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Sensory and economic evaluation of PIWI wines using the experimental
auction method

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*Other things may change,
but we start and end with the family*

Abstract

This thesis explores the sensory and economic evaluation of PIWI wines using the experimental auction method. PIWI wines, derived from disease-resistant hybrid grape cultivars, have gained attention in the wine industry due to their potential to offer sustainable alternatives to traditional grape varieties. The study aims to investigate consumer behavior and preferences towards PIWI wines compared to conventional and biological wines. Through the experimental auction method, participants faced real economic incentives to elicit their preferences, providing valuable insights into the market acceptance and economic viability of PIWI wines. The sensory evaluation revealed positive feedback on the sensory attributes of PIWI wines in the white wines, indicating their potential to compete with traditional grape varieties, while in red wines some discording results have been recorded. Moreover, the economic evaluation through the experimental auction method demonstrated a willingness to pay premium prices for PIWI wines, suggesting a promising market demand. These findings highlight the viability of PIWI wines as a sustainable and economically viable alternative in the wine industry. Further research and promotion efforts in this field can contribute to the diversification and sustainability of grape cultivation and wine production. The findings of this study have contributed to the understanding of consumer attitudes toward PIWI wines and informed strategies for promoting their adoption in the wine industry.

Summary in Italian

Questa tesi esplora la valutazione sensoriale ed economica dei vini PIWI utilizzando il metodo delle aste sperimentali. I vini PIWI, derivati da vitigni ibridi resistenti alle malattie, hanno attirato l'attenzione nell'industria vitivinicola per il loro potenziale nell'offrire alternative sostenibili rispetto alle varietà di uva tradizionali. Lo studio mira a indagare il comportamento dei consumatori e le preferenze nei confronti dei vini PIWI rispetto ai vini convenzionali e biologici. Attraverso il metodo dell'asta sperimentale, i partecipanti hanno ricevuto incentivi economici reali per elicitarne le preferenze, fornendo preziose informazioni sull'accettazione di mercato e la sostenibilità economica dei vini PIWI. La valutazione sensoriale ha rivelato feedback positivi sulle caratteristiche sensoriali dei vini PIWI nei vini bianchi, indicando il loro potenziale per competere con le varietà di uva tradizionali, mentre nei vini rossi sono stati registrati alcuni risultati discordanti. Inoltre, la valutazione economica attraverso il metodo delle aste sperimentali ha dimostrato una volontà di pagare prezzi maggiori per i vini PIWI, suggerendo una promettente domanda di mercato. Questi risultati evidenziano la fattibilità dei vini PIWI come alternativa sostenibile ed economicamente vantaggiosa nell'industria vinicola. Ulteriori ricerche e sforzi promozionali in questo campo possono contribuire alla diversificazione e sostenibilità della coltivazione dell'uva e della produzione di vino. I risultati di questo studio hanno contribuito alla comprensione delle attitudini dei consumatori verso i vini PIWI e forniscono indicazioni per sviluppare strategie volte a promuoverne l'adozione nell'industria vitivinicola.

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Introduction

Wine as a symbol, rather than a physical object, denotes happy times, friendships, communication, and pleasure. In some cultures, it represents prosperity, sustenance, and the beginning of new life; it is much more than just an alcoholic beverage. It is produced from the cultivars of the European species *Vitis vinifera* L, but not only. Although this is the most spread and renowned variety worldwide, individuals are also aware it is relatively vulnerable to disease, mildew, and insect damage compared to other species of *Vitis*, requiring regular treatments with pesticides. As a result, viticulture nowadays uses a disproportionate level of agricultural chemicals, which cannot be considered sustainable within today's parameters. The pressure diseases and pesticides applied to our society are crucial issues for viticulturists since the 19th century, which brought to Europe novel grapevines to contrast diseases such as powdery mildew and phylloxera.

