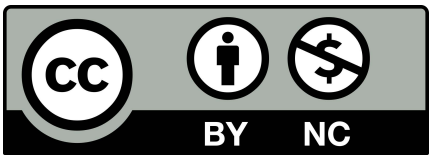
To appear in the *International Journal of Wine Business Research.*
DOI: 10.1108/IJWBR-03-2022-0012
Accepted 04-Jan-2023.



# Financial Resilience of Spanish Wineries during the COVID-19 Lockdown

Núria Arimany-Serrat
*Department of Economics and Business, University of Vic-Central University of Catalonia, Vic, Spain*
M. Àngels Farreras-Noguer
*Department of Business Administration, University of Girona, Girona, Spain*
Germà Coenders
*Department of Economics, University of Girona, Girona, Spain*

**Abstract**

**Purpose** – The research focuses on the impact of COVID-19 on the Spanish wine sector and the financial resilience of Spanish wineries in the period 2019-2020.

**Design/methodology/approach –**The dataset contains 355 limited companies of the Spanish wine sector which were active in the period 2019-2020. The explanatory variables used are size and age of the company, exports, subsidies, and gender distribution in the workforce. The financial statements of the companies are treated as compositional data, using log-ratios for asset structure, leverage, margin, turnover, and debt maturity. The first-difference estimator is used for the panel-data model relating the differences in the log-ratios between 2020 and 2019 to the explanatory variables.

**Findings –** In average terms, margin and turnover have significantly worsened between 2019 and 2020 while debt maturity has increased. A larger firm size, a greater age, a higher share of women in the workforce, and subsidies have made wineries more resilient between 2019 and 2020.

**Originality/value –** This is the first financial statement analysis of the impact of COVID-19 in the winery sector.

**Keywords** COVID19, Spain, compositional data (CoDa), financial ratios, financial statement analysis, wine industry

**Paper type** Research paper

## Introduction

The Spanish wine sector was especially affected by COVID-19 during the 2019-2020 period, and there were notable changes at the economic and social level, directly related to sales, exports, innovation and employment (Marco-Lajara *et al.,* 2021). The significant impact of COVID-19 on the wine sector in 2020 led to a 14% drop in sales worldwide (Lu, 2020; Wittwer and Anderson, 2021), the loss of traditional distribution channels (Coyne, 2020) and the indirect impact on other sectors of activity related to the wine sector (DeYoung, 2020; Almeida et al., 2022). Specifically, with COVID-19 there have been changes such as the opening of new digital distribution channels (Coyne, 2020; Jorge *et al.,* 2020) and the transition towards more social, sustainable and hybrid business models, with subsidies from the government and from associations (DeYoung, 2020), along with new digital experiences in the sector (Carmer *et al.,* 2020). All these changes have had an impact on the financial statements of companies in the sector.

In Spain, the sector generates many jobs in the 17 autonomous communities that produce wine, and it helps prevent the depopulation of certain rural areas. In addition, it is a sector subject to innovation, which attracts tourism thanks to the 70 Denominations of Origin (DO) and the 42 Protected Geographical Indications, with an internationalized wine resulting from its exports and the fact that it represents 13% of vineyard surface worldwide (Vizcaino *et al.,* 2020). It should be borne in mind that before the pandemic the sector generated 2.2% of gross value added and 2.4% of jobs in Spain, and that this country was the world's largest exporter of wine in volume and the third in value (Vizcaino *et al.,* 2020). It is, therefore, an important sector at both an economic and social level, with a demographic challenge in certain depopulated rural areas, and which can help to structure the territory, even more so with the growing wine tourism (Vizcaino *et al.,* 2020).

Having presented the background, the aim of this study is to analyze the impact of COVID-19 on the financial statements of the Spanish wine sector, highlighting the financial resilience of the companies in the sector to survive the pandemic. With this purpose, a dynamic regression model of the evolution of the financial ratios of Spanish wineries between 2019 and 2020 is presented where the predictors of resilience are identified.

This issue is important, since the pandemic has aroused scientific interest in the financial impact on the wine sector in the face of health crises such as COVID-19 as an unprecedented exceptional situation.

The contribution of this article to the academic knowledge makes it possible to assess the impact of subsidies, the gender perspective, and other variables to mitigate the pandemic effects. At a professional level, it makes it possible to determine which factors are relevant in the event of pandemics or potential health crises with economic and social impact. Thus, the main contribution of the study is to identify and explain the variables that positively affect the resilience of the sector in the face of a pandemic and that can serve as a reference to companies that intend to increase their resilience to face this type of exceptional scenarios. On the other hand, the analysis of the financial statements in the wine sector before and after COVID-19 allows us to assess the appropriate decisions to manage the pandemic and survive COVID-19. In this respect it should be considered that the wine sector represents an important economic activity in many countries, due to the

jobs and income it generates (Migliaccio and Tucci, 2019). This article analyses for the first time the financial statements of companies in the wine sector in times of COVID-19.

After the introduction, this article first presents the review of the literature and the hypotheses, then the methodology, then the results and their discussion, and finally the conclusions.

## Literature review

The health emergency caused by COVID-19 forces academics to investigate its effects on the performance of companies (Almeida *et al.,* 2022; Paoloni and Cosentino, 2021) although in the Spanish wine sector there are no studies on the effects of COVID-19 on the financial statements. Furthermore, as a result of the pandemic, the economic and social model has been revised (Juliá Igual *et al.,* 2022) in different sectors. Particularly in the wine sector, a degree of resilience is detected in production, distribution, sale, and consumption (Vergamini *et al.,* 2021). In other words, the pandemic highlights the resistance of organizations and their survival with the appropriate management systems. Thus, in the wine sector, the study of financial resilience is relevant due to the sector's exposure to natural disasters, and to the need for innovation and for a proper winery management (Casprini *et al.,* 2022; Wittwer and Anderson, 2021).

This article focuses on the search for the organizational and situational predictors of the financial resilience of the sector during the pandemic, in order to detect the key factors of its survival, including its management system considering gender policy, due to its relevance in the sector (Casprini *et al.,* 2022; Paoloni and Cosentino, 2021). The period 2019-2020 is analyzed to assess the impact of the pandemic.

The financial ratios that are used as indicators of financial resilience and as dependent variables are asset structure, indebtedness, and debt maturity (to assess whether the debt is excessive and its maturity in the short term), as well as margin and turnover (to assess their decline during the pandemic).

Margin (Bresciani *et al.,* 2016; Muñoz *et al.,* 2021; Neves *et al.,* 2022; Soler *et al.,* 2017) and turnover (Challita *et al.,* 2017) are decisive in this analysis since both are the components of the return on assets. Excessive indebtedness (Migliaccio and Tucci, 2019; Muñoz *et al.,* 2021; Neves *et al.,* 2021; Rodríguez-Cohard *et al.,* 2021) is a clear and universally recognized threat to the survivability of companies. An asset structure (Castillo Valero and García Cortijo, 2013; Migliaccio and Tucci 2019) with too high a current-asset weight can reveal an excess in unsold stock or unpaid receivables. The role of debt maturity (Bernardi, 2021) is more controversial. Debt maturity can increase as a result of converting short-term debt to long-term debt, which increases the survivability of the company, but it can also increase as a result of a reduction in activity and hence in the volume of accounts payable.

The hypotheses with respect to the determinants of the financial resilience are as follows.

With regards to the size of the company, Ozdemir *et al.* (2022) highlight the more efficient risk management in large companies; Juliá Igual *et al.* (2022) and Chen and Yang (2021) state that business size is decisive in dealing with the pandemic and Zahedi *et al.* (2021);

Ichsani *et al.* (2021); and Pattiruhu and Paais (2020) indicate that company size affects the financial structure. This leads us to the following hypothesis:

H1. The larger companies in the wine sector have more financial resilience.

As regards the age of the company Gallizo *et al.* (2019) point out that difficult financial situations are better overcome by companies that have already demonstrated their ability to survive, in other words, companies that have been established for years. Therefore, the following hypothesis is put forward:

H2. The older companies in the wine sector have more financial resilience.

