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Review

# Understanding the willingness to pay for sustainable wine: a meta-analytical approach

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## HIGHLIGHTS

- The meta-analysis investigated wine consumers' WTP for sustainability.
- Environmental aspects command higher WTP, mainly as vineyard and production practices.
- Social sustainability is underexplored, highlighting the need for awareness and policies.
- Sustainability aspects have different effects on the WTP distribution.

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## ABSTRACT

In recent years, numerous studies have explored consumers' perceptions and trends regarding sustainability attributes in wine products. One of the most common quantitative approaches for assessing consumer preference is evaluating their willingness to pay (WTP). Through a meta-analysis, we statistically synthesized and evaluated marginal WTP estimates for various sustainability attributes in wine, aiming to identify moderators that might explain WTP heterogeneities. We explored preferences for sustainability aspects through different classification approaches, helping to unpack the complex nature of sustainability in the wine industry. Following a rigorous systematic review protocol, we selected 52 studies based on predefined eligibility criteria. Our findings highlight that social sustainability remains underexplored, with no significant influence on wine consumers' purchasing behavior. In contrast, environmentally beneficial attributes command higher premium prices, particularly when framed as vineyard practices. However, alternative sustainable packaging is, on average, less favorably perceived by consumers. The review also reveals systematic effects on marginal WTP due to study characteristics, such as methodology and geographical area. The application of quantile regression models underscored the variation in the effects of the independent variables across the marginal WTP distribution. In particular, we found that consumers who are willing to pay lower prices for sustainability attributes do not discriminate between different sustainability aspects or communication forms. These findings provide valuable insights for producers and policymakers, offering a statistical synthesis that can guide product valorization strategies and sustainability-oriented policies.

## 1. Introduction

In recent decades, the wine industry has undergone significant changes, driven in part by evolving consumer preferences and increasing societal demands for more environmentally and socially responsible products. This shift is part of a broader movement toward sustainable consumption, in which consumers increasingly consider ethical, environmental, and social factors in their purchasing decisions. Wine, as a product deeply connected to land, climate, and culture, has consequently become a prominent focus of sustainability-related discussions. As a result, sustainability has emerged as a strategic concern for wine producers, regulators, and marketers alike.

Concurrently, a growing body of research has sought to understand how sustainability influences wine consumers' behavior, using both

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monetary and non-monetary measures (e.g., Bazzani et al., 2025; Scozzafava et al., 2024; Soregaroli et al., 2021). The most widely used monetary measure to assess how a product attribute affects consumers' behavior is willingness to pay (WTP). Existing studies have examined a wide range of sustainability-related wine attributes, including agricultural practices in vineyards (Nesselhauf et al., 2020), responsible management of resources such as water (Li et al., 2018) and energy (Tait et al., 2019a,b), as well as the protection of workers' rights (Jr Gilinsky et al., 2016; Piracci et al., 2022). WTP has been assessed using various methods, most notably stated preference methods such as choice experiments and contingent valuation. These studies aim to identify the extent to which consumers are willing to support sustainable practices through price premiums, thereby offering insights into how market mechanisms can promote sustainability in the wine sector.

Despite the proliferation of empirical studies on this topic, the literature remains heterogeneous and fragmented. Therefore, this study aims to synthesize the existing evidence. The methodological foundation is a meta-analysis, defined as a statistical review that combines the quantitative results of multiple previous studies (Page et al., 2021; Stanley and Jarrell, 2005). By applying this method, we can integrate and assess consumers' estimated marginal WTPs (mWTPs) for various sustainability attributes of wine, providing a comprehensive overview of how these attributes influence purchasing. Our review addresses both primary and secondary objectives. The primary goals are to quantify the overall effect of sustainability attributes on consumers' WTPs across multiple studies and to assess the consistency of these results. Hence, one of the main objectives of this review is to investigate the sources of heterogeneity in studies' outcomes, considering the nature of the sustainability attribute analyzed, methodological differences, sample characteristics, and other features of study design. In addition, the review evaluates the risk of bias and identifies gaps in the current understanding of wine consumers' preferences regarding sustainability.

This paper contributes to the literature in three main ways. First, it offers the most comprehensive quantitative synthesis to date of consumers' valuation of sustainability in the wine sector. Second, it provides a structured comparison of different sustainability dimensions, such as environmental and social indicators, which can inform more effective sustainability labeling and marketing strategies. Third, by analyzing the drivers of heterogeneity based on methods, the study contributes to improving research design and comparability in future studies. Overall, this research advances both the academic understanding of consumer behavior in the context of sustainable wine and the practical relevance of this knowledge for producers, retailers, and policymakers seeking to promote sustainability through market-based approaches.

## 2. Literature review

Wine sustainability encompasses multiple dimensions that may influence consumers' monetary valuation, which is typically expressed in terms of WTP. Following established economic theory, the WTP for a given attribute is defined as the maximum monetary amount an individual would be willing to sacrifice to obtain a specific characteristic, feature, or quality improvement of a good, while maintaining the same level of satisfaction (Hanemann, 1991).

The WTP for sustainability attributes in wine has become an increasingly studied topic within the broader context of sustainable consumption (Moscovici et al., 2021; Valenzuela et al., 2022). Wine, however, represents a highly differentiated product within the food market, with consumer purchases largely driven by price and origin (Dominici et al., 2024; Giacomarra et al., 2020; Jantzi and McSweeney, 2019; Jauregui-García et al., 2024). Despite the central role of these factors and the abundance of information conveyed through wine labels, previous systematic reviews (Deroover et al., 2021; Maesano et al., 2019; Schäufele and Hamm, 2017) agree that individuals tend to perceive sustainability features positively.

Within the sustainability framework, the environmental dimension has been the most investigated, often overshadowing the social component. Within this dimension, organic certification has received substantial scholarly attention, reflecting its widespread diffusion within the wine sector. Organic viticulture is practiced in 63 countries and covers approximately 454,000 ha of cultivated land, predominantly concentrated in Italy, France, and Spain, which together account for 75% of this area (OIV, 2025). Empirical evidence consistently shows that consumers exhibit a positive WTP for organic wines, driven by favorable perceptions related to both environmental protection and human health (Tsourgiannis et al., 2015; Deroover et al., 2021; Vecchio et al., 2023; Dominici et al., 2025). This positive valuation is generally attributed to organic farming practices that restrict the use of synthetic fertilizers and pesticides, thereby reducing environmental impacts and potential health risks.

Beyond organic certification, the concept of sustainability has recently expanded to include a broader set of eco-friendly practices for winemaking along the entire wine production chain, many of which have emerged as relevant drivers of WTP. These include wines characterized by reduced pesticides use (Nesselhauf et al., 2020), biodynamic production method (Fanasch and Frick, 2020), lower carbon footprint (Pattara et al., 2017), and sustainable packaging solutions (Ferrara et al., 2020). While consumer awareness and familiarity with these practices may vary, several studies suggest positive WTP when appropriate labeling or communication strategies are employed (Capitello et al., 2021; Mesidis et al., 2023). Overall, the literature converges on the finding that environmental attributes are generally associated with price premiums, and that differences in their nature can explain variations in WTP.

In contrast, the social dimension of wine sustainability, such as fair labor practices, local community support, and inclusive employment, has received comparatively less empirical attention, although its relevance has been increasing. Evidence on consumers' WTP for socially sustainable wines, such as those employing marginalized workers or supporting social projects, remains mixed. Some scholars have identified a positive WTP for the social sustainability of wine. For instance, Vecchio (2013) found that consumers were willing to pay more for a social attribute than for an environmental one. Conversely, Piracci et al. (2022) observed stronger preferences for organic attributes relative to the fair labour labels. This result aligns with Mueller Loose and Remaud (2013), who found higher marginal WTP for environmental claims than for social ones across seven markets. Notably, while WTP for environmental responsibility remained non-negative in all analyzed markets, WTP for social responsibility was negative in two of them.

Nevertheless, the heterogeneity observed in WTP estimates cannot be explained solely by differences between environmental and social sustainability dimensions. Rather, variations in results also reflect a complex interplay of methodological, contextual, and individual-level factors. WTP can be estimated using market-based techniques based on transactions or consumer preference elicitation methods. The hedonic price method belongs to the former category, whereas contingent valuation, experimental auction, and choice experiments rely on elicited preference data to assess WTP (Lee and Hatcher, 2001). Within these approaches, the way attributes are presented, such as through binary labels or detailed descriptions, can significantly affect consumer valuation (Bernard et al., 2019). Furthermore, individual characteristics, including age, gender, and income, are generally recognized as moderators of WTP for sustainability attributes (Maesano et al., 2021; Vecchio, 2013), alongside attitudinal factors such as environmental orientation, wine knowledge, and involvement with the product (Nesselhauf et al., 2020; Schäufele and Hamm, 2017; Vecchio, 2013). Geographic and cultural contexts further contribute to heterogeneity, as consumers in different regions may interpret sustainability claims differently based on local values, regulatory frameworks, and previous exposure to eco-labeling schemes (Mueller Loose and Remaud, 2013; Schäufele and Hamm, 2017).

Although previous reviews have provided valuable qualitative overviews of sustainable wine consumption (e.g., Schäufele and Hamm, 2017; Maesano et al., 2019; Deroover et al., 2021), they have not systematically examined how these multiple factors jointly shape WTP outcomes. The absence of a quantitative synthesis leaves open questions regarding the relative importance of different sustainability drivers and the robustness of observed preferences across study designs and populations. This meta-analytic review addresses this gap by aggregating findings across studies to quantify the effects of sustainability attributes on WTP and to identify the moderators underlying observed heterogeneity.

## 3. Methods

Meta-analysis is the core methodological approach of this study. First introduced by Glass (1976) in the field of psychotherapy, this statistical review is now widely used across numerous disciplines due to its flexibility of application (e.g., Santeramo and Lamonaca, 2019; Piracci et al., 2024; Zhang et al., 2023). It is recognized as an appropriate method for summarizing the results of the existing literature investigating consumers' WTPs for sustainability-related attributes of various kinds. In our case, the meta-analysis consisted of two main phases: first, a systematic data collection was conducted, followed by the meta-regressions performed on the data collected in the previous phase. The systematic review adhered to an explicit and transparent process aligned with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021), encompassing data extraction, selection, coding, and descriptive analysis. This approach ensures compliance with the principle of scientific reproducibility, thereby enhancing the study's consistency and reliability. Covidence systematic review software was used to streamline the management of the studies, including their collection and screening, and to facilitate collaboration between the two researchers who actively contributed to the selection process.

### 3.1. Data collection

Data collection is a crucial phase in conducting a meta-analytical review, and it is fundamental to first establish eligibility criteria, which guide the selection of studies. We considered only English full-text peer-reviewed scientific articles and book chapters in case they provided quantitative WTPs for sustainability attributes in wine. Eligibility criteria regarding the year of publication were also established. Specifically, we considered only studies published after the Brundtland Report publication in 1987 (World Commission on Environment and Development, 1987), which for the first time introduced the concept of "sustainable development". Regarding the method employed, we did not set any limitations; therefore, we included WTPs obtained by different non-market valuation techniques both hypothetical and non-hypothetical, i.e. choice experiments, contingent valuation, multiple price lists, experimental auctions, and lab experiments. The only exception was for studies based on hedonic pricing models since the resultant WTPs were not completely comparable with other WTP outputs. While the latter are based on consumer expressions, hedonic models observe market prices, typically using transaction data (Rosen, 1974). This distinction in data sources introduces fundamental differences in how outcomes are derived and interpreted and aligning them often requires strong assumptions. One key methodological divergence lies in the underlying assumptions about the product space. Hedonic models assume a continuous spectrum of products,[1] in contrast to discrete choice methods and experimental auctions (Wong, 2018), which typically involve a finite and well-defined set of alternatives, allowing researchers to observe choices among limited options under controlled conditions. Experimental approaches also differ in terms of the underlying behavioral mechanisms that they capture. Whereas hedonic pricing reflects trade-offs in fully functioning markets, elicited preference approaches are subject to different context-dependent behavioral influences (Wong, 2018).

**Table 1**
Boolean search string.

| Product | "wine" |
|---|---|
| AND | |
| Outcomes | "willingness to pay" OR "premium price" OR "consumer*" OR "preference*" OR "purchas*" OR "choice*" |
| AND | |
| Sustainability attributes | "sustainab*" OR "environment*" OR "social*" OR "green*" OR "fair*" OR "organic" OR "ethical*" OR "local*" OR "ecologic*" OR "eco-friendly" OR "biodiversity" OR "emission*" OR "greenhouse gas*" OR "carbon neutral" OR "footprint" OR "recycl*" OR "waste" OR "circular" OR "by-products" |

For the search strategy, Scopus and Web of Science Core Collection were chosen as the online databases to extract the scientific literature of our interest, given that they fulfilled the performance criteria for conducting systematic reviews (Gusenbauer and Haddaway, 2020). Web of Science Core Collection is a multidisciplinary database with extensive coverage of peer-reviewed studies in agriculture and environmental sciences, while Scopus provides diverse information, including social sciences, to understand consumer preferences and WTP (Madududu et al., 2024). The searches were conducted without applying any a priori filter and the search terms were identified in the title, abstract, and keywords sections. We employed specific Boolean strings, which were refined through multiple trial searches. This process involved integrating the strings with targeted terms and verifying how the first 10 results aligned with our focus. The definitive combination of the selected keywords and Boolean terms is represented in Table 1. The sustainability attributes terms were specifically chosen to encompass both the environmental and the social dimensions of sustainability. This allowed us to include in the meta-analysis WTP outputs related to green sustainable production methods, low-impact production practices, biodiversity preservation, more sustainable packaging, and fair working conditions. We also considered "local" as a sustainability attribute for wine. Although this term has no official definition and is distinct from geographical indications,[2] it is commonly recognized by consumers as an environmentally advantageous characteristic (Bimbo et al., 2021; Sirieix et al., 2013), despite some reported controversy (Stein and Santini, 2022).

The selection process consisted of multiple phases. First, Covidence automatically identified and removed all the duplicates. This was followed by an initial screening of titles and abstracts, and subsequently by a full-text review. During this latter phase, two researchers worked independently to enhance the reliability of the studies' selection and reduce the risk of error (Stoll et al., 2019). Even though the independent screening process resulted in a substantial level of agreement for study

[1] The continuum of products refers to the assumption that consumers have access to a wide range of differentiated products, each differing slightly in their attributes. This premise enables the hedonic pricing approach to analyze how variations in product characteristics affect market prices and consumer preferences in a continuous manner (Wong, 2018).

