



## Determinants of organic wine production: An application in the DOC Rioja wine industry

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### Abstract

**Aim of study:** To analyse the role that valuable resources and agglomeration would play in the decision to produce organic wines.

**Area of study:** The Controlled Designation of Origin (DOC) Rioja wine industry in Spain, the leading qualified denomination of origin of Spain.

**Material and methods:** Taking into account the nature of the dependent variable, a binomial logit model was used.

**Main results:** This paper confirms the significance of valuable resources such as financial resources and human resources, but also of knowledge-based spillovers from proximate organic wineries in improving the probability of producing organic wines. Contrary to expectations, technological resources and experience in the wine industry have no significant effect.

**Research highlights:** The resource based-view and the cluster approach are complementary to improving the predictive elements of producing organic wine in the DOC Rioja wine industry. The authors were unable to pre-register the analysis involving primary data collection before the data collection exercise starts. This requirement is from January 2022 and the survey period of this paper was on 2017. According to the editorial policy of the journal this analysis should be considered exploratory.

**Additional key words:** cluster approach; firm resources; organic wine production; resource-based view.

**Abbreviations used:** DOC (Controlled Designation of Origin); EU (European Union); R&D (Research and Development); RBV (Resource-based View); ROC (Receiver Operating Characteristic); SME (Small and Medium-sized Enterprises).

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## Introduction

In recent years, wine consumers have become increasingly interested in sustainability issues and are concerned in particular about the effects of conventional viticulture practices on both human and environmental health. Many wineries have responded to these concerns with the application of both organic and biodynamic viticulture techniques, which are based on natural principles of production, reducing the use of synthetic chemical inputs, and thus, meet all requirements for quality, and healthiness (Laureati & Pagliarini, 2016).

Currently, 121,279 hectares are devoted to organic viticulture in Spain, representing the European Union (EU) country with the largest organic vineyard area. Organic wine means a wine complying with specific requirements and standards of Regulation 203/2012 of 8 March 2012 (EC, 2012). Although its production has largely grown over recent years (since 2013, organic wine production has grown more than 70%), organic vineyards still represent less than 13% of the total vineyard area in Spain, which is similar to the percentage in France and Italy. Thus, Spain is expected to significantly increase production in the coming years (OEMV, 2019).

It is well known that the Spanish wine sector in general, and the organic wine industry in particular, have a markedly international character, essentially due to the evolution in demand. The majority of the organic wine produced in Spain is sold in international markets. Among the main markets for organic wine are Sweden, Germany, Northern Europe, France, USA, Canada, Japan and Australia. In the current scenario, the organic wine market is a niche market that is likely to evolve into a mainstream market over the coming years (International Organisation of Vine and Wine, <https://www.oiv.int/>).

Another factor that is projected to play a key role in the development of the organic wine market is policy support, particularly from the EU Common Agricultural Policy (CAP), which regulates the production of organic wines in accordance with EU Commission Regulation 203/2012 (EC, 2012) and promotes organic agricultural production.

In this study, we aim to understand the factors that lead SME (small and medium-sized enterprises) wineries to produce organic<sup>1</sup> wines. This research uses both the resource-based view and the cluster approach when attempting to identify those factors that may improve the organic wine production of wineries. We endeavour to understand how the internal pool of resources and access to locally bound externalities may affect the organic production of wineries.

As a consequence, this paper firstly contributes to the understanding of the role that valuable resources would

play in the decision to produce organic wines. The resource-based view of the firm has become influential in explaining internationalization in the wine industry (*e.g.*, Fernández-Olmos, 2011), but, there is scant evidence about the determinants of organic wine production. Second, this study aims to complement the resource-based view with the cluster approach, showing how clustered wineries can improve their explorative learning capacity using external information and knowledge spillovers to produce organic wines. Finally, this paper contributes in being the first quantitative study to investigate the determinants of organic production at the winery level in the Controlled Designation of Origin (DOC) Rioja wine industry, the leading qualified denomination of origin of Spain. At present, it has around 600 wineries, 14,800 winegrowers and with an international presence in 130 different countries (<https://www.riojawine.com/>). In this area, winemakers are significantly increasing their organic supply because of the EU subsidies for organic producers, the saturation of the current wine market and the growing concern over the sustainability of Rioja wines (Silva & Cobos, 2017). As the data collection was undertaken in 2017, the authors were unable to pre-register the analysis. However, in line with the editorial policy of the journal, our findings should be considered exploratory.