The subsidies firms receive represent a valuable resource to face different challenges that companies face throughout their life span (DeYoung, 2020; Duarte-Alonso, 2015; Duarte-Alonso and Bressan; 2015). Specifically, in the Spanish case, the wine sector accessed subsidies for COVID-19 from the government, as detailed by Marco-Lajara *et al.* (2021). More generally, Zahedi *et al.* (2021) report government support for determinant factors of financial resilience. Therefore, the following hypothesis is put forward:

H3. Companies that receive government capital grants and subsidies in the wine sector have more financial resilience.

Regarding the percentage of women in the workforce, when there is a larger share of women, the financial performance of the company tends to be considered together with environmental performance, as stated by Gazzola *et al.* (2022). In addition, Paoloni and Cosentino (2021) point out that when there are women in the management team, in difficult times such as the pandemic, adversities are responded to with more fluidity and skill. Therefore, the following hypothesis is posed:

H4. A higher presence of women in the workforce implies more financial resilience in the wine sector.

Whether the company exported or not was also affected by the pandemic. Specifically, Expósito-Langa *et al.* (2021) indicate that exports internationalize wine and should not be interrupted in adverse situations, although the pandemic was exceptional. Moreover, Mozas-Moral *et al.* (2021) establish that the internationalization of wine is decisive for improving the performance of wineries and for being able to recover quickly from adverse situations. In a similar vein, Wittwer and Anderson, (2021) consider that exports should be diversified to discover new markets and diversify risk in different countries to resist difficult situations. Therefore, the following hypothesis is put forward:

H5. Exports in the wine sector imply more financial resilience.

On the other hand, at the level of control variables, the geographical areas analysed and the typology of the companies (public limited versus private limited) may also affect the resilience of wine companies (Expósito-Langa *et al.,* 2021; Juliá Igual *et al.,* 2022; Zahedi *et al.,* 2021). Specifically, the areas analyzed in this study have different strategic management policies, such as having a single DO in the case of La Rioja or having 12 DOs as in the case of Catalonia, with implications for instance on the international marketing of wine. These policies are irrespective of the geographic proximity of the analyzed territories (Arimany-Serrat and Farreras-Noguer, 2020).

## Method

*Data*

Financial statements were obtained from the SABI (Iberian Balance sheet Analysis System, accessible at https://sabi.bvdinfo.com/) database, developed by INFORMA D&B in collaboration with Bureau Van Dijk. Search criteria were winery companies (NACE 1102 "Manufacture of wine from grape") in Spain with available data for 2019 and 2020, with the form of public and private limited companies, with at least ten employees, and with positive sales values both in 2019 and 2020. The search was performed on 10th January 2022. 370 firms complied with the search criteria. The total net sales of these firms is 2815 million Euro in 2019, accounting for 87% of the net sales of the sector in Spain. All data accord to the current 2007 General Accounting Plan in Spain and are thus comparable with respect to accounting methods and criteria.

The explanatory variables related to the hypotheses and the control variables, as available in the SABI data base, refer to 2019 and are:

- Number of employees, log transformed, as an indicator of company size (Hypothesis H1).
- Firm age in years (Hypothesis H2).
- The firm gets capital grants or subsidies (yes, no; Hypothesis H3).
- The workforce gender distribution (High: proportion of women larger than the median, Low: proportion of women lower than the median, Not disclosed; Hypothesis H4).
- The firm exports part of its produce (yes, no; Hypothesis H5).
- Spanish region (*comunidad autónoma*) in which the firm is located (AND: Andalusia, ARA: Aragon, BC: Basque Country, BI: Balearic Islands, CAT: Catalonia, CI: Canary Islands, CL: Castile-Leon, CM: Castile-La Mancha, EXT: Extremadura, GAL: Galicia, MAD: Madrid Community, MUR: Murcia Region, NAV: Navarre, RIO: La Rioja, VAL: Valencian Community; control variable).
- Type of limited company (public, private; control variable).

*Statistical analysis*

When treated as variables in statistical analyses, standard financial ratios of turnover, margin, indebtedness, asset structure, and debt maturity have been reported to incur a number of serious statistical and practical problems which seriously affect statistical inference, such as asymmetry (Faello, 2015; Linares-Mustarós *et al.*, 2022), non-linearity (Cowen and Hoffer, 1982), severe non-normality (Deakin, 1976; So, 1987), and even dependence of the results on the arbitrary decision regarding which accounting magnitude appears in the numerator and which in the denominator of the ratio (Frecka and Hopwood, 1983).

The Compositional Data (CoDa) methodology, dating back from four decades ago (Aitchison, 1982; 1986), has recently become a well-established toolbox when the research interest lies in ratios among the data (Egozcue and Pawlowsky-Glahn, 2019) and is available in accessible textbooks (van den Boogaart and Tolosana-Delgado, 2013;

Filzmoser *et al.,* 2018; Greenacre, 2018; Pawlowsky-Glahn *et al.,* 2015). This methodology can be effectively used to solve the statistical problems of ratios mentioned in the previous paragraph (Carreras-Simó and Coenders, 2020; Creixans-Tenas *et al.,* 2019; Saus-Sala *et al.,* 2021). Far from being a statistical refinement, the CoDa methodology leads to very substantial differences in the analysis results whenever it has been compared to standard financial ratios in several industries (Carreras-Simó and Coenders, 2021; Jofre-Campuzano and Coenders, 2022; Linares-Mustarós *et al.,* 2018), including the winery sector (Arimany-Serrat *et al.,* 2022; Linares-Mustarós *et al.,* 2022).

The CoDa methodology proceeds by defining a set of log-transformed financial ratios computed from positive and non-overlapping accounting figures (Creixans-Tenas *et al.,* 2019). In our article we consider the following:

$$\begin{gathered} x_1\text{=non-current assets} \\ x_2\text{=current assets} \\ x_3\text{= non-current liabilities} \\ x_4\text{=current liabilities} \\ x_5\text{=operating revenues} \\ x_6\text{=operating costs + financial costs.} \end{gathered} \tag{1}$$

These accounting figures make it possible to compute the intended ratios of turnover, margin, indebtedness, asset structure, and debt maturity.

The so-called isometric log-ratio (ilr) coordinates (Egozcue and Pawlowsky-Glahn, 2005; Egozcue *et al.,* 2003) are the most often recommended log-ratio transformation in CoDa, on the grounds that they are usable in virtually any statistical analysis. Ilr coordinates can be easily formed from a sequential binary partition (SBP) of accounting figures. To create the first ilr coordinate, the complete composition $x_1,x_2,\ldots,x_6$ is split into two subsets of accounting figures: one for the numerator and the other for the denominator of the log-ratio. In the following step, one of the two subsets is further split to create the second ilr coordinate. At any step, the ilr coordinate is a scaled log-ratio of the geometric averages of each subset of accounting magnitudes. The researcher chooses the SBP which lends itself to building analogues to the standard financial ratios of interest. The SBP is commonly expressed as a sign matrix, in which positive signs indicate the accounting figures in the numerator of the ilr coordinate, and negative signs the accounting figures in the denominator. Blank cells indicate the accounting figures which are neither in the numerator nor in the denominator. The SBP we use in this article is:

| | $z_1$ | $z_2$ | $z_3$ | $z_4$ | $z_5$ |
|---|---|---|---|---|---|
| $x_1$: Non-current assets | - | | - | + | |
| $x_2$: Current assets | - | | - | - | |
| $x_3$: Non-current liabilities | - | | + | | + |
| $x_4$: Current liabilities | - | | + | | - |
| $x_5$: Revenues | + | + | | | |
| $x_6$: Costs | + | - | | | |

(2)

At the start of the SBP the $z_1$ coordinate splits the whole composition into revenues and costs versus assets and liabilities. Altogether it can be interpreted as a turnover indicator.

