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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).

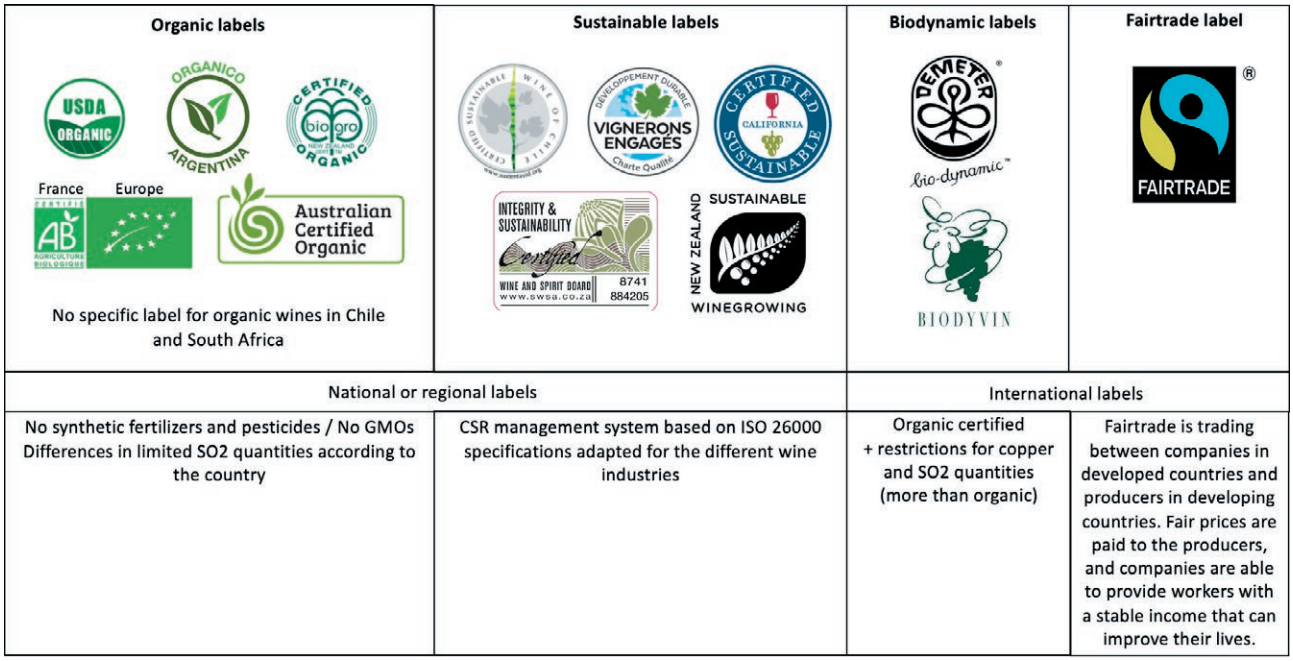



**Figure 1.** SD wine labels (examples and specifications) (Source: authors).

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-

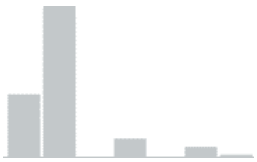
| Attribute | Distribution | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|---|
| Average Price Premium Biodynamic |  | 3.07 | 0.87 | 0 | 13.5 |
| Average Price Premium Organic |  | 3.03 | 0.87 | 0 | 13.5 |
| Average Price Premium Fairtrade |  | 2.92 | 0.91 | 0 | 13.5 |
| Average Price Premium 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<br>0.98 | 1.142199<br>0.16 | **4.828255***<br>**2.12** | 1.195554<br>0.23 | 2.139022<br>1.18 |
| How often do you buy certified food | 1.540636<br>1.5 | **2.115084****<br>**2.88** | **1.754584****<br>**2.61** | 1.306585<br>1.33 | **1.664622***<br>**2.4** |
| Expenditure/Year in € | 0.999916<br>-0.44 | 0.9998272<br>-0.95 | 1.00008<br>0.43 | 0.9996783<br>-1 | **1.000337***<br>**2.02** |
| Heard of certification before | **7.778052****<br>**3.24** | 1.607506<br>0.49 | 1.621343<br>1.23 | **2.379079***<br>**2.06** | 2.154973<br>1.73 |
| Importance certification | **2.854495*****<br>**3.84** | **2.305237*****<br>**4.67** | **2.359608**<br>**4.97** | **3.235772*****<br>**7.01** | **2.940351*****<br>**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.

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