The current process of environmental sustainability has increased the competitive pressures on wineries worldwide (Alonso *et al.*, 2021). To reduce the environmental impact, wineries can implement strategies aimed at incorporating sustainability into their production practices such as reducing the use of pesticides or clarifying with natural products.

In the face of these challenges, Spanish wineries lead the world in the production of organic wine (International Organisation of Vine and Wine, <https://www.oiv.int/>). After new legislation was passed in the EU in 2012 (EC, 2012), it is possible to label wine as an organic<sup>2</sup> food product if it satisfies the requirements set out under this regulation. Among other conditions, the use of chemical fertilisers, synthetic pesticides and transgenics are prohibited. Likewise, there is a restricted list of additives and oenological auxiliaries. To achieve certification status, wine producers are required to demonstrate they understand the organic system and comply with the regulations after a minimum of three years. They are inspected by a government-accredited certifier.

Based on this regulation, the cost of producing organic wine compared to conventional one is higher due to its more labor-intensive method and lower grape yields. It explains that recently many studies have emerged on the perspective of the consumer within the context of organic wines, such as purchasing behaviors (Tozer *et al.*, 2015),

<sup>1</sup> In this paper, the terms organic and biodynamic related to wine production are used in contrast to the term conventional (nonorganic wines) to indicate different viticultural practices.

<sup>2</sup> In order to also be biodynamic, vineyards must be harvested sustainably according to a specific astronomical calendar, as Rudolf Steiner established in the 1920s (Steiner, 1920).

consumer attitudes (Castellini *et al.*, 2017), consumer perception (Caliskan *et al.*, 2020); and willingness to pay (Mazzocchi *et al.*, 2019; Caliskan *et al.*, 2020; Alonso *et al.*, 2021).

Yet, although the winery perspective in organic wine production has not been overlooked in the literature (*e.g.*, Dodds *et al.*, 2013; Castellini *et al.*, 2014; Nave *et al.*, 2021; for wine tourism companies), there is scarce research on which wineries are integrating environmental considerations into their production routine, leading to changing their production habits from traditional to organic production.

As being one of the most commonly known perspectives and the theoretical foundation of the strategic management field, the resource-based view is chosen to examine the factors explaining the adoption of organic practices by wineries as the main aim of this research. This theoretical approach asserted that the efficiency of sustainability practices is strongly dependent of their resources and capabilities<sup>3</sup> (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993; Pullman *et al.*, 2010).

In order to have the potential to generate competitive advantage wineries' resources must have four attributes: valuable, rare, not substitutable and inimitable.

Before going into the organic wine business, a winery needs to secure sufficient financial resources to be able to operate efficiently and well. It must be taken into account that the cost associated with organic wines is generally greater than conventional wines for several reasons: organic grape supply is limited; ecological viticulture tends to have slightly lower yields; and the distribution chain for organic wines involves higher costs because of relatively small volumes. Thus, the *size of a winery* is considered a *valuable* resource, given that a small size could indicate the lack of certain resources, such funding, might hold back organic production (De Steur *et al.*, 2020). Several contributions have supported that firms with limited financial resources are less likely to assign funds for sustainable initiative (Horbach, 2008; De Marchi, 2012).