Actually, it represents a generalized concept of turnover covering not only how many times revenues pay for assets but also how many times costs are contained in liabilities:

$$z_1 = \sqrt{\frac{8}{6}} \log \frac{\sqrt[2]{x_5 x_6}}{\sqrt[4]{x_1 x_2 x_3 x_4}}. \tag{3}$$

The second partition splits revenues versus costs and the resulting $z_2$ coordinate can be interpreted as a margin indicator:

$$z_2 = \sqrt{\frac{1}{2}} \log \left( \frac{x_5}{x_6} \right). \tag{4}$$

The third partition splits the balance sheet into liabilities versus assets and the resulting $z_3$ coordinate is an indicator of indebtedness:

$$z_3 = \sqrt{\frac{4}{4}} \log \frac{\sqrt[2]{x_3 x_4}}{\sqrt[2]{x_1 x_2}}. \tag{5}$$

The fourth partition splits assets into non-current and current, and the resulting $z_4$ coordinate can be interpreted as an asset-structure indicator. The higher the coordinate the greater the non-current-asset share:

$$z_4 = \sqrt{\frac{1}{2}} \log \left( \frac{x_1}{x_2} \right). \tag{6}$$

The fifth partition splits liabilities into non-current and current, and the resulting $z_5$ coordinate can be interpreted as a debt-maturity indicator:

$$z_5 = \sqrt{\frac{1}{2}} \log \left( \frac{x_3}{x_4} \right). \tag{7}$$

The factors $\sqrt{8/6}$, $\sqrt{1/2}$ and $\sqrt{4/4}$ are scaling constants which take into consideration the number of accounting figures involved in the coordinates and do not affect their interpretation or their relationships with other variables (see Egozcue *et al.,* 2003 and Linares-Mustarós *et al.,* 2018; 2022 for details). Five ilr coordinates contain all the information about the relative importance of the six original accounting magnitudes (Linares-Mustarós *et al.,* 2018).

The accounting figures of interest may contain no zero values in order for log-ratios to be computed (Martín-Fernández *et al.,* 2011). The same holds for standard financial ratio analysis regarding the figure in the denominator. Unlike the case in standard-financial-ratio analysis, CoDa include an advanced toolbox for zero imputation prior to log-ratio computation. This makes financial statement analysis possible even when some accounting figures of interest equal zero. We use the modified EM approach in Palarea-Albaladejo and Martín-Fernández (2008) which is recommended when there are few zeros in the dataset. Only non-current liabilities ($x_3$) had 3.8 % and 4.1 % zero values in

2019 and 2020 respectively.

In order to detect extreme outliers, squared Mahalanobis distances are computed on the ilr coordinates which, under multivariate normality and for large samples, follow approximately a $\chi^2$ distribution (Filzmoser *et al.,* 2018). An appropriate percentile for this distribution (e.g. $0.95^{(1/n)}$ to take multiple testing into account with a global significance level 0.05) can be used as cut-off criterion for outlier detection (Coenders and Saez, 2000). The number of identified outliers is 15 firms, which are removed from the dataset, thus leaving 355 usable firms.

Once zeros have been imputed, outliers have been removed, and ilr coordinates have been computed, any statistical analysis, no matter how simple or sophisticated, can be performed with standard statistical methods (Arimany-Serrat *et al.,* 2022; Carreras-Simó and Coenders, 2021; Linares-Mustarós *et al.,* 2018; 2022), starting with ordinary least squares regression, in which the ilr coordinates computed from the financial statement figures are either explanatory or dependent variables (Coenders and Pawlowsky-Glahn, 2020; Egozcue *et al.,* 2011), which may be static models for cross-sectional data, or dynamic models for panel data as in our case (Carreras-Simó and Coenders, 2021).

Since we are interested in the factors which determine resilience of wineries to the COVID-19 shock, the main dependent variables $y_1$ to $y_5$ are differences of the coordinates $z_1$ to $z_5$ between 2020 and 2019 (this approach is related to the first-difference estimation for panel-data models, e.g. Wooldridge, 2010):

$$\begin{aligned} y_1 &= z_{1,2020} - z_{1,2019} \\ y_2 &= z_{2,2020} - z_{2,2019} \\ y_3 &= z_{3,2020} - z_{3,2019} \\ y_4 &= z_{4,2020} - z_{4,2019} \\ y_5 &= z_{5,2020} - z_{5,2019}. \end{aligned} \tag{8}$$

The explanatory and control variables are age, employees, exports, subsidies, gender distribution, region, and company type, coded as described above. The initial values $z_{1,2019}$ to $z_{5,2019}$ are also included in all equations as statistical controls of the starting situation of each firm (Maynou *et al.,* 2016), and they are not interpreted. The five equations are thus specified as follows:

$$y_i = f\left(\begin{array}{c}\text{employees, age, subsidies, gender distribution, exports,} \\ \text{region, company type, } z_{i,2019}\end{array}\right), i = 1 \cdots 5. \tag{9}$$

It is also of interest to evaluate the determinants of the financial indicators immediately before the COVID-19 shock in order to have a joint picture of the drivers of the start situation and the changes after the pandemic outbreak. Being better off before the start of a crisis also makes firms more resilient. With this purpose, the following set of five equations is specified:

$$z_{i,2019} = f\left(\begin{array}{c}\text{employees, age, subsidies, gender distribution, exports,} \\ \text{region, company type}\end{array}\right), i = 1 \cdots 5. \tag{10}$$

The ordinary least squares estimator is deemed appropriate for both Eq. (9) and (10) after checking the model diagnostic plots.

All analyses are performed with the R packages `compositions` (Van den Boogaart and Tolosana-Delgado, 2013), `zCompositions` (Palarea-Albaladejo and Martín-Fernández, 2015), and `coda.base` (Comas-Cufí, 2020).

## Results

Descriptive statistics are in Tables I and II. Most firms are not exporting, are receiving subsidies and do not disclose the gender distribution in the workforce. Most firms are private limited companies. Castile-Leon (CL), Castile-La Mancha (CM), and Catalonia (CAT) are the most frequent regions in the data base in accordance with the structure of the sector in Spain.

The median company has been operating for 24 years and has 17 employees. Also in median terms, the most substantial differences between 2019 and 2020 are the increase of non-current liabilities ($x_3$), and the decreases in current liabilities ($x_4$) and revenues ($x_5$).

**Table I.** Sample distribution

| | | | |
|---|---|---|---|
| Subsidies | | Spanish region | |
| No | 27.9 % | AND | 5.1 % |
| Yes | 72.1 % | ARA | 2.8 % |
| Gender distribution | | BC | 7.6 % |
| High | 27.3 % | BI | 1.7 % |
| Low | 26.2 % | CAT | 16.1 % |
| Not disclosed | 46.5 % | CI | 2.0 % |
| Exports | | CL | 20.6 % |
| No | 70.4 % | CM | 10.1 % |
| Yes | 29.6 % | EXT | 1.7 % |
| Type of limited company | | GAL | 7.9 % |
| Private | 67.0 % | MAD | 4.2 % |
| Public | 33.0 % | MUR | 4.2 % |
| | | NAV | 4.2 % |
| | | RIO | 7.6 % |
| | | VAL | 4.2 % |

**Table II.** Descriptive statistics

| | Mean 2019 | SD 2019 | Median 2019 | Mean 2020 | SD 2020 | Median 2020 |
|---|---|---|---|---|---|---|
| Employees | 29.3 | 44.9 | 17 | -- | -- | -- |
| Age | 25.7 | 12.5 | 24 | -- | -- | -- |
| $x_1$ | 8035 | 14923 | 3745 | 8223 | 14801 | 3872 |
| $x_2$ | 8732 | 16966 | 3353 | 8832 | 16901 | 3462 |
| $x_3$ | 2514 | 4906 | 857 | 3090 | 5829 | 1268 |
| $x_4$ | 4073 | 8376 | 1473 | 3552 | 7551 | 1153 |
| $x_5$ | 7864 | 16824 | 2773 | 7247 | 16040 | 2311 |
| $x_6$ | 7309 | 16286 | 2571 | 6832 | 15563 | 2341 |
| $z_1$ | 0.594 | 0.878 | 0.525 | 0.378 | 0.923 | 0.339 |
| $z_2$ | 0.023 | 0.156 | 0.024 | -0.015 | 0.208 | 0.012 |
| $z_3$ | -1.316 | 1.072 | -1.021 | -1.285 | 1.060 | -0.985 |
| $z_4$ | -0.009 | 0.645 | -0.086 | -0.015 | 0.615 | -0.088 |
| $z_5$ | -0.633 | 1.311 | -0.437 | -0.301 | 1.325 | -0.015 |

**Note:** $x_1$: non-current assets, $x_2$: current assets, $x_3$: non-current liabilities, $x_4$: current liabilities, $x_5$: revenues, $x_6$: costs, $z_1$: turnover, $z_2$: margin, $z_3$: indebtedness, $z_4$: asset structure, $z_5$: debt maturity. Age is expressed in years and accounting figures in thousands of Euros.

