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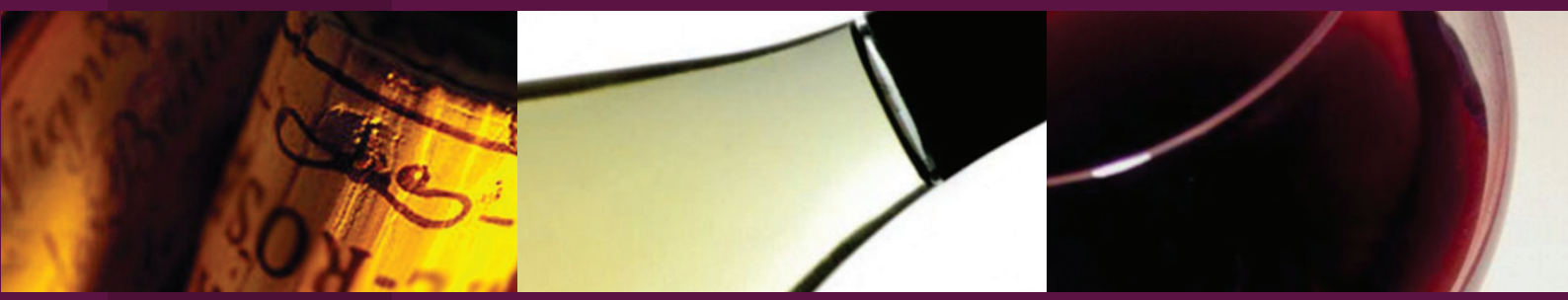

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Productive efficiency of wine grape producers in the North of Portugal

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Abstract. Portugal is a country traditionally dedicated to viticulture and characterized by the production of wines of high quality. It has been among the top of 15 countries in the sector in terms of vineyard area extension and wine production, however in recent years Portugal have lost market share in these fields. This situation can be related to the level of productive efficiency of vineyards. Therefore, this study aims to analyse the productive efficiency of wine-growing farms and the determinants that make farms more efficient. The specific hypothesis to be tested is if structural factors of the wine grape farms are determinant of its productive efficiency. To achieve this purpose, we use a database collected by face-to-face surveys from a sample of 154 wine-growing farms with specific input-output information from 2017. These farms are locating in the three regions of the North of Portugal (Minho, Douro and Trás-os-Montes), which represents more than 40% of the Portuguese vineyard area. To analyse the productive efficiency of the farms, we use the Stochastic Frontier Analysis (SFA). The results show that the efficiency level in the wine-growing farms from the North of Portugal is around 68/67%, but with significant differences at regional level. Many of these discrepancies may be due to structural factors, such as the type of wine grapes and the specific characteristics of the region. In conclusion, farms must adjust production management to the existing structural characteristics.

Keywords: technical efficiency, productivity, grape production, stochastic frontier analysis.

1. INTRODUCTION

The wine market is becoming increasingly competitive and is no longer an exclusive sector of the Southern European countries (Fleming et al., 2014; Goncharuk and Figurek, 2017). Literature designates the traditionally wine-producing countries as "Old World" and as "New World" the countries

that were colonized by the former group, but the first continue to lead the 2018 market in the following order Italy, France and Spain (OIV, 2019). Portugal, being the 9th with the largest vineyard area and the 11th largest wine producer on a worldwide level, needs to improve its competitiveness position to get a better podium place in the world market and this can upstream of the sector. Viticulture is an expensive activity in the wine production (Moreira et al., 2011) and therefore it could play an important role to improve the sector competitiveness through its grapes production efficiency.

The North of the Portugal has three wine regions – Minho, Douro and Trás-os-Montes – that integrates 42% of the total vine area of the country and corresponds to 35% of the national production of wine in 2019 (IVV, 2019).

Minho is located in the Northwest of Portugal and integrates *Vinho Verde* region (Green Wine, 23.999 ha, 12,5% and 759.757 hl, 12,5% of total national) cradle of the famous *Alvarinho* variety; in the extreme northeast of the country to the north of the Douro region, there is the wine production region of Trás-os-Montes (TOM, 12.252 ha, 6,4% and 50.670 hl, 0,8% of total national); and the Demarcated Region of Douro (DRD, 43.863 ha, 22,8% and 1.259.683 hl, 20,8% of total national) is considered to be the first demarcated region of the world since 1756 (IVV, 2019). Douro is a mountain vineyard region with high slopes, which increases production costs due to the difficulty of mechanization and to the labour intensive activity. Nevertheless, it is a wine region characterized by the production of Port wine, a generous wine known internationally, where the grapes are sold at higher price.

Despite the geographical proximity of the three regions, they have very distinct characteristics in terms of climate, soil and types of wines produced. These different structural factors present in these three regions cannot be changed. Thus, the aim of this paper is to estimate the productive efficiency of the three regions of Northern Portugal and to verify if these structural factors are responsible for the different levels of efficiency.

The analysis of farms efficiency is imperative to check how the resources are being used and if its reduction can lead to the same level of production. In the farmers' vineyards context, this methodology allows to identify which ones are the most efficient and the characteristics of the system that are likely to get better performance.

This work not only contributes to the relevant literatures, as it is an original study that analysis the efficiency of grape farms in the North of Portugal, which integrates wine regions such as Minho and Trás-os-Montes never tested, besides DRD, but also overcomes the lack of data, applying face-to-face surveys at a farm level. Furthermore, the hypothesis tested are innovative, revealing new insights into the determinants of efficiency on wine grape farms.

2. LITERATURE REVIEW

2.1 Concepts and methodologies

Efficiency is linked to a very important economy premise, the scarcity of resources. Since resources are limited, the productive efficiency analysis confirms if a Decision Making Unit (DMU) is minimizing the use of productive factors to achieve a desired amount of production. This literature began with Farrell (1957) work and since that the efficiency analysis is applied to several sectors. The efficiency analysis in agriculture sector is very common and is an ascendant topic over the years (Bravo-Ureta et al., 2007; Mareth et al., 2016; Thiam et al., 2001).

To analyse the productive efficiency, two types of methodologies have been applied in the literature, the parametric and non-parametric ones. The Stochastic Frontier Analysis (SFA) is the widely used method as a parametric and stochastic approach that was introduced by Aigner, Lovell and Schmidt (1977) and Meeusen and van Den Broeck (1977), while Data Envelopment Analysis (DEA), created by Charnes, Cooper and Rhodes (1978), is the non-parametric and deterministic method most used.

Both present advantages/potentialities and disadvantages/deficiencies that have been pointed out by several authors (Alvarez and Orea, 2001; Coelli, 1995; Cullinane et al., 2006). The DEA is an easier method to apply, because does not need to specify a functional form (Lemba et al., 2012). However, to use SFA is necessary to choose a functional form that best describe the reality, because the production function is never known in practice (Farrell, 1957). The functional forms most used in empirical studies are Cobb-Douglas and Translog. In addition, the relationship of inputs and outputs is not made in DEA, in opposite to SFA (Thiam et al., 2001). The SFA allows for measurement errors (two distinct error components) besides efficiency estimation (Cullinane, Wang, Song and Ji, 2006). The random error captures noise that is beyond of control of the producer and can affect the production such as weather, disease and pest infestation (Alem et al., 2018).

Although there is no consensus on the best methodology, Lampe and Hilgers (2015) through a bibliometric analysis verified that DEA is most used (maybe because is an easier method), but the SFA had been preferred

in Agriculture and in Economics themes and DEA in Operation Research. Moreover, Oh and Shin (2015) state that DEA is chosen when it is not possible to express an algebraic form and to impose a distribution of inefficiency, whereas the SFA is preferable when it is possible to express a functional form and to assume distributions of efficiency and measurement errors. In addition, SFA includes random error that is very important in any agriculture activity, where there are factors beyond the farm's control (Alem et al., 2018; Moreira et al., 2011). For these reasons, we have chosen to use the SFA in this work as some previous studies have done (Coelli and Sanders, 2013; Moreira et al., 2011; Tóth and Gál, 2014).

2.2 Literature from previous empirical studies

Some empirical studies have analysed efficiency in wine sector and they are synthetized in Table 1.

Overall, there is a consensus in the choice of variables for output and input, with grape or wine production in quantity or value being used for output and land, labour and capital used for inputs (Aparicio et al., 2013; Brandano et al., 2019; Coelli and Sanders, 2013; Conradie et al., 2006; Freitas, 2014; Henriques et al., 2009; Marta-Costa et al.; 2017; Moreira et al., 2011; Santos et al., 2018 and 2020; Sellers-Rubio et al., 2016; Sellers-Rubio and Más-Ruiz, 2015; Tóth and Gál, 2014; Urso et al., 2018). Intermediate consumptions also has been tested by Freitas (2014) and Santos et al. (2018, 2020).

The determinants of efficiency in wine sector seems to be an important analysis in previous studies and only the research papers from Aparicio et al. (2013); Coelli and Sanders (2013); Marta-Costa et al. (2017) and Sellers-Rubio et al. (2016) have not verified their impact on productive efficiency. The variables to be tested are diverse and depend on the objective of the study and whether it is been analysed grape or wine production.

As efficiency determinants intertwined to grape production we found in the literature the specialization of the farm in viticulture, training systems, irrigation, mechanization, number of plots, age of plantation, vineyard landscaping, farm slope index, climate, land ownership, farmers' age, and transformation of grapes into wine (Henriques et al., 2009; Moreira et al., 2011; Santos et al., 2020, 2018; Urso et al., 2018). Other variables are specifically connected with wine production, which is not the focus of this study.

However, some variables could be implemented in the wine sector at any stage of production in the value chain such us farm or company experience, share of paid work or average of wages paid, education or quality of human capital, public aid, financing and investment, type of grape or wine, grapes or wine with a designation of origin and market price of grapes or wine (Freitas, 2014; Henriques et al., 2009; Moreira et al., 2011; Santos et al., 2020, 2018; Sellers-Rubio and Más-Ruiz, 2015; Tóth and Gál, 2014; Urso et al., 2018).

The factors that could influence the efficiency have been discussed by several authors among the years (Mareth et al., 2017) and the effect of specific efficiency determinants is not consensual between the previous studies. The systematic literature review in efficiency analysis of Mareth et al. (2017) offers a controversial results table on the efficiency dairy farm determinants. While some of the referenced studies show a significant impact of the location, farm size, education, farm age, among others on the farm efficiency, other studies found a non-significant relationship between them.

In the wine sector, Coelli and Sanders (2013), Moreira et al. (2011), Santos et al. (2020) and Urso et al. (2018) showed that efficiency performances between regions were significantly different in Australia, Chile, Portugal and Italy, respectively. Moreover, Sellers-Rubio and Más-Ruiz (2015), Vidal, Pastor, Borras and Pastor (2013) and Urso et al. (2018) verified significant differences in productive efficiency levels between Designations of Origin (DO) and these DO are associated with specific regions. These findings highlight the relevance of a more detailed study of production efficiency at regional level, since all previous revised studies in the wine sector show a significant impact of the location in efficiency farm performance. However, this relationship has not always been consensual in other agricultural sectors (Mareth et al., 2017). Mostly empirical studies have shown that location has a significant influence on production efficiency (e.g. Bravo-Ureta et al., 2007; Mareth et al., 2016; and Santos et al. 2021), with some exceptions (e.g. Thiam et al., 2001; and Álvarez and González, 1999).

Size is a determinant of efficiency and productivity that has been studied for quite some time (Baumol, 1967) and can influence economic performance and competitiveness. However, this relationship can be somewhat controversial (Mareth et al., 2017; Townsend et al., 1998). In the studies conducted in the wine sector the debate remains, since some have found a positive relationship with efficiency (Brandano et al., 2019; Henriques et al., 2009; Sellers and Alampi-Sottini, 2016; Sellers-Rubio and Más-Ruiz, 2015), others a negative impact (Santos et al., 2020; Urso et al., 2018) and one a non-significative influence (Santos et al., 2018).

The positive relationship between size and productivity and efficiency can be explained by increasing returns to scale (Diewert and Fox, 2010; Sheng et al., 2015), more mechanization linked to better performance

Table 1. Summary of previous empirical studies on efficiency analysis in wine sector.

Study	Sample	Methodology	Outputs	Inputs	Determinants
Conradie (2006)	70 farms in Western Cape Province of South Africa, between 2003 and 2004	SFA	Grapes in volume	Land; labour; maquinery	Location average wage; electricity in irrigation; percentage of non-bearing vines; farmers age; education
Henriques et al. (2009)	22 farms of the Alentejo region of Portugal, between 2001 and 2004	DEA	Grapes production in value	Agricultural area; labour; machinery and equipment costs; vegetal production costs; other costs	Area; experience; land ownership; irrigation; labour type; product specialization
Moreira et al. (2011)	38 Chilean wine grape producers that belong to Tecnovid and 263 observations, in 2005-2006	SFA	Grapes production per block in volume	Size of blocks; labour cost; machinery cost; other inputs (e.g. fertilizer, pesticides).	Age of plantation (>5); type of wine (red); grape quality (premium); training system (cordon); location
Brandano et al. (2019)	Unbalanced panel dataset of conventional wineries and cooperatives in the island of Sardinia, Italy, between 2004 and 2009	DEA bootstrap	Sales and earnings of wine production in value	Labour cost; capital; land	Cooperative wineries; size of board of directors of each firm; included in a specialized tasting magazine; total number of hotel beds in the municipality; amount of public aid for investment received; average temperature; average rain
Aparicio et al. (2013)	24 wine Spanish DOs, in 2010	DEA Weight Additive Model	Domestic sales and foreign sales of wine in volume	Surface area; number of wine growers	NA
Coelli and Sanders (2013)	Unbalanced panel dataset of 135 Farms (214 observations) in the Murray-Darling Basin region of Australia, between 2006-07 and 2009-10	SFA	Wine grapes in volume	Land; water; capital; labour; other inputs costs (fertiliser, fuel and chemicals)	NA
Freitas (2014)	14 European Union countries, between 1999 and 2009	DEA	Wine Production in value	Intermediate consumption costs; labour; capital	Percentage of paid labour; vineyard area; wine consumption per capita; proportion of wine destined for export; degree of specialisation.
Tóth and Gál (2014)	16 major wine producing countries, 11 of Old World and 5 of New World, over the period 1995-2007	SFA	Wine production in volume	Vineyard area; agricultural employment; net agricultural capital stock (proxy: agricultural machinery)	Openness to international trade; development of financial system; quality of human capital; wine consumption (tradition of wine); old wine world
Sellers-Rubio and Más-Ruiz (2015)	1257 Spanish wineries, which 437 are not members of any DO, and 820 are members of the 58 PDOs	DEA	Sales volume and the profit volume of wineries	Number of employees; funds of the company; level of debt	PDO; age of company; average wages paid by the company; size of company
Sellers-Rubio et al. (2016)	622 Spanish and 609 Italian wineries, between 2005 and 2013	DEA	Sales revenue and profit volume of wineries	Number of employees; equity; level of debt	NA
Marta-Costa et al. (2017)	95 observations in 5 Portuguese vineyard regions, between 1989 and 2007	DEA and SFA	Wine and grape production in value	Vineyard area; labour (hours); capital; total specific costs	NA

Study	Sample	Methodology	Outputs	Inputs	Determinants
Urso et al. (2018)	623 Italian farms in 2005 and 842 farms in 2010	DEA	Gross marketable output in value	Land; labour costs; capital	Vineyard size; investments; irrigation; mechanization; PDO; localization; yield; market price
Santos et al. (2018)	20 Portuguese farms in Douro Region, in 2016/17 season	DEA	Grape production in value	Land, labour, capital, intermediate consumption cost	Vineyard area, farmers' age, grape as main source of income, training systems (cordon), vineyard landscaping (vertical)
Santos et al. (2020)	110 Portuguese farms in Douro Region, in 2017 season	DEA	Grape production in volume	Land, labour, capital, intermediate consumption cost	Vineyard area, Training systems, vineyard landscaping, farm slope index, number of farm plots, education of the farmer/manager, viticulture as only activity, sub-region, type of wine grapes, transform grapes into wine

(Gleyses, 2007) and higher investment capacity allowing better technological progress (Hooper et al., 2002). On the other hand, Santos et al. (2020) highlight a negative relationship between those variables due to the finer management developed and the better adaptation of the production system on a smaller area.

Another highpoint regarding the determinants of efficiency is the type of wine, which was observed by Moreira et al. (2011) and Santos et al. (2020). In both cases, grapes with superior quality have a negative and significant impact on productive efficiency. The study of Santos et al. (2020) highlights a specific type of grapes of the region with higher quality, the grapes used for Port wine, which in turn are sold at much higher prices.

Taking into account the empirical evidence of the analysed studies, in which structural (e.g. region and type of wine grapes) and non-structural (e.g. traction and farm size) determinants of efficiency are included, it becomes relevant to test for the wine grape producing systems of Northern Portugal whether structural factors determine their productive efficiency.

3. METHODOLOGY AND DATA

3.1 Stochastic Frontier Analysis (SFA)

Following the above, we assume that SFA is the better methodology to use to our purpose, since it can establish the functional form for the grapes production, includes random errors (important when production is dependent on uncontrollable factors such as climate) and it can estimate efficiency levels and examines its determinants in the same stage.

Therefore, this work follows the SFA method, through the software FRONTIER 4.1, based on Battese and Coelli (1995) and with two stages in the same step, to overcome the criticized assumption of independence of the inefficiency effects in the two-stages method (Coelli, 1996).

The stochastic frontier production function was estimated by Equation 1:

$$Y_i = \exp(x_i\beta + v_i - u_i) \quad (1)$$

Where:
Y_i denotes the production for *i-th* farm (i = 1, 2, … , N);
x_i is a (1 x k) vector of values of know functions of inputs of production;
β is a (k x 1) vector of unknown parameters to be estimated;
v_i is assumed to be *iid* $N(0,\sigma^2_v)$ random errors, independently distributed of the u_i;
u_i is non-negative random variables, associated with technical inefficiency of production, which are assumed to be independently distributed, such that u_i is obtained by truncation (at zero) of the normal distribution with mean, $z_i\delta$, and variance, σ^2;
z_i is a (1 x m) vector of explanatory variables associated with technical inefficiency of production of firms over time; and
δ is an (m x 1) vector of unknown coefficients.

The technical efficiency effect, u_i, in the stochastic frontier model could be specified by Equation 2:

$$u_i = z_i\delta + w_i \quad (2)$$

Where random variable w_i is defined by the truncation of the normal distribution with zero mean and variance, σ^2.

The method of maximum likelihood is proposed for simultaneous estimation of the parameters of the stochastic frontier and the model for the technical inefficiency effects. The likelihood function and its partial derivatives with respect to the parameters of the model are presented in Battese and Coelli (1993).

The technical efficiency of production for the i-th farm at the t-th observation is defined by Equation 3:

$$TE_i = \exp(-u_i) = \exp(-z_i\delta + w_i) \quad (3)$$

Following the previous literature, to specify the production frontier functions we use 2 alternative forms, the Cobb-Douglas (equation 4 such as Moreira et al. 2011) and the Translog (equation 5 such as Coelli and Sanders, 2013), which is a more flexible functional form (e.g. Rae et al., 2006 and Jin et al., 2010):

$$\ln Q_i = \beta_0 + \beta_1 \ln Xl_i + \beta_2 \ln Xt_i + \beta_3 \ln Xa_i + \beta_4 \ln Xi_i + v_i - u_i \quad (4)$$

$$\ln Q_i = \beta_0 + \beta_1 \ln Xl_i + \beta_2 \ln Xt_i + \beta_3 \ln Xa_i + \beta_4 \ln Xi_i + 0{,}5\beta_5 (\ln Xl_i)^2 + 0{,}5\beta_6 (\ln Xt_i)^2 + 0{,}5\beta_7 (\ln Xa_i)^2 + 0{,}5\beta_8 (\ln Xi_i)^2 + \beta_9 \ln Xl_i \ln Xt_i + \beta_{10} \ln Xl_i \ln Xa_i + \beta_{11} \ln Xl_i \ln Xi_i + \beta_{12} \ln Xt_i \ln Xa_i + \beta_{13} \ln Xt_i \ln Xi_i + \beta_{14} \ln Xa_i \ln Xi_i + v_i - u_i \quad (5)$$

These variables of regressions are described in Table 2.

3.2 Data

The data used for this work was gathered from a sample of 154 grape producers of the North of Portugal and he agricultural season of inquiry was 2017 (cross-sectional data).

The data were collected through face-to-face surveys of winegrowers and/or entrepreneurs that were generally contacted in advance by their farmers' associations or cooperative wineries. The questionnaire was appreciated by the head of this structures and also by experts from the scientific areas involved and then it was pretested. The survey data included information about the respondent and the entrepreneur, farm, vineyard, its inputs and outputs, costs and yields and information on environmental and social issues. The gathered data was then validated by a formal meeting through the World Café model realized at 2019, that was attended by around forty representatives of associations and viticulturists from the various geographical areas under study. The event was developed around two small-groups rounds of questions dedicated to (1) presentation and discussion of the results obtained; and (2) the future of viticulture. In the first panel the aim was to explore and justify the findings and, in the second panel, to identify the main variables of the system that the sector's agents consider relevant for its analysis and evolution.

The variables used for output, input and as explanatory variables of efficiency were chosen according with (1) the characteristics of the activity in the North of Portugal, which were collected by the surveys and (2) the variables used in previous empirical studies (Brandano et al., 2019; Coelli and Sanders, 2013; Fuensantana et al., 2015; Marta-costa et al., 2017; Moreira et al., 2011; Santos et al., 2018; Sellers-Rubio et al., 2016; Sellers-Rubio and Más-Ruiz, 2015; Urso et al., 2018). Both procedures conduct to the output and inputs variables that are described in Table 2.

The explanatory variables of efficiency translate not only the characteristics of region profiles from the North of Portugal and the chosen variables in the previous studies, but also the availability of data. As output (grapes production) and input (land, labour, capital and intermediate consumption costs) variables we used the most consensual determinants found in the previous studies. As explanatory variables we included the size of the vineyard, which is a determinant of preference in the agriculture sector (Freitas, 2014; Henriques et al., 2009; Santos et al., 2020, 2018; Sellers-Rubio and Más-Ruiz, 2015; Urso et al., 2018); the number of plots that revealed a significant effect on grapes production efficiency of Douro in the study of Santos et al. (2020); and the mechanization, reflected by the number of hours of traction, was considered forasmuch as an unusual behaviour in this variable due to the different landscape physiography of the region.

The geographical location and type of wine produced were also tested as determinants in the efficiency approach by virtue of the structural context of the region of study. In this matter, Moreira et al. (2011) show that red and premium grapes affect efficiency negatively which makes more relevant the inclusion of Port and Alvarinho wines production as explanatory variables, due to the quality of this type of wine with the correspondingly highest remuneration on the market. In our sample, the Port grapes are the most expensive (1,21€ versus 0,41€ in the regular grapes). All these variables and their descriptive statistics are shown in Table 2.

The analysis of Table 2 shows a large discrepancy of the variables from the grape farms contacted, but supported in a large distinct sample of farms.

Table 2. Descriptive Statistics of Inputs and Outputs used from the database collected.

Type of Variables		Average	Standard-deviation	Min.	Max.
Output	Production (kg) - *Q*	81079.48	134245.31	3300.00	900000.00
Input	Land (ha) - *Xl*	14.00	25.94	1.00	184.38
	Labour (days) - Xt	768.91	1725.27	42.33	12602.64
	Capital (Amortization €) - *Xa*	6784.86	9627.89	0.00	72701.03
	Intermediate Consumption (€) - *Xi*	21009.67	40716.13	634.38	449861.15
Explanatory	Vineyard size (index)	100.00	185.28	7.14	1316.99
	Plots (number)	5.82	5.97	1.00	51.00
	Port wine (%)	30.59	26.87	0	1
	Alvarinho (%)	6.34	23.47	0	1
	Traction (hours/ha)	32.85	14.22	0	74.48

4. RESULTS AND DISCUSSION

Table 3 contains the results of efficiency estimation using Equation 3 for Cobb-Douglas and Translog functional forms. In general, we could see that the average efficiency and efficiency scores trends in Table 3 are almost identical in both specifications. The average efficiency for the farms that produce grapes are around 68 and 67% and its efficiency levels are very discrepant between the production units. Relatively to the regions, Minho appears to be the most efficient region (0.9859 and 0.9898), while the most inefficient is Trás-os-Montes region (0.4776 and 0.4877).

The size class of the farms has also proved relevant in the achieved efficiency levels, but in a conversely way. The farms that have more than 20 ha have the lower average efficiency scores (0.5915 and 0.4470) and the smallest ones have highest average efficiency scores (around 0.72).

The classes of plots, which coincide with its quartiles, show an increase of its efficiency scores with the number of plots, but it is in the class with the highest number of plots (above 6) the efficiency values decreased. The data collected by the surveys exposes that when the size of the farms increases, the number of plots also increases, however this variable appears to have distinct influences on efficiency scores (Table 3). The situation can be explained in two ways. On the one hand, less plots may lead to a lower use of production factors (lower costs), such as traction, which will conduct to greater efficiency. On the other hand, a larger number of plots may allow a better adaptation of the system used in each plot to its conditions and consents to higher efficiency level. This situation was also reported in the recent study of Santos et al. (2020).

Relatively to the traction, we observe a general positive relationship between this production factor and the average of efficiency of farms.

Table 4 reports the results of SFA gathered with Equation 4 and 5, that uses a Coob-Douglas and a Translog functional forms and regress the inputs and determinants of inefficiency in the same stage. Observing the LR test-statistic (2) we cannot reject the null hypothesis of using Cobb-Douglas versus Translog. As an alternative, we present the results of both, since the Translog is considered a less restrictive form. Moreover, the results presented by this second alternative are very similar, reinforcing robustness and adding information that may be of interest to the discussion. Observing the LR test-statistic (1), the determinants of inefficiency present a clear overall significance in the both models. However, when Translog is used, there are more factors that are significant (size, plots, Douro and traction).

All coefficients of productive factors are positive and they demonstrate a direct relationship with production. All inputs variables are significative, except capital in the Cobb-Douglas specification and labour in the Translog functional form. According to the partial elasticity of production, the most influential variable are land in the two models (0.6553 and 0.597). All significative inputs variables are significative at 1%, with exception of labour in the Cobb-Douglas that are significative at 10%.

The results of both specifications show that Trás-os-Montes region and Port wine grapes influence negatively and significantly (at 5% and 1% respectively) the farms efficiency performance. In addition, the Translog model, show that the number of plots influence the efficiency levels positively and significantly (at 1%), while the vineyard size, Douro region and the traction affect it negatively and also significantly (at 10%, 5% and 5% respectively).

Firstly, the farms that produce more percentage of grapes intended for Port wine are more inefficient. This is in agreement with Santos et al. (2020). In addition, Moreira et al. (2011) also verifies that some type of wine grapes (red and premium) influences the farms efficiency

Table 3. Average efficiency scores.

Variables		Observations	Average efficiency – Cobb-Douglas	Average efficiency - Translog
North		154	0.6814	0.6706
Region	Douro	110	0.6058	0.5885
	Minho	34	0.9859	0.9898
	TOM	10	0.4776	0.4877
Farm dimension (ha)	[1;5[	51	0.7129	0.7254
	[5;10[	47	0.7161	0.7221
	[10;20[	37	0.6400	0.6253
	≥20	19	0.5915	0.4843
Plots (number)	[0;3[	35	0.6477	0.6484
	[3;4[	24	0.6909	0.6925
	[4;7[	54	0.7196	0.7204
	≥7	41	0.6542	0.6110
Type of wine (%)	Port	108	0.5997	0.5817
	Alvarinho	12	0.9876	0.9915
	Others	34	0.8328	0.8397
Traction (hours)	[0;23,06[	38	0.6320	0.6189
	[23.06;29.92[	39	0.6427	0.6092
	[29,92;42,52[	39	0.6991	0.6951
	≥42,52	38	0.7523	0.7600

Note: Plots and Traction intervals are based on quartiles.

scores. The lower yields of this grapes of higher quality and the severe and protective regulation, which imposes limits to the production of the Port wine, can be the reason for its lower levels of efficiency. However, the situation is compensated by the higher prices pay per kg of grapes for this type of wine (1.21€) compared to the regular grapes (0.41€).

Secondly, Trás-os-Montes reveals to be the most inefficient region and this is aligned with the low relevance of this wine region of Portugal, with less land productivity from the North (3698 and 6559 kg/ha, respectively, from our database) and yet with the fewer recognized wines.

Additionally, the Translog functional form presents others results that could complement the analysis.

This model detects a negative impact of farm size and the explanation of negative influence of the farm size is supported in the results of Table 3, which present a decrease in average efficiency when the farm size increases. As a matter of fact, the farms with less than 10 hectares have higher yields with more than 6754 kg of grapes produced per hectare, while the biggest farms (≥ 20 ha) have the lowest productivity (5715 kg/ha). In addition, the small farms benefit from a larger share of family labour and the biggest farms of our database present the highest average real costs per hectare (3545 €/ha against 3371 of the total average). This inverse relationship between size and efficiency is supported in some previous studies (e.g. Akamin, Bidogeza, Minkoua and Afari-Sefa, 2017; Chen, Huffman and Rozelle, 2011; Urso et al., 2018). Recently in the viticulture sector, Santos et al. (2020) also confirmed an opposite connection of the same variables, in the Portuguese Douro region.

The findings with the number of plots in Translog specification are also consistent with Table 3 and corroborate the affirmation of the management of the production system can be more specific to the characteristics of land and the type of grapes when land are divided in plots. Also the work of Moreira et al. (2011) support this evidence which conduct to a more efficient production system.

Although the size of the farm and the plots have a direct and positive relationship between them, they have an opposite influence on efficiency as already predicted by the results of Table 3.

Besides Trás-os-Montes, Douro demonstrates to be less efficient than Minho (in the Translog specification) and several indicators can support this result. Douro has lower productivity (5784 kg/ha against 9909 in Minho) and it is more labour-intensive (53 days/ha against 48 in Minho) due to the mountain viticulture that characterizes the region which exacerbates the difficulties of mechanisation and, in turn, increases the production costs. This is also confirmed in the Hogg and Rebelo (2018) study, which refer Douro as very dependent on labour, a scarce production factor in the region and in the sector.

The importance of the region in efficiency scores has been demonstrated in many previous studies such as Bravo-Ureta et al., (2007); Coelli and Sanders (2013); Mareth et al., (2016); Moreira et al. (2011); Santos et al., (2020); Sellers-Rubio and Más-Ruiz (2015); Thiam et al., (2001); Urso et al. (2018) and Vidal et al. (2013).

Yet, the grapes used for Port wine are produced only in the Douro region and they show a negative relationship with efficiency levels. However, the prices charged for these types of grapes can compensate its production and originate a positive impact on profitability, as mentioned before. Relatively to the Alvarinho type of wine, it was not proved any significant influence on farms productive efficiency.

The traction per hectare, when used more intensively, leads to higher farm costs and a negative relationship with production efficiency. This result make sense and it is in accordance with Urso et al. (2018), but the authors measured the use of the production factor in horsepower. However, the mechanization is important to make

Table 4. Results of SFA.

Variables Frontier Production Function	Cobb-Douglas specification Coefficient	Translog specification Coefficient
Constant	0.4385*** (0,0697)	0.4091*** (0.0616)
ln*Xl*	0.6553*** (0,1244)	0.5971*** (0.1169)
ln*Xt*	0.1883* (0,1020)	0.1588 (0.0987)
ln*Xa*	0.0282 (0,0358)	0.1612*** (0.0543)
ln*Xi*	0.1826*** (0,0639)	0.1983*** (0.0747)
$0{,}5(\ln Xl)^2$		-0.3580 (0.5061)
$0{,}5(\ln Xt)^2$		-0.0852 (0.4319)
$0{,}5(\ln Xa)^2$		0.0195 (0.0331)
$0{,}5(\ln Xi)^2$		-0.0653 (0.1234)
ln*Xl* ln*Xt*		0.1674 (0.4218)
ln*Xl* ln*Xa*		0.1712 (0.1534)
ln*Xl* ln*Xa*		-0.0575 (0.2179)
ln*Xt* ln*Xa*		-0.0622 (0.1480)
ln*Xt* ln*Xi*		0.1114 (0.1478)
ln*Xa* ln*Xi*		-0.0076 (0.0807)
Constant	-0.7636 (0,6073)	-0.5952*** (0.2050)
Size	0.0003 (0,0003)	0.0011* (0.0006)
Plots	-0.0068 (0,0048)	-0.0105*** (0.0039)
Douro	0.6647 (0,5105)	0.4690** (0.2314)
Trás-os-Montes	1.4488** (0,5871)	1.2538*** (0.2726)
Port	1.3672*** (0,1907)	1.3836*** (0.2264)
Alvarinho	-0.1551 (0,6162)	-0.0989 (0.0988)
Traction	0.0021 (0,0020)	0.0017** (0.0008)
Sigma-squared	0.1351*** (0,0147)	0.1208*** (0.0121)
Gamma	0.0846*** (0,0171)	0.0518** (0.0265)
LR test-statistic (1)	94.19***	99.14***
LR test-statistic (2)	15.54	

*, **, *** Significance at 10%, 5% and 1%, respectively. Standard error in parentheses.
(1) This test-statistic allows us to test the hypothesis of the absence of inefficiency effects.
(2) This test-statistic allows us to test the Cobb-Douglas versus Translog specification.

the production process faster and can solve the labour shortage in the region and others studies proved their importance (Abass et al., 2017; Hormozi et al., 2012; Park et al., 2018).

In this sense, the hypothesis that structural factors are responsible for different efficiency levels should be accepted, since the intrinsic characteristics of the region and the type of wine specifically produced in a location affect farm efficiency. In addition, the farm size and number of plots can be difficult to change as it can be associated with structural characteristics of the region such as slope, topography of the land and social characteristics. Furthermore, efficient mechanization can be difficult when it comes to a region like Douro where mountain viticulture with steep slopes prevails.

5. CONCLUSION

Productive efficiency analysis is crucial to verify whether the wine-growing farms are using the available resources efficiently to produce grapes and to identify which characteristics make the farms less efficient.

To analyse efficiency in the wine grapes farms of the Northern of Portugal, SFA was used, because it allows to separate the efficiency from other factors through random errors, which is essential for agriculture that has many external factors affecting its production and efficiency. In addition, the use of two specifications (Cobb-Douglas and Translog) allowed for more robustness of the results since both model findings are similar and complement each other.

This study estimates an average efficiency score in North of Portugal around 0.68/0.67, leading to the conclusion that farms can improve their efficiency by 32/33%. The most significant determinants in both models were Trás-os-Montes region and the production of Port wine grapes, which were shown to have a negative influence on farm efficiency. In addition, the Translog specification also shows that the number of plots and Minho region positively affect farm efficiency, while the size of vineyards, Douro region and traction have a negative impact.

We can conclude that most variables that affect efficiency are structural and therefore cannot be changed (e.g. region and specific type of wine grapes produced), whilst other determinants are difficult to modify (e.g. farm size or number of plots). Hence the producer cannot do much to improve farm efficiency in this perspective. We believe that these structural factors or intrinsic characteristics explain the main differences in efficiency between regions such as edapho-climatic conditions and the type of wine produced exclusively in one region (Alvarinho and Port Wine).

However, this study makes reference to some performance determinants that are likely to change, such as farm size, number of plots and traction hours. In this sense, the policies that support parcelling can be questioned, since the small farms (predominant in the region) and the ones with a larger number of plots are the most efficient. Relatively to the use of traction, despite its inefficient use, this practice is important for those regions where labour is increasingly scarce, notwithstanding its difficulty in mountain viticulture region like Douro.

Minho as undoubtedly the most efficient region (0.99) against Trás-os-Montes (0.48 and 0.49) and Douro (0.61 and 0.59). Therefore, despite its intrinsic characteristics, Minho seems to use its production factors more efficiently and the region can be used as a model for the others geographical areas to adopt better production routines or new technologies.

In conclusion, the farms will be more efficient if its management fits the specific structural factors (climate, soil type, slope of the land, type of grapes, economy, market, crop size, complexity of the production process that are mostly specific to the region, the farm, or even the plot). However, each farm is unique and has a set of inimitable resources that makes them more heterogeneous. Thus, it is expected that farms operating in different contexts, with distinct technologies, resources and using diverse combinations of them will have dissimilar levels of efficiency.

Although this paper studies the efficiency of the viticulture sector, the profitability of the farm has been the most important management issue. Small farms can be more efficient due to more precise practices, where their managers or farmers control and identifies its needs more easily. However, since big farms transform 83% of their grapes into wine (11% of the sample with an average of 65 ha), they can earn more at the end of the value chain. Grapes production for Port wine may be inefficient, but the price paid per kilogram of grapes (1.21€ against 0.41€ for still wine in Douro) makes them more profitable. Taking these conclusions into consideration, an analysis of the grape farms profitability and efficiency-related would be important for future research together with its contribution to the sustainability of production systems.

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REFERENCES

Abass, A., Amaza, P., Bachwenkizi, B., Wanda, K., Agona, A., Cromme, N., 2017. The impact of mechanized processing of cassava on farmers' production efficiency in Uganda. Appl. Econ. Lett. 24, 102–106. https://doi.org/10.1080/13504851.2016.1167817

Aigner, D., Lovell, C.A.K., Schmidt, P., 1977. Formulation and estimation of stochastic frontier production function models. J. Econom. 6, 21–37.

Akamin, A., Bidogeza, J.-C., Minkoua N, J.R., Afari-Sefa, V., 2017. Efficiency and productivity analysis of vegetable farming within root and tuber-based systems in the humid tropics of Cameroon. J. Integr. Agric. 16, 1865–1873. https://doi.org/10.1016/S2095-3119(17)61662-9

Alem, H., Lien, G., Hardaker, J.B., 2018. Economic performance and efficiency determinants of crop-producing farms in Norway. Int. J. Product. Perform. Manag. 67, 1418–1434. https://doi.org/10.1108/IJPPM-01-2018-0026

Álvarez, A. M., González, E., 1999. Using Cross-Section Data to Adjust Technical Efficiency Indexes Estimated With Panel Data. Am. J. Agric. Econ.. 81, 894-901. https://doi.org/10.2307/1244332

Alvarez, A., Orea, L., 2001. Different approaches to model multi-species fisheries using a primal approach. Effic. Ser. Pap. 3, l.

Baumol, W. J., 1967. Macroeconomics of unbalanced growth: the anatomy of urban crisis. Am. Econ. Rev., 57, 415-426.

Brandano, M.G., Detotto, C., Vannini, M., 2019. Comparative Efficiency Of Agricultural Cooperatives And Conventional Firms In A Sample Of Quasi-Twin Companies. Ann. Public Coop. Econ. 90, 53–76.

Bravo-Ureta, B.E., Solís, D., Moreira López, V.H., Maripani, J.F., Thiam, A., Rivas, T., 2007. Technical efficiency in farming: A meta-regression analysis. J. Product. Anal. 27, 57–72. https://doi.org/10.1007/s11123-006-0025-3

Charnes, A., Cooper, W.W., Rhodes, E., 1978. Measuring the efficiency of decision making units. Eur. J. Oper. Res. https://doi.org/10.1016/0377-2217(78)90138-8

Chen, Z., Huffman, W.E., Rozelle, S., 2011. Inverse relationship between productivity and farm size: The case of China. Contemp. Econ. Policy 29, 580–592. https://doi.org/10.1111/j.1465-7287.2010.00236.x

Coelli, T.J., 1995. Recent developments in frontier modelling and efficiency measurement. Aust. J. Agric. Resour. Econ. 39, 219–245.

Coelli, T.J., 1996. A guide to FRONTIER version 4.1: a computer program for stochastic frontier production and cost function estimation. CEPA Working papers.

Coelli, T.J., Sanders, O., 2013. The technical efficiency of wine grape growers in the Murray-Darling Basin in Australia, in: Wine Economics. Springer, pp. 231–249.

Conradie, B., Cookson, G., Thirtle, C., 2006. Efficiency and farm size in Western Cape grape production: Pooling small datasets. South African J. Econ. 74, 334–343.

Cullinane, K., Wang, T.F., Song, D.W., Ji, P., 2006. The technical efficiency of container ports: Comparing data envelopment analysis and stochastic frontier analysis. Transp. Res. Part A Policy Pract. 40, 354–374. https://doi.org/10.1016/j.tra.2005.07.003

Diewert, W., Fox, K., 2010. Malmquist and törnqvist productivity indexes:returns to scale and technical progress with imperfect competition. J. Econ., 101, 73–95. https://doi.org/10.1007/s00712-010-0137-0

Farrell, M.J., 1957. The measurement of productive efficiency. J. R. Stat. Soc. Ser. A 120, 253–290.

Fleming, E., Mounter, S., Grant, B., Griffith, G., Villano, R., 2014. The New World challenge: Performance trends in wine production in major wine-exporting countries in the 2000s and their implications for the Australian wine industry. Wine Econ. Policy 3, 115–126. https://doi.org/10.1016/j.wep.2014.12.002

Freitas, R., 2014. Sobre a eficiência dos países produtores de uvas para vinho na União Europeia : uma aproximação DEA em duas etapas. Master thesis in Universidade Católica Portuguesa.

Fuensantana, M.J.R., Sancho, F.H., Marco, V.S., 2015. In vino veritas : competitive factors in wine-producing industrial districts. J. Reg. Res. 32, 149–164.

Gleyses, G., 2007. Rendement d'échelle et économies d'échelle en agriculture. In: T.editor (Ed.), Cemagref, Action 4, UMR G-Eau, Montpellier, p. 29, politiquespubliques, aversion au risque des agriculteurs et demande en eau d'irrigation.

Goncharuk, A.G., Figurek, A., 2017. Efficiency of winemaking in developing countries. Int. J. Wine Bus. Res. 29, 98–118. https://doi.org/10.1108/IJWBR-02-2016-0007

Henriques, P.D. de S., Carvalho, M.L. da S., Fragoso, R.M. de S., 2009. Technical efficiency of portuguese wine farms. New Medit 8, 4–9.

Hogg, T., Rebelo, J. (2018), Rumo estratégico para o setor dos vinhos do Douro e Porto. ISBN: 978-989-704-344-4, Vila Real: UTAD.

Hooper, S., Martin, P., Love, G., Fisher, B. S., 2002. Farm size and productivity: where are the trends taking us?. Aust Commod, 9, 495.

Hormozi, M.A., Asoodar, M.A., Abdeshahi, A., 2012. Impact of Mechanization on Technical Efficiency: A Case Study of Rice Farmers in Iran. Procedia Econ. Financ. https://doi.org/10.1016/s2212-5671(12)00021-4

IVV (2019). Dados Estatísticos do setor vitivinícola. Instituto da Vinha e do Vinho.

Lampe, H.W., Hilgers, D., 2015. Trajectories of efficiency measurement: A bibliometric analysis of DEA and SFA. Eur. J. Oper. Res. 240, 1–21. https://doi.org/10.1016/j.ejor.2014.04.041

Lemba, J., D'Haese, M., D'Haese, L., Frija, A., Speelman, S., 2012. Comparing the technical efficiency of farms benefiting from different agricultural interventions in Kenya's drylands. Dev. South. Afr. 29, 287–301. https://doi.org/10.1080/0376835X.2012.675698

Mareth, T., Thomé, A. M. T., Scavarda, L. F., Oliveira, F. L. C., 2017. Technical efficiency in dairy farms: research framework, literature classification and research agenda. Int. J. Product. Perform. Manag., 66, 380-404.

Mareth, T., Thomé, A.M.T., Cyrino Oliveira, F.L., Scavarda, L.F., 2016. Systematic review and meta-regression analysis of technical efficiency in dairy farms. Int. J. Product. Perform. Manag. 65, 279–301. https://doi.org/10.1108/IJPPM-02-2015-0027

Marta-costa, A., Martinho, V., Santos, M., 2017. Productive Efficiency of Portuguese vineyard regions. Reg. Sci. Inq. IX, 97–107.

Meeusen, W., van Den Broeck, J., 1977. Efficiency estimation from Cobb-Douglas production functions with composed error. Int. Econ. Rev. (Philadelphia). 435–444.

Moreira, V.H., Troncoso, J.L., Bravo-Ureta, B.E., 2011. Technical efficiency for a sample of Chilean wine grape producers: A stochastic production frontier analysis. Cienc. e Investig. Agrar. 38, 321–329. https://doi.org/10.4067/S0718-16202011000300001

Oh, S.-C., Shin, J., 2015. The impact of mismeasurement in performance benchmarking: A Monte Carlo comparison of SFA and DEA with different multi-period budgeting strategies. Eur. J. Oper. Res. 240, 518–527. https://doi.org/10.1016/j.ejor.2014.07.026

OIV (2019). 2019 Statistical Report on World Viticulture. International Organization of Vine and Wine.

Park, A.G., McDonald, A.J., Devkota, M., Davis, A.S., 2018. Increasing yield stability and input efficiencies with cost-effective mechanization in Nepal. F. Crop. Res. https://doi.org/10.1016/j.fcr.2018.08.012

Santos, M., Marta-Costa, A., Santos, C., Galindro, A., 2018. Efficiency of wine grape growers at farm level: a case study. E3S Web Conf. 50, 01010. https://doi.org/10.1051/e3sconf/20185001010

Santos, M., Rodríguez, X.A., Marta-Costa, A., 2020. Efficiency analysis of viticulture systems in the Portuguese Douro region. Int. J. Wine Bus. Res. https://doi.org/10.1108/IJWBR-10-2019-0052

Santos, M.; Marta-Costa, A.; Rodríguez, X. A., 2021. Meta-regression analysis of technical (in)efficien-

cy in agriculture: a regional approuch. Econ. Reg. forthcoming.

Sellers-Rubio, R., Alampi Sottini, V., Menghini, S., 2016. Productivity growth in the winery sector: evidence from Italy and Spain. Int. J. Wine Bus. Res. 28, 59–75. https://doi.org/10.1108/IJWBR-05-2015-0019

Sellers-Rubio, R., Más-Ruiz, F.J., 2015. Economic efficiency of members of protected designations of origin: sharing reputation indicators in the experience goods of wine and cheese. Rev. Manag. Sci. 9, 175–196. https://doi.org/10.1007/s11846-014-0124-x

Sheng, Y., Zhao, S., Nossal, K., Zhang, D., 2015. Productivity and farm size in Australian agriculture: reinvestigating the returns to scale. Aust. J. Agric.Resour. Econ. 59, 16–38. https://doi.org/10.1111/1467-8489.12063

Thiam, A., Bravo-Ureta, B.E., Rivas, T.E., 2001. Technical Efficiency in developing country agriculture: a meta-analysis. Agric. Econ. 25, 235–243.

Tóth, J., Gál, P., 2014. Is the New Wine World more efficient? Factors influencing technical efficiency of wine production. Stud. Agric. Econ. 116, 95–99. https://doi.org/10.7896/j.1411

Townsend, R. F., Kirsten, J., Vink, N., 1998. Farm size, productivity and returns to scale in agriculture revisited: a case study of wine producers in South Africa. Agric. Econ., 19, 175-180. https://doi.org/10.1111/j.1574-0862.1998.tb00524.x

Urso, A., Timpanaro, G., Caracciolo, F., Cembalo, L., 2018. Efficiency analysis of Italian wine producers. Wine Econ. Policy 7, 3–12. https://doi.org/10.1016/j.wep.2017.11.003

Vidal, F., Pastor, J.T., Borras, F., Pastor, D., 2013. Efficiency analysis of the designations of origin in the Spanish wine sector. Spanish J. Agric. Res. 11, 294–304. https://doi.org/10.5424/sjar/2013112-3607

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Organic and conventional grape growing in Italy: a technical efficiency comparison using a parametric approach

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Absract. Several studies have focused attention on the differences between organic and conventional farms in terms of efficiency, and controversial findings have resulted from these applications. One source of controversy concerns the assumption about the frontier(s) adopted for the comparison: a common frontier or two separate frontiers for organic and conventional methods? This paper aims to estimate technical efficiency in Italian grape farming. A stochastic frontier analysis (SFA) was applied to a sample of 531 farms (440 conventional and 91 organic farms) collected from the Farm Accountancy Network Database. Among others, a test for evaluating whether a unique or separate frontier was performed. The findings suggest that organic and conventional farms would lie on a common frontier and that organic farms have greater capacity than conventional farms in using their technical inputs (efficiency amounts to 83.6% and 77.8%, respectively). Several implications derive from these findings.

Keywords: stochastic frontier analysis, technological homogeneity, inefficiency sources.

1. INTRODUCTION

Organic farming is a well-established reality in Europe, where it has been regulated since 1991. One of the most debated topics in this field consists of measuring organic and conventional agriculture's technical and economic performance [1] to highlight similarities and differences. Comparison between organic and conventional farming is a very interesting field of research where different approaches have been adopted to find out differences between the two systems mainly to compensate for organic farming additional costs and income foregone. The assumption is that the organic method discounts a gap on the production level compared to conventional agriculture [2,3].

This paper tries to give evidence of the effective differences in terms of technical efficiency in using inputs by farms as controversial findings have been found on this topic. The analysis is focused on the European grape-growing sector since the relevance of the organic wine sector and because the European Union (EU) accounts for 49% of the world grape-growing area [4]. Italy is the country that devotes the larger land in the world to organic grape-growing [5]. Specifically, Italian organic vineyards covered about 110K hectares (23% in conversion), corresponding to 15.5% of the total world organic vineyards area [4].