The characteristic of rare implies that a winery producing organic wine as a product portfolio differentiation strategy can enjoy a competitive advantage as long as such strategy is not implemented by many other wineries at the same time (Barney, 1991). Organic wine production is a highly professional activity and, as such, it requires a fairly good knowledge of technological requirements and regulations to do it successfully. In particular, organic wine producers must acquire general knowledge about which inputs and standard practices are permitted or prohibited. To fulfil these requirements, wineries need human resources which master this added complexity associated with organic production. Thus, winery's *human resources*, with clear implications for business practices in organic production, could be categorized as *rare* and valuable

resources contributing achieving competitive advantage. Supporting this argument, Bro *et al.* (2019) find that coffee farmers with higher education levels are more likely to adopt sustainable practices.

Applying new technology and innovation activities in the production of new organic wines can be a factor for leading success and increasing competitiveness of organic wineries. Aligned with this notion, investment in R&D (research and development) can improve the performance of organic wineries and obtain the competitive ability with innovative strategy focused on the quality of organic wine. The importance of creativity in R&D can be considered as a *non-substitutable* resource. Fairweather (1999) surveyed 83 New Zealand farmers to conclude that a motivation for converting to organic production is having developed techniques to solve the technical problems associated with organic production.

While physical and financial assets can be easily replicated by new wineries, the reputation of a winery, which is gained through consistent performance over the years, is inimitable (or at least not easily imitable). Among organic wines, the quality of them is often a result of a particular path through history, dependent on continuous learning and based on trial and error (Dierickx & Cool, 1989). Thus, the unique *experience* of a winery is expected to be an *imperfectly imitable* resource by other competitors. Corroborating this idea, some papers have shown that the level of experience affects behavioural intention (Taylor & Todd, 1995; Kijisanayotin *et al.*, 2009). Recently, not-significant effect is obtained in Cobelli *et al.*'s (2021) paper, but it can be explained because the market trend and public incentives for support organic wine production is much more relevant than experience.

Drawing upon the resource-based view (RBV), we hypothesized that:

*Hypothesis 1: Winery's resources have a positive impact on the probability of producing organic wine.*

In addition to leveraging internal resources, the RBV also acknowledges external factors such as a winery's business network as vital sources of knowledge for influencing action with regards to organic production.

According to Michael Porter's cluster theory (Porter, 1998), clusters may help to increase the competitive advantage held by small and medium-sized wineries, thereby allowing them to compete more effectively than their dispersed counterparts in the global wine market. It is due to the agglomeration externalities enjoyed by proximate wineries located in geographical clusters.

Previous literature in agglomeration economies has outlined the dichotomy between tacit and codifiable knowledge proposed by Polanyi (1966). In the wine indus-

<sup>3</sup> The concepts of resources and capabilities are not similar but are used interchangeably.

**Table 1.** Information from the structural survey conducted for the study and description of variables.

Unit of analysis	Winery
Population	Wine-making processors belong to the DOC Rioja who have to present accounting information
Census	580 (list provided by the Regulatory Council of the Rioja Designation of Origin)
Sample size	123
Response rate	21.21%
Margin of error	7.85%
Confidence level	95%
Information sources	Structural surveys
Survey period	January-September 2017
Computer programs	Stata 14

Variable	Measure
Organic production ( <i>Organic</i> )	Dummy: 1 the winery produces organic wine; 0 otherwise
Financial resources ( <i>Size</i> )	Logarithm of the number of employees
Human resources ( <i>Human_resources</i> )	The proportion of the winery's employees with university degrees
R&D investments ( <i>R&amp;D_intensity</i> )	A proportion of R&D expenditures of total sales
Experience ( <i>Experience</i> )	Logarithm of the winery's age
Agglomeration ( <i>Agglomeration</i> )	The number of other organic wine producers within the same municipality

try, tacit knowledge could be defined as skills, ideas and experiences making wines that wineries have but are not codified and may not necessarily be easily imitated. Considering that organic wine production can be considered a knowledge-based innovation, most of the relevant knowledge associated to it is tacit and difficult to transmit among wineries (Arikan, 2009). Wineries' knowledge about their previous experience in organic wine production is not easily transferred to other wineries, because learning is a path dependent process wherein what wineries learn depends in part on their past experience in markets, social context and culture (Teece *et al.*, 1997).