The boxplots of the dependent $y_1$ to $y_5$ variables are as shown in Figure 1. $y_1$ to $y_5$ indicate respectively the differences in turnover, margin, indebtedness, asset structure and debt maturity between 2019 and 2020. In general, turnover and margin have decreased between 2019 and 2020, i.e., worsened (negative median of $y_1$ and $y_2$), and debt maturity has increased, with a higher share of non-current liabilities (positive median of $y_5$). 75.5 % of firms have decreased their turnover, 66.8 % of firms have decreased their margin, and 69.9 % of firms have increased their debt maturity. The mean values of $y_1$, $y_2$ and $y_5$ are significantly different from zero at 5% following a paired-samples t-test (Table III).

The reduction in margin is especially dramatic, as 77.7 % of firms in the dataset had a positive margin ratio in 2019 and only 63.1 % in 2020. According to Table II the reduction in margin has been driven mainly by a reduction in revenue which is also at the core of the reduction in turnover. This reduced activity can also be partly responsible for the increase in debt maturity via a reduction in accounts payable. However, Table II does show an increase in non-current liabilities in both average and median terms which is also responsible for the debt maturity evolution.

Regarding indebtedness ($y_3$) and non-current-asset share ($y_4$), the percentages of firms with increases and decreases are nearly balanced and their differences are in any case not statistically significant in Table III. The fears that the pandemic would lead to a generalized increase of indebtedness or to an increased volume of unsold stocks or pending accounts receivable have not been realized. It must be considered that in the Spanish wine sector as a whole, cash and cash equivalents only represent 9,2 % of current assets so that current assets basically contain stocks and accounts receivable.

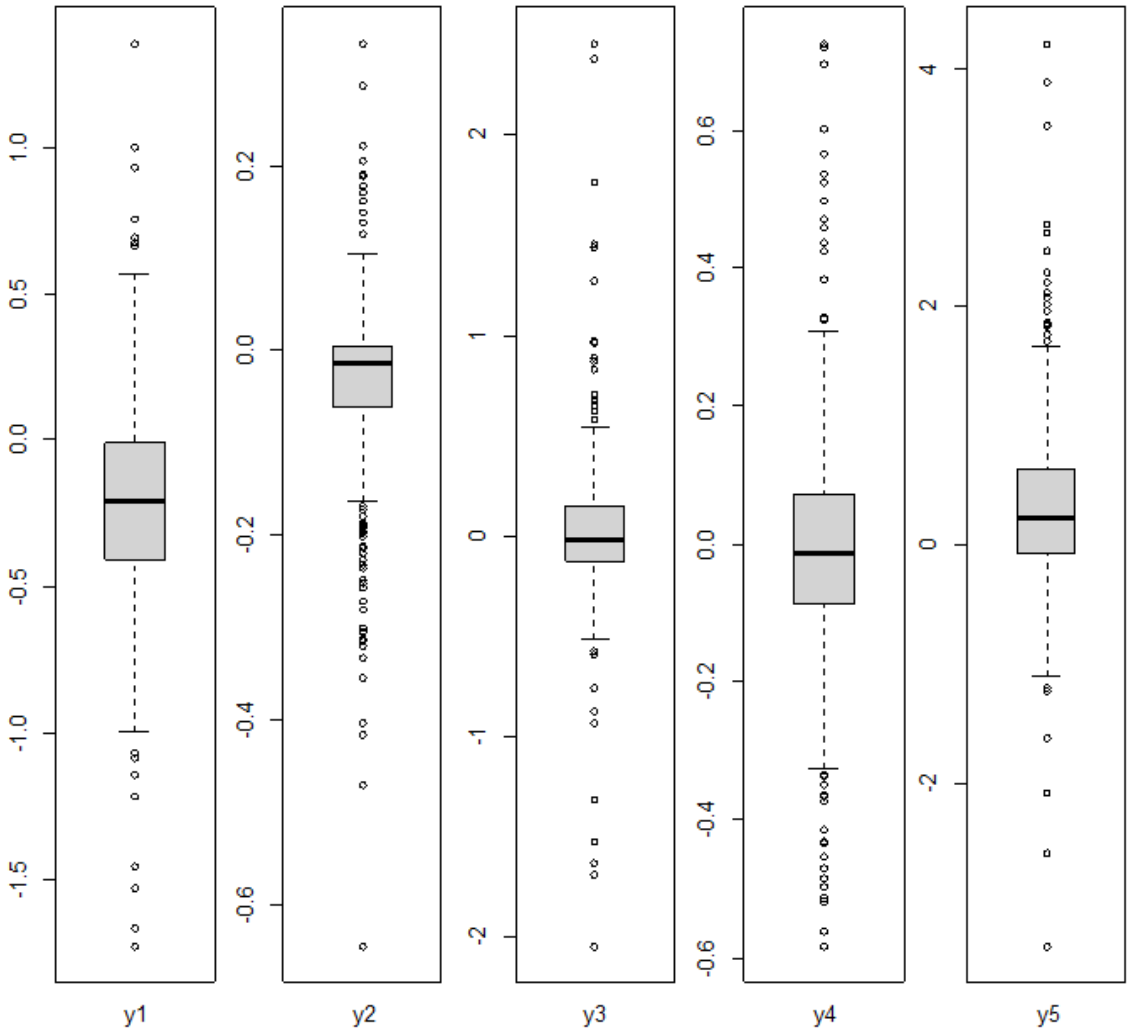



**Figure 1.** Boxplots of the differences in coordinates between 2020 and 2019. $y_1$: turnover, $y_2$: margin, $y_3$: indebtedness, $y_4$: asset structure, $y_5$: debt maturity.

**Table III.** Statistics of the differences in coordinates between 2020 and 2019

| | Mean | SD | Median | % Values > 0 | p-value of t-test of zero mean |
|---|---|---|---|---|---|
| $y_1$ | -0.216 | 0.372 | -0.207 | 24.5 | <0.001 |
| $y_2$ | -0.039 | 0.105 | -0.014 | 33.2 | <0.001 |
| $y_3$ | 0.032 | 0.422 | -0.020 | 44.5 | 0.159 |
| $y_4$ | -0.006 | 0.186 | -0.012 | 47.0 | 0.534 |
| $y_5$ | 0.332 | 0.763 | 0.224 | 69.9 | <0.001 |

**Note:** $y_1$: turnover, $y_2$: margin, $y_3$: indebtedness, $y_4$: asset structure, $y_5$: debt maturity

Each of the five columns in Table IV shows the estimates of the effects on the initial 2019 coordinate values ($z_{1,2019}$ to $z_{5,2019}$ indicating respectively pre-pandemic turnover, pre-pandemic margin, pre-pandemic indebtedness, pre-pandemic asset structure, and pre-pandemic debt maturity), according to Eq. (10). Each of the five columns in Table V shows the estimates of the effects on the coordinate changes between 2019 and 2020 ($y_1$ to $y_5$ indicating respectively turnover change, margin change, indebtedness change, asset-structure change, and debt-maturity change) according to Eq. (9). Non-significant explanatory variables are kept in all equations but their estimates are not shown. The

explanatory and control variables without any significant effect in a complete table are removed from the table for the sake of readability. This includes the type of company and gender in Table IV and age, employees, region, type of company and $z_{1,2019}$ in Table V. The type of company (public vs. private limited company) is the only variable with no significant effect, neither on the 2019 level nor on the change between 2020 and 2019.