[2] Geographical indications, such as PDO (Protected Designation of Origin) and PGI (Protected Geographical Indication), can be distributed over long distances and are established and regulated by the EU (European Parliament and Council of the European Union, 2024).

selection, as reported by Covidence (proportionate agreement = 0.90; Cohen's kappa = 0.73), any disagreements were resolved through in-person meetings to reach a shared consensus. At this stage, the reference lists of a subset of included studies were also examined to assess the effectiveness of the literature search strategy. Fig. 1 reports the PRISMA flowchart, illustrating the numerical evolution of studies included in the meta-analysis. The collection of resources began in early February 2024 and concluded with the extraction of the data from the 52 included studies in early June 2024. The selected studies are listed in Table A1 in Appendix A. Most of the studies identified during the identification phase (see Fig. 1) were unsuitable for inclusion in the meta-analysis, either because their primary research focus was not the WTP for sustainable wine or because they did not report mean empirical results in their publications (e.g., Bonn et al., 2016; Ferrara et al., 2020; Mastroberardino et al., 2020). Although several studies initially appeared to meet the eligibility criteria described in Table 1, some were excluded due to specific characteristics that made them inappropriate for the next steps. For instance, three articles were excluded because their results were not comparable in terms of wine volume units[3] (Capitello et al., 2019; Ogbeide et al., 2015; Ruggeri et al., 2022). Another common reason for exclusion concerned studies that asked respondents to indicate a price premium for specific wine attributes using predefined price ranges (e.g., Berghoef and Dodds, 2011; Forbes et al., 2009; Gow et al., 2022; Mauracher et al., 2019; Moscovici et al., 2022). These studies reported the percentage of participants willing to pay within specific ranges (e.g., 30% willing to pay 6–10% more for sustainably produced wine, and 9.2% willing to pay 11–15% more). This reporting format did not allow the computation of a single continuous estimate of mWTP, which was necessary for inclusion in the meta-analysis and subsequent statistical evaluation.

The scientific works deemed suitable in the selection process were subjected to data extraction. Specifically, from each study, we gathered the mWTP for sustainability attributes, representing the maximum additional amount that consumers are willing to pay relative to the conventional product, i.e., the wine that does not carry the specific sustainability attribute or certification under consideration in a given study. A negative mWTP suggests that consumers are willing to purchase sustainable products only at a lower price than conventional ones. Given that wine is a highly heterogeneous product in terms of quality, price, and origin (Chandra and Moschini, 2022; Scozzafava et al., 2018; Wang and Spence, 2018), we converted the mWTP actual values into relative percentages to ensure comparability across studies. Following Lusk et al. (2005) and Sun et al. (2024), we applied the following Equation (1):

$$mWTP(\%) = \left[ \frac{(WTP_{sustainable\ wine} - WTP_{conventional\ wine})}{WTP_{conventional\ wine}} \right] * 100 \quad (1)$$

where $WTP_{conventional\ wine}$ is intended as the value of the wine without sustainability attributes. In experimental auction studies, this corresponded to the WTP expressed by participants for the conventional wine, while when base price information was unavailable, we used the market price.[4] In the case of discrete choice experiments, when not explicitly reported in the text, the first level price of the experimental design has been assumed to be the reference.[5] Because the baseline price is not explicitly defined and no alternative price information is provided in these studies, it is not possible to assess whether this assumption leads to an overestimation or underestimation of the premium, nor to quantify the magnitude of any potential bias. Nevertheless, this limitation should be taken into consideration when interpreting the estimated results.

Usually, the outputs in choice experiment studies that run such methods are expressed as coefficients of the models implemented. For this reason, in these occurrences, we converted mWTPs into a common interpretation form following Equation (2):

$$mWTP = -\left( \frac{\beta_{attribute}}{\beta_{price}} \right) \quad (2)$$

where $\beta_{attribute}$ and $\beta_{price}$ are the coefficients referred to the sustainability attribute and the price, respectively. Hence, we extracted mWTP values, which were transformed in percentage on the proportion of the relative reference price to translate it into a comparable metric. The mean percentage of the collected mWTP values served as the independent variable in the meta-regression models. Eventual informative statistical measures (i.e., standard deviation, standard errors, confidence intervals, t-student) were not always reported in the publications, thus we rely on the sample size as a measure of precision, following Stanley (2005). While it would also be useful to collect demographic data, the studies employed different scales to measure these variables. For instance, income and age were often grouped into different brackets and, in some cases, not reported at all. Therefore, the main issue is that demographic data, when available, are reported inconsistently across studies, preventing them from being combined effectively.

### 3.2. Sustainability attributes classification

Each mWTP value corresponds to a specific sustainability attribute of wine, identified during the data extraction phase. These attributes convey sustainability in various ways. Some are comprehensive, encompassing multiple aspects of sustainability (e.g., Equalitas[6] certification), while others focus specifically on quantifying environmental benefits (e.g., carbon footprint label). Additionally, some attributes focus solely on the social aspects of wine production (e.g., Fairtrade). To understand the various components of sustainability represented by each attribute, we categorized the different types of attributes according to several classification approaches (see Table 2). Primarily, we considered the different dimensions of sustainability, distinguishing between environmental and social aspects. We also based one of the classifications on some of the requisites for each sustainability pillar determined by Equalitas (2024), selecting those that best fit our attributes collection. Alongside this, we propose a self-developed categorization that differentiates sustainability attributes according to the type of information they convey and the way in which sustainability attributes are framed. In some cases, the attributes can be better represented by two simultaneous categories of the same classification (see Table B1 in Appendix B for more details). Moreover, we distinguished the two most represented attribute categories from the others, identifying the organic-related attributes and the one concerning more sustainable packaging.

### 3.3. Meta-regressions models

The meta-regressions involve the application of regression models to the data extracted from each study collected during the screening phase.

[3] Each study included in the meta-analysis reported WTP results referring to a traditional 750 ml wine bottle.

[4] This was the case of only two studies (Jorge et al., 2020; Pinto et al., 2022). For these studies, market prices were retrieved from publicly available sources (e.g., producer websites or online wine retailers), converted to euro currency through the Big Mac Index (The Economist, 2024) and adjusted for inflation though the use of the Consumer Price Index (World Bank, 2024).

[5] Studies treated using this approach include Bazzani et al. (2024), Boncinelli et al. (2019), Dominici et al. (2020), Gassler (2015), Ghvanidze et al. (2017), Lim and Reed (2020), Mesidis et al. (2023), Nesselhauf et al. (2020), and Tait et al. (2019a,b).

[6] Equalitas is an Italian organization that owns the homonymous sustainability standard. It covers sustainability efforts in winemaking in its broadest sense.

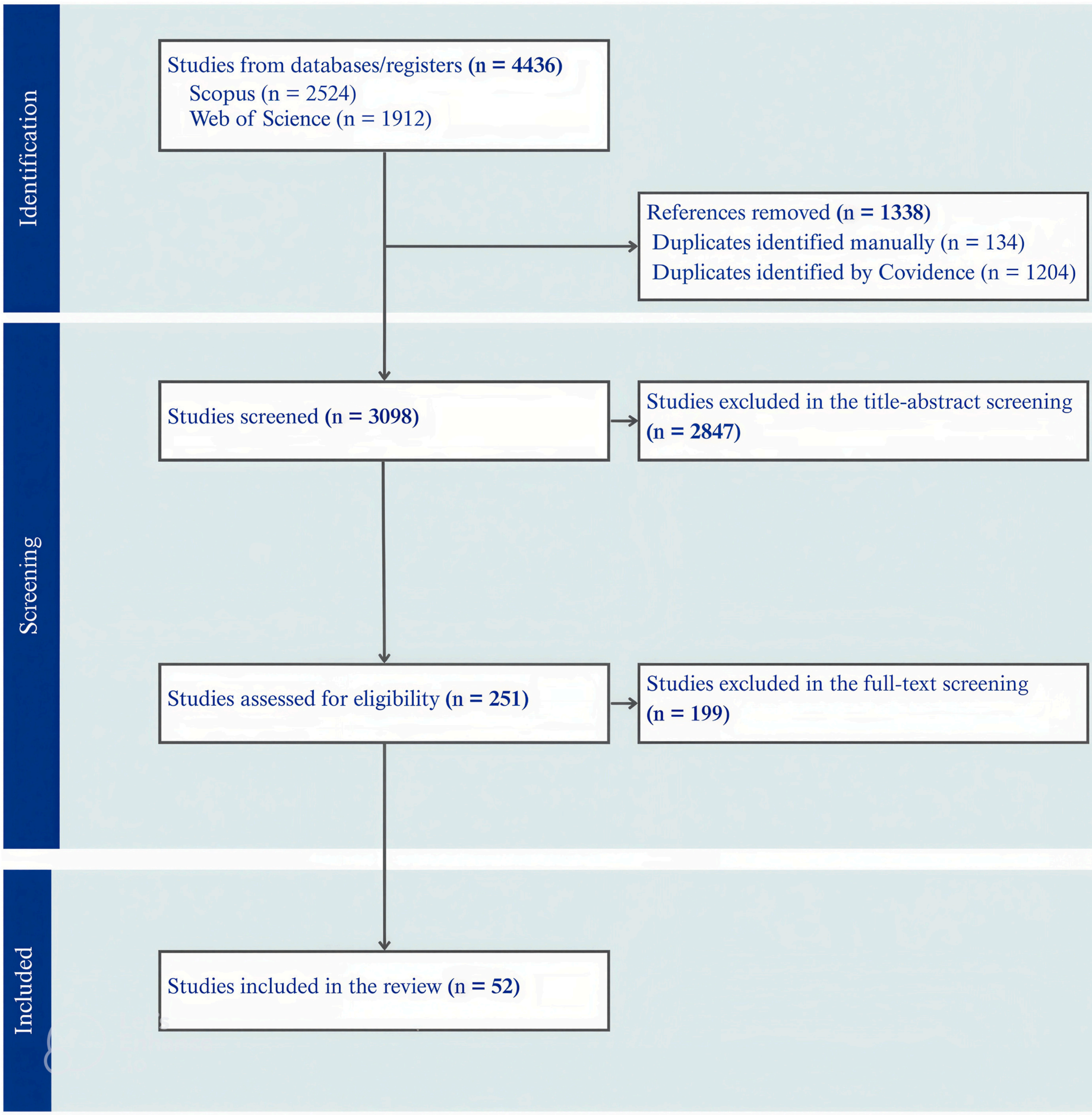


**Fig. 1.** PRISMA flowchart. It reports the numerical evolution of studies across the identification and selection phases.

Typically, ordinary least squares (OLS) models[7] are used in this context to examine the effect of explanatory variables on the dependent variable, which, in this case, is represented by the mWTP. The OLS model is expressed as:

$$mWTP_i = \alpha + \beta X_i + \gamma z_i + \varepsilon_i \quad (3)$$

where $mWTP_i$ $(i = 1, \ldots, n)$ is the dependent variable that is explained by a matrix of the control variables $X_i$, which captures the main characteristics specific to each study (see Table D1 in Appendix D). The coefficient vectors $\beta$ are estimated for these variables. The scalar $z_i$ corresponds to each category of the sustainability attributes based on various classifications applied uniquely for each model specification, where $\gamma$ represents the relative coefficient. Here, $\alpha$ denotes the constant, while $\varepsilon_i$ is the error term.

However, this technique recognizes that observations from the same study may be related to each other. To address this, we applied regression models with robust standard errors clustered by study, as errors may be correlated within the same research study while assumed to be independent across different studies. This adjustment provides more reliable estimates of statistical significance without changing the estimated effects themselves. Furthermore, statistical analysis cannot rely on the assumption of normality. We attempted to normalize the data

[7] The term “OLS models” refers to regression models estimated via the OLS method.

**Table 2**
Overview and specification of the different attribute classification approaches.

| Classification approach | Category | |
|---|---|---|
| *Sustainability dimension* | Environmental | Attributes referred to any kind of environmental benefit. |
| | Social | Attributes referred to any kind of social benefit. |
| *Derived from the Equalitas principles* | Good agriculture practices | Attributes associated with sustainable practices implemented in the field. |
| | Good practices in the winery and bottling | Attributes associated with sustainable practices implemented during winery phases or bottling. |
| | Workers' rights | Attributes that ensure respect for fair working conditions and respect for workers' rights. |
| | Relations with local communities | Attributes associated with projects for local communities that ensure lasting positive impacts. |
| *Self-generated classification* | Production method | Attributes linked to a particular sustainable production approach. |
| | Environmental impact | Attributes reporting quantitative information about the total wine production input and output. |
| | Social commitment | Attributes engaging in efforts that demonstrate social commitment. |
| | Local production | Attributes indicating that the wine is produced locally. |
| | Sustainable grapes variety | Utilization of grape varieties that require a minimum level of chemical inputs. |
| *Most represented attribute types* | Organic | Organic certification or organic claims. |
| | Sustainable packaging[a] | Alternative packaging that resulted in a more sustainable environmental impact. |

[a] This attribute type includes the use of alternative packaging and the claim "10% less glass". Table C1 reports the frequency of occurrence among the total observations.

using an arcsine transformation of mWTP percentages, but this required excluding 25 observations that fell outside the 0-1 range.[8] However, both visual inspection and the Shapiro-Wilk test (W = 0.974, p = 0.032) confirmed that the data deviate from a normal distribution. For this reason, quantile regression is an effective alternative to OLS, as it does not rely on the normality assumption and provides a natural solution for addressing the issue of heteroskedasticity (Dai et al., 2023). First introduced by Koenker and Bassett (1978), quantile regression examines the effects of explanatory variables across different points of the dependent variable's distribution, allowing for robustness to outliers. In this study, we considered the 25th, 50th (median), and 75th percentiles. Considering the same explanatory variables of the OLS model specified above, the quantile regression models applied are expressed by the following Equation (4):

$$Q_{mWTP_i}(\tau \mid X_i, z_i) = \alpha(\tau) + \beta X_i(\tau) + \gamma z_i(\tau) + \varepsilon_i(\tau) \quad (4)$$

where $\tau$ refers to the quantiles analyzed (0.25, 0.50, 0.75). Here, $Q_{mWTP_i}(\tau \mid X_i, z_i)$ is the conditional $\tau$-quantile of $mWTP_i$ given $X_i$ and $z_i$. To overcome the issue of intra-study correlations among the collected observations, similar to the OLS models approach, quantile regressions were performed with robust standard errors clustered by study (Parente and Santos Silva, 2016).

[8] Arcsine transformation is appropriate to transform the distribution of data expressed ad proportion. However, it requires that all the data fit within the range 0 and 1 (Warton and Hui, 2011), which is not the case of 25 observations.

### *3.4. Publication bias assessment*

One of the most common biases that can potentially affect causal inference is publication bias, which has been documented in both top-tier and leading academic journals (Brodeur et al., 2020). Publication bias refers to the selective publication of studies based on the nature or significance of their results and can therefore distort aggregated empirical evidence (Brodeur et al., 2020; Mathur and Vanderweele, 2020; Rothstein et al., 2005; Stanley, 2005). To assess the presence of publication bias, we used funnel plot analysis as a visual diagnostic tool. It consists of a scatter diagram that relates a measure of precision to the effect size (mWTP), where symmetry (or asymmetry) is indicative of potential publication bias. Precision is commonly measured as the inverse of the standard error (1/SE). However, because our dataset includes WTP estimates derived from both revealed and stated preference methods, standard errors were not available for all observations. Given that precision can be measured in different ways, we opted to use the square root of the sample size. This choice is supported by Stanley (2005), who demonstrated a strong correlation between the square root of sample size and 1/SE. Consistent with previous WTP meta-analysis (Hirsch, 2018; Printezis et al., 2019; Yeh and Hirsch, 2023), we calculated the average of the top 10% most precisely estimated relative mWTP values for sustainable wine to obtain a consolidated proxy for the true empirical value. As shown in Fig. 2, it served as a reference to judge the symmetry (asymmetry) of the distribution.