In particular, organic wineries' physical and cognitive proximity facilitate the transmission of knowledge among clustered organic wineries (Giuliani, 2005). There is a dense network of cooperation among wineries, based on reciprocity and mutual trust (David *et al.*, 2010). Since knowledge transfer occurs in a shared social context in which cooperation is promoted among the local wineries, clusters incentive accumulation of learning skills while also facilitate mutual understanding among wineries (Dei Ottati, 1991). Inside a cluster, wineries develop repetitive patterns of wine activities, *i.e.* routines, based on their shared experiences and beliefs, which allow them to process others' tacit knowledge easily (Grant, 1996; Expósito-Langa & Molina-Morales, 2010).

In sum, this component of tacit knowledge can be used to explain the alleged competitive advantages enjoyed by

SME wineries in the Rioja wine cluster. Superior ways of producing organic wine can be facilitated by tacit forms of knowledge that are embedded in the DOC Rioja context and which are therefore difficult to transfer elsewhere (Maskell & Malmberg, 1999). Physical proximity allows for frequent face-to-face interactions between the numerous wine producers in DOC Rioja and as a result it can facilitate the exchange of this knowledge through "learning-by-doing". Based on that, it is hypothesized:

*Hypothesis 2: Proximity to organic wineries has a positive impact on the probability of producing organic wine.*

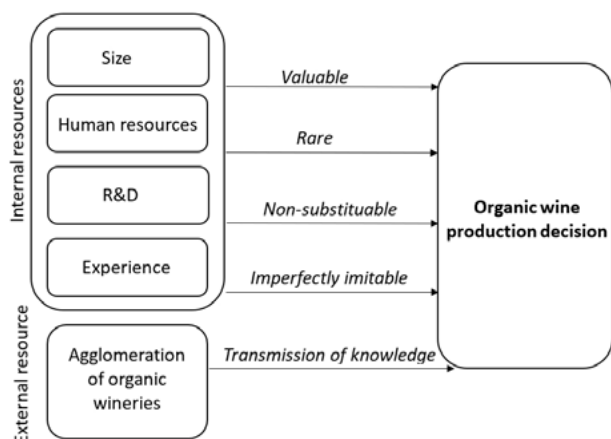
A graphical illustration of the proposed model is in Fig. 1.

## Material and methods

We selected the DOC Rioja wine industry to test our hypotheses because sustainability is very important to their wineries<sup>4</sup> and many of them are working on the long process of attaining organic accreditation.

Table 1 summarizes information from the structural survey conducted for the study. The population from which the sample was drawn consisted of wine-making processors who belong to the Rioja Designation of Origin, which are obligated to present accounting information to

<sup>4</sup> An example is Bo de ga Beronia's new winery, which has been deemed the most efficient and sustainable in all of Europe (<https://www.foodswinesfromspain.com>).



**Figure 1.** Theoretical model. *Source:* Own elaboration based on our proposed model.

the authorities. The survey was returned by 123 participants, 21.21% of the population.

In this study, our objective was to examine the role of valuable resources and agglomeration in the decision to produce organic wines.

The binomial logit model was used to analyse the choice between two alternatives (Maddala, 1983), “adopting organic wine production” or “do not adopt wine organic production”. Taking into account that a discrete variable destroys the linearity assumption between the dependent variable and independent variables, the least squares method was clearly inappropriate (Amemiya, 1984).