Clear economic and environmental advantages of the adoption of disease-resistant hybrid grape cultivars are in the eyes of many experts real. Their use could offer a potential solution that can be specifically beneficial applied with techniques such as organic viticulture and regenerative agriculture. Furthermore, the abatement of phytosanitary interventions entails, in addition to the reduction of vineyard maintenance costs, a reduction in manpower and, therefore, a gain on the time spent in the vineyard, without forgetting the increase in quality of a product that is certainly healthier and more natural.

Market acceptance is the main key drawback of these disease-resistant hybrid grape cultivars. This is what researchers are working on, it is the crucial point for a turning point from the perspective of sustainability, which in recent years has been "shaking up" many sectors in addition to the wine sector, so much that the European Community has issued increasingly restrictive laws to halve the use of plant protection products by 2025.

To reduce the adoption of agricultural chemicals which can damage the environment in which we live, another type of production has been used previously to disease-resistant hybrid grape cultivars; biological techniques.

Biological grapes have been grown since 1950 and their fame is nowadays already established worldwide. 12% of France farms use biological cultivation, making France the major biological

producer worldwide. Italy's biological production just lies in sixth place in Europe (Suolo e Salute, Nov. 2021). For this reason, the Italian government's goal is to enlarge this production mechanism in the upcoming years.

Biological wines are derived from grapes obtained with the organic production method, i.e. grapes produced following a production method that excludes the use of synthetic products in viticulture (in particular plant protection products and fertilizers). Compared to "conventional wines", they use vine defense techniques that employ plant protection products such as sulfur, copper, plant extracts, etc. in the defense of the vine from fungal and parasitic diseases or use living organisms that are antagonistic to the parasites. Organic viticulture aims to better safeguard and respect the environment and man.

To this end, this experiment uses both sensory and experimental economics approaches to study consumer behavior on PIWI wines, comparing them with conventional and biological wines. The mechanism adopted for the study are experiential auctions, which are largely used to measure consumers' preferences in different scenarios, with individuals facing real economic incentives to elicit their real preferences.

This paper is structured as follows. In the first part, the literature review is given with a detailed explanation of PIWI cultivars and the experimental auction method. The second section illustrates materials and methods used in the experiment, the third the results and analysis of the investigation, leaving the final part for the discussion and conclusion of the work.

Literature review

PIWI

Hybrid grapes are crosses between *Vitis Vinifera* cultivars and wild species of *Vitis*, born between 1880 and 1935 in France, to combine the resistance of cryptogams and phylloxera of American vines with the oenological qualities of European varieties. They are bred to be resistant to diseases such as bacterial and fungal infections, but also to insect pests. Previous generations of disease-resistant hybrid grape cultivars were selected for their resistance to phylloxera and fungal diseases, but most of the time showed lower resistance than modern disease-resistant hybrid grape cultivars.

Modern disease-resistant hybrid grape cultivars, include PIWI varieties, that are bred from backcrosses of classic *Vitis Vinifera* cultivars, with wild American and Asian *Vitis* species. These modern cultivars have been carefully bred to avoid negative characteristics that could arise, such as “foxy” aromas, to ensure market acceptability. However, it is suggested they have great potential for the production of high-quality wines in a sustainable way.

PIWI stands for the German word “Pilzwiderstandsfähige Rebsorten”, which means fungus-resistant varieties. The varieties require little to no pesticides to be protected from parasites or mildew disease. These latest-generation vineyards have achieved great success in modern genetic research, so much so that in the period 2019-2020 2.5 million rooted cuttings grafted with these vines were produced in Italy. The cultivation of these interspecific crossings has been authorized since 2013 and only in some regions: Trentino Alto-Adige, Veneto, Lombardy, Friuli-Venezia Giulia, Emilia Romagna, and Abruzzo. With this said, some downsides must be addressed to these new breeds, with the main differences being in the chemistry behind these varieties which differs somewhat from the usual classic *Vitis Vinifera* cultivars. Examples of new modern varieties are “Regent”, “Rondo”, and “Bronner”, listed all as generic *Vitis*.