The funnel plot highlights the presence of outliers and, more importantly, reveals a right-skewed distribution of mWTP estimates, indicating a lack of symmetry and suggesting a potential risk of publication bias in the meta-analysis. Specifically, this visualization implies that the risk of bias is due to the detected tendencies of the publications included in the meta-analysis to be more likely to report larger WTP effects. The graph also depicts that studies that concluded lower WTPs are characterized by higher precision indicators (i.e., higher sample sizes). However, this assessment method is intended as an exploratory evaluation, which is thus integrated with the FAT (Funnel-Asymmetry Test) and PET (Precision Effect Estimate), the results of which are presented in Table E1 in Appendix E.

## 4. Results

### *4.1. Descriptive statistics*

The selection process resulted in 52 studies, yielding a total of 170 observations. Although the review covers the period from 1987 to early 2024, the studies that met the eligibility criteria for inclusion in the meta-analysis span from 2003 to early 2024 (Fig. 3), showing an increasing frequency over time. Each study contributed more than one observation, as individual papers often report multiple estimates due to the use of different methods, varied sample populations, or the analysis of distinct sustainability attributes.

Table 3 presents an overview of the main descriptive statistics of the mWTP percentages. Both arithmetic and weighted means[9] were calculated, with weights determined by the sample size associated with each observation. Consequently, mWTP estimates derived from larger samples carry greater weight, while those from smaller samples have less influence. This weighting scheme reflects the fact that larger samples provide more precise estimates, as sample size is inversely related to the standard error. While the mWTP distribution (see Fig. 4) is slightly left-skewed, both the arithmetic mean (24.3%) and the weighted mean (16.6%) are positive. At the same time, the standard deviations, along with the maximum and minimum values, indicate substantial variance. This high degree of dispersion points to significant heterogeneity in

[9] The weighted means were calculated to provide robust information supporting our findings.

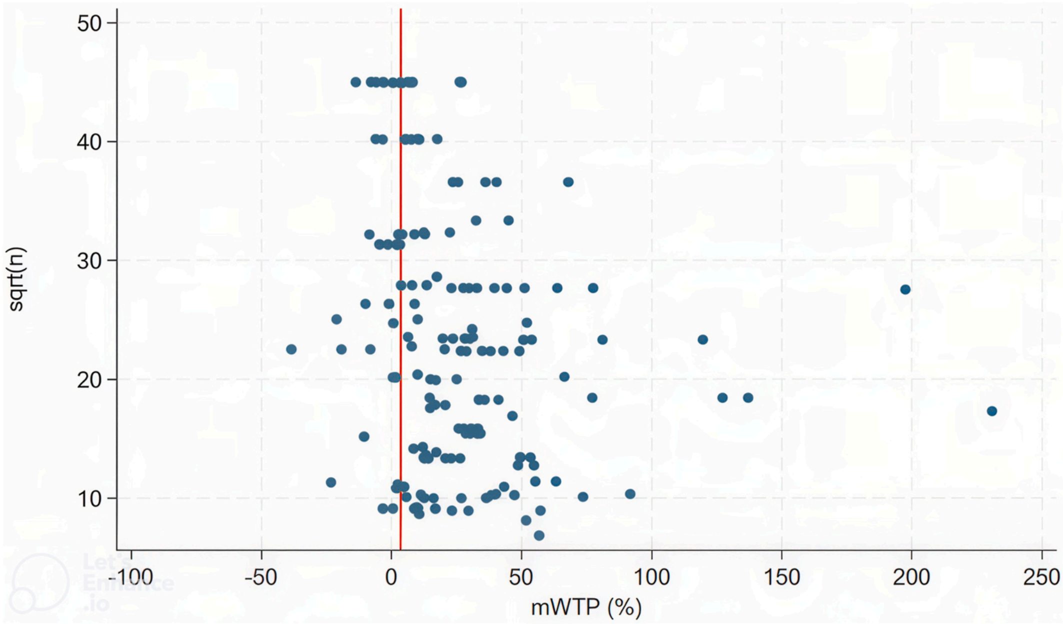


**Fig. 2.** Funnel plot. The y-axis reports the square root of the sample size (sqrt(n)) for each study, while the x-axis reports the mWTP expressed as a percentage. The vertical orange line represents the mean on the 10% most precise estimates. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

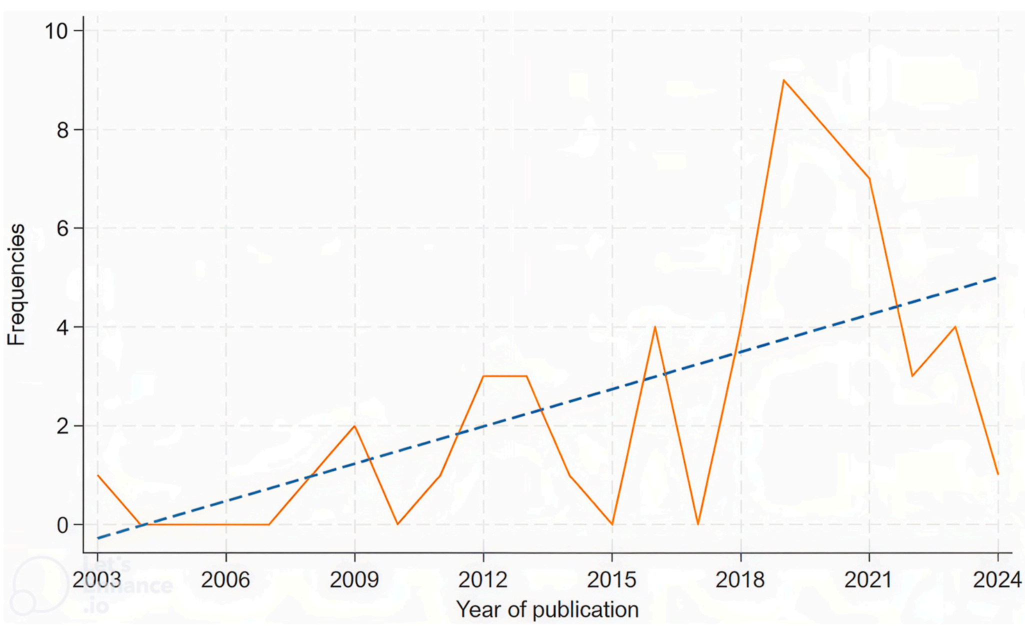


**Fig. 3.** Selected studies' frequencies over the years. The blue dashed line represents the trendline. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

mWTP estimates, which is also reflected in the presence of observable outliers in the distribution. These findings underscore the need for further investigation into the factors driving such variability, which may arise from several sources, including differences in the sustainability attributes examined, the methods applied, and the experimental designs adopted across studies. Additionally, the frequencies of observations within the respective subgroups are reported. Discrete choice experiments are the most predominant method used to estimate WTP for sustainable wine (57%), followed by experimental auctions (18%). Therefore, these two method categories are the most represented for the stated and revealed preference approaches, respectively. Excluding the methods categorized in the "others", the discrete choice experiments result in the highest mWTP percentages.

Observations were also grouped by the geographic location of data collection. In particular Southern European population appears to be among the most studied, likely due to the prominence of major wine-producing countries such as Italy and Spain (Food and Agriculture Organization of the United Nations, 2024). Northern Europe and North

**Table 3**
Descriptive statistics of the overall mWTP percentages and by subgroups (method, geographical area of data collection).

| | | | mWTP (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Obs | Freq. % | Mean | Weighted mean | Min | Max | P25 | P50 | P75 |
| Overall mWTP | 170 | 100 | 24.3 (33.9) | 16.6 (30.2) | −38.5 | 230.8 | 0.36 | 16.9 | 35.7 |
| *Sub-groups by methods* | | | | | | | | | |
| Discrete choice experiments | 97 | 57 | 25.7 (41.3) | 15.5 (31.9) | −38.5 | 230.8 | | | |
| Experimental auctions | 30 | 18 | 16.4 (23.0) | 13.5 (19.4) | −23.3 | 91.7 | | | |
| Contingent valuation | 24 | 14 | 20.7 (15.9) | 16.0 (15.8) | −21.1 | 55.3 | | | |
| Others | 19 | 11 | 34.2 (16.0) | 36.6 (12.2) | 11.3 | 63.2 | | | |
| *Subgroups by geographic area* | | | | | | | | | |
| South Europe | 53 | 31 | 39.2 (44.9) | 44.6 (51.3) | −21.1 | 230.8 | | | |
| North Europe | 50 | 29 | 25.2 (21.5) | 14.3 (20.9) | −13.8 | 91.7 | | | |
| North America | 53 | 31 | 16.3 (26.8) | 14.3 (23.9) | −23.3 | 119.6 | | | |
| UK | 9 | 5 | 6.9 (12.7) | 3.3 (8.4) | −3.0 | 30.1 | | | |
| Others | 10 | 6 | −3.1 (17.3) | −3.1 (16.2) | −38.5 | 20.4 | | | |

Note: P25, P50, and P75 refer to the 25th, 50th and 75th percentiles, respectively. The weighted mean is calibrated on the sample sizes referred to each observation. Standard deviations are in the brackets.

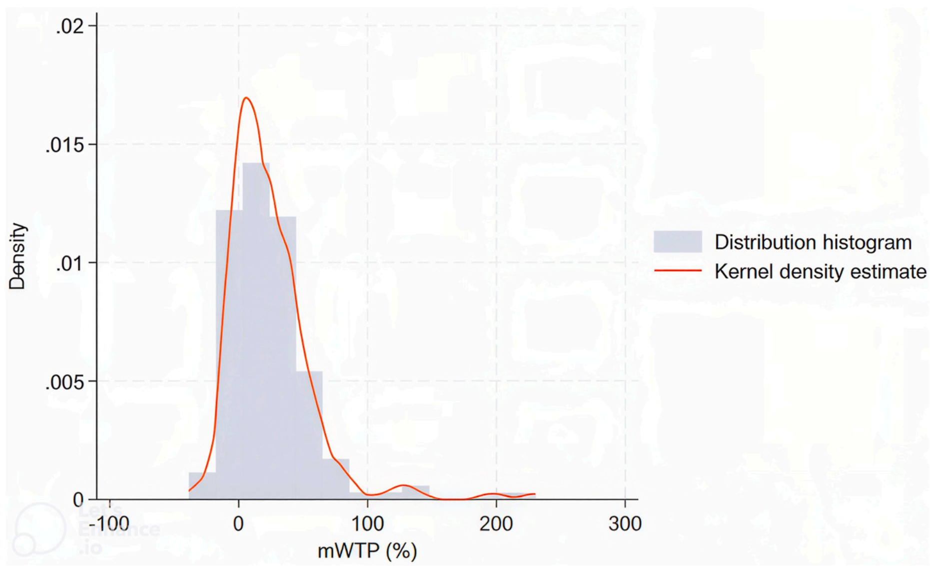


**Fig. 4.** Kernel density distribution of the mWTPs (%).

America also represent important geographic areas in this field, especially given their relevance in terms of wine consumption patterns (OIV, 2025). In line with the conclusions of Schäufele and Hamm (2017), the descriptive results indicate a lack of investigation into New World wine-producing countries along with the Asian population.

### 4.2. Meta-regressions results

The meta-regression results are summarized in Tables 4–6. Table 4 presents the outputs referred only to the control variables that demonstrate statistical significance in at least one instance, either in the OLS or the robust quantile regressions (refer to Table F1 in Appendix F for the complete results). One notable finding anticipated by the descriptive results and then confirmed by the regression analyses is the significant relation between the use of discrete choice experiments and higher mWTP values. This effect is particularly significant when examining the mean and 75th percentile values. Looking at the geographical area, the results consistently show a positive effect of Southern Europe.[10] Alongside this, as the sample size grows, the influence of extreme values diminishes, potentially resulting in lower average WTP estimates. Lastly, studies published in Q3 journals seem to be systematically associated with higher mWTP values at the lower end of the mWTP distribution. This trend may reflect certain publication biases or methodological factors specific to this category of journals.

Table 5 illustrates the outcomes resulting from a series of robust OLS regression models that incorporate the sustainability attribute categories. Each model includes the same set of control variables but differs in the specification of the sustainability attribute category. This modeling strategy allows us to isolate the effects of sustainability-related variables within each conceptual framework while minimizing concerns about multicollinearity Variance Inflation Factor (VIF) analysis confirms that multicollinearity is not an issue for the set of control variables nor within each sustainability attribute category, as VIF remain well below conventional thresholds (O'Brien, 2007) across all model specifications (see Table C1 in Appendix C). As shown in the detailed mapping in Appendix Table B1, there is substantial conceptual overlap across categories. For example, the attribute “Organic” is the most prevalent and is simultaneously represented across multiple categories (e.g., “Environmental dimension,” “Good agricultural practices,” “Good practices in winery and bottling,” and “Production method”). Including such overlapping attributes in a single model would likely introduce multicollinearity. By estimating separate models for each classification scheme, we mitigate this issue and enable a clearer interpretation of the

[10] This variable refers to the region where the data were collected. The Southern Europe region encompasses the following countries: Italy, Greece, Spain, and Portugal.

**Table 4**
Control variables coefficients from the robust OLS and the robust quantile regression models.

| | Robust OLS | Robust quantile regression | | |
|---|---|---|---|---|
| | | P25 | P50 | P75 |
| *Study characteristics* | | | | |
| Discrete choice experiment | 24.58** (10.70) | −4.74 (15.72) | 5.58 (8.62) | 25.16* (13.97) |
| Attribute represented as a statement | 6.92 (6.88) | −4.70 (9.62) | 4.25 (8.14) | 17.02* (9.58) |
| Sample size | −0.02** (0.01) | −0.01 (0.02) | −0.01* (0.01) | −0.01 (0.01) |
| *Wine characteristics* | | | | |
| *Geographical area* | | | | |
| Southern Europe | 35.88** (16.00) | 18.00 (14.74) | 20.86 (26.59) | 34.82 (23.52) |
| *Journal's best quartile* | | | | |
| Q3 | 8.67 (11.42) | 30.75** (17.35) | 16.33 (17.29) | 4.20 (12.60) |
| $R^2$ | 0.29 | 0.12 | 0.22 | 0.23 |
| Observations | 170 | 170 | 170 | 170 |

Note: ***, **, * indicate significance at the 1%, 5%, and 10%-level, respectively. P25, P50, and P75 refer to the 25th, 50th and 75th percentiles, respectively. The table only reports the variables that resulted to be significant for at least one model among the OLS and the quantile regressions. Constants are not reported in the table, as they resulted to be not statistically significant. Robust standard errors are reported in the brackets.

**Table 5**
Estimated coefficients and $R^2$ for sustainability attribute categories from each robust OLS regression model (n = 170).

| Model | Attribute classification approach | Variable specified (+ control variables) [a] | Coefficient | $R^2$ |
|---|---|---|---|---|
| | *Sustainability dimension* | | | |
| (1.a) | | Environmental dimension | 11.53* (6.70) | 0.30 |
| (1.b) | | Social dimension | −7.58 (6.32) | 0.29 |
| | *Equalitas principles* | | | |
| (1.c) | | Good agricultural practices | 15.79*** (4.58) | 0.32 |
| (1.d) | | Good practices in the winery and bottling | 4.33 (5.47) | 0.29 |
| (1.e) | | Workers' rights | −1.10 (5.78) | 0.29 |
| (1.f) | | Relations with the local communities | −7.84 (10.40) | 0.29 |
| | *Self-developed classification* | | | |
| (1.g) | | Production method | 9.70 (5.82) | 0.30 |
| (1.h) | | Environmental impact | −6.03 (9.06) | 0.29 |
| (1.i) | | Social commitment | −7.58 (6.32) | 0.29 |
| (1.j) | | Local production | 7.86 (15.97) | 0.29 |
| (1.k) | | Sustainable grape variety | −15.99 (21.17) | 0.29 |
| | *Most represented sustainability attributes type* | | | |
| (1.l) | | Organic | 10.78* (5.58) | 0.30 |
| (1.m) | | Sustainable packaging | −25.67** (9.86) | 0.32 |

Note: ***, **, * indicate significance at the 1%, 5%, and 10%-level, respectively. Constants are not reported in the table, as they resulted to be not statistically significant. Robust standard errors are reported in the brackets.