In making this decision, it may be assumed that the winery weighs up the marginal advantages and disadvantages of producing organically (Burton *et al.*, 1999). As the parameters of this decision are not usually observable, we can define a latent variable,  $y^*$ , which is an unobservable index of the willingness of each winery to adopt organic wine production practices, and which can be related to a set of explanatory variables  $X$  as follows (Aldrich & Nelson, 1984; Greene, 2000):

$$y_i^* = \beta' X_i + \mu_i \quad i=1 \dots N \quad (1)$$

The observed pattern of adoption of organic wine production practices can then be described by a dummy variable,  $y$ , such that  $y_i = 1$  if winery  $i$  has adopted,  $y_i = 0$  if it has not adopted organic wine production practices. These observed values of  $y$  are related to  $y^*$  as follows:

$$y_i = 1 \text{ if } y_i^* > 0 \quad P[y_i = 1|X_i] = \frac{e^{\beta_0 + \sum_{j=1}^5 \beta_j X_{ji}}}{1 + e^{\beta_0 + \sum_{j=1}^5 \beta_j + \beta_j X_{ji}}} \quad (2)$$

$$y_i = 0 \text{ otherwise}$$

where  $X_{1i}, X_{2i}, X_{3i}, X_{4i}, X_{5i} = X$  stands for the five determinants described above for winery  $i$  and  $P[y_i=1|X_i]$  is the likelihood of the  $i_{th}$  winery using organic wine production.

The model will be estimated by the maximum likelihood method used in the STATA software. An important aspect of estimation in a binary choice model is that coefficients cannot be interpreted directly as estimates of the magnitude of the marginal effects of changes in the explanatory variables on the expected value of the dependent variable. Therefore, to interpret the sensitivity of the likelihood of organic wine production with respect to explanatory variables, we also report marginal effects<sup>5</sup>.

### Variable operationalization

*Dependent variable: Organic production decision*

We created a dummy variable if the winery produced organic wine because we believe that the managerial skills and investment needed for producing organic wine are similar regardless of the percentage of organic wine production of the total wine production (organic).

*Independent variables*

As managers are reluctant to provide information related to financial aspects, we proxy financial resources with the size of the winery measured as the logarithm of the number of employees<sup>6</sup> (Diez-Vial & Fernández-Olmos, 2013) (*size*).

As we mentioned previously, human resources play an essential role in organic production because it requires activities which are much more complex and uncertain than traditional production activities. To measure this variable, we included the proportion of the winery’s employees with university degrees as a proxy for employee education (Fernández-Olmos, 2011). Rather than evaluating the employees’ experience in the wine industry, we tried to measure their level of education since qualified workers are predicted to have more skills (than non-qualified workers) to increase organic production (*human\_resources*).

DOC Rioja organic wineries are investing in up-to-date technologies and processes to elaborate high-quality organic wine. The majority of firm-level studies on innovation have utilized R&D investments as a measure of technological resources. R&D investments are generally measured as a proportion of R&D expenditures of total sales (Diez-Vial & Fernández-Olmos, 2013) and it is this measure that we used in this research (*R&D\_intensity*).

<sup>5</sup> When the dependent variable is discrete, the marginal effect is calculated as the difference between the likelihoods estimated at the sample mean when the dummy variable takes on a value of 1 and 0, respectively (Futing, 1994).

<sup>6</sup> The total sample was SMEs.

**Table 2.** Spearman correlations.

	1	2	3	4	5	6
1. Organic	1					
2. Size	0.178*	1				
3. Human_resources	0.212*	0.286*	1			
4. R&D_intensity	0.089	0.285*	0.229*	1		
5. Experience	0.124	0.252*	-0.069	0.035	1	
6. Agglomeration	0.447*	0.126	0.061	0.125	0.217*	1

\* $p < 0.05$ 

It is expected that newly established wineries face more difficulties in producing and selling organic wines due to a lack of organizational resources, managerial experience, and wine market and business experience. Wineries need to obtain good organic grapes either in their own vineyards or through relationships with grape growers learn the particularities of the organic production and develop a reputation in the organic wine industry. All of this requires time. Thus, it is thought that what is truly influencing organic wine production is not the absolute wine business experience of a winery but its relative change in experience. For this reason, we measured organizational experience through a logarithmic transformation of the winery's age (*experience*).