**Table IV.** Effects on coordinate values in Eq. (10) for 2019 ($z_{1,2019}$ to $z_{5,2019}$)

| | $z_{1,2019}$ | $z_{2,2019}$ | $z_{3,2019}$ | $z_{4,2019}$ | $z_{5,2019}$ |
|---|---|---|---|---|---|
| Employees | n.s. | 0.041** | n.s. | n.s. | n.s. |
| Age | 0.010* | n.s. | -0.023*** | n.s. | -0.019** |
| Subsidies Yes | n.s. | 0.079*** | n.s. | 0.201* | n.s. |
| Exports Yes | n.s. | n.s. | 0.270* | -0.174* | n.s. |
| Region ARA | n.s. | -0.058*** | n.s. | n.s. | n.s. |
| Region BC | n.s. | -0.005*** | n.s. | n.s. | n.s. |
| Region BI | n.s. | -0.078*** | n.s. | n.s. | n.s. |
| Region CAT | n.s. | 0.005*** | n.s. | n.s. | n.s. |
| Region CI | n.s. | 0.033*** | n.s. | n.s. | n.s. |
| Region CL | n.s. | 0.097*** | n.s. | n.s. | n.s. |
| Region CM | n.s. | -0.026*** | n.s. | n.s. | n.s. |
| Region EXT | n.s. | -0.001*** | n.s. | n.s. | n.s. |
| Region GAL | n.s. | 0.028*** | n.s. | n.s. | n.s. |
| Region MAD | n.s. | -0.063*** | n.s. | n.s. | n.s. |
| Region MUR | n.s. | 0.024*** | n.s. | n.s. | n.s. |
| Region NAV | n.s. | -0.070*** | n.s. | n.s. | n.s. |
| Region RIO | n.s. | 0.028*** | n.s. | n.s. | n.s. |
| Region VAL | n.s. | -0.026*** | n.s. | n.s. | n.s. |
| R-squared | 0.083 | 0.196 | 0.129 | 0.117 | 0.081 |

**Note:** * p-value<0.05; ** p-value<0.01; *** p-value<0.001; n.s. non significant at 0.05. $z_{1,2019}$: turnover, $z_{2,2019}$: margin, $z_{3,2019}$: indebtedness, $z_{4,2019}$: asset structure, $z_{5,2019}$: debt maturity.

**Table V.** Effects on the changes in Eq. (9) between 2019 and 2020 ($y_1$ to $y_5$)

| | $y_1$ | $y_2$ | $y_3$ | $y_4$ | $y_5$ |
|---|---|---|---|---|---|
| Subsidies Yes | n.s. | n.s. | -0.110* | n.s. | -0.249** |
| Gender Low | n.s. | -0.004* | n.s. | n.s. | n.s. |
| Gender Not disclosed | n.s. | -0.033* | n.s. | n.s. | n.s. |
| Exports Yes | n.s. | n.s. | n.s. | n.s. | 0.238* |
| $z_{2,2019}$ | -- | 0.160*** | -- | -- | -- |
| $z_{3,2019}$ | -- | -- | -0.103*** | -- | -- |
| $z_{4,2019}$ | -- | -- | -- | -0.085*** | -- |
| $z_{5,2019}$ | -- | -- | -- | -- | -0.153*** |
| R-squared | 0.094 | 0.129 | 0.091 | 0.141 | 0.130 |

**Note:** * p-value<0.05; ** p-value<0.01; *** p-value<0.001; n.s. non significant at 0.05. $y_1$: turnover, $y_2$: margin, $y_3$: indebtedness, $y_4$: asset structure, $y_5$: debt maturity.

A positive significant effect of a numeric explanatory variable on $z_{1,2019}$, $z_{2,2019}$, $z_{4,2019}$ and, possibly, $z_{5,2019}$ in Table IV indicates a variable whose increase makes wineries better off just before the CoViD-19 outbreak, associated to a higher initial turnover, margin, non-current-asset share and debt maturity. It must be borne in mind that the improvement in debt maturity is both driven by higher non-current liabilities and by lower accounts

payable resulting from the reduction in activity, the latter having nothing to do with resilience. A negative significant effect of an explanatory variable on $z_{3,2019}$ indicates the same, associated to a lower initial indebtedness. As usual, qualitative explanatory variables with $k$ categories can be included if coded with $k$-1 binary variables. A positive significant coefficient of a binary variable on $z_{1,2019}$, $z_{2,2019}$, $z_{4,2019}$ and, possibly, $z_{5,2019}$ indicates that the corresponding firm category is better performing in 2019 than the reference category (the category which is left without a binary variable: AND region, no exports, no subsidies and women presence disclosed and above the median). A negative significant effect on $z_{3,2019}$ indicates the same.

A positive significant effect of a numeric explanatory variable on $y_1$, $y_2$, $y_4$ and, possibly, $y_5$ in Table V indicates a variable whose increase makes wineries resilient to the CoViD-19 shock, by limiting the decrease of turnover and margin, or by increasing non-current-asset share and debt maturity. A negative significant effect of an explanatory variable on $y_3$, indicates the same, by decreasing indebtedness. A positive significant coefficient of a binary variable on $y_1$, $y_2$, $y_4$ and, possibly, $y_5$ indicates that the corresponding firm category is more resilient than the reference category. A negative significant effect on $y_3$ indicates the same.

According to Table IV, a higher firm age is associated to a higher firm's turnover before the pandemic ($z_{1,2019}$). A larger number of employees, and receiving subsidies are associated to a larger firm's margin before the pandemic ($z_{2,2019}$). A higher firm age is associated to a lower indebtedness level in 2019 before the pandemic ($z_{3,2019}$) while exports are associated to a higher pre-pandemic indebtedness. In 2019 firms with subsidies had a greater weight of non-current assets in their asset structure ($z_{4,2019}$), and firms exporting a lower weight. Debt maturity in 2019 ($z_{5,2019}$) was lower for older firms. As regards the control variable, the estimates of each region, including the reference region AND whose implicit coefficient is 0, make it possible to rank regions from higher to lower 2019 margin as CL (highest), CI, GAL, RIO, MUR, CAT, AND, EXT, BC, VAL, CM, ARA, MAD, NAV and BI (lowest).

According to Table V, low proportions of women in the workforce or not disclosing the gender distribution leads to a decrease in margin ($y_2$) between 2019 and 2020 as compared to disclosing a high proportion of women. Receiving subsidies leads to a reduction in indebtedness between 2019 and 2020 ($y_3$). Subsidies are associated to a lower increase of debt maturity ($y_5$) between 2019 and 2020 and exports to a higher increase.

R-squared values are admittedly rather low, explanatory power being hampered by the availability of explanatory variables in the SABI database and the sheer difficulty in predicting financial performance indicators and their differences.

## Discussion

Firm size as measured by the number of employees is associated to a better initial margin, thus supporting the first hypothesis (H1). Age is associated with a higher initial turnover and a lower initial indebtedness, thus supporting the second hypothesis (H2). Receiving subsidies is associated to a higher initial margin, to a higher initial non-current asset share, and to a better indebtedness evolution between 2019 and 2020, thus supporting the third hypothesis (H3). Disclosing the gender distribution of the workforce and a higher presence of women are associated to a better evolution of margin between 2019 and 2020,

thus supporting the fourth hypothesis (H4). Exports are associated with a higher initial indebtedness, and a higher initial current asset share. The fifth hypothesis (H5) is thus not supported. Effects on debt maturity are not considered to provide evidence for or against the hypotheses, as explained above.

In general terms, the research results indicate that the margin and turnover of medium-sized companies in the Spanish wine sector worsened between 2019 and 2020 as a result of the pandemic, as in other geographical areas (Wittwer and Anderson, 2021), even though the online sale of wine increased during the pandemic (Jorge *et al.,* 2020). The only other significant difference between 2020 and 2019 is debt maturity, which increased as a result of both a reduction in activity and an increase in long-term debt. There was no significant growth in indebtedness. Firms simply renegotiated the repayment term, increasing the debt maturity. Regarding the structure of assets, there was only a slight increase in current assets in the companies analysed, due to a slight increase in inventories and accounts receivable between 2019 and 2020.

As regards hypothesis 1, the importance of margin in wine management should be highlighted, as stated by Castillo Valero and García Cortijo (2013). A high margin enhances the survival of companies in the sector and translates into higher returns on assets in line with the value of the wine brand, its DO, and the quality of its bottled reserve wines, as indicated by Vizcaino *et al.* (2020). In 2019 large companies had better margins, which helped to face the subsequent COVID-19 crisis in line with Zahedi *et al.* (2021).