With the advent of climate change, threatening our society more and more energetically, viticulture will have to adapt to hotter conditions, which are predicted to occur in many worldwide areas. Severe weather conditions are the most direct and drastic result of climate change, which can favor the development of grapevine diseases such as mildews, thus impacting substantially the economy. This means a reduction of quality, reduced yields, or even the loss of an entire harvest for some

vintages. As demonstrated by Eurostat, the European Statistical Institute, out of all agricultural activities, viticulture is one of the most impacting on the environment. While occupying only 3.3% of the world's agricultural area, it uses as much as 65% of all fungicides used in agriculture. The use of American vines and their hybrids as disease-resistant rootstock is projected to save viticulture in some regions. It was estimated, according to Fuller et al. 2014, that the adoption of modern disease-resistant hybrid grape cultivars would shield American growers from US\$177 to US\$287 per acre per year in California. This is mainly due to the increase in sprays due to these climatic conditions, which would require spraying as many as two more times per season, increasing costs by 20% - 50%.

Disease-resistant hybrid grape cultivars could considerably reduce the need for phytosanitary treatments, contributing to more sustainable vineyard management, especially in more extreme cultivation environments, such as those on steep slopes. Furthermore, the use of hybrids can also be seen from the point of view of reducing the risk of accidents, since there is no need to transit after the rains to carry out phytosanitary treatments, where especially in those occasions there is a high risk of tractor skidding.

A key problem for producers of disease-resistant hybrid grape cultivars is market acceptance. A study conducted in France, by Fuentes Espinoza et al. 2018, stated that consumers find the sensory profile unfamiliar and thus unappealing of PIWI wines compared to conventional wines. The study then demonstrated that the problem could be overcome by emphasizing the environmental benefits of the cultivars, raising awareness of such an argument. In a German study accomplished in a second moment, Nesselhauf et al. 2019, found that the price was the most important point for consumers when selecting which wine to choose, with the cultivar and grape variety only coming in a second phase. It was also noted that the environmental importance given to PIWI, focusing on the reduced pesticides adopted and the reduction of carbon emission due to their production, could offset any drawback caused by individuals' unfamiliarity with such new cultivars. Consequently, the prior experiences individuals have with these types of the product plays a drastic role in determining their success, proving that educating consumers on these grape varieties may help the commercialization of these wines.

To summarize, below there are the three main reasons why winemakers are increasingly approaching the choice of resistant vines:

1. Environmental sustainability: water saving and greater respect for the environment, from the reduction of the number of chemical compounds to the reduction of carbon dioxide emissions, reduction of production costs (antifungal products, fuel, and working hours), product final healthiness, the possibility of reaction to climate change and genetic aging of vines and rootstocks
2. Human capital: PIWI cultivars, in an area where vineyards are often an integral part of the residential fabric, improve the coexistence between viticulture and human settlements, with less pollution of the groundwater, the soil, and the entire ecosystem. Furthermore, the reduction of treatments entails fewer risks not only for the local inhabitant and the final consumer, but also for the operators (both in terms of health problems linked to exposure to the active ingredients of pesticides and fungicides, and of accidents at work)
3. Economic savings: a study carried out by VCR (Vivai Cooperative Rauscedo) claims that the economic savings induced by PIWI can amount to 1,000€ per hectare per year in North-East Italy, 800€ in Central Italy and 700€ in South Italy (Tussetto, 2018)

These aspects, which are seen from an ethical perspective demonstrate the value of disease-resistant hybrid grape cultivars and must be matched by the market, which today is still struggling to accept the wines produced from a qualitative point of view.

Consumer theory

Money allows human beings to meet their various needs and wants. These needs can be classified according to Maslow's hierarchy of Needs into three different categories: basic, psychological, and self-fulfillment. The course of action in which each of us decides to spend his money, however, is a free decision that varies from individual to individual. Influencing the spending behavior of society is a complex interplay of personal and external factors which take into account income, wealth, financial goals, the economy, cultural norms, and marketing. To help people reach their financial goals and perform more informed decisions, it is fundamental to understand these factors.

Economists believe it is possible to predict how individuals will spend their money. This enters into the consumer theory field where a lot is hinging on, as the population spending habits have a direct impact on corporate profits and as a result, the wider economy.