The density of organic wine wineries located in the same geographical area was measured, as has been used in previous studies (Clerides *et al.*, 1998; Malmberg *et al.*, 2000; Barrios *et al.*, 2003; Bernard & Jensen, 2004; Lovely *et al.*, 2005; Greenaway & Kneller, 2008). For each winery, the present research estimates externalities by counting the number of other organic wine producers within the same municipality (Costa-Campi & Viladecans-Marsal, 1999). A municipality constitutes the lowest level of territorial organization in the country. The organic wine producers in DOC Rioja are based in 144 municipalities, which cover an average area of 3,599 km<sup>2</sup>. Since there are large differences in population density within DOC Rioja, the number of wineries in each municipality was divided by its corresponding area (*agglomeration*).

## Descriptive analysis

As a preliminary analysis we calculated Spearman's correlations for each pair (see Table 2). Correlations ranged from 0.17 to 0.45, which indicated weak to moderate associations. Table 3 provides means of the variables for each subsample defined by its organic production decision, as well as the results of mean difference tests evaluating significant differences across subsamples. With the exception of technological resources and experience, the differences were statistically significant, as expected.

## Results and discussion

The findings in the model were generally consistent with the predictions of resource-based view. The first hypothesis is expressed by the coefficients of size, human\_resources, R&D\_intensity and age (see Table 4). They should be positive and significant, indicating that the availability of financial, human, technological and organizational resources leads to organic wine production. Table 4 shows that the results for the size and human\_resources of wineries in DOC Rioja support the prediction given by H1. However, the coefficients for R&D\_intensity and age are not significant.

The significant positive coefficient of size suggests that larger wineries can have more financial resources as well as production capacity (Reid, 1984; Cavusgil & Naor, 1987; Katsikeas & Morgan, 1994), thus enabling them to direct greater efforts to producing organic wine than smaller firms.

If an organic wine production lot does not meet established standards, government regulations may be used to ban production. Thus, organic wine production requires enologists and grape and wine production experts with customized approaches that can meet established standards for organic wine. As we expected, the coefficient for human resources was positive and significant, supporting the view that human resources play a key role in the decision to produce organic wine.

However, the variable used for technological resources, *R&D intensity*, was not significant. A possible explanation for these results could be that the soil is the heart and the *raison d'être* of organic viticulture. Thus, maintaining the fertility of the soil with a minimum of technological intervention is an essential prerequisite for producing organic wine. This result is in line with previous papers such as that of David *et al.* (2010), who found a stagnation in the technological performance in organic agriculture may be explained by the limited number of technological advances and the "purist" involved from the start in organic production.

Firm organizational experience plays no significant role in terms of explaining organic wine production. This sug-

**Table 3.** Means and mean differences between subsamples.

	Entire sample (N=123)	Organic subsample (N=25)	Non-organic subsample (N=98)	p-value (difference in means)
Size <sup>[1]</sup>	9.884	22.16	6.765	0.003
Human_resources	30.251	39.045	28.007	0.089
R&D_intensity	1.741	2.084	1.653	0.759
Experience <sup>[1]</sup>	31.016	33	30.510	0.761
Agglomeration	0.075	0.153	0.055	0.001

<sup>[1]</sup> Variables without logarithm.

gests that younger and older wineries are not more likely to produce organic wine than middle-aged wineries. While old experienced wineries may be more likely to produce organic wine because they have learned how to do things better, younger wineries may perhaps benefit from fewer organisational rigidities and inertia, which age brings about.