Estimating differences in grape-growing productivity is a crucial issue for better addressing policies and strategies in the sector. At the same time, assessing the role of efficiency in affecting production would provide useful information for understanding if the gap that organic grape-growing pays is only attributable to different productivity – therefore to the adoption of a less performing technology than the conventional one – or, vice versa, to another ability in using the inputs bundle.

This paper aims to provide a comparative analysis between Italian organic and conventional farms by estimating productivity and efficiency to confirm if a real difference in productivity exists and to evaluate the role of efficiency in affecting observed production level.

This paper also tackles the debate on the typology of frontiers that must be used to compare organic and conventional farms. The question turns on the consideration of organic and conventional orientation as two different techniques within a single technological horizon or, conversely, as two different technologies that, in turns, refer to two different types of agriculture that are not directly comparable. In this context, some conceptual and methodological problems arise and should be addressed: a) firstly, the risk is to consider systems that are not homogeneous from a technological or organisational point of view because organic farming is developed on well-defined production processes and use of technical inputs; b) secondly, conventional agriculture can be considered as a jumble of a plethora of agronomic techniques, some of them very close to the organic method, and it is difficult to trace back to a well-defined technical-production paradigm.

Regarding the latter aspect, conventional agriculture can be understood as the most widespread practice in each territory or, conversely, all alternative techniques to the organic method can be included in this category [6]. The answer to this question has pivotal implications. In the first case, due to the use of the same frontier for the two orientations and thus the possibility of directly comparing them, any different productivity levels are mainly determined by inefficiencies rather than by actual technological gaps. Conversely, the two measures are not comparable in the second case because of the difference in productivity derived from both inefficiencies and the different technology adopted by the two production orientations. This implies that the efficiency measure must be related to specific production frontiers, one for the organic method and one for the conventional one.

The remainder of this paper is organised as follows. Section 2 provides a review of the literature on efficiency estimation between organic and conventional agriculture and some information on the organic wine market. The research methodology and sample description are illustrated in Section 3. Section 4 shows the research results and discussion, and Section 5 concludes our paper, outlines the implications for practitioners, academics, and policymakers, and makes recommendations for future research.

2. BACKGROUND

Using an efficiency analysis, the manuscript aims to fill the gap in the current literature. In fact, although numerous studies have appeared on wine grape farms in other geographical contexts, these efficiency analyses have been applied without distinguishing between organic and conventional farming [7–12].

Concerning this sort of comparison research between organic and conventional wine grape farms, some controversial pieces of evidence have been provided by Bayramoglu and Gundogmus [13] on the Turkish sector, Tzouvelekas et al. [14] on Grecian farms, and Guesmi et al. [15] regarding Spain. Furthermore, Aldanondo-Ochoa et al. [16] analysed environmental and economic efficiency in the Spanish sector. Previous studies on organic farming have focused on the relationship between environment and competitiveness and the different use of resources between organic and conventional farms that green approaches could produce in terms of efficiency [17,18].

Other scholars have put attention on the comparisons related to production practices, yields and economic performance [2,3,19,20] or again on profitability [21]. Other recent studies have used meta-analysis to compare different countries' situations by implementing various methods and approaches, which gave evidence of the environmental and economic comparisons [22–25].

Still, some studies have assessed the agri-environmental schemes and organic measure impact of rural development policies [26–29]. Particular attention has been paid to estimating the technical and economic efficiency [30–34], and out of which conflicting results have

emerged. On the one hand, studies focused on farm technical efficiency analysis – applying parametric or non-parametric techniques – have analysed both desirable and non-desirable outputs (ex. pollution) in different crop productions. These studies showed that it is not so evident that organic farms are less profitable and/or less efficient than conventional ones. Lansink et al. [35] compared crop and livestock farms in Finland, finding that organic crop is more efficient than conventional farming considering capital, land, labour, energy as inputs and the revenue as output. A study on the coffee sector in Nepal [36] found that organic farms are more efficient than conventional ones in terms of production, inter/shade crops, considering farm size, capital, labour cost, fertiliser and plant protection as inputs.

Tzouvelakas et al. [37], analysing the olive sector in Greece applying a Stochastic Frontier Analysis (SFA), found that organic crop is more efficient than conventional farming. On the other hand, the Data Envelopment Analysis (DEA) technique applied on the studies of Damara et al. [38], Alkahtani and Elhendy [39], Beltrán-Esteve and Reig-Martínez [40], confirms the greater efficiency of conventional farms respectively as production, total revenue and sales are concerned.

In the same vein, Madau [34] and Serra and Goodwin [41], using the SFA to analyse the cereal sector in Italy and Spain, respectively, concluded that conventional farms are more efficient in terms of income and production terms. Kramol et al. [42] analysed the efficiency of vegetable farms in Thailand, considering the revenue as the output variable, finding that conventional farms are more efficient than organic ones. Tiedemann and Latacz-Lohmann [43] concluded the same for a group of arable farms in Germany. A two-stage DEA approach was performed to compare organic and conventional rain-fed cereals in Spain [44]. The results show that organic farms are more efficient in term of input consumption and GHG emissions.

A Local Maximum Likelihood (LML) approach was proposed by Guesmi et al. [15] to compare the efficiency levels of organic and conventional farms in Egypt. They found that results are slightly better for organic farms. Organic farms in Switzerland, Austria and Southern Germany were analysed by Lakner et al. [45] starting from the perspective of diversification and multifunctionality. They found that the benefits and drawbacks of diversification by applying a stochastic frontier combined with a metafrontier analysis estimating the effects on both productivity and efficiency.

Concerning the analysed sector, the wine market has traditionally represented an important and strategic segment of the EU agri-food system and, since the beginning of the EU Common Agricultural Policy (CAP), the wine sector policy has undoubtedly enjoyed a particular treatment [46–49].

Italy is the EU leader in terms of wine market (47,5 Mhl) – followed by France (42,1 Mhl) and Spain (33,5 Mhl) – and varieties included in the vineyard register (504), and production is well oriented to bulk wines and premium certified types, specifically PDO wines.

In this context, a remarkable role is played by organic production, which is constantly increasing in terms of the market and investments – this market is worth approximately 90 billion dollars worldwide [50] – and has highlighted growth that affects both demand and supply. Consumers look for healthy, environmentally friendly and safe wines, while producers aim at valid and marketable alternatives to conventional production to satisfy consumer demand [51–57].

Consumers with hedonistic and environmental protection values and beliefs would have a higher propensity to purchase organic wines [58,59]. Moreover, previous studies showed that the environmental benefits of organic wine production push consumers willing to pay more for it [54,57,60]. Fanasch and Frick [61] found that "organic practices are a credible signal for consumers, inducing them to pay a price premium" [61] (p. 20).

Concerning the organic certification, Abraben et al. [62] found that it exerts a positive effect on the price of low-quality rating wines, and this effect diminishes with increasing wine quality, till becoming penalising for higher quality wine. According to Ruggeri et al. [63], consumer attention and the WTP for certifications vanish when there are indications of the high quality of wine as the perception of high wine quality may generate less willingness to pay for more eco-certifications. Moreover, organic certification appears less important in the high-price segment than self-declaration [61]. Lim and Reed [64] research revealed a greater WTP for eco-labels of wines from less-prestigious regions rather than wines from higher-prestige regions, besides a greater WTP for organic wine than sustainable wines.

Preferences for organic wine are affected by socio-demographic and attitudinal variables [63]. Previous literature identifies the most frequent demographic characteristics of organic consumers: persons with higher incomes [e.g. 65–67], living in urban areas [e.g. 56,68], millennials and young adults [69,70] and women [e.g. 55,56,67]. But also the frequency of consumption [66], wine education [63] and knowledge degree of the labels [63,71].

Therefore, as eco-labelled products, organic wines allow wine producers to sell products with higher added value than conventional wines and will enable them to stay competitive in an increasingly globalised market.

3. MATERIALS AND METHODS

Technical efficiency (TE) is defined as the measure of the ability of a firm to obtain the best production from a given set of inputs (*output-increasing oriented)* or, vice versa, as the measure of the ability to use the minimum feasible amount of inputs given a level of output (*input-saving oriented*) [72,73]. In these terms, technical inefficiency is defined as the degree to which firms fail to reach optimal production.

Different methods have been proposed in the literature to estimate TE and its related measures. In this study, a stochastic frontier analysis (SFA) approach was adopted. A parametric approach was preferred to the non-parametric approach because of three inherent abilities: first, the possibility of including in a unique model the production frontier and the inefficiency models; second, the ability to estimate the input elasticities directly; and third, the possibility of testing the more appropriate function that describes the production process.

In the SFA model, the production frontier is specified, defining output as a stochastic function of a given bundle of inputs. This approach means that the error term e may be separated into two terms: a random error and a random variable explanatory of inefficiency effects as follows.

$$y_i = f(x_i, ß) \bullet \exp(\varepsilon) \text{ and } \varepsilon = (v_i - u_i) \quad i = 1,2,\ldots N \qquad (1)$$

Where y_i denotes the level of output for the i-th observation; x_i is the row vector of inputs; $ß$ is the vector of parameters to be estimated; $f(.)$ is a suitable functional form for the frontier; v_i is a symmetric random error assumed to account for measurement errors and other factors not under the control of the firm; and u_i is an asymmetric nonnegative error term assumed to account for technical inefficiency in production. The MLE (maximum likelihood estimation) of (1) allows us to estimate the vector $ß$ and the variance parameters $\sigma^2 = \sigma^2_u + \sigma^2_v$ and $\gamma = \sigma_u / \sigma_v$; where g varies between 0 and 1.

Consequently, $TE_i = \exp(-u_i)$, and the frontier production is calculated as its observed production divided by its TE_i value.

Some authors have proposed a *one-stage* method that permits contextual estimation of the inefficiency effects caused by factors that affect efficiency, assuming that inefficiency effects (u_i) are expressed as a function of a vector of observable explanatory variables . Specifically, Battese and Coelli (1995) adapted these models and proposed an approach where the inefficiency term u_i has a truncated (at zero) normal distribution with mean m_i:

$$u_i = m_i + W_i \text{ and } m_i = \mathbf{Z}(z_i, \delta) \quad i = 1,2,\ldots N \qquad (2)$$

Where W_i is a random error term that is assumed to be independently distributed, with a truncated (at $-m_i$) normal distribution with mean zero and variance σ^2; $\mathbf{Z}$ is the vector (Mx1) of the z_i firm-specific variables of inefficiency; and d is the (1xM) vector of unknown coefficients associated with z_i. In this way, we can estimate inefficiency effects arising from the z_i explanatory variables.

The model adopted by Battese and Coelli [77] was used in this study.

Data description

The information used was collected from cross-sectional data of Italian specialised grape-growing farms. Specifically, we analysed 531 farms that participated in the official Farm Accountancy Data Network (FADN) during 2017.

The dataset consists of 440 conventional and 91 organic farms. All the selected organic farms were in the maintenance phase. However, we excluded farms with less than 40K Euros of Gross Farm Revenue (GFR) from the sample to limit the risk of considering too small and not very market-oriented activities.

A summary description of the sample is reported in Table 1.

It must be emphasised that farms were included with different inputs and capital endowments. The choice depends on the need for estimating the possible difference in productivity in the sample and, more precisely, whether switching from conventional to organic in Italian grape growing affects productivity. In other words, we estimated if conventional and organic farms lie on the same technologic horizon, or vice versa, they separately describe two production functions, each one characterised by a given level of productivity. For this reason and contrary to other studies [e.g. 34], we did not select two homogeneous subsamples of farms.

For the same reason, we included both farms that produce grapes for processing PDO and GPI wine and farms that produce other wines. Indeed, analytically, we estimated whether quality orientation affects productivity or, more generally, if all farms lie or not on the same technological horizon.

Table 1 shows that, on average, organic farms appear more productive than conventional farms. However, an empirical test would suggest whether this represents a discriminating factor for considering conventional and organic as two different agricultural methods in Italian grape growing.

Table 1. Summary statistics of the collected sample.

	Conventional		Organic		Total	
Variable	Mean	s.d	Mean	s.d	Mean	s.d
Value of production (*Euros*)	196,634	*420,374*	240,784	*378,282*	204,200	*413,461*
Land area (*hectares*)	18.8	*26.0*	32.8	*39.4*	21.2	*29.1*
Labour (*working units*)	2.5	*3.2*	3.3	*3.2*	2.6	*3.2*
Annual capital depreciation (*Euros*)	13,552	*20,549*	22,505	*45,769*	15,086	*26,775*
Variable costs (*Euros*)	62,166	*184,542*	79,642	*147,163*	65,161	*178,688*
PDO and GPI (% of farms)						
Oriented	*82.4*		*85.0*		*84.6*	
No oriented	*17.6*		*15.0*		*15.4*	
Management (% of farms)						
Only or mostly family workers	*86.2*		*60.3*		*82.2*	
Only or mostly wage workers	*13.8*		*39.7*		*17.8*	
Gender of farmer (% of farms)						
Male	*81.8*		*74.7*		*80.6*	
Female	*18.2*		*25.3*		*19.4*	
Age of farmer (% of under 40)	*11.4*		*9.9*		*11.1*	
Region (% of farms)						
Northern Italy	*60.7*		*28.6*		*55.2*	
Central Italy	*28.4*		*35.1*		*29.6*	
Southern Italy	*10.9*		*36.3*		*15.2*	

Source: Authors' data processing on FADN data.

The functional model

A translog functional form was assumed as the frontier technology specification for the farms. Using the Battese and Coelli [77] procedure, the translog function is specified as follows.

$$\ln Y_i + ß_0 + \Sigma^4_{j=1} \ln x_{ji} + ½ \Sigma^4_{j\leq}\Sigma^4_{K=1} ß_{jk} \ln x_{ki} * \ln x_{ki} + S_m + S_q + R_n + R_c + R_s + A_m + A_h + A_p + (v_i - u_i) \quad (3)$$

Where the subscript i =1,2…N denotes the observation for the i-th firm and j,k = 1,2…J stand for the technical inputs used. The dependent variable (Y) represents the value (in Euros) of production and corresponds to the GFR. The bundle of inputs is composed by

X_1 is the total *land* area (expressed in UAA hectares) devoted to grapes by each farm;
X_2 is the total amount of *labour* (expressed in working units);
X_3 is the cost (Euros) of capital in terms of annual depreciation;
X_4 represents the other variable costs (Euros) supported by each farm.

Furthermore, we included other *dummy* variables that can affect grape-growing productivity and, as a consequence, determine the technological differences among farms.

First, the model involves a *dummy* variable (S_m) that considers the agronomic method practised (organic cultivation = 1; conventional cultivation = 0). The inclusion of a given variable permits us to estimate whether technological homogeneity exists between organic and conventional grape growing. In this sense, a unique technological frontier for both organic and conventional farms was assumed. The variable's eventual estimated significant effect would suggest refereeing the analysis on separate frontiers (nontechnological homogeneity). In one case (unique frontier), possible differences in estimated efficiency by the two groups would be solely related to different abilities in using technical factors available to the farmer; in the other case (separate frontiers), efficiencies cannot directly be compared because a difference in productivity also exists.

Second, a variable (S_q) that takes into account farm orientation towards the production of PDO and GPI wines was included (farms that grow grapes for PDO

and GPI wines = 1; any orientation = 0). According to this distinction, we would understand if orientation to this well-defined quality standard plays a role in conditioning productivity and efficiency, living aside the cultivation method (conventional or organic).

Finally, three *dummies* (0 = No; Yes = 1) reflecting the geographical location of the farms (Northern R_n, Central R_c, and South R_s Italy) and three other variables corresponding to altimetry (Mountain A_m, Hilly A_h, and Plane A_p) were introduced in the model.

Concerning the inefficiency effects, the model has the following form:

$$u_{it} = \delta_0 + \delta_1 Z_{i1} + \delta_2 Z_{i2} + \delta_3 Z_{i3} + \delta_4 S_m + \delta_5 S_q + \delta_6 R_n + \delta_7 R_c + \delta_8 R_s + \delta_9 A_m + \delta_{10} A_h + \delta_{11} A_p + W_i \quad (4)$$

Where Z_1 represents the type of farm management (only or mostly family workers = 0; only or mostly wage workers = 1); Z_2 represents the gender of the farmer (male = 1; female = 2); and Z_3 represents the age of the farmer.

The other variables are identified with the same dummies that appeared in the function model, whereas W_i is the error term.

4. RESULTS AND DISCUSSION

The production function and inefficiency parameters were estimated simultaneously using the computer program FRONTIER© 4.1, created by Coelli [78].

The preferable efficiency model

A set of tests was applied to evaluate the suitability and significance of the adopted model concerning the data. All tests were carried out by the generalised likelihood-ratio test procedure, which permits evaluating a restricted model with respect to the adopted model [79]. The statistic associated with this test is defined as follows:

$$l = -2\ln\Lambda = -2\left[\ln\frac{L(H_0)}{L(H_1)}\right] = -2\ln L(H_0) - \ln L(H_1)] \quad (5)$$

Where L(H1) and L(H0) are the log-likelihood values of the adopted model and the restricted model, respectively. The statistical test λ has approximately a chi-square or a mixed-square distribution with several degrees of freedom equal to the number of parameters (restrictions) assumed to be zero in the L(H0) null hypothesis. If the value of λ is lower than the corresponding critical value (for α = 0.05 significance level), the null hypothesis cannot be rejected, and therefore, the preferred model would avoid these variables.

The first test concerned the functional form of the function. The starting (null) hypothesis (Cobb-Douglas; $\beta_{ij} = 0$) was compared with the adopted hypothesis (Translog). The null hypothesis was not rejected, implying that Cobb-Douglas can be a good representation of the data.

The second test concerned the hypothesis of technological homogeneity between organic and conventional grape growing. The starting hypothesis implies that the two methods are homogenous bundles of a defined technology ($S_m = 0$), and it was compared with the adopted hypothesis of nontechnological homogeneity between the two methods ($S_m \neq 0$). The null hypothesis was not rejected. Therefore, the variable can be avoided in the preferred model, and as a consequence, organic and conventional grape-growing farms lie on a unique production frontier.

The third test concerned the comparison between the null hypothesis of invariance with respect to quality orientation ($S_q = 0$) and the hypothesis of variance ($S_q \neq 0$) *a priori* adopted. We found that the null hypothesis could not be rejected; hence, the preferred model is invariant to quality orientation.

The fourth and fifth tests were applied to the hypotheses about the role of geographical location (R variables) and altimetry (A variable) in conditioning productivity, respectively. Additionally, in these cases, the results from the two tests suggest that geographical location and altimetry would not be significant factors in describing the technology, and a common frontier can be adopted in the preferred model (without these variables).

All the estimated results of the tests on the production frontier are reported in Table 2.

The model was re-estimated considering these findings, and the following tests of the inefficiency model were applied to the re-estimated Cobb-Douglas model:

- if inefficiency effects (γ; δ_0; $\delta_1 \ldots \delta_3$) are present in the model;
- the stochastic nature of the inefficiency effects (presence of γ and δ_0);
- the presence of the intercept (δ_0);
- if the firm-specific factors ($\delta_1 \ldots \delta_3$) are present;
- if the S_m and S_q variables significantly affect inefficiency;
- if the geographical location significantly affects inefficiency;
- if altimetry significantly affects inefficiency;
- if each firm-specific factor is present.

The results suggest that all the null hypotheses could

Table 2. Tests of hypotheses for the frontier function and inefficiency model parameters.

Restrictions	Model	$L(H_0)$.	λ	d.f.	$\chi^2_{0.95}$	Decision
Production Function						
None	Translog	-97.08				
$H_0 : b_{ij} = 0$	Cobb-Douglas	-104.71	15.26	10	18.31	Not rejected
$H_0 : S_m = 0$	Conventional vs. organic	-97.98	1.80	1	3.84	Not rejected
$H_0 : S_q = 0$	PDO vs. No PDO	-98.33	2.50	1	3.84	Not rejected
$H_0 : R_n, R_c, R_s = 0$	Geographical location	-99.05	3.94	3	7.82	Not rejected
$H_0 : A_m, A_c, A_p = 0$	Altimetry	-99.41	4.66	3	7.82	Not rejected
Inefficiency model						
None	Cobb-Douglas	-105.44				
$H_0 : g = d_0; d_1 \ldots d_3 = 0$	No inefficiency effects	-112.55	14.22	4	8,76*	Rejected
$H_0 : g = d_0 = 0$	No stochastic effects	-109.01	7.14	2	5.14*	Rejected
$H_0 : d_0 = 0$	No intercept	-107.88	4.88	1	3.84	Rejected
$H_0 : d_1 \ldots d_3 = 0$	No firm-specific factors	-110.41	9.94	3	7.82	Rejected
$H_0 : S_m = 0$	No conv vs. org.	-108.82	6.76	1	3.84	Rejected
$H_0 : S_q = 0$	No quality	-110.11	9.34	1	3.84	Rejected
$H_0 : R_n, R_c, R_s = 0$	No geograph. location	-108.73	6.58	3	7.82	Not rejected
$H_0 : A_m, A_c, A_p = 0$	No altimetry	-108.90	6.92	3	7.82	Not rejected
$H_0 : Z_1 = 0$	No management	-108.05	5.22	1	3.84	Rejected
$H_0 : Z_2 = 0$	No age	-107.99	5.10	1	3.84	Rejected
$H_0 : Z_3 = 0$	No gender	-108.90	6.92	1	3.84	

* The statistic l for these variables is distributed as a mixed c^2 because the tests involve equality and inequality restrictions. The relative upper bounds are shown in Table 1 in Kodde and Palm [80].
Source: Authors' analysis of FADN data.

be rejected except for the geographical location and altimetry variables that hence can be excluded by the final model. The estimated parameters of the preferred model are reported in Table 3.

The production function

Each parameter related to the function model satisfies the monotonicity and diminishing marginal productivity properties at the point of approximation (positive signs), and it can be taken as an elasticity indicator. This finding means that *capital* would contribute the most to grape production in the Italian sector (0.585). *Labour* was estimated as the second most influential factor (0.371), whereas *variable costs* (0.121) and *land* area (0.085) appear to affect productivity weakly. Specifically, to the latter input, the low elasticity might depend on the fact that grapes are typically grown in an intensive or semi-intensive way in the case of scarce land availability. In this sense, the land is a factor that affects production, but as estimated, it plays no relevant role in conditioning productivity.

For this reason, the low amount of land contrasts with what was found in other wine grape-growing realities, where this factor was estimated to be among the factors most affecting efficiency [7,12] or in other efficiency studies carried out on (more extensive) small farms [81].

Returns to scale – calculated summarising the single input elasticities – are generally increasing (1.162), implying that margins exist (approximately 16%) for improving the scale inefficiency of the grape-growing farms to increase the returns to scale.

Similar findings have been found in other studies on the wine grape-growing sector. Regarding the South African sector, for example, Townsend et al. [82] and Conradie et al. [7] estimated that farms are too small and prevalently operate on returns to scale conditions. On the other hand, Liu and Lv [83], in a study on Chinese wine grape farms, found that medium farms reveal a higher efficiency than smaller and larger farms.

Table 3. ML Estimates for SFP parameters for the organic and conventional data – preferred model.

Variable	Parameter	Coeff.	S.e.
Frontier Model			
Constant	b_0	0.818	0.105
Land area	b_1	0.085	0.222
Labour	b_2	0.371	0.219
Capital	b_3	0.585	0.280
Other expenditures (variable costs)	b_4	0.121	0.050
Inefficiency Model			
Constant	Z_0	-0.003	0.018
Management	Z_1	0.142	0.186
Gender	Z_2	-0.051	0.100
Age	Z_3	0.059	0.136
Organic	S_m	-0.185	0.115
Quality	S_q	-0.126	0.156
Variance parameters			
	σ^2	0.277	0.133
	g	0.042	0.026
	g*	0.467	
Log-likelihood function		-106.386	

Source: Authors' data processing on FADN data.

Research findings from Carvalho [8], Moreira [9], and Coelli and Sanders [10] on the Portuguese, Chilean, and Australian sectors, respectively, reveal that returns to scale are close to unity.

The inefficiency model

Table 3 also reports the estimated parameters related to the inefficiency model. The findings suggest that efficiency tends to increase in the case of farms managed by young farmers (the positive sign associated with the variable *Age* indicates that it positively affects inefficiency) and by males (vice versa, the negative sign of the variable *Gender* means that efficiency would increase with the increase in the variable).

We also found that capitalistic farms tend to be less efficient than (solely or prevalently) family-run businesses. This last finding is only apparently surprising because it is probably related to the general intensive or semi-intensive grape cultivation in Italy, living aside from the management. Furthermore, family-run farms are likely to be more cautious in using their inputs to compensate for the productivity gap, which could be a reason that may help explain this finding.

Furthermore, organic and quality-oriented farms tend to be more efficient than conventional and non-oriented farms, respectively. Specifically, the parameter associated with the organic/conventional dichotomy shows the highest magnitude, implying that it is the variable that mostly affects efficiency among the selected dichotomies.

The technical efficiency

The estimated technical efficiency of the sample amounts, on average, to 0.788 (Table 4). This means that room for improvement of approximately 21% exists for increasing the ability of Italian grape-growing farmers to use their technical inputs more efficiently.

The value is very close to the mean technical efficiency estimated by Carvalho [8] on Portuguese wine grape farms in 2000 (0.793), even if this value tends to decrease over time. Additionally, Moreira et al. [9] and Coelli and Sanders [10] estimated similar scores on wine grape farms (0.778 and 0.790, respectively).

However, as expected in light of the estimated inefficiency parameters, the organic farms reveal a greater technical efficiency than the conventional farms. Since these scores refer to a unique frontier and the difference appears significant (for $\alpha = 0.01$), it is possible to argue that organic farms have greater capacity than conventional units in using technical inputs (in the availability of the farmer). Since technical efficiency scores are calculated as an *output-oriented* measure in this study, the results imply that both farming methods might increase production using the same input bundle.

Organic and conventional grape-growing farmers would be able to increase output by 16.5% and 22.2%, respectively, with the present state of technology and using their disposable resources more efficiently.

These findings confirm previous studies. In a study on Greek organic and conventional wine grape farms, Tzouvelekas et al. [84] found that organic farms show

Table 4. Estimated technical efficiency scores.

	Mean	s.d.
Total sample (n. 531)	0.788	0.108
Organic (n. 91)	0.835	0.102
Conventional (n. 440)	0.778	0.107

* *p*-values for t-tests on the mean difference between the two subsamples: TE = 1.33×10^{-4}.

higher efficiency than conventional farms (0.680 and 0.612, respectively). In the Spanish sector, Guesmi et al. [15] estimated a greater difference between the two categories (0.796 and 0.642, respectively). Aldanondo-ochoa et al. [16], comparing the total farm revenues of wine grape producers using inputs, such as land, labour and other costs, and assessing the environmental impact, found a higher efficiency for organic farms.

Conversely, the results from Bayramoglu and Gundogmus [13] on Turkish farms suggest that conventional grape farms are more efficient than organic farms. However, these scores refer to two separate frontiers; therefore, our findings are not comparable to those of this previous study.

Considering the observed GFR, it means that the achievement of full efficiency would lead to income increases of 47.6 M € and 55.3 M € for organic and conventional farms, respectively. Therefore, conventional farms could partially fill the revenue gap concerning organic farms in the case of full efficiency.

An important point is to assess the weight of inefficiency in affecting production to evaluate whether a possible improvement in efficiency could significantly affect productivity in grape-growing farms. Analysis of the ratio parameter g provides information on the TE relevance for the production process.

The estimated g is significant at the 1% level, which indicates that TE is relevant in explaining output variability. On the other hand, the parameter value could not be taken as a measure of the relative contribution of the inefficiency term to the total output variance. However, this measure can be obtained by estimating parameter γ^*, calculated as described in Table 3. The estimation suggests that 46.7% of the general differential between observed and best-practice output is due to farmers' existing difference in efficiency.

This study highlights some pieces of evidence in the management of organic and conventional grape farming in Italy. The results suggest that organic and conventional farming systems would lie on a common frontier and that those organic farms seem more careful in using factors of production factors (technical inputs). This factor would be partly due to their awareness of the existing gap in terms of yields compared to conventional farms, which would also represent a general behaviour of organic producers who are constantly looking for greater performance.

Pricing and output value

As far as the output is concerned, it has to be considered that the production data estimation has been carried out in terms of farms' production value. Since the output is higher for organic farms (compared to conventional farms), our findings show that in the wine grape-growing sector, organic farms are more technically efficient than conventional farms. This point requires some further comment.

First, it is worth noting that the higher selling prices that organic farms can manage to command for their products play a role in the organic and conventional farming match. It must be said in fairness that the value of the grapes is substantially different, depending on their quality and typology [85]. Moreover, it is also true that the price of grapes varies according to many characteristics, such as the land on which the vineyards are grown, the costs of cultivation, the environmental conditions and any legislative decisions [86,87]. The main distinction is to be made between DOP wine grapes (more expensive) and table grapes. We find different varietals with different prices within the two types, depending on the yields and the wine qualities they could express.

In Italy, common criteria and specific associations are generally used to establish the prices of wine grapes, sometimes private and sometimes governmental. The latter annually provides the grape prices in agreement with the Chambers of Commerce. Then, there are private agreements between high-quality companies and winegrowers. Differences are both dependent on whether the wine producer is also a grape grower or not and the owner or not of the vineyards. When the wine market is rising sharply, the large brand wine producers could find it difficult to meet their needs with their vineyards (sometimes they cannot cover all the production in terms of grape quantities), and therefore they must go to the grape market.

These companies consistently turn to the same trusted growers, entering into multi-year contracts. Any DOP wine producer uses this strategy and pays different prices, depending on the area of origin. When producing high-quality wine, it is essential to establish a lasting relationship of trust and collaboration to obtain the best results. Prices can vary by a wide range, mainly depending on the quality, type (red or white), grape varietal and other factors, ranging from 20 Euros to more than 200 Euros per quintal for some special wines [88].

We should also not forget that sustainable and environmentally friendly practices, as known, require higher costs and higher prices for the final products (to compensate). Suffice it to say that among other rules, the EU normative, for example, states that to obtain authorisation for organic wine, producers must include a maximum sulphite content (set at 100 mg per litre for red wine and 150 mg/L for white/rosé). The premium price

should compensate for the higher costs for organic wine production. Today, the price of organic grapes in Italy is, on average, approximately 2,20 €/kg [89].

Second, comparing prices, another point to be considered is producers' ability to promote and communicate the product's characteristics. In the recent past, in many Italian regions, organic grapes were sold as high-quality grapes, but the added value of being organic was not valued [90]. In recent years, the scenario has changed since increasing attention has been given to sustainability and climate change issues [91]. In this evolving context, grape producers have become more aware of the importance of communicating the agricultural methods adopted to respect both the territory and human health. In effect, "consumers seem more interested in environmental aspects associated with organic production, that have more direct benefits on health than other environmental issues [and their] perception of sustainable wines seems generally associated with the terms such as organic and local" [92].

In this scenario, since a higher quality is traditionally attributed to sustainable wine, its communication to consumers through recognisable signs appears to be a very important marketing and competitive factor for wine producers [92,93]. In this respect, the Regulation of the European Commission [49], which defines and regulates organic wine production, allows farmers that respect these rules to boast the EU certification of "organic".

Finally, it must be underlined that a time lag would exist between when grapes are paid to produce wines and when wines are sold because wine generally takes several years to become market-ready. It means that the premium price applied by organic wine producers to grape-growers would reflect future wine price expectations, and it can be a source of distortion along with the price transmission from buyers to farmers.

5. CONCLUSIONS

With a specific application to grape growth, this study contributes to the debate on the efficiency and productivity of organic and conventional farming, which has produced controversial evidence throughout the world; however, it requires many more studies on the wine grape-growing sector.

As far as the farm's efficiency is concerned, it turns out that being organic and quality-oriented are characteristics that lead to a more efficient system.

Because grape-growing managed by young male farmers shows a higher efficiency level, the policymaker should encourage new farms' opening by young entrepreneurs and the generational shift even more. Moreover, the lower efficiency of companies run by women implies that there is an increasing need to provide more training and tools to support female entrepreneurs. A significant point concerns the variable of business-conducting typology. The higher level of efficiency of grape-growing conducting family-run businesses must push policymakers increasingly to support these activities. Using their production inputs more carefully to respond to the need for an ever-decreasing use of resources, family farms appear to be crucial agents in achieving sustainable development goals.

Concerning the two production orientations, the findings show that capital and labour are the two key issues that contribute the most to grape production in Italy, confirming previous studies in the Spanish sector [94]. Moreover, this study disavows previous studies that see land as one of the most important factors affecting the efficiency of wine grape growth [7,12].

Another noteworthy item is the positioning of the two production orientations along the same technological horizon due to the lack of a significant difference in productivity between organic and conventional wine grape farms. This aspect is relevant for those companies that, looking at the trend of organic wine and sparkling wine (+ 15.5% variation between 2020/2019) compared to non-organic products (+ 4%) [5] but also in light of the "*Farm to Fork"* strategy [95] aim to accelerate our transition to a sustainable food system also through the increase of up to 25% by 2030 of the area cultivated organically, intending to convert their production.

This finding is also relevant for academics, who, despite the increasing number of studies that compare the performance of organic and conventional agriculture in terms of yield, environmental, and economic impacts, still quote methodological difficulties of comparing conventional and organic systems [1].

This paper has some limitations. The focus is on only one country (Italy). Further multi-country research could be useful to confirm our findings in other fields, and more research needs to be done, also concerning our case (i.e., estimation of scale efficiency and the role of price in affecting productivity), to obtain more evidence on this issue. However, more research needs to be done to improve the quality of information about differences in efficiency between organic and conventional farming, especially in the wine grape-growing sector.

REFERENCES

[1] A. Le Campion, F.-X. Oury, E. Heumez, B. Rolland, 2020. Conventional versus organic farming systems: dissecting comparisons to improve cereal organic breeding strategies. Org. Agric. 10, 63–74.

[2] N.H. Lampkin, 1994. Researching organic farming systems, in: The Economics of Organic Farming: An International Perspective. Cab International Wallingford, 343–359.

[3] F. Offermann, N. Lampkin, 2005. Organic farming in FADNs–comparison issues and analysis. Eur. Framew. Org. Mark. Inf. 107, 106.

[4] OIV, 2020. Nota di congiuntura del settore vitivinicolo mondiale nel 2019.

[5] SINAB, 2020. Bio in cifre 2020.

[6] F. Offermann, H. Nieberg, 2000. Economic performance of organic farms in Europe, Economics and Policy. Universität Hohenheim, Hohenheim.

[7] B. Conradie, G. Cookson, C. Thirtle, 2006. Farm size in Western Cape grape production: An enquiry into pooling small datasets. South Afr. J. Econ. 74, 334–343.

[8] M. Carvalho, P. Henrique, F. Costa, R. Pereira, 2008. Characterization and technical efficiency of Portuguese wine farms, in: Proceedings of the XIIth Congress of the EAAE. Ghent, Belgium.

[9] V.H. Moreira, J.L. Troncoso, B.E. Bravo-Ureta, 2011. Technical efficiency for a sample of Chilean wine grape producers: A stochastic production frontier analysis. Int. J. Agric. Nat. Resour. 38, 321–329.

[10] T. Coelli, O. Sanders, 2013. The technical efficiency of wine grape growers in the Murray-Darling Basin in Australia, in: Wine Economics: Quantitative Studies and Empirical Applications. Palgrave Macmillan, Basingstoke, United Kingdom, 231–249.

[11] J. Lwelamira, P. Wambura, J. Safari, 2015. Technical efficiency in grape farming among smallholder farmers in Dodama urban districh, central Tanzania. Rural Plan. J. 17, 1–16.

[12] J. Piesse, B. Conradie, C. Thirtle, N. Vink, 2018. Efficiency in wine grape production: comparing long-established and newly developed regions of South Africa. Agric. Econ. 49, 203–212.

[13] Z. Bayramoglu, E. Gundogmus, 2008. Cost efficiency on organic farming: a comparison between organic and conventional raisin-producing households in Turkey. Span. J. Agric. Res. 6, 3–11.

[14] V. Tzouvelekas, C.J. Pantzios, C. Fotopoulos, 2002. Measuring multiple and single factor technical efficiency in organic farming. Br. Food J.

[15] B. Guesmi, T. Serra, Z. Kallas, J.M.G. Roig, 2012. The productive efficiency of organic farming: the case of grape sector in Catalonia. Span. J. Agric. Res. 552–566.

[16] A.M. Aldanondo-Ochoa, V.L. Casasnovas-Oliva, A. Arandia-Miura, 2014. Environmental efficiency and the impact of regulation in dryland organic vine production. Land Use Policy 36, 275–284.

[17] M.E. Porter, C. Van der Linde, 1995. Toward a new conception of the environment-competitiveness relationship. J. Econ. Perspect. 9, 97–118.

[18] S. Ambec, P. Lanoie, 2008. Does it pay to be green? A systematic overview. Acad. Manag. Perspect. 45–62.

[19] H. Nieberg, F. Offermann, 2000. Economic performance of organic farms in Europe. Universität Hohenheim, Stuttgart-Hohenheim.

[20] F. Offermann, 2004. Comparing organic and conventional farm incomes in FADN: Issues in international harmonisation and quality assurance. Presented at the Development of a European information system for organic markets-improving the scope and quality of statistical data: Proceedings of the 1st EISFOM European Seminar. Frick: FiBL, 115–118.

[21] H. Nieberg, F. Offermann, 2003. The profitability of organic farming in Europe. Organic agriculture: sustainability, markets and polices. Organic agriculture: sustainability, markets and polices. OECD workshop on organic agriculture, Washington, UK, USA.

[22] K. Mondelaers, J. Aertsens, G. Van Huylenbroeck, 2009. A meta-analysis of the differences in environmental impacts between organic and conventional farming. Br. Food J. 111, 1098–1119.

[23] D. Pimentel, P. Hepperly, J. Hanson, D. Douds, R. Seidel, 2005. Environmental, energetic, and economic comparisons of organic and conventional farming systems. BioScience 55, 573–582.

[24] H.L. Tuomisto, I. Hodge, P. Riordan, D.W. Macdonald, 2012. Does organic farming reduce environmental impacts?–A meta-analysis of European research. J. Environ. Manage. 112, 309–320.

[25] S. Uthes, B. Matzdorf, 2013. Studies on agri-environmental measures: a survey of the literature. Environ. Manage. 51, 251–266.

[26] L. Arata, P. Sckokai, 2016. The impact of agri-environmental schemes on farm performance in five EU member states: a DID-matching approach. Land Econ. 92, 167–186.

[27] F. Cisilino, A. Bodini, A. Zanoli, 2019. Rural development programs' impact on environment: An ex-

post evaluation of organic faming. Land Use Policy 85, 454–462.
[28] A. Pufahl, C.R. Weiss, 2009. Evaluating the effects of farm programmes: results from propensity score matching. Eur. Rev. Agric. Econ. 36, 79–101.
[29] M. Raggi, D. Viaggi, F. Bartolini, A. Furlan, 2015. The role of policy priorities and targeting in the spatial location of participation in Agri-Environmental Schemes in Emilia-Romagna (Italy). Land Use Policy 47, 78–89.
[30] A. Bonfiglio, A. Arzeni, A. Bodini, 2017. Assessing eco-efficiency of arable farms in rural areas. Agric. Syst. 151, 114–125.
[31] G. Breustedt, U. Latacz-Lohmann, T. Tiedemann, 2011. Organic or conventional? Optimal dairy farming technology under the EU milk quota system and organic subsidies. Food Policy 36, 223–229.
[32] T.J. Coelli, D.S.P. Rao, C.J. O'Donnell, G.E. Battese, 2005. An introduction to efficiency and productivity analysis. Springer Science & Business Media, New York, NY.
[33] W.W. Cooper, L.M. Seiford, K. Tone, 2007. Data envelopment analysis: a comprehensive text with models, applications, references and DEA-solver software: Springer Science & Business Media. N. Y. USA.
[34] F.A. Madau, 2007. Technical efficiency in organic and conventional farming: Evidence from Italian cereal farms. Agric. Econ. Rev. 8, 5–21.
[35] A.O. Lansink, K. Pietola, S. Bäckman, 2002. Effciency and productivity of conventional and organic farms in Finland 1994–1997. Eur. Rev. Agric. Econ. 29, 51–65.
[36] K.L. Poudel, T.G. Johnson, N. Yamamoto, S. Gautam, B. Mishra, 2015. Comparing technical efficiency of organic and conventional coffee farms in rural hill region of Nepal using data envelopment analysis (DEA) approach. Org. Agric. 5, 263–275.
[37] V. Tzouvelekas, C.J. Pantzios, C. Fotopoulos, 2001. Technical efficiency of alternative farming systems: the case of Greek organic and conventional olive-growing farms. Food Policy 26, 549–569.
[38] E. Dimara, C.J. Pantzios, D. Skuras, K. Tsekouras, 2005. The impacts of regulated notions of quality on farm efficiency: A DEA application. Eur. J. Oper. Res. 161, 416–431.
[39] S. Alkahtani, A. Elhendy, 2012. Organic and conventional date farm efficiency estimation, and its determents at Riyadh province, Kingdom of Saudi Arabia. WIT Trans. Ecol. Environ. 162, 219–230.
[40] M. Beltrán-Esteve, E. Reig-Martínez, 2014. Comparing conventional and organic citrus grower efficiency in Spain. Agric. Syst. 129, 115–123.
[41] T. Serra, B.K. Goodwin, 2009. The efficiency of Spanish arable crop organic farms, a local maximum likelihood approach. J. Product. Anal. 31, 113–124.
[42] P. Kramol, R. Villano, P. Kristiansen, E. Fleming, 2015. Productivity differences between organic and other vegetable farming systems in northern Thailand. Renew. Agric. Food Syst. 30, 154.
[43] T. Tiedemann, U. Latacz-Lohmann, 2013. Production risk and technical efficiency in organic and conventional agriculture–the case of arable farms in Germany. J. Agric. Econ. 64, 73–96.
[44] E. Gutiérrez, E. Aguilera, S. Lozano, G.I. Guzmán, 2017. A two-stage DEA approach for quantifying and analysing the inefficiency of conventional and organic rain-fed cereals in Spain. J. Clean. Prod. 149, 335–348.
[45] S. Lakner, S. Kirchweger, D. Hoop, B. Brümmer, J. Kantelhardt, 2018. The effects of diversification activities on the technical efficiency of organic farms in Switzerland, Austria, and Southern Germany. Sustainability 10, 1304.
[46] E. Pomarici, R. Sardone, 2020. EU wine policy in the framework of the CAP: post-2020 challenges. Agric. Food Econ. 8, 1–40.
[47] G. Meloni, J.F.M. Swinnen, 2012. The Political Economy of European Wine Regulations (SSRN Scholarly Paper No. ID 2279338). Social Science Research Network, Rochester, NY.
[48] S. Green, 2018. The European Union and action on climate change, through the lens of the wine industry. Wine Econ. Policy 7, 120–127.
[49] Regulation (EU) 203/2012, 2012. Amending Regulation (EC) No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007, as regards detailed rules on organic wine.
[50] FIBL & IFOAM, 2019. The World of Organic Agriculture 2019.
[51] A. Castellini, C. Mauracher, S. Troiano, 2017. An overview of the biodynamic wine sector. Int. J. Wine Res. 9, 1–11.
[52] M.A. Bonn, J.J. Cronin, M. Cho, 2016. Do Environmental Sustainable Practices of Organic Wine Suppliers Affect Consumers' Behavioral Intentions? The Moderating Role of Trust. Cornell Hosp. Q. 57, 21–37.
[53] M. D'Amico, G. Di Vita, L. Monaco, 2016. Exploring environmental consciousness and consumer preferences for organic wines without sulfites. J. Clean. Prod. 120, 64–71.
[54] C. Fotopoulos, A. Krystallis, M. Ness, 2003. Wine produced by organic grapes in Greece: using

means—end chains analysis to reveal organic buyers' purchasing motives in comparison to the non-buyers. Food Qual. Prefer. 14, 549–566.

[55] M. Lanfranchi, A. Zirilli, A. Alibrandi, C. Giannetto, 2020. The behaviour of wine consumers towards organic wine: a statistical analysis through the non-parametric combination test. Int. J. Wine Bus. Res.

[56] S. Mann, A. Ferjani, L. Reissig, 2012. What matters to consumers of organic wine? Br. Food J. 114, 272–284.

[57] M.M.B. Mollá-Bauzá, L. Martínez-Carrasco, A. Martínez-Poveda, M.R. Pérez, 2005. Determination of the surplus that consumers are willing to pay for an organic wine. Span. J. Agric. Res. 3, 43–51.

[58] J. Olsen, L. Thach, L. Hemphill, 2012. The impact of environmental protection and hedonistic values on organic wine purchases in the US. Int. J. Wine Bus. Res.

[59] I. Schäufele, U. Hamm, 2018. Organic wine purchase behaviour in Germany: Exploring the attitude-behaviour-gap with data from a household panel. Food Qual. Prefer. 63, 1–11.

[60] E. Pagliarini, M. Laureati, D. Gaeta, 2013. Sensory descriptors, hedonic perception and consumer's attitudes to Sangiovese red wine deriving from organically and conventionally grown grapes. Front. Psychol. 4.

[61] P. Fanasch, B. Frick, 2020. The value of signals: Do self-declaration and certification generate price premiums for organic and biodynamic wines? J. Clean. Prod. 249, 119415.

[62] L.A. Abraben, K.A. Grogan, Z. Gao, 2017. Organic price premium or penalty? A comparative market analysis of organic wines from Tuscany. Food Policy 69, 154–165.

[63] G. Ruggeri, C. Mazzocchi, S. Corsi, 2020. Drinking biodiversity: a choice experiment on Franciacorta sparkling wines. Br. Food J.

[64] K.H. Lim, M. Reed, 2020. Do ecolabels cheapen wines? J. Clean. Prod. 245, 118696.

[65] J. Aschemann-Witzel, S. Zielke, 2017. Can't buy me green? A review of consumer perceptions of and behavior toward the price of organic food. J. Consum. Aff. 51, 211–251.

[66] G. Migliore, A. Thrassou, M. Crescimanno, G. Schifani, A. Galati, 2020. Factors affecting consumer preferences for "natural wine": An exploratory study in the Italian market. Br. Food J. 122, 2463–2479.

[67] G. Szolnoki, K. Hauck, 2020. Analysis of German wine consumers' preferences for organic and non-organic wines. Br. Food J.

[68] E. Pomarici, M. Amato, R. Vecchio, 2016. Environmental Friendly Wines: A Consumer Segmentation Study. Agric. Agric. Sci. Procedia, Florence "Sustainability of Well-Being International Forum". 2015: Food for Sustainability and not just food, FlorenceSWIF2015 8, 534–541.

[69] D. Moscovici, R. Rezwanul, R. Mihailescu, J. Gow, A.A. Ugaglia, L. Valenzuela, A. Rinaldi, 2020. Preferences for eco certified wines in the United States. Int. J. Wine Bus. Res.

[70] E.C. Thach, J.E. Olsen, 2006. Market segment analysis to target young adult wine drinkers. Agribus. Int. J. 22, 307–322.

[71] M.A. Delmas, L.E. Grant, 2014. Eco-labeling strategies and price-premium: the wine industry puzzle. Bus. Soc. 53, 6–44.

[72] S.E. Atkinson, C. Cornwell, 1994. Estimation of output and input technical efficiency using a flexible functional form and panel data. Int. Econ. Rev. 35, 245–255.

[73] W.H. Greene, 1980. On the estimation of a flexible frontier production model. J. Econom. 13, 101–115.

[74] C.J. Huang, J.-T. Liu, 1994. Estimation of a non-neutral stochastic frontier production function. J. Product. Anal. 5, 171–180.

[75] S.C. Kumbhakar, S. Ghosh, J.T. McGuckin, 1991. A generalized production frontier approach for estimating determinants of inefficiency in US dairy farms. J. Bus. Econ. Stat. 9, 279–286.

[76] D. Reifschneider, R. Stevenson, 1991. Systematic departures from the frontier: a framework for the analysis of firm inefficiency. Int. Econ. Rev. 32, 715–723.

[77] G.E. Battese, T.J. Coelli, 1995. A model for technical inefficiency effects in a stochastic frontier production function for panel data. Empir. Econ. 20, 325–332.

[78] T. Coelli, 1996. A Guide to Frontier Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation, Centre for Efficiency and Productivity Analysis (CEPA) Working paper 96/07, University of New, Australia. Center for Efficiency and Productivity Analysis, University of New England: Armidale, Australia.

[79] D. Knoke, G.W. Bohrnstedt, A.P. Mee, 1994. Statistics for social data analysis. Itasca, Illinois.

[80] D.A. Kodde, F.C. Palm, 1986. Wald criteria for jointly testing equality and inequality restrictions. Econom. J. Econom. Soc. 54, 1243–1248.

[81] F.A. Madau, 2011. Parametric estimation of technical and scale efficiencies in Italian citrus farming. Agric. Econ. Rev. 12, 91–111.