Regarding hypothesis 2, the long-established companies had less worrying indebtedness and a higher turnover in 2019 before the pandemic and were better prepared to withstand the COVID-19 crisis. In reality the size of the company and its age guarantee that there has been good management for years and more efficient management in the face of exceptional risks (Ozdemir *et al.,* 2022). In addition, the adequate indebtedness of companies with a long history also favors the management of exceptional risks such as COVID-19 (Vizcaino *et al.,* 2020).

As regards hypothesis 3 related to subsidies, as background it must be taken into account that public policies through Royal Decree-Law 8/2020 approved a line of guarantees issued by the state to mitigate the economic effects of COVID-19 and access long-term financing with loans from the Official Credit Institute (ICO). This is one of the reasons why COVID-19 increased debt maturity since companies in the sector were able to finance themselves with more long-term debt. On the contrary, the debt maturity of companies that had subsidies shortened since they did not renegotiate as much long-term debt. It is also evident that the subsidies improved indebtedness. In 2019 companies with subsidies had better margins and a higher share of non-current assets, in line with pre-pandemic studies (Castillo Valero and Garcia Cortijo, 2013), which helped them to cope with COVID-19.

Regarding hypothesis 4, related to the gender distribution of the workforce, the research indicates that having a greater presence of women and disclosing it helps to prevent margins from being excessively reduced between 2019 and 2020. León-Pozo *et al.* (2019) show that gender diversity in the workplace is favorable for equal opportunities in the wine sector and there is still a lack of research regarding gender diversity in this sector. In addition, gender policies in management are aligned with the Sustainable Development Goals (SDG number 5) of the 2030 Agenda (Martinez-Leon *et al.,* 2020). It should be

noted that Paoloni and Cosentino (2021) endorse the management skills of women during COVID-19, with a good response to the pandemic due to the better management of both financial and environmental indicators as pointed out by Gazzola *et al.* (2022). This article shows that the presence of women in the management of the sector in the face of the pandemic helped to prevent margins from collapsing, thus contributing to gender research in the wine sector and to defending management skills with a gender perspective to deal with COVID-19.

Regarding hypothesis 5, related to exports, it must be borne in mind that all wineries in Spain exported less after the COVID-19 outbreak (Lu, 2020; Marco-Lajara *et al.,* 2021; Minondo, 2021). Exporting companies were less prepared because of a higher initial indebtedness and a higher initial current asset share likely resulting from unsold stock. Hypothesis 5 thus does not only fail to find support but is actually contradicted. Exporting did however increase debt maturity between 2019 and 2020, a fact which is not conclusive in terms of financial resilience.

## Conclusion

The study shows that the margins and turnover of the companies studied worsened during the pandemic due to the decrease in sales in the 2019-2020 period. On the other hand, large companies with subsidies are shown to have coped better with COVID-19, due to the better pre-pandemic margins. Female presence in the workforce favours that the margins of the 2019-2020 period have not been excessively damaged, in line with the sustainable development challenges set out in the 2030 Agenda. Non-disclosure of the gender distribution is also telling about gender policy and firms not disclosing have an even worse margin evolution than firms with a low female presence. Exporting firms did not fare any better than non-exporting firms, after the failure to confirm the fifth hypothesis.

The study also analyses the structure of the assets of the companies under study in order to assess the potential accumulation of inventories during this period and the status of collections due to the drop in sales and increase in insolvencies. Indebtedness and debt maturity during the pandemic are also analysed. Out of these two variables the only significant difference between 2019 and 2020 is debt maturity which increases both because of a reduction in activity (lower accounts payable) and an increase in long-term debt. Asset structure was not greatly affected when compared to the pre-pandemic situation, with acceptable stock turnover and customer insolvencies. There is no evidence either of the feared increase in indebtedness; in fact, COVID-19 in the wine sector has shown that, as in other periods, public intervention has had an impact on the pandemic crisis. This intervention especially improved the situation of younger companies, which renegotiated long-term debts thanks to derivative guarantees of the Royal Decree-Law 8/2020 to alleviate the economic effects of COVID-19, debts that will have to be repaid when the sector recovers from the exceptional pandemic. Regarding the wineries which have been established for a long time and are not excessively indebted, the subsidies have allowed them to better withstand COVID-19.

One limitation of this research is the time period used to assess the post-COVID-19 effects on the financial statements of the wine companies analysed, which has only allowed their short-term impact to be evaluated (in 2020). Another limitation is that data from only one country were used, including only limited companies and not, for instance,

cooperatives. Yet another limitation is the reduced range of explanatory variables available in the SABI database resulting in low R-squared values. Having said this, the study benefits from rigorous statistical treatment of financial ratios using the CoDa methodology and avoiding the most commonly encountered distributional problems in standard financial ratios like asymmetry and non-linearity.

Our future lines of research will focus on the resilience of this sector to future challenges, including other financial ratios and explanatory variables and more countries and time periods. Apart from COVID-19, whose effects are still noticeable in 2021 and to a lesser extent in 2022, the most important challenges for wine companies are sustainability and digitization. In terms of sustainability, the SDGs are not unrelated to the wine sector (Bernardi, 2021; Boyer and Touzard, 2021; Mozas-Moral *et al.,* 2021), especially in terms of climate change challenges, affecting both the vineyards themselves (Bonfante *et al.,* 2018; Boyer and Touzard, 2021; Canavati *et al.,* 2020), and future certifications of environmentally sustainable production that will impact the financial statements (Gomes *et al.,* 2021) entailing higher production costs (McDermaid and Newton, 2020). Likewise the digital transformation is becoming essential in the post-COVID scenario (Bartoli *et al.,* 2022; Jorge *et al.,* 2020) and requires a vast amount of resources (Vázquez *et al.,* 2019).

## Funding

This article was supported by the Spanish Ministry of Science and Innovation/AEI/10.13039/501100011033 and by ERDF A way of making Europe [grant number PID2021-123833OB-I00]; the Spanish Ministry of Health [grant number CIBERCB06/02/1002]; and the Government of Catalonia [grant numbers 2017SGR656, 2017SGR386, 2017SGR155]. The funding sources did not participate in the design or conduct of the study, the collection, management, analysis, or interpretation of the data, nor the preparation, review, or approval of the manuscript.

## References

Aitchison, J. (1982), "The statistical analysis of compositional data", *Journal of the Royal Statistical Society Series B (Methodology)*, Vol. 44 No. 2, pp. 139-177.

Aitchison, J. (1986), *The Statistical Analysis of Compositional Data. Monographs on Statistics and Applied Probability*, Chapman and Hall, London, UK.

Almeida, S., Mesquita, S. and Carvalho, I. (2022), "The covid-19 impacts on the hospitality industry highlights from experts in Portugal", *Tourism and Hospitality Management*, Vol. 28 No. 1, pp. 61-81.

Arimany-Serrat, N., Farreras-Noguer, A. and Coenders, G. (2022), "New developments in financial statement analysis. Liquidity in the winery sector", *Accounting*, Vol.8 No.3, pp. 355-366.

Arimany-Serrat, N. and Farreras-Noguer, À. (2020), "A comparison of the wine sectors in Catalonia, La Rioja, Languedoc-Roussillon and Emilia-Romagna", *Journal of Intelligent & Fuzzy Systems*, Vol. 38 No 5, pp. 5553-5563.

Bartoli, C., Bonetti, E. and Mattiacci, A. (2022), "Marketing geographical indication products in the digital age: a holistic perspective", *British Food Journal*, Vol. 124 No. 9, pp. 2857-2876.

Bernardi, A. (2021), "Sustainability and supply chain: Evidence from the wine industry", *Micro & Macro Marketing*, Vol. 30 No. 2, pp. 381-408.

Bonfante, A., Monaco, E., Langella, G., Mercogliano, P., Bucchignani, E., Manna, P. and Terribile, F. (2018), "A dynamic viticultural zoning to explore the resilience of terroir concept under climate change", *Science of the Total Environment*, Vol. 624, pp. 294-308.