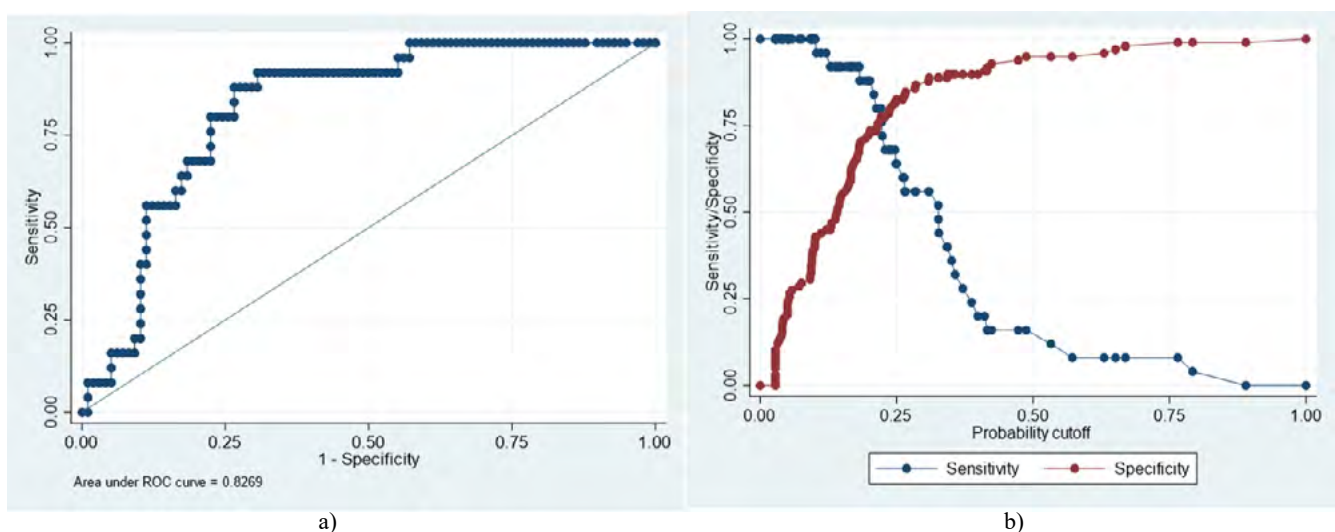
Hypothesis 2 refers to a positive effect of agglomeration of organic wineries on the likelihood of producing organic wine. Consistent with this hypothesis, the proximity to organic wineries was positively related to the decision to produce organic wine. That is, proximity to resources, information and knowledge from other organic wineries seem to increase local organic wineries.

### Robustness check

The model presented satisfactory indicators of overall significance, with a chi-squared value corresponding to levels of significance lower than 0.001, indicating that the 6 predictor variables used for performing binary logistic regression analysis were jointly efficient.

We conducted additional goodness-of-fit tests to verify the reliability of our results for binary logistic re-

gression analysis. First, the classification table showed that the fitted model had an overall percentage of correct classification of 78.049%, indicating that the fitted model was quite reliable in accurately classifying wineries. A percentage sensitivity (*i.e.*, % of observations correctly predicted as 1), of 12 % and a percentage specificity of 94.90% (*i.e.*, % of observations correctly predicted as 0). Second, the Hosmer-Lemeshow Test showed that our model is correctly specified ( $p=0.8149$ ). Third, to evaluate the model in a graphical manner, we represented a Receiver Operating Characteristic (ROC) plot (see Fig. 2a). The area under the curve is a useful criterion for model evaluation. In this case, the area under the ROC plot was 82.69% (significantly above 75%), which means that the unexplained proportion of variation was equal to 17.31%. Moreover, we plotted the sensitivity/specificity vs probability cut-off point (*i.e.*, the point in which observations are classified correctly) in Fig. 2b. As the two plots crossed each other fairly close to the vertical axis, it can be considered that the fitted model is adequately sensitive and specific. Thus, the fitted model is highly reliable in explaining variability in organic wine production as a function of the explanatory variables used for logistic regression analysis.



**Figure 2.** Area under the receiver operating characteristic (ROC) plot (a). Plot of sensitivity/specificity vs probability cut-off point (b).