[a] See Appendix F (Tables F2) for the complete model results, including the coefficients for the control variables.

marginal effects associated with sustainability attributes. Considering all the specifications, each robust OLS model explains around 30% of the mWTP variability. The results indicate that attributes related to the environmental dimension of sustainability are valued significantly more than those associated solely with the social dimension. Attributes related to sustainable practices applied in the vineyard exhibit a positive and significant relationship with mWTP. However, the findings suggest that communicating environmental efforts through quantitative information on inputs or emissions along the production chain (i.e., environmental impact-related attributes) does not effectively increase consumers' willingness to pay a price premium for wine. Additionally, efforts aimed at improving the sustainability of wine packaging appear to be poorly received by consumers, as indicated by significant negative coefficients.

Results from the quantile regression models indicate that sustainability attributes do not influence mWTP in the lower part of the distribution. This suggests that consumers with a low mWTP for sustainable wine are generally indifferent to various sustainability aspects conveyed by specific attributes and are instead more sensitive to the price. However, when considering regressions at the median and the 75th percentile, the attributes associated with significant coefficients mirror those identified as significant in the OLS model results.

## 5. Discussions

### 5.1. Sources of heterogeneity in mWTP estimates

The heterogeneity observed in mWTP values across studies confirms the importance of examining moderating factors such as methods, geographical focus, and the type of attribute considered.

The significant effect associated with the use of discrete choice experiments is likely due to their hypothetical nature, which could lead participants to express inflated values than those revealed in real-world scenarios where they face financial constraints (Aoki and Akai, 2022; Haghani et al., 2021; Liu and Tian, 2021; Lusk and Schroeder, 2004). In line with this interpretation, Schmidt and Bijmolt (2020) show that non-real indirect methods, such as choice-based conjoint analysis, amplify hypothetical WTP to a greater extent than non-real direct methods.

Beyond methodological considerations, geographical factors also influence WTP. The consistent positive effect observed for Southern Europe suggests that cultural familiarity with wine production and consumption, together with the widespread adoption of sustainable wine practices, may enhance WTP in that region. Cultural factors specific to consumers from different territories, greater consumer familiarity with the sustainability-related wine attributes (Sirieix et al., 2013), and the widespread adoption of sustainable winemaking practices (OIV, 2025) likely play a significant role in shaping preferences for these wine characteristics.

The variation in sensitivity across sustainability attribute categories within the mWTP distribution reflects the heterogeneity of consumer preferences. It reflects the nuanced balance between price sensitivity and the value placed on communicated sustainability attributes, which differs across consumer segments characterized by varying levels of WTP. The results contribute to consumer segmentation theory by indicating that differentiating sustainability efforts is effective mainly among high-WTP consumers, suggesting that price sensitivity plays a moderating role in sustainability valuation. Consequently, price-oriented policy tools, such as tax incentives or subsidies, may be particularly effective for mainstreaming sustainable consumption among price-sensitive segments by improving the competitiveness of sustainable wines relative to conventional alternatives.

**Table 6**
Estimated coefficients, robust Standard Errors (SE), and $R^2$ for sustainability attribute categories from each robust quantile regression model (n = 170)[b].

| Model | Attribute classification approach | Variable specified (+ control variables) [a] | Coefficients | | | $R^2$ | | |
|---|---|---|---|---|---|---|---|---|
| | | | P25 | P50 | P75 | P25 | P50 | P75 |
| | *Sustainability dimension* | | | | | | | |
| (2.a) | | Environmental dimension | 3.26 (6.52) | 4.81 (4.37) | 10.13* (5.69) | 0.13 | 0.23 | 0.26 |
| (2.b) | | Social dimension | −2.36 (4.71) | −3.20 (3.84) | −3.37 (8.23) | 0.12 | 0.23 | 0.24 |
| | *Equalitas principles* | | | | | | | |
| (2.c) | | Good agricultural practices | 8.97 (7.55) | 13.50** (5.81) | 16.95* (9.18) | 0.14 | 0.25 | 0.29 |
| (2.d) | | Good practices in winery and bottling | −2.33 (4.38) | 0.82 (4.38) | 5.29 (6.95) | 0.12 | 0.22 | 0.24 |
| (2.e) | | Workers' rights | 3.40 (4.07) | −0.97 (3.83) | −2.64 (6.37) | 0.13 | 0.22 | 0.24 |
| (2.f) | | Relations with the local communities | −4.18 (14.04) | −3.20 (15.50) | −1.02 (11.95) | 0.12 | 0.22 | 0.24 |
| | *Self-developed classification* | | | | | | | |
| (2.g) | | Production method | 8.67 (6.64) | 9.12 (5.39) | 9.24 (6.04) | 0.19 | 0.24 | 0.26 |
| (2.h) | | Environmental impact | −7.96 (6.39) | −8.45 (7.54) | −6.88 (9.84) | 0.12 | 0.23 | 0.26 |
| (2.i) | | Social commitment | −2.36 (4.71) | −3.20 (3.84) | −3.37 (8.23) | 0.12 | 0.23 | 0.24 |
| (2.j) | | Local production | 4.21 (11.09) | −6.63 (25.27) | −6.20 (21.69) | 0.11 | 0.19 | 0.23 |
| (2.k) | | Sustainable grape variety | −37.18 (20.84) | −19.50 (23.31) | −5.27 (20.40) | 0.12 | 0.22 | 0.23 |
| | *Most represented sustainability attributes type* | | | | | | | |
| (2.l) | | Organic | 9.17 (5.54) | 8.61** (3.77) | 8.23 (8.56) | 0.11 | 0.25 | 0.27 |
| (2.m) | | Sustainable packaging | −13.76 (9.25) | −18.03* (9.76) | −22.17** (9.62) | 0.14 | 0.26 | 0.29 |

Note: ***, **, * indicate significance at the 1%, 5%, and 10%-level, respectively. P25, P50, and P75 refer to the 25th, 50th and 75th percentiles, respectively. Constants are not reported in the table, as they resulted to be not statistically significant. Robust standard errors are reported in the brackets.

[a] See Appendix F (Tables F3, F4, and F5) for the complete model results, including the coefficients for the control variables.

[b] Unlike sub-sample analyses, quantile regressions estimate the conditional effects of covariates at specific points in the distribution (25th, 50th, 75th percentiles in this case) using the full dataset (Koenker and Hallock, 2001).Unlike sub-sample analyses, quantile regressions estimate the conditional effects of covariates at specific points in the distribution (25th, 50th, 75th percentiles in this case) using the full dataset (Koenker and Hallock, 2001).

### *5.2. Valuation of sustainability attribute categories*

The classification of sustainability attributes into distinct categories allowed for a deeper exploration of these aspects by unpacking them within the context of the wine supply chain. Overall, environmental attributes are valued significantly more (+11,5%) than attributes only capturing the social dimension. This finding aligns with existing literature (e.g., Forbes et al., 2020; Sander et al., 2021), which documents stronger consumer responsiveness to environmentally oriented sustainability initiatives compared to purely social ones. Aligning with this, sustainability functions as a multidimensional credence attribute with asymmetric valuation across dimensions. Specifically, attributes related to sustainable vineyard practices are positively associated with mWTP. Given their perceived environmental benefits, these findings help explain the significance of the positive effect observed for environmental dimension-related attributes on mWTP discussed above. In light of this, when wine producers consider improving the sustainability initiatives along the wine-making process, they should take in mind that sustainable wine consumers appear to discriminate between environmental and social attributes, demonstrating a significant preference for environmental ones. Specifically, their effort will likely be valorized more when focusing on practices applied at the vineyard level, as they are associated with higher WTP than those implemented at later stages, such as winemaking or bottling.

In contrast, environmental impact labels do not exhibit a significant effect on mWTP. This result diverges from evidence in the broader food literature. For example, Piracci et al. (2024) reported substantial price premiums for environmental impact attributes in food products, ranging from 22% for low-priced items to 74% for high-priced ones. Although these findings pertain to different product categories, the discrepancy highlights how sustainability attributes may be interpreted differently in wine compared to food markets. One possible explanation lies in the wine industry's relatively slower progress in addressing sustainability issues compared to the food industry. Considering this, environmental impact labels in the wine sector could be very unfamiliar among consumers and they may still be perceived as more technical and complex. This suggests that emphasizing the quantitative benefits of sustainability practices (e.g., environmental footprint labels) is not an effective communication strategy for the valorization of the wine product.

A similar pattern emerges for the “local” attribute, which appears to underperform in the wine context compared to food products, as reported by Printezis et al. (2019). From their review, this food attribute seems to be evaluated in a range between 1.70 \$/lb and 2.08 \$/lb. However, it is worth pointing out that again the food category considered can play a significant role in explaining this divergence (Wägeli et al., 2016). Kemp et al. (2022) interviewed 190 consumers from Ontario to explore the meaning they associate with “local” in the context of food and wine purchasing. They found that, for wine, this characteristic is mainly perceived as encompassing a broader geographical scale compared to other food categories, where spatial boundaries are more narrowly defined. This broader interpretation may reduce trust in the attribute among wine consumers, who likely perceive geographical indications logos, such as PDO and PGI, as more reliable communication tools than non-certified local attributes (Costanigro et al., 2025; Vecchio and Annunziata, 2011).

The rejection of sustainable packaging confirms the findings of Stanco et al. (2020), who show that environmentally friendly packaging attributes (such as being environmentally friendly or recyclable) ranked low in wine consumers’ preferences compared to traditional choice drivers. Despite evidence that single-use glass bottles are less eco-friendly than alternatives like bag-in-box or cartons (Ferrara et al., 2020; Ponstein et al., 2019), glass bottles remain the preferred wine packaging (Ferrara et al., 2020; Mesidis et al., 2023; Orlowski et al., 2022). One possible reason is that, among wine consumers, packaging serves as a quality indicator, especially the traditional glass bottle. Consequently, presenting wine as more environmentally friendly while using bag-in-box packaging may lead to perceptions of lower quality (Ferrara et al., 2020; Schäufele and Hamm, 2017) and worse taste (Orlowski et al., 2022). In this regard, both producers and consumers could benefit from greater dissemination of information and knowledge on this topic.

The strong positive association between the organic attribute and mWTP may be inflated by the dual perception of the organic attribute. Organic wine is frequently perceived not only as environmentally friendly but also as healthier (Deroover et al., 2021; Migliore et al., 2020; Tsourgiannis et al., 2015; Vecchio et al., 2023). As a result, confounding effects across studies in the meta-analysis could overestimate the true relationship. These effects could arise from unobserved factors, such as environmental attitudes or health concerns, which influence both the decision to purchase organic products and the WTP for them. Furthermore, organic certification is typically classified under good agricultural practices; its widespread presence across studies and significant positive effect likely amplify the overall impact of these attribute categories on mWTP. Consequently, the higher remuneration observed for attributes related to good agricultural practices might primarily result from consumer interest driven by the perception of healthier wine products, rather than from a genuine concern for the specific agricultural practices employed during the wine-making process.

## 6. Conclusions

This meta-analysis synthesizes existing evidence on consumers' WTP for sustainable wine and investigates the sources of heterogeneity across studies using OLS and quantile regression approaches. By integrating methodological moderators and a multi-level classification of sustainability attributes along the wine supply chain, the study provides a more structured understanding of how sustainability is valued within this market. The evidence reveals substantial variation in WTP, driven by differences in sustainability dimensions, stages of the production chain, methodological choices, and the elements emphasized by various attributes. These effects are mainly observed among high-WTP consumers, whereas low-WTP consumers appear largely price-driven and do not differentiate between specific attributes. This suggests that their choices are predominantly driven by price rather than sustainability considerations. Overall, these findings provide valuable insights for both wine producers looking to refine their marketing strategies that capitalize on the company's sustainability efforts and offer a comprehensive empirical benchmark for future research in this domain.

### 6.1. Limitations of the study

This meta-analysis has several limitations that should be acknowledged. First, we were unable to collect detailed information on the samples used in the various studies due to inconsistencies in the reporting of sociodemographic characteristics. Given that sociodemographic factors play a critical role in explaining heterogeneity in WTP, future research should address this gap by ensuring a more comprehensive representation and analysis of these variables. One possible approach would be to directly contact the corresponding authors of the included studies to obtain missing or more detailed sample information. Second, due to the relatively small number of observations, we did not provide subgroup results from the meta-regressions, as doing so could lead to unreliable or misleading conclusions. However, in light of the growing number of studies on consumers' perceptions of sustainable wine, future research could adopt this approach and conduct further analyses on subdivided samples based on criteria such as wine type, period of data collection, or geographic area.

Another limitation relates to the variability in study methodologies. Differences in research designs, data collection methods, and measurement tools across studies may have affected the consistency of the results. Each methodological approach introduces distinct types and degrees of bias, potentially influencing outcomes in varying ways (Stanley and Doucouliagos, 2012). To improve comparability and robustness, future research should strive for greater methodological alignment and carefully control for experimental factors that may affect the resulting mWTP.

Finally, although grey literature can enrich a review, guaranteeing a more comprehensive perspective, it was not included in the present meta-analysis. The exclusion of unpublished studies may introduce a potential source of publication bias, as studies with non-significant results are less likely to be published (Stanley, 2001). Nevertheless, we chose to include only peer-reviewed publications to ensure the authenticity and the quality of the evidence considered, given that grey literature studies have not undergone the same level of scrutiny through the peer-review process.

Despite these limitations, this meta-analysis remains a valuable tool for exploring WTP for sustainable wine, emphasizing transparency and robustness in assessing results. It therefore provides a solid foundation for future research aimed at investigating specific consumer segments, alternative methodological approaches, and contextual factors that influence WTP for sustainable wine.

## CRediT authorship contribution statement

**Elena Radicioni:** Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Andrea Dominici:** Writing – review & editing, Writing – original draft, Software, Methodology, Data curation, Conceptualization. **Leonardo Casini:** Writing – review & editing, Supervision, Funding acquisition. **Fabio Boncinelli:** Writing – review & editing, Validation, Supervision, Methodology, Conceptualization.

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A

List of the studies included in the analysis.