Bresciani, S., Giacosa, E., Broccardo, L. and Culasso, F. (2016), "The family variable in the French and Italian wine sector", *EuroMed Journal of Business*, Vol 11 No. 1, pp. 201-118.

Van den Boogaart, K.G. and Tolosana-Delgado, R. (2013), *Analyzing Compositional Data with R*, Springer, Berlin, DE.

Boyer, J. and Touzard, J.M. (2021), "To what extent do an innovation system and cleaner technological regime affect the decision-making process of climate change adaptation? Evidence from wine producers in three wine clusters in France", *Journal of Cleaner Production*, Vol. 315, 128218.

Canavati, S., Bauman, M. and Wilson, D. (2020), "The wine industry & the COVID-19 pandemic", *Wine Business Journal*, Vol. 4 No. 2, pp. 1-4.

Carmer, A., Velikova, N., Hertzman, J., Bergman, C., Wray, M. and Pippert, T.L. (2020), "An inquiry into the pedagogy of the sensory perception tasting component of wine courses in the time of COVID-19", *Wine Business Journal*, Vol. 4 No. 2, pp. 96-115.

Carreras-Simó, M. and Coenders, G. (2020), "Principal component analysis of financial statements. A compositional approach", *Revista de Métodos Cuantitativos para la Economía y la Empresa*, No. 29, 18-37.

Carreras-Simó, M. and Coenders, G. (2021), "The relationship between asset and capital structure: a compositional approach with panel vector autoregressive models", *Quantitative Finance and Economics,* Vol. 5 No. 4, pp. 571-590.

Casprini, E., Pucci, T. and Zanni, L. (2022), "From growth goals to proactive organizational resilience: first evidence in women-led and non-women-led Italian wineries", *Review of Managerial Science*, 1-20. Ahead-of-print. https://doi.org/10.1007/s11846-022-00557-1

Castillo Valero, J.S. and García Cortijo, M.D.C. (2013), "Analysis of explanatory factors of profitability for wine firms in Castilla-La Mancha", *Revista de la Facultad de Ciencias Agrarias, Universidad Nacional de Cuyo*, Vol. 45 No. 2, pp. 141-154.

Challita, S., Aurier, P. and Sentis, P. (2017), "Linking branding strategy to ownership structure and financial performance and stability: Case of French wine cooperatives", Rossi, P. (Ed.), *Marketing at the Confluence between Entertainment and Analytics*, Springer, Cham, CH, pp. 745-757.

Chen, J. and Yang, C. (2021), "How COVID-19 affects agricultural food sales: based on the perspective of China's agricultural listed companies' financial statements", *Agriculture*, Vol. 11 No. 12, p. 1285.

Coenders, G. and Pawlowsky-Glahn, V. (2020), "On interpretations of tests and effect sizes in regression models with a compositional predictor", *SORT. Statistics and Operations Research Transactions*, Vol. 44 No 1, pp. 201-220.

Coenders, G. and Saez, M. (2000), "Collinearity, heteroscedasticity and outlier diagnostics in regression. Do they always offer what they claim?", Ferligoj, A. and Mrvar, A. (Eds.), *New Approaches in Applied Statistics,* FDV, Ljubljana, SI, pp. 79-94.

Comas-Cufí, M. (2020), "A basic set of functions for compositional data analysis. Package coda.base", available at https://cran.rstudio.com/web/packages/coda.base/coda.base.pdf (accessed 1 March 2022).

Cowen, S.S. and Hoffer, J.A. (1982), "Usefulness of financial ratios in a single industry", *Journal of Business Research*, Vol. 10 No. 1, pp. 103-118.
Coyne, M. (2020), "Three sticks wines: digital marketing, branding, and hospitality during a crisis", *Wine Business Journal*, Vol. 4 No. 2, pp. 27-51.
Creixans-Tenas, J., Coenders, G. and Arimany-Serrat, N. (2019), "Corporate social responsibility and financial profile of Spanish private hospitals", *Heliyon,* Vol. 5 No. 10, p. e02623.
Deakin, E.B. (1976), "Distributions of financial accounting ratios: some empirical evidence", *The Accounting Review*, Vol. 51 No. 1, *pp.* 90-96.
DeYoung, H. (2020), "Napa green: funding nonprofit social ventures in crisis", *Wine Business Journal*, Vol. 4 No. 2, pp. 54-83.
Duarte-Alonso, A. (2015), "Resilience in the context of two traditional Spanish rural sectors: an exploratory study", *Journal of Enterprising Communities: People and Places in the Global Economy*, Vol. 9 No. 2, pp. 182-203.
Duarte-Alonso, A. and Bressan, A. (2015), "Resilience in the context of Italian micro and small wineries: an empirical study", *International Journal of Wine Business Research*, Vol. 27 No. 1, pp. 40-60.
Egozcue, J.J. and Pawlowsky-Glahn, V. (2005), "Groups of parts and their balances in compositional data analysis", *Mathematical Geology*, Vol. 37 No. 7, pp. 795-828.
Egozcue, J.J. and Pawlowsky-Glahn, V. (2019), "Compositional data: the sample space and its structure", *TEST*, Vol. 28 No. 3, pp. 599-638.
Egozcue, J.J., Pawlowsky-Glahn, V., Daunis-i-Estadella, J., Hron, K. and Filzmoser, P. (2011), "Simplicial regression. The normal model", *Journal of Applied Probability and Statistics*, Vol. 6 No. 1-2, pp. 87-108.
Egozcue, J.J., Pawlowsky-Glahn, V. Mateu-Figueras, G. and Barceló-Vidal, C. (2003), "Isometric logratio transformations for compositional data analysis", *Mathematical Geology*, Vol. 35 No. 3, pp. 279-300.
Expósito-Langa, M., Bărbulescu, O. and Tomás-Miquel, J.V. (2021), "Overcoming geographical barriers to international presence. The case of the emerging Romanian Tuscany wine cluster", *European Planning Studies*, Vol. 29 No. 5, pp. 923-941.
Faello, J. (2015), "Understanding the limitations of financial ratios", *Academy of Accounting and Financial Studies Journal*, Vol. 19 No. 3, pp. 75-85.
Filzmoser, P., Hron, K. and Templ, M. (2018), *Applied Compositional Data Analysis with Worked Examples in R*, Springer, New York, NY.
Frecka, T.J. and Hopwood, W.S. (1983), "The effects of outliers on the cross-sectional distributional properties of financial ratios", *Accounting Review*, Vol. 58 No. 1, pp. 115-128.
Gallizo, J.L., Salvador, M. and Moreno, J. (2019), "The influence of family ownership in the profitability of vertically integrated companies. Evidence from the Spanish agri-food industry", *Spanish Journal of Agricultural Research*, Vol. 17 No. 2, p. e0108.
Gazzola, P., Grechi, D., Pavione, E. and Gilardoni, G. (2022), "Italian wine sustainability: new trends in consumer behaviors for the millennial generation", *British Food Journal*, Vol. 124 No. 11, pp. 4103-4121.
Gomes, M.J., Sousa, A., Novas, J. and Jordão, R.V.D. (2021), "Environmental sustainability in viticulture as a balanced scorecard perspective of the wine industry: Evidence for the Portuguese region of Alentejo", *Sustainability*, Vol. 13 No. 18, p. 10144.
Greenacre, M. (2018), *Compositional Data Analysis in Practice*, Chapman and Hall/CRC press, New York, NY.

Ichsani, S., Susanto, N.Z., Kamaludin, A.H., Haq, E.D.U. and Ma'mun, P.N. (2021), "Variables affecting the capital structure of agricultural companies", *Review of International Geographical Education Online*, Vol. 11 No. 5, pp. 2389-2394.

Jofre-Campuzano, P. and Coenders, G. (2022), "Compositional classification of financial statement profiles: The weighted case", *Journal of Risk and Financial Management*, Vol. 15 No. 12, p. 546.

Jorge, O., Pons, A., Rius, J., Vintró, C., Mateo, J. and Vilaplana, J. (2020), "Increasing online shop revenues with web scraping: a case study for the wine sector", *British Food Journal,* Vol. 122 No. 11, pp. 3383-3401.