[82] R.F. Townsend, J. Kirsten, N. Vink, 1998. Farm size, productivity and returns to scale in agriculture revisited: a case study of wine producers in South Africa. Agric. Econ. 19, 175–180.
[83] H. Liu, K. Lv, 2010. Productive efficiency and its influencing factors of wine-making firms in China. A research based on DEA-Tobit approach. Collect. Essays Finance Econ. 2, 1–6.
[84] V. Tzouvelekas, C.J. Pantzios, C. Fotopoulos, 2002. Measuring multiple and single factor technical efficiency in organic farming. Br. Food J. 104, 591–609.
[85] J.M. Alston, O. Sambucci, 2019. Grapes in the world economy, in: The Grape Genome. Springer, 1–24.
[86] G. Jones, M. White, O. Cooper, K. Storchmann, 2005. Climate Change and Global Wine Quality. Climate Change, 73, 319-343.
[87] S. Petropoulos, C.S. Karavas, A.T. Balafoutis, I. Paraskevopoulos, S. Kallithraka, Y. Kotseridis, 2017. Fuzzy logic tool for wine quality classification. Comput. Electron. Agric. 142, 552–562.
[88] ISMEA, 2020. Ismea Mercati.
[89] CCIAA Bologna, 2019. Chamber of Commerce of Bologna. Commissione bio della Camera di Commercio di Bologna.
[90] F. Cisilino, L. Cesaro, 2009. Organic versus Conventional Farming: A Marketing Survey on Wine Production, in: The Crisis of Food Brands. Routledge, London, UK, 135–150.
[91] G. Sogari, C. Mora, D. Menozzi, 2016. Sustainable wine labeling: a framework for definition and consumers' perception. Agric. Agric. Sci. Procedia 8, 58–64.
[92] N. Palmieri, M. Perito, 2020. Consumers' willingness to consume sustainable and local wine in italy. Ital. J. Food Sci. 32.
[93] G. Scozzafava, F. Gerini, A. Dominici, C. Contini, L. Casini, 2018. Reach for the stars: The impact on consumer preferences of introducing a new top-tier typology into a PDO wine. Wine Econ. Policy 7, 140–152.
[94] A.M. Aldanondo-Ochoa, V.L. Casasnovas-Oliva, A. Arandia-Miura, 2014. Environmental efficiency and the impact of regulation in dryland organic vine production. Land Use Policy 36, 275–284.
[95] EU COM/2020/381 final, 2020. Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions.

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Competitiveness framework to support regional-level decision-making in the wine industry: a systematic literature review

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Abstract. This study aims to identify the main performance indicators and group them in dimensions within a regional competitiveness framework to support decision-making in the wine industry. For this research, a systematic literature review (SLR) was conducted in the Scopus database. There is a limited number of studies identifying indicators with impact on the performance of wine regions, and even fewer studies including indicators in an integrated approach to measure the different dimensions of wine regions' performance. From a set of 85 papers, only 9 studies related to performance indicators with a specific focus on the regional level were considered. We document that under a convention framework, economic and territorial indicators cover 84.90% of all SLR indicators analysed, and under a regional competitiveness framework, infrastructure and innovation and intellectual capital indicators fill 81.25% of all the indicators. As this group of indicators is limited to a set of sub-dimensions, we found that several groups of indicators are misrepresented, such as the ones related to human and socio-cultural capital areas, which play a crucial role in the regional competitiveness of the wine industry. This paper contributes to the literature identifying indicators according to convention and regional competitiveness frameworks in three dimensions – economic, environmental and territorial dimensions and five main areas – productive capital, human capital, socio-cultural capital, infrastructure and intellectual capital. These indicators are to be used at regional-level to support decision-making in the wine industry. For regional entities, it discloses the most pertinent indicators which need improvement to craft regional strategies. This framework is of added value for policymakers to customize their support programmes so that specific producers can enhance their competitive strategies. It could also be deployed in teaching programmes as a tool to address the importance of aligning different types of indicators to achieve better performance in the wine industry.

Keywords: regional competitiveness, performance indicator, wine industry, competitiveness framework, systematic literature review.

1. INTRODUCTION

Wine production constitutes one of the most ancient industries in the agri-food sector, providing important economic revenues for many countries and regions worldwide [1, 2]. The international trade of wine has mainly been dominated by three European countries – Italy, Spain, and France – which together export 57.1 million hectoliters (mhl) and represent 54% of the global market [3]. The growth of the wine industry highlights the importance of ensuring a competitive industry through the entire supply chain and in all its dimensions [4].

Wine-producing firms in Bordeaux, La Rioja, Tuscany, and Douro, among others, leverage their reputation supported by their association with the region in which they operate [5]. Today's world requires that businesses in a specific region should focus not only on their internal development and success, but also on the development of the social, economic, and environmental conditions of the contexts in which they operate [6].

Regional competitiveness, which has been attracting more attention due to its importance for economic growth and wealth creation, lies between the business and the national levels of competitiveness [e.g., 7, 8, 9].

Competitiveness frameworks can be considered as a way for wine territories to systematize current practices or innovative entrepreneurial ways to improve wine management and promote innovation processes. Wine regions have been creating their own frameworks, presented as national (or regional) programmes to be implemented in their contexts and deal with local issues. Additionally, these frameworks support the positioning of the wine territory [10].

Convention theory has been used as an explanatory framework in agri-food sectors and regions worldwide in order to understand the current trends in the agri-food system [11] and also analyse a wide range of cases [12] in various territories. Thus, one perspective to frame competitiveness in the wine regions is based on convention theory.

In regional competitiveness, the intervening factors, albeit resources that lie outside business processes, can be summarized as various types of capital, such as productive, human, social-cultural, infrastructure and intellectual. According to the World Economic Forum (WEF) Competitiveness Global Index (CGI) and the European Commission (EC) Regional Competitiveness Index (RCI), regional competitiveness should include two additional dimensions: efficiency (higher education and training; market size; labour markets); and innovation (technological readiness; business sophistication; innovation). According to Lengyel [13], the enhancement of regional competitiveness may follow a pyramid model. At the top sits the objective of regional competitiveness: quality of life and standard of living. On the bottom are the success determinants related to human/intellectual capital (skills of the workforce, innovative activity), infrastructure (regional accessibility, environment), socio-cultural (regional identity, social structure, decision centres), economic structure. In the middle are the development factors (foreign direct investment, small and medium-sized enterprises, institutions and social capital, research, and technological development) which are related to the basic categories (labour productivity, employment rate, regional performance/gross regional product).

Despite there being several studies associated with performance in the wine business [14], there is a lack of emphasis on the development of studies that contain or summarize the major indicators applied in a regional context (in this research, 9 of the 85 selected studies). These are crucial for the identification of commonly used indicators for monitoring the wine industry [15]. Nevertheless, we can observe a growing interest and development for regional studies in recent years [e.g., 16, 17, 18, 19] and the indicators cited in these studies refer mostly to protected designations of origin (7 of 9 studies apply to Spanish protected designations of origin).

Regional indicators can contribute to improving knowledge about the decision-making processes of wine regions and consequently to the design of policy programmes to support the competitiveness of this industry. Furthermore, they could help to attain a clear view of the potential impacts associated with their strategy and, consequently, to adjust them in the future [20].

In line with the concept of competitiveness, traditionally defined as the intersection of economic, environmental, and territorial dimensions, we believe it is crucial to adopt a global approach that combines the interactions of these dimensions. Nevertheless, when studies adopt a global approach regarding performance, we note that the territorial dimension is not given its proper importance. Despite its relevance in the wine industry, the territory plays a substantial role in economic, environmental, and infrastructural terms, among others, that are not properly addressed. As a result, we believe that all information must be integrated to obtain a better understanding of the main wine territorial/regional competitiveness factors. This gap in the literature could be filled as a starting point to study performance in the wine industry at the regional level, including economic, environmental, and territorial dimensions.

With the aim of identifying the main performance indicators used at a regional level to support decision-making in the wine industry, a systematic literature review (SLR) was carried out on papers published in the Scopus database from 2009 to 2019.

This paper contributes to the literature by: (i) identifying indicators that can be easily adopted by wine regions, to make comparisons and support decision-making processes; (ii) grouping the indicators into three dimensions, based on an inductive thematic analysis and interpretative synthesis – territorial, economic and environmental – and five main areas – productive capital, human capital, social-cultural capital, infrastructure and intellectual capital; and (iii) structuring a regional competitiveness framework of analysis for the performance of wine-producing regions.

This present paper is organized as follows: after this introduction, section 2 describes the research methodology and section 3 discusses the research results. Conclusions, practical implications, and future research recommendations of the study are presented in section 4.

2. RESEARCH METHODOLOGY

Wine as a research topic continues to address a plethora of diverse contexts (Bonn et al., 2017). In order to analyse topics, patterns and/or development of a specific area in the wine industry, an SLR seems an appropriate technique for the purpose of this study.

SLRs consist of the identification, selection, analysis, and synthesis of existing research on a specific topic and its presentation to display what is known and not known about the topic [21]. The main advantages of SLRs are transparency in data collection and synthesis, which results in a higher level of objectivity and reproducibility [22]. SLRs have also other advantages: they provide an overview of areas in which the research is disparate and interdisciplinary; they provide an overview of a certain issue or research problem; they identify gaps in research; they provide the basis for building a new conceptual model or theory; and they can be valuable when aiming to map the development of a particular research over time [23]. An effective and well-conducted review as a research method can provide new directions and challenges for future research studies [24].

In this research, the papers analysed in the SLR cover several performance indicators to support decision-making in wine regions. In order to identify the main indicators and frameworks used in the analyses of the wine industry, an SLR was carried out following the protocol proposed by Tranfield et al. [22], which comprises three main stages: a) planning; b) conducting; and c) reporting and disseminating the results.

For a credible outcome, the use of scholarly, top peer-reviewed, published journal articles is highly important [25, 26]. Based on the quality, plurality and relevance of its scholarly reputed journals, the Scopus database was adopted. One of the particularities of the Scopus database is that is allows researchers to analyse and easily compare literature review outputs through a comprehensive and easy search customization procedure that allows the inclusion/exclusion of search word criteria.

In order to properly plan the SLR, it is mandatory to define the objective of the SLR, which in this paper is to identify the main performance indicators used at regional level to support decision-making in the wine industry. To conduct the review, it is necessary to properly use explicit inclusion search criteria to identify relevant literature. This needs to be assessed following exclusion criteria, so that only the relevant studies are incorporated and then fine graining the quality of the studies reviewed to strengthen the quality of the findings. The final stage involves reporting and getting the evidence into practice.

The planning of the review involved the definition of the following search words searched by *title*, *keywords* and *abstract*: *'indicator', 'performance indicator', 'wine', 'wine sector', 'wine industry' and 'winer*'*. The information of the inclusion criteria is as follows:

i. **Publication date**: 2009-2019
ii. **Language**: documents written in English, French, Portuguese, and Spanish.
iii. **Type of document**: articles, reviews, articles in press, conference papers and conference reviews.

As no exclusion criteria were defined, 464 documents that contained one or more search terms were considered in the analysis. Table 1 summarizes the research method applied in the Scopus database.

Publication citation data – author(s), title, date, keywords and abstract – were downloaded for each document published in Scopus since 2009. The data were then imported into Microsoft Excel for further cleaning and processing to ensure all information elements had successfully been downloaded.

A cross-sectional reading of the 464 results was carried out to select publications whose title, abstract, keywords would suggest the presence of indicators related to the wine industry. To increase the reliability of the selection, the documents were evaluated by three researchers and doubts and disagreements were discussed until consensus was achieved. The documents were included if all reviewers agreed.

Table 1. Research method in the Scopus database.

3. **Scope of research**	Scopus database
Keywords	Indicators; Performance indicators; Wine; Wine sector; Wine industry; Winery; Wineries
Queries (TITLE-ABS-KEY)	TITLE-ABS-KEY (("indicator*" OR "performance indicator*") AND ("wine" OR "wine sector" OR "wine industry" OR "winer*"))
Inclusion criteria	Documents in English, French, Portuguese, and Spanish between 2009-2019; Type of document: articles, reviews, articles in press, conference papers and conference reviews.
Quality criteria	The research was carried out on two different dates, confirming the same results. The steps in the two searches were: (i) access to the database; (ii) consultation; (iii) application of the inclusion criteria and (iv) export the results to Excel.
Results	The research achieved 1053 results before the application of the criteria stated above.

After selecting the most relevant studies for the purpose of this research (85 publications), we examined and selected only the documents that contain indicators from a regional perspective (9 results). Figure 1 synthesizes the methodological process adopted during the identification and selection of documents.

The following section aims to answer the main purpose of this study. The following three specific steps were thus defined: i) to present the main descriptive results of the selected studies (date of publication; publication source and geographical location); ii) to examine which indicators are proposed in frameworks; and iii) establish how the literature classifies them. As such, it was possible to map the state of the art of the main indicators analysed. Following Braun and Clarke [27] and Silva and Moreira [26], we sought to organize the literature in patterns of topics involving inductive thematic analysis – indicators, e.g., average size of the winery per region, number of wineries per region, number of brands per region, surface of the vineyard, surface area planted with high yielding grape varieties, and percentage of young wines. Based on Jones et al. [28] and Ribau et al. [29], following an interpretative synthesis, we managed to cluster the papers in related topics or indicators and aggregated them in higher order classes that we call categories – economic, environmental, and territorial – and five main areas – productive capital, human capital, socio-cultural capital, infrastructure, and intellectual capital.

3. RESULTS

Despite the growing number of studies carried out in the wine industry and given the multiplicity of themes present in the literature, only a total of nine theoretical and empirical papers present regional level

Figure 1. Methodological process.

performance indicators according to the aim of this research.

Date of publication

The survey reveals a growing interest and development of studies in recent years as most of the studies identified were published between 2015-2019 (66.7%), reinforcing the relevance of the thematic studied. Table 2 summarizes the number of publications per year.

Publication source

The papers were published in eight different journals, as shown in Table 3, which is a clear indication of how scattered the publication outlets were in the last decade. However, most sources of publication are related to geography or agro-environmental issues. Regarding publications per number of authors, as demonstrated in Figure 2, most were carried out by two authors (4 of 9 studies).

Geographical location

The papers feature limited geographic dispersion, demonstrating that the subject matter is studied predominantly in European countries. This research also confirms that the nine publications were applied in one specific country, more precisely in Spain (n = 7), Argentina (n = 1) and Hungary (n = 1).

Table 2. Number of publications per year.

Year	Publications (N)	Percentage
2009	1	11.1%
2011	1	11.1%
2014	1	11.1%
2015	1	11.1%
2017	3	33.3%
2018	2	22.2%
Total	9	100.00%

Table 3. Main sources of publication.

Sources of Publication	N
Cuadernos Geográficos	2
Géographie Economie Société	1
Geoforum	1
Mundo Agrario	1
Annales de Geographie	1
Boletín de la Asociación de Geógrafos Españoles	1
Economía Agraria y Recursos Naturales	1
Applied Ecology and Environmental Research	1

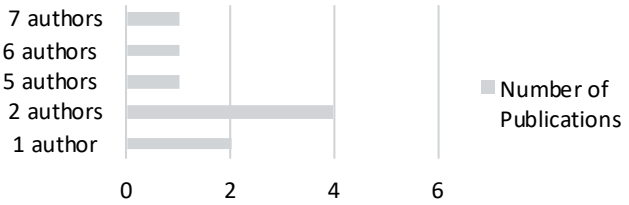

Figure 2. Publications per number of authors.

Relating to wine regions, we observe growing interest and development for regional studies [e.g., 16, 17, 18, 19, 30]. In addition to the nature of the studies, these indicators refer mostly to wine with protected designation of origin. In this sense, Table 4 summarizes the selected studies according to geographical coverage and sample.

Comparative studies were observed in this review. On examining Table 4, we identified studies applied in different regions or protected designations of origin (PDO). For instance, Sánchez-Hernández et al. [18] include 16 protected designations of origin in their research, whereas Climent-López and Sánchez Hernández [11] and Esteban-Rodriguez and Climent-López [30] analyse a sample of all the Spanish wine PDOs. The same pattern is followed by Esteban-Rodríguez [19] and Esteban-Rodríguez and Climent-López [16] as they considered all wine PDOs present in Spanish territory. On the other hand, Esteban-Rodriguez and Climent-López [17] analyse 88 of 90 PDOs. Finally, De Villanueva [31] characterizes the wine industry located in the province of Mendoza, Argentina, and Szenteleki et al. [32] include three Hungarian wine regions: Etyek-Budai; Kunsági and Mátrai (including 17 sub-regions).

Indicators and frameworks: a regional perspective

The use of frameworks and indicators is a way to read and interpret the situation, simultaneously allowing a comparison of contexts over time [10]. A correct use of indicators may be applied to determine the critical areas of intervention to ensure competitive viticulture and may represent a decision-making tool to support wine regional entities, winemakers, and other related professionals [33]. One challenge is the selection of the most representative performance indicators to be included in a framework for wine regions. As a result of the SLR carried out in this paper, a list with 112 regional indicators was generated, which were based exclusively on

Table 4. Studies by their geographical coverage and sample.

References	Countries where survey was conducted	Geographical Coverage
Climent-López and Sánchez Hernández [11]	Spain	12 PDO wine districts: Arlanza, Arribes, Bierzo, Calatayud, Campo de Borja, Cariñena, Cigales, Ribera del Duero, Rueda, Somontano, Tierra de León and Toro.
Climent-López et al. [12]	Spain	16 PDO: Arlanza, Arribes, Bierzo, Calatayud, Campo de Borja, Cariñena, Cigales, Mondéjar, Ribera del Duero, Rueda, Somontano, Tierra de León, Tierra del Vino de Zamora, Toro, Uclés, Vinos de Madrid.
De Villanueva [31]	Argentina	Province of Mendoza
Esteban-Rodriguez and Climent-López [17]	Spain	88 protected designations of origin
Esteban-Rodriguez and Climent-López [30]	Spain	All Spanish wine PDOs: Rioja, Ribera del Duerao, Montilla-Morilles, Vinos de Madrid, Terra Alta, Penedés, Costers del Segre, Bierzo, Tierra del Vino de Zamora, Pago Guijoso, Pago Dominio de Valdepusa and Cigales.
Esteban-Rodríguez [19]	Spain	90 protected designation of origin
Esteban-Rodriguez and Climent-López [16]	Spain	90 protected designation of origin
Sánchez-Hernández et al. [18]	Spain	3 regions in 16 Spanish wine districts: Aragón (Catalayud; Campo de Borja; Cariñena; Somontano); Castilla y León (Arlanza; Arribes; Bierzo; Cigales;Ribera del Duero; Rueda; Tierras de León; Tierra del Vino de Zamora; Toro); Castilla-La Mancha (Mondéjar; Uclés) and Comunidad de Madrid (Vinos de Madrid).
Szenteleki et al. [32]	Hungary	Etyek-Budai; Kunsági and Mátrai wine regions (includes 17 sub-regions)

the articles under analysis and related exclusively to the presence of regional indicators in them.

To document which indicators are included in the frameworks, as well as how the research classified them, it is crucial to specify the criteria applied in this research. Bearing in mind the articles selected through the SLR, '*indicator classification*' was considered to be when: i) the authors had explicit categories/dimensions; and ii) even though not explicitly mentioned, it was possible to ascertain an indicator category/classification inductively generated according to the researchers' perspective.

The identification of the dimensions/categories was explicit in the cases of Climent-López and Sánchez-Hernández [11] and Climent-López et al. [12], in which the indicators followed quality conventions: industrial, commercial, domestic, civic, public and ecological. Despite addressing the same study field, Esteban-Rodríguez and Climent-López [30], Esteban-Rodríguez [19] and Esteban-Rodríguez and Climent-López [16] characterize the indicators based on different dimensions: market, technology and competition type. Conversely, Sánchez-Hernández et al. [18] classify the indicators into products or resources and, finally, Szenteleki et al. [32] categorize them as climate-based indicators. The second case occurs, for example in Esteban-Rodríguez and Climent-López [17] in which, although the presented indicators are not explicitly classified, the combination of them makes it possible to set suitable indicators to identify different production models of PDOs in Spain.

Convention theory has been used as an explanatory framework in agri-food sector studies, including the wine industry, and provides comparative studies through several wine-producing areas with PDO label. Despite the limited number of papers that address regional performance indicators, it is clearly possible to conclude that they use six different types of classification [12, 11, 19, 16, 17, 30]. These are synthetized in Table 5, as well as the number of indicators and frameworks.

According to Table 5, Climent-López et al. [12] classify the indicators into five quality conventions – industrial, commercial, domestic, civic and public. Despite using the same classification of indicators, Climent-López and Sánchez-Hernández [11] introduces a sixth quality convention – ecological. Despite that, while the previous authors characterize the indicators according to six quality conventions, which are an aggregation of indicators, Esteban-Rodríguez and Climent-López [16, 30] and Esteban-Rodríguez [19] categorize the indicators simultaneously according to the following dimensions – market, technology, and competition type –as part of the framework. On the same logic, Sánchez-Hernandez et al. [18] aggregate 21 indicators according to product and resources and Szenteleki et al. [32] analyse 11 indicators from the perspective of climatic conditions, which are both integrated into a framework. Finally, there are cases such as De Villanueva [31] where no classification or framework is observed at all, and the indicators are scattered.

Table 5. Number of indicators with their classification and framework.

Authors	Indicators	Framework	Classification
Climent-López and Sánchez-Hernández [11]	28	Yes	Industrial, Commercial, Domestic, Civic, Public and Ecological Conventions (market and technology)
Climent-López et al. [12]	19	Yes	Industrial, commercial, domestic, civic and public conventions
De Villanueva [31]	8	No	Not classified
Esteban-Rodríguez and Climent-López [17]	6	Yes	Production models
Esteban-Rodríguez and Climent-López [30]	9	Yes	Technology and market type (quality conventions)
Esteban-Rodríguez [19]	4	Yes	Technology and market type (quality conventions)
Esteban-Rodríguez and Climent-López [16]	6	Yes	Technology, market, and competition indicators (quality conventions)
Sánchez-Hernández et al. [18]	21	Yes	Products and resources
Szenteleki et al. [32]	11	Yes	Climatic indicators

In sum, most of the indicators are integrated into frameworks (8 of 9 publications), corresponding to 104 of 112 regional level indicators. Considering the papers mentioned in Table 5, where indicators are classified and simultaneously integrated into frameworks, four viewpoints can be highlighted: i) indicators related to products and resources of a specific territory; ii) indicators associated with climate conditions of a given region; iii) indicators classified according to known quality conventions (industrial, commercial, domestic, civic, public, and ecological); and iv) indicators grouped into technology and market types.

Given the similarity of the indicators among the four perspectives and bearing in mind the purpose of the present study, the indicators were reclassified according to the territorial, economic, and environmental dimensions. Under the territorial dimension, the exhibited indicators may be grouped into following areas – territorial resources and marketing. Regarding the economic dimension, the indicators were grouped in two main dimensions – productivity and competitiveness. Lastly, the environmental dimension features indicators related to sustainability issues. Considering their geographical scope, Tables 6 to 8 summarize the most mentioned regional level indicators found in the SLR.

As the wine production is an activity that depends on the availability of '*territorial resources',* the importance given by the wine regions to the measurement and impact on their businesses is crucial. Under this dimension, indicators such as 'average size of the farm per region', 'average size of the winery per region', 'number of wineries per region', 'number of brands per region' and the 'surface of the vineyard' are essential to characterize the wine industry on a regional scale.

Regarding '*marketing*', indicators such as the 'use of brands' is related to an intention to associate the image of wine with a specific territory and to obtain recognition as a product of origin. The 'average of stars obtained in wine guides' and the 'average awards/medals won in contests' measure the reputation based on expert assessments. Following a similar perspective, the number of 'references in specialized journals' measures the reputation in magazines which specialize in the wine industry and the 'number of results in internet search engines' analyses the popularity in a broader context. Additionally, the 'number of awards obtained by volume sold' is also a relevant indicator that reflects the importance of product quality. In summary, these previous indicators may provide crucial insights to wine regions related to their performance in terms of image and awareness. Table 6 presents the most cited indicators in the literature according to the territorial dimension.

Other indicators reported as having an important impact on the measurement of wine regions performance are those related to '*productivity*'. According to the literature, the 'surface area planted with high-yielding grape varieties' indicates a search for high yields per area and per wine region. In the same way, the 'average production of wine per type/region' quantifies the average size of the wine businesses and the 'percentage of young wines' show the extent to which wine businesses are looking for wines that require less time for production. Further, high values for these indicators show the pursuit of economies of scale and subsequently reveal higher productivity.

Concerning '*competitiveness*', a high percentage of vineyard area cultivated by global varieties reflects the adjustment of the suppliers to the demands of the international market. The 'percentage of vineyards controlled by cooperatives' focuses on the economic benefits of the industry and whether they are widely distributed among the local population. This indicator is an important measure of the level of collective involvement and economic cooperation within a region. 'Wine produc-

Table 6. Territorial indicators.

Indicators	N	Authors
Number of brands per region	3	Climent-López and Sánchez-Hernández [11]; Esteban-Rodríguez and Climent-López [16, 30]
Average size of the farm per region	2	Esteban-Rodríguez and Climent-López [16, 17]
Average size of the winery per region	2	Esteban-Rodríguez and Climent-López [16, 17]
Surface extension of vineyard (ha)	2	De Villanueva [31]; Esteban-Rodríguez and Climent-López [30]
Number of wineries per region	2	De Villanueva [31]; Esteban-Rodríguez and Climent-López [30]
Average size of brands	2	Esteban-Rodríguez [19]; Esteban-Rodríguez and Climent-López [30]
Brands of local products	2	Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]
Average stars obtained by wineries in wine guides within a region	2	Climent-López et al. [12]; Climent-López and Sánchez-Hernández [11]
Awards/medals won by wineries in contests	2	Climent-López et al. [12]; Sánchez-Hernández et al. [18]; Climent-López and Sánchez-Hernández [11]
Average reference in specialized journals	2	Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]
Average results obtained in internet search engines	2	Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]
Number of awards obtained by volume sold	2	Esteban-Rodríguez and Climent-López [30]; Esteban-Rodríguez [19]

Table 7. Economic indicators.

Indicators	N	Authors
Wine per region (hl)	3	Climent-López et al. [12]; Climent-López and Sánchez-Hernández [11]; De Villanueva [31]
Percentage of vineyard controlled by cooperatives	3	Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]; Sánchez-Hernández et al. [18]
Average price of the bottle per region	2	Sánchez-Hernández et al. [18]; Climent-López and Sánchez-Hernández [11]
Average production of wine per region	2	Climent-López et al. [12]; Climent-López and Sánchez-Hernández [11]
Vineyard surface area planted with global grape varieties	2	Sánchez-Hernández et al. [18]; Climent-López et al. [12]
Vineyard surface area planted with high-yielding grape varieties	2	Sánchez-Hernández et al. [18]; Climent-López et al. [12]
Percentage of young wine	2	Climent-López et al. [12]; Sánchez-Hernández et al. [18]
Wineries that organized guided tours within a region	2	Sánchez-Hernández et al. [18]; Climent-López and Sánchez-Hernández [11]

tion' and 'average price per bottle' are also key indicators which when well managed can influence the business strategies of wine regions and even their national and international markets performance. Additionally, the 'number of wineries within a region that organized guided tours' may reveal a competitive advantage and a strong marketing strategy. Table 7 exhibits the indicators related to economic dimension.

Several indicators are related to '*sustainability*'. For example, the 'percentage of organic certified wineries by a regulatory board' is based on the existence of labels that certify products made by processes that respect the environment and show an awareness of wine business organizations towards sustainable production processes. Furthermore, the 'percentage of planted vineyard area with rare grape varieties' provides an additional criterion: the designation of 'rare' alludes to certain native grape varieties that have unique characteristics, and in some cases, have practically disappeared because they have been replaced by others, whether autochthonous or foreign, so vineyards can become more productive or more competitive. Thus, the recovery of these rare varieties shows a positive attitude towards sustainability. Finally, higher values of 'vineyards planted with native varieties' reveal the intent to produce wine from local/endogenous resources, which clearly contributes to the local development and their preservation. Table 8 synthesizes the most cited indicators from an environmental perspective.

Additionally, we reclassified the indicators according to a regional competitiveness framework into the following five basic competitiveness dimensions: pro-

Table 8. Environmental indicators.

Indicators	N	Authors
Vineyard cultivated with rare grape varieties (%)	3	Sánchez-Hernández et al. [18]; Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]
Percentage of vineyard surface area planted with native grape varieties	3	Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]; Sánchez-Hernández et al. [18]
Wine certified as organic by the regulatory council	2	Sánchez-Hernández et al. [18]; Climent-López and Sánchez-Hernández [11]

Table 9. Infrastructure indicators.

Indicators	N	Authors
Vineyard cultivated with rare grape varieties (%)	3	Sánchez-Hernández et al. [18]; Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]
Percentage of vineyard surface area planted with native grape varieties	3	Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]; Sánchez-Hernández et al. [18]
Average size of the farm per region	2	Esteban-Rodríguez and Climent-López [16, 17]
Average size of the winery per region	2	Esteban-Rodríguez and Climent-López [16, 17]
Surface extension of vineyard (ha)	2	De Villanueva [31]; Esteban-Rodríguez and Climent-López [30]
Number of wineries per region	2	De Villanueva [31]; Esteban-Rodríguez and Climent-López [30]
Vineyard surface area planted with global grape varieties	2	Sánchez-Hernández et al. [18]; Climent-López et al. [12]
Vineyard surface area planted with high yielding grape varieties	2	Sánchez-Hernández et al. [18]; Climent-López et al. [12]

ductive capital, human capital, social-cultural capital, infrastructure, and intellectual capital [following, for example, 7, and 13]. Under the infrastructure dimension, indicators such as 'Vineyard cultivated with rare grape varieties (%)', 'Percentage of vineyard surface area planted with native grape varieties', 'Average size of the farm per region', and 'Surface extension of vineyard (ha)' demonstrate the importance of existing infrastructure for regional competitiveness (see Table 9).

The productive capital dimension covers aspects such as economic development, stability, or market size. In our study this dimension includes indicators such as 'Average production of wine per region', 'Wine per region (hl)', 'Percentage of young wine' and 'Average price of the bottle per region' (see Table 10).

For the social and institutional capital that should include variables relating to the efficiency of public administration or the legal framework, in our study an indicator 'Percentage of vineyard controlled by cooperatives' could be identified [11, 12, 18].

Finally, Indicators as, e.g., 'number of brands per region', 'wineries that organized guided tours within a region', 'average stars obtained by wineries in wine guides within a region', and 'wine certified as organic by the regulatory council', were classified under the innovation and intellectual dimension (see Table 11).

5. CONCLUSIONS, IMPLICATIONS, LIMITATIONS, AND FUTURE RESEARCH

Given the increasing importance of the wine industry, and especially of well-managed wine regions, conducting a study to identify indicators and competitiveness frameworks with impact on performance at the regional level seemed an interesting and challenging research task. Based on an SLR, we sought to identify the main performance indicators used at regional level to support decision-making in the wine industry.

The results document that there is a limited number of research works identifying indicators with impact on the performance of wine regions, and even fewer studies including indicators in an integrated approach to measure the different dimensions of wine regions performance. Thus, our research contributes to the literature by identifying indicators according to a regional competitiveness framework grouped into five main dimensions: productive capital, human capital, social-cultural capital, infrastructure and intellectual capital. According to this SLR, the indicators grouped and ranked under this framework are the most referred to and are used to address the overall performance of the wine industry. Moreover, most of them are used in highly competitive PDO regions. As such, they could be clustered as the

Table 10. Productive capital indicators.

Indicators	N	Authors
Wine per region (hl)	3	Climent-López et al. [12]; Climent-López and Sánchez-Hernández [11]; De Villanueva [31]
Average price of the bottle per region	2	Sánchez-Hernández et al. [18]; Climent-López and Sánchez-Hernández [11]
Average production of wine per region	2	Climent-López et al. [12]; Climent-López and Sánchez-Hernández [11]
Percentage of young wine	2	Climent-López et al. [12]; Sánchez-Hernández et al. [18]

Table 11. Innovation and intellectual capital indicators.

Indicators	N	Authors
Number of brands per region	3	Climent-López and Sánchez-Hernández [11]; Esteban-Rodríguez and Climent-López [16, 30]
Wineries that organized guided tours within a region	2	Sánchez-Hernández et al. [18]; Climent-López and Sánchez-Hernández [11]
Average size of brands per region	2	Esteban-Rodríguez [19]; Esteban-Rodríguez and Climent-López [30]
Brands of local products	2	Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]
Average stars obtained by wineries in wine guides within a region	2	Climent-López et al. [12]; Climent-López and Sánchez-Hernández [11]
Awards/medals won by wineries in contests	2	Climent-López et al. [12]; Sánchez-Hernández et al. [18]; Climent-López and Sánchez-Hernández [11]
Average reference in specialized journals	2	Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]
Average results obtained in internet search engines	2	Climent-López and Sánchez-Hernández [11]; Climent-López et al. [12]
Number of awards obtained by volume sold	2	Esteban-Rodríguez and Climent-López [30]; Esteban-Rodríguez [19]
Wine certified as organic by the Regulatory Council	2	Sánchez-Hernández et al. [18]; Climent-López and Sánchez-Hernández [11]

main dimensions and indicators to be used at regional level to support decision-making in the wine industry.

Under the regional competitiveness framework, the only basic competitiveness dimension for which we have not identified any indicators was that of human capital. This dimension should incorporate indicators related to the efficiency of the labour market, basic and higher education, and ongoing training.

To achieve the target of regional competitiveness and to increase the well-being of the population in a certain region, it is essential to fulfil the basic dimensions of regional competitiveness. Our results document that infrastructures, intellectual capital and productivity are dimensions that are given importance in terms of regional competitiveness in the wine industry. However, the same importance is not given to the dimensions of human and socio-cultural capital.

To improve the quality of life of a region, e.g., represented by means of the gross regional product, it is essential to increase labour productivity and the employment rate, which is difficult to accomplish without including the human capital dimension.

Industry-wise, this paper contributes to the development of a meaningful and useful framework to assess collective wine business organizations/wine regions by means of performance indicators. Nevertheless, regional specificities and their different business units must be considered when designing and proposing performance indicators in a framework. As referred to in the document, certain regions based their competitiveness on PDOs, which might aggregate several of those indicators. From an academic viewpoint, this paper highlights the main research areas that require more attention in the future and might help researchers to update knowledge on this field.

Based on these regional indicators, future research could focus on developing studies/indicators related to National Board Commissions in the wine industry.

REFERENCES

[1] B. Rugani, I. Vázquez-Rowe, G. Benedetto, E. Benetto, A comprehensive review of carbon footprint analysis as an extended environmental indicator in the wine sector, J. Cleaner Prod. 54(1) (2013) 61-77.

[2] C. Maurel, A. Ugaglia, B. Del'homme, Evolution of the concept of performance in the wine industry:

A literature review, Int. J. Entrepreneurship Small Bus. 32(1/2) (2017) 254-279.
[3] OIV (International Organisation of Vine and Wine) OIV State of the World Vitivinicultural Sector in 2019. Accessed May 7, 2020 at http://www.oiv.int/en/oiv-life/current-situation-of-the-vitivinicultural-sector-at-a-global-level (accessed at 07/05/2020).
[4] R. Bandinelli, D. Acuti, V. Fani, B. Bindi, G. Aiello, Environmental practices in the wine industry: an overview of the Italian market, Br. Food J. 122(5) (2020) 1625-1646.
[5] T. Atkin, D. Wilson, L. Thach, J. Olsen, Analyzing the impact of conjunctive labeling as part of regional wine branding strategy, Wine Econ. Policy. 6(2) (2017) 155-164.
[6] M. Del Giudice, Z. Khan, M. De Silva, V. Scuotto, F. Caputo, E. Carayannis, The microlevel actions undertaken by owner-managers in improving the sustainability practices of cultural and creative small and medium enterprises: A United Kingdom–Italy comparison, J. Organizational Behav. 38(9) (2017) 1396-1414.
[7] J. Vega, J. Azorín, A. Segura, M. Yago, A new measure of regional competitiveness, Appl. Econ. Anal. 27(80) (2019) 108-126.
[8] P. Annoni, K. Kozovska, EU regional competitiveness index 2010, Joint Research Centre, Scientific and Technical Reports. (2010).
[9] D. Borozan, J. Strossmayer, Regional competitiveness: some conceptual issues and policy implications. Interdiscip. Manage. Res. 4 (2008) 50-63.
[10] S. Flores, What is sustainability in the wine world? A cross-country analysis of wine sustainability frameworks, J. Cleaner Prod.. 172 (2018) 2301-2312.
[11] E. Climent-López, J. Sánchez-Hernández, La théorie des conventions en géographie économique: Un éclairage apporté par l'application à l'industrie espagnole du vin, Géographie, Economie, Société. 17(1) (2015) 25-50.
[12] E. Climent-López, J. Sánchez-Hernández, C. Canto-Fresno, J. Alonso-Santos, S. Ramírez-García, V. Rodero-González, E. Ruiz-Budría, Measuring quality conventions in the food industry: Applications to the wine sector in Spain, Geoforum. 56 (2014) 148-160.
[13] I. Lengyel, The pyramid model: enhancing regional competitiveness in Hungary, Acta Oeconomica. 54(3) (2004) 323-342.
[14] A. Goncharuk, Exploring the factors of efficiency in German and Ukrainian wineries, J. Wine Res. 28(4) (2017) 294-312.
[15] J. Mota, A. Moreira, R. Costa, S. Serrão, V. Pais-Magalhães, C. Costa, Performance indicators to support firm-level decision-making in the wine industry: a systematic literature review, Int. J. Wine Bus. Res. 33(2) (2020) 217-237.
[16] S. Esteban-Rodríguez, E. Climent-López, Los mundos de producción de las denominaciones de origen protegidas del vino en España: Disparidad de convenciones tecnológicas y comerciales, Economía Agraria y Recursos Naturales. 17(1) (2017) 101-125.
[17] S. Esteban-Rodríguez, E. Climent-López, Modelos productivos de las DOP de vino en España, Cuadernos Geográficos. 57(1) (2018a) 259-282.
[18] J. Sánchez-Hernández, E. Climent-López, S. Ramírez-García, V. Rodero-González, B. Loscertales-Palomar, C. Canto-Fresno, Clasificación de las Denominaciones de Origen vinícolas en la tipología de los mundos de producción: una aplicación al caso español, Cuadernos Geográficos. 56(2) (2017) 263-282.
[19] S. Esteban-Rodríguez, Changes in Protected Designations of Origin in the Spain Wine Sector: Movements between worlds of production, Boletín de la Asociación de Geógrafos Españoles. 74 (2017) 627-633.
[20] D. Vergamini, F. Bartolini, P. Prosperi, G. Brunori, Explaining regional dynamics of marketing strategies: The experience of the Tuscan wine producers, J. Rural Stud. 72 (2019) 136-152.
[21] D. Denyer, D. Tranfield, Producing a systematic review, in: D. Buchanan, A. Bryman (Eds.), The Sage Handbook of Organizational Research Methods, Sage, London, 2009, pp. 671-689.
[22] D. Tranfield, D. Denyer, P. Smart, Towards a methodology for developing evidence-informed management knowledge by means of systematic review, Br. J. Manage. 14(3) (2003) 207-222.
[23] H. Snyder, Literature review as a research methodology: An overview and guidelines, J. Bus. Res. 104 (2019) 333-339.
[24] A. Bonn, M. Cho, H. Um, The evolution of wine research: A 26 year historical examination of topics, trends and future direction, Int. J. Contemporary Hospitality Manage. 30(1) (2017) 286-312.
[25] R. Light, D. Pillemer, Summing Up: The Science of Reviewing Research, Harvard University Press, Cambridge, MA, 1984.
[26] P. Silva, A. Moreira, A systematic review of the literature on industrial divestment, Baltic J. Manage. 14(3) (2019) 443-461.
[27] V. Braun, V. Clarke, Using thematic analysis in psychology, Qual. Res. Psychol. 3(2) (2006) 77-101.

[28] M. Jones, N. Coviello, Y. Tang, International entrepreneurship research (1989-2009): a domain ontology and thematic analysis, J. Bus. Venturing. 26(6) (2011) 632-659.
[29] C. Ribau, A. Moreira, M. Raposo, SME internationalization research: mapping the state of the art, Canadian J. Administrative Sci. 35(2) (2018) 280-303.
[30] S. Esteban-Rodríguez, E. Climent-López, Les appellations d'origine protégée du vin en Espagne, d'après la théorie des mondes de production: Une approche quantitative, Annales de Géographie. 3(721) (2018b) 279-306.
[31] B. De Villanueva, Caracterización del boom vitivinícola en Mendoza (Argentina), 1904-1912, Mundo Agrario. 9(13) (2009).
[32] K. Szenteleki, M. Ladányi, M. Gaál, G. Zanathy, G. Bisztray, Climatic risk factors of central Hungarian grape growing regions, Appl. Ecol Environ. Res. 10(1) (2017) 87-105.
[33] R. Merli, M. Preziosi, A. Acampora, Sustainability experiences in the wine sector: toward the development of an international indicators system, J. Cleaner Prod. 172 (2018) 3791-3805.

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Does belonging to an appellation make a difference? New evidence from Ontario Viticultural Areas

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Abstract. Assuming that wine markets are efficient, ultimately a bottle of wine's cost and therefore its price should reflect its vintage, grape variety as well as how it is vinified. Yet, being an experiential good, a wine's price is also closely related to its place of origin. If the designated viticultural area of wine is coming from is not considered, even in a relatively new wine country, wine makers may end up over-estimating the premium attached to vintage, variety as well as how it is vinified. Regression results indicate that, for Ontario wines, the over-estimations vary between 1% points and 18% points.

Keywords: appellation, AVA, price.

INTRODUCTION

Until recently, Canadian wine was almost an oxymoron. Other than its infamous ice wine, even well-informed wine drinkers were not aware of Canadian wines. The reason being that Canada resides out of conventional wine growing zone between 30 and 50 degrees latitude north and south of the equator; Canada was dismissed as a wine country. Yet, Canadians have been making wine for centuries. (Phillips, 2017). Moreover, recently their wine industry is growing at an accelerating rate. For instance, from 2011 to 2018, Canadian wine sales in Canada went up by 41%, from 1.67 to 2.35 billion CAN$; while the imported wine sales were up by 34% during the same time period. (Source: Statistics Canada via Statista.) In particular, wineries in the Ontario region are building a good reputation and market share in Canada. With 6,663 hectares of wine grape area, Ontario region has 60% of the Canadian bearing vineyard area. (VQA Ontario Wine Appellation Authority, 2019.)

Since 1999, Canadian wine industry has been heavily regulated. (Carew and Florkowski, 2012.) For instance, Vintners Quality Alliance, or VQA Ontario Wine Appellation Authority is a regulatory agency responsible for "maintaining the integrity of local wine appellations and enforcing win-

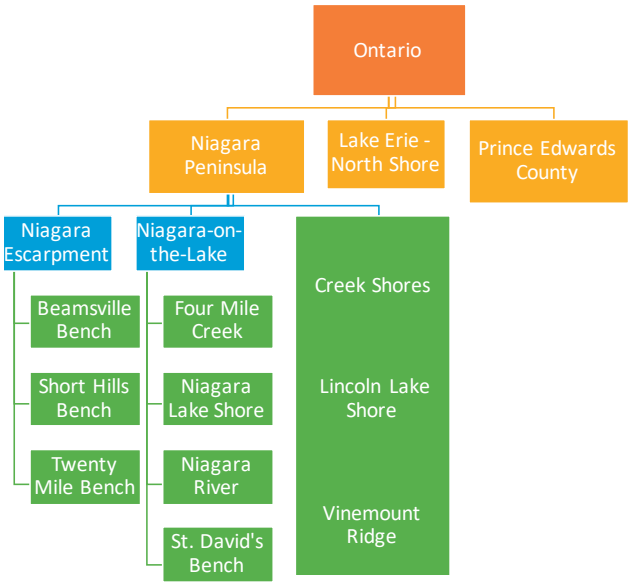

Figure 1. Ontario appellations.

emaking and labelling standards in Ontario."[1] As is shown in Figure 1, VQA Ontario divides Ontario into three primary Viticultural Areas or appellations of origin: Niagara Peninsula, Lake Erie North Shore, and Prince Edward County. Within the Niagara Peninsula appellation, ten sub-appellations are identified; four of them on the plains close to Lake Ontario (Four Mile Creek, Niagara Lake Shore, Niagara River, and St. David's Bench) and three on the bench lands of the Niagara Escarpment (Beamsville Bench, Short Hills Bench, Twenty Mile Bench). The other three sub-appellations are Creek Shores, Lincoln Lake Shore, and Vinemount Ridge. Thus, there are effectively four layers of appellations within the Ontario wine region.

Cross, Plantingab and Stavins (2011) shows the economic importance of the concept of terroir but not the reality of terroir – as proxied for by locational attributes on the sale prices of vineyards. Similarly, as is argued in Gokcekus and Finnegan (2017, p. 345-346), "… it is well established that terroir can have a demonstrable effect on wine's worth, but there is no consensus on whether terroir matters as a fundamental reality or solely economically due to the perceived reputation of a particular area. Nevertheless, the prices at which winemakers can sell their wines vary depending on the wines' geographic origins." (Matthews, 2016; Landon and Smith, 1997, Lecocq and Visser, 2006; Patterson and Buechsenstein, 2018).

[1] For details, see VQA Ontario Wine Appellation Authority's web page: https://www.vqaontario.ca/Home.

Table 1. Summary statistics for 4,213 Ontario wines.

Variable	Average
Price	$ 23.12
Price (2002)*	$ 17.81
Single Variety	86%
Named Vineyard	11%
Estate Bottled	7%
White Wine	53%
Chardonnay	16%
Riesling	14%
Pinot Noir	10%
Cabernet Franc	10%

*Real, 2002 prices (Canadian consumer price index is used in deriving real prices.)

In this study, we ask the following questions: Does it make a price difference whether a wine is coming from a particular Ontario appellation? In particular, is there a regional reputation premium attached to a particular appellation or sub-appellation? Moreover, does the premium for vintage, variety, and vinification change whether the regional differences are taken into account or not?

DATA

For 4,213 table wines from Ontario wine region, between 2015-2018, we have information regarding their retail price, vintage, size, grape variety(ies), appellation, as well as vinification—whether they are from a name vineyard or estate bottled. Table 1 provides summary statistics for these wines.

CALCULATIONS AND FINDINGS

To set a benchmark, first, as an ad-hoc regression model, the real price of each bottle of Ontario wine is set as a function of vintage, variety, and vinification[2] without taking appellations differences into account.

[2] The wine must be made from at least 85% of the grape variety named to be considered a single variety. Estate Bottled are variations such as "Estate Grown" or "grown, produced and bottled by" are permitted if the wine qualifies for the estate bottled designation, close variations are not permitted for non-VQA wines. Vineyard (any named vineyard indicating origin is not permitted for non-qualifying VQA wines or non-VQA wines, two or more vineyards may not be named but general references to vineyards or multiple but unnamed vineyards are permitted).

$$\ln(Price_i) = \beta_0 + \beta_1\ Vintage_i + \beta_{2j}\ \Sigma^7_{j=1}\ Variety_{j,i} + \beta_{3k}\ \Sigma^4_{k=1}\ Vinification_{j,i} + \varepsilon_i$$

where, *ln* is natural logarithm operator; *Vintage* is the age of the wine; $Variety_j$ is a dummy variable, where j = chardonnay, pinot noir, cabernet sauvignon, cabernet franc, riesling, sauvignon blanc, merlot, or pinot grigio; Vinification is a dummy variable, where k = single variety, estate bottled, named vineyard, or named vineyard and estate bottled; finally ε_i is a well behaving error term.

According to the robust regression results, as is summarized in column (2) of Table 2, there is a statistically significant relationship between real price and vintage, variety, and vinification: (1) Vintage matters; (2) there is a premium for red wines—pinot noir, cabernet sauvignon, cabernet franc, and merlot as well as a white wine, chardonnay; (3) making wines by using a single variety and estate or/and named vineyard bottling increases the price.

Second, the real price of each bottle of Ontario wine is set as a function of vintage, variety, vinification as well as fifteen appellation/sub-appellations:

$$\ln(Price_i) = \beta_0 + \beta_1\ Vintage_i + \beta_{2j}\ \Sigma^7_{j=1}\ Variety_{j,i} + \beta_{3k}\ \Sigma^4_{k=1}\ Vinification_{j,i} + \beta 4l\ \Sigma^{15}_{l=1}\ Appellation_{k,i} + \varepsilon_i$$

Column (3) of Table 2 presents the robust regression results for this specification. These findings indicate that for Ontario wine prices 'terroir' matter. For example, compared to an Ontario wine with no particular appellation designation, a wine from Four Mile Creek acquires an additional 35% premium of which 19% is due to having its own sub-appellation, 7% for being under Niagara-on-the-Lake, and 9% for a Niagara Peninsula appellation. The size of the premium differences from one appellation to another is striking: It varies between 5% (Lake Erie North Shore) and 39% (St. David's Bench). These differences highlight the importance of appellation designations even in a relatively new and also small wine region of Ontario.

Another finding is about the size of the over-estimation regarding the premium attached to vintage, variety, and vinification, if we ignore appellation/sub-appellation differences. According to the regression results in Table 2 – the difference between column (2) and column (3) – the estimated coefficients for vintage, variety and vinification variables were over-estimated by between 1% points and 18% points. For instance, premium attached to grape varieties pinot noir, chardonnay, and cabernet franc are 7.2%, 4.2%, and 4.1% points respectively were over-estimated unless appellation designations were taking into account. Similarly, regarding vinification, over-estimations are 17.6%, 8.7%, 7.4%, and 6.8% points for name vineyard and estate, named vineyard, estate bottled, and single variety, respectively. These differences are not only statistically significant; indeed, they are economically significant too.