**Table A1**
List of the selected studies with relative information.

| Study | Journal | Year of data collection | Country of research | Sample size | Sustainability attribute | WTP % |
|---|---|---|---|---|---|---|
| Ahlheim and Frör (2011) | Journal of Environmental Policy & Planning | 2009 | Germany | 518 | Cork oak landscape preservation | 7.8 |
| Ay et al. (2017) | Environmental and Resource Economics | 2013 | France | 555<br>555 | Organic<br>Local | 31.2<br>6.3 |
| Barber et al. (2009) | International Journal of Wine Research | 2008 | US | 820 | Environmentally friendly | 17.4 |
| Barber et al. (2016) | International Journal of Wine Business Research | 2015 | US | 117<br>124 | Pro-environmental | 0[a]<br>0 |
| Barber et al. (2012) | Journal of Consumer Marketing | 2011 | US | 120<br>120<br>120 | Environmental approach in the production<br>Certified California Sustainable Winegrowing (CCSW) program | 43.3<br>4.2<br>4.8 |
| Bazzani et al. (2024) | Food Quality and Preference | 2021 | Italy | 340<br>340<br>340<br>340 | VinNatur<br>Demeter<br>Organic<br>Natural wine claim | 77.2<br>127.2<br>137.1<br>0 |
| Boncinelli et al. (2021) | Agricultural and Food Economics | 2017 | Italy | 318 | Organic | 0 |
| Boncinelli et al. (2019) | Food Quality and Preference | 2017 | Italy | 318<br>300 | Organic | 0<br>230.8 |
| Borrello et al. (2021) | PLoS ONE | 2019 | Italy | 627<br>627 | Fungus resistant grapes (horticultural hybrids)<br>Fungus resistant grapes (genome-edited hybrids) | 10.1<br>−21.1 |
| Brugarolas et al. (2010) | Renewable Agriculture and Food Systems | 2007 | Spain | 400<br>400 | Organic | 25.0<br>15.0 |
| Chikumbi· et al. (2021) | Wine Economics and Policy | 2019 | South Africa | 611 | Organic | 0.6 |
| Dominici et al. (2020) | British Food Journal | 2018 | Italy | 408 | Organic | 66.4 |
| Espinoza et al. (2018) | Oeno One | 2017 | France | 163<br>163 | Organic<br>Resistant variety grapes | 54.7<br>48.6 |
| Everett et al. (2018) | International Journal of Wine Business Research | 2015 | US | 309 | Local | 14.9 |
| Galati et al. (2019) | Journal of Cleaner Production | 2018 | Italy | 286 | Natural wine | 46.4 |
| Gallenti et al. (2019) | Agricultural and Food Economics | 2018 | Italy | 587 | Carbon footprint | 31.0 |
| Gassler (2015) | Journal of the Austrian Society of Agricultural Economics | 2013 | Austria | 180<br>180<br>180 | Organic<br>Sustainable wine<br>Carbon neutral | 53.4<br>49.5<br>49.3 |
| Gassler et al. (2019) | International Journal of Wine Business Research | 2018 | Germany | 107<br>107 | Organic | 40.1<br>91.7 |
| Ghvanidze et al. (2017) | British Food Journal | 2016 | Germany<br>UK<br>US | 779<br>779<br>779<br>779<br>549<br>549<br>549<br>549<br>544<br>544<br>544<br>544 | Minimum chemical emissions<br>Reduced ecological impact<br>Outreach activities for local communities<br>Good working condition | 7.9<br>13.5<br>13.5<br>3.7<br>30.1<br>28.1<br>0.0<br>0.0<br>81.1<br>119.6<br>50.7<br>53.8 |
| Grebitus et al. (2013) | Ecological Economics | 2009 | Germany | 47 | Local | 56.7 |
| Jorge et al. (2020) | Journal of Cleaner Production | 2018 | Spain | 85 | Organic | 9.5 |
| Krystallis et al. (2006) | Journal of International Consumer Marketing | 2005 | Greece | 130<br>130 | Organic | 55.3<br>63.2 |
| Lerro et al. (2021) | Food Quality and Preference | 2017 | Italy \| Greece | 178<br>178<br>178<br>178<br>178<br>178 | Organic<br>VIVA sustainable wine<br>Carbon footprint | 26.4<br>26.4<br>12.5<br>20.7<br>22.8<br>14.2 |
| Li et al. (2018) | Ecological Economics | 2017 | US | 230<br>230 | "Wine made from grapes irrigated with recycled water" | −10.5<br>−10.6 |
| Lim and Reed (2020) | Journal of Cleaner Production | 2017 | US | 1047<br>1047 | Sustainable wine<br>Organic grapes wine | 12.4<br>22.4 |
| Loose and Remaud (2013) | British Food Journal | 2009 | US<br>Canada<br>UK<br>Germany<br>France | 1617<br>1614<br>1036<br>982<br>2021 | Social responsibility<br>Environmental responsibility<br>Organic<br>Carbon zero<br>10% less glass | 0.0<br>0.0<br>0.0<br>0.0<br>0.0 |

(continued on next page)

**Table A1** (*continued*)

| Study | Journal | Year of data collection | Country of research | Sample size | Sustainability attribute | WTP % |
|---|---|---|---|---|---|---|
| | | | | 2025 | | 0.0 |
| | | | | 2027 | | 0.0 |
| | | | | 1617 | | 0.0 |
| | | | | 1614 | | 0.0 |
| | | | | 1036 | | 0.0 |
| | | | | 982 | | 0.0 |
| | | | | 2021 | | 0.0 |
| | | | | 2025 | | 0.0 |
| | | | | 2027 | | 0.0 |
| | | | | 1617 | | 17.6 |
| | | | | 1614 | | 10.7 |
| | | | | 1036 | | 12.8 |
| | | | | 982 | | 2.9 |
| | | | | 2021 | | 3.9 |
| | | | | 2025 | | 27.0 |
| | | | | 2027 | | 26.1 |
| | | | | 1617 | | 9.6 |
| | | | | 1614 | | 5.2 |
| | | | | 1036 | | 4.1 |
| | | | | 982 | | 3.3 |
| | | | | 2021 | | 3.4 |
| | | | | 2025 | | −5.9 |
| | | | | 2027 | | −6.6 |
| | | | | 1617 | | −6.2 |
| | | | | 1614 | | −3.4 |
| | | | | 1036 | | −8.6 |
| | | | | 982 | | −4.7 |
| | | | | 2021 | | −3.0 |
| | | | | 2025 | | −13.8 |
| | | | | 2027 | | −7.9 |
| Loureiro (2003) | Food Policy | 2001 | Italy | 406 | Local | 0.4 |
| | | | | 406 | Environmentally friendly | 1.7 |
| Macht et al. (2022) | British Food Journal | 2018 | Germany | 192 | Organic | 17.2 |
| Mazzocchi et al. (2019) | Wine Economics and Policy | 2018 | Italy | 102 | Biodiversity protection | 73.6 |
| | | | | 102 | Organic | 0.0 |
| | | | | 105 | | 38.4 |
| | | | | 105 | | 47.2 |
| Mesidis et al. (2023) | Journal of Cleaner Production | 2022 | Australia | 507 | Alternative packagings (carton, PET, bag-in-box) | 20.4 |
| | | | | 507 | | −8.1 |
| | | | | 507 | | −19.2 |
| | | | | 507 | | −38.5 |
| | | | | 694 | | −0.8 |
| | | | | 694 | | 8.9 |
| | | | | 694 | | −1.2 |
| | | | | 694 | | −10.0 |
| Migliore et al. (2020) | British Food Journal | 2018 | Italy | 613 | Natural wine | 52.0 |
| Nassivera et al. (2020) | British Food Journal | 2017 | Italy | 759 | Carbon footprint | 197.4 |
| Nesselhauf et al. (2020) | International Journal of Wine Business Research | 2016 | Germany | 1339 | 80% reduction of pesticides | 40.4 |
| | | | | 1339 | 50% reduction of pesticides | 67.9 |
| | | | | 1339 | 30% reduction of carbon emissions | 23.6 |
| | | | | 1339 | 50% reduction of carbon emissions | 36.1 |
| | | | | 1339 | Organic | 25.6 |
| Palmieri et al. (2023) | Wine Economics and Policy | 2015 | Italy | 200 | Water saving label | 8.4 |
| Peres et al. (2020) | Foods | 2017 | France | 106 | Organic | 11.3 |
| Piracci et al. (2022) | Applied Economic Perspectives and Policy | 2021 | Italy | 500 | Organic | 49.1 |
| | | | | 500 | Fair labour | 38.1 |
| | | | | 500 | Recycled glass | 28.7 |
| Raineau et al. (2023) | Ecological Economics | 2018 | France | 416 | Organic | 10.0 |
| | | | | 416 | Natural | 10.0 |
| Ruggeri et al. (2020) | British Food Journal | 2018 | France | 334 | Biodiversity protection | 34.2 |
| | | | | 334 | Organic | 41.1 |
| | | | | 334 | | 33.5 |
| | | | | 334 | | 35.7 |
| Saayman and Saayman (2019) | South African Journal of Economic and Management Sciences | 2017 | South Africa | 397 | Fair labour | 17.0 |
| Schmit et al. (2013) | Journal of Agricultural Economics | 2010 | US | 83 | Fungicides reduction (shoot thinning) | 8.7 |
| | | | | 83 | Fungicides reduction (leaf removal) | −3.4 |
| | | | | 83 | | 10.1 |
| | | | | 83 | | 16.8 |
| | | | | 83 | | 0.4 |
| | | | | 83 | | 17.0 |
| Scozzafava et al. (2021) | Food Quality and Preference | 2019 | Italy | 100 | Organic biodynamic | 26.9 |
| | | | | 100 | | 12.5 |
| | | | | 100 | | 36.4 |
| | | | | 100 | | 16.1 |

(*continued on next page*)

**Table A1** (*continued*)

| Study | Journal | Year of data collection | Country of research | Sample size | Sustainability attribute | WTP % |
|---|---|---|---|---|---|---|
| Seabra Pinto et al. (2022) | (Book) Improving Sustainable Viticulture and Winemaking Practices | 2019 | Portugal | 205 | Nonuse of herbicides | 12.0 |
| Sellers-Rubio and Nicolau-Gonzalbez (2016) | Wine Economics and Policy | 2014 | Spain | 182 | Sustainable wine | 12.5 |
| | | | | 187 | | 12.9 |
| | | | | 184 | | 13.2 |
| Stanco and Lerro (2020) | Sustainability | 2020 | Italy | 251 | Integrated cultivation practices | 25.8 |
| | | | | 251 | (SQNPI) | 30.6 |
| | | | | 251 | Environmental sustainability | 33.2 |
| | | | | 251 | standards (VIVA) | 27.4 |
| | | | | | Organic | |
| | | | | | Environmental and Social | |
| | | | | | Sustainability Standards (Equalitas) | |
| Streletskaya et al. (2018) | PLoS ONE | 2017 | US | 128 | Organic | −23.3 |
| Tait et al. (2019) | Journal of Cleaner Production | 2017 | US | 766 | Biodiversity management | 23.0 |
| | | | | 766 | Water management | 44.3 |
| | | | | 766 | By-product management | 39.6 |
| | | | | 766 | Energy management | 27.5 |
| | | | | 766 | Pest and disease management with | 51.1 |
| | | | | 766 | integrated strategies | 77.5 |
| | | | | 766 | Organic | 32.9 |
| | | | | 766 | Social responsibility | 63.7 |
| | | | | 766 | Organic grapes wine | 29.7 |
| | | | | | GHG emission management | |
| Ugaglia et al. (2021) | Wine Economics and Policy | 2020 | France | 239 | Sustainable wine | 28.5 |
| | | | | 239 | Natural wine | 30.1 |
| | | | | 239 | Fairtrade | 32.5 |
| | | | | 239 | Organic | 33.7 |
| | | | | 239 | Biodynamic | 34.1 |
| Vecchio (2013) | Wine Economics and Policy | 2013 | Italy | 80 | Green footprint | 57.2 |
| | | | | 80 | Libera Terra | 29.6 |
| | | | | 80 | Social responsibility (Wine for Life) | 23.2 |
| Vecchio et al. (2023) | Organic Agriculture | 2020 | Italy | 501 | Natural | 43.0 |
| | | | | 501 | Organic | 34.8 |
| | | | | 501 | Biodynamic | 26.6 |
| Vecchio et al. (2023) | International Journal of Wine Business Research | 2021 | Italy | 1113 | Organic | 45.0 |
| | | | | 1113 | Natural | 32.5 |
| Wang et al. (2022) | Food Quality and Preference | 2019 | Denmark | 75 | Organic | 10.6 |
| Wiedmann et al. (2014) | British Food Journal | 2011 | Germany | 66 | Organic | 51.7 |

*Note:* When not reported, the year of data collection was assumed to be the year before the articles' publication year.
[a] mWTP% is equal to 0 when the results are not statistically significant.

## Appendix B

Sustainability attributes classification.

**Table B1**
Sustainability attributes analyzed in the screened studies. The different categories of belonging are specified for each attribute.

| Attribute | Freq (n°) | Classification approach | | |
|---|---|---|---|---|
| | | Sustainability dimension | Derived by Equalitas principles | Self-generated classification |
| Organic | 44 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| Social responsibility | 8 | Social | Workers' rights | Social commitment |
| Natural | 8 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| Alternative packaging | 8 | Environmental | Good practices in winery and bottling | Production method |
| "10% less glass" | 7 | Environmental | Good practices in winery and bottling | Environmental impact |
| Carbon zero | 7 | Environmental | Good agricultural practices, good practices in winery and bottling | Environmental impact |
| Environmental responsibility | 7 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| "Fungicides reduction" | 6 | Environmental | Good agricultural practices | Production method |
| Biodynamic | 5 | Environmental | Good agricultural practices, good practices in winery and bottling, workers' rights | Production method |
| Sustainable wine | 5 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| Biodiversity protection | 4 | Environmental | Good agricultural practices | Production method |
| Local | 4 | Environmental | Relations with local community | Local production |
| Carbon footprint | 4 | Environmental | Good agricultural practices, good practices in winery and bottling | Environmental impact |
| "Minimum chemical emission" | 3 | Environmental | Good agricultural practices, good practices in winery and bottling | Environmental impact |
| "Minimum chemical emissions and reduced ecological impact" | 3 | Environmental | Good agricultural practices, good practices in winery and bottling | Environmental impact |
| "Outreach activities for local communities" | 3 | Social | Relations with local community | Social commitment |
| "Outreach activities for local communities and good working conditions" | 3 | Social | Relations with the local community, workers' rights | Social commitment |

(*continued on next page*)

**Table B1** (*continued*)

| Attribute | Freq (n°) | Classification approach | | |
|---|---|---|---|---|
| | | Sustainability dimension | Derived by Equalitas principles | Self-generated classification |
| VIVA sustainable wine | 3 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| Certified California Sustainable Winegrowing (CCSW) program | 2 | Environmental, Social | Good agricultural practices, good practices in winery and bottling, workers' rights, relations with the local community | Production method, Social commitment |
| Environmentally friendly | 2 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| Fair labor | 2 | Social | Workers' rights | Social commitment |
| "Wine made with fungus-resistant grapes" | 2 | Environmental | Good agricultural practices | Production method |
| Made with organic grapes | 2 | Environmental | Good agricultural practices | Production method |
| "Wine made from grapes irrigated with recycled water" | 2 | Environmental | Good agricultural practices | Production method |
| Pro-environmental wine | 2 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| "30% reduction of carbon emissions" | 1 | Environmental | Good agricultural practices, good practices in winery and bottling | Environmental impact |
| "50% reduction of carbon emissions" | 1 | Environmental | Good agricultural practices, good practices in winery and bottling | Environmental impact |
| "50% reduction of pesticides" | 1 | Environmental | Good agricultural practices | Environmental impact |
| "80% reduction of pesticides" | 1 | Environmental | Good agricultural practices | Environmental impact |
| Biodiversity management | 1 | Environmental | Good agricultural practices | Production method |
| By-product management | 1 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| Energy management | 1 | Environmental | Good practices in winery and bottling | Production method |
| GHG emission management | 1 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| Water management | 1 | Environmental | Good practices in winery and bottling | Production method |
| Green footprint | 1 | Environmental | Good agricultural practices, good practices in winery and bottling | Environmental impact |
| Carbon neutral | 1 | Environmental | Good agricultural practices, good practices in winery and bottling | Environmental impact |
| Cork oak landscape preservation | 1 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| "Environmental approach used in the production" | 1 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| Equalitas standards | 1 | Environmental, Social | Good agricultural practices, good practices in winery and bottling, workers' rights, relations with local communities | Production method, Social commitment |
| Fairtrade | 1 | Social | Workers' rights | Social commitment |
| Sustainable winemaking | 1 | Environmental | Good agricultural practices, good practices in winery and bottling | Production method |
| "Resistant variety wine" | 1 | Environmental | Good agricultural practices | Sustainable grapes variety |
| SQNPI (National Quality System of Integrated Production) Certification | 1 | Environmental | Good agricultural practices | Production method |
| Libera Terra | 1 | Environmental, Social | Good agricultural practices, good practices in winery and bottling, workers' rights, relation with local communities | Production method, social commitment |
| "Nonuse of herbicides" | 1 | Environmental | Good agricultural practices | Production method |
| "Pest and disease management with integrated strategies" | 1 | Environmental | Good agricultural practices | Production method |
| "Recycled glass" | 1 | Environmental | Good practices in winery and bottling | Production method |
| Water saving label | 1 | Environmental | Good practices in winery and bottling | Production method |
| Wine for Life | 1 | Social | -[a] | Social commitment |

*Note*: [a] The classification derived from Equalitas principles was not applicable in the case of "Wine for Life" attribute.

