | | | |
| Legal | -0.2109* | -0.0036 | -0.0202 | 1 | | | | | |
| Producer size | -0.2327* | -0.0586 | -0.1052* | 0.1096* | 1 | | | | |
| Experience | -0.0789* | 0.1034* | 0.0909* | 0.0532 | 0.1203* | 1 | | | |
| Winery group | 0.1937* | 0.0512 | 0.0778* | -0.1918* | 0.0668 | 0.0334 | 1 | | |
| Participants | 0.1415* | . | 0.6313* | -0.0861* | -0.0249 | -0.0073 | 0.1239* | 1 | |
| Area | -0.1484* | . | 0.2754* | -0.0221 | 0.2762* | 0.0335 | 0.0692 | 0.5882* | 1 |

[a] When this value is 0, it is not possible to compute correlations between *GI* and the two GI organizational features *Participants* and *Area* because such values do not exist.
* $p < 0.05$

## Table 7: Regression models (I)

| Variables | Quality | | | |
|---|---|---|---|---|
| | Model Ia | | Model Ib | |
| | β | Stand. Dev. | β | Stand. Dev. |
| GI | 0.6287* | (0.3208) | - | - |
| GI category [(1)] | | | | |
| PGI | - | - | –0.1453 | (0.4382) |
| PDO | - | - | 0.5858* | (0.3226) |
| QDO | - | - | 1.1220*** | (0.3782) |
| SEW | - | - | 2.4158*** | (0.9013) |
| Legal [(2)] | | | | |
| Cooperative | –1.1509*** | (0.2322) | –1.1013*** | (0.2314) |
| Sole proprietor | –0.4960 | (0.4201) | –0.5472 | (0.4177) |
| Producer size | –0.0277*** | (0.0051) | –0.0258*** | (0.0051) |
| Experience | –0.0207*** | (0.0057) | –0.0221*** | (0.0057) |
| Experience$^2$ | 0.0001*** | (0.0000) | 0.0001*** | (0.0000) |
| Winery group | 1.0769*** | (0.2156) | 1.0390*** | (0.2148) |
| Constant | 88.0425*** | (0.3256) | 88.0605*** | (0.3233) |
| N | 805 | | 805 | |
| F | 20.263825*** | | 15.960896*** | |
| $r^2$ | 0.143630 | | 0.156887 | |

[(1)] Reference group: non-GI wineries

[(2)] Reference group: investor-owned firms

* p < 0.1; ** p < 0.05; *** p < 0.01

## Table 8: Regression models (II)

| Variables | Quality | | | | | |
|---|---|---|---|---|---|---|
| | **Model IIa** | | **Model IIb** | | **Model IIc** | |
| | **Reference group PGI (GI category = 1)** | | **Reference group PDO (GI category = 2)** | | **Reference group QDO (GI category = 3)** | |
| | β | Stand. Dev. | β | Stand. Dev. | β | Stand. Dev. |
| GI category | | | | | | |
| PGI | - | - | –0.7526** | (0.3184) | –1.2847*** | (0.3700) |
| PDO | 0.7526** | (0.3184) | - | - | –0.5320** | (02320) |
| QDO | 1.2847*** | (0.3700) | 0.5320** | (0.2320) | - | - |
| SEW | 2.5812*** | (0.8670) | 1.8286** | (0.8191) | 1.2965 | (0.8401) |
| Legal [(1)] | | | | | | |
| Cooperative | –1.1260*** | (0.2241) | –1.1260*** | (0.2241) | –1.1260*** | (0.2241) |
| Sole proprietor | –1.1143** | (0.4496) | –1.1143** | (0.4496) | –1.1143** | (0.4496) |
| Producer size | –0.0253*** | (0.0050) | –0.0253*** | (0.0050) | –0.0253*** | (0.0050) |
| Experience | –0.0208*** | (0.0056) | –0.0208*** | (0.0056) | –0.0208*** | (0.0056) |
| Experience$^2$ | 0.0001*** | (0.0000) | 0.0001*** | (0.0000) | 0.0001*** | (0.0000) |
| Winery group | 1.0820*** | (0.2120) | 1.0821*** | (0.2120) | 1.0821*** | (0.2120) |
| Constant | 87.8619*** | (0.3354) | 88.6145*** | (0.1840) | 89.1465*** | (0.2734) |
| N | 740 | | | | | |
| F | 18.945514*** | | | | | |
| $r^2$ | 0.179354 | | | | | |

[(1)] Reference group: Investor-owned firms

* p < 0.1; ** p < 0.05; *** p < 0.01

## Table 9: Regression models (III)

| | Quality | | | |
|---|---|---|---|---|
| | **Model IIIa** | | **Model IIIb** | |
| | **Number of wineries** | | **GI hectares** | |
| **Variables** | β | Stand. Dev. | β | Stand. Dev. |
| GI category [(1)] | | | | |
| PDO | 0.9171*** | (0.3179) | 1.1016*** | (0.3618) |
| QDO | 1.9448** | (0.7670) | 2.1217*** | (0.4213) |
| SEW | 3.3230*** | (0.8776) | 2.7368*** | (0.8770) |
| Legal [(2)] | | | | |
| Cooperative | –0.9646*** | (0.2257) | –1.1411*** | (0.2223) |
| Sole proprietor | –0.9897** | (0.4464) | –1.1845*** | (0.4443) |
| Producer size | –0.0263*** | (0.0049) | –0.0178*** | (0.0052) |
| Experience | –0.0220*** | (0.0056) | –0.0187*** | (0.0056) |
| Experience$^2$ | 0.0001*** | (0.0000) | 0.0001*** | (0.0000) |
| Winery group | 0.9810*** | (0.2114) | 1.0453*** | (0.2138) |
| Participants | 0.0062*** | (0.0016) | - | - |
| Participants$^2$ | –7.70e-06*** | (2.41e-06) | - | - |
| Area | - | - | –1.21e-05*** | (2.882e-06) |
| Constant | 87.1462*** | (0.3760) | 87.6670*** | (0.3803) |
| N | 740 | | 725 | |
| F | 17.3200*** | | 19.1832*** | |
| $r^2$ | 0.1954 | | 0.2007 | |

[(1)] Reference group: PGI wineries
[(2)] Reference group: investor-owned firms
* p < 0.1; ** p < 0.05; *** p < 0.01