Table 2. ln (wine price$_{2002}$) = f (wine characteristics); robust regression results.

(1)	(2)		(3)	
Characteristics	coefficient	t-stat	coefficient	t-stat
Vintage				
Wine Age	4.56%	11.94***	3.88%	10.66***
Variety				
Chardonnay	9.34%	5.39***	5.16%	3.07***
Pinot Noir	25.40%	12.59***	18.23%	9.25***
Cabernet Sauvignon	25.47%	11.12***	23.02%	10.4***
Cabernet Franc	16.81%	8.47***	12.67%	6.61***
Riesling	-0.99%	-0.55	-4.16%	-2.36**
Sauvignon Blanc	-1.42%	-0.55	-3.28%	-1.33
Merlot	22.69%	10.02***	20.09%	9.2***
Pino Grigio	-1.01%	-0.40	-3.45%	-1.43
Vinification				
Single variety	22.04%	13.83***	15.27%	9.88***
Estate bottled	14.97%	7.29***	7.61%	3.69***
Named vineyard	30.48%	17.46***	21.80%	8.59***
Named vineyard and estate	34.87%	13.81***	17.25%	9.31***
Appellation/sub-appellation				
Beamsville Bench			4.69%	1.26
Creek Shores			8.34%	1.79*
Four Mile Creek			18.69%	6.1***
Lincoln Lake Shore			22.99%	7.78***
Niagara Lake Shore			-8.81%	-2.33**
Niagara River			10.09%	2.62***
Short Hills Bench			-2.37%	-0.37
St. David's Bench			22.27%	5.8***
Twenty Mile Bench			2.47%	0.62
Vinemount Ridge			20.04%	5.53***
Niagara Escarpment			17.70%	5.6***
Niagara-on-the Lake			7.15%	3.41***
Niagara Peninsula			9.28%	6.14***
Lake Erie – North shore			5.14%	1.8*
Prince Edwards County			32.50%	13.28***
Constant	2.315	124.27***	2.289	125.57***
Obs. No.		4,213	4,213	
adjusted- R^2		0.27	0.34	
F(13, 4199)		119.99***		
F(28, 4184)			78.48***	

Note: Significance levels (two-tailed) 1% (***), 5% (**), and 10% (*)

DISCUSSION

To summarize, these findings 1) highlight the economically significant effect of terroir or a regional reputation even in a relatively new wine region; 2) indicate that ignoring the importance of terroir clearly could result in an overestimation of the premiums attached to different vintages, varieties, and vinification; and, moreover, 3) show that these premiums are not uniformly overestimated; there are variations among vintage, varieties as well vinification. Consequently, a wine maker should be paying attention to things that they can choose or control, but meanwhile they should keep in mind the location of their winery in order to set realistic expectations for the return on their investments and efforts.

REFERENCES

Carew, R. and Florkowski, W. J. Regulatory and institutional developments in the Ontario wine and grape industry. *International Journal of Wine Research* 4 (2012): 33-44.

Cross, R., Plantingab, A. J. and Stavins, R. N. "The Value of Terroir: Hedonic Estimation of Vineyard Sale Prices." *Journal of Wine Economics* 6, no. 1 (2011):1-14.

Gokcekus, O. and Finnegan, C. "Price Effects of Establishing a New Sub-AVA within Oregon's Willamette Valley AVA." *Journal of Wine Economics* 12, no. 4 (2017): 345-353.

Landon, S., and Smith, C. E. "The use of quality and reputation indicators by consumers: The case of Bordeaux wines." *Journal of Consumer Policy* 20, no. 3 (1997): 289–323.

Lecocq, S., and Visser, M. "What determines wine prices? Objective vs. sensory characteristics." *Journal of Wine Economics* 1, no. 1 (2006): 42-56.

Matthews, M. A. *Terroir and Other Myths of Winegrowing*. Oakland: University of California Press, 2016.

Phillips, Rod. *The Wines of Canada*. Oxford: Infinite Ideas Ltd, 2017.

Patterson, T. and Buechsenstein, J. *Wine and Place: A Terroir Reader*. Oakland: University of California Press, 2018.

VQA Ontario Wine Appellation Authority (2019). *2019 Annual Report*.

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How do sparkling wine producers adopt a sub-appellation? Evidence from an exploratory study on heroic Prosecco Superiore Rive

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Abstract. This exploratory paper investigates why sparkling wine houses producing Conegliano Valdobbiadene Prosecco Protected Designation of Origin (CVPP) wines decided to adopt the sub-appellation "Rive" to increase the value of their wines. We estimated both logistic and generalized linear models to explain Rive sub-appellation (SA) firms' choice and market share, respectively. By using data gathered from CVPP producers, we divided wineries into two groups, namely, those that adopted the Rive SA and those that did not. By means of a stepwise procedure, we categorized factors that were likely to explain the Rive SA choice within a set of structural, marketing and wine tourism-related variables. The results showed that structural drivers such as the human capital of younger producers, firm size, resource endowments, wine production, and involvement in ad hoc promotional activities (i.e., Primavera del Prosecco) have the greatest effects on the choice of Rive SA. On the other hand, the effects of small sizes, cellar door sales, and key CVPP wine tourism events have emerged as vital factors in the growth of Rive SA in terms of market share. The adoption of the Rive SA may play an important role in supporting and valuing the work of a vine-growers community who have been able to transform the difficulties and the passion of vine cultivation on steep slopes parcels into distinguishing features and may help the CVPP Tutelary Consortium appropriately undertake promotional policies to differentiate wines and improve competitiveness. This could have positive effects on wine tourism, hospitality, and winery visits considering the recent recognition of the CVPP as the 55th Italian UNESCO World Heritage site.

Keywords: sub-geographical indication, Prosecco sparkling wine firms, intraregional wine differentiation, steep-slope viticulture, market differentiation, wine tourism strategies.

1. INTRODUCTION

Over the last few decades, the international wine market has dramatically changed by, inter alia, increasing the number of appellations and sub-appellations. Under the pressure of several market and socioeconomic forces,

the Italian wine supply has followed these developments towards a reference model of higher quality wines [1]. As evidenced by Scozzafava et al. [2], Italian wine legislation has designed a model that differs from the French model based on the hierarchical territorial classification, where vineyards or groups of vineyards are typically recognized for quality. Therefore, a new appellation (or sub-appellation) faces difficulties in attempting to become successful mainly for institutional, wine labelling, and market differentiation reasons [3-5]. However, some of these new designations may build a reputation of excellence as an acclaimed and successful collective brand [6].

In this context, Conegliano Valdobbiadene Prosecco Protected Designation of Origin (CVPP) appellations are encompassed within the most prominent case studies deserving of attention, with a supply of over 91 million bottles in 2018 [7-9]. The CVPP is made up of 15 districts (municipal areas), and it takes its name from the two main towns of the zone. It represents the top Protected Designation of Origin (PDO) for Prosecco, as it is rooted in a specific tradition, rural heritage, terroir, and landscape. Prosecco wine is made from the Glera grape variety and is obtained using the Martinotti method after secondary fermentation in pressure tanks. The Prosecco Reform (2009) provided by the Italian Ministry of Agriculture, upgraded the former CVPP's from DOC (Controlled Designation of Origin) to DOCG (Controlled and Guaranteed Designation of Origin), and instituted the new Prosecco DOC, which covers nine provinces belonging to Veneto and Friuli-Venezia Giulia regions [10]. It is the largest Italian wine PDO for the number of bottles (500 million bottles in 2020), most of which are exported worldwide [11].

The CVPP hierarchical quality model is in turn classified into three geographical levels. These levels are Superiore di Cartizze sub-appellation (SA), which is locally considered in the same manner as the first-growth or *grand cru* and represents 1.7% of the CVPP supply; Rive SA, a second-growth wine or small SA, which accounts for a proportion of 2.9%; and the basic Prosecco Superiore (PS), (i.e., the classical CVPP sparkling wine), which is the most widespread (95,4%) [12].

The first sub-appellation (1.5 million bottles sold) indicates absolute top-quality wines within the CVPP appellation. It comes from a subzone that covers just 107 hectares of vineyards in the borough of Valdobbiadene, where the maximum yield allowed by the disciplinary system is 12 tons of grapes per hectare. It has not changed its territorial boundaries since the CVPP was set up in 1969. Its supply has stabilized since the 1980s. Hence, the alternative decision to produce Superiore di Cartizze has substantially no chance of being developed by the CVPP's sparkling wine houses. Therefore, it can be excluded from the choice set due to the current CVPP's disciplinary rules. In contrast, a major choice in adding value to CVPP supply chains is through Rive SA's adoption strategy by replacing PS production. In July 2009, the Prosecco Reform introduced the Prosecco Superiore and Rive SAs, both stemming from the CVPP's Spumante (sparkling wine) DOC [10]. Production for the former is approximately 83.8 million bottles, and the maximum yield allowed is 13.5 tons of grapes per hectare. Rive SA production and yield lie between those already described for Superiore di Cartizze and Prosecco Superiore. In 2018, the Rive SA covered an area of approximately 249 hectares with a supply equal to 2.7 million bottles sold. Interestingly, over the 2010-2018 period, the number of bottles claimed under the Rive SA increased at a double-digit annual growth rate (15%), which is almost three times higher than that of the PS.

The term "Rive" indicates, in the patois of the local inhabitants, small parcels of steeply sloped vineyards that are characteristic of the area and where the best-quality grapes are produced (*sensu stricto*). This category of wine highlights the different expressions of the CVPP. Rive wines are often obtained from grapes grown in the steepest, highest-quality vineyards in a single borough or hamlet, thus emphasizing the characteristics that a terroir gives to the wine. The concept of the Rive SA as a brand arose as an answer to the awareness of the need to link the image of a wine to its terroir to highlight the synergies between soil, weather, grape and winegrower [13].

Within the CVPP appellation, 43 Rive wines are now allowed, of which 12 get their name from their borough and 31 from their borough's hamlet. Each terroir expresses a different and specific combination of soil, exposure, microclimate, and human factors. In the Rive, yields are limited to 13 tons of grapes per hectare, the grapes are picked exclusively by hand, and the vintage must be shown on the label. The Rive SA represents a viticultural potential of 83.7% of the CVPP area, of which 48.4% falls within the UNESCO "Core Zone," and the rest falls within the so-called "Buffer Zone" (Figure 1).

The marketing literature on geographical indications is rather vast and has mostly focused on the consumer side [2, 14, 15]. However, less attention on the supply side has been paid to sub-appellations or small appellations within larger ones. The soundness of SAs proposed for the Niagara Region of Canada has been investigated from both a consumer viewpoint [5, 16] and a *terroir* perspective [17]. In Europe, Gergaud and Ginsburgh [18] tested the *terroir* impact on the quality of Bordeaux wines. On the supply side, Cross et al. [19] show a strong impact of new SAs on vineyard sale prices with-

(a) (b)

Figure 1. Rive SA: 43 sub-appellations within the CVPP area; (b) inside and outside of UNESCO's World Heritage Site (*bordered by the red line*).

in the Willamette American Viticulture Area (AVA), while Gokcekus and Finnegan [20] demonstrate that SA wine reputation premiums have increased significantly with their creation. The CVPP appellation is somewhat similar to the Willamette AVA, given that new SAs are superimposed within an existing, wide appellation.

According to the extant literature concerning the wine sector, the adoption of an SA is expected to bring benefits to firms, such as increased competitiveness through increased supply or greater market differentiation [21]. Given that some firms in the CVPP area use Rive SA, while others do not, this study aims to ascertain what factors make a difference in deciding to adopt Rive SA. This leads to the following research questions: 1) What are the drivers (i.e., structural, market and wine tourism-related variables) of the adoption of Rive SA? What is their relative importance? 2) Additionally, what structural, market and wine tourism-related factors have effects on the Rive SA share of the total CVPP sparkling wine sales?

This study focuses on two traditional CVPP sparkling wines (PS and Rive SA), where Rive SA can be considered a potential driver of innovation [22]. To consider the expected impacts of structural, marketing and wine tourism-related variables, a set of factors capable of explaining a firm's likelihood of adopting Rive SA was evaluated [23-26].

The CVPP's sparkling wine houses face an important decision regarding whether to adopt the Rive SA over PS or reject that innovation while maintaining the PS. Thus, weighing the pros and cons of adoption represents a challenging and temporary choice (i.e., made at the time of harvest selection).

– *Rive SA's advantages over PS.* Rive SA represents the sparkling wine of the "core zone". It has an image linked to heroic viticulture and Colline del Prosecco di Conegliano e Valdobbiadene, which is recognized as a UNESCO Heritage Site. This implies a role of the product in promoting wine tourism with higher CVPP quality. In their attempts to be more competitive and differentiate themselves, CVPP firms have a growing interest in adopting Rive SA over PS [26]. According to the CVPP's Research Centre for Market Studies and the CVPP's production specifications, on the one hand, the PS allows a maximum production of 12,600 bottles per hectare with an average price of 5.44 euros per bottle at the production phase; on the other hand, the yield of the Rive SA is 12,133 bottles per hectare with an average unit value of 6.23 euros per bottle. Consequently, other production costs being equal, the opportunity cost for giving up or postponing Rive SA adoption would consist of approximately 10% of the revenue.
– *Rive SA's disadvantages over PS.* The price differential between Rive SA and PS in the grape and base wine markets should be greater to properly sustain both higher labour intensity and its expanding effect among producers. Yet, compared to PS, the spread of Rive SA is more linked to the domestic market than to exports; given its recent creation, the promotion of Rive SA has not been established. Ultimately, consumers' knowledge of PS in a broader sense is stronger than that of Rive SA [27].

The paper is organized as follows. Section two presents the theoretical approach. Section three relates to the methodology and the data employed. Section four addresses the results, and section five discusses those results. Final considerations conclude the work.

2. THEORETICAL APPROACH AND HYPOTHESES

As argued by Rogers [28], the adoption of Rive SA can be contextualized as the process of deciding on the introduction of an innovation. The entrepreneur, to

start with, goes through a phase of acquiring knowledge about the rules of the product specification and then the assessments of conditions for its claims and of market demand, which leads to the formation of a positive or negative attitude towards the Rive SA when ultimately deciding whether to adopt the new SA.

The review of the literature has widely investigated the relevance of factors affecting the introduction of new geographical indications for wines. For instance, the process can be influenced by a wide variety of patterns [29-32], including cultural and psychological factors (e.g., belonging to a community of heroic winegrowers, personality, empathy); structural factors (e.g., land under cultivation, human capital, production size); marketing factors (firms' entries into new channels and markets, price positioning, branding); factors related to the development of wine tourism (e.g., visitor reception, wine events); and political factors (e.g., differentiation strategies implied by the Tutelary Consortium at the territorial level).

Thus, a broader framework can be applied to study the model for the adoption of SA by firms in the CVPP territory [33, 34]. The framework can identify group variables derived from the structure–conduct–performance model [35] that can influence the process by which firms adopt the Rive SA as a relevant innovation, i.e., the structural, marketing, and wine tourism contexts. This design is in line with similar research and strategies implemented in the wine industry [19, 20, 36, 37].

This study considers that the development of the conceptual adoption model assumes that the differentials in the vineyard yield per hectare, average selling prices and production costs between the PS and Rive SA in current and future years are known with certainty to winegrowers. Therefore, one can assume that the decision has low risk and uncertainty to properly portray the Rive SA adoption decision process; this process is aligned with the CVPP Consortium's aim to support the added value of the heroic viticulture wines of the Designation as a UNESCO World Heritage Site.

2.1 Rive SA adoption

Structural variables. According to the existing literature and empirical evidence, structural resources have been consistently identified as important factors for the adoption of a SA [13, 26, 38]. Winery size is supposed to affect the choice of introducing the Rive SA. However, the decision is challenging. On the one hand, large wineries have more possibilities to diversify their portfolios than small ones do. On the other hand, small wineries are more focused on local consumers who may be more interested in terroir features. Given this ambiguity about the size effect, we include various size indicators in the model: the number of bottles, PDO surface, pressure tank capacity and three categories of employees. Considering the human factor, a younger entrepreneur is thought to be more likely to push for the adoption of new SAs. The amount of CVP bottled by third parties should imply a lower incentive to use SAs, as more third-party bottling indicates a weaker tie to the winegrowing area. A similar consideration may apply to the quantity of purchased grapes to be crushed in the winery, given that this can be an obstacle to a strong supply identity based on a winery's own grapes. Therefore, it is reasonable to hypothesize the following:

> H1: Firms with higher levels of human factors, owned structural endowments, and commercial size are more likely to adopt Rive SA than firms with lower levels.

Market variables. The company's decision to adopt Rive SA may also be influenced by market or distribution channel conditions [22, 39, 40]. A possible impact on Rive SA adoption may derive from a higher tendency to favour selling to the domestic market in comparison with the export market, as Rive SA is arguably more acknowledged and appreciated by Italian consumers. The degree of use of some marketing channels may also favour the Rive SA; e.g., a large share of Prosecco sold by winery shops or in the Horeca channels, where quality and reputation affect the outcome more than in other outlets, would imply higher interest for the Rive SA, while the opposite would happen for a large share sold to the mass market, i.e. Large scale retail (LSR). Hence, we can hypothesize the following:

> H2: Firms with higher Italian market shares and higher penetration rates in the wine shops or in the Horeca channels are more likely to adopt the Rive SA than firms with lower shares and rates.

Tourism variables. Since "Rive" sparkling Prosecco is linked more strongly to terroir, viticulture tradition and landscape than Superior Prosecco is, we can expect that a strong involvement of wineries in wine tourism may increase the probability of including this sub-brand in their portfolio [41]. To verify and clarify this aspect, we test the number of visitors and propose the hypothesis that the greater the involvement in certain events, the greater the likelihood of adopting the Rive SA [42, 43]. Therefore, we hypothesize the following:

> H3: Firms with higher levels of involvement in wine tourism and particularly in events organized on-site are more likely to adopt Rive SA than firms with lower levels.

Although this paper's main issue concerns Rive SA adoption by CVPP wineries, a secondary field of investigation is the intensity of this adoption, i.e., its share of total CVPP sparkling wine sales. In particular, we are interested in verifying the effect of two variables on it: the share of direct sales on total sales and winery size. Given previous considerations, the former is expected to affect Rive SA market share, while the latter should reduce it.

The lack of investigation on SA choice makes our analysis explorative. Therefore, in achieving the two goals of our research, we have not estimated models based on specific sets of variables; rather, we have attempted to select sets of variables among those suggested by the previous theoretical considerations.

3. MATERIAL AND METHODS

3.1 Quasi-census study and data collection

The study is based on 2017 data, and the sample is made up of 158 wineries that produce sparkling CVPP, 38 of which have chosen the Rive SA. The data were collected through an ad hoc survey using the listed CVPP's sparkling wine house members. The survey showed a very high response rate (over 89%), which was yielded by face-to-face interviews with the business owner and/or the firm's management representatives while ensuring that gathered data were treated anonymously with confidence and sensitivity. Although some firms were initially less inclined to participate in the survey, they were persuaded to take part after some telephone reminders.

The population distribution was analysed using data coming from the certification bodies in charge of Prosecco production control [11] by using strata based on bottled production. The variable distribution from this database was compared with our dataset by considering the size of the bottled production sold annually (standard = 0.75 litres) and avoiding omitting the largest companies. Hence, our data represent a quasi-census study having specific representativeness of the surveyed population. The remaining share of sparkling wine houses (11%) did not respond to the research because they were either too busy to participate or not available to provide the requested information.

3.2 Variables

The following is the list of dependent and explanatory variables that were used in the analysis for this paper.

The dependent variable is a discrete binary variable that is assigned a '1' if the firm has already adopted the Rive SA; otherwise, the firm has adopted the PS (Prosecco Superior SA firm) and is thus assigned a '0'.

The explanatory variables were grouped into three components. The explanatory variables were grouped into three components (Table 1). The first group concerns structural variables, the second group of variables relies on the conduct of firms in the industry by markets and sales channels, and the third group considers the performance of wine- and tourism-related events [44].

Regarding structural assets, marketing skills (i.e., young commercial employees, young CEO, oenologist, young owner), physical and technological resources (i.e., Glera Docg surface, purchased grapes, own wine production, storage capacity of pressure tanks, under-contract bottling,) and firm size (i.e., small-, medium-, large- and very large-) have been analysed and implemented following a criterion that focuses on the importance of human capital and firm resources as crucial dimensions in Rive SA's innovation processes. All the variables are numerical, except for both owner and size, which were transformed into factors with two and four levels, respectively.

In the framework of market conduct, the model used tries to capture, in terms of the competitive strategy, the effects of Rive SA on market share of CVPP firms in Italy and abroad and on the domestic market through distribution channels (i.e., wine shops, Horeca, large-scale retail, wholesalers, e-commerce and others) and major export markets (i.e., Germany, the United Kingdom, Switzerland and the United States).

Wine tourism events were assessed considering: a) actions aimed at promoting CVPP wines and b) their performance in pursuing wine tourism policies. Drivers have been defined to capture the effects of how important the economic return of major wine events was (Likert scale from 1 to 5 points) and the number of visits per winery [45]. The major wine events, ranging from domestic to international, with a significant impact on CVPP firms, were as follows. Conegliano Valdobbiadene's Wine Festival is the most important event devoted to CVPP and takes place in May at the Castle of San Salvatore. Conegliano Valdobbiadene's Prosecco Wine Route was created in 1966 (the first Wine Route in Italy) as an oenological circuit covering the entire hilly area. Additionally, the major sporting events in the CVPP area (e.g., Prosecco Cycling Classic, Prosecchissima and Tour of Italy) were grouped. Vinitaly is among the most important international wine festivals and takes place in Verona. The Cantine Aperte ("Open Cellars") is one of Italy's major wine tourism events.

Table 1. Overview of the explanatory variables used in the models.

Variable description	How the variable was measured	References
Structure:		
Vineyard employees	Numeric	[33]
Winery employees:	Numeric	[33]
Oenologists	Numeric	Self-developed
Young[a] commercial and sales	Numeric	Self-developed
Young CEO	Numeric	Self-developed
Young owner	1 if any, 0 if not present	Self-developed
Glera DOCG[b] vineyard surface	Hectares	[33]
Purchased grapes crushed	Thousand tons	Self-developed
Own wine production	Hectolitres (in thousand)	Self-developed
Storage capacity of pressure tanks	Hectolitres	Self-developed
Under-contract bottling	Bottles produced (in thousand)	Self-developed
Firm size[c]	Bottles sold (in thousand)	[7, 46]
	1=small-sized (less than 150,000 bottles sold), 0=otherwise	[7, 47]
	1=medium-sized (150,001-500.000 bottles sold), 0=otherwise	
	1=large-sized (500.001-1.000.000 bottles sold), 0=otherwise	
	1=very large-sized (more than 1,000,000 bottles sold), 0=otherwise	
Conduct:		
Market share in domestic and foreign markets	Percentage of bottles sold (%)	[15, 48]
Italy	Percentage of bottles sold (%)	
Direct sales (%)	Percentage of bottles sold (%)	
Hotellerie-Restaurant-Café and Wine Bar (%)	Percentage of bottles sold (%)	
Large-scale retail (%)	Percentage of bottles sold (%)	
Wholesalers (%)	Percentage of bottles sold (%)	
E-commerce (%)	Percentage of bottles sold (%)	
Other channels (%)	Percentage of bottles sold (%)	
Major export markets:	Percentage of bottles sold (%)	
Germany	Percentage of bottles sold (%)	
Switzerland	Percentage of bottles sold (%)	
United Kingdom	Percentage of bottles sold (%)	
United States	Percentage of bottles sold (%)	
Performance:		
Visitors per winery	Numeric	[19 45, 46]
Major wine tourism events:		
Conegliano Valdobbiadene's Wine Festival	1= Not at all important; 2=low importance; 3=important; 4=very important; 5=extremely important	
Vinitaly		
Prosecco Wine Route		
Cantine Aperte ("Open Cellars")		
Sports events		

[a] Less than 40 years old. [b] Appellation of Controlled and Guaranteed Origin. [c] Categorial variables were developed according to CVPP's Research Centre for Market Studies.

3.3 The model specification

To find the determinants of Rive SA choice, we estimated a logistic regression, which is a model broadly employed to examine the factors that affect a binary outcome such as undertaking an action [49, 50].

The logistic regression model allows us to identify the variables that have the most impact on the choice to use the Rive SA for branding. We modelled the probabilities of the outcome based on producer characteristics and marketing behaviours. More specifically, this technique determines the significant drivers for classifying a winery as belonging to the Rive group or to the other group. Therefore, it offers a "prognosis" (or propensity) relative to adopting the Rive SA.

Logistic regression represents a way to evaluate factors affecting the decision to produce a sparkling wine under the Rive collective brand. Briefly, for each winery in our sample (i=1…n), the dependent variable Y_i indicates the following values: 1 if the winery chooses the

Rive SA and 0 if the winery does not choose the Rive SA but instead remains with the Superiore SA. The probability of choosing the Rive SA is as follows:

$$\Pr(Y_i = 1|X_1,X_2,\ldots,X_k) = \frac{e^{\beta_0+\beta_1X_{1i}+\beta_2X_{2i}+\cdots+\beta_kX_{ki}}}{1+e^{\beta_0+\beta_1X_{1i}+\beta_2X_{2i}+\cdots+\beta_kX_{ki}}}$$

where β_k is the estimate of the k^{th} parameter and X_{ki} is the k-th characteristic of the i^{th} winery.

Although, as we discussed earlier, economic theory may suggest some reasons in favour of the Rive SA choice, we have not made any a priori assumptions about which variables should be included in the model.

Furthermore, a generalized linear model approach was used to determine the main drivers for Rive SA market share by employing the same candidate variables as those of the logistic regression [51, 52]. Therefore, the estimations of both models rely on an exploratory stepwise procedure.

3.4 The data analysis

In our initial table of descriptive statistics, we present t-tests of differences in variables according to Rive SA or non-Rive SA.

In the stepwise logistic regression model-building procedures, backward selection, rather than forward selection, has been used to avoid the so-called suppressor effect [50, 53]. As suggested by Snipes & Taylor [54], to discover the best logistic regression model, Akaike's criterion was used to support the model choice. As argued by Bendel & Afifi [55], to ensure less risk of failure when trying to find a relationship between explanatory and dependent variables when one exists, the usual $p < 0.05$ statistical significance criterion has been relaxed to 0.10. In the tables of results, we have reported not only the estimated coefficients and associated odds ratios but also the marginal effects of each variable. The marginal effects are the change in the probability that a winery chooses to produce Rive SA sparkling wine due to a unit change of a specific independent variable. To estimate the marginal effects, we have followed the approach where marginal effects on the binary dependent variable are computed by using the command 'margins' in Stata, as suggested by Cameron and Trivedi [56].

A generalized linear model (GLM) was fit using the maximum pseudolikelihood algorithm to estimate Rive SA's market share, which is its proportion on total wines sold in the firms' portfolio of Prosecco wines. This variable was rescaled into a range between 0 and 1. We used a binomial family GLM, link to logit, following the method proposed by Papke and Wooldridge [57], which was subsequently and particularly enhanced in Stata by Baum to handle with fractional response data [58]. To model the data, we jointly considered the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) [54] [59].

4. RESULTS

The results that examine the hypotheses of the study are presented considering a) the direction and significance of the differences between the average value of the variables for adopting and not adopting Rive SA and b) the contribution of the various independent variables to explain the adoption of Rive SA using logistic regression. Findings about the main drivers of Rive SA market share conclude the paragraph.

4.1 Differences between Rive SA adopters and non-adopters

The results of the t-test for the homogeneity of the means are shown in Table 2.

First, the differences between the average value of the group of Rive SA adopters and that of nonadopters are positive for some crucial structural variables, while they are negative for a firm's own-grapes crushed and small-size firms. Among the former, the differences between the variables' average values are statistically significant for PDO area under cultivation, higher firm commercial size (i.e., large, and very large firms), number of winery employees and young commercial and sales staff, young owner, share of production under contract, own grapes crushed, and winery pressure tank sizes. Second, when detailing the analysis of the leading foreign markets, only the US shows a significant difference that is higher for Rive SA. Only the difference in large-scale retail market share is negative and almost significant. Third, the level of involvement in communication activities such as Vinitaly and Primavera del Prosecco (i.e., Prosecco Spring) show significant differences between the groups of firms.

Therefore, these first outcomes appear to confirm hypotheses 1 and 3 previously formulated (see paragraph 2) but seem to be inconclusive for hypothesis 2. The following estimates from multivariate logistic regression contribute to providing further insight into the relationship between the set of independent variables and the dependent binary variable.

4.2 Factors influencing Rive sub-appellation adoption

The results of logistic regression are presented in Table 3. According to Pregibon [60] and Mehmetoglu

Table 2. Sample winery description: t-test results comparing Rive and Prosecco Superiore firms.

Variables	Mean *(Rive=1)*	Mean *(Rive=0)*	p-value
Structure:			
Vineyard employees (no.)	2,16	1.49	0.148
Winery employees (no.)	8,13	4.93	0.069
Oenologist (no.)	1,71	1.44	0.178
Young commercial and sales (no.)	2.32	0.64	0.006
Young CEO (no.)	0.18	0.11	0,248
Young owner (dichotomous)	0.42	0,25	0,043
Glera DOCG vineyard surface (hectares)	13.51	7.00	0.001
Own-grapes crushed (tons)	20.60	90.55	0.002
Purchased-grapes crushed (% of total grapes)	13.42	24.59	0.092
Own wine production (thousand hectolitres)	4.72	2.22	0.158
Production bottled under contract (% of total bottles)	2.50	14.90	0.002
Pressure tank capacity (thousand hectolitres)	7.05	2.87	0.048
Firm size (thousand bottles):	1,665.00	928.59	0.231
Small-sized (dichotomous)	0.29	0.63	0.000
Medium-sized (dichotomous)	0.29	0.19	0.203
Large-sized (dichotomous)	0.16	0.05	0.029
Very large-sized (dichotomous)	0.26	0.13	0.061
Conduct:			
Italian market share by channels (%):	70.87	74.81	0.391
Direct sales (%)	25.31	32.03	0.266
Hotellerie-Restaurant-Café and Wine Bar (%)	46.19	39.22	0.205
Large-scale retail (%)	0.50	5.48	0.078
Wholesalers (%)	19.66	17.70	0.685
E-commerce (%)	0.32	0.35	0.918
Other channels (%)	5.40	5.23	0.950
Export shares by major markets (%):	29.13	25.19	0.391
Germany (%)	18.02	15.31	0.538
Switzerland (%)	8.72	15.75	0.090
United Kingdom (%)	8.25	9.96	0.638
United States (%)	14.42	6.16	0.008
Performance:			
Wine tourism:			
Visitors per winery (no.)	2,796.16	1,668.96	0.250
Wine event involvement (1-5 points Likert scale):			
Conegliano Valdobbiadene's Wine Festival	2.45	2.08	0.203
Vinitaly	3.13	2.43	0.027
Primavera del Prosecco	3.32	2.68	0.026
Prosecco Wine Route	2.74	2.90	0.549
Cantine Aperte	2.42	2.42	0.988
Sports events	2.55	2.14	0.098

and Jakobsen [61], the assumptions that the model is good and correctly specified were tested by link test, p = .000 for linear predicted value and p = 0.793 for squared predicted value variables. A likelihood ratio (LR) chi-square test showed that the model with the constant and the set of explanatory variables is able to explain Rive SA adoption significantly better than the model with the intercept only, χ^2 = 59.05 (with 10 degrees of freedom), p < .001. However, the Hosmer–Lemeshow (H-L) test, which was computed from the chi-square distribution with eight degrees of freedom, did not indicate lack of fit (p = 0.100). This empirical evidence indicates that this group of variables contributes significantly to explaining the choice of CVPP firms to adopt or not to adopt Rive SA. The estimated value of McFadden's R^2 is 0.339, which suggests that it is quite good for cross-sectional data. In CVPP firms, this model can screen for likely Rive SA adopters with a sensitivity of 55% and a specificity of 94%.

The direction of the estimated effects is generally in line with expectations. Regarding the group of structural variables, marketed bottles[1], Prosecco base wine production, and young owners are positively and significantly associated with the adoption of the Rive SA, while the percentage of purchased grapes has a negative effect on the propensity to adopt the Rive SA.

Among these explanatory variables, winery size is the most significant. The analysis of the marginal effects indicates that the probability of adopting the Rive SA increases by 25 percentage points for medium-sized wineries and by 48 points for very large wineries in comparison with small wineries. The larger the Prosecco base wine production is, the more likely the Rive SA choice is; i.e., one hundred thousand hectolitres increase the probability of adopting the Rive SA by approximately 7 percentage points. The presence of a young owner was a less significant variable (p = 0.060). Wineries with the last feature have a propensity to adopt the Rive SA that is 2.7 times greater than for those who do not. Marginal effects show that, ceteris paribus, the probability of the Rive SA, when a young owner is present, increases by 11 percentage points.

Among the independent variables relating to market share, only the use of LSR appears to affect the propensity to adopt Rive SA by undermining it, although less relevantly than the other factors. More specifically, the analysis of the marginal effects for different values of LSR share shows that when this variable is above 10%, the probability of the Rive choice becomes almost zero. It may be argued that the role of distribution channels

[1] Splitting the number of marketed bottles into three binary variables has performed better than dealing with it as a single numerical variable.

Table 3. Logistic regression model.

Variable	B	St. err.	Odds ratio (β)	p values	Marginal effects
Human capital and productive structure:					
Young owner (dichotomous)	0.983	0.523	2.672	0.060	0.113
Medium-sized (dichotomous)	2.125	0.600	8.370	0.000	0.245
Large-sized (dichotomous)	3.114	1.008	22.520	0.002	0.358
Very large-sized (dichotomous)	4.211	0.953	67.435	0.000	0.485
Purchased grapes crushed (% of total grapes)	-0.034	0.010	0.967	0.001	-0.004
Own wine production (thousand hectolitres)	0.057	0.022	1.058	0.012	0.007
Market Conduct:					
Large-scale retail (%)	-0.238	0.117	0.788	0.041	-0.027
Wine tourism events:					
Primavera del Prosecco (score=3)	1.813	0.787	6.127	0.021	0.209
Primavera del Prosecco (score=4)	1,794	0.738	6.015	0.015	0.207
Primavera del Prosecco (score=5)	2.180	0.985	8.842	0.027	0.251
Constant	-3.684	0.781	0.020	0.000	
Goodness-of-link test:					
Linear predicted value	0.000				
Squared predicted value	0.793				
Goodness-of-fit test - χ^2	0.568				
LR χ^2 (11)***	59.05				
H-L's test	0.100				
McFadden-R^2	0.339				
AIC	137.27				
BIC	170.96				

Notes: Number of observations = 158. Goodness-of-link test calculated according to Tukey [62] and Pregibon [60]. The goodness-of-fit test was tested following Hosmer et al. [63]. Akaike's information criterion (AIC) and Bayesian information criterion (BIC). Sensitivity = 21 firms out of 38 (55.3%), specificity = 113 firms out of 120 (94.2%), positive predictive value = 21 firms out of 28 (75.0%), negative predictive value = 113 firms out of 130 (86.9%), predictive accuracy = 134 firms out of 158 (84.8%).

is overshadowed by the firm size, given a sort of channel specificity according to the size. However, we found no large variance inflation factors (all lower than 3), suggesting that collinearity was not a substantial problem between firm size and distribution variables[2].

Primavera del Prosecco, which is a proxy for wine tourism events, is positively and significantly related to Rive SA adoption. For wineries rating Primavera del Prosecco from important (3 points) to extremely important (5 points), the propensity to use the Rive SA increased by a minimum of 6 to a maximum of 9 times in comparison to wineries poorly scoring this event[3]. The marginal effects show that the probability of adopting the Rive SA increases by 21-25% if the winery is involved in the Primavera del Prosecco and gives this event an importance score equal to or higher than 3 points.

4.3 Drivers of the Rive SA market share

The goodness of the link test has provided evidence that the model was correctly specified concerning linear predictors (p = 0.000), regardless of whether the regression equation specification error test indicates that the model has no omitted variables. Other statistic indicators appear satisfactory as well; among them, results did not show a large value of the condition index (17.1), implying that multicollinearity is not a problem [64].

Table 4 presents the GLM regression results for Rive SA market share determinants.

[2] The variance inflation factors for reported distribution channels (2.48 for Direct sales; 1.80 for Hotellerie-Restaurant-Café and Wine Bar; 1.90 for Large retail scale) when firms' size was included in the model (1.76 for medium-sized; 1.52 for large-sized; 2.92 for very large-sized) were quite small.

[3] Using the Primavera del Prosecco score as multiple binary variables has performed better than dealing with it as a single categorical variable.

Table 4 – Generalized linear model: drivers for Rive SA market share.

Variables	β	St. err.	z value	p value
Structure:				
Small-sized (dichotomous)	1.630	0.485	3.36	0.001
Conduct:				
Italy (%)	-0.042	0.009	-4.51	0.000
Direct sales (%)	0.033	0.012	2.75	0.006
Performance:				
Primavera del Prosecco (score=4)	1.142	0.421	2.09	0.036
Prosecco Wine Route (top scores=4 and 5)	0.748	0.399	1.88	0.023
Constant	-1.271	0.503	-2.52	0.012
Goodness-of-link test:				
Linear predicted value	0.037			
Squared predicted value	0.344			
Condition number	17.1			
Log pseudolikelihood	-9.970			
Deviance	4.347			
AIC	31.399			
BIC	41.225			

Note: Number of observations = 38. GLM fitted using Newton-Raphson (maximum likelihood) optimization; distribution family (Binomial); link function (Logit) [59]. The goodness-of-link test was calculated according to Tukey (1949) and Pregibon [60]. Multicollinearity diagnostics followed procedures found in Belsley, Kuh, and Welsch [64]. Akaike's information criterion (AIC) and Bayesian information criterion (BIC).

First, the coefficient related to small-sized firms exhibits a positive sign and significant relationship with market share (p = 0.006), which supports the statement that smaller sizes create greater value in wine portfolios through the growth of Rive SA.

Second, the results show positive and significant effects of direct sales (p = 0.006), while for the role of Italian market, a negative impact is shown, which indirectly confirms that product growth is currently not linked to other domestic channels, which do not have closer relationships between producers and customers as much as direct sales [65];

Finally, the positive coefficients of the organized wine tourism events suggest that the Prosecco Road and the Primavera del Prosecco are positive and significant tools (p = 0.061 and p = 0.036, respectively) to promote growth and achieve the strategic objectives of Rive SA firms.

5. DISCUSSION

The three hypotheses stated at the beginning of the work find partial confirmation from the t-test analysis. The logistic regression model reinforces the validity of H1 and H3 by deepening the effect of the most explicative variables.

Given that Rive SA is a type of marketing innovation, younger entrepreneurs are more inclined to adopt it in comparison with those who are older. Moreover, it seems the only human factor that matters in the Rive SA choice. Among structural factors, both basic wine production and marketed bottles play the most important role. We observe that as winery size increases, it is more likely that the winery will include the Rive SA within its wine portfolio. When the number of end markets, channels or consumer segments grows, the need to rely on a wide diversified assortment of Prosecco by not simply using the traditional residual sugar content (brut, extra dry, dry) drives a winery to explore other products, such as those that can be produced in the Rive SA. Both the marketed bottles and basic wine enlighten a specific contribution to the model. In fact, to understand how they can coexist in the logistic model, we have to consider that the latter can only partly be transformed into bottles of sparkling CVPP to be sold by the winery: part can be sold as bulk wine to plain bottlers [5], part can be reclassified and sold under other appellations. As expected, the purchase of grapes from other estates does not favour a propensity for Rive SA adoption. The analysis of marginal probabilities for different percentages of purchased grapes shows that, for medium-high percentages, the likelihood the winery uses the Rive SA is reduced to nearly zero. Therefore, it seems quite clear that Rive SA is viewed as being strongly rooted in the *terroir* of the firm's vineyards and is closely linked to the concept of "estate-bottled" sparkling Prosecco.

If the t-test results show that wineries choosing the Rive SA are significantly more involved than others in the first Italian wine event (Vinitaly), where both wine differentiation and portfolio diversification play a crucial role in achieving successful public relations, the logistic model underlines that they are even more involved in the wine tourism business. In fact, the propensity to adopt Rive SA increases when wineries give a rating of 3 or more for the main wine tourism event, i.e., the "Primavera del Prosecco".

With reference to market features, hypothesis 2 seems to be rejected because neither the effect of the domestic market share, nor the penetration rate in the wine shop nor in the Horeca channels can be assumed to be significant factors driving the Rive SA choice. Only

the share of bottles marked through LSR is somewhat important for this choice. Hence, because the share of bottles sold by other channels does not seem to significantly affect the choice of SA use, we can conclude that the distribution policy can be an obstacle to it only when the winery has a nonnegligible interest in the mass market. A similar consideration may be applied for sales in specific foreign markets. Their shares do not significantly influence the choice, a fact that could partially depend on the relatively new definition of the Rive brand and knowledge of it based mainly on local consumers.

Regarding the main factors affecting Rive SA market share, we observe that the two hypotheses previously formulated are well confirmed. Once a winery has chosen the Rive SA option, its weight in the total Prosecco wine supply increases with its cellar door share, which depends both on local customers and wine tourists, while it decreases with the firm's size. Therefore, considering previous results, we can conclude that while winery size positively influences the adoption of SA, once it has happened, it plays a negative role in the weight of the Rive SA in the winery sparkling wine assortment, where the Rive SA has to compete with an increased number of CVPP labels as the firm size grows. Moreover, being too focused on other domestic channels other than direct sales, where the interest in a SA subdivision is likely to be lower, may divert attention from improving the SA proportion in the CVPP portfolio.

Involvement in wine tourism is confirmed to be important in also determining the SA share. In fact, in addition to the variables included in the logistic model, the high scores attributed to both the Prosecco Wine Route and "Primavera del Prosecco" show a significant impact on the dependent variable. Hence, we can argue that, as the French wine classification system shows [66], a process of intense subdivision within a geographic region is much more effective when it is accompanied by sound wine tourism perspectives, which rely mainly on a considerable number of people willing to obtain a remarkable experience in the wine world.

6. CONCLUSIONS

This survey highlights the relevance of structural, market-related and wine tourism-related features in explaining SA adoption choice by measuring how these features can contribute to supporting and valuing a sparkling wine produced with considerable efforts by heroical vine-growers (Rive SA) within the CVPP.

Among them, we want to stress the increased likelihood of using Rive SA as business size (however measured) grows. If the linkage with wine tourism involvement was rather expected, this was not straightforward given that it could also be supposed that small wineries focused on niche markets would have better appreciated the new SA as a tool to better differentiate their small sparkling Prosecco products from that of other producers [67]. We can hypothesize that a core business based on a consolidated simple portfolio and a reduced level of flexibility in comparison with larger producers may contribute to explaining this empirical evidence.

Our study suggests the CVPP wineries key-conditions for benefitting of the Rive SA:

- to be strongly rooted in their land (i.e., to be as much as possible self-sufficient for grape production);
- to undertake a coherent strategy, based on the values of a heroic SA coupled with the prestige of the Unesco World Heritage, whereas the values preservation of the local culture is a core subject to work for the common good of that wine community;
- to promote the knowledge on Rive SA, by boosting sales especially at the cellar door, which represents the best channel to communicate consumers the values embedded in the Rive brand;
- to get actively involved in crucial wine tourism events to build and operate higher value-generating positioning (i.e., Primavera del Prosecco, Prosecco Wine Route, etc.).

In a scenario where Prosecco is becoming increasingly popular worldwide, the knowledge of factors that make Rive SA adoption likely may help the Tutelary Consortium define an appropriate promotion strategy to widen the use of Rive SA among CVPP producers as a tool for further differentiating their Prosecco along with their own brand. It should be based on four aspects to be considered:

- to looks to a model for economically and technically sustaining heroic viticulture and vine-grower's backbreaking work, to preserve socio-economics and cultural values, landscape and biodiversity values [68-70];
- to implement distinguishing promotional activities with in-person information, exclusively in the cellar door and in Horeca channels, which are the most relevant in generating higher value for consumers [71];
- to improve the ties between Rive SA and landscape values, which can be grasped passionately by the territorial firms, thanks to key wine tourism events promoted in the Prosecco Hills of Conegliano and Valdobbiadene (i.e., Conegliano Valdobbiadene's Wine Festival, UNESCO World Heritage Site's Association, etc) [45];

– to maintain careful and close control of the quality from the grapes selection phase to the sales phase (i.e., through ad hoc members' courses and training, etc).

Our study has some limitations. First, this research is focused on CVPP firms that produce sparkling wines in a SA in Italy. Second, while the most significant drivers in Rive SA adoption were identified, they do not represent the whole of sparkling wine production in Italy or, for example, sparkling wines in other areas with steep-slope viticulture. Third, further research on this topic is necessary over time to capture changes in firm strategies depending on circumstances (i.e., due to the market or the Protected Designation of Origin's product specification rules) that can enable or constrain SA adoption.

Finally, the results should be viewed as a first step in the attempt to build a theory of SA economics concerning drivers that support the firm's choice of a SA. We believe that our study provides useful intuitions for those who would broaden this research strand in different countries with other specificities.

REFERENCES

[1] A. Corsi, E. Pomarici, and R. Sardone, *Italy: from quantity to quality. In: Anderson, K.(Ed.),The World's Wine Markets – Globalisation atWork*. London: Edward Elgar, 2004.

[2] G. Scozzafava, F. Gerini, A. Dominici, C. Contini, and L. Casini, "Reach for the stars: The impact on consumer preferences of introducing a new top-tier typology into a PDO wine," *Wine Economics and Policy,* vol. 7, no. 2, pp. 140-152, 2018/12/01/ 2018, doi: https://doi.org/10.1016/j.wep.2018.09.001.

[3] E. Giraud-Héraud, L. G. Soler, S. Steinmetz, and H. Tanguy, "La régulation interprofessionnelle dans le secteur vitivinicole est-elle fondée économiquement?," *Bulletin de l'OIV,* vol. 71, no. 813-14, pp. 1059-1084, 1998.

[4] M. L. Loureiro, "Rethinking new wines: implications of local and environmentally friendly labels," *Food Policy,* vol. 28, no. 5–6, pp. 547-560, 10// 2003, doi: http://dx.doi.org/10.1016/j.foodpol.2003.10.004.

[5] I. Lesschaeve, "Branding an emerging wine region: Do appellation or sub-appellation matter?," in *American Wine Economists Association*, Reims, France, 2009.

[6] J. Patchell, "Collectivity and differentiation: a tale of two wine territories," *Environment and Planning A,* vol. 40, no. 10, pp. 2364-2383, 2008.

[7] E. Pomarici, L. Barisan, V. Boatto, and L. Galletto, "The Prosecco Superiore DOCG Industry Structure: Current Status and Evolution over Time," in *The Palgrave Handbook of Wine Industry Economics*, A. Alonso Ugaglia, J.-M. Cardebat, and A. Corsi Eds. Cham: Springer International Publishing, 2019, pp. 421-435.

[8] V. Boatto, L. Barisan, and E. Pomarici, "Le produzioni," in *Rapporto annuale 2018. L'analisi socio-economica attraverso la storia della Denominazione: valore inestimabile per il futuro della Comunità*. Pieve di Soligo (Treviso): Conegliano Valdobbiadene Prosecco DOCG, 2018, pp. 32-35.

[9] OIV. "The global sparkling wine market." https://mail.google.com/mail/u/1/#search/citazione/KtbxLxgNKchfSjCPDfLmsNMCTHwDlWmxdV?projector=1&messagePartId=0.2 (accessed.

[10] L. Rossetto, V. Boatto, and L. Barisan, "Strategies and Interpreting Models of a Reformed DOC: the Prosecco Case Study," *Enometrica,* vol. 4, no. 1, pp. 57-77, 2011. [Online]. Available: http://eum.unimc.it/riviste/enometrica/4-1-2011-enometrica.

[11] Valoritalia, "Certificazioni vini Doc e Docg," ed. Solighetto, 2021.

[12] V. Boatto, L. Barisan, and E. Pomarici, "Le produzioni," in *Rapporto Economico 2019. L'analisi socio-economica attraverso la storia della Denominazione: valore inestimabile per il futuro della Comunità*. Pieve di Soligo (Treviso): Conegliano Valdobbiadene Prosecco DOCG, 2018, pp. 78-97.

[13] D. Tomasi, F. Gaiotti, and G. V. Jones, *The power of the terroir: the case study of Prosecco wine*. Springer, 2013.

[14] T. Atkin and R. Johnson, "Appellation as an indicator of quality," *International Journal of Wine Business Research,* vol. 22, no. 1, pp. 42-61, 2010, doi: doi:10.1108/17511061011035198.

[15] P. Bazoche, P. Combris, E. Giraud-Héraud, and J.-B. Traversac, "Willingness to Pay for Appellation of Origin: Results of an Experiment with Pinot Noir Wines in France and Germany," in *Wine Economics*: Springer, 2013, pp. 129-145.

[16] J. J. Willwerth, A. G. Reynolds, and I. Lesschaeve, "Sensory Analysis of Riesling Wines from Different Sub-Appellations in the Niagara Peninsula in Ontario," *American Journal of Enology and Viticulture,* 2015, doi: 10.5344/ajev.2015.14081.

[17] S. J. Haynes, "Geology and Wine 2. A geological foundation for terroirs and potential sub-appellations of Niagara Peninsula wines, Ontario, Canada," *Geoscience Canada,* vol. 27, no. 2, 2000.