## Appendix C

Variation Inflation Factors (VIF) as multicollinearity test.

**Table C1**
VIF for all the model specifications.

| Variable | Controls | Controls + Environmental dimension | Controls + Social dimension | Controls + Good agricultural practices | Controls + Good practices in winery and bottling | Controls + Production method | Controls + Environmental impact | Control + Social commitment | Controls + Local production | Controls + Sustainable grape variety | Controls + Organic | Controls + Packaging |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northern America | 5.14 | 5.69 | 5.18 | 5.29 | 5.18 | 5.25 | 5.34 | 5.18 | 5.14 | 5.17 | 5.17 | 5.91 |
| Northern Europe | 3.85 | 4.31 | 3.85 | 4.12 | 3.85 | 4.04 | 4.05 | 3.85 | 3.86 | 3.91 | 3.89 | 4.65 |
| Southern Europe | 3.83 | 4.2 | 3.83 | 4.36 | 3.85 | 4.20 | 4.08 | 3.83 | 3.88 | 3.84 | 3.9 | 4.72 |
| Sample size | 3.56 | 3.58 | 3.56 | 3.58 | 3.57 | 3.59 | 3.58 | 3.56 | 3.62 | 3.63 | 3.59 | 3.58 |
| Discrete choice experiment | 2.87 | 2.9 | 2.88 | 2.88 | 2.89 | 2.92 | 2.98 | 2.88 | 2.88 | 2.96 | 2.89 | 2.89 |
| Remuneration | 2.46 | 2.61 | 2.48 | 2.48 | 2.47 | 2.49 | 2.57 | 2.48 | 2.47 | 2.46 | 2.48 | 2.46 |
| Experimental auction | 2.29 | 2.30 | 2.30 | 2.29 | 2.31 | 2.32 | 2.35 | 2.3 | 2.29 | 2.34 | 2.29 | 2.33 |
| Reference price | 2.25 | | 2.25 | 2.27 | 2.25 | 2.36 | 2.31 | 2.25 | 2.25 | 2.25 | 2.26 | 2.26 |
| After 2011 | 2.20 | 2.22 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.23 | 2.21 | 2.22 | 2.23 |
| Q1 | 1.9 | 1.93 | 1.9 | 1.92 | 1.9 | 1.93 | 1.91 | 1.9 | 1.9 | 1.9 | 1.9 | 1.96 |
| United Kingdom | 1.88 | 2.02 | 1.91 | 1.91 | 1.89 | 1.9 | 1.92 | 1.91 | 1.88 | 1.9 | 1.89 | 2.06 |
| Geographical indication | 1.88 | 1.92 | 1.88 | 1.95 | 1.88 | 1.89 | 1.88 | 1.88 | 1.88 | 1.88 | 1.88 | 1.91 |

(*continued on next page*)

**Table C1** (*continued*)

| Variable | Controls | Controls + Environmental dimension | Controls + Social dimension | Controls + Good agricultural practices | Controls + Good practices in winery and bottling | Controls + Production method | Controls + Environmental impact | Control + Social commitment | Controls + Local production | Controls + Sustainable grape variety | Controls + Organic | Controls + Packaging |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Attribute representation | 1.69 | 1.72 | 1.69 | 1.69 | 1.72 | 1.69 | 1.69 | 1.69 | 1.69 | 1.71 | 1.69 | 1.71 |
| Sensory evaluation | 1.55 | 1.58 | 1.56 | 1.57 | 1.59 | 1.57 | 1.55 | 1.56 | 1.62 | 1.56 | 1.60 | 1.56 |
| Q3 | 1.29 | 1.44 | 1.29 | 1.29 | 1.30 | 1.30 | 1.30 | 1.29 | 1.3 | 1.29 | 1.30 | 1.30 |
| Environmental dimension | | 1.16 | | | | | | | | | | |
| Social dimension | | | 1.06 | | | | | | | | | |
| Good agricultural practices | | | | 1.29 | | | | | | | | |
| Good practices in winery and bottling | | | | | 1.16 | | | | | | | |
| Production method | | | | | | 1.43 | | | | | | |
| Environmental impact | | | | | | | 1.42 | | | | | |
| Social commitment | | | | | | | | 1.06 | | | | |
| Local production | | | | | | | | | 1.12 | | | |
| Sustainable grape variety | | | | | | | | | | 1.11 | | |
| Organic | | | | | | | | | | | 1.17 | |
| Packaging | | | | | | | | | | | | 1.51 |
| Mean VIF | 2.58 | 2.64 | 2.49 | 2.57 | 2.5 | 2.57 | 2.57 | 2.49 | 2.5 | 2.51 | 2.51 | 2.69 |

## Appendix D

Control variables specification.

**Table D1**
Control variables considered in the meta-regression models.

| Variable | Type | |
|---|---|---|
| Northern Europe | dummy | 1 if data have been collected in a Northern European country, 0 otherwise |
| Southern Europe | dummy | 1 if data have been collected in a Southern European country, 0 otherwise |
| United Kingdom | dummy | 1 if data have been collected in the United Kingdom country, 0 otherwise |
| North America | dummy | 1 if data have been collected in the Northern American country, 0 otherwise |
| Others | dummy | 1 if data have been collected in the Australia or South Africa countries, 0 otherwise |
| After 2011[a] | dummy | 1 if data the study has been published after 2011, 0 otherwise |
| Sensory evaluation | dummy | 1 if participants completed a sensory evaluation before the WTP elicitation experiment, 0 otherwise |
| Remuneration | dummy | 1 if participants received remuneration for participating in the experiment, 0 otherwise |
| Choice experiment | dummy | 1 if the choice experiment was the core methodology, 0 otherwise |
| Experimental auction | dummy | 1 if the experimental auction was the core methodology, 0 otherwise |
| Sample size | continuous | |
| Geographical indication | dummy | 1 if the wine took into consideration have a geographical indication, 0 otherwise |
| Reference price (€) | continuous | |
| Attribute representation | dummy | 1 if the sustainability attribute is represented as a claim, 0 when represented as a graphical icon |
| Q1 | dummy | 1 if the publisher's journal is a Q1 journal, 0 otherwise |
| Q2 | dummy | 1 if the publisher's journal is a Q2 journal, 0 otherwise |
| Q3 | dummy | 1 if the publisher's journal is a Q3 journal, 0 otherwise |

[a] The year 2011 was significant for the sustainable wine sector for several reasons. At the European level, the Commission renewed discussions about the recognition of organic wine programs, which culminated in the approval of Regulation (EU) No. 203/2012. In Italy, the Ministry of Environment and Energy Security launched the VIVA program, which is a key initiative at the national level (VIVA, 2025). Additionally, in 2011, the California Sustainable Winegrowing Program saw a notable increase in participation, with many vineyard and winery owners voluntarily joining the initiative (A. Gilinsky et al., 2016).

## Appendix E

Publication bias assessment.

Table E1 summarizes the results of the application of the robust OLS model, using mWTP as the dependent variable and sample size square root as the precision indicator of the studies, considering the lack of standard errors (Printezis et al., 2019; Stanley, 2005). The *t*-test for the coefficient associated with the square root of the sample size, known as FAT evaluation, here indicates the presence of publication bias, as this coefficient is statistically significantly different from zero. At the same time, the PET serves as a method for identifying a significant WTP for sustainable wine after adjusting for publication bias by statistically evaluating the constant's coefficient. In this case, the relative coefficient is also significantly different from zero, suggesting a positive WTP for sustainable wine, independently from the presence of publication bias, which affects the meta-analysis to some extent.

**Table E1**
FAT and PET results from the application of OLS with clustered robust standard errors model.

| | Coefficient | Robust SE |
|---|---|---|
| Squared root(n) | −0.692** | 0.335 |
| Constant | 40.37*** | 7.62 |
| $R^2$ | 0.051 | |
| Observation | 170 | |

*Note*: *** and ** indicate significance at the 1% and 5% levels, respectively; "n" refers to the sample size.

## Appendix F

Quantile regression model results.

**Table F1**
Resultant coefficients of the control variables from the robust OLS and the robust quantile regression models.

| | Robust OLS | Robust quantile regression | | |
|---|---|---|---|---|
| | | P25 | P50 | P75 |
| *Study characteristics* | | | | |
| Discrete choice experiment | 24.58** (10.70) | −4.74 (15.72) | 5.58 (8.62) | 25.16* (13.97) |
| Experimental auction | 2.46 (10.46) | 1.71 (16.77) | −2.81 (14.51) | −8.68 (7.93) |
| Remuneration | −8.78 (9.33) | −11.08 (21.04) | −12.92 (16.42) | −4.16 (7.27) |
| Sensory evaluation | 1.60 (7.31) | −5.71 (8.84) | −9.14 (11.78) | 6.11 (8.66) |
| Data collected after 2011 | 10.86 (8.44) | 4.68 (15.38) | 12.05 (9.52) | 4.76 (11.14) |
| Attribute represented as a statement | 6.92 (6.88) | −4.70 (9.62) | 4.25 (8.14) | 17.02* (9.58) |
| Sample size | −0.02** (0.01) | −0.01 (0.02) | −0.01* (0.01) | −0.01 (0.01) |
| *Wine characteristics* | | | | |
| Reference price (€) | −0.70 (0.48) | −0.12 (1.11) | −0.58 (0.57) | −0.83 (0.57) |
| Geographical indication | −6.51 (9.60) | 7.81 (13.96) | 11.42 (9.29) | 4.33 (7.18) |
| *Geographical area*[a] | | | | |
| Northern Europe | 20.01 (13.51) | 14.94 (13.65) | 16.89 (22.92) | 20.10 (19.14) |
| Southern Europe | 35.88** (16.00) | 18.00 (14.74) | 20.86 (26.59) | 34.82 (23.52) |
| United Kingdom | 2.14 (17.09) | 16.63 (15.03) | 15.55 (23.36) | −3.18 (24.09) |
| North America | 20.92 (15.78) | 13.37 (20.60) | 22.53 (19.86) | 11.19 (20.66) |
| *Journal best quartile*[b] | | | | |
| Q1 | −8.92 (8.42) | −6.69 (11.39) | 0.81 (6.77) | −2.59 (7.20) |
| Q3 | 8.67 (11.42) | 30.75* (17.35) | 16.33 (17.29) | 4.20 (12.60) |
| Constant | 1.71 (20.48) | 5.83 (25.23) | 2.71 (30.82) | 5.29 (34.02) |
| $R^2$ | 0.29 | 0.12 | 0.22 | 0.23 |
| Obs | 170 | 170 | 170 | 170 |

*Note*: ***, **, * indicate significance at the 1%, 5%, and 10%-level, respectively. P25, P50, and P75 refer to the 25th, 50th and 75th percentiles, respectively. Robust standard errors are reported in the brackets.
[a] The category "Others"'(i.e., Australia and South Africa) has been treated as the reference category.
[b] "Q2" was dropped in the estimations due to multicollinearity problems.

**Table F2**
Estimated coefficients and $R^2$ from each robust OLS regression model (n = 170).

| | Models | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1.a) | (1.b) | (1.c) | (1.d) | (1.e) | (1.f) | (1.g) | 1.h) | (1.i) | (1.j) | (1.k) | (1.l) | (1.m) |
| *Study characteristics* | | | | | | | | | | | | | |
| Discrete choice experiment | 24.96** (10.53) | 24.46** (10.58) | 25.67** (10.43) | 24.95** (10.60) | 24.51** (10.88) | 24.76** (10.55) | 26.21** (10.22) | 25.97** (11.01) | 24.46** (10.58) | 24.69** (10.72) | 23.43** (10.47) | 23.67** (10.41) | 25.87** (10.72) |
| Experimental auction | 3.20 (10.30) | 3.23 (10.37) | 2.31 (9.85) | 3.14 (10.49) | 2.57 (10.45) | 3.07 (10.37) | 0.49 (10.09) | 1.05 (9.65) | 3.23 (10.37) | 2.37 (10.35) | 1.27 (10.76) | 1.79 (9.92) | −0.86 (9.22) |