**Table 4.** Results of logistic regression (N=123).

Parameter	Coefficient	Marginal effect
Size	0.552** (0.221)	0.073*** (0.028)
Human_resources	0.019** (0.009)	0.003** (0.001)
R&D_intensity	0.028 (0.041)	0.004 (0.005)
Experience	-0.387 (1.539)	-0.051 (0.203)
(Experience)^2	0.061 (0.237)	0.080 (0.031)
Agglomeration	6.010*** (1.789)	0.791*** (0.233)
Constant	-2.973 (2.519)	
LR Chi <sup>2</sup> (6)	21.20	
Prob > Chi <sup>2</sup>	0.0017	
Pseudo R <sup>2</sup>	0.1707	
Correctly classified	78.049%	

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . Standard errors in parentheses.

## Conclusions

The involvement of wineries in organic production to sell their wines on domestic and international markets has been broadly considered as an indicator of their overall competitiveness. Wineries that are able to produce organic wines are exposed to specific production requirements, while they also incur in the sunk costs associated with doing this. As a consequence, wineries that dedicate part of their effort to producing organic wines need to intensify the search for their source of competitive advantage on the world wine market.

Our results suggest that SME wineries can improve their organic wine production both by developing tangible and intangible resources and by leveraging local externalities from a cluster. In particular, this research contributes to knowledge of the wine industry by identifying a complementarity between these internal resources and those externally obtained from the cluster. In the resource-based view, wineries are heterogeneous in their valuable resources and such heterogeneity is sustainable over time insofar as these resources are not perfectly mobile across firms (Barney, 1991). Different resources, such as financial resources and human resources, are influential factors of organic wine production decisions in DOC Rioja wine industry. From a regional point of view, clustered wineries share a complex social and cultural identity, based on collective beliefs, conventions and history, which facilitates coordination, communication and learning among neighbouring wineries (Becattini, 1990; Maskell, 2001). Thus, geographical agglomeration of organic wineries in the DOC Rioja cluster may help organic wineries by offering advantages only available in a bounded geographical area such as DOC Rioja (Porter, 1998). These advantages can derive from externalities created by having an increasing number of proximate organic wineries.

Contrary to our expectations, technological resources have no significant effect on organic wine production. Fu-

ture research could look further at the role of technological resources in the birth of organic wineries. In addition, it would be interesting to examine other measures of technological resources, such as product innovations.

It is interesting that SME wineries can begin production of organic wine regardless of their previous experience in the wine industry. Taking into account this result, future research could focus on younger organic wineries as they might have a higher capacity to garner knowledge and information from other wineries.

Recently, Rodrigues *et al.* (2020) have concluded that the country-of-origin impacts wine traders' mental representation about wines. In the future, it could also be interesting to analyse how the country-of-origin impacts in the organic wine production.

Our results, however, have some limitations that deserve further research. As the study is focused on a single-industry sample collected in DOC Rioja, it limits the generalization of the findings. As with all cross-sectional research, the longitudinal effects of the determinant variables on the organic wine strategy remain unexplored. Future research could take a longitudinal approach. This would allow for testing to establish whether these factors change over time. Another limiting factor in this study is the measures used. Although we were able to collect data on a substantial number of DOC Rioja wineries to perform the analysis, a lack of information about key variables, such as production supported with public funding, limits the research.

Although our study has focused on the simple dichotomy between organic production vs non-organic production, we are sensitive to the fact that there is a wide array of production strategies – in terms of its intensity and diversity – that can be developed in future research.

Despite these limitations, this study sheds some light on the process of decision-making about organic wine. Although agricultural economists have shown interest in



the resource-based view and cluster approach, surprisingly little empirical attention has been paid to the role of human resources and agglomeration in relation to organic production. Since modelling the decisions of established wineries can provide a useful benchmark for future decision making, our findings may be of considerable value to winery managers faced with the complex decision of producing organic wine to deal with the intense competition in the wine industry.

## Authors' contributions

**Conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, writing – review & editing:** N. Dejo-Oricain, M. Fernández-Olmos, A. F. Gargallo-Castel.

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