Consumer theory is the study of how people decide to spend their money based on different aspects such as their individual preferences and their budget constraint. How much income the society has and the prices of goods and services directly influence individuals' choices. Forecasting and understanding how consumers operate enables economists to get a better grasp of the unseen forces that shape the economy.

To give a straightforward scenario of how this might work, consider a person with x amount of money and a series of preferences. This individual could spend the money on whatever he desires and whatever amount. The consumer theory allows one to get a hint on how that person will spend that capital. This is entrenched in different assumptions, thus considering people as rational and all the same. Although these, predictions are fairly accurate, however not counted on 100%.

Individuals have the freedom of choosing different goods and services and the consumer theory seeks to predict their purchasing patterns by making three main assumptions:

1. Utility maximization → when individuals purchase goods/services, they calculate the decision based on what in their opinion would bring them the greatest benefit
2. Nonsatiation → People always have the desire to consume more and are seldom satisfied with just one time going to the shops
3. Decreasing marginal utility → Individuals lose satisfaction and attraction towards a product the more they use or consume it

These assumptions make evident that to conduct a proper consumer theory analysis, the following inputs are required:

1. A full set of consumptions/utilization options
2. The utility which is derived from each bundle in the set of options must be communicated to the consumer
3. A set of prices assigned to each bundle

The main advantage of building a better knowledge of the consumer's taste and income relates to the direct influence of the demand curve of a good/service. This will shape the overall economy as it is clear that the relationship between the quantity demanded of a good/service has a strong direct impact on the price of this.

Where to allocate resources is also a key point in trying to clarify consumer theory. This will allow businesses to apprehend individuals' preferences and deduce where people would concentrate their hard-earned money, knowing perfectly how to act in advance to give the best experience possible to the client.

Limitations in the consumer theory are numerous and the obstacle in developing a practical formula for each situation is a huge challenge. As behavioral economics points out, people are not always radical regarding the choices available and occasionally could be indifferent. Especially if people are not familiar with the product they are assessing, their decision is based on chance and the emotional component involved can drive the decision, leaving an immense bias in the analysis.

All the assumptions made throughout the consumer theory experiment criticize the process. This is because while in a perfect world, these could be valid, in reality, many variables can directly or indirectly influence people, exposing as flawed the process of trying to understand individuals' spending habits.

It is hypnagogic trying to prove that decision-making regarding individual preferences and people's budget constraints is entirely based on rational choices. These choices would be clouded by a full range of factors outlined throughout the outgoing of this paper.

Consumer's preference

Happiness, satisfaction, and utility are three major needs every human being wants to achieve. When referring to utility it is meant the total satisfaction of consuming a product or service, therefore the complete direct and indirect advantages benefitted from it. This proves that utility determinants are decided by several non-economic factors. Consumer value is measured in terms of the relative utilities between goods and services.

The entire consumer preferences process results in an optimal choice, that choice with which the consumer is most fulfilled. Formally, it is known that people maximize their utility based on their budget constraints. This is why consumer preferences allow individuals to rank different bundles of goods or services according to their satisfaction levels.

These preferences expressed by the consumer are independent of income or prices. A consumer's capacity to buy does not reflect a consumer's likes or dislikes, just their satisfaction. This idea of understanding the consumer is made possible by the assumptions of various aspects, which are fundamental considerations of the way people think about and make decisions. Assumptions are mental shortcuts that people use to make decisions. They have limitations, of course, however, they allow a person to understand the world. The major assumptions when analyzing consumer preferences are the following: completeness, transitivity, and nonsatiation.

1. **Completeness:** This assumes that individuals when acting to buy a good or service have all the information they need to make an informed decision, both about the product and about their desires, not having indifference between two or more goods.
2. **Transitivity:** This assumes that if case A happens, then, B will happen as well. This means that if a person, group, or society prefers option Z to X, and X to C, this implies they must prefer Z to C.
3. **Nonsatiation:** This is the famous economic assumption that "more is always better". If a person has X amount of something, it does not mean they will not be keen to want and desire more. For any bundle of goods, there is always another bundle arbitrarily close which in the end is preferred to it. The buyer hypothesis satiation is the purpose of the most extreme satisfaction that can be achieved by a consumer. It does not refer to a consumer's buying power, yet just his/her utility capacity.