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**Table F2** (*continued*)

| | Models | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1.a) | (1.b) | (1.c) | (1.d) | (1.e) | (1.f) | (1.g) | 1.h) | (1.i) | (1.j) | (1.k) | (1.l) | (1.m) |
| Remuneration | −10.29 (9.49) | −9.54 (9.60) | −10.46 (8.79) | −8.50 (9.36) | −8.88 (9.45) | −8.75 (9.34) | −7.16 (8.79) | −7.23 (9.11) | −9.54 (9.60) | −9.04 (9.49) | −8.67 (9.41) | −7.44 (8.76) | −8.21 (8.35) |
| Sensory evaluation | 0.49 (7.18) | 0.73 (7.22) | −1.08 (7.07) | 0.44 (7.16) | 1.54 (7.30) | −0.03 (7.06) | 0.01 (7.35) | 1.81 (7.09) | 0.73 (7.22) | 2.53 (7.41) | 2.28 (7.54) | −1.30 (7.12) | 3.25 (6.76) |
| Data collected after 2011 | 11.30 (8.42) | 10.96 (8.58) | 9.90 (8.58) | 10.90 (8.49) | 10.86 (8.47) | 10.66 (8.70) | 11.04 (8.46) | 10.86 (8.41) | 10.96 (8.58) | 11.29 (8.42) | 11.36 (8.37) | 12.22 (8.56) | 8.35 (8.41) |
| Attribute represented as a statement | 7.92 (6.56) | 6.78 (6.87) | 7.42 (6.67) | 7.59 (6.67) | 6.88 (6.90) | 6.82 (6.86) | 7.52 (6.56) | 6.61 (6.56) | 6.78 (6.87) | 6.89 (6.90) | 7.56 (6.90) | 7.10 (6.77) | 4.98 (6.94) |
| Sample size | −0.02** (0.01) | −0.02** (0.01) | −0.01* (0.01) | −0.02** (0.01) | −0.02** (0.01) | −0.02** (0.01) | −0.01** (0.01) | −0.02** (0.01) | −0.02** (0.01) | −0.02** (0.01) | −0.02** (0.01) | −0.01* (0.01) | −0.01** (0.01) |
| *Wine characteristics* | | | | | | | | | | | | | |
| Reference price (€) | −0.74 (0.52) | −0.72 (0.52) | −0.83* (0.49) | −0.72 (0.49) | −0.70 (0.48) | −0.76 (0.56) | −0.89* (0.53) | −0.78 (0.47) | −0.72 (0.52) | −0.69 (0.48) | −0.71 (0.48) | −0.78 (0.50) | −0.80* (0.45) |
| Geographical indication | −5.33 (9.72) | −5.96 (9.80) | −2.21 (9.30) | −6.24 (9.77) | −6.45 (9.73) | −6.50 (9.73) | −5.13 (9.77) | −6.73 (9.53) | −5.96 (9.80) | −6.69 (9.65) | −6.21 (9.70) | −6.70 (9.49) | −3.65 (8.78) |
| *Geographical area*[a] | | | | | | | | | | | | | |
| Northern Europe | 20.05 (13.74) | 20.17 (13.76) | 13.31 (11.51) | 20.15 (14.02) | 19.99 (13.62) | 20.64 (13.61) | 16.29 (12.47) | 17.99 (12.48) | 20.17 (13.76) | 19.80 (13.40) | 18.96 (13.68) | 18.30 (12.76) | 8.08 (9.51) |
| Southern Europe | 35.26** (16.23) | 35.60** (16.25) | 26.53* (13.57) | 35.29** (16.42) | 35.88** (16.11) | 35.36** (16.17) | 30.71* (15.48) | 33.61** (15.75) | 35.60** (16.25) | 36.42** (16.11) | 35.41** (16.37) | 33.44** (15.24) | 23.46* (12.32) |
| United Kingdom | 3.97 (16.17) | 3.90 (16.30) | −2.16 (14.97) | 2.60 (17.31) | 2.25 (17.04) | 4.14 (16.24) | 0.26 (15.20) | 0.41 (15.35) | 3.90 (16.30) | 2.14 (16.99) | 1.05 (17.12) | 2.71 (16.17) | −9.40 (16.54) |
| North America | 23.13 (18.54) 21.87 (16.54) | 21.85 (16.62) | 16.12 (14.37) | 21.61 (16.54) | 20.97 (15.93) | 21.92 (16.85) | 18.12 (14.69) | 18.91 (15.85) | 21.85 (16.62) | 20.91 (15.79) | 20.17 (16.01) | 22.37 (15.44) | 9.40 (13.54) |
| *Journal best quartile* [b] | | | | | | | | | | | | | |
| Q1 | −9.36 (8.32) | −9.21 (8.32) | −7.30 (7.84) | −9.01 (8.48) | −8.91 (8.44) | −9.42 (8.28) | −10.19 (7.75) | −9.36 (8.17) | −9.21 (8.32) | −9.00 (8.45) | −8.97 (8.49) | −8.44 (8.36) | −5.94 (7.51) |
| Q3 | 5.96 (12.68) | 8.95 (11.67) | 8.04 (11.99) | 8.26 (11.69) | 8.76 (11.63) | 6.93 (11.22) | 7.22 (10.98) | 7.92 (11.31) | 8.95 (11.67) | 9.15 (11.29) | 8.51 (11.14) | 7.13 (10.35) | 6.71 (11.62) |
| *Sustainability dimension* | | | | | | | | | | | | | |
| Environmental dimension | 11.54* (6.70) | | | | | | | | | | | | |
| Social dimension | | −7.58 (6.32) | | | | | | | | | | | |
| *Equalitas principles* | | | | | | | | | | | | | |
| Good agricultural practices | | | 15.79*** (4.58) | | | | | | | | | | |
| Good practices in winery and bottling | | | | 4.33 (5.47) | | | | | | | | | |
| Workers' rights | | | | | −1.10 (5.78) | | | | | | | | |
| Relations with the local communities | | | | | | −7.84 (10.40) | | | | | | | |
| *Self-developed classification* | | | | | | | | | | | | | |
| Production method | | | | | | | 9.70 (5.82) | | | | | | |
| Environmental impact | | | | | | | | −6.03 (9.06) | | | | | |
| Social commitment | | | | | | | | | −7.58 (6.32) | | | | |
| Local production | | | | | | | | | | 7.86 (15.97) | | | |
| Sustainable grape variety | | | | | | | | | | | −15.99 (21.17) | | |
| *Most represented sustainability attributes type* | | | | | | | | | | | | | |
| Organic | | | | | | | | | | | | 10.78* (5.58) | |
| Sustainable packaging | | | | | | | | | | | | | −25.67** (9.86) |
| Constant | −9.06 (20.65) | 2.90 (20.85) | −3.98 (18.51) | −1.73 (20.93) | 1.85 (20.56) | 4.03 (20.99) | −0.05 (18.95) | 5.05 (19.58) | 2.90 (20.85) | 0.67 (20.53) | 2.33 (20.73) | −0.82 (20.13) | 16.09 (18.49) |
| $R^2$ | 0.30 | 0.29 | 0.32 | 0.29 | 0.29 | 0.29 | 0.30 | 0.29 | 0.29 | 0.29 | 0.29 | 0.30 | 0.32 |

*Note*: ***, **, * indicate significance at the 1%, 5%, and 10%-level, respectively. P25, P50, and P75 refer to the 25th, 50th and 75th percentiles, respectively. Robust standard errors are reported in the brackets.

[a] The category "Others"'(i.e., Australia and South Africa) has been treated as the reference category.

[b] "Q2" was dropped in the estimations due to multicollinearity problems.

**Table F3**
Estimated coefficients and $R^2$ from each robust quantile regression model (n = 170).

| | Models | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (2.a) | | | (2.b) | | | (2.c) | | | (2.d) | | | (2.e) | | | (2.f) | | |
| | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 |
| *Study characteristics* | | | | | | | | | | | | | | | | | | |
| Discrete choice | −2.78 | 6.41 | 24.36** | −4.61 | 7.93 | 24.20** | −4.62 | 7.09 | 26.90** | −2.40 | 5.91 | 24.88 | −2.69 | 4.18 | 24.46** | −4.31 | 6.21 | 25.16 |
| experiment | (15.58) | (8.72) | (10.00) | (16.62) | (9.36) | (11.42) | (16.88) | (7.47) | (13.19) | (12.19) | (13.26) | (17.37) | (19.10) | (8.48) | (12.18) | (15.38) | (9.80) | (13.08) |
| Experimental | −3.53 | −3.29 | −8.89 | 1.32 | −3.26 | −8.23 | −0.38 | −4.47 | −7.09 | 0.92 | −2.86 | −10.12 | −1.56 | −3.16 | −8.24 | −0.67 | −4.22 | −8.68 |
| auction | (12.06) | (14.92) | (8.59) | (17.17) | (15.03) | (8.06) | (11.67) | (18.21) | (15.09) | (13.04) | (14.10) | (9.24) | (11.74) | (15.10) | (8.05) | (16.58) | (16.04) | (7.60) |
| Remuneration | −6.01 | −10.10 | −5.79 | −10.82 | −12.51 | −4.28 | −6.58 | −11.48 | −3.09 | −10.07 | −13.10 | −1.27 | −8.11 | −11.43 | −4.65 | −9.32 | −12.77 | −4.16 |
| | (18.72) | (11.84) | (6.88) | (20.67) | (17.14) | (7.15) | (20.62) | (20.31) | (9.79) | (17.34) | (18.72) | (9.33) | (19.47) | (18.28) | (7.21) | (19.81) | (17.77) | (6.61) |
| Sensory | −4.16 | −9.26 | 5.94 | −5.71 | −9.74 | 6.40 | −5.67 | −8.78 | 4.69 | −3.54 | −8.79 | 6.12 | −3.84 | −10.86 | 6.13 | −5.71 | −8.96 | 6.11 |
| evaluation | (7.64) | (10.69)- | (6.88) | (8.83) | (10.67) | (8.39) | (10.86) | (10.68) | (8.80) | (8.15) | (10.93) | (8.11) | (7.72) | (9.20) | (8.52) | (13.11) | (13.07) | (8.40) |
| | | 12.24 | | | | | | | | | | | | | | | | |
| | | (12.91) | | | | | | | | | | | | | | | | |
| Data collected | 3.77 | 13.86 | 13.37 | 4.29 | 10.55 | 9.29 | 10.56 | 9.74 | 8.95 | 3.25 | 10.65 | 5.89 | 5.11 | 14.65 | 8.26 | 5.97 | 10.03 | 5.26 |
| after 2011 | (15.47) | (9.04) | (9.45) | (15.75) | (9.79) | (11.93) | (27.41) | (9.02) | (17.54) | (14.07) | (10.87) | (11.69) | (14.89) | (9.93) | (11.37) | (17.83) | (11.41) | (10.03) |
| Attribute | −4.81 | 2.57 | 15.07 | −4.83 | 4.02 | 15.91 | −3.13 | 4.78 | 15.22 | −4.52 | 4.60 | 18.91* | −5.03 | 3.16 | 16.87* | −5.37 | 4.41 | 17.02 |
| represented | (9.39) | (7.54) | (12.03) | (9.44) | (8.41) | (10.59) | (10.06) | (6.99) | (16.15) | (8.67) | (10.00) | (10.39) | (9.28) | (7.46) | (9.90) | (9.87) | (10.27) | (9.59) |
| as a statement | | | | | | | | | | | | | | | | | | |
| Sample size | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | 0.00 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | (0.01) | (0.01) | (0.01) | (0.02) | (0.01) | (0.01) | (0.02) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| *Wine characteristics* | | | | | | | | | | | | | | | | | | |
| Reference price | −0.14 | −0.65 | −1.03* | −0.12 | −0.59 | −0.83 | 0.01 | −0.53 | −1.04 | 0.06 | −0.54 | −0.82 | −0.11 | −0.64 | −0.83 | −0.10 | −0.49 | −0.83 |
| (€) | (0.77) | (0.60) | (0.57) | (1.15) | (0.58) | (0.63) | (0.66) | (0.47) | (0.90) | (0.46) | (0.61) | (0.70) | (0.70) | (0.58) | (0.58) | (0.60) | (0.58) | (0.66) |
| Geographical | 8.70 | 8.85 | 5.71 | 7.68 | 9.53 | 4.87 | 9.90 | 12.24 | 5.01 | 6.39 | 11.64 | 5.39 | 6.99 | 11.28 | 5.20 | 10.83 | 10.60 | 4.33 |
| indication | (15.12) | (9.27) | (7.25) | (14.61) | (9.37) | (8.05) | (9.76) | (8.31) | (12.60) | (9.67) | (10.78) | (9.35) | (19.55) | (7.97) | (7.65) | (9.56) | (10.39) | (7.19) |
| *Geographical area*[a] | | | | | | | | | | | | | | | | | | |
| Northern | 8.67 | 19.82 | 16.90 | 14.81 | 18.94 | 20.41 | 10.18 | 14.24 | 5.86 | 17.50 | 16.46 | 17.80 | 12.93 | 17.15 | 20.85 | 10.40 | 16.62 | 20.10 |
| Europe | (16.73) | (24.69) | (21.23) | (13.75) | (24.19) | (20.34) | (15.65) | (14.85) | (29.61) | (14.49) | (30.84) | (20.41) | (16.19) | (22.12) | (19.78) | (18.37) | (23.60) | (18.50) |
| Southern | 12.52 | 20.43 | 31.44 | 17.61 | 22.66 | 35.57 | 9.15 | 20.07 | 22.84 | 19.59 | 20.98 | 33.64 | 14.84 | 19.73 | 35.41 | 11.62 | 21.14 | 34.82 |
| Europe | (17.78) | (29.39) | (21.31) | (14.89) | (27.27) | (23.61) | (20.10) | (17.29) | (24.66) | (13.80) | (32.44) | (24.03) | (18.02) | (24.94) | (23.93) | (20.97) | (28.22) | (22.75) |
| United | 10.14 | 15.71 | 5.43 | 15.99 | 15.31 | 4.52 | 10.13 | 12.52 | −4.16 | 17.60 | 14.99 | 3.04 | 13.96 | 16.01 | 2.42 | 12.10 | 15.02 | −2.68 |
| Kingdom | (16.38) | (25.17) | (24.12) | (12.99) | (23.94) | (21.98) | (15.58) | (16.46) | (36.41) | (16.04) | (27.58) | (24.08) | (18.39) | (22.16) | (22.74) | (18.64) | (23.81) | (21.09) |
| North America | 6.88 | 24.99 | 18.18 | 12.73 | 22.92 | 15.79 | 9.99 | 19.39 | 13.59 | 12.60 | 21.68 | 13.26 | 11.09 | 24.34 | 14.70 | 9.14 | 21.39 | 11.70 |
| | (20.95) | (21.92) | (23.83) | (21.28) | (21.02) | (21.24) | (21.58) | (13.86) | (35.69) | (17.17) | (26.11) | (22.49) | (19.77) | (19.53) | (20.48) | (22.91) | (20.66) | (20.26) |
| *Journal best quartile*[b] | | | | | | | | | | | | | | | | | | |
| Q1 | −5.51 | −0.74 | −1.84 | −6.30 | 0.51 | −1.92 | −5.89 | 1.68 | −0.69 | −5.89 | 0.66 | −3.50 | −3.48 | 0.05 | −1.29 | −4.42 | 0.54 | −2.59 |
| | (10.71) | (6.64) | (7.09) | (11.71) | (6.84) | (7.32) | (12.35) | (7.19) | (11.05) | (9.50) | (6.84) | (7.64) | (11.79) | (6.43) | (7.21) | (10.14) | (7.11) | (7.08) |

(*continued on next page*)

**Table F3** (*continued*)

| | Models | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (2.a) | | | (2.b) | | | (2.c) | | | (2.d) | | | (2.e) | | | (2.f) | | |
| | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 |
| Q3 | 30.28* | 15.78 | 12.46 | 30.62* | 17.22 | 8.47 | 30.99 | 21.67** | 10.02 | 30.93** | 20.29 | 6.19 | 30.60 | 15.57 | 7.74 | 30.36 | 16.03 | 4.20 |
| | (16.45) | (17.18) | (21.48) | (18.05) | (17.96) | (15.06) | (19.49) | (10.19) | (33.54) | (14.38) | (27.79) | (13.67) | (19.12) | (16.63) | (12.77) | (19.38) | (17.82) | (11.55) |
| *Sustainability dimension* | | | | | | | | | | | | | | | | | | |
| Environmental dimension | 3.26 | 4.81 | 10.13* | | | | | | | | | | | | | | | |
| | (6.52) | (4.37) | (5.69) | | | | | | | | | | | | | | | |
| Social dimension | | | | −2.36 | −3.20 | −3.37 | | | | | | | | | | | | |
| | | | | (4.71) | (3.84) | (8.23) | | | | | | | | | | | | |
| *Equalitas principles* | | | | | | | | | | | | | | | | | | |
| Good agricultural practices | | | | | | | 8.97 | 13.50** | 16.95* | | | | | | | | | |
| | | | | | | | (7.55) | (5.81) | (9.18) | | | | | | | | | |
| Good practices in winery and bottling | | | | | | | | | | −2.33 | 0.82 | 5.29 | | | | | | |
| | | | | | | | | | | (4.38) | (4.38) | (6.95) | | | | | | |
| Workers' rights | | | | | | | | | | | | | 3.40 | −0.97 | −2.64 | | | |
| | | | | | | | | | | | | | (4.07) | (3.83) | (6.37) | | | |
| Relations with the local communities | | | | | | | | | | | | | | | | −4.18 | −3.20 | −1.02 |
| | | | | | | | | | | | | | | | | (14.04) | (15.50) | (11.95) |
| Constant | 8.43 | −3.16 | −7.06 | 6.35 | 3.03 | 0.78 | −6.07 | −9.57 | 1.36 | 3.94 | 3.28 | 0.87 | 5.41 | 2.06 | 0.63 | 8.88 | 4.60 | 4.79 |
| | (31.86) | (32.37) | (29.45) | (25.45) | (31.91) | (34.79) | (37.55) | (20.56) | (38.24) | (25.18) | (36.10) | (34.95) | (30.83) | (29.33) | (35.34) | (30.87) | (32.07) | (33.59) |
| $R^2$ | 0.13 | 0.23 | 0.26 | 0.12 | 0.23 | 0.24 | 0.14 | 0.25 | 0.29 | 0.12 | 0.22 | 0.24 | 0.13 | 0.22 | 0.24 | 0.12 | 0.22 | 0.24 |

*Note*: ***, **, * indicate significance at the 1%, 5%, and 10%-level, respectively. P25, P50, and P75 refer to the 25th, 50th and 75th percentiles, respectively. Robust standard errors are reported in the brackets.