[18] O. Gergaud and V. Ginsburgh, "Natural endowments, production technologies and the quality of

wines in Bordeaux. Does terroir matter?," *The Economic Journal,* vol. 118, no. 529, pp. F142-F157, 2008.

[19] R. Cross, A. J. Plantinga, and R. N. Stavins, "The Value of Terroir: Hedonic Estimation of Vineyard Sale Prices," *Journal of Wine Economics,* vol. 6, no. 1, pp. 1-14, 2011/001/001 2011, doi: 10.1017/S1931436100001036.

[20] O. Gokcekus and C. M. Finnegan, "Classification and re-classification: Oregon's Willamette Valley AVA and its new sub-AVAs," American Wine Economists Association, 2014. [Online]. Available: http://www.wine-economics.org/list-of-aawe-working-papers/.

[21] L. Camanzi, C. Grazia, E. Giraud-Héraud, and G. Malorgio, "Quality differentiation in the Italian wine industry: Terroir-based vs. brand-based strategies," *International Journal of Globalisation and Small Business,* Article vol. 9, no. 2-3, pp. 86-104, 2017, doi: 10.1504/ijgsb.2017.088920.

[22] L. Galletto, L. Barisan, and V. Boatto, "Aspetti economici di una viticoltura ad elevata pendenza: il caso delle Rive nell'area del Conegliano Valdobbiadene Prosecco DOCG.," in *V Convegno internazionale sulla viticoltura di montagna e in forte pendenza (CERVIM)*, Susegana - Treviso (Italy), 2017, pp. 1-22.

[23] M. Manente, S. Meneghello, and E. Mingotto, "Dinamiche del turismo nel Distretto del Conegliano Valdobbiadene Prosecco DOCG. Focus sulla fruizione turistica," in *Rapporto annuale 2018. L'analisi socio-economica attraverso la storia della Denominazione: valore inestimabile per il futuro della Comunità*. Pieve di Soligo (Treviso): Conegliano Valdobbiadene Prosecco DOCG, 2018, pp. 117-129.

[24] V. Boatto, L. Barisan, and E. Pomarici, "Struttura produttiva," in *Rapporto annuale 2018. L'analisi socio-economica attraverso la storia della Denominazione: valore inestimabile per il futuro della Comunità*. Pieve di Soligo (Treviso): Conegliano Valdobbiadene Prosecco DOCG, 2018, pp. 16-31.

[25] V. Boatto, L. Barisan, and E. Pomarici, "Il mercato nazionale," in *Rapporto annuale 2018. L'analisi socio-economica attraverso la storia della Denominazione: valore inestimabile per il futuro della Comunità*. Pieve di Soligo (Treviso): Conegliano Valdobbiadene Prosecco DOCG, 2018, pp. 36-47.

[26] V. Boatto, L. Barisan, and E. Pomarici, "Le strategie," in *Rapporto annuale 2018. L'analisi socio-economica attraverso la storia della Denominazione: valore inestimabile per il futuro della Comunità*. Pieve di Soligo (Treviso): Conegliano Valdobbiadene Prosecco DOCG, 2018, pp. 78-97.

[27] G. Galletto and L. Barisan, "A new sub-appellation among local restauratns: the Rive case in the Conegliano Valdobbiadene Prosecco District," in *12th Annual Conference of American Association of Wine Economists (AAWE)*, Ithaca (NY), United States, 2018: American Association of Wine Economists (AAWE), pp. 1-19. [Online]. Available: https://www.youtube.com/watch?v=Ss-aMjO4QUY. [Online]. Available: https://www.youtube.com/watch?v=Ss-aMjO4QUY

[28] E. M. Rogers, *Diffusion of innovations*. Simon and Schuster, 2010.

[29] J. R. R. Alavalapati, M. K. Luckert, and D. S. Gill, "Adoption of agroforestry practices: a case study from Andhra Pradesh, India," *Agroforestry Systems,* vol. 32, no. 1, pp. 1-14, 1995/10/01 1995, doi: 10.1007/BF00713844.

[30] F. A. Caveness and W. B. Kurtz, "Agroforestry adoption and risk perception by farmers in Sénégal," *Agroforestry Systems,* vol. 21, no. 1, pp. 11-25, 1993/01/01 1993, doi: 10.1007/BF00704923.

[31] P. T. Evans, "Designing agroforestry innovations to increase their adoptability: a case study from Paraguay," *Journal of Rural Studies,* vol. 4, no. 1, pp. 45-55, 1988/01/01/ 1988, doi: https://doi.org/10.1016/0743-0167(88)90078-2.

[32] J. B. Raintree, "Strategies for enhancing the adoptability of agroforestry innovations," *Agroforestry Systems,* vol. 1, no. 3, pp. 173-187, 1983/09/01 1983, doi: 10.1007/BF00130606.

[33] R. P. Neupane, K. R. Sharma, and G. B. Thapa, "Adoption of agroforestry in the hills of Nepal: a logistic regression analysis," *Agricultural Systems,* vol. 72, no. 3, pp. 177-196, 2002/06/01/ 2002, doi: https://doi.org/10.1016/S0308-521X(01)00066-X.

[34] A. Soares-Aguiar and A. Palma-dos-Reis, "Why Do Firms Adopt E-Procurement Systems? Using Logistic Regression to Empirically Test a Conceptual Model," *IEEE Transactions on Engineering Management,* vol. 55, no. 1, pp. 120-133, 2008, doi: 10.1109/tem.2007.912806.

[35] J. S. Bain, "Industrial Organization. John Willey & Sons," *Inc. New York,* pp. 12-44, 1968.

[36] O. Gokcekus and C. M. Finnegan, "Price Effects of Establishing a New Sub-AVA within Oregon's Willamette Valley AVA," *Journal of Wine Economics,* vol. 12, no. 4, pp. 345-353, 2017, doi: 10.1017/jwe.2017.13.

[37] R. Carew and W. J. Florkowski, "The Importance of Geographic Wine Appellations: Hedonic Pricing of

Burgundy Wines in the British Columbia Wine Market," *Canadian Journal of Agricultural Economics/ Revue canadienne d'agroeconomie,* vol. 58, no. 1, pp. 93-108, 2010, doi: 10.1111/j.1744-7976.2009.01160.x.

[38] Wineanorak Global Wine Journal. "Developing appellations in emerging regions " https://wineanorak.com/developingappellations.htm (accessed 3rd April 2020, 3rd April 2020).

[39] C. Gurau and F. Duquesnois, "Direct marketing channels in the French wine industry," *International Journal of Wine Business Research,* vol. 20, no. 1, pp. 38-52, 2008.

[40] E. Brentari, R. Levaggi, and P. Zuccolotto, "Pricing strategies for Italian red wine," *Food. Qual. Prefer.,* vol. 22, no. 8, pp. 725-732, 2011/12/01/ 2011, doi: https://doi.org/10.1016/j.foodqual.2011.06.001.

[41] C. M. Hall, A. M. Longo, R. Mitchell, and G. Johnson, "Wine tourism in new Zealand," in *Proceedings of tourism down under II: A research conference*, 1996: University of Otago Dunedin, pp. 109-119.

[42] J. Bruwer, "South African wine routes: some perspectives on the wine tourism industry's structural dimensions and wine tourism product," *Tourism Management,* vol. 24, no. 4, pp. 423-435, 2003/08/01/ 2003, doi: https://doi.org/10.1016/S0261-5177(02)00105-X.

[43] B. Carmichael, "Understanding the Wine Tourism Experience for Winery Visitors in the Niagara Region, Ontario, Canada," *Tourism Geographies,* vol. 7, no. 2, pp. 185-204, 2005/05/01 2005, doi: 10.1080/14616680500072414.

[44] L. Galletto, "A comparison between tourists profiles in two Italian wine routes," *Revista de la Facultad de Ciencias Agrarias,* vol. 50, no. 1, 2018. [Online]. Available: https://bdigital.uncu.edu.ar/10799.

[45] V. Boatto, L. Galletto, L. Barisan, and F. Bianchin, "The development of wine tourism in the Conegliano Valdobbiadene area," *Wine Economics and Policy,* vol. 2, no. 2, pp. 93-101, 2013, doi: 10.1016/j.wep.2013.11.003.

[46] J. H. Tanya, H. D. Jennifer, G. L. Roberto, and I. M. Maria, "Factors Affecting Growers' Willingness to Adopt Sustainable Floriculture Practices," (in English), *HortScience horts,* vol. 44, no. 5, pp. 1346-1351, 01 Aug. 2009 2009, doi: 10.21273/HORTSCI.44.5.1346.

[47] P. Mora, "Key factors of success in today's wine sector," *International Journal of Wine Marketing,* vol. 18, no. 2, pp. 139-149, 2006, doi: doi:10.1108/09547540610681112.

[48] K. M. Thome and V. A. L. Paiva, "Sparkling wine international market structure and competitiveness," *Wine Economics and Policy,* vol. 9, no. 2, pp. 37-47, 2020.

[49] T. F. Liao, *Interpreting Probability Models: Logit, Probit, and other Generalized Linear Models* (no. 101). New Delhi: Sage Publications, 1994.

[50] S. Menard, *Applied logistic regression analysis* (no. 106). New Delhi: Sage Publications Ltd, 2002.

[51] J. A. Nelder and R. W. Wedderburn, "Generalized linear models," *Journal of the Royal Statistical Society: Series A (General),* vol. 135, no. 3, pp. 370-384, 1972.

[52] J. W. Hardin and J. M. Hilbe, *Generalized linear models and extensions*. Texas, USA: Stata Press Publication StataCorp LLC College Station, 2007.

[53] B. Finlay and A. Agresti, *Statistical methods for the social sciences (3rd ed.)*. New Jersey: Prentice-Hall, 1997.

[54] M. Snipes and D. C. Taylor, "Model selection and Akaike Information Criteria: An example from wine ratings and prices," *Wine Economics and Policy,* vol. 3, no. 1, pp. 3-9, 6// 2014, doi: http://dx.doi.org/10.1016/j.wep.2014.03.001.

[55] R. B. Bendel and A. A. Afifi, "Comparison of Stopping Rules in Forward "Stepwise" Regression," *Journal of the American Statistical Association,* vol. 72, no. 357, pp. 46-53, 1977/03/01 1977, doi: 10.1080/01621459.1977.10479905.

[56] A. C. Cameron and P. K. Trivedi, *Microeconometrics Using Stata*. College Station, Texas: Stata Press, 2009.

[57] L. E. Papke and J. M. Wooldridge, "Econometric methods for fractional response variables with an application to 401(k) plan participation rates," *Journal of Applied Econometrics,* vol. 11, no. 6, pp. 619-632, 1996, doi: https://doi.org/10.1002/(SICI)1099-1255(199611)11:6<619::AID-JAE418>3.0.CO;2-1.

[58] C. F. Baum, "Stata tip 63: Modeling proportions," *The Stata Journal,* vol. 8, no. 2, pp. 299-303, 2008.

[59] P. Deb, E. C. Norton, and W. G. Manning, *Health econometrics using Stata*. Stata Press College Station, TX, 2017.

[60] D. Pregibon, "Goodness of link tests for generalized linear models," *Journal of the Royal Statistical Society: Series C (Applied Statistics),* vol. 29, no. 1, pp. 15-24, 1980.

[61] M. Mehmetoglu and T. G. Jakobsen, *Applied statistics using Stata: a guide for the social sciences*. Thousand Oaks, CA, United States: Sage Publishing, 2016.

[62] J. W. Tukey, "One Degree of Freedom for Non-Additivity," *Biometrics,* vol. 5, no. 3, pp. 232-242, 1949, doi: 10.2307/3001938.

[63] D. W. Hosmer Jr, S. Lemeshow, and R. X. Sturdivant, *Applied logistic regression*. John Wiley & Sons, 2013.
[64] D. A. Belsley, E. Kuh, and R. Welsch, "Identifying influential data and sources of collinearity," *Regression Diagnostics,* 1980.
[65] V. Boatto, L. Barisan, and E. Pomarici, "Le strategie.," in *Rapporto Economico 2019. L'analisi socio-economica attraverso la storia della Denominazione: valore inestimabile per il futuro della Comunità*. Pieve di Soligo (Treviso): Conegliano Valdobbiadene Prosecco DOCG, 2018, pp. 78-97.
[66] O. Gergaud, A. J. Plantinga, and A. Ringeval-Deluze, "Anchored in the past: Persistent price effects of obsolete vineyard ratings in France," *Journal of Economic Behavior & Organization,* vol. 133, pp. 39-51, 2017.
[67] M. E. Porter, *Competitive strategy: Techniques for analyzing industries and competitors*. New York: The Free Press, 2008.
[68] L. Strub, A. Kurth, and S. Muller Loose, "Effects of Viticultural Mechanization on Working Time Requirements and Production Costs," *American Journal of Enology and Viticulture,* vol. 72, no. 1, pp. 46-55, 2021.
[69] L. Galletto and L. Barisan, "Sustainability and Landscape Importance in vine growing: Evidence from a Survey of the Conegliano Valdobbiadene Prosecco Wineries," in *Sixth International Congress on Mountain and Steep Slope Viticulture: "Heroic viticulture: from grape to wine through sustainability and quality"*, La Laguna (Tenerife Island) – Spain. Available at: file:///C:/Users/utente/Downloads/actos_orales_1133_1.pdf.
[70] E. Ostrom, *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press, 1990.
[71] L. Galletto, F. Caracciolo, V. Boatto, L. Barisan, D. Franceschi, and M. Lillo, "Do consumers really recognise a distinct quality hierarchy amongst PDO sparkling wines? The answer from experimental auctions," *British Food Journal,* vol. 123, no. 4, pp. 1478-1493, 2021, doi: 10.1108/BFJ-07-2020-0625.

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Motivation factors for organic wines. An analysis from the perspective of German producers and retailers

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Abstract. This study investigates the motives for producers that inform decisions to convert or not convert to organic wine production as well as the motives for retailers to offer or not offer organic wine and promotion of organic wine from producers' and retailers' perspectives. In total, 100 semi-structured in-depth interviews with 25 different types of retailers, 50 organic wineries and 25 non-organic wineries were conducted and analysed using content analysis and grounded theory. Additionally, the wine offers of 25 stores were analysed to develop an understanding of the distribution and promotion of organic wines. Producers choose to switch or not to switch to organic farming for primarily altruistic reasons. Because organic wine producers do not specifically focus on the organic nature of their wines in their communications, this attribute is typically disregarded by retailers and consumers during their wine-buying decisions, which undermines the growing demand for organic wine. There are significant differences between wine-growing regions in Germany and their vine cultivation conditions due to weather, the steepness of slopes and the attitudes towards converting conventional wine production to organic wine production. Missing knowledge and a low demand for organic wines are barriers for retailers to focus on organic wine. To our knowledge, this is the first study to investigate organic wines from numerous producers in every wine-growing region in Germany and various retailers in Germany. The focus on communication shows a lack in the knowledge transfer along the value chain of organic wine. Therefore, this study fills a research gap and provides valuable practical insight into the organic market for the wine industry and the scientific community.

Keywords: organic wine, Germany, producers, retailers, qualitative research

1. INTRODUCTION

In Germany, the agricultural area devoted to organic farming has almost doubled in the last 5 years, with around 10 % of German farmland now certified for organic farming. The USA and Europe are the largest organic markets around the world [1]. In 2016, Germany was one of the most important organic markets worldwide [2]. Nonetheless, although it has since lost its leading position and now occupies the sixth largest organic market in

Europe [1], it is still the world's largest market for organic wine [3].

Organic viticulture in Germany covers around 9 % of German vineyards, or 9,300 hectares in total. The supply of organic wine is similar to the organic food market, suggesting that the demand for organic wine is comparable to the demand for organic food [1]. However, several studies have indicated that the growing supply for organic wine is not a direct indicator of high demand for the product. Rather, according to findings by Remaud *et al*., Hoffmann and Szolnoki and Szolnoki and Hauck [4,5,6], the active demand for organic wine is small.

In addition, wine producers face many local and global challenges, such as climate change and a saturated wine market [7,8,9]. While the majority of organic wine (86 %) is produced in Europe, the number of German organic vineyards is comparatively small [10]. Moreover, traditional German food retailers and discounters with a high market share in the German wine market have increased their supply of organic food and wine [1,11].

The present study examines the motives that inform producers' decisions to convert to organic farming and the resulting changes in costs and sales structures and the motives of retailers to offer organic wine. The paper also analyses producers' and retailers' perceptions and promotion of organic wine to determine the driving factors behind the discrepancy between the supply and demand of organic wine. Finally, the study assesses consumer knowledge and the demand for organic wine to draw practical implications for the organic wine industry in Germany.

2. LITERATURE REVIEW

The motivators behind farmers' decisions to shift from conventional to organic production were evaluated in several studies. While ethical and lifestyle factors appeared to significantly influence farmers' decisions to convert to organic production in the past [12,13], today the decision making is more complex [14]. According to some authors, organic farming is more far-reaching than conventional production techniques and can involve social movements [15,16,17,18,19]. The conversion from conventional to organic production has been described as a major change [18] and transformation [20,21] that requires a strong need for change and an adjustment to mindset [22,18]. Xu *et al.* [23] found that conventional farmers are typically unwilling to accept the challenges of producing organic goods when they are already satisfied with their businesses. A study by Darnhofer *et al.* [24] examined different barriers and drivers on the organic markets in Austria, Italy and France. These are relations between organic agriculture and broader issues in the agrifood system such as structural change, environmental protection, gastronomic heritage, fairness in the food chain or export promotions. Within the EU, the history of relations within the agrifood stakeholders and consequently market structure, market power and interaction between these stakeholders play a crucial role in the development of the organic sector and differ in each country.

Karipidis and Karypidou [14] identified external factors as market factors, demand, price, distance to the market or point of sale, supply chain, certification schemes, technologies, institutional factors, social networks and knowledge transfer, relationships between market players and institutions, financial factors and the public policy. Furthermore, they described also internal factors such as farm business characteristics, farmers´ characteristics, demographic and other social characteristics and psychographic and behavioural characteristics.

According to a study by Castellini *et al.* [25], wineries most frequently convert from conventional to organic wine production for ethical reasons, followed by factors related to higher product quality and to differentiate themselves from other producers. In a qualitative research study, Bouzdine-Chameeva [26] interviewed organic wine producers in France and Italy to investigate their motivations, production approaches and marketing strategies, determining that their motives varied considerably. Risk, quality loss and the lack of recognisable international quality certification resulted in an ambivalent gap between the producers' ecological and economic goals. Although an EU organic label was introduced in 2010, Zander et al. [27] found in an international study in six countries that only about 15 % of consumers are aware of the label and the knowledge about its meaning is low.

The producers' motivations for converting from conventional to organic farming also varied significantly. When Siepmann and Nicholas [28] interviewed wine producers in Germany, they determined that soil protection is one of the primary motives for switching to organic farming. In addition, they found that some wine producers doubt the overall sustainability of organic wine production, especially regarding the use of copper. Ideologies for or against organic production are the main drivers for switching or not switching to organic farming.

Although the concept of organic farming was first introduced almost a century ago, its benefits to humanity and nature remain under debate. Reganold and Wachter [29] examined studies on organic and conven-

tional farming that had been published over the last 40 years, concluding that organic farming is generally more sustainable than conventional farming due to its lesser impact on ecosystems as a more balanced form of agriculture. They also determined that organic producers' yields are 8 % to 25 % lower than those of conventional winegrowers. Regarding organic viticulture, one German study surmised that due to slower wine growth and smaller yields, the productivity of organic vineyards is an average of 35.9 % lower than that of conventionally farmed vineyards [30]. These results were corroborated by an Australian study that observed that organic wine producers' yields are 21 % lower than those of conventional producers [31]. Siepmann and Nicholas [28] found that the lower yields of organic wine production are linked to efforts to increase wine quality and can be offset with higher prices.

In terms of economic sustainability, Reganold and Wachter [29] posited that organic farming can result in higher profits when the products are charged at a premium. Without these premium prices, the cost ratio decreases and is much lower than the cost ratio for conventional production. Nonetheless, according to Crowder and Reganold [32] and MacRae *et al.* [33], significantly higher labour costs in organic production can offset the lower costs for synthetic products and make the costs more comparable to conventional farming. Crowder and Reganold [32] also concluded that organic agriculture could only grow if it is financially profitable. Although Siepmann and Nicholas's [28] study noted that economic incentives are important drivers in decisions to convert to organic farming, it found that ideology was the primary factor that motivated these types of decisions. In a South African study that examined organic farmers' production costs and revenues [34] and explored whether conventional or organic farming benefited wine producers, the authors concluded that the benefits of organic farming depend on the price premium of organic wines. Regarding economic motivation, Zilber *et al.* [35] observed that because labour intensity increases production costs, farmers' decisions to produce organically should be informed by factors related to differentiation rather than expense.

Delmas and Grant [36] observed that consumer demand, subsidies and challenges to selling conventional wines are less relevant to the producers' decisions to convert to organic farming. This suggests that some wineries produce organic wines without seeking organic certification. Nevertheless, while most organic wine producers are proud of their organically grown wines and want to share this information with their customers by obtaining organic certification and labelling their wines as organic, organic labels can only prove successful if consumers are familiar with them and aware of the differences between organically and conventionally farmed wines. Fanasch [37] found that an eco-certification and individual reputation can have a significant, positively impact on the corporate performance.

Hauck and Szolnoki [38] reported that only 44.7 % of German consumers are aware of the EU organic label and that their awareness of other German certifications, such as Biokreis, Bioland, ECOVIN, Naturland and Demeter, are even lower. In Risius *et al. 's* [39] choice experiment with German consumers, they found that organic labels carried a positive part-worth coefficient that was rather marginal when compared to other attributes. A study by Gassler *et al.* [40] examined the willingness to pay for organic wine and found that organic labelled wines were perceived as tastier and of higher quality and value than conventional wines. Schäufele and Hamm [41] reported an attitude-behaviour gap in household panel data of organic wines in Germany. The results revealed that the expenditure share remained low for German organic wines. An analysis by Pomarici and Vecchio [42] assumed, that sustainability will gain in in the development of competitive advantage of single wineries and of country wine-supply chains.

Consumers buy organic foods for several reasons, such as health, taste and altruism [43]. These same categories apply to organic wine. Sireix and Remaud [44] determined that most wine consumers associate organic wine with health benefits. Consumers with strong health awareness are also more willing to pay a premium for organic wines [45]. A study by Fanasch and Frick [46] analysed 55,500 wines in Germany to find a significant price premium for organic and biodynamic wines, but the magnitude was far smaller than previous surveys and laboratory experiments expected.

Because wine is viewed as a luxury item, taste is a relevant factor during purchase decisions [47]. Altruistic motives for buying organic food, such as environmental protection and animal welfare, are usually not associated with wine production [36]. Consumers with a strong environmental orientation are often more willing to purchase organic wine [48] and pay a premium for environmentally friendly organic wines [49]. This sentiment was confirmed by Schäufele and Hamm [41], who examined six different segments of German wine consumers whose attitudes and purchasing behaviours towards organic wines differed significantly.

As mentioned earlier, there are similarities in the motives between purchasing organic foods and organic wines. Both products also encounter many purchasing barriers. To illustrate, customers are often hesitant to

buy organic food due to its higher pricing, inferior taste or because they are unfamiliar with or lack knowledge about the product [43]. Sirieix and Remaud [44] discovered that consumers typically perceive organic wine as more expensive than conventional wine. Consumers also have little knowledge about organic wine production [50,51] and often perceive wine as a natural product. As a result, there is not the same level of positive differentiation between conventional and organic wines as there is with conventional and organic foods [44]. Therefore, consumers of organic food rarely consider buying organic wine and purchase the conventional alternative more often [4]. For consumers who have little knowledge of organic wine, tasting it can have a positive impact on their perceptions of its quality [36]. Sohn *et al.* [52] demonstrated in their study that the organic wine purchase intensions can be influenced by social cues, which are increasing trust during the online purchase.

Zander and Janssen [53] found that consumers who regularly buy wine are more willing to purchase organic wine. This was confirmed by Szolnoki and Hauck's [6] study, which revealed that consumers consume more organic wine when they have a greater interest and more knowledge of wine.

As the literature review has illustrated, few papers have investigated producers' motives for converting to organic wine production [25,26,28] and consumers' perception of organic wine [36,38,43,44].

To date, no study has examined the challenges that organic wine producers encounter or how producers and retailers influence the consumer demand for organic wine. In addition, there is no study investigating organic wineries including all German winegrowing regions and dealing also with conventional wineries to identify the barriers to convert. Therefore, this study aims to analyse along the value chain the German producers' and retailers' perceptions of organic wine by addressing the following three research questions (RQ):

RQ 1: What are the motives for converting or not converting from conventional to organic wine production? Based on the findings in the study by Castellini *et al.* [25], Fairweather *et al.* [15]; Darnhofer *et al.* [16]; Rigby *et al.* [17]; Sutherland *et al.* [18]; Pavie *et al.* [19].

RQ 2: How are production and sales structures affected by organic wine production? Based on the findings in the study by Darnhofer *et al.* [24] Karipidis and Karypidou [14] Reganold and Wachter [29].

RQ 3: Why and how do retailers offer organic wine? Based on the fact that there are no publications dealt with the role of retailers and organic wines.

3. MATERIALS AND METHODS

Data for this survey were collected using a qualitative research method. This involved interviews with the managing directors of selected organic and conventional wineries in all 13 German wine-growing regions and wine buyers of retail stores. The face-to-face or telephone interviews were conducted by using semi-structured interview guidelines [54,55]. All experts, both form the wineries and from the retail shops, are in decision-making positions. The interviews were conducted in 2018.

The set of questions for the wineries covered the following topics: 1) the motives for converting to organic wine production; 2) changes in workload and cost after the conversion; 3) changes in sales structure; 4), the characteristics of organic wine consumers and 5), how organic wine is promoted. The retailers were asked about 1) the share of (German) organic wine in their range of wines; 2) the development of the demand for organic wine; 3) the reasons they listed organic wines in their wares; 4), the characteristics of organic wine consumers; and 5), the promotion of organic wine. All interviews were recorded and transcribed. Based on the derived research questions, theoretical assumptions were made in order to use grounded theory. The contents of the transcription were analysed before open, axial and selective coding with MAXQDA.

The interviewed wineries differed in location, size and according to the type of organic certification (or lack thereof) in order to cover a broad variety in the sample. The number of interviews per region depended on the size of the region. The aim was to analyse a heterogeneous set of organic wine producers and conventional wine producers. In particular, conventional wine producers were needed to represent each wine-growing region in Germany, as some regions have only a few or no organic wine producers. External validity was maximised due to the involvement of differently sized wineries. To increase internal validity, we selected wineries with various sales channels, instead of only direct sales, in order to cover the complete value chain of organic wine. Wineries with EU organic, Biokreis, Bioland, ECOVIN, Naturland or Demeter labels were included in the research.

The interviewed retailers sold organic wines either exclusively or together with conventional wines. The retailers were categorised as local retailers and retailers selling nationwide. We interviewed two owner-managed local supermarket, one supermarket, four organic supermarket and one discounter. Additional 17 specialised wine store owners were interviewed. Table 1 shows key data about the interviewed wineries and retailers. To

maintain anonymity, the names of the interviewed producers and retailers are not listed.

The interviews were summarised by performing a content analysis using an inductive scheme for coding the open-ended questions. Content analysis reduced the material while preserving the essential content so that the material could be reflected. Generalised and double answers were decreased, and the material was paraphrased based on a defined criterion and specific levels of abstraction. The results objectively reflected the material and were not influenced by our research questions. In a final step, the content was analysed and interpreted. Content analysis had been defined as a systematic, replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding [56]. We quantified and analysed the presence, the meanings and the relationships of the words and concepts in the interviews undertaken and then we made inferences about the messages within the texts [57,58].

Grounded theory is an open method that comes from qualitative social studies. The idea behind Grounded theory is to "generate new theory where little is already known" [59]. Grounded theory is a four-stage process: steps 1 (coding data) and 2 (memo writing) helped keep track of the interview results as they arrived. Steps 3 (theoretical sampling) and 4 (integrating analysis) facilitated sorting the topics of the interview memos and starting to create clear links between the emerging topics of the incoming interview transcripts.

Krippendorff's [56] special quality criteria were used to verify the validity and reliability of the study. Wineries and retailers of various sizes were selected from different wine-growing regions with several certifications, locations and sales channels (external sample validity). The potential interview partners were selected and contacted according to their certifications and interests, which had been defined beforehand (internal sample validity). All interviews were conducted and analysed by the same interviewer to ensure the consistency of the investigation (reliability).

In addition to the interviews, store tests were conducted to analyse the supply of organic wine at the point of sale. To this end, the following standardised criteria were considered: the number of wines in a store's selection, the organic wine share, the German organic wine share, the share of foreign organic wines and the labelling of organic wines.

These results provide a snapshot of the supply and promotion of organic wines during the tests and can be used to support the findings of the interview. In total,

Table 1. Interviewed wineries and retailers.

	Total number	Size/Type (Number)	Region (Number)
Wineries	75	≤ 5 hectares (12), 6–10 hectares (15), 11–20 hectares (31), 21–100 hectares (17); conventional (25); organic certified: Biokreis (2), Bioland (9), ECOVIN* (21), Naturland (2), Demeter (15)	Ahr (4), Baden (9), Franconia (5), Hess. Bergstraße (2), Middle Rhine (4), Mosel (4), Nahe (5), Palatinate (10), Rheingau (5), Rhine Hesse (11), Saale-Unstrut (4), Saxony (4), Wuerttemberg (8)
Retailers	25	specialised wine stores (17); organic supermarkets (4); supermarkets without focus on organic (3); discounter (1)	local (17); national (8); Baden-Wuerttemberg (2), Bavaria (2), Berlin (2), Hamburg (2), Hesse (4), Lower Saxony (1), North Rhine-Westphalia (2), Rhineland-Palatinate (1), Saxony (2), Thuringia (2)

*Double certification possible.

Table 2. Stores analysed in the store tests.

Stores/Characteristics	Number of stores	Number of wines in the range	Number of organic wines	Distribution
Discounters	5	487	19	National
Supermarkets	5	3756	218	National
Specialised wine stores (brick-and-mortar)	5	915	49	Local
Specialised wine stores (online)	5	3177	152	National
Organic stores	5	248	248	Local
Sum	**25**	**8583**	**623**	

25 stores were analysed in Germany; these stores were located in Baden-Wuerttemberg (4), Bavaria (3), Berlin (3), Hamburg (2), Hesse (4), Lower Saxony (2), North Rhine-Westphalia (2), Rhineland-Palatinate (2), Saxony (1) and Thuringia (2). In Table 2 the sum of offered wines across all stores are described.

4 RESULTS

4.1 Motives for converting to organic wine production

A variety of motives influenced the wine producers' decisions to convert or not to convert to organic farming (Table 3). Personal conviction was the primary reason underpinning decisions to favour or oppose organic farming. Wineries that switch to organic wine production are largely driven by altruistic motives, such as their responsibility towards nature and younger generations. An interviewee from a medium-sized winery summarised this outlook as follows: 'How can we not care about the environment when we are working in it?' Other motives were linked to product quality, the winegrowers' health, the birth of children or generational changes within the wineries. Therefore, although the producers who switched to organic production considered the market situation for switching to organic wine to be difficult, their decision-making processes rarely included market-related factors. As one organic wine producer said, 'At the time when we decided to switch to organic wine production, no one was asking for organic wine'. Economic goals were also negligible. In addition, while consumer demand proved not to be a motive for switching to organic wine production, especially for small producers, larger producers took economic factors into consideration more frequently.

Conventional wineries tended to evaluate the market situation in a similar manner. To illustrate, a representative of one of these wineries claimed as follows: 'We do not perceive a demand for organic wine or any restrictions in our sales because our wines are conventionally farmed'. Economic and market-orientated factors prevent conventional wineries from switching to organic farming. While 5 out of 25 of the conventional wineries still used glyphosate, most of them attempted to follow organic principles by adhering to environmentally friendly practices without certification. To that end, most conventional wineries viewed certification as a useless and overly complex process. By comparison, the organic wineries perceived certification as a means of providing evidence and control to consumers.

The conventional wineries believed that organic wine production was not necessarily more sustainable than environmentally friendly wine production, and they were particularly critical of the use of copper to protect plants in organic farming. In summary of the attitude that most conventional producers shared, one producer said, 'For me, it is less sustainable to use cooper instead of other types of plant protection'. Nonetheless, economic goals could sway a majority of conventional wineries to switch to organic wine production in the future.

Although personal conviction is typically the primary reason that conventional wine producers choose not to switch to organic farming, vine cultivation conditions in certain wine-growing regions are a more important factor. Due to the geographic distribution of organic wineries, some German wine regions only have a few organic wine producers. According to the organic and conventional producers in our sample, this is due to local weather and the conditions of vine cultivation. Certain wine regions, such as Mosel, Mittelrhein, Sachsen and Saale-Unstrut, have a large share of steep slopes, terraces and a decreased ability to work mechanically, preventing wine growers from switching to organic production. Because organic farming requires a higher degree of manual work and a greater commitment from personnel, the costs are considerably high. Nonetheless, organic wine producers in these regions did not view the higher workload and costs as obstacles to producing organic wine due to their personal convictions.

4.2 Influence of organic wine production on production and sales

According to the interviewed producers, there is no economic incentive for converting to organic farming.

Table 3. Reasons for and against switching to organic wine production.

For	Against
• More sustainable	• Less sustainable (due to copper)
• Responsibility towards nature and younger generations	• Lack of active demand for organic wines
• Producers' health	• Higher labour costs
• Certification includes control	• Local production conditions (e.g. weather, steep slopes, terraces)

All producers stated that the management of organic vineyards requires a significantly higher amount of work. They also noted that crop protection and pruning involve more procedures than conventional production. At the same time, protecting the crops against Peronospora and Oidium remains a challenge. According to the wine producers, organic wine production requires quicker reactions and shorter spray intervals. In addition, the approved crop protections are not as effective as they are for conventional products. The higher workload also requires more personnel and results in higher costs.

All organic producers reported a general change in cost structure and higher production costs. While crop protection costs decreased, labour costs increased significantly. As one organic wine producer remarked, 'We need more staff to react faster to weather conditions. At the same time, producers faced yields that were as much as 20 % lower when switching from conventional to organic production. Even before converting to organic production, wineries that farmed according to yield regulations were less affected by harvesting fewer grapes. However, most of the interviewed wineries stated that they had to charge higher prices due to their reduced yields. According to most producers, higher prices for organic wines are rarely accepted or not accepted at all in the organic wine market. In total, 42 of 50 respondents did not raise their prices after initiating organic production (Figure 1). The eight organic wineries that increased their prices after converting found it challenging to sell at these price levels, especially when compared to sales of conventional wines. According to a producer from a medium-sized winery, 'We were always compared with conventional wines, and if the quality of our wine is not better, most of the customers or retailers will not pay a higher price just because the wine is produced organically'. In this producer's opinion, customer acceptance depended on their individual attitudes towards organic products as a whole. Without a positive attitude towards organic products, consumers are less willing to pay more for a bottle of organic wine. In sum, there is no economic benefit for producers to convert from conventional to organic farming. However, our results indicate that despite the lack of economic incentive, these factors do not influence producers' beliefs in a more sustainable form of agriculture and their responsibility towards nature.

None of the interviewed producers lost customers after converting to organic production. Nevertheless, according to 40 of the 50 respondents, only a few clients asked specifically for organic wines. Although most wine consumers and retailers appreciate organic wine, wine quality, a winery's image and the price and relationship between a customer and winery play a more critical role in purchasing decisions. As one organic wine producer from Palatinate noted, 'Organic is nice to have, but if the wine is too expensive or does not taste good, customers will not buy it or buy it just once'.

Most wineries sell their wines through various distribution channels, such as direct sales, retail and gastronomy. Organic farming makes it possible to distribute wines to selected export markets, organic wholesalers or retailers. In traditional wholesalers and discounters, the active demand for organic wines is low. Furthermore, only larger wineries can supply these sales channels due

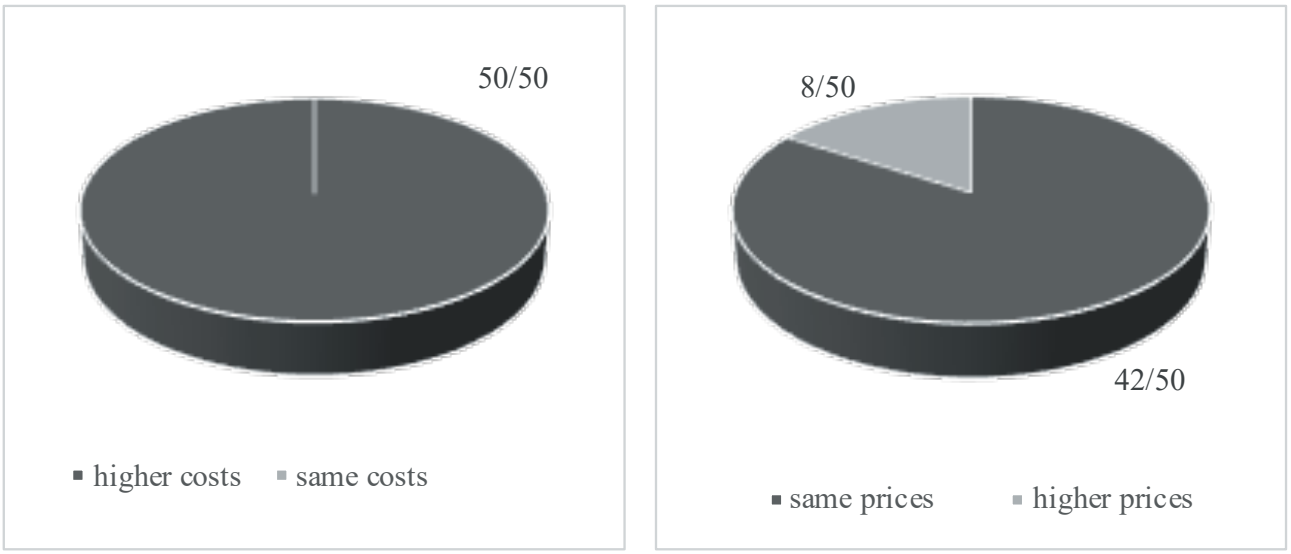

Figure 1. Impact of conversion on costs and prices. (n = 50 interviewed organic wineries).

to the high quantity and low prices of the wines that they sell. Some organic wineries also believe that while certain distributors, such as traditional food retailers or discounters, offer organic products to improve their image, they do not carry the same personal convictions as organic food stores or organic producers.

Apart from the legal requirements to use the EU organic label, most producers do not actively communicate the fact that they have organic wine certification to consumers or retailers. Rather, they focus their communications on other factors, such as their history and/or the quality of their wines. Because the conversion to organic farming is mostly driven by personal convictions, organic wineries perceive certification as self-evident. This is one of the main reasons why several wineries do not market it as a unique selling point to promote their wines. The fact that wine consumers often lack knowledge about organic labels and wine production is another reason that wineries choose not to promote their organic certification. This discrepancy is illustrated in Figure 2.

4.3 Organic wine in retail

According to retailers, the market share for organic wine has risen continuously over the last ten years due to the growing number of organic vineyards. However, organic wines only generate a small share of the total revenue from wines for many retailers. While traditional food retailers and specialist wine stores adjust their range of organic wines to meet their customers' demands, organic stores modify their range of goods according to their wholesalers' offers. Regardless, the critical factors driving a retailer's decision to include organic wines in their portfolio primarily include the quality, taste and price of the products. As one retailer asserted, ‚The value-for-money ratio is the main decision criterion'. The range of organic wines is dominated by foreign wines rather than organic wines from Germany. Most of these wines are cheap and from larger producers, as smaller producers are unable to deliver many bottles or offer their wines for a low price to stores like discounters.

In terms of price, traditional food retailers perceive the price of organic wines in Germany to be too high. As shoppers in traditional food stores can be quite sensitive to price, organic wines lose their attractiveness if they are priced above a certain threshold. Retailers at specialist wine stores appear to carry the same impression. According to the owner of one of these stores, ‚Some wineries start at 8 Euros per bottle. That is way too high for a basic wine in retail'. This indicates a discrepancy between the perceptions of organic wine producers and retailers. While organic wine producers in Germany view the price of organic wine as too low, most retailers consider the price of German organic wine to be too high.

In specialist wine stores, personal recommendations significantly influence consumers' willingness to purchase wine. This sentiment was confirmed by one of many interviewees: ‚The customers trust my choice'. When compared to products offered at traditional food stores and discounters, the range of products at specialist wine stores includes wine from smaller wineries and/or premium wines. The promotion and visibility of organic wines varies depending on the personal convictions of store managers. While some managers promote organic products as an added value, few consumers demand organic wines and the demand for vegan wines is higher.

The importance of organic labels within the distribution process is somewhat low, as most consumers do

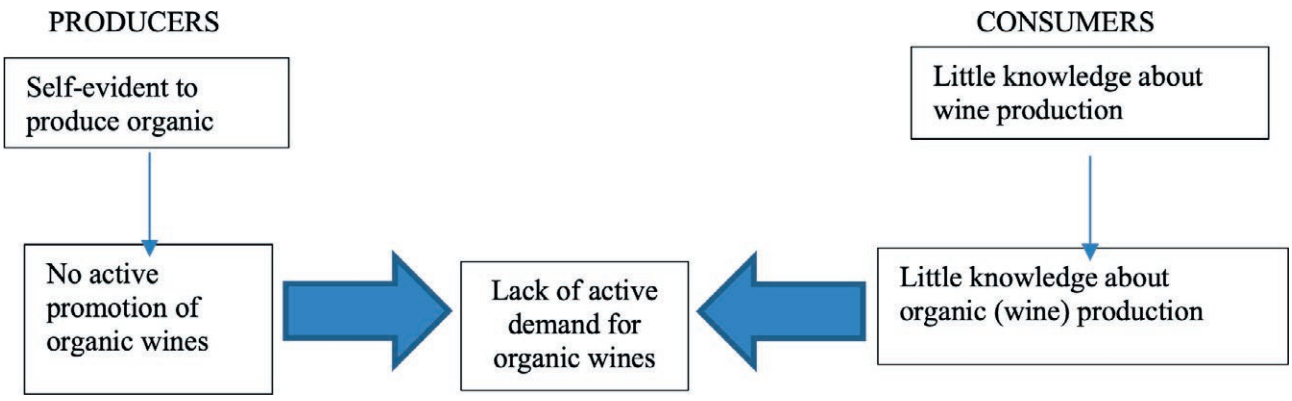

Figure 2. Discrepancy in communication of organic wines.

Table 4. Summary of store test.

Characteristics	Share of organic wine	Share of foreign organic wines	Share of German organic wines
Discounters	< 2 %	> 1.5 %	< 0.5 %
Full-range stores	< 2 %	> 1.5 %	< 1 %
Specialised wine stores (brick-and-mortar)	10–100 %	70–99 %	1–30 %
Specialised wine stores (online)	10–100 %	70–99 %	1–30 %
Organic stores	100 %	90–100 %	1–10 %
TOTAL			

not know enough about them and only some organic stores demand specific labels. Furthermore, retailers admitted that organic wines are rarely communicated in stores. They agreed that consumers have too little contact with organic wine and so rarely demand it. In particular, retailers who do not exclusively sell organic products claimed that the variety of organic wine labels can confuse consumers. At the same time, the EU requires an organic certification for retailers to promote organic products, which includes wine retailers, to avoid fraud. Since the range of organic products in discounters, traditional food stores and organic stores is typically higher than in specialist wine stores, larger stores are more frequently certified as organic and can promote organic products. For smaller specialist wine stores specifically, certification is not attractive due to the bureaucratic procedures involved and the lack of positive impact on sales. For these reasons, retailers have more or less the same incentive to buy organic or conventional wines. There is no widespread view on whether the inclusion of organic wines in store portfolios attracts new customers. As it stands today, only organic stores can gain new customers and increase awareness by offering organic wines.

In addition to these results, the store tests revealed that 7% of wine ranges were organic. Almost 80% of the stores offered organic wines originating from Germany, and 20% did not offer German organic wines. The most frequently sold organic wines were from France, followed by Italy and Spain. The share of organic wines ranged from 1% to 100%. Although organic stores or specialist wine stores with a focus on organic wines offered up to 100% organic wines, some traditional food retailers and discounters offered only a few organic wines or none whatsoever. Moreover, the share of German organic wines that were offered by traditional food retailers and discounters was under 1%. In organic stores, there was usually only a small selection of wines and rarely organic wines from Germany. The highest share of organic wines was found in specialist wine stores that focused on organic wines. On the other hand, some specialist wine stores offered only a few organic wines. Therefore, the amount of organic wines that stores provide can vary considerably (Table 4).

Apart from a few exceptions, German organic wines are generally underrepresented. The price can range from 1.59 Euros to 79.99 Euros for a 0.75-litre bottle. In the stores we tested, 80% of organic wines were priced between 4.00 and 7.99 Euros; 62% of organic wines featured one organic label; and 38% of organic wines featured two organic labels. More specifically, 97% of organic wines featured the EU organic label and 15% featured the German organic label. Some organic wines featured private organic labels, such as 13 % for Demeter, 12.5% for ECOVIN and 7% for Bioland. Most organic wines (95%) were only labelled as organic on the back of the bottle. To boost visibility, the majority of traditional food stores mark wines as organic on the price tag.

Regardless of the types of sales channels, all interviewed producers and retailers confirmed that there are no typical consumers of organic wine. Wine consumers vary widely depending on shopping location. Because traditional food stores and discounters have a large product range, they reach a wide range of customers. Specialist wine stores target an older, affluent and well-educated group. For some specialist wine stores and organic wine producers, women seek organic wines more often than men, even when the majority of their customers are male.

Other retailers described a lack of loyalty for organic wines, indicating that wine consumers who buy organic wines also buy conventional wines. At this stage, it is clear that certification plays a less significant role in purchasing decisions than other factors, such as price, taste, wine quality and personal recommendations. Communications about organic wines within stores, which could attract attention and boost interest in organic products, are very rare. As one retailer described, 'Organic wines are just like conventional wines. For us, there is no difference. That is why we do not promote organic'.

5. DISCUSSION

Similar to the findings by Castellini *et al.* [25] and Siepmann and Nicholas [28], our study confirms that personal conviction is the primary reason that winegrowers in Germany choose to convert to organic farming in all winegrowing regions in Germany. Nevertheless, this is the same factor that prevents conventional wineries from converting to organic production. Other reasons that discourage conventional wineries from producing organic wines include lack of demand and challenges related to production, such as steep slopes or unsuitable weather conditions. As such, some winegrowing areas in Germany have a higher share of organic wine producers than others.

Regarding the production costs of organic wines, German wine producers complain about the lower yields and the increased costs of higher staff requirements. Studies by Reganold and Wachter [29] and Hough and Nell [34] arrived at similar conclusions about the cost structure of organic wine production. Surprisingly, only 15 % of organic wine producers who have been impacted by higher costs have raised their prices. Nonetheless, organic wine producers consider organic wine production to be the only sustainable form of agriculture that is suitable to the production of grapes and wine. According to Crowder and Reganold [32], organic agriculture will only grow if it becomes more financially profitable than conventional agriculture. In addition, our results indicate that economic motives can influence most conventional wineries to convert to organic farming.

Our results are consistent with studies that have posited that consumers base their buying decisions on a variety of factors, such as wine quality, taste and their relationship with the producer [47]. A special interest in wine can increase the willingness to purchase organic wines at a premium [4,45,48,49]. Studies by Hoffmann and Szolnoki [5] and Remaud *et al.* (2008) [4] determined that at least one consumer group buys organic food but not organic wines. This segment of the population should be targeted by organic wine producers and retailers to increase their interest in organic wine and generate a more active demand for the product.

Because wine growers produce organic wines due to their personal convictions, there is a clear gap in the way they communicate their beliefs to consumers. In line with previous research, the present study found that a lack of knowledge about organic farming serves as a barrier to buying organic food [43,50,51]. Furthermore, consumers' unfamiliarity with organic wine is the primary contributor to the product's low demand. For organic wine producers, communicating about organic wine is critical to better informing potential consumers. Active communication can increase consumers' knowledge and familiarity with organic wines and grow the active demand for the product as a result. In addition, because the current study confirmed findings by Delmas and Grant [36] and Szolnoki and Hauck [6] that consumers lack knowledge about different organic wine labels, the role that organic labels play in the sale of organic wines must be reconsidered. Increasing their knowledge about these labels and what they represent will likely boost the active demand for organic wines.

When selecting wines for their portfolios, most retailers and consumers base their decisions on similar attributes. Retailers are important gatekeepers in the distribution process. For this reason, producers must consider the wine purchasing processes from both consumers' and retailers' points of view. Only retailers who believe that a product's organic designation is important to the purchasing decisions of their consumers will actively communicate organic certification or show willingness to educate their customers about the production of organic wines. Therefore, organic wine producers should emphasise that their products are organic to both consumers and retailers during the purchasing process. According to the retailers in our study, the cost of organic wine is not necessarily higher than the cost of conventional wine. Nonetheless, there is a clear price difference between German organic wines and organic wines from foreign countries. As such, the higher price of German organic wines can serve as a barrier to consumers (and retailers) that prevents them from purchasing organic wines from Germany. According to the perceptions of organic wine producers and retailers, no typical organic wine consumer exists. Organic wine producers agree with Barber *et al.* [48], who found that consumers with a strong environmental orientation have a greater willingness to buy organic wine. However, in contrast to Schäufele and Hamm [41], who defined six different segments of German wine consumers based on their attitudes towards and purchasing behaviour of organic wine, Szolnoki and Hauck [6], who also defined organic wine consumers, wine producers and retailers, were unable to identify a typical organic wine consumer.