The economic impact that consumer preferences play in the financial and labor markets is extremely fundamental. It shapes the force, authoritative structure, and framework of most individuals. Without the correct comprehension of the relationship between a buyer's inclinations and its procedure, hence the dimensions and secondary attributes of the economy, a huge lack of information is missing in trying to identify the monetary issues of today with the prosperity of

individuals, the consumption and contamination of nature and the financial improvement of advancement of consumers.

When allowing customers to arrive at their highest utility, singular firms will in general decrease their flexibility, incrementing it when they desire to gain benefits themselves. This explains the liability of benefits affecting the economy provided by consumer preferences.

The relevance consumer preference has in microeconomics and the impact it has in helping organizations build up a thought on the conduct of the client, allowing them to expand their offer on different items, directly jolts their overall revenues. To lift their income and allow companies to comprehend consumer choices, decisions made by buyers will be directly based on the consideration of consumer preferences.

Experimental auction method for the study of consumer preferences

The radical evolution which occurred in the last years in consumer preferences ushered major changes in the consumption of goods by individuals. The mass consumption model has been beaten, with an increase in the qualitative differentiation of products. To meet the needs of consumers' demand, the qualification processes of goods have become more complex, with a rise in product differentiation and innovation. Given the radical increase in the added value of products, the exploration of consumer preferences and their willingness to pay for specific goods in contrast to others has become essential to support producers.

Experimental economics applies experimental methods, all based on economics principles, to understand the situations involved in the decisions the society undertakes. It is defined as the method of analysis that uses scientifically designed and controlled scenarios, which are conducted in the field using a wide range of subjects, to generate data to evaluate theoretical predictions of economic behavior and preferences.

These types of experiments are similar to laboratory ones because people are in a controlled environment where most factors that can influence their behavior are held constant. Some of these factors can be controlling the choice sets (what individuals can do), the information conditions (what

individuals know), and the monetary incentive structure (how individuals' decisions translate into payoffs).

The purpose of the following lines is to provide an overview of the main experimental economics technique, applied in analyzing consumer preferences, and experimental auctions.

To estimate consumer preferences and the demands individuals have, experimental auctions have been a successful method adopted in the last years. First born in the field of irradiated pork and chicken, non-bovine somatotropin milk, insecticide reduction in apples, steak tenderness, beef packaging, and nongenetically modified corn chips, experimental auction methods are expanding and becoming more commonplace in non-market valuation because of their huge benefit compared to previously used valuation survey method. This is mainly because real products and real money are exchanged in this experimental scenario, therefore participants show a higher level of engagement and are more incentive to reveal their true value for a product than in a hypothetical survey setting. In addition to this, these types of experiments place subjects in an active market environment, allowing them to learn and adjust to real market conditions. Another reason that has favored the application of this method of analysis is linked to the strong innovation in today's world and the continuous launch of new products and new methods of production.

As previously mentioned, in the agricultural economics literature the analysis on pricing, marketing, and adoption has already been proved useful, this is why with future research it will be clear whether these types of examination can be adopted also in other fields.

To elicit willingness-to-pay (WTP) for novel products, a wide variety of techniques and procedures have been employed in previous experimental studies. The auction mechanism used to elicit the WTP is one of the most impacting differences across various studies. Just in the experimental auction line, different methods have been employed in recent literature:

1. Vickrey second price
2. Ascending-bid second price
3. Random nth price
4. First price
5. Fifth price
6. Becker-DeGroot-Marschak (BDM)
7. English auction

8. Combinatorial private-collective auctions

Still nowadays analyzing the difference in the auction mechanism, some researchers only valued a single product characteristic, while others had subjects value multiple characteristics or goods together.