[a] The category “Others”'(i.e., Australia and South Africa) has been treated as the reference category.

[b] “Q2” was dropped in the estimations due to multicollinearity problems.

**Table F4**
Continued from Table E3. Estimated coefficients and $R^2$ from each robust quantile regression model ($n = 170$).

| | Models | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.g | | | 2.h | | | 2.i | | | 2.j | | | 2.k | | |
| | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 | P25 | P50 | P75 |
| *Study characteristics* | | | | | | | | | | | | | | | |
| Discrete choice experiment | 4.63 | 10.10 | 24.80 | −2.70 | 10.34 | 26.05** | −4.61 | 7.93 | 24.20** | −4.28 | 2.03 | 25.16 | −8.30 | 5.66 | 24.68** |
| | (12.02) | (8.06) | (8.80) | (22.31) | (10.27) | (11.24) | (16.62) | (9.36) | (11.42) | (11.76) | (10.20) | (18.64) | (13.93) | (8.45) | (13.28) |
| Experimental auction | 0.22 | −3.51 | −16.63 | −6.88 | −2.60 | −14.24 | 1.32 | −3.26 | −8.23 | −2.46 | −5.65 | −8.68 | −4.80 | −2.70 | −11.97 |
| | (13.77) | (16.66) | (7.81) | (10.02) | (15.67) | (8.48) | (17.17) | (15.03) | (8.06) | (9.03) | (16.17) | (9.44) | (8.40) | (14.47) | (9.33) |
| Remuneration | −8.48 | −10.50 | −2.89 | −0.05 | −12.02 | −3.92 | −10.82 | −12.51 | −4.28 | −6.05 | −10.82 | −4.16 | −4.39 | −13.17 | −2.67 |
| | (17.71) | (20.32) | (7.44) | (14.27) | (22.46) | (8.40) | (20.67) | (17.14) | (7.15) | (14.27) | (17.89) | (7.10) | (14.70) | (16.44) | (8.33) |
| Sensory evaluation | −3.62 | −10.42 | 13.03 | −3.54 | −11.13 | 10.10 | −5.71 | −9.74 | 6.40 | −3.57 | −8.67 | 6.11 | −5.58 | −8.82 | 9.17 |
| | (8.87) | (10.61) | (9.26) | (8.41) | (9.01) | (10.22) | (8.83) | (10.67) | (8.39) | (6.43) | (10.19) | (9.07) | (7.95) | (10.87) | (9.34) |
| Data collected after 2011 | 6.35 | 10.66 | 10.71 | 8.34 | 12.53 | 8.24 | 4.29 | 10.55 | 9.29 | 2.31 | 11.61 | 5.30 | 8.78 | 11.72 | 3.22 |
| | (14.67) | (13.11) | (14.10) | (17.53) | (13.38) | (13.94) | (15.75) | (9.79) | (11.93) | (10.99) | (7.93) | (11.57) | (15.62) | (9.13) | (8.06) |
| Attribute represented as a statement | −3.62 | 3.65 | 8.42 | −2.77 | 5.02 | 8.82 | −4.83 | 4.02 | 15.91 | −4.07 | 3.97 | 17.02 | −5.03 | 4.52 | 17.13* |
| | (10.69) | (7.26) | (11.35) | (11.29) | (9.49) | (15.03) | (9.44) | (8.41) | (10.59) | (9.11) | (7.04) | (12.24) | (9.91) | (8.03) | (9.95) |
| Sample size | −0.01 | −0.74 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | 0.00 | −0.01* | −0.01 |
| | (0.01) | (0.54) | (0.01) | (0.01) | (0.01) | (0.01) | (0.02) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| *Wine characteristics* | | | | | | | | | | | | | | | |
| Reference price (€) | −0.17 | −0.74 | −1.23 | 0.04 | −0.71 | −1.11* | −0.12 | −0.59 | −0.83 | −0.03 | −0.39 | −0.83 | −0.43 | −0.57 | −0.82 |
| | (0.54) | (0.54) | (0.41) | (0.65) | (0.44) | (0.61) | (1.15) | (0.58) | (0.63) | (0.97) | (0.51) | (0.67) | (0.98) | (0.57 | (0.54) |
| Geographical indication | 8.20 | 9.08 | 1.19 | 3.01 | 6.34 | −1.35 | 7.68 | 9.53 | 4.87 | 2.05 | 11.90 | 4.33 | 3.79 | 11.59 | 4.89 |
| | (9.92) | (8.88) | (5.92) | (13.35) | (7.86) | (7.82) | (14.61) | (9.37) | (8.05) | (11.74) | (8.97) | (7.09) | (10.31) | (9.25) | (7.43) |
| *Geographical area*[a] | | | | | | | | | | | | | | | |
| Northern Europe | 11.35 | 12.33 | 19.06 | 10.76 | 12.90 | 21.16 | 14.81 | 18.94 | 20.41 | 16.74 | 13.96 | 20.10 | 8.39 | 16.65 | 19.26 |
| | (11.15) | (16.72) | (19.72) | (15.09) | (22.98) | (21.90) | (13.75) | (24.19) | (20.34) | (13.61) | (28.97) | (17.94) | (13.28) | (22.84) | (17.90) |
| Southern Europe | 14.63 | 16.56 | 33.78 | 11.26 | 17.12 | 36.31* | 17.61 | 22.66 | 35.57 | 18.85 | 17.11 | 34.82 | 13.56 | 20.94 | 34.21 |
| | (12.19) | (17.99) | (19.49) | (15.92) | (20.96) | (20.80) | (14.89) | (27.27) | (23.61) | (12.95) | (30.61) | (23.65) | (14.12) | (26.51) | (22.01) |
| United Kingdom | 9.76 | 13.67 | 3.79 | 10.54 | 13.48 | 3.02 | 15.99 | 15.31 | 4.52 | 13.95 | 15.38 | −2.64 | 7.31 | 15.28 | −3.49 |
| | (11.44) | (14.64) | (24.50) | (16.59) | (19.39) | (26.33) | (12.99) | (23.94) | (21.98) | (12.92) | (26.39) | (21.60) | (13.71) | (23.29) | (21.09) |
| North America | 10.16 | 17.45 | 22.05 | 7.97 | 18.79 | 20.58 | 12.73 | 22.92 | 15.79 | 12.00 | 20.33 | 11.74 | 10.52 | 22.12 | 10.48 |
| | (16.29) | (15.44) | (22.40) | (19.11) | (20.74) | (27.10) | (21.28) | (21.02) | (21.24) | (16.07) | (24.60) | (21.08) | (22.81) | (19.80) | (19.65) |
| *Journal best quartile*[b] | | | | | | | | | | | | | | | |
| Q1 | −5.28 | −0.68 | −1.18 | −5.89 | −1.49 | −2.53 | −6.30 | 0.51 | −1.92 | −5.27 | −0.05 | −2.59 | −4.34 | 0.81 | −2.73 |
| | (10.94) | (7.05) | (7.84) | (12.54) | (5.89) | (10.92) | (11.71) | (6.84) | (7.32) | (9.54) | (6.30) | (9.65) | (11.65) | (6.68) | (7.34) |
| Q3 | 23.64 | 14.76 | 15.18 | 31.51 | 17.32 | 7.14 | 30.62* | 17.22 | 8.47 | 32.63** | 23.85 | 4.20 | 33.90 ** | 16.59 | 3.36 |
| | (9.45) | (13.49) | (24.38) | (20.41) | (23.56) | (28.41) | (18.05) | (17.96) | (15.06) | (14.14) | (14.88) | (12.82) | (16.05) | (17.20) | (11.48) |
| *Self-developed classification* | | | | | | | | | | | | | | | |
| Production method | 8.67 | 9.12 | 9.24 | | | | | | | | | | | | |
| | (6.64) | (5.39) | (6.04) | | | | | | | | | | | | |
| Environmental impact | | | | −7.96 | −8.45 | −6.88 | | | | | | | | | |
| | | | | (6.39) | (7.54) | (9.84) | | | | | | | | | |
| Social commitment | | | | | | | −2.36 | −3.20 | −3.37 | | | | | | |
| | | | | | | | (4.71) | (3.84) | (8.23) | | | | | | |
| Local production | | | | | | | | | | 4.21 | −6.63 | −6.20 | | | |
| | | | | | | | | | | (11.09) | (25.27) | (21.69) | | | |
| Sustainable grape variety | | | | | | | | | | | | | −37.18 | −19.50 | −5.27 |
| | | | | | | | | | | | | | (20.84) | (23.31) | (20.40) |
| Constant | −2.83 | 1.95 | 2.65 | 2.41 | 9.62 | 12.14 | 6.35 | 3.03 | 0.78 | 3.41 | 5.05 | 4.75 | 8.68 | 2.90 | 7.88 |
| | (30.33) | (21.14) | (34.23) | (29.37) | (28.93) | (35.71) | (25.45) | (31.91) | (34.79) | (24.46) | (33.02) | (34.55) | (29.30) | (30.71) | (32.65) |
| $R^2$ | 0.19 | 0.24 | 0.26 | 0.12 | 0.23 | 0.26 | 0.12 | 0.23 | 0.24 | 0.11 | 0.19 | 0.23 | 0.12 | 0.22 | 0.23 |

*Note*: ***, **, * indicate significance at the 1%, 5%, and 10%-level, respectively. P25, P50, and P75 refer to the 25th, 50th and 75th percentiles, respectively. Robust standard errors are reported in the brackets.

**Table F5**
Continued from Table E4 Estimated coefficients and $R^2$ from each robust quantile regression model (n = 170).

| | Models | | | | | |
|---|---|---|---|---|---|---|
| | 2.l | | | 2.m | | |
| | P25 | P50 | P75 | P25 | P50 | P75 |
| *Study characteristics* | | | | | | |
| Discrete choice experiment | −9.56 (21.62) | 7.39 (7.46) | 19.76 (16.98) | −4.14 (14.82) | 8.23 (15.21) | 25.75** (10.36) |
| Experimental auction | −3.04 (13.99) | −2.88 (19.99) | −16.97 (12.77) | −9.80 (17.65) | −4.05 (15.07) | −14.93** (7.23) |
| Remuneration | −9.18 (17.96) | −8.14 (14.90) | −2.28 (15.33) | 0.87 (26.67) | −11.44 (19.07) | −7.14 (7.56) |
| Sensory evaluation | −10.30 (13.50) | −10.76 (13.55) | 4.77 (7.39) | −3.63 (8.19) | −7.56 (11.09) | 11.91 (8.78) |
| Data collected after 2011 | 10.25 (18.57) | 14.75 (9.89) | 9.36 (14.56) | 4.76 (14.44) | 10.71 (10.59) | 3.97 (11.85) |
| Attribute represented as a statement | 0.51 (13.83) | 2.00 (7.29) | 10.10 (18.13) | −6.00 (8.27) | 3.49 (9.62) | 9.92 (10.47) |
| Sample size | 0.00 (0.01) | −0.01 (0.01) | −0.01 (0.01) | −0.01 (0.01) | −0.01 (0.01) | −0.01 (0.01) |
| *Wine characteristics* | | | | | | |
| Reference price (€) | −0.01 (0.66) | −0.68 (0.55) | −1.17 (1.29) | −0.19 (0.82) | −0.59 (0.61) | −1.11** (0.49) |
| Geographical indication | 8.21 (16.80) | 7.68 (9.09) | 0.42 (12.37) | 9.39 (13.57) | 11.25 (11.31) | 1.24 (6.31) |
| *Geographical area*[a] | | | | | | |
| Northern Europe | 12.46 (15.18) | 17.37 (22.18) | 19.11 (24.46) | 1.96 (19.00) | 9.09 (19.91) | 13.47 (16.93) |
| Southern Europe | 10.17 (12.92) | 18.82 (25.10) | 34.82 (25.50) | 7.58 (15.52) | 15.29 (19.60) | 30.20 (18.99) |
| United Kingdom | 13.12 (16.92) | 15.65 (22.37) | 7.60 (31.51) | 2.80 (20.77) | 7.43 (18.35) | −5.22 (24.93) |
| North America | 16.09 (20.33) | 24.15 (20.11) | 22.66 (29.40) | 1.89 (22.04) | 14.99 (16.35) | 12.41 (19.11) |
| *Journal best quartile*[b] | | | | | | |
| Q1 | −3.61 (15.97) | −1.12 (7.10) | −3.18 (10.85) | −6.36 (14.23) | 0.12 (6.95) | −1.34 (8.52) |
| Q3 | 35.40 *** (13.64) | 12.80 (14.46) | 5.94 (24.77)) | 32.12** (14.19) | 19.11 (29.87) | 0.76 (16.44) |
| *Most represented sustainability attributes type* | | | | | | |
| Organic | 9.17 (5.54) | 8.61 ** (3.77) | 8.23 (8.56) | | | |
| Sustainable packaging | | | | −13.76 (9.25) | −18.03* (9.76) | −22.17** (9.62) |
| Constant | −3.85 (32.92) | 1.51 (31.31) | 11.93 (40.75) | 16.46 (29.96) | 10.24 (23.15) | 21.94 (35.19) |
| $R^2$ | 0.11 | 0.25 | 0.27 | 0.14 | 0.26 | 0.29 |

*Note*: ***, **, * indicate significance at the 1%, 5%, and 10%-level, respectively. P25, P50, and P75 refer to the 25th, 50th and 75th percentiles, respectively. Robust standard errors are reported in the brackets.

## Data availability

Data will be made available on request.

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