Our results can afford the following recommendations to producers and retailers: 1) Use organic stores as distributions channels. Organic stores can play a critical role in the distribution of organic wine since shoppers in these stores have a special interest in organic food and are therefore more predisposed to purchasing organic wine [53]. In addition, because organic stores sell organic wines only, there is no com-

petition from conventional wines. 2) Producers and retailers should practice active communication. For consumers to familiarise themselves with and gain knowledge about organic wine, producers and retailers must teach them about the product. They can achieve this by practising active communication. Moreover, organic wine producers should actively communicate about their products with their retailers, as retailers are intermediaries at the interface between producers and consumers. 3) Improve communications about organic wine labels. The low level of consumer knowledge about organic wine labels can result in a low active demand for organic wine, as consumers may not understand the relevance of the different labels. Therefore, to garner the support of organic associations and make organic wines more accessible to consumers, communicating the purpose of these labels is vital.

The present study can help organic wine producers reduce the communication barriers between producers, retailers and consumers that result from issues with supply and a lack of knowledge about organic wine. Because this study adopts a qualitative research approach, it may be limited in that its results cannot be generalised on the total population. Although the study aimed to interview and analyse the input from many experts, its data are not representative. Nonetheless, we made an adequate sampling with a solid data collection and analysis. This study provides a general overview of wine producers' and retailers' perceptions towards organic wine and the organic wine market in a heterogeneous sample. Therefore, because the study only covers data from producers and retailers, consumers' attitudes towards organic wine may be investigated in subsequent research. While consumers purchase organic food, the reasons they hesitate to buy organic wine require further analysis. As consumer knowledge about organic wines and their motivations to purchase and consume these products remain unclear to producers and retailers, we recommend another qualitative study that examines these factors. Based on these results, a quantitative study could also provide representative results, allowing strategies to be defined according to the knowledge, personal attitudes and shopping locations of consumers.

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LIST OF ABBREVIATIONS

BÖLW – Bund Ökologische Lebensmittelwirtschaft, Organic Food Production Alliance in Germany
FIBL – Forschungsinstitut für biologischen Landbau, Research Institute of Organic Agriculture in Swiss
IFOAM – Organics International
IWSR – International Wines and Spirits Record in UK
VDP – Verband Deutscher Prädikatsweingüter, Association of German Prädikat Wine Estates in Germany

REFERENCES

[1] BÖLW (2020): Bund ökologische Lebensmittelwirtschaft – Branchenreport 2020: https://www.boelw.de/fileadmin/user_upload/Dokumente/Zahlen_und_Fakten/Broschüre_2020/BÖLW_Branchenreport_2020_web.pdf ; 04.03.20.

[2] FIBL and IFOAM (2016). The World of organic agriculture - Statistics and Emerging Trends 2016. https://orgprints.org/31151/1/willer-lernoud-2016-world-of-organic.pdf, 03.02.2020

[3] IWSR (2020). "IWSR sees growth in global organic wine market", https://www.theiwsr.com/wp-content/uploads/Press-Release-IWSR-Sees-Growth-in-Global-Organic-Wine-Market_9Apr19.pdf, 20.05.19

[4] Remaud, H., Mueller, S., Chvyl, P. and Lockshin, L. (2008). Do Australian wine consumers value organic wine? AWBR Conference, Siena, July 2008

[5] Hoffmann, D. and Szolnoki, G. (2010). Verbrauchereinstellungen zu Bioweinen in Deutschland, OIV Congress, Tiflis, June 20-27, 2010.

[6] Szolnoki, G., & Hauck, K. (2020). Analysis of German wine consumers' preferences for organic and non-organic wines. British Food Journal, 122(7), 2077–2087. https://doi.org/10.1108/bfj-10-2019-0752

[7] Fraga, H., Malheiro, A. C., Moutinho-Pereira, J., & Santos, J. A. (2012). An overview of climate change impacts on European viticulture. Food and Energy Security, 1(2), 94–110. https://doi.org/10.1002/fes3.14

[8] Koch, J., Martin, A., & Nash, R. (2013). Overview of perceptions of German wine tourism from the winery perspective. International Journal of Wine Business Research, 25(1), 50–74. https://doi.org/10.1108/17511061311317309

[9] Mozell, M. R., & Thach, L. (2014). The impact of climate change on the global wine indus-

try: Challenges & solutions. Wine Economics and Policy, 3(2), 81–89. https://doi.org/10.1016/j.wep.2014.08.001

[10] Willer, H. and Lernoud, J. (Eds.) (2018). The World of Organic Agriculture. Statistics and Emerging Trends 2018. Research Institute of Organic Agriculture FiBL and IFOAM - Organics International, Frick and Bonn.

[11] German Wine Institute (2020), Deutscher Wein Statistik ´19/ ´20, https://www.deutscheweine.de/fileadmin/user_upload/Statistik_2019-2020.pdf, 03.04.20

[12] Michelsen, J. (2001). Organic Farming in a Regulatory Perspective. The Danish Case. Sociologia Ruralis, 41(1), 62–84. https://doi.org/10.1111/1467-9523.00170

[13] Tovey, H. (1997). Food, Environmentalism and Rural Sociology: On the Organic Farming Movement in Ireland. Sociologia Ruralis, 37(1), 21–37. https://doi.org/10.1111/1467-9523.00034

[14] Karipidis, P.; Karypidou, S. (2021): Factors that Impact Farmers' Organic Conversion Decisions. Sustainability 13, no. 9: 4715. https://doi.org/10.3390/su13094715

[15] Fairweather, J. R. (1999). Understanding how farmers choose between organic and conventional production: Results from New Zealand and policy implications. Agriculture an Human Values, 16(1), 51–63. https://doi.org/10.1023/a:1007522819471

[16] Darnhofer, I., Schneeberger, W., & Freyer, B. (2005). Converting or not converting to organic farming in Austria:Farmer types and their rationale. Agriculture and Human Values, 22(1), 39–52. https://doi.org/10.1007/s10460-004-7229-9

[17] Rigby, D., Young, T., & Burton, M. (2001). The development of and prospects for organic farming in the UK. Food Policy, 26(6), 599–613. https://doi.org/10.1016/s0306-9192(01)00023-9

[18] Sutherland, L.-A., Burton, R. J. F., Ingram, J., Blackstock, K., Slee, B., & Gotts, N. (2012). Triggering change: Towards a conceptualisation of major change processes in farm decision-making. Journal of Environmental Management, 104, 142–151. https://doi.org/10.1016/j.jenvman.2012.03.013

[19] Pavie J, Dockès A-C & Echevarria L. (2002). Etude des freins à la conversion à l'agriculture biologique des exploitations laitières bovines. Institut de L'Élevage.

[20] Rickards, L., & Howden, S. M. (2012). Transformational adaptation: agriculture and climate change. Crop and Pasture Science, 63(3), 240. https://doi.org/10.1071/cp11172

[21] Dowd, A.-M., Marshall, N., Fleming, A., Jakku, E., Gaillard, E., & Howden, M. (2014). The role of networks in transforming Australian agriculture. Nature Climate Change, 4(7), 558–563. https://doi.org/10.1038/nclimate2275

[22] Barbier, C., Cerf, M., & Lusson, J.-M. (2015). Cours de vie d'agriculteurs allant vers l'économie en intrants: les plaisirs associés aux changements de pratiques. Activites, 12(2), 1–66. https://doi.org/10.4000/activites.1081

[23] Xu, Q., Huet, S., Poix, C., Boisdon, I., & Deffuant, G. (2018). Why do farmers not convert to organic farming? Modeling conversion to organic farming as a major change. Natural Resource Modeling, 31(3), 1. https://doi.org/10.1111/nrm.12171

[24] Darnhofer, I., D'Amico, S., & Fouilleux, E. (2019). A relational perspective on the dynamics of the organic sector in Austria, Italy, and France. Journal of Rural Studies, 68, 200–212. https://doi.org/10.1016/j.jrurstud.2018.12.002

[25] Castellini, A., Mauracher, C., Procidano, I., & Sacchi, G. (2014). Italian market of organic wine: A survey on production system characteristics and marketing strategies. Wine Economics and Policy, 3(2), 71–80. https://doi.org/10.1016/j.wep.2014.12.001

[26] Bouzdine-Chameeva, T. (2011). More risks or/and more benefits? Prospect theory application to the analysis of the bio wines' evolution in France. 6th AWBR International Conference, Bordeaux

[27] Zander, K., Padel, S. & Zanoli, R. (2015). EU organic logo and its perception by consumers. British Food Journal, Vol. 117 No. 5, pp. 1506-1526. https://doi.org/10.1108/BFJ-08-2014-0298

[28] Siepmann, L., & Nicholas, K. (2018). German Winegrowers' Motives and Barriers to Convert to Organic Farming. Sustainability, 10(11), 4215. https://doi.org/10.3390/su10114215

[29] Reganold, J. P., & Wachter, J. M. (2016). Organic agriculture in the twenty-first century. Nature Plants, 2(2), 1–8. https://doi.org/10.1038/nplants.2015.221

[30] Döring, J., Frisch, M., Tittmann, S., Stoll, M., & Kauer, R. (2015). Growth, Yield and Fruit Quality of Grapevines under Organic and Biodynamic Management. PLOS ONE, 10(10), 1–28. https://doi.org/10.1371/journal.pone.0138445

[31] Collins, C., Penfold, C., Johnston, L., Marschner, P. and Bastian, S. (2015). The Relative Sustainability of Organic, Biodynamic and Conventional Viticulture. AGWA Final Report, Project No. UA 1102, University of Adelaide

[32] Crowder, D. W., & Reganold, J. P. (2015). Financial competitiveness of organic agriculture on a global scale. Proceedings of the National Academy of Sciences, 112(24), 7611–7616. https://doi.org/10.1073/pnas.1423674112

[33] MacRae, J., Frick, B., Martin, R.C. (2007). Economic and social impacts of organic production systems. Can. J. Plant Science 87 (5), 1037-1044, https://doi.org/10.4141/CJPS07135

[34] Hough, E., Nell, W. (2003): The financial aspect of growing organic wine grapes in the vredendal district. International Farm Management Association, 14th Congress, Perth, Western Australia

[35] Zilber, S., Friel, D., & Felipe Machado do Nascimento, L. (2010). Organic wine production: the case of Bodega Colomé in Argentina. International Journal of Wine Business Research, 22(2), 164–177. https://doi.org/10.1108/17511061011061720

[36] Delmas, M. A., & Grant, L. E. (2010). Eco-Labeling Strategies and Price-Premium. Business & Society, 53(1), 6–44. https://doi.org/10.1177/0007650310362254

[37] Fanasch, P. (2019) Survival of the fittest: The impact of eco-certification and reputation on firm performance. Bus Strat Env.; 28: 611– 628. https://doi.org/10.1002/bse.2268

[38] Hauck, K. and Szolnoki, G. (2020). "Consumers of Organic Wine", unpublished manuscript, Hochschule Geisenheim University

[39] Risius, A., Klann, O. & Meyerding, S. (2019). Choosing a lifestyle? Reflection of consumer extrinsic product preferences and views on important (extrinsic) wine characteristics in Germany. Wine Economics and Policy. 8. 10.1016/j.wep.2019.09.001.

[40] Gassler, B., Fronzeck, C., & Spiller, A. (2019). Tasting organic: the influence of taste and quality perception on the willingness to pay for organic wine. International Journal of Wine Business Research, Vol. 31 No. 2, pp. 221-242. https://doi.org/10.1108/IJWBR-09-2017-0062

[41] Schäufele I, Hamm U (2018) Organic wine purchase behaviour in Germany: Exploring the attitude-behaviour-gap with data from a household panel. Food Qual Prefer 63: 1-11. https://doi.org/10.1016/j.foodqual.2017.07.010

[42] Pomarici, E., Vecchio, R. (2019). Will sustainability shape the future wine market? Wine Economics and Policy, 8 (1), 1-4. https://doi.org/10.1016/j.wep.2019.05.001

[43] Hughner, R. S., McDonagh, P., Prothero, A., Shultz, C. J., & Stanton, J. (2007). Who are organic food consumers? A compilation and review of why people purchase organic food. Journal of Consumer Behaviour, 6(2–3), 94–110. https://doi.org/10.1002/cb.210

[44] Sirieix, L. and Remaud, H. (2010). Consumer perceptions of eco-friendly vs. conventional wines in Australia, AWBR Conference, Auckland, February 8-10, 2010.

[45] Brugarolas Mollá-Bauzá, M. M., Martínez-Carrasco, L., Martínez-Poveda, A., & Rico Pérez, M. (2005). Determination of the surplus that consumers are willing to pay for an organic wine. Spanish Journal of Agricultural Research, 3(1), 43–51. https://doi.org/10.5424/sjar/2005031-123

[46] Fanasch, P., Frick, B. (2020). The value of signals: Do self-declaration and certification generate price premiums for organic and biodynamic wines? Journal of Cleaner Production, Vol. 249, https://doi.org/10.1016/j.jclepro.2019.119415.

[47] Lockshin, L., Jarvis, W., D'Hauteville, F. and Perrouty, J. P. (2004). Sensitivity analysis of purchase cues for wine using a discrete choice experiment, 7th Sensometrics Conference, California, July 28-30, 2004.

[48] Barber, N., Taylor, C., & Strick, S. (2009). Wine consumers' environmental knowledge and attitudes: Influence on willingness to purchase. International Journal of Wine Research, 1(1), 59–72. https://doi.org/10.2147/ijwr.s4649

[49] Olsen, J., Thach, L., & Hemphill, L. (2012). The impact of environmental protection and hedonistic values on organic wine purchases in the US. International Journal of Wine Business Research, 24(1), 47–67. https://doi.org/10.1108/17511061211213783

[50] Delmas, M. (2010), "Perception of eco-labels: Organic and biodynamic wines", UCLA Institute of the Environment, pp. 9-10.

[51] Zucca, G., Smith, D. E. and Mitry, D. J. (2009). Sustainable viticulture and winery practices in California: What is it, and do customers care? International Journal of Wine Research, 189. https://doi.org/10.2147/ijwr.s5788

[52] Sohn, S., Seegebarth, B., Kissling, M., Sippel, T. (2020). Social Cues and the Online Purchase Intentions of Organic Wine. Foods. 9(5):643. https://doi.org/10.3390/foods9050643

[53] Zander, K., Janssen, M. (2012). Präferenzen deutscher Öko-Konsumenten für Wein, Schriften der Gesellschaft für Wirtschafts-und Sozialwissenschaften des Landbaus eV, Vol. 48, pp. 177-188.

[54] Hughey, K. F. D., Tait, S. V., & O'Connell, M. J. (2005). Qualitative evaluation of three' environ-

mental management systems' in the New Zealand wine industry. Journal of Cleaner Production, 13(12), 1175–1187. https://doi.org/10.1016/j.jclepro.2004.07.002

[55] Gabzdylova, B., Raffensperger, J. F., & Castka, P. (2009). Sustainability in the New Zealand wine industry: drivers, stakeholders and practices. Journal of Cleaner Production, 17(11), 992–998. https://doi.org/10.1016/j.jclepro.2009.02.015

[56] Krippendorff, K., (2004). Content Analysis: An Introduction to Its Methodology. Sage Publications, CA.

[57] Weber RP. (1990), Basic Content Analysis, second ed. CA: Newbury Park.

[58] Stemler, S. (2001). An overview of content analysis. Practical Assessment. Research & Evaluation, 7(17), 1-8.

[59] Malhotra, N. & Nunan, D. & Birks, D. (2017). Marketing Research: An Applied Approach. 5th edition, Pearson

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Consumer preferences for certified wines in France: A comparison of sustainable labels

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Abstract. The wine industry has faced various environmental and social challenges. On the demand side, consumer demand for sustainable wines has been increasing but, to date, it is unknown whether consumers perceive wine companies' efforts to obtain sustainable development (SD) certifications and labels as being valuable or how they differentiate them. On the supply side, sustainable wine production is increasing but producers report a lack of information to engage and select their SD strategy. This article uses a logistic regression and an artificial neural network model to show how French consumers differentiate and value different SD labels (Organic, Biodynamic, Sustainable, Fairtrade, Natural). Results show that consumers' willingness to buy and willingness to pay are influenced by the importance each consumer gives to the certification. For all other drivers, consumers differentiate between labels, highlighting the importance of comparison between and knowledge about each of them, thereby aiding producers in choosing an appropriate marketing strategy.

Keywords: consumer preferences, stated preferences, wine, certified wines.

1. INTRODUCTION

The French wine industry dates back to ancient times and holds an important place in the French economy, representing the 2nd largest net trade surplus and creating numerous jobs in rural regions (Alonso Ugaglia et al., 2019; Cardebat, 2017; Porter and Takeuchi, 2013). French wines have an

excellent reputation, based mainly on appellation regulations (Protected Designation of Origin [PDOs] and Protected Geographical Indications [PGIs]), but since the 1970's the production and consumption of wine have been experiencing a long-term decline in France. At the same time, the wine industry has been facing a number of environmental[1] and social challenges (Delmas et al., 2008) in the form of the growth of societal demands for more environmentally-friendly and ethical practices in the vineyards and the cellars. Sustainable development (SD) certification has, thus, became a critical success factor (Sampedro, 2010), turning the wine industry into a 'green business' (Silverman et al., 2005).

On the demand side, consumers are increasingly demanding to know what inputs are used in food production and processing, to know producers' labor standards, and to understand the environmental impacts of production (Paloviita, 2010; Pullman et al., 2009; Trienekens et al., 2012). Additionally, the wine industry is under considerable pressure from regulators to evaluate, reduce, and report its environmental and social impacts (Christ and Burritt, 2013), and to incorporate sustainability into its management practices. The attributes of a wine, however, whether ethical, social or environmental, are not verifiable by consumers before purchase, or even after purchase and consumption in the case of sustainability attributes. Producers, therefore, must adopt a symbol on the bottle to solve this asymmetric information attribute. This symbol, SD certification or label, attests the compliance of the wine with a certain norm or a standard (Hoberika et al., 2013). It informs consumers and differentiates a wine from other wines (Giraud-Héraud and Hoffman, 2010).

Until now, however, it has not been known whether consumers perceive wine companies' efforts to obtain SD certifications and labels as being valuable (Barber et al., 2010) or how they differentiate between the various SD labels. In practice, the diffusion of such labels is still limited (Delmas and Gergaud, 2021). The way the consumers perceive the labels is therefore still an issue of discussion (Ashenfelter et al., 2018).

On the supply side, the wine sector has seen the emergence of specific eco-certification schemes and labelling programs, including SD specifications, in response to this demand (Sogari et al., 2016), leading to a proliferation of voluntary and institutional social and environmental certification systems (McEwan and Bek, 2009). In this sense, we observe the development of multiple SD labels such as Biodynamic, Fairtrade, Natural, and Sustainable (Moscovici and Reed, 2018; Moscovici et al., 2020), corresponding to different definitions of what a sustainable wine can be. Sustainable wine production has also been increasing, not only for marketing purposes, but also because of wine producers' personal convictions (Alonso Ugaglia et al., 2017). However, producers in many countries associate 'sustainability' mainly with the environmental dimension and sometimes confuse the different terms and SD labels (Szolnoki, 2013). They complain about the lack of information about SD wine labels and the associated potential added value. One option for producers to choose the best certification for their wines considering the many choices could be to know more about consumers' preferences for SD certified wines and how these drive preference-based purchasing decisions (Poelmans and Rousseau, 2017; Tozer et al., 2015), as consumer perception is indeed an important issue to take into consideration when making business decisions (Lockshin and Corsi, 2012; Mariani and Vastola, 2015).

This paper contributes to the growing literature on consumers' valuation of SD certified wines. In comparison with studies that deal with the general interest of consumers for SD wines (Casini et al., 2009; Schimmenti et al., 2016; Vecchio, 2013), sometimes without defining what they call 'sustainable' (Lanfranchi et al., 2019), this paper analyses whether consumers differ in their preferences for various SD labels and certifications and why and how they value them.

The paper is organized into six sections: Section 2 provides a literature review; Section 3 presents the survey and the data; Section 4 explains the methodology; Section 5 includes the descriptive results from the logistic regression and the artificial neural networks model; and Section 6 discusses the results and draws conclusions.

2. LITERATURE REVIEW

2.1 SD labels and certifications

Eco-labels signal to the consumer that the wine is an eco-friendly product (Delmas and Grant, 2010), with organic wines being the most discussed SD wines at present. The production and sale of organic wines has experienced a boom in recent years due to the pressure of consumer demand for environmentally-friendly agricultural products, the expectations of producers (health considerations), conversion subsidies, and the attractiveness of the market (OIV, 2017). Organic viticulture represented 12% of French vineyards in 2018, with prospects for further growth in 2019. France is ranked third

[1] Water quality and use of chemicals, air pollution, soil erosion, waste, and land use, among others (Chris and Burritt, 2013).

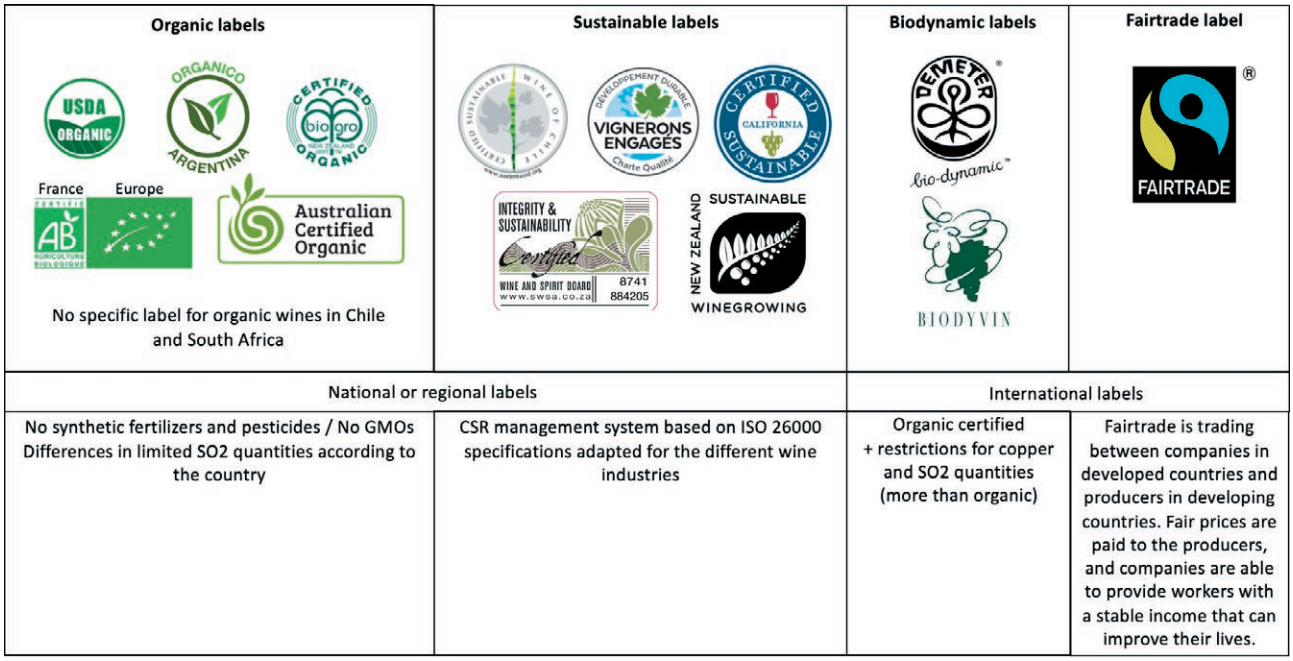


Figure 1. SD wine labels (examples and specifications) (Source: authors).

in worldwide production of organic wines and is set to become the world's leading consumer of organic wine by 2021, overtaking Germany and having doubled its consumption since 2013 (IWSR, 2019) while conventional wine is experiencing a downturn. But there are around 300 definitions of sustainability (Manderson, 2006) and what is considered to be a 'sustainable' wine can be interpreted in different ways. This paper focuses on five main SD wine labels and on the associated certifications and specifications (Figure 1). For 'Natural' wine, there is no official bottle label, but production in France is growing, despite there being no official rules corresponding to this designation.

2.2 Stated preference approach

The literature on consumers' perceived value of SD certified wines mainly addresses the issue through wine pricing and willingness to pay (WTP). Wine is an experience good, meaning that the consumer cannot gain any utility from the product until it is consumed (Nelson, 1970 in Ashton, 2014). Consumers generally have limited knowledge of wine production and it may, therefore, be difficult for them to decide upon a sustainable wine. Signals can help them to make purchasing decisions based on their preferences, to form quality expectations, and influence whether they will purchase the product again (Gabrielyan et al., 2014; Tozer et al., 2015). Representative signals are usually available on packaging, hence labels in the case of wine. Consumers interested in buying certified wine actively seek appropriate options and are willing to pay a price premium for such preferences (Poelmans and Rousseau, 2017; Sellers-Rubio and Nicolau-Gonzalbez, 2016).

From a theoretical standpoint, the estimation of the WTP is a stated preference approach, while 'revealed preference' approaches obtain data from observed behavior. Both approaches link the derived utility to the observed (revealed) or stated choice (Carson and Louviere, 2011). The choices in stated preference approaches are made by choosing between different options offered in the context of hypothetical situations, mostly asked within the framework of surveys or interviews that also facilitates the offering of attributes that are not currently on offer or not on offer at a certain (desired) level. The stated preference methods are the contingent valuation method (CVM), the conjoint analysis method, conjoint behavior, and the stated choice method (Freeman et al., 2014; Louviere, 1988; 2001; Louviere et al., 2000). The CVM is the most commonly used method, asking consumers whether or not they are willing to pay a specific price premium for certain attributes of a product, which enhance the utility of consuming the product (Baker

and Ruting, 2014; Mitchell and Carson, 1989; Mogas et al., 2002). The answer to the question is interpreted as the expression of each consumer's value for the respective attribute (Freeman et al., 2014). This is the chosen approach for exploring our research question in line with other papers for different products (Amato et al., 2017; Sellers-Rubio and Nicolau-Gonzalbez, 2016; Skuras and Vakrou, 2002; Vecchio, 2013; Vecchio and Annunziata, 2015).

2.3 SD wine consumption

The extant literature focuses mostly on eco-labels dealing with environmental specifications (Cholette et al., 2005; Loureiro, 2003; Mueller and Remaud, 2013) and focuses especially on organic labels (Burgarolas et al., 2005; Schmit et al., 2013). Remaud et al. (2008) suggest that there is a tendency to pay a price premium for organic wine. Mihailescu (2015) corroborates these findings for tourists in South Africa who show a WTP a premium for organic wine. Additionally, Corsi et al. (2013) mention that the premium alters the impact of other variables on the wine price. Bazoche et al. (2008), analyzing consumers' WTP for French wines with environmental specifications on the label (including organic wine), show that consumers are only willing to pay a (quite low) premium for organic wine. Gow et al. (2020) show that Australian consumers are willing to pay more for biodynamic wines, while in Italy there is a WTP a price premium for Natural wine (Galati et al., 2019).

Vecchio (2013) shows that customers are willing to pay between 23% and 57% more than the average price for the attribute 'sustainability'. In New Zealand, Forbes et al. (2009) find that consumers believe that the quality of sustainable wines is superior to that of conventional wines and are prepared to pay higher prices for them. For South African Fairtrade wine sold in the US, Niklas et al. (2017) find that the price premiums are negative. Some studies underline that consumers have a higher WTP when social attributes are combined with environmental ones (Mueller Loose and Remaud, 2013). Some studies find no premiums for SD wines (Barber et al., 2009; Gabzdylova et al., 2009; Vecchio, 2013) or even decreasing demand when SD wines are associated with lower quality (Sogari et al., 2006).

Some studies also provide insights into characteristics of wine consumers who are willing to buy or even to pay more for SD labels. Results are controversial and it is difficult to identify global trends. The main consensus is that women and younger consumers in general are willing to pay more for sustainable wines (Gow et al., 2020; Lanfranchi et al., 2019; Moscovici et al., 2020; Vecchio, 2013). McDonal et al. (2013) and Tach and Olsen (2006) underline that young consumers are interested in both environmental and social concerns related to wine. Having knowledge and information about SD labeling is also of importance to determine the WTP (Barber et al., 2009; Bazoche et al., 2008; Galati et al., 2019; Vecchio, 2013). Some other determinants are marital status, with unmarried people willing to pay more, education level, income level, the likelihood of buying eco-certified goods, the price consumers usually pay for wine, the occasion related to the purchase, lifestyle, and the link to wine tourism (Barber et al., 2009; Bazoche et al., 2008; Burgarolas et al., 2005; Gow et al., 2020; Lanfranchi et al., 2019; Moscovici et al., 2020; Vecchio, 2013).

Yet, the numerous SD wine labels have led to confusion for consumers and exacerbate the imperfect perception of products (OIV, 2017). Marette (2004) shows that this is particularly true for eco-labels that complement brands in signaling green, lead-free, fair-trade, organic, no child labour, and/or low-cholesterol attributes. There are few articles that compare SD labels with conventional wines. Moscovici et al. (2020) compare five SD certifications for the North eastern United States and find no specific differences between them. It remains unclear how consumers respond to the different eco-labels and how they value different SD certifications and labels. It is this gap in the literature that the current study aims to close.

3. DATA: WINE CONSUMER SURVEY

This research project gathered data through surveys established on the Qualtrics survey platform, which has been used to access wine consumers in the United States, Australia, Chile, France, Italy, the Netherlands, and South Africa (Moscovici and Reed, 2018; Valenzuela et al., 2019). The research sample was obtained through convenience sampling. Eligibility criteria for the selection of respondents were that they were adults (18 years of age or older) who were habitual consumers of wine. Exclusion criteria included those who worked in the wine or hospitality industries. Within these international data, this paper analyzes the French data sample based on 239 completed questionnaires.

The survey was divided into four sections. In the first section, we asked consumers about their backgrounds and habits with respect to wine knowledge and consumption. Questions included motivations for drinking, favorite varieties, purchasing behaviors, and self-evaluated wine knowledge. The second set of questions collected perspectives and opinions on the various

environmental wine certifications. Questions included which certifications they have heard of, whether they had purchased any type of certified wine, future willingness to purchase certified wine, ranking of certifications, interest in further information about certifications, and labelling. In the third section, we asked consumers whether they would be willing to buy a certified wine. If the answer was 'yes', we asked the (maximum) price they would be willing to pay by offering a large number of predetermined price brackets from which to choose ('take it or leave it' approach) which finally results in the estimation of the value consumers connect to attributes of a product (in our case the respective wine certifications) (Kealy and Turner, 1993; Mihailescu and Hecht, 2015; Sellers-Rubio and Nicolau-Gonzalbez, 2016). Finally, the fourth set of questions collected demographic information such as country of residence, gender, age, income, education, and marital status. The surveys were disseminated in each country through wine newsletters and social networks, especially LinkedIn and WhatsApp.

4. METHODOLOGY: LOGIT MODELS & MACHINE LEARNING

First, we provide a generic description of the sample and then analyze the data. We explain our dependent variable, 'Willingness to buy a certified wine' (WTB), for different types of labels (Organic, Biodynamic, Nature, Sustainable, Fairtrade) from a set of quantitative and qualitative explanatory variables, and the probabilities for the two alternatives of the WTB question (yes, no – coded as 1/0) are estimated applying a binary logit model as suggested in the literature (Hanemann, 1984; Mogas et al., 2002).

Second, we explain the variable 'Willingness to Pay' (WTP). For the WTP question, there are no binary responses, but respondents could decide between six WTP categories. Models with categorical dependent variables in the economic literature are predominantly estimated by applying multinominal logit models (Mogas et al., 2002), which belong to the parametric models. Disciplines such as engineering or stock exchange trading have been applying machine learning, especially artificial neural networks (ANN), as the core technology for these kind of models over the past two decades (Shavlik and Diettrich, 1990; Stone et al., 2016). ANN belong to the group of non-parametric models and are able to also capture non-linear relationships between independent variables and dependent variables. Studies applying this approach suggest that ANN outperform multinominal logit models in their predictive potential (Hensher et al., 2000; Lee et al., 2018; Mohammadian and Miller, 2002; Tran et al., 2019) and possess higher capabilities to identify the (non-linear) relationships between dependent and independent variables. To explain WTP we are interested to find the dominating variables for each type of label and their average semi-elasticities[2] related to WTP. Farsi (2007) shows that a non-linear WTP estimation has a higher accuracy (higher R square) than a linear estimation model. Therefore, we decided to apply a non-linear modelling technique for our WTP analysis and chose a machine learning model based on ANN, which allows to make use of the above-mentioned non-linear estimation advantages (Rinke, 2015)[3].

For each sustainable wine label, we use a separate fully interconnected feed forward ANN model, which consists of 18 nodes for the input layer representing all selected independent variables, five nodes for the hidden layer, and one node for the output layer which represents the dependent variable WTP. These ANN models are used to calculate the dependency factors (Rinke, 2015) and the average semi-elasticities for each label[4]. Dependency factors are sometimes called 'average linear importance factors' and can be compared to significance levels of a normal OLS regression (Yeh and Cheng, 2010). The average semi-elasticities show the percentage change of the dependent variable (WTP in this case) according to a unit change in the respective independent variable (Owen, 2012).

5. RESULTS

5.1 Descriptive results

Table 1 shows the descriptive statistics of the variables which are used in the models below. The survey was answered by 54% women (128) and 46% men (111) and the age of the respondents was grouped into 7 categories with an average age of 37.7 years for women and 43.2 years for men. The annual household income was grouped into 11 categories with the majority of respondents being in the income group 35,000 to <50,000 € annually and an average annual income of 44,906 €. The majority of respondents (42.26%) had a Master's or equivalent degree, followed by those with a Bachelor's

[2] Average semi-elasticities are derived from the sensitivity analysis of the ANN model according to Hashem (1992), Yeh and Cheng (2010) and Owen (2012).

[3] For a more detailed explanation of the approach, please refer to Hornik (1990), Rumelhart (1986) or Witten (2017).

[4] For a more detailed description of the approach, please see Niklas and Rinke (2020).

Table 1. Descriptive statistics for important model variables (Source: authors).

Variable name	Mean	SD	Variable coding
Age group	3.04	1.70	Age ranging from 18-24 years =1 to >75 years = 7
Gender	0.54	0.50	0 = male, female = 1
Education Group	4.65	1.89	Education ranging from High School = 1 to Doctorate = 7
Yearly income group	3.24	2.00	Yearly income ranging from <20,000 = 1 to >165,000 = 11
Average price paid per bottle	8.99	4.96	Average price in €
Annual expenditure on wine in €	725	2,060	Annual expenditure in €
How often do you buy certified food	3.84	1.13	1-6 (1 = never, 6 = always)
Knowledge of Wine	2.85	1.57	1-6 (1 = very little knowledge, 6 = wine expert)
Days of Winery visits per year	3.64	8.79	Visits in days
Importance of Eco-Certification	3.99	1.60	1-7 (1 = no importance, 7 = very high importance)
Importance of Expert Rating	2.87	1.32	1-7 (1 = no importance, 7 = very high importance)
Importance of Place of Origin	5.78	1.28	1-7 (1 = no importance, 7 = very high importance)
Heard of Biodynamic before	0.67	0.47	0 = No, 1 = Yes
Heard of Fairtrade before	0.55	0.50	0 = No, 1 = Yes
Heard of Natural before	0.58	0.50	0 = No, 1 = Yes
Heard of Organic before	0.94	0.24	0 = No, 1 = Yes
Heard of Sustainable before	0.34	0.47	0 = No, 1 = Yes
Bought Biodynamic before	0.49	0.50	0 = No, 1 = Yes
Bought Fairtrade before	0.12	0.33	0 = No, 1 = Yes
Bought Natural before	0.33	0.47	0 = No, 1 = Yes
Bought Organic before	0.82	0.39	0 = No, 1 = Yes
Bought Sustainable before	0.15	0.35	0 = No, 1 = Yes
Importance of certification Biodynamic	2.95	1.26	1-5 (1 = not at all important, 5 = extremely important)
Importance of certification Fairtrade	2.99	1.12	1-5 (1 = not at all important, 5 = extremely important)
Importance of certification Natural	2.84	1.24	1-5 (1 = not at all important, 5 = extremely important)
Importance of certification Organic	3.27	1.24	1-5 (1 = not at all important, 5 = extremely important)
Importance of certification Sustainable	3.09	1.17	1-5 (1 = not at all important, 5 = extremely important)
WTB Biodynamic	0.65	0.48	0 = No, 1 = Yes
WTB Fairtrade	0.70	0.46	0 = No, 1 = Yes
WTB Natural	0.63	0.48	0 = No, 1 = Yes
WTB Organic	0.78	0.41	0 = No, 1 = Yes
WTB Sustainable	0.63	0.48	0 = No, 1 = Yes
WTP Biodynamic	2.80	0.97	Categories ranging from no price premium = 1 to > 13 € = 6
WTP Fairtrade	2.77	0.94	Categories ranging from no price premium = 1 to > 13 € = 6
WTP Natural	2.64	1.03	Categories ranging from no price premium = 1 to > 13 € = 6
WTP Organic	2.82	0.92	Categories ranging from no price premium = 1 to > 13 € = 6
WTP Sustainable	2.61	0.99	Categories ranging from no price premium = 1 to > 13 € = 6

degree (16.32%) and those with a High school certificate (13.81%). On average, the respondents usually pay 8.99 € per bottle of wine, spend about 724 € per year on wine, and visit a winery 3.64 times per year. With regard to preferences, respondents articulate a high importance of the Place of Origin (5.78 on a 1-7 scale), an above average importance of SD certifications in general (3.99) and, interestingly, lower importance of expert ratings (2.87). 94% of the respondents had heard of and 82% had bought Organic wine previously, while the numbers are lower for all other certifications: Biodynamic (67%/49%), Fairtrade (55%/12%), Natural (58%/33%) and Sustainable (34%/15%). The importance of the certification ranges from 3.27 for Organic, 3.09 for Sustainable, 2.99 for Fairtrade, 2.95 for Biodynamic, to 2.84 for Natural. 78% of the respondents say that they are willing to buy an Organic wine, 70% a Fairtrade wine, 65% a Biodynamic wine, and 63% a Natural or Sustainable wine.

The WTP categories are quite similar for all certifications, representing an average WTP of 2.56 € for Sustainable, 2.71 € for Natural, 2.92 € for Fairtrade, 3.03 € for Organic and 3.07 € for Biodynamic wine (see fig-

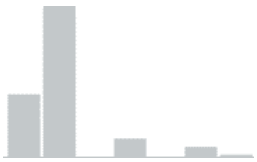
Attribute	Distribution	Mean	Std. Dev.	Min.	Max.
Average Price Premium Biodynamic		3.07	0.87	0	13.5
Average Price Premium Organic		3.03	0.87	0	13.5
Average Price Premium Fairtrade		2.92	0.91	0	13.5
Average Price Premium Natural		2.71	1.00	0	13.5
Average Price Premium Sustainable		2.56	1.04	0	13.5

Figure 2. Mean, standard deviation, minimum and maximum of bids per wine certification (Source: authors).

ure 2), but the differences in means are still significant according to the Kruskall Wallis H-test[5], so that it is interesting to analyze the determinants of the WTB and WTP for the respective certifications.

5.2 Logistic regression

First, the correlation matrix of the most important independent variables was checked and with only two values being higher than 0.3 but still below 0.5, correlations and multicollinearity were not considered to be a problem. With the dependent variable being a binary response variable, both probit and logistic models are optional approaches to analyze the impact of various independent variables on the WTB a certified wine[6]. To evaluate the goodness of fit of both probit and logistic models, the pseudo Mc Fadden's R2 revealed that they have very similar degrees of efficiency in explaining the WTB, but we favor the logistic approach as it can be readily transformed to the odds ratio. The general model can be described as follows:

WTB_{ij} = f (socio economic characteristics of consumers, wine knowledge, wine purchasing and consumption patterns, knowledge and importance of certifications, purchasing behavior with regard to certified wine and food)[7]
For each label j=1,…,5 and i respondents

The answer to the WTB question is coded as 1 if the response indicates a 'yes' and 0 if it indicates a 'no'. Table 2 only shows significant variables of the logistic regression for WTB. These results suggest that the probability to buy a certified wine is significantly enhanced by the 'importance' the consumer attaches to a label and ranges from a higher probability of 2.31 for Organic up to 3.24 times for Sustainable wines which is in line with general household theory, as wine consumers seem to buy wine according to their respective preferences (Varian, 2010).

The variable 'Heard of certification' is also significant for Biodynamic and Sustainable labels. The probability to buy Organic, Natural, and Fairtrade wines is higher for consumers who often buy certified food in general. This result supports suggestions that households have a similar behavior with regard especially to organically certified food and wine (Di Vita et al., 2019). For Fairtrade, the variable 'Bought this certification before' changes the probability significantly. Here, being an experience good is important for wine, because those who have experienced a Fairtrade wine before seem to like it and purchase it again.

5.3 ANN model

The 'WTP' answers in the survey are coded from 1 to 6 into categories, from 'no WTP' to a very high WTP. For each label, dependency factors and semi-elasticities are calculated as described in the methodology section and, in Table 3, those results with a high importance for

[5] A Kruskal-Wallis H test was conducted to determine if the average price premium was different for the five certificates: Biodynamic (n = 205), Fairtrade (n = 211), Organic (n = 229), Natural (n=221) and Sustainable (n=204). The Kruskal-Wallis H test showed that there was a statistically significant difference in the average price respondents are willing to pay, $\chi^2(2) = 10.850$, $p = 0.0283$.

[6] The approaches differ only with regard to the distribution of the errors. While the logistic model assumes a cumulative logistic distribution function, the probit model assumes a cumulative normal distribution function. Both are estimated by maximum likelihood, the results hardly differ (Horowitz and Savin, 2001).

[7] For a more detailed overview of the variables, please see table 1.

Table 2. Results of the Logistic Regression (Source: authors).

	WTB Biodynamic	WTB Organic	WTB Fairtrade	WTB Sustainable	WTB Natural
Bought certification before	1.951981 0.98	1.142199 0.16	**4.828255*** **2.12**	1.195554 0.23	2.139022 1.18
How often do you buy certified food	1.540636 1.5	**2.115084**** **2.88**	**1.754584**** **2.61**	1.306585 1.33	**1.664622*** **2.4**
Expenditure/Year in €	0.999916 -0.44	0.9998272 -0.95	1.00008 0.43	0.9996783 -1	**1.000337*** **2.02**
Heard of certification before	**7.778052**** **3.24**	1.607506 0.49	1.621343 1.23	**2.379079*** **2.06**	2.154973 1.73
Importance certification	**2.854495***** **3.84**	**2.305237***** **4.67**	**2.359608** **4.97**	**3.235772***** **7.01**	**2.940351***** **6.32**
N	225	225	225	225	225
pR^2	51.6	38.11	28.39	35.21	37.93

Table 3. Results of the ANN (Source: authors).

	WTP Biodynamic		WTP Organic		WTP Fairtrade		WTP Sustainable		WTP Natural	
	dependency	avg. dy/dx	dependency	avg. dy/dx	dependency	avg. dy/dx	dependency	avg. dy/dx	dependency	avg. dy/dx
Average price per bottle in €	0,281	0,172	**0,889**	**0,366**	**0,709**	**0,554**	**0,801**	**0,113**	**0,752**	**0,124**
Bought certification before	**0,720**	**-0,127**	0,410	-0,160	0,385	0,112	**0,963**	**-0,469**	0,554	-0,030
Customer education	0,410	0,080	0,361	0,068	**0,724**	**-0,211**	0,510	-0,352	0,321	-0,225
Customer age group	0,604	-0,179	**0,805**	**-0,170**	**0,706**	**-0,325**	**0,831**	**-0,285**	**0,718**	**-0,198**
Days of winery visits	0,367	-0,013	**0,841**	**-0,579**	0,513	0,161	**0,889**	**0,321**	**0,921**	**-0,043**
Expenditure/year in €	**1,000**	**0,840**	**0,889**	**0,466**	0,295	0,129	0,595	-0,065	**1,000**	**-0,165**
Importance certification	**0,799**	**0,316**	**1,000**	**0,253**	**1,000**	**0,637**	**1,000**	**0,674**	**0,843**	**0,405**
Importance eco-certification in general	0,636	0,187	**0,771**	**0,059**	0,404	0,090	0,511	0,382	0,655	0,223
Importance expert opinion	0,245	0,049	0,696	0,029	**0,736**	**0,151**	0,688	0,319	0,596	0,000
Importance PoO	0,687	0,095	**0,740**	**0,033**	0,431	-0,121	**0,732**	**0,467**	0,384	0,108
Knowledge about certification	**0,772**	**-0,018**	0,236	0,097	0,244	-0,105	0,472	-0,124	0,471	0,165
N	149	179	154	140	140					
R2	0,894	0,920	0,922	0,956	0,865					

the WTP and the respective semi-elasticities are highlighted in bold numbers.

For Biodynamic wine, the average expenditure per year on wine in general is the most important variable for the WTP, showing the more they spend on wine, the higher the WTP for Biodynamic wine, and those who judge the certification as being important as well have a positive WTP. Knowledge about the certification and the variable 'Bought certification before' perform a negative influence which suggests some bad experiences and that the Biodynamic wines did not meet consumer expectations. Biodynamic is the only certification where the results do not show an important difference for age groups, nonetheless, the younger the respondents the higher the WTP. The WTP is hardly influenced by the average price that respondents usually pay for a wine bottle.

For Organic wine, again the average expenditure per year on wine in general and the importance of the certification (and additionally of eco-certifications in general) are important variables for the WTP. This is in line with the literature which shows that Organic is the strongest label and the most visible one for consumers. Another important variable with a positive impact on the WTP is the average price that the respondents usually pay for a wine bottle and, to a lesser degree, the 'Place of origin'. As for all other wines (except for Biodynamic), the younger the respondents the higher the WTP. The only variable that has a negative influence is 'Days of winery

visits', which is a little surprising but is supported by the results for Natural wine and, with lesser importance, Biodynamic wine. If we assume that visiting wineries means to learn more (Bazoche et al., 2008), this might be due to some negative experiences during the visit or – that by accident as we do not have a random sample – respondents visited more wineries offering 'non-certified' or Sustainable or Fairtrade wines.

For Fairtrade wine, the importance of the certification is again the most important variable for the WTP. As in the case of Organic, there is a positive impact of the average price that the respondents usually pay for a bottle of wine on the WTP. Fairtrade is the only certification where expert opinion is important for the WTP. As wine is an experience good, consumers tend to obtain information on quality and study expert opinions. Again, the younger the respondents, the higher the WTP. This impact is stronger for Fairtrade wines compared to all other labels. Fairtrade is also the only label for which education performs an important and negative impact on the WTP. One explanation might be that those being higher educated know more about fair trade and are aware of the fact that it focuses more on social than environmental aspects, with the latter being more favored by this consumer group.

For Sustainable wine, the importance of the certification is again the most important variable for the WTP. As in the case of Organic and Fairtrade, there is a positive impact of the average price that the respondents usually pay for a bottle of wine on the WTP. This holds also for the variables 'Place of Origin' and 'Days of winery visits'. This means that they had good experiences when visiting and they link 'sustainable' to this experience. When consumers only 'Bought the certification before', the WTP is lower, which means that if they just buy a bottle their WTP is lower and are disappointed when not linking the label with the experience of the winery visit. The younger the respondents the higher the WTP.

For Natural wine, the importance of the certification and the average price that the respondents usually pay for a bottle of wine have a positive impact on the WTP and the younger the respondents, the higher the WTP. Those respondents with high annual expenditures on wine – even if they have a WTB – don't want to pay higher premiums for Natural wine. The same holds for those who have many annual winery visits.

6. DISCUSSION AND CONCLUSIONS

The wine industry is facing major environmental challenges and a growing concern among consumers about environmental and SD issues can be observed (Casini et al., 2009; Schimmenti et al., 2016; Vecchio, 2013). On the other hand, we know little about consumers' preferences relating to a growing number of different sustainable certifications that serve as producers' signals of sustainable attributes. Extant studies focus either on Organic wine, show contradictory results, or fail to compare different sustainable labels. Our paper seeks to fill this gap by comparing five different labels and to show commonalities and differences between labels with regard to determinants for WTB and WTP.

The WTB analysis shows that the respondents who judge the certification important have a higher probability of buying a wine possessing this certification, irrespective of the certification. Further, this holds true for those who regularly buy certified food (for Organic, Fairtrade and Natural wines) and have heard of the certification before (for Biodynamic and Sustainable wines). Those who have bought Fairtrade wine before will tend to buy it again.

Additionally, our WTP analysis shows which determinants impact respondents' WTP for a certified wine. The results of the ANN model suggest that the importance consumers attach to a label positively influences their WTP. The higher the importance they give to a label, the higher the WTP, irrespective of which label it is. The average price usually paid for a bottle of wine also positively influencing WTP (expect for Biodynamic wine). In general, the younger the customers are, the higher their WTP. In addition, those with higher expenditures per year on wine have a higher WTP, but only for Biodynamic and Organic certified wines.