Juliá Igual, J. F., Bernal Jurado, E. and Carrasco Monteagudo, I. (2022), "Economía social y recuperación económica tras la crisis del COVID-19", *CIRIEC-España, Revista de Economía Pública, Social y Cooperativa*, Vol. 104, pp. 7-33.

León-Pozo, A., Meraz-Ruiz, L. and Woolfolk-Ruiz, D.E. (2019), "Wine industry in Baja California, Mexico: A gender perspective", Peris-Ortiz M., Cabrera-Flores M. and Serrano-Santoyo A. (Eds.), *Cultural and Creative Industries. Innovation, Technology, and Knowledge Management*, Springer, Cham, CH, pp. 197-214.

Linares-Mustarós, S., Coenders, G. and Vives-Mestres, M. (2018), "Financial performance and distress profiles. From classification according to financial ratios to compositional classification", *Advances in Accounting*, Vol. 40, pp. 1-10.

Linares-Mustarós, S., Farreras-Noguer, M.A., Arimany-Serrat, N. and Coenders, G. (2022), "New financial ratios based on the compositional data methodology", *Axioms,* Vol. 11 No.12, p. 694.

Lu, Y. (2020), "Wine report 2020, Statista consumer market outlook-segment report", available at https://www.statista.com/study/48818/wine-report/ (accessed 1 March 2022).

Marco-Lajara, B., Seva-Larrosa, P., Ruiz-Fernández, L. and Martínez-Falcó, J. (2021), "The effect of COVID-19 on the Spanish wine industry", Coşkun Özer, A. (Ed.), *Impact of Global Issues on International Trade*, IGI Global, Hershey, PA, pp. 211-232.

Martinez-Leon, I.M., Olmedo-Cifuentes, I., Martínez-Victoria, M. and Arcas-Lario, N. (2020), "Leadership style and gender: A study of Spanish cooperatives", *Sustainability*, Vol. 12 No. 12, 5107.

Martín-Fernández, J.A., Palarea-Albaladejo, J. and Olea, R.A. (2011), "Dealing with zeros", Pawlowsky-Glahn, V. and Buccianti, A. (Eds.), *Compositional Data Analysis. Theory and Applications,* Wiley, New York, NY, pp. 47-62.

Maynou, L., Saez, M., Kyriacou, A. and Bacaria, J. (2016), "The impact of structural and cohesion funds on Eurozone convergence, 1990-2010", *Regional Studies*, Vol. 50 No. 7, pp. 1127-1139.

McDermaid, M. and Newton, S.K. (2020), "Paradise Ridge Winery: Can a tragedy strengthen a brand?", *Wine Business Journal*, Vol. 4 No. 2, 22075.

Migliaccio, G. and Tucci, L. (2019), "Economic assets and financial performance of Italian wine companies", *International Journal of Wine Business Research*, Vol. 32 No. 3, pp. 325-352.

Minondo, A. (2021), "Impact of COVID-19 on the trade of goods and services in Spain", *Applied Economic Analysis*, Vol. 29 No. 85, pp. 58-76.

Mozas-Moral, A., Fernández-Uclés, D., Medina-Viruel, M.J. and Bernal-Jurado, E. (2021), "The role of the SDGs as enhancers of the performance of Spanish wine cooperatives", *Technological Forecasting and Social Change*, Vol. 173, p. 121176.

Muñoz, R.M., Fernández, M.V. and Salinero, Y. (2021), "Sustainability, corporate social responsibility, and performance in the Spanish wine sector", *Sustainability*, Vol. 13 No. 1, 7.

Neves, E., Ferreira, M. and Dias, A. (2021), "Determining factors of wine firms performance: the Iberian case", Boguslavsky, I., Dikonov, V., Frolova, T., Iomdin, L., Lazoursky, A., Rygaev, I., Timoshenko, S., Murcia, C.L., Romero, F.P., Correia, A. and Agua, P.B. (Eds.), *16th Iberian Conference on Information Systems and Technologies (CISTI), 23 - 26 June 2021, Chaves, Portugal*, Iberian Association for Information Systems and Techonologies (AISTI), Lousada, PT, pp. 1-9.

Neves, E., Dias, A., Ferreira, M. and Henriques, C. (2022), "Determinants of wine firms' performance: the Iberian case using panel data", *International Journal of Accounting & Information Management*, Vol. 30 No. 3, pp. 325-338.

Ozdemir, D., Sharma, M., Dhir, A. and Daim, T. (2022), "Supply chain resilience during the COVID-19 pandemic", *Technology in Society*, Vol. 68, 101847.

Palarea-Albaladejo, J. and Martín-Fernández, J.A. (2008), "A Modified EM alr-algorithm for replacing rounded zeros in compositional data sets", *Computers & Geosciences*, Vol. 34 No. 8, pp. 902-917.

Palarea-Albaladejo, J. and Martín-Fernández, J.A. (2015), "zCompositions-R package for multivariate imputation of left-censored data under a compositional approach", *Chemometrics and Intelligent Laboratory Systems*, Vol. 143, pp. 85-96.

Paoloni, P. and Cosentino, A. (2021), "Are women managers and relational capital supporting firms' resilience? An answer from the wine industry?", Pereira, E.T., Costa, C. and Breda, Z. (Eds.), *4th International Conference on Gender Research, ICGR 2021*, Academic Conferences International Limited, Reading, UK, pp. 218-227.

Pattiruhu, J.R. and Paais, M. (2020), "Effect of liquidity, profitability, leverage, and firm size on dividend policy", *The Journal of Asian Finance, Economics, and Business*, Vol. 7 No. 10, pp. 35-42.

Pawlowsky-Glahn, V., Egozcue, J.J. and Tolosana-Delgado, R. (2015), *Modeling and Analysis of Compositional Data*, Wiley, Chichester, UK.

Rodríguez-Cohard, J.C., Juste-Carrión, J.J. and Vázquez-Barquero, A. (2021), "Challenges and responses of agri-food activities under COVID-19 pandemic: The case of the Spanish territories producing wine and olive oil", *Sustainability*, Vol. 13 No. 24, p. 13610.

Saus-Sala E., Farreras-Noguer À., Arimany-Serrat N., Coenders G. (2021), "Compositional DuPont analysis. A visual tool for strategic financial performance assessment", Filzmoser, P., Hron, K., Martín-Fernández, J.A. and Palarea-Albaladejo, J. (Eds.), *Advances in Compositional Data Analysis. Festschrift in Honour of Vera Pawlowsky-Glahn,* Springer, Cham, CH, pp. 189-206.

So, J.C. (1987), "Some empirical evidence on the outliers and the non-normal distribution of financial ratios", *Journal of Business Finance & Accounting*, Vol. 14 No. 4, pp. 483-496.

Soler, I. P., Gemar, G. and Guerrero-Murillo, R. (2017), "Family and non-family business behaviour in the wine sector: A comparative study", *European Journal of Family Business*, Vol. 7 No. 1-2, pp. 65-73.

Vázquez, J.J., Cebolla, M.P.C. and Ramos, F.S. (2019), "Digital transformation in the Spanish agri-food cooperative sector: Situation and prospects", *CIRIEC-España, Revista de Economía Pública, Social y Cooperativa,* Vol. 95, pp. 39-70.

Vergamini, D., Bartolini, F. and Brunori, G. (2021), "Wine after the pandemic? All the doubts in a glass", *Bio-based and Applied Economics*, Vol. 10 No. 1, pp. 51-71.

Vizcaino, D., Domínguez, A. and Sosa, J. (2020), "Importancia económica y social del sector vitivinícola en España", Organización Interprofesional del vino en España, Madrid, available at https://www.agro-alimentarias.coop/ficheros/doc/06306.pdf (accessed 1 March 2022)

Wittwer, G. and Anderson, K. (2021), "COVID-19's impact on Australian wine markets and regions", *Australian Journal of Agricultural and Resource Economics*, Vol. 65 No. 4, pp. 822-847.

Wooldridge, J.M. (2010), *Econometric Analysis of Cross Section and Panel Data*, MIT press, Cambridge, MA.

Zahedi, J., Salehi, M. and Moradi, M. (2021), "Identifying and classifying the contributing factors to financial resilience", *Foresight*, Vol. 24 No. 2, pp. 177-194.