These findings highlight two main and robust results. First, the importance that consumers give to the certifications influences their WTB and WTP, irrespective of the SD label, showing the importance of their personal values and knowledge about the certifications. Second, the drivers differ for each SD label, meaning that consumers behave differently with regard to their purchasing decisions for each label. This confirms the interest in having different SD labels or certifications representing different kinds of social and environmental practices, giving producers a reason to engage in sustainable practices and the need to signal these on the label. Thus, we open a new direction for further investigations with regard to marketing and policy implications to better promote SD wines as, with more information, producers will be able to better choose an appropriate strategy (Mariani and Vastola, 2015). These results could also have further implications with the development of online purchasing (and online communication from the supply side) and

crowdfunding campaigns as a new form of early purchase (Bargain et al., 2018).

There are some methodological limitations to our study. There is still a chance that people taking part in such surveys seek to satisfy social norms more than their true preferences (Fischer and Katz, 2000). The method directly eliciting WTP for attributes without forcing respondents to make trade-offs between product attributes (e.g., product price vs. organic) can result in invalid and unrealistically high attribute importance (Louviere and Islam, 2007). Further, we cannot prove to which reference price respondents relate their price mark-ups; it is possible that respondents refer their respective answers to other prices than those given in response to the question on their average wine purchase price (Islam et al., 2007). Additionally, as this was a convenience rather than a random sample, the results cannot be assumed to be representative of French wine consumers in general. We did not have the chance to develop experimental economics (no tasting) or a real market in our survey. However, this remains an interesting approach that could confirm the precision of our results under experimental conditions. In this case, it would be interesting to control for conventional (i.e. non-certified) wines.

REFERENCES

Alonso Ugaglia, A., Cardebat, J.M., Jiao, L. (2019). The French wine industry (Chap.2), in: A. Alonso Ugaglia, J.M. Cardebat and A. Corsi (Eds.), *The Palgrave Handbook of Wine Industry Economics*, Palgrave Macmillan, Cham, pp. 17-46.

Alonso Ugaglia, A., Cardebat, J.M., Dupuy, L., Sloop, S. (2017). Sustainability certifications in the wine industry: what are the drivers for adoption? *INFER conference*, *Wine sustainability* 1-2 September, Pescara, Italy.

Amato, M., Ballco, P., Lopez-Galan, B., De Magistris, T., Vernau, F. (2017). Exploring consumers' perception and willingness to pay for "non-added sulphite" wines through experimental auctions: A case study in Italy and Spain, Wine Economics and Policy, 6(2), 146-154. doi: 10.1016/j.wep.2017.10.002.

Ashenfelter, O., Gergaud, O., Storchmann, K., Zimb, W. (Eds) (2018). *World Scientific Reference on Handbook of the Economics of Wine*, Volume 1. Prices, Finance and Expert Opinion, World Scientific Handbook in Financial Economics Series, vol. 6. Singapore and Hackensack, NJ: World Scientific.

Ashton, R.H. (2014). Wine as an experience good: price versus enjoyment in blind tastings of expensive and inexpensive wines, *Journal of Wine Economics*, 9(2), 171-182.

Baker, R., Ruting, B. (2014). *Environmental Policy Analysis: A Guide to Non-Market Valuation, Productivity*, Commission Staff Working Paper, Canberra.

Bargain, O., Cardebat, J.M., Vignolles, A. (2018). Crowdfunding in the wine industry, *Journal of Wine Economics*,13(1), 57-82.

Bazoche, P., Deola, C., Soler, L.G. (2008). An experimental study of wine consumers' willingness to pay for environmental characteristics, *European Association of Agricultural Economists (EAAE) 2008 International Congress*, August 26-29, 2008, Ghent, Belgium. doi: 10.22004/ag.econ.4365.

Cardebat, J.M. (2017). Économie du vin, Ed. La Découverte, Paris, 128 p.

Carson, R.T., Louviere, J.J. (2011). A Common Nomenclature for Stated Preference Approaches, *Environmental and Resource Economics*, 49(4), 539-59.

Christ, K., Burritt, R. (2013). Critical environmental concerns in wine production: an integrative review, *Journal of Cleaner Production,* 53, 232-242.

Delmas, M.A., Gergaud, O. (2021). Sustainable practices and product quality: Is there value in eco-label certification? The case of wine, *Ecological Economics*, 183, 106953. doi: 10.1016/j.ecolecon.2021.106953.

Di Vita, G., Pappalardo, G., Chinnici, G., La Via, G., D'Amico, M. (2019). Not everything has been still explored: Further thoughts on additional price for organic wine. *Journal of Cleaner Production*, 231, 520-528.

IWSR (2019). *Organic Wine Report*, 2019. Available at https://www.theiwsr.com/organic-wine-report/ (Accessed on 29/04/2021).

Farsi, M. (2007). Risk-Aversion and Willingness to Pay in Choice Experiments, ETH-Zürich, CEPE Working Paper No. 55 / February 2007.

Forbes, S.L., Cohen, D.A., Cullen, R., Wratten, S.D., Fountain, J. (2009). Consumer attitudes regarding environmentally sustainable wine: an exploratory study of the New Zealand marketplace, *Journal of Cleaner Production* 17, 1195-1199.

Freeman I.I.I., A.M., Herriges, J.A., Kling, C.L. (2014). *The Measurement of Environmental and Resource Values: Theory and Methods,* RFF Press: Routledge.

Gabrielyan, G., Marsh, T.L., McCluskey, J.J., Ross, C.F. (2018). Hoppiness is Happiness? Under-fertilized Hop Treatments and Consumers' Willingness to Pay for Beer, *Journal of Wine Economics*, 13(2), 160-181.

Galati, A.G., Schifani, M. Crescimanno, G., Migliore, G. (2019). "Natural Wine" consumers and interest in label information: An Analysis of Willingness to

Pay in a New Italian Wine Market Segment, *Journal of Cleaner Production*, 227(1), 405-413.

Gow, J., Moscovici, D., Rezwanul, R., Mihailescu, R., Alonso Ugaglia, A., Valenzuela, L., Rinaldi, A., Coelli, R., 2020. Consumer Willingness to pay for environmental characteristics of Australian wine, *AAWE Working paper.*

Hanemann, W.M., (1984). Welfare evaluations in contingent valuation experiments with discrete responses, *American Journal of Agricultural Economics*, 66, 332-341.

Hashem, S., (1992). Sensitivity for feetforward artificial neural networks with differentiable activation functions, *Proceedings of the international joined conference on neural networks*, Baltimore, USA, 419-424.

Hornik, K., Stichcombe, M., White, H. (1990). Universal approximation of an unknown mapping and its derivatives using multilayer feedforward networks, *Neural Networks*, 3, 551-560.

Horowitz, J.L., Savin, N.E. (2001). Binary Response Models: Logits, Probits and Semiparametrics, *Journal of Economic Perspectives*, 15(4), 43-56.

Kealy, M.J., Turner, R.W. (1993). A test of the equality of closed-ended and open-ended contingent valuations, *American Journal of Agricultural Economics,* 75, 321-331.

Lee, D., Derrible, S., Pereira, F.C. (2018). Comparison of Four Types of Artificial Neural Network and a Multinomial Logit Model for Travel Mode Choice Modeling, *Transportation Research Record*, 2672(49), 101-112. doi: 10.1177/0361198118796971.

Louviere, J.J., Hensher, D.A., Swait, J.D. (2000). *Stated Choice Methods. Analysis and Application*, Cambridge: Cambridge University Press.

Manderson, A.K. (2006). A systems-based framework to examine the multi- contextual application of the sustainability concept, *Environment, Development and Sustainability,* 8(1), 85-97.

Marette, S. (2014). Economics benefits coming from the absence of labels proliferation, *Journal of Agricultural and Food Industrial Organization,* 12, 65–73. doi: 10.1515/jafio-2013-0014.

Mariani, A., Vastola, A. (2015). Sustainable winegrowing: Current perspectives, International Journal of Wine Research, 7(1), 37-48. doi: 10.2147/IJWR.S68003.

Mihailescu, R., Hecht, K. (2015). Is there a scope for Organic wine tourism development? A focus on South African wine industry, *Revista Di Scienze Del Turismo,* 6(1-2), 1-11.

Mitchell, R.C., Carson, R.T. (1989). *Using Surveys to Value Public Goods: The Contingent Valuation Method*, Washington, D.C.: Resources for the Future.

Mc Donald, J.B., Saliba, A., Bruwer, J. (2013). Wine choice and drivers of consumption explored in relation to generational cohorts and methodology, *Journal of Retailing and Consumer Services*, 20(3), 349-357.

Mogas, J., Riera, P., Bennett, J. (2002). A Comparison of Contingent Valuation and Choice Modelling: estimating the environmental values of Catalonian Forests. *Occasional Paper No. 1, National Centre for Development Studies*, Australian National University, Canberra, Australia.

Mohammadian A., Miller E.J., 2002. Nested logit models and artificial neural networks for predicting household automobile choices: comparison of performance, *Transportation Research Record: Journal of the Transportation Research Board*, 1807(1). doi: 10.3141/1807-12.

Moscovici, D., Rezwanul, R., Mihailescu, R., Gow, J., Alonso Ugaglia, A., Valenzuela, L., Rinaldi, A., 2020. Preferences for eco certified wines in the United States, *International Journal of Wine Business Research*, 23. doi:10.1108/ijwbr-04-2020-0012.

Moscovici, D., Reed, A. (2018). Comparing Wine Sustainability Certifications around the World: History, Status, and Opportunity, *Journal of Wine Research*, 29(1), 1-25.

Nelson, P. (1970). Information and consumer behavior. *Journal of Political Economy*, 78(2), 311-329.

Niklas, B., Storchmann, K., Vink, N. (2017). Fairtrade Wine Price Dispersion in the United Kingdom, *Journal of Wine Economics*, 12(4), 446-456.

Niklas, B., Rinke, W. (2020). Pricing Models for German Wine: Hedonic Regression vs. Machine Learning, *Journal of Wine Economics,* 15(3), 284-311. doi:10.1017/jwe.2020.16.

OIV, 2017. *Prospective filière française des vins biologiques,* Les Études FranceAgriMer, FranceAgriMer Vin, April 2017, 199p.

Owen, G.W. (2012). Applying point elasticity of demand principles to optimal pricing in management accounting, *International Journal of Applied Economics and Finance*, 6, 89–99.

Paloviita, A. (2010). Consumers' Sustainability Perceptions of the Supply Chain of Locally Produced Food, *Sustainability,* 2, 1492-1509.

Poelmans, E., Rousseau, S. (2017). Beer and Organic Labels: Do Belgian Consumers Care?, *Sustainability*, 9(9), 1509-1523.

Porter, M., Takeuchi, H. (2013). *The French Wine Cluster*, Microeconomics of Competitiveness, Harvard Business School, Winter 2013, 33p.

Pullman, M., Maloni, M., Carter, C. (2009). Food for thought: Social versus environmental sustainabil-

ity practices and performance outcomes, *Journal of Supply Chain Management*, 45(4), 38-54.

Remaud, H., Mueller, S., Chvyl, P., Lockshin, L. (2008). Do Australian Wine Consumers Value Organic Wine?, *International Conference of the Academy of Wine Business Research*. Refereed paper, Siena, Italy.

Rinke, W. (2015). Calculating the dependency of components of observable nonlinear systems using artificial neural networks, *MakeLearn & TIIM conference proceedings*, 367-374. Available from: https://EconPapers.repec.org/RePEc:tkp:mklp15:367-374.

Rumelhart, D.E., Hinton, G.E., Williams, R.J. (1986). Learning representations by backpropagating errors, *Nature*, 323, 533-536.

Sellers-Rubio, R., Nicolau-Gonzalbez, J.L. (2016). Estimating the willingness to pay for a sustainable wine using a Heckit model, *Wine Economics and Policy*, 5(2), 96-104.

Shavlik, J.W., Diettrich, T.G. (eds.) (1990). *Reading in Machine Learning*, San Mateo, CA: Morgan Kaufmann.

Skuras, D., Vakrou, A. (2002). Consumers' willingness to pay for origin labelled wine - Greek case study, *British Food Journal*, 11, 898-912.

Stone, P., Brooks, R., Brynjolfsson, E., Calo, R., Etzioni, O., Hager, G., Hirschberg, J., Kalyanakrishnan, S., Kamar, E., Kraus, S., Leyton-Brown, K., Parkes, D., Press, W., Saxenian, A., Shah, J., Tambe, M., Teller, A. (2016). *Artificial intelligence and life in 2030. One hundred years study on artificial intelligence: Report of the 2015-2016*, Study Panel, 8. Available from: https://ai100.stanford.edu/sites/default/files/ai100report10032016fnl_singles.pdf.

Szolnoki, G. (2013). A cross-national comparison of sustainability in the wine industry, *Journal of Cleaner Production,* 53, 243-251.

Tach, E.C., Olsen, J.E. (2006). Market segment analysis to target young adult wine drinkers, Agribusiness, 22(3), 307-322.

Tozer, P.R., Galinato, S.P., Ross, C.F., Miles, C.A., McCluskey, J.J. (2015). Sensory Analysis and Willingness to Pay for Craft Cider, *Journal of Wine Economics*, 10(3), 314-328.

Tran V.H., Takumi A., Mikiharu A. (2019). Determination of the influence factors on household vehicle ownership patterns in Phnom Penh using statistical and machine learning methods, *Journal of Transport Geography*, 78(2019), 70-86. doi: 10.1016/j.jtrangeo.2019.05.015.

Trienekens, J.H., Wognum, P.M., Beulens, A.J.M., van der Vorst, J.G.A.J. (2012). Transparency in complex dynamic food supply chains, *Advanced Engineering Informatics*, 26, 55-65.

Valenzuela, L., Moscovici, D., Mihailescu R., Alonso Ugaglia, A., Gow, J., Rinaldi, A. (2019). Wine consumers market sustainability: an international study, *13th Annual AAWE Conference*, 14-18 July, Vienna, Austria.

Varian, H.R. (2010). *Intermediate Microeconomics. A Modern Approach*, 78th Edition. New York, USA, W.W. Norton & Company, 73-89.

Vecchio, R. (2013). Determinants of Willingness-to-Pay for Sustainable Wine: Evidence from Experimental Auctions, *Wine Economics and Policy,* 2(2), 85-92.

Vecchio, R., Annunziata, A. (2015). Willingness-to-pay for sustainability-labelled chocolate: an experimental auction approach, *Journal of Cleaner Production*, 86, 335-342.

Witten, I., Eibe F., Hall, M. (2017). *Data mining – practical machine learning tools and techniques*, 4th Edition. New York, USA, Morgan Kaufmann, 261-269.

Yeh, I.C., Cheng, W.L. (2010). First and second order sensitivity analysis of ML, *Neurocomputing*, 73, 2225–2233.

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Wine ratings and advertising strategies: is there a link?

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Abstract. Advertising is one of the most widely used marketing resources in the beverage industry, yet the wine industry has not made an intense use of this resource over time. The small average size of wineries together with rising concerns about the effectiveness of advertising has led many wineries to use alternative strategies to market their products: collective brands, the display of prizes and medals on their labels, or positive ratings in expert guides. In this sense, the objective of the present study was to analyse the behaviour of wineries regarding their use of advertising as a marketing resource. Specifically, we analysed the advertising strategy of wineries with respect to the existence of publicly available wine ratings. The method was based on the estimation of a Heckit model that simultaneously identifies the variables underlying the decision to invest in advertising and the determinants of the amount of money invested. The results revealed a nonlinear relationship between wine ratings and advertising investment.

Keywords: advertising, Heckit model, wine ratings, winery.

1. INTRODUCTION

Food and beverage companies resort to different strategies to promote their products. Among them, advertising is often used to convince consumers to select a specific product over that of competitors, communicating positive and persuasive information about the company and its products to the target market. In fact, advertising can enhance brand awareness [1], brand equity [2] and create a reputation premium, enabling the price of an advertised brand to be higher than that of competing products with the same characteristics [3]. Furthermore, advertising can discourage potential competitors to enter the market [4]. When a firm has a strong market position, an effective use of advertising can be helpful to charge higher prices and increase profits [5].

Despite its potential benefits, there is some uncertainty in the academic literature as to the effectiveness of advertising [6–8]. Some researchers have raised doubts about the relationship between advertising investment and performance [3,9–11]. Several researchers have even found an absence of a link between advertising investment and sales performance [11–16]. Consequently,

advertising effectiveness is under continuous scrutiny by researchers and practitioners.

In the wine industry, the link between advertising investment and performance is under- researched, and the scarce number of studies that do exist on this topic do not offer conclusive results. On the one hand, [17] provide evidence that advertising might positively impact sales. Their results for the US market show that the advertising of imported wines significantly increases imports for most countries. On the other hand, [18] show that advertising investments are not significantly related to wine sales in the US market at an aggregate level. However, they suggest that in mature markets competition is intense, and firms attempt to increase their revenue and market share through their marketing efforts. The authors can hardly conclude, however, that advertising is the only driver of sales. Indeed, other factors such as brand appeal or discounts may have an impact on sales and revenues.

In Spain, wineries have introduced several marketing and advertising campaigns in the media since the 1980s in order to overcome decreasing domestic demand and growing international competition [19]. The absence of a clear effect, however, of advertising investments on firm performance has led many small wineries to employ alternative marketing strategies, including some which are specific to the wine industry (e.g. fostering high ratings in wine guides). This situation has led to the existence of two different groups of wineries: a first group of wineries that relies on advertising as a powerful marketing strategy (with varying degrees of advertising intensity), and a second group of wineries that do not make these types of investments and rely on alternative strategies. In this paper, we seek to contribute to the literature by exploring the reasons underlying wineries' behaviours. We focus in particular on the effect that wine ratings have on the advertising strategy of Spanish wineries. Wine ratings are frequently used in the wine industry to signal product quality because they represent a useful tool to compensate for information asymmetries between consumers and wineries. Although some authors (e.g. [20–22]) have raised concerns about quality assessment inconsistencies between judges or incoherence by a same judge over time, they still constitute important informative clues for consumers. Indeed, [23] provide evidence that consumers attribute a high credibility to independent expert recommendations. These ratings may, to some extent, affect wineries' advertising strategies.

In this sense, the objective of the present study was twofold. First, we sought to find out the variables that might explain the decision to invest in advertising or not. We propose a model to explain the differences between wineries that do invest in advertising and firms that do not. Furthermore, we tried to explain the amount of money invested in advertising. We focused on the effect that publicly available ratings may have on these strategic advertising decisions. Second, we compared several performance and profitability ratios among these two groups of wineries to assess the effectiveness of advertising investments in the Spanish wine industry.

2. LITERATURE REVIEW

2.1 Advertising effectiveness and the wine industry

In a mature competitive market, firms have different strategies at their disposal to promote their products [24], such as price discounts, vouchers, increasing the amount of sales staff and points of sale, or advertising, which is a major means of appealing to consumers [25]. Through advertising, firms send a message that allows consumers to obtain information about the firm/brand and compare it with that of various competitors to make their purchase decisions. In this sense, firms advertise across several media vehicles, striving to build a cohesive message to increase the individual and joint effect of their investment [26]. Advertising can be used to convince consumers to buy a certain brand instead of that of competitors, to increase consumers' loyalty, and to reduce their sensitivity to price which can ultimately raise a firm's market share [27, 28].

Given their potential benefits, some scholars have focused on estimating the positive effects expected of advertising investments on different performance and profitability ratios. Most of these studies find a positive effect of advertising investments on performance [27, 29–33]. For example, [30] provide evidence of a long-term relationship between advertising spending and market capitalisation. Their results show that advertising has an effect on firms' market capitalisation through its effect on sales and profits. In the same line, [29] state that a productive firm should be able to expand its market share through advertising. However, some studies have failed to find a clear relationship between advertising and performance [3, 10, 30] or have even found no link at all between these variables [12, 14–16, 34].

Several explanations have been given to these contradictory results. For example, [34] suggest that advertising effectiveness may differ between expansion and contraction economic periods. They show that advertising investment during recessions may lead to more financial outcomes (e.g. sales) than advertising investment dur-

ing periods of growth. According to other authors, it is reasonable to expect that not all companies will reap the same benefits from advertising. Thus, [35] claim that the relationship between advertising and performance is not straightforward and other factors, such as advertising intensity or firm size might moderate this relationship. Indeed, certain authors [35–38] have found that bigger firms make a more intense use of advertising and obtain higher returns than smaller firms. In the same line, [33] point out that advertising has a moderate influence on sales in the short and long term. Advertising should thus be considered an adaptive learning process that may take some time to be noticed. [39] provide evidence of robust positive effects of advertising but stress the need to consider the originality and creativity of advertising, as the effects are stronger for high-involvement products compared to low-involvement products.

In the beverage industry, most of the previous literature has focused on analysing the effect of advertising on alcohol consumption at an aggregate level. Contrary to what could be expected a priori, most of the studies found no effect of advertising on total alcohol consumption [40]. However, a recent study [41] suggests a tiny yet consistent positive correlation between alcohol advertising exposure (wine, beer and spirits) and drinking behaviour.

In the specific case of the wine industry, few studies have estimated the effect of advertising on wine consumption, and the scarce number of studies in this area that do exist do not offer conclusive results. On the one hand, [17] illustrate how advertising might have a positive effect on sales in the US market. They show that advertising of imported wines significantly increases the quantity of imports for most countries. On the other hand, [18] show that advertising investments are not significantly related to wine sales in the US market at an aggregate level. However, they do suggest that in mature markets competition among firms is intense. Although firms strive to increase their revenue and market share through marketing efforts, it would be highly unrealistic to suggest that advertising is the only sales driver. Indeed, other promotional activities (e.g. price discounts) may also have an impact on sales, so it would be difficult to precisely determine the effect of advertising on sales without considering these issues. [42] examine advertising effectiveness from the perspective of advertising productivity, showing that it is greater in the case of wineries associated with a collective brand than for non-associated wineries. Their results also indicate that advertising productivity is higher in the case of brands with a better firm reputation, and this result is moderated by the degree of competition.

In the Greek market, [43] show that firms' promotions offering information about the origin and other specific wine attributes, free samples, leaflets or new market channels through "wine routes" are more effective than advertising. Furthermore, according to their results, promotional expenses along with market share affect profitability.

Based on a different perspective, [44] focused on advertising creativity and examined the potential effectiveness of advertising targeted towards Millennials. They showed that current wine advertising is not appealing to this market segment, who would prefer wine advertisements based on fun, social, and relaxed settings. Similarly, [45] found that wine brands should focus their advertising on the social aspects of wine when trying to reach Millennials. In the same line, [46] examine the contents of wine advertising (types of photographs) and their effect on the adoption of technological solutions in this field.

Eventually, [47] have estimated the relationship between advertising investment and reputation in the framework of companies that belong to a collective brand in the Spanish wine industry and invest in advertising. Their results evidence a curvilinear relationship between advertising investment and reputation. Besides, results also show that the market share of the winery negatively moderates this relationship. To some extent, our paper expands this previous article as our sample includes wineries that invest in advertising but also wineries that do not invest in advertising.

2.2 Wine quality and advertising investment: the role of wine ratings

The link between quality and advertising investment is a major marketing issue [48] as advertising investment can be informative about product quality. But the complexity of this theoretical relation shows that a clear relationship between quality and advertising investment has in fact not been demonstrated in past research [49].

On the one hand, the signalling theory [50] indicates a positive relationship between quality and advertising investment in the case of experience goods [48] because firms that produce high-quality products might use advertising to signal to consumers their commitment to quality [51, 52]. For example, [53] found that advertising can be a useful signal to improve consumers' evaluations of advertised products. On the other hand, firms with low-quality products may also use advertising to compensate for the loss of quality as advertising differentiates products and reduces demand cross-elasticities. Following this reasoning, product quality and

advertising investment would present a negative association [27, 54]. Indeed, the seminal study by [55] suggests a negative relationship, since a high degree of advertising intensity may be used to increase consumer preferences for low quality products [27]. [56] provides a review that shows how different studies offer conflicting evidence in support of these contradictory viewpoints.

In the case of experience products, quality is very difficult to assess before consumption and alternative theoretical approaches consider the link between quality and advertising investment, focusing on reputation. When consumers are not able to assess quality before their purchase, some extrinsic cues may in fact act as a proxy of quality [57, 58]. For example, in the wine industry, price has played a traditional role as a proxy of wine quality [59]. At the same time, the brand (commercial brand and collective brand like a denomination of origin [60]) may have a role in this sense. In this paper we focus on the potential effect of firm and product reputations. However, prior evidence has also revealed conflicting results. Some studies find a positive association when quality ratings are published and widely disseminated (e.g., [51]). In the same line, [53] illustrate how more highly rated experience products are found to be advertised more. This evidence is consistent with the company reputation model of [52] that assumes that reputation has a positive effect on advertising because firms with high quality products use advertising to inform consumers of their commitment to quality [51]. Conversely, [49] show that available online ratings have a negative effect on advertising investment as firms with higher ratings invest less in advertising, suggesting that reputation through ratings might act as a substitute for advertising investment.

Based on the reasoning above, we adopted in this study the integrated view of [48] according to which a non-linear link exists between quality and advertising investment. In this sense, we propose the following hypothesis:

H1a. Publicly available wine ratings affect the likelihood of investing in advertising.
H1b. Wine ratings have a nonlinear effect on the amount of money invested in advertising.

3. METHOD AND DATA

3.1 Method

A Heckit model estimation was conducted to explain the advertising strategy of wineries. This model was originally developed by [61, 62], and its main advantage is to avoid sample selection bias, which involves the incidental truncation that arises when the dependent variable is observed only if other variables take on particular values [63]. Under the Heckit model the dependent variable is only observable for a portion of the data, and this model permits the error terms to co-vary. Thus, in our context, the model decomposes a winery's advertising strategy into two stages: the decision to invest in advertising (or not) and the amount of money invested. The model has been previously used in the wine industry to test the willingness to pay for sustainable wines [64]. The resulting two-equation model was as follows:

$$d_{i^*} = \sum^{R}_{r=1} \gamma_r \, W1_{ir} + u_i \quad (1)$$

$$Inv_i = \sum^{S}_{s=1} \beta_s \, W2_{is} + \varepsilon_i \text{ observed only if } d_{i^*} > 0 \quad (2)$$

where $W1_{ir}$ is a vector of r variables related to winery i that determine the decision to invest in advertising d_i, and g_r are the associated parameters. The d_i variable is binary, with a unitary value when the latent variable is above zero ($d_{i^*}>0$), and zero otherwise. $W2_{is}$ is a vector of s variables related to winery i associated with the decision regarding the amount of money invested (Inv_i), and b_s reflects the effect of these variables on this decision. It is worth noting that the log-transformation is applied to the dependent variable Inv_i, thus semi-elasticities are obtained directly from the parameters. The error terms u_i and e_i follow a bivariate standard normal distribution, and standard deviations s_u and s_e, and covariance s_{eu}. Full information maximum likelihood is used to obtain the parameter estimates. To test the effect of wine ratings on advertising spending, two different models were estimated, including linear (Model 1) and quadratic (Model 2) effects separately. To implement this methodology, we use the *sampleSelection* library of the statistical package R [65].

3.2 Sample and variables

The hypotheses were tested within the framework of the Spanish wine industry. For the sample selection we use the population of wineries included in the 1102 section of CNAE-2009, which is the equivalent of code 2084 of the US SIC classification (wines, brandy and brandy spirits), and is found in the Bureau Van Dijk database. From the initial sample we discarded companies with missing values in any of the relevant variables. Besides, to ensure the homogeneity of the sample, we excluded wineries that mainly produce brandy and other distilled high alcohol products. Following this procedure, the final sample comprised a total of 835 winer-

ies, operating between 2004 and 2014, and represented more than 70% of Spain's total wineries' sales revenue over the whole period.

The data was collected and matched based on the sources described next. Data on advertising spending were obtained from the Information for Advertising Expenditures (Infoadex) database (https://www.infoadex.es), which provides information on advertising expenditure in Spanish media in the form of print, broadcast, outdoor, and Internet advertising. Financial, accounting and another specific firm information was obtained from the Bureau Van Dijk database (https://www.bvdinfo.com). Information on designations of origin (DO) was gathered from the publicly available listings of the different DOs and their respective websites. Wine ratings were obtained from the renowned Spanish guide *The best wines in Spain (Repsol Guide)*, which offers expert blind tasting quality scores on a 100-point scale. All monetary values are deflated by the GDP deflator index.

The model's dependent variable is the winery's advertising strategy, which is broken down into two decisions: the decision to invest in advertising (measured through a dummy variable that takes the value of 1 if the winery invests in advertising in period t, and 0 elsewhere); and the decision of how much money the winery *i* invests during period *t*, which is measured in euros (Inv_{it}).

The variables listed below are considered to explain the winery's advertising decisions:

i) Number of wine references with ratings ($NumRefs_j$): this variable reflects the number of wine references marketed by the winery that appear in the guide. Advertising investment can be influenced by this variable because a wider product assortment is more likely to be associated with greater levels of advertising [54].

ii) Wine ratings (WR_j): this variable is measured through the average quality ratings of the wines marketed by the winery. It is a proxy of the winery's reputation. Wine guides ratings based on sensory assessments are used in the wine industry to measure quality and reputation [66].

iii) Designation of origin (DO_j): this variable reflects whether the winery belongs to a Designation of Origin that acts as a collective trademark, signaling the origin, nature or quality of the wines. It is measured through a dummy variable that takes the value of 1 if the winery belongs to a Designation of Origin and 0, otherwise.

iv) Type of designation of origin ($DOType_j$): this variable is based on the different requirements established to achieve a DO status and is a proxy of the collective trademark reputation [67]. If a winery uses a collective trademark to market its wines, this information will be indicated on the wine's label, which is publicly available to consumers. The Spanish system establishes four different categories of DO wines. Thus, this variable takes a value of 4 for Estate Wines, 3 for Qualified Designations of Origin, 2 for Designations of Origin and 1 for Quality Wines. For wineries that belong to several indications we have considered the highest level of DO type achieved, as we don't know the percentage that every DO represents for the winery.

v) Winery experience ($Experience_j$): this variable is measured as the number of years since the winery's establishment. The age of the company is usually associated with its advertising investment. Indeed, the reputation of a firm spreads through positive (or negative) word of mouth once it has been established for the first time [68]. Hence, consumers will have more information about earlier entrants in the market and will depend less on advertising, so later entrants will probably need to invest more in advertising [54].

vi) Winery size ($Size_j$): this variable is measured based on the winery's volume of assets [69]. This variable is included because firm size can affect advertising investment as larger firms dispose of more financial resources to invest in promotion [70].

The descriptive statistics are shown in Table 1. Of the sample's 835 wineries, 189 invest in advertising and 646 do not. The average monetary amount invested is 51,240 euros per year. A total of 696 wineries belong to a DO, while 139 do not. Of the total, 273 wineries appear in the guide each year, 347 never appear in the guide, and 215 wineries appear only some years. Most of the correlations among the variables are relatively low. However, and as it might be expected, advertising spending and size of the winery are positively correlated (0.553). Besides, the correlation between the variables DO and DOType is closed to 1.

4. RESULTS

First, a Heckit model estimation was conducted to explain the wineries' advertising strategy and to test the proposed hypotheses. The procedure allowed us to identify the drivers of the advertising strategy, which was broken down into the decision to invest (or not) and the decision on the amount of money invested. To test the effect of wine ratings on advertising spending, two different models were estimated, including linear (Model 1) and quadratic (Model 2) effects separately (see Table 2). The variables DO and Experience served as instruments and were included only in the selection equation (Eq.1).

We implemented the two-step Heckman procedure that includes the inverse Mills ratio in the second step as

Table 1. Descriptive statistics and correlations among variables.

Variable	Mean (SD)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) AdvSpending	51240 (4783 E02)	1.000	0.125	-0.009	0.043	0.062	0.198	0.553
(2) NumRefs	1.174 (1.713)		1.000	0.145	0.278	0.245	0.203	0.266
(3) Wine ratings	90.486 (1.791)			1.000	-0.012	0.030	-0.029	0.067
(4) DO	0.833 (0.372)				1.000	0.933	0.012	0.087
(5) DOType	2.5579 (1.344)					1.000	0.014	0.127
(6) Experience	19.141 (15.658)						1.000	0.274
(7) Size	9856.6 (31645)							1.000

Table 2. Determinant factors of wineries' advertising strategy.

	Model 1			Model 2		
	Coeff	*SD*	*p-value*	*Coeff*	*SD*	*p-value*
Eq.1						
Intercept	−5.084	0.151	<0.001	−5.085	0.151	<0.001
NumRefs	0.289	0.011	<0.001	0.289	0.011	<0.001
DO	0.512	0.078	<0.001	0.512	0.078	<0.001
Experience	0.007	0.001	<0.001	0.007	0.001	<0.001
Size	0.390	0.016	<0.001	0.390	0.016	<0.001
Eq. 2						
Intercept	6.973	2.736	0.011	211.426	82.005	0.009
NumRefs	0.043	0.034	0.209	0.045	0.034	0.186
Wine ratings	−0.015	0.029	0.610	−4.551	1.818	0.012
Wine ratings (^2)				0.025	0.010	0.012
DOType	0.049	0.063	0.431	0.041	0.063	0.512
Size	0.455	0.067	<0.001	0.431	0.067	<0.001
lambda	−0.361	0.176	0.040	−0.378	0.181	0.037
Log-L	−6357.247			−6354.139		
Sigma	1.816			1.815		
Rho (ρ)	−0.199			−0.208		
Obs.	8351			8351		

a regressor. Results show that the coefficient of this variable (λ) is significant in both models. Besides, the results showed significant correlations (ρ), which proves that the correlation between the disturbances of the decision to invest in advertising and the amount of money invested is significantly different from zero. The latter shows the advantages offered by the Heckit model for this analysis as it permits the error terms to co-vary. Moreover, it confirms the two-step managerial decision process: first, the decision to invest (or not) in advertising and, second, the amount of money invested.

Regarding the determining factors of the decision to invest in advertising (Eq. 1), all the variables included were significant. According to the results, the num-

ber of wine references in the portfolio included in the guide was significant, showing that a wider assortment of products with available quality ratings is associated with a greater probability of investment in advertising [54]. This result supports Hypothesis 1a, implying that wine ratings are not substitutes for advertising. It seems that wineries that produce quality wines wish to inform consumers of their commitment. In addition, the results also provide evidence that wineries that belong to a DO are more likely to invest in advertising. Despite the fact that the collective trademark reputation might help to market the wines, the results showed that it is more likely that wineries with a DO decide to invest in advertising, probably to reinforce their market position. Ultimately, the control variables that reflect a winery's experience and size were also significant in the selection equation (Eq.1). The latter finding shows that market pioneer entrants are more likely to invest in advertising than later entrants. Furthermore, firm size was positively and significantly associated with advertising investment, which suggests that larger wineries are more likely to invest in advertising. An explanation could be that big companies have more resources to invest in promotion than smaller ones [70]. These results were robust in Models 1 and 2.

In relation to the determinants of the amount of money invested in advertising (Eq.2), the estimations generated interesting insights. Model 1 proposes a linear relationship between wine ratings and advertising investment, while Model 2 proposes a nonlinear relationship. First, the number of wine references with publicly available ratings was also non-significant, so this variable did not have any influence on the amount of money invested. However, the results showed that the average rating of the wines included in the guide was not significant in Model 1, where a linear relationship was assumed. For its part, Model 2 illustrates a U-shaped relationship between wine ratings and the amount of money invested (the parameter of the variable WR is negative and significant and the parameter of the variable WR (^2) is positive and significant). These results show that wineries with low-level average ratings and wineries with high-level average ratings invest more money in advertising than wineries with medium- level average ratings. These results confirm Hypothesis 1b as publicly available wine ratings (which act as a proxy of the winery's reputation) have a nonlinear effect on the amount of money invested in advertising. It seems that the number of references appearing in the guide presents less significance than the average valuation of these wines, which can act as a sign of reputation [66] and better reflect the winery's commitment to quality. In both models, the DO type variable is non-significant, implying that the collective reputation of the different DO types does not influence the amount of money invested in advertising. Finally, as expected, the winery's size also exerts a positive effect on the amount of money invested in advertising.

In the second stage, traditional profitability indexes were estimated to test the differences between wineries that invest in advertising and wineries that do not. We also tested the difference between wineries with (and without) publicly available wine ratings. Specifically, the traditional returns on assets (ROA), returns on equity (ROE) and returns on investments (ROI) ratios were computed. Results are shown in Table 3.

The average profitability ratios were 0.6 per cent for ROA, 4.2 per cent for ROE and 6.9 per cent for ROI. To test the differences between investing and non-investing in advertising wineries a two-tailed t-test was performed. This test accounts for the possibility of the relationship in both directions. In this sense, the ROA was higher for investing wineries while the ROE was higher for non-investing wineries, and these differences were statistically significant. Furthermore, the ROA was higher for wineries with publicly available ratings while the ROE was higher for wineries without publicly available ratings, and these differences were also statistically significant. However, no significant differences appeared when considering ROI as a performance measure. Nevertheless, much caution should be exercised, because performance ratios do not give the whole picture of winery performance. This descriptive approach shows that

Table 3. ROI, ROE and ROA estimates.

		ROA	ROE	ROI
Advertising				
Yes	Mean	0,018	0,021	0,048
	(SD)	(0,074)	(0,268)	(0,344)
No	Mean	0,002	0,048	0,075
	(SD)	(0,071)	(0,576)	(1,424)
	Test difference	t=-9,084 (p=0,000)	t=2,062 (p=0,039)	t=0,877 (p=0,380)
Public wine ratings				
Yes	Mean	0,012	0,030	0,054
	(SD)	(0,075)	(0,428)	(0,819)
No	Mean	0,001	0,052	0,083
	(SD)	(0,069)	(0,592)	(1,547)
	Test difference	t=-7,623 (p=0,000)	t=1,981 (p=0,048)	t=1,102 (p=0,270)
Total	Mean	0,006	0,042	0,069
	(SD)	(0,072)	(0,522)	(1,262)

no one-size-fits-all strategy exists, since no robust and consistent differences can be obtained regarding the performance of wineries that invest (or not) in advertising and the wineries that appear (or not) in publicly available quality ratings. These results are consistent with the findings of other studies that have failed to find a clear association between advertising investment and performance (e.g. [11]).

In this paper we have focused on the potential effect of wine ratings (a signal of reputation) on the advertising strategy of a winery. Although prior evidence has revealed conflicting results, our results evidence a positive association between the existence of publicly available quality ratings and advertising investment, what is in line with [51]. Besides, our results are aligned with [53], who evidence that more highly rated experience products are advertised more. In this sense, this evidence is consistent with the company reputation model [52]. When it comes to the association between advertising and performance, our results are aligned with [11], as the relationship between advertising and performance is not clearly supported.

5. CONCLUSIONS

In the wine industry, some firms make the decision to invest while others foster alternative marketing strategies to promote their wines. Despite the potential benefits of advertising, the lack of a clear link between advertising investments and performance and the small average size of wineries might explain why the intensity of this resource is very low in this industry compared to other beverage industries. Thus, alternative marketing strategies —such as promoting positive worth of mouth, the presence of medals and awards on wine labels or fostering ratings in the best-known wine guides— are frequently used by wineries [71]. Wine ratings are particularly popular in the wine industry because they offer consumers a signal of wine quality which they can rely on to make informed purchase decisions. In this paper, we focused on the effect of these publicly available wine ratings on wineries' advertising strategy.

The results of the present study showed that the number of wine references with publicly available wine ratings in wine guides has a positive influence on the winery's likelihood to invest in advertising. Moreover, the results provide evidence of a U-shaped relationship between wine ratings and advertising investment: wineries with low and high average wine ratings invest greater amounts of money than firms with medium wine ratings.

According to [72] the most effective means of communication in the wine industry is word of mouth, since most consumers often follow other people's recommendation when buying wines. To spread a positive word of mouth, wineries can employ different strategies, from direct visits to wineries to advertising, which is considered the last item in the communication mix. In fact, long-term advertising is an effective tool to communicate the winery's positioning in the market [72]. From a managerial viewpoint, two important decisions regarding the advertising strategy are made. First, managers decide whether to invest in advertising or not, and in a second stage, they decide which amount of money should be invested. Bearing in mind that the wineries aim to choose the best available strategy to promote their wines, no one-size-fits-all strategy seems to exist. While some wineries invest in advertising, others rely on collective brands (DO) to promote their wines. Our results showed that the wineries that belong to a DO are more likely to invest in advertising. In addition, the number of wines with publicly available wine ratings also has a positive influence on the probability of investing in advertising: it seems that wineries seek to inform consumers of their commitment to quality. Once the winery has decided to invest in advertising, it must determine the amount of money to be invested. Our results demonstrate that this strategy is employed by low- and high-quality producers. Indeed, wineries with low ratings would use advertising to convince consumers to buy their wines, while wineries with high ratios also strive to reinforce their market position to attract consumers. Both types of wineries attempt to spend their advertising budgets effectively while meeting customer needs.

The present work presented several limitations that should be addressed in future studies. First, only two dimensions of wineries' advertising strategy were explored: the decision to invest or not and the amount of money invested. However, other decisions, such as the media employed or advertisements' content and creativity, were not considered. They are, however, also part of wineries' advertising strategy. Second, this paper only considered one Spanish wine guide (i.e. the Repsol guide) as the publicly available rating variable. Despite being very well-known during the sample period, it is not the only guide available to consumers. For example, other professional guides such as "Peñin" or "Gourmets" are also very popular in Spain. Future research should address these limitations. In the same way, it would be interesting to consider the influence of publicly available rating that are not professional. Indeed, wine ratings featuring in user-generated platforms, such as Vivino, have

become very popular in recent years and they may also affect the advertising strategies of wineries.

REFERENCES

[1] C. R. Clark, U. Doraszelski, M. Draganska, The effect of advertising on brand awareness and perceived quality: An empirical investigation using panel data, Qme 7(2) (2009) 207–236.

[2] K. Jedidi, C. F. Mela, S. Gupta, Managing advertising and promotion for long-run profitability, Mark. Sci. 18(1) (1999) 1–22.

[3] G. Erickson, R. Jacobson, Gaining Comparative Advantage Through Discretionary Expenditures: The Returns to R&D and Advertising, Manag. Sci. 38(9) (1992) 1264–1279, https://doi.org/10.1287/mnsc.38.9.1264.

[4] Y. K. Ho, H. T. Keh, J. M. Ong, The effects of R&D and advertising on firm value: An examination of manufacturing and nonmanufacturing firms, IEEE Trans. Eng. Manag. 52(1) (2005) 3–14.

[5] G. S. Low, J. J. Mohr, Advertising vs sales promotion: a brand management perspective, J. Prod. Brand Manag. 9(6) (2000) 389–414, https://doi.org/10.1108/10610420010356984.

[6] D. A. Aaker, J. M. Carman, Are you over-advertizing, J. Advert. Res. 22(4) (1982) 57–70.

[7] A. Pergelova, D. Prior, J. Rialp, Assessing advertising efficiency, J. Advert. 39(3) (2010) 39–54.

[8] G. J. Tellis, Effective advertising: Understanding when, how, and why advertising works. Sage Publications, 2003.

[9] S. Camino-Mogro, Does Investment in Advertising Boost Economic Performance? Firm-Level Evidence of Ecuadorian Manufacturing, J. Technol. Manag. Innov. 14(4) (2019) 100–118, https://doi.org/10.4067/S0718-27242019000400100.

[10] B. H. Han, D. Manry, The value-relevance of R&D and advertising expenditures: Evidence from Korea, Int. J. Account. 39(2) (2004) 155–173, https://doi.org/10.1016/j.intacc.2004.02.002.

[11] A. Joshi, D. M. Hanssens, Movie advertising and the stock market valuation of studios: A Case of "Great Expectations?", Mark. Sci. 28(2) (2009) 239–250, https://doi.org/10.1287/mksc.1080.0392.

[12] S. Z. Ali Shah and S. Akbar, Value relevance of advertising expenditure: A review of the literature, Int. J. Manag. Rev. 10(4) (2008) 301–325, https://doi.org/10.1111/j.1468-2370.2007.00228.x.

[13] D. M. Hanssens, L. J. Parsons, R. L. Schultz, Market Response Models: Econometric and Time Series Analysis. Springer Science & Business Media, 2003.

[14] R. E. Kihlstrom, M. H. Riordan, Advertising as a signal, J. Polit. Econ. 92 (1984) 427–450, https://doi.org/10.1086/261235.

[15] H. I. Mesak, An aggregate advertising pulsing model with wear out effects, Mark. Sci. 11(3) (1992) 310–326, https://doi.org/10.1287/mksc.11.3.310.

[16] P. Milgrom, J. Roberts, Price and advertising signals of product quality, J. Polit. Econ. 94(4) (1986) 796–821, https://doi.org/10.1086/261408.

[17] A. G. Sam, S. R. Thompson, Country of origin advertising and US demand of imported wine: an empirical analysis, Appl. Econ. Lett. 19 (2012) 1871–1877.

[18] G. B. Wilcox, E. Y. Kang, L. A. Chilek, Beer, wine, or spirits? Advertisings impact on four decades of category sales, Int. J. Advert. 34 (2015) 641–657, https://doi.org/10.1080/02650487.2015.1019961.

[19] G. Alcaraz-Mármol, F. J. Medina-Albaladejo, Adapting marketing strategies: a linguistic analysis of wine advertising in Spain, 1970-2010, J. Evol. Stud. Bus. 4 (2019) 1, https://doi.org/10.1344/jesb2019.1.j054.

[20] R. H. Ashton, Reliability and consensus of experienced wine judges: Expertise within and between, J. Wine Econ. 7(1) (2012) 70–87.

[21] R. H. Ashton, Is there consensus among wine quality ratings of prominent critics? An empirical analysis of red Bordeaux, 2004-2010, J. Wine Econ. 8(2) (2013) 225.

[22] R. T. Hodgson, An examination of judge reliability at a major US wine competition, J. Wine Econ. 3 (2008) 105–113.

[23] A. G. Parsons, A. Thompson, Wine recommendations: who do I believe?, Br. Food J. 111(9) (2009) 1003–1015, https://doi.org/10.1108/00070700910992899.

[24] D. W. Carlton, J. M. Perloff, K. T. vant Veld, Modern industrial organization. Scott, Foresman/Little, Brown Higher Education Glenview, IL, 1990.

[25] R. Sethuraman, G. J. Tellis, R. A. Briesch, How well does advertising work? Generalizations from meta-analysis of brand advertising elasticities, J. Mark. Res. 48(3) (2011) 457–471.

[26] S. Sridhar, F. Germann, C. Kang, R. Grewal, Relating online, regional, and national advertising to firm value, J. Mark. 80 (2016) 39–55.

[27] W. S. Comanor, T. A. Wilson, Advertising and Market Power. Harvard University Press, 1974.

[28] C. R. Taylor, S. Zou, A. Özsomer, Advertising and its effect on industrial concentration: A contingency perspective, J. Curr. Issues Res. Advert. 18 (1996) 35–44.

[29] J. Chen, G. Waters, Firm efficiency, advertising and profitability: Theory and evidence, Q. Rev. Econ. Finance 63 (2017) 240–248, https://doi.org/10.1016/j.qref.2016.04.004.
[30] A. Joshi, D. M. Hanssens, The direct and indirect effects of advertising spending on firm value, J. Mark. 74 (2010) 20–33.
[31] A. Kirmani, P. Wright, Money talks: perceived advertising expense and expected product quality, J. Consum. Res. 16 (1989) 344, https://doi.org/10.1086/209220.
[32] C. F. Mela, S. Gupta, D. R. Lehmann, The long-term impact of promotion and advertising on consumer brand choice, J. Mark. Res. 34(2) (1997) 248–261, https://doi.org/10.1177/002224379703400205.
[33] E. C. Osinga, P. S. H. Leeflang, S. Srinivasan, J. E. Wieringa, Why do firms invest in consumer advertising with limited sales response? a shareholder perspective, J. Mark. 75 (2011) 109–124, https://doi.org/10.1509/jm.75.1.109.
[34] K. D. Frankenberger, R. C. Graham, Should firms increase advertising expenditures during recessions?, MSI Rep. 3 (2003) 65–85.
[35] A. Assaf, A. Josiassen, A. S. Mattila, L. Kneževic Cvelbar, Does advertising spending improve sales performance?, Int. J. Hosp. Manag. 48 (2015) 161–166, https://doi.org/10.1016/j.ijhm.2015.04.014.
[36] K. W. Chauvin, M. Hirschey, Advertising, R&D expenditures and the market value of the firm, Financ. Manag. 22 (1993) 128, https://doi.org/10.2307/3665583.
[37] L. L. Eng, H. T. Keh, The Effects of advertising and brand value on future operating and market performance, J. Advert. 36 (2007) 91–100, https://doi.org/10.2753/JOA0091-3367360407.
[38] S. Sun, Foreign Entry and firm advertising intensity: evidence from China, Rev. Ind. Organ. 45 (2014) 79–97, https://doi.org/10.1007/s11151-014-9426-z.
[39] S. Rosengren, M. Eisend, S. Koslow, M. Dahlen, A meta-analysis of when and how advertising creativity works, J. Mark. 84 (2020) 39–56, https://doi.org/10.1177/0022242920929288.
[40] H. Saffer, D. Dave, Alcohol consumption and alcohol advertising bans, Appl. Econ. 34 (2002) 1325–1334.
[41] J. Niederdeppe, R. J. Avery, E. Tabor, N. W. Lee, B. Welch, C. Skurka, Estimated televised alcohol advertising exposure in the past year and associations with past 30-day drinking behavior among American adults: results from a secondary analysis of large-scale advertising and survey data, Addiction 116 (2021) 280–289, https://doi.org/10.1111/add.15088.
[42] F. Mas-Ruiz, F. Sancho-Esper, R. Sellers-Rubio, The effect of collective brand on advertising productivity, Br. Food J. 118 (2016) 2475–2490, https://doi.org/10.1108/BFJ-01-2016-0032.
[43] A. Vlachvei, O. Notta, I. Ananiadis, Does advertising matter? An application to the Greek wine industry, Br. Food J. 111 (2009) 686–698, https://doi.org/10.1108/00070700910972378.
[44] E. C. Thach, J. E. Olsen, Market segment analysis to target young adult wine drinkers, Agribusiness 22 (2006) 307–322, https://doi.org/10.1002/agr.20088.
[45] N. Barber, T. Dodd, R. Ghiselli, Capturing the younger wine consumer, J. Wine Res. 19(2) (2008) 123–141, https://doi.org/10.1080/09571260802622225.
[46] S. Sillani, A. Miccoli, F. Nassivera, Different preferences for wine communication, Wine Econ. Policy 6(1) (2017) 28–39, https://doi.org/10.1016/j.wep.2017.03.002.
[47] R. Sellers-Rubio, F. Mas-Ruiz, F. Sancho-Esper, Reputation and advertising of collective brand members in the wine industry: the moderating role of market share, J. Wine Econ. (2021) 1–20, https://doi.org/10.1017/jwe.2020.52.
[48] I. J. Horstmann, S. Moorthy, Advertising spending and quality for services: The role of capacity, Quant. Mark. Econ. 1(3) (2003) 337–365.
[49] B. Hollenbeck, S. Moorthy, D. Proserpio, Advertising strategy in the presence of reviews: An empirical analysis, Mark. Sci. 38 (2019) 793–811.
[50] P. Nelson, Advertising as information, J. Polit. Econ. 82 (1974) 729–754, https://doi.org/10.1086/260231.
[51] R. B. Archibald, C. A. Haulman, C. E. Moody Jr., Quality, price, advertising, and published quality ratings, J. Consum. Res. 9 (1983) 347–356, https://doi.org/10.1086/208929.
[52] B. Klein, K. B. Leffler, The Role of market forces in assuring contractual performance, J. Polit. Econ. 89 (1981) 615–641, https://doi.org/10.1086/260996.
[53] N. S. Sahni, H. S. Nair, Does Advertising serve as a signal? evidence from a field experiment in mobile search, Rev. Econ. Stud. 87 (2020) 1529–1564, https://doi.org/10.1093/restud/rdz053.
[54] G. J. Tellis, C. Fornell, The relationship between advertising and product quality over the product life cycle: A contingency theory, J. Mark. Res. 25 (1988) 64–71.

[55] R. Dorfman, P. O. Steiner, Optimal advertising and optimal quality, Am. Econ. Rev. 44(5) (1954) 826–836.
[56] K. Bagwell, The Economic Analysis of Advertising, in Handbook of Industrial Organization 3, M. Armstrong and R. Porter, Eds. Elsevier, 2007 pp.1701–1844. https://doi.org/10.1016/S1573-448X(06)03028-7.
[57] M.P. Sáenz-Navajas, E. Campo, A. Sutan, J. Ballester, D. Valentin, Perception of wine quality according to extrinsic cues: The case of Burgundy wine consumers, Food Qual. Prefer. 27 (2013) 44–53, https://doi.org/10.1016/j.foodqual.2012.06.006.
[58] S. Troiano, F. Marangon, T. Tempesta, D. Vecchiato, Organic vs local claims: substitutes or complements for wine consumers? A marketing analysis with a discrete choice experiment, New Medit, 2 (2016) 14–21.
[59] F. Boncinelli, A. Dominici, F. Gerini, E. Marone, Consumers wine preferences according to purchase occasion: Personal consumption and gift-giving, Food Qual. Prefer. 71 (2019) 270–278, https://doi.org/10.1016/j.foodqual.2018.07.013.
[60] G. Scozzafava, F. Gerini, A. Dominici, C. Contini, L. Casini, Reach for the stars: The impact on consumer preferences of introducing a new top-tier typology into a PDO wine, Wine Econ. Policy 7(2) (2018) 140–152, https://doi.org/10.1016/j.wep.2018.09.001.
[61] J. J. Heckman, Sample selection bias as a specification error, Econometrica 47(1) (1979) 153–161, https://doi.org/10.2307/1912352.
[62] J. J. Heckman, The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such models, Annals Econ. Soc. Meas. 5 (1976) 475–492.
[63] J. M. Wooldridge, Econometric analysis of cross section and panel data. MIT Press, 2010.
[64] R. Sellers-Rubio, J. L. Nicolau-Gonzalbez, Estimating the willingness to pay for a sustainable wine using a Heckit model, Wine Econ. Policy 5(2) (2016) 96–104, https://doi.org/10.1016/j.wep.2016.09.002.
[65] O. Toomet, A. Henningsen, Sample selection models in R: Package sampleSelection, J. Stat. Softw. 27 (2008) 1–23.
[66] B. A. Benjamin, J. M. Podolny, Status, quality, and social order in the California wine industry, Adm. Sci. Q. 44 (1999) 563–589.
[67] R. Sellers-Rubio, F. Mas-Ruiz, F. Sancho-Esper, Firm reputation, advertising investment, and price premium: The role of collective brand membership in high-quality wines, Agribusiness 34(2) (2018) 351–362, https://doi.org/10.1002/agr.21526.
[68] R. R. Thomas, R. S. Barr, W. L. Cron, J. W. Slocum, A process for evaluating retail store efficiency: a restricted DEA approach, Int. J. Res. Mark. 15(5) (1998) 487–503, https://doi.org/10.1016/S0167-8116(98)00021-4.
[69] R. Sellers, V. Alampi-Sottini, The influence of size on winery performance: Evidence from Italy, Wine Econ. Policy 5(1) (2016) 33–41, https://doi.org/10.1016/j.wep.2016.03.001.
[70] S. Castriota, M. Delmastro, The economics of collective reputation: Evidence from the wine industry, Am. J. Agric. Econ. 97 (2015) 469–489.
[71] U. R. Orth, P. Krška, Quality signals in wine marketing: the role of exhibition awards, Int. Food Agribus. Manag. Rev. 4 (2001) 385–397.
[72] T. Spawton, Marketing planning for wine, Int. J. Wine Mark. 2 (1990) 2–49.

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Adaptive market hypothesis: An empirical analysis of the Wine Market

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Abstract. We test the nature of weak form informational efficiency present in the wine market using daily return of LIV-EX 50 index from 1/1/2010 to 12/6/2020. First, we employ a number of statistical tests including variance ratio tests, tests for linear and non-linear dependence and Hurst coefficient. The tests are applied on the full dataset and on four non overlapping sub-samples of equal length. The variance ratio tests provide a mixed regarding informational efficiency. Evidence of non-linear dependence in the return series was found. The Hurst coefficient values confirm the presence of long run persistence in the wine market. Based on the mixed evidence, we test the possibility of adaptive nature of the wine market. We employ the newly proposed Adaptive Index (AI) to quantify the degree of information inefficiency in the wine market at any instance. Our results confirm that wine market is adaptive and periodically shifts between states of efficiency and inefficiency. The wine market is found to be relatively free from the Covid-19 induced shock and the safe haven property of wine is thus confirmed. Finally, impact of various macroeconomic and financial events on wine market efficiency is identified by using AI.

Keywords: LIV-EX 50, EMH, adaptive markets, VR tests.

INTRODUCTION

Ever since its inception, the Efficient market hypothesis (EMH henceforth), proposed by Fama [1] has been at the center of many academic discussions. Fama proposed a financial market that is informationally efficient. He postulated that asset prices contain all relevant information and they instantaneously absorb all the fresh information. EMH talks about a market populated by rational investors, optimally using all the information available to them. If a market is informationally efficient, any deviation from the asset's equilibrium value should be temporary, as market participants would instantaneously make use of any new information signal. In such a scenario, the possibility for arbitrage is absent. Fama postulated that EMH has three versions. The first version is called weak form EMH. In weak form EMH, current price of an asset contains all past price information. In semi-strong form EMH, current price of an asset reflects past price information and all publicly available information. In strong form EMH, current prices include past price information, public and

private information. Among these three forms, weak form EMH is the easiest to verify. Therefore, the current analysis is limited in that aspect.

As mentioned earlier, EMH in its weak form states that current price of an asset contains all information pertaining to its past prices. In such a scenario, price fluctuations are transient and hence, extreme price fluctuations can be ruled out. In that case, the asset's return series should follow a geometrical Brownian motion or random walk. If an asset is weak form efficient, we cannot employ past prices to predict future value. For an investor, it will not be possible to gain abnormal profits in the long run. If the market is informationally inefficient, there is scope for investors to make abnormal profits using appropriate strategies.

Empirical validation of weak form EMH resulted in mixed results across different financial markets. The varying outcomes are often attributed to the differences in sample size, statistic used, and the regional factor [2]. Moreover, most of the test statistics are binary in nature, i.e. the series is either weak form efficient or not. These issues encouraged researchers to investigate for alternate planations. Lo [3] argued that informational efficiency is not a static concept. Rather, it is time varying in nature. Lo proposed Adaptive Market Hypothesis (AMH henceforth) to reconcile EMH and assumptions from behavioral economics. He proposed that the market participants evolve. Further, they adapt according to the market conditions and structural changes. A market switches between states of efficiency and inefficiency if it is adaptive. Modeling dynamic nature of information efficiency in a financial market has its own practical uses. If one can identify the states of inefficiency, it is possible to apply relevant trading strategies and make a profit.

AMH have been verified in Equity markets [3–6] Forex markets [2,7], Commodity markets [8,9] and cryptocurrency markets [10,11]. Here, our purpose is to test the validity of AMH in the fine wine market. Of late, fine wine has emerged as an alternative investment option. The literature provides ample evidence of investment potential of fine wine. In the following paragraphs, we discuss select studies that analyzed this aspect.

[12] employed the data from auctions at the Chicago Wine Company for the period of 1996 to 2007 and studied the evolution of wine prices. They constructed wine indices and found them to be cointegrated. Further, they found that wine returns and equity returns are not significantly correlated. Using the repeat sales regression model, [13] estimated the return to the Australian wine. He found that the wine returns are low compared to other financial assets. However, in spite of lower returns, wine is found to have diversifier property.

[14] compared from results from repeated sales regression model, hedonic pricing model and a hybrid model using Australian fine wine price data. The results suggested that hybrid model is way to incorporate Australian wines in a diversified portfolio in comparison with repeated sales regression and hedonic approach. Employing a threshold cointegration approach, [15] studied the interaction between Wine and stock markets of Australia, France, Chile, China and the US. The results indicated cointegration between wine and stock markets. Further, the speed of adjustment of the wine index for US and France was found to be slower compared to the stock market index, indicating that wine prices may be predictable in the short-run and informed traders can anticipate price movements and make profit.

[16] used Australian wine auction price data and showed that the estimation method has a significant impact on the wine return distribution and the type of diversification benefit test employed determines the extent of diversification potential of wine. They found that employing the efficient frontier method along with bootstrapped confidence intervals provide the best results regarding the diversification aspect of wine. Using a historical database for five long-established Bordeaux wines, [17] studied the impact of aging on wine prices and its potential as a long-term investment asset. They found that wine returns underperform compared to equites, but performs better compared to government bonds.

Employing cointegration methods and causality tests, [18] studied the short-term and long-term price linkages between fine wine and equity markets. Instead of wine index data, they employed auction price data of world's mostly traded vintage pairs. They found that the wine prices and global equity markets move together. Further, the causality test results revealed that wine prices influence each other. [19] employed dynamic conditional correlation GARCH model and studied the relationship between fine wines and equity indexes returns for United States, United Kingdom, Germany, France, and Japan. The study found evidence that fine wine exhibit hedge and weak safe haven properties against equity price fluctuations.

[20] analyzed the time varying risk premium related to fine wine investments in the context of financial crisis by employing a conditional CAPM model and a multivariate GARCH model. They found Boudreaux fine wine prices to be more volatile during financial crisis and less volatile during stable periods. Further, they found non-French wines to exhibit an inverse volatility trend while compared to French wines. Using Dynamic conditional correlation model, [21] analyzed the properties of fine

wine as a hedge and safe haven instrument against UK stock price fluctuations. They found that wine can act as an effective hedge against stock price fluctuations. However, wine could not act as a safe haven against market turmoil.

[22] analyzed the role of Wine in investment portfolios for the French market. Using Liv-Ex and Wine-Dex index data along with equity and bond prices, they employed mean-variance portfolio optimization approach and modified value-at-risk approach. They found that inclusion of wine in the investment portfolios increases the portfolio performance. Further, they suggested that wine is an ideal investment asset for risk-averse investors. Using Engle-Granger and Johanson cointegration methods, [23] studied the nature of cointegration between fine wine, non-fine wine and equity markets. They used Liv-Ex 100 index for fine wine prices, Mediobanca Global Wine Industry Share Price for normal wine, and the MSCI World Index to proxy the stock market. They found absence of co-integration between the series and confirmed the existence of diversification benefits of wine.

[24] analysed the long-term co-movement between the fine wine market and world equity markets by applying a cointegration based approach for a period of 21 years. They found statistically significant cointegration between emerging markets and fine wine markets. They found causal relationship from Emerging equity markets to wine markets, indicating that the slowdown of emerging countries can have an adverse effect on the fine wine market. Further, China was identified as a main driver of fine wine prices.

[25] studied the investment diversification potential of wine by employing portfolio diversification methods such as mean-variance optimization and stochastic dominance method. Their findings suggested that wine is the best individual investment asset in comparison to equities, bonds, gold, and housing. Further, they found that the investors prefer wine-included portfolios compared to without-wine portfolios in the absence of short selling. [26] employed auction hammer prices for the years 1996-2009 and constructed wine price indices. From the analysis, they found that fine wine yields higher return and exhibits low volatility compared to stocks. Further, they found that wine prices are mainly influenced by macroeconomic events than market risk.

From the literature, it is clear that wine is effectively used as an investment option. It can be used as a diversifier to reduce investment risk. Fine wine is considered as an investment option because it acts as a store of value. As Wine prices are often affected by non-economic factors such as the brand, year of vintage, grape composition and production process [27], it can be used as an effective hedge and safe haven against portfolio fluctuations [19,21].If wine is to be included in an investment portfolio, it is important to confirm whether wine prices are efficient or adaptive. If it is informationally efficient, the investor only needs to be concerned with the systemic risk, and the portfolio could be passively managed. If the markets are dynamically efficient, then there is non-systemic risk and the portfolio will need to be actively managed.

There is a serious dearth of studies discussing informational efficiency of the wine prices. So far, we have come across only the pioneering study by Bouri et al. [29]. Here, the author used a set of unit root tests and found that wine market is informationally inefficient if structural breaks are considered. However, there is mounting evidence against static nature of information efficiency/inefficiency across other financial markets as mentioned earlier. Therefore, it is only logical for us to check the same for wine market. We aim the present study at that direction. We structure rest of the article as follows. Section 2 discusses data and methodology used. In section 3, we discuss the results. We present our concluding remarks in section 4.

2. DATA AND METHODS

Daily returns of LIV-EX 50 index from 1/1/2010 to 12/6/2020 is used for the analytical purposes. We select LIVE-EX 50 index as it includes price movement of most heavily traded commodities in the wine market. Therefore, it can act as a suitable proxy for studying market dynamics. The methodology comprises two parts. First, we statistically test the possible presence of weak form market efficiency using six variance ratio tests and two tests for serial dependence. In the second part, we capture the dynamic nature of informational efficiency by employing a newly constructed index. Brief description of the tests employed are provided in the forthcoming paragraphs.

2.1. Variance ratio tests

Variance Ratio (VR) tests occupy a prominent position among the methods to test for weak form informational efficiency in a time series. Lo and McKinlay [30] proposed the first VR test. Later, there were many extensions and modifications. Here, six commonly used VR test results are employed. Brief test descriptions are given in the following paragraphs.

2.1.1.Lo and McKinlay VR Test

In Lo and McKinlay [17] , RWH for a time series X_t is shown as:

$$X_t = \mu + X_{t-1} + \varepsilon_t \quad (1)$$

μ is the constant and follows an i.i.d normal distribution with zero mean and variance $\sigma^2{}_o$.

Here, the null hypothesis is stated as:

$$H{:}\varepsilon_{ti} \text{ i.i.d. } N(0,\sigma^2{}_o) \quad (2)$$

Then, variance at k^{th} lag shall be k times variance at first Lag, Or:

$$VR(k) = \frac{1}{q}\frac{\sigma_k^2(k)}{\sigma_1^2(k)} = 1 \quad (3)$$

Two test statistics, $Z_1(k)$ and $Z_2(k)$ were developed by Lo and Mackinlay [30,31] (Lo and McKinlay, 1988; Lo and McKinlay, 1989) in order to account for homoscedastic and heteroscedastic error terms.

2.1.2 Automatic VR test of Choi

Selection of lag k is important while testing weak form EMH using VR tests. Often, the lags are selected in an arbitrary fashion. Choi [32] (1999) used a quadratic spectral (QS) kernel based method to determine the optimal value of k. Andrews [33] (1991) stated that QS kernel has the ability in calculating the spectral density at zero frequency. Hence, it was employed

VR estimator of Choi is then defined as:

$$VR(k) = 1 + 2\sum_{i=1}^{T-1} h(i/k)\ \hat{\rho}(i) \quad (4)$$

Here, $\hat{\rho}(i)$ is the autocorrelation function, and $h(x)$ is the QS window

The normalized statistic is calculated as:

$$VR_f = \frac{VR(k)-1}{\frac{1}{(2)^{\frac{1}{2}}}(T/k)^{-1/2}} \quad (5)$$

Under H0, VR_f follows asymptotic standard normal distribution.

2.1.3 Wright's Non-Parametric Variance Ratio Tests

Due to the parametric nature of Lo-MacKinlay test, small sample results were found to be biased. Wright [34] (2000) proposed a non-parametric VR test using signs and ranks to overcome this bias. As rank ($R1$ and $R2$) and sign ($S1$ and $S2$) tests have an exact sampling distribution, there is no need to approximate the asymptotic distribution. Further, these tests outperform the conventional VR tests while tested against data containing autocorrelation and fractional integration.

2.1.4 VR Test of Richardson and Smith

If the VR test statistics are computed over long lags with overlapping observations, the conventional parametric tests could not be used to draw useful inference as the distribution of the VR test becomes non-normal. To address this shortcoming, Richardson and Smith [35] (1991) suggested a joint test based on the following Wald statistic. The statistic is defined as:

$$RS(k) = T(VR\text{-}1_k)'\phi^{-1}(VR\text{-}1_k) \quad (6)$$

VR is the ($k \times 1$) vector of sample k VRs, is the ($k \times 1$) unit vector and is the covariance matrix of **VR**. The joint $RS(k)$ statistic follows a χ^2 distribution with k degrees of freedom.

2.1.5 Chow and Denning multiple VR test

Chow and Denning [36] (1993) observed that the individual VR tests lack the ability to see whether all the variance ratios at different lags are equal to 1 simultaneously. This is a requirement to reject the RWH. Further, individual VR tests fail to control for the overall test size, resulting in the probability of a Type 1 error. The Chow and Denning test controls the joint test size and facilitate a comparison of variance ratios at multiple lags by employing Studentized Maximum Modulus (SMM) critical values. Chow and Denning statistics are calculated as follows:

$$Z^*{}_1\,(K) = \underset{1\le i\le K}{\text{Max}} \left|Z_1\,(k_i)\right| \quad (7)$$

$$Z^*{}_2\,(K) = \underset{1\le i\le K}{\text{Max}} \left|Z_2\,(k_i)\right| \quad (8)$$

$Z_1(k)$ and $Z_2(k)$ is calculated same as in Lo and MacKinlay [30,31] (1988, 1989).

Here, (q_i) are the different lags for $\{q_i \mid i = 1,2,\ldots,m\}$. Acceptance or rejection of the null hypothesis is based on the maximum absolute value of individual variance ratio test statistics.

2.1.6 Chen and Deo Joint VR Test

Chen and Deo [37] (2006) Variance ratio test is based on a power transformation of the VR statistic. The

transformation is used to achieve a better approximation to the normal distribution in finite samples with small lags k. Further, the test statistic is found to be performing well against possible conditional heteroscedasticity present in the data.

2.1.7 Escanciano and Lobato Test for Autocorrelation

Escanciano and Lobato [38] (2009) automatic portmanteau test is employed to test the dependence structure in a given financial time series. The test statistic is defined as:

$$AQ = T\sum_{i=1}^{p}(\widetilde{\rho_i})^2 \quad (9)$$

$\widetilde{\rho_i}$ is the estimated autocorrelation coefficients from lags *i* to *p*. The optimal lag length is determined using Akaike or Bayesian information criterion.

2.1.8 Dominguez and Lobato Test for non-linear dependence

Dominguez and Lobato [39] (2003) proposed test for nonlinear dependence in a time series. The test is based on Cramer-von Mises (CM) and Kolmogorov-Smirnov (KS)statistics. For a time series , the test statistics are defined as :

$$CM = \frac{1}{\hat{\sigma}^2 T^2}\sum_{j=1}^{T}[\sum_{t=1}^{T}(Y_t - \overline{Y})1\left(\tilde{Y}_{t-p} \le \tilde{Y}_{j-p}\right)]\text{^}2 \quad (10)$$

$$KS = max(1\le i\le T)\left|\frac{1}{\hat{\sigma}\sqrt{T}}\sum_{t=1}^{T}(Y_t - \overline{Y})1\left(\tilde{Y}_{t-p} \le \tilde{Y}_{j-p}\right)\right| \quad (11)$$

Where $\tilde{Y}_{t-p} = (Y_t, Y_{t-1}.....Y_{t-p})$, 1() is an indicator function and p is the non-negative lag. They obtain the asymptotic p values for the statistics from a wild bootstrap method.

2.2 Alternatives to Efficient Market Hypothesis: The Adaptive Market Hypothesis

In AMH, Lo [40] (2004) stated that the market participants adapt according to the prevailing conditions, and the market switches between states of efficiency and inefficiency. He proposed an intuitive method to test this hypothesis by estimating rolling window first-order autocorrelation. If the market is efficient, the value of AC should be zero. The deviation of AC from its theoretical minimum can provide the degree of inefficiency at any given period.

Another common method to test AMH is the estimation of rolling window Hurst coefficient. Hurst coefficient was proposed by Hurst [41] in order to test long-memory or self-similarity in a time series. Hurst introduced Hurst coefficient to model the water flow in the river Nile. Existence of long memory in a financial time series provides the possibility of price forecasting its behavior. Further, such information could be of use to investors to design investment strategies and risk diversification. Hurst exponent is estimated through different methods. The basic formulation is explained as follows.

Let x_t be a stationary time series and λτ be its auto-covariance function at lag τ. Then, the asymptotic property of the auto-covariance function is given as follows:

$$\lambda_\tau \approx |\tau|^{-\alpha} f(\tau)\ as\ |\tau| \to \infty$$

Where α (0, 1) and f(τ) is a slowly varying function at infinity. The degree of long memory is given by the exponent α; smaller the exponent, longer the persistence. The Hurst Exponent and α are related in the following way: $H = \frac{2-\alpha}{2}$

H lies in the range 0 ≤ H ≤ 1. If H=0.5, then the series is said to be uncorrelated. H implies long memory or persistence in the return series. If the prices or returns are exhibiting an upward momentum in this period, it would persist in the next period and vise versa. Hsuggests short memory or mean reversion in the series. With short memory, an upward trend in this period would be followed by a downward trend in the next period and vise versa. For a market that is weak form EMH, the Hurst coefficient should have a value of 0.5.

Using the aforementioned measures, Kumar et.al. [42] (2020) proposed the adaptability index (AI). AI is formulated as follows:

$$AI = \left((H-0.5)^2 + \left(\frac{ACF}{2}\right)^2\right)^{0.5} \quad (12)$$

H is the Hurst coefficient and ACF is the first-order autocorrelation coefficient. ACF is rescaled using its maximum (1) and minimum (-1) values for comparability. If a market is efficient, H=0.5 and ACF=0, hence EI=0. The extent of deviation of EI from its theoretical minimum can explain the degree of inefficiency present in the market at any given time. H and ACF are included in the index as both of them are bounded. While autocorrelation captures the nature of dependence, the Hurst coefficient measure the 'memory' present in the series. We estimate the EI over a rolling window of 500 observations in order to dynamically test for AMH in the wine market.

3. RESULTS AND DISCUSSION

Before proceeding to the evaluation of test results, we estimate the summary statistics for the LIV-EX 50 return series. We present the results in Table 1. Here, we estimate basic summary statistics like minimum, maximum, mean, standard deviation, skewness and kurtosis along with the Jarque-Bera test to see if the returns are normally distributed. Further, we employ Ljung-Box test and Box-Pierce test to see if the returns exhibit autocorrelation. From the minimum and maximum values, we can find the range in which the returns are moving. From the skewness measure, we can see whether the return distribution is symmetric. From Kurtosis, we can see if the return distribution is fat-tailed, i.e. whether there are extreme fluctuations in the return series. The returns are found to be oscillating within the range of -3.2% and 5.6%, as evidenced by the maximum and minimum value of the returns. From the skewness and kurtosis values, we can see that the returns are positively skewed and exhibit fat tails. The Jarque-Bera test checks the null of normal distribution. From the p-value, we can infer that the null hypothesis is rejected and the return series is not normally distributed. The null of no autocorrelation is rejected for both Ljung-Box and Box-Pierce test at a lag of 5, as evidenced from the p-value. Thus, presence of autocorrelation in the LIV-EX 50 return series is confirmed.

From the diagnostic testing, we can infer certain things. First, the LIVE-EX 50 returns are skewed, indicating possible asymmetry. We see evidence of fat-tails, pointing towards increased activity at the tails. These two findings are confirmed by the Jarque-Bera statistic result that the returns are non-normally distributed. The two autocorrelation test results point towards the presence of a dependence structure in the return series. Next, we evaluate the statistical test results. We apply the tests on the whole sample and on four non-overlapping sub-samples of equal length. The sub-samples testing is employed to see if information efficiency is episodic in nature. We present the results in Table 2.

Here, Lo-McKinlay and Choi are individual VR tests whereas Chen-Deo, Chow-Denning, Richardson and Smith and Wright are joint VR tests. In the individual VR tests, the weak form EMH is tested at separate holding periods. In the case of joint VR tests, the null of EMH is jointly tested for all the holding periods. We decided the holding periods as 2,5,10 as suggested by [43].

First, we go through the test results for the entire sample. The Lo-Mac(M1) statistics reject the null of weak form efficiency for the lags 5 and 10. However, when we account for heteroscedasticity (the M2 statistics), the returns are found to be weak form efficiency. Looking into the Automatic VR Test results (Choi), we can see that the null of EMH is not rejected for the whole sample. Among the joint VR tests, Wald test and Wright's joint rank and sign test results suggest that the wine market is informationally inefficient whereas Chen-Deo and Chow-Denning test results do not reject the null of weak form efficiency. Looking into the test results for serial dependence, the Escariano and Lobato test result does not reject of linear dependence structure. However, the Dominic-Lobato test results reject the null non-linear independence. The Hurst coefficient is 0.552 and statistically significant and thus confirms weak long memory. Overall, the results are mixed. VR test results give some indication towards weak form inefficiency. The presence of non-linear dependence and long memory in the return series is confirmed. The mixed nature of result warrants more examination to see if weak form EMH is an episodic phenomenon. Towards this, we examine the test results estimated for the four non-overlapping sub-samples.

In case of the first sub-sample, Lo-Mac M1 statistics reject the null of weak form EMH at holding periods 2 and 5 whereas M2 does not reject the null hypothesis. Choi test also cannot reject the null of EMH. Among the joint VR test results, Wright's test result shows that the sub-sample is weak form inefficient, whereas Cho-Denning and Chen-Deo test result confirm that the sub-sample is weak form efficient. Escariano and Lobato test result do not reject of linear dependence structure while Dominic-Lobato test confirm non-linear dependence. The Hurst coefficient value is 0.568 and statistically significant, showing weak persistence.

Table 1. Summary statistics.

Statistic	Value
Minimum	-0.032353
Maximum	0.05631
Mean	4.06E-05
Stand. Deviation	0.0028422
Skewness	1.264 (0.000)
Excess Kurtosis	53.506 (0.000)
Jarque-Bera(JB)	532610 (0.000)
Ljung-Box(5)	58.094 (0.000)
Box-Pierce(5)	11.6040 (0.040)

Note: P values are provided in the parenthesis

Table 2. Test results.

Statistics		Whole Sample	Subsample1	Subsample2	Subsample3	Subsample4
Lo-Mac M1	2	1.554	0.826	-1.323	0.864	-2.424**
	5	4.507**	2.272**	-0.156	4.892***	-1.408
	10	4.315 **	2.074	1.847	8.094***	-0.073
Lo-Mac M2	2	0.464	0.476	-1.148	0.775	-2.191**
	5	1.424	1.385	-0.143	4.305***	-1.250
	10	1.443	1.338	1.705	7.060***	-0.065
Choi	1.787	0.466	-0.738	2.927	-1.856	
	(0.454)	(0.634)	(0.320)	(0.002)	(0.030)	
Chow-Denning (2,5,10)	CD1	4.507***	2.272	1.847	8.094***	2.424**
	CD2	1.443	1.385	1.705	7.060***	2.191
Chen- Deo (2,5,10)	2.832	2.701	12.001**	33.839***	8.576**	
RS Wald (2,5,10)	26.798***	6.672	16.105***	86.564***	9.292**	
JR1 (2,5,10)	15.359***	15.205***	1.941	6.732***	1.655	
JR2 (2,5,10)	18.023***	15.118***	1.621	6.998***	2.101	
JS1 (2,5,10)	9.346***	10.262***	2.358**	4.638***	1.256	
Dominguez and Lobato	CM	0.472	0.514	0.578	0.170	0.452
		(0.000)	(0.030)	(0.010)	(0.280)	(0.050)
	KS	1.135	1.109	1.387	1.068	1.388
		(0.000)	(0.060)	(0.030)	(0.120)	(0.050)
Escanciano and Lobato(ES)	0.215	0.226	1.242	87.960	4.776	
	(0.643)	(0.633)	(0.265)	(0.000)	(0.026)	
Hurst coefficient (H)	0.552	0.568	0.696	0.559	0.731	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	

Note: In table 2, Lo-Mac M1 and M2 stands for Lo-McKinlay VR test statistics, with homoscedastic and heteroscedastic errors. Choi stands for Choi's automatic VR test. Similarly, Chow Denning CD1 and CD2 denotes the Chow-Denning Joint VR test statistics with homoscedastic and heteroscedastic errors. Chen-Deo stands for Chen and Deo's joint VR test. Wald test statistic of Richardson and Smith is denoted by RS Wald. Wright's joint rank and sign VR test statistics are denoted by JR1, JR2 and JS1.The Crammer-Von and Kolmogorov-Smirnov statistic of Dominiguez and Lobato are represented by CM and KS. Similarly, Escanciano and Lobato test statistic is represented by ES. The measure for long memory, i.e. Hurst coefficient is denoted by H. The p values are presented in the parenthesis. The symbols *** and ** indicates the rejection of the null hypothesis of weak form efficiency at 1% and 5% significance respectively

In the second sub-sample, both Lo-Mac and Choi test results do not reject the null of weak form EMH. Among joint VR tests; Chen-Deo, Chow-Denning and Wald test results confirm weak form EMH in the sub-sample whereas the Wright test results showing that the sub-sample is weak form inefficient. Escariano and Lobato test result show absence of linear dependence structure where Dominic-Lobato test results confirm non-linear dependence in the sub-sample. Hurst coefficient value is 0.696 and statistically significant, showing moderate persistence or long memory.

In the third sub-sample, we can see that all the variance ratio tests (except Lo-Mac M1 and Lo-Mac M2 at lag 2) reject the null of weak form efficiency. Looking into the Escariano and Lobato test result, we can confirm presence of linear dependence structure. However, Dominic-Lobato test results show the absence of non-linear dependence in the sub-sample. The Hurst coefficient value is 0.559 and statistically significant, pointing towards the existence of weak persistence.

In the fourth sub-sample, it is seen that the null of weak form EMH is rejected for Lo-Mac M1 and Lo-Mac M2 at lags 2, whereas it is not rejected at other lags. Choi test result indicates that the sub-sample is weak form inefficient. Choi-Denning (CD1) statistic value shows that the series is weak form inefficient. However, when we consider heteroscedastic errors (CD2), the null of weak form EMH is not rejected. Both Chen-Deo and Wald test results show that the sub-sample is weak form efficient. However, the Wright test results show that the sub-sample is weak form efficient. Escariano and Lobato test result confirms linear dependence while Dominic-

Lobato test results indicate non-linear dependence in the sub-sample. The Hurst coefficient is statistically significant with a value is 0.731, showing strong persistence in the sub-sample.

Looking into the results, we see a mixed picture. VR test results show mixed evidence regarding weak form efficiency of the wine market. Further, there is evidence of non-linear dependence in the return series. The presence of long memory across all the four sub-samples indicates persistence in the return series. In this context, it would be ideal to study the market efficiency in a time varying context. Towards this, we estimate the AI over a rolling window of 500 length. We present the result in Figure 1.

From the plot, it is clear that the wine market oscillates between relative states of efficiency and inefficiency. However, it never touches the theoretical minimum zero, indicating that the wine market was never truly efficient. The market becomes more inefficient as the AI values move away from zero. During times of extreme market movements, any dependence structure present in the market will be lost because of the prevailing uncertainty and market volatility, resulting in AI values being close to zero.

We identify the first dip in wine prices around end of 2012. This period coincides with the Chinese-lead Bordeaux bubble collapse. With the post 2008 economic boom in China, the demand for fine wine increased multifold. Majority of the demand was aimed at fine wine produced in the Bordeaux region of France. Fine wine was mainly employed as a gift in China. This increased demand resulted in a steep rise of fine wine prices, resulting in the asset bubble. For example, a case of Chateau Margaux 2000 cost £10,500 during the peak of the bubble.

The building of the asset bubble is characterized by the increased AI values, indicating the increasing returns in the market. This is in line with the earlier results that wine prices are influenced by Economic growth[30] (Jiao,2016). However, with the 2011 anti-corruption drive in China, demand for fine wine as a gift steeply declined, resulting in the bubble's collapse. The same is characterized in the plot by the decreasing AI values. Next, we see a drop in AI values between January-June 2013. The possible reason for the decrease in the AI values is the QE3 tapering by US FED in 2013. Later, we see AI values exhibiting a decline, starting from 2014 January. This period coincides with the US FED's tapering of the bond-buying back program starting in January 2014. The AI reaches its minimum value around June 2014, coinciding with then FED chairman Bernanke's announcement regarding QE tapering and the resultant stock market crash in June 2014. [30] had shown that macroeconomic factors indirectly influence wine prices through shocks from the financial markets

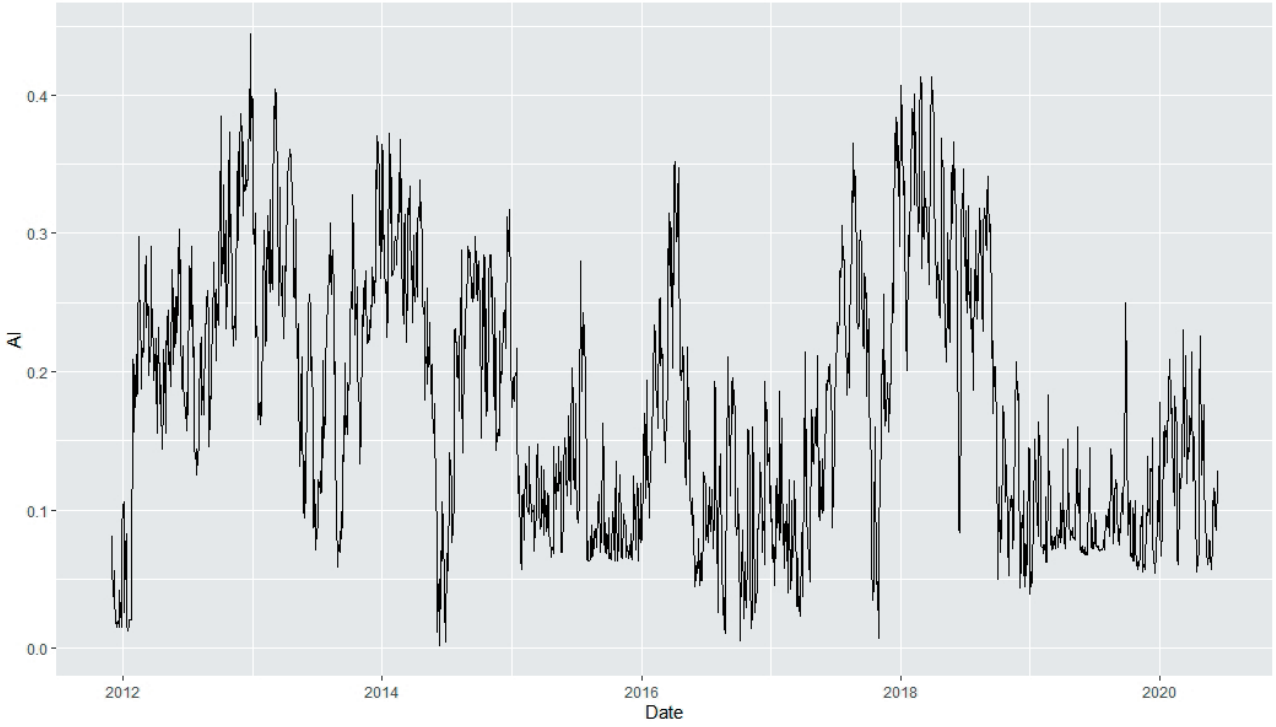

Figure 1. The adaptability index plot.

via the channels such as wealth effect, cash effect and volatility transmission. Further, there is a direct but delayed impact. The AI values suggest that the QE 3 tapering and the resultant economic turbulence affected wine prices. Later, we find a drop in AI values starting around the first quarter of 2016. This period coincides with the Brexit announcement and the subsequent turmoil in the wine market. UK is one of the largest wine markets in the world. Therefore, leaving the EU affects the wine market in two ways. First, the import tariffs will undergo a change. The earlier free trade agreements with the EU will no longer be applied. The increased tariffs will have a negative impact on wine consumption because of the price rise. Second, the depreciation of Pound since Brexit makes wine imports costlier and driving its prices up and may cause a price bubble. We see a recovery around the beginning of 2017 with the AI values reaching its peak by mid-2017 and then drop. Bordeaux Index grew 43% in the first six months of 2017, compared to the same period in 2016. [31] found evidences of an asset bubble during this period because of the exchange rate fluctuations. The collapse of the 2017 bubble is characterized by decreasing AI values post June 2017. The period 2019-20 is characterized by low AI values (oscillating between 0.2 and 0.05), indicating that the market was relatively efficient during this period. If we analyze the wine market's response to the Covid-19 crisis, we can see no significant fluctuations in the AI, indicating that wine market was not significantly affected by the Covid-19 induced economic crisis so far. However, a delayed impact cannot be ruled out.

CONCLUDING REMARKS

The purpose behind this study was to analyze nature of informational efficiency in the wine market. To achieve our objective, we used six variance ratio tests and two tests for serial dependence on the daily returns of LIV-EX 50. We applied the tests on the whole sample and four equally sized non-overlapping sub-samples to see if weak form efficiency could be categorized as episodic. We estimated Hurst coefficient to test for the presence of long memory in the data. The statistical tests exhibited mixed results regarding weak form efficiency, while the Hurst coefficient values confirmed long memory. Further, presence of non-linear dependence was detected. Considering these factors, we tested the dynamic nature of information efficiency by estimating the adaptability index (AI) for the LIV-EX 50 returns over a rolling window of length 500.The AI values showed that the wine market is periodically oscillating between states of relative efficiency and inefficiency. We use the word relative as AI never reached its theoretical minimum value of zero. Periods of inefficient behavior often coincided with episodes of economic turmoil. Our analysis revealed that the Wine market was adversely affected by events such as the Bordeaux wine price bubble, the Quantitative Easing 3 (QE3) tapering by US FED, Brexit and Covid-19. Our results confirm the findings of [44] , that wine markets are influenced by Macroeconomic fluctuations directly and indirectly.

Regarding market efficiency, our results confirm the findings of [29], indicating that wine market is informationally inefficient. However, our study reveals that the notion of informational efficiency in wine market is dynamic than static. That is, the market participants adapt according to the prevailing market conditions. Therefore, our study extends the work carried out by [29].

From the AI values, we can see that the wine market switches between states of relative efficiency and inefficiency. An inefficient market implies that the wine returns do not follow a random walk and there can be predicted. Hence, there is chance of excess profit to be made. Further, When the market is the in period of inefficiency, the Wine prices do not reflect all the available information, enabling the market participants to incorporate their own hidden information set while creating strategies and reap extra gains. However, this would not be desirable in the long run, as mispricing of assets invariably leads to asset bubbles and market crashes [45]. Therefore, from a policy perspective, it would be better to make wine market related information to be more accessible to all stakeholders so that the information asymmetry in the market could be minimized.

Our results reveal that the wine market was largely unaffected by the COVID-19 induced financial shock. From an investor perspective, this is a positive news, as wine could be employed as a safe haven instrument during times of crisis. Our results reiterate the safe haven property of Wine market, previously discussed by [19] and [21]. For practical purposes, the AI could be used as an indicator to measure relative market efficiency at any point. If AI values are away from zero, there is a dependence structure present in the market and it may persist for some time. An investor could employ appropriate models to identify the nature of persistence and design necessary trading strategies.

To conclude, it is better to treat information efficiency as a dynamic concept rather than a static notion. Our results conclusively proved the dynamic nature of information efficiency of the wine market and confirmed the safe haven property of wine. We suggest investors to consider these aspects while making investment decisions.

REFERENCES

[1] E.F. Fama, The behavior of stock-market prices, J. Bus. 38 (1965) 34–105.

[2] S. Khuntia, J.K. Pattanayak, G.S. Hiremath, Is the foreign exchange market efficiency adaptive? The empirical evidence from India, J. Asia-Pacific Bus. 19 (2018) 261–285.

[3] A.W. Lo, The adaptive markets hypothesis, J. Portf. Manag. 30 (2004) 15–29.

[4] G.S. Hiremath, J. Kumari, Stock returns predictability and the adaptive market hypothesis in emerging markets: evidence from India, Springerplus. 3 (2014) 428.

[5] G.S. Hiremath, S. Narayan, Testing the adaptive market hypothesis and its determinants for the Indian stock markets, Financ. Res. Lett. 19 (2016) 173–180.

[6] J.H. Kim, A. Shamsuddin, K.-P. Lim, Stock return predictability and the adaptive markets hypothesis: Evidence from century-long US data, J. Empir. Financ. 18 (2011) 868–879.

[7] C.J. Neely, P.A. Weller, J.M. Ulrich, The adaptive markets hypothesis: evidence from the foreign exchange market, J. Financ. Quant. Anal. (2009) 467–488.

[8] M.N. Shahid, M. Jehanzeb, A. Abbas, A. Zubair, M.A.H. Akbar, Predictability of precious metals and adaptive market hypothesis, Int. J. Emerg. Mark. (2019).

[9] M.M. Ghazani, S.B. Ebrahimi, Testing the adaptive market hypothesis as an evolutionary perspective on market efficiency: Evidence from the crude oil prices, Financ. Res. Lett. 30 (2019) 60–68.

[10] J. Chu, Y. Zhang, S. Chan, The adaptive market hypothesis in the high frequency cryptocurrency market, Int. Rev. Financ. Anal. 64 (2019) 221–231.

[11] S. Khuntia, J.K. Pattanayak, Adaptive market hypothesis and evolving predictability of bitcoin, Econ. Lett. 167 (2018) 26–28.

[12] P.Masset, C. Henderson, Wine as an alternative asset class. *Journal of Wine Economics*, *5*(1) (2010),87-118.

[13] J.J. Fogarty,Wine investment and portfolio diversification gains. *Journal of Wine Economics*, *5*(1) (2010),119-131.

[14] J.J. Fogarty,C. Jones, Return to wine: a comparison of the hedonic, repeat sales and hybrid approaches. Australian Economic Papers 50(4)(2011), 147–156.

[15] L. Baldi, M. Peri, D. Vandone, Investing in the wine market: a country-level threshold cointegration approach. Quantitative Finance, 13(4)(2013), 493–503.

[16] J.J. Fogarty, R. Sadler, To save or savor: A review of approaches for measuring wine as an investment. *Journal of Wine Economics*, *9*(3)(2014), 225-248.

[17] E. Dimson, P. Rousseau, C. Spaenjers,The price of wine. Journal of Financial Economics, 118 (2) (2015),431-449

[18] B.Faye,E. Le Fur, S. Prat, Dynamics of fine wine and asset prices: evidence from short-and long-run co-movements. *Applied Economics*, *47*(29)(2015), 3059-3077.

[19] E.I. Bouri, Fine wine as an alternative investment during equity market downturns, J. Altern. Investments. 17 (2015) 46–57.

[20] E. Le Fur, H.B. Ameur, B. Faye, Time-varying risk premiums in the framework of wine investment. *Journal of Wine Economics*, *11*(3)(2016) , 355 - 378

[21] E.I. Bouri, D. Roubaud, Fine Wines and Stocks from the Perspective of UK Investors: Hedge or Safe Haven? Journal of Wine Economics, 11(02) (2016), 233–248.

[22] B.Aytaç,C. Mandou, Wine: To drink or invest in? A study of wine as an investment asset in French portfolios. *Research in International Business and Finance*, *36(2016)*, 591-614.

[23] S. Introvigne, E. Bacchiocchi, D. Vandone, A cointegration analysis of wine wine stock indexes. Risk Governance and Control: Financial Markets & Institutions. 7(4–2)(2017), 178–188

[24] J.M. Cardebat, L. Jiao, The long-term financial drivers of fine wine prices: The role of emerging markets. *The Quarterly Review of Economics and Finance*, *67(2018)*, 347-361.

[25] E. Bouri, R. Gupta, W.-K. Wong, Z. Zhu, Is wine a good choice for investment?, Pacific-Basin Financ. J. 51 (2018) 171–183

[26] P. Masset, J.P. Weisskopf, Raise your glass: Wine investment and the financial crisis. In *World Scientific Reference on Handbook of the Economics of Wine: Volume 1: Prices, Finance, and Expert Opinion* (2018),271-295

[27] K. Storchmann, Wine economics, J. Wine Econ. 7 (2012) 1–33.

[28] E.I. Bouri, Beyond the negative relation between return and conditional volatility in the wine market, Int. J. Wine Bus. Res. (2014). 279-294

[29] E. Bouri, T. Chang, R. Gupta, Testing the efficiency of the wine market using unit root tests with sharp and smooth breaks, Wine Econ. Policy. 6 (2017) 80–87.

[30] A.W. Lo, A.C. McKinlay, Stock market prices do not follow random walks: Evidence from a simple specification test, Rev. Financ. Stud. 1 (1988) 41–66.

[31] A.W. Lo, A.C. McKinlay, The size and power of the variance ratio test in finite samples: A Monte Carlo investigation, J. Econom. 40 (1989) 203–238.
[32] I. Choi, Testing the random walk hypothesis for real exchange rates, J. Appl. Econom. 14 (1999) 293–308.
[33] D.W.K. Andrews, Heteroskedasticity and autocorrelation consistent covariance matrix estimation, Econom. J. Econom. Soc. (1991) 817–858.
[34] J.H. Wright, Alternative variance-ratio tests using ranks and signs, J. Bus. Econ. Stat. 18 (2000) 1–9.
[35] M. Richardson, T. Smith, Tests of financial models in the presence of overlapping observations, Rev. Financ. Stud. 4 (1991) 227–254.
[36] K.V. Chow, K.C. Denning, A simple multiple variance ratio test, J. Econom. 58 (1993) 385–401.
[37] W.W. Chen, R.S. Deo, The variance ratio statistic at large horizons, Econom. Theory. (2006) 206–234.
[38] J.C. Escanciano, I.N. Lobato, An automatic portmanteau test for serial correlation, J. Econom. 151 (2009) 140–149.
[39] M.A. Domínguez, I.N. Lobato, Testing the martingale difference hypothesis, Econom. Rev. 22 (2003) 351–377.
[40] A. Lo . The Adaptive Markets Hypothesis: Market Efficiency from an Evolutionary Perspective, The Journal of Portfolio Management 30th Anniversary Issue 30 (5)(2004), 15-29
[41] H.E. Hurst, Long-term storage capacity of reservoirs, Trans. Amer. Soc. Civ. Eng. 116 (1951) 770–799.
[42] A.S. Kumar, T. Nagaraju, T. Ajaz, On the Informational Efficiency of the Cryptocurrency Market, IUP J. Appl. Econ. 19 (2020).
[43] R.S. Deo, M. Richardson, On the asymptotic power of the variance ratio test, Econom. Theory. (2003) 231–239.
[44] L. Jiao, Macroeconomic determinants of wine prices. The American Association of Wine Economists, AAWE Working Paper, 2016.
[45] C.-W. Su, L.I. Xin, When will bubbles occur in the fine wine market?, Econ. Comput. Econ. Cybern. Stud. Res. 54 (2020).

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