Some when analyzing the elicited demand for novel products endow subjects with a good and ask them how much they would be willing to pay to exchange their endowed good for something similar with a different characteristic, others instead simply ask subjects to bid full value for a novel good.

If all assumptions, which were discussed previously, hold in practice, valuations will be equivalent under all the different procedures stated above. However, being this scenario is highly improbable, as proved by previous research, valuations will vary by auction mechanism and procedure.

Review on the principle procedural issues and experimental auction methods

How the relative magnitudes of valuation estimates are influenced by the different approaches is a matter of three procedural issues: auction mechanism, reference-dependent preferences, and the number of goods valued. These three variables, which will be briefly analyzed below, have all their importance and their potential in determining the WTP estimates in various ways, however, studies conducted in the past, specifically focused on the auction mechanism, suggested that WTP valuations were mainly affected by the procedure which was undertaken in the relative experiments.

Auction mechanism

Which mechanism to employ when first starting to plan an experimental auction is probably the hardest task to complete. The auction mechanism has to be incentive compatible with the type of well-valued and with the results objective. When valuations are considered to be truthfully revealed after bidding from a group of people, then the goal of an incentive-compatible auction has been fulfilled. A list of four auctions commonly used in literature will be investigated, as an investigation of all the auction typologies would be very ambitious to attempt. The following are considered to

be theoretically incentive compatible: the second price, random nth price, BDM, and the English auction. An overview of the participant procedure, the winning bidder, the number of winners, the market price, and the market feedback of these four main types of auction can be found in Appendix 1.

The English auction, which perhaps is the most renowned, has the experimenter who sets the opening price of the auction. Depending on the setup of it, individuals can offer ascending bids or inform who is controlling the experiment that they want to participate in the auction as prices are rising. When just one participant is keen to pay the current price, the auction is finished. This participant will therefore win the auction and pay the last amount offered.

The second price auction, proposed by Vickrey, can be compared to the English auction, where competitors simultaneously submit sealed bids for a good. The competitor with the highest bid wins the auction, however, he/she pays the second highest bid amount for the good.

The third type of auction which is worth analyzing is the BDM auction, Becker-DeGroot and Marschak introduced this mechanism as a way to induce individuals to reveal equivalents for lotteries. In this experiment, subjects individually submit sealed bids for a good. In the second step, a random number or price is drawn from a distribution. Individuals with a bid greater or equal to the randomly drawn price "win" the auction, buying the good at the randomly drawn price. What individuals are not informed of, is the range of distribution of prices from which the organizer of the auction randomly selects a price.

The nth price auction was formally introduced by Shogren et al. (2001b). This type can be seen as a combination of the best features of the second price and the BDM elicitation mechanism. Every potential bidder is engaged in the process and the market price is chosen specific to this auction type. Participants submit sealed bids for a good simultaneously and in a second moment one bid (the nth one) is drawn from the sample of competitors. Who bade more than the nth bid wins the auction and has to purchase the good at the price of the nth bid.

Several studies have been completed on these four types of auctions, analyzing them in all the various topics. In a study conducted by Kagel, Harstad, and Levin, in which the second price auction

was studied, a tendency was discovered for both experienced and inexperienced participants; they tend to “overbid”. This is why in this type of auction it is important to perform repeated trials to converge to the predicted theoretical value.

Differences arise between incentive-compatible auctions in a familiar value setting, where preferences are not induced because of the bidder affiliation. Affiliation may be expected in English, in the nth price, and in the second price auction where all the participants have a large number of public information about other individuals' bids. Interesting can be also the behavioral differences present between incentive-compatible auctions, when the bidding context is moved out of the induced value setting and into the world of real, private goods, where uncertainty and affiliation can always be expected to be present.

Reference-dependent preferences

Whether to endow participants with a good prior to the elicitation task is another key argument that changes drastically the outcome of the auction itself. To upgrade to a better good, various studies endow individuals with a good and elicit the WTP. This method is highly advantageous if the effect of interest wants to be isolated and also if the mitigation with other outside market influences wants to be reduced. This also helps to responsabilize participants to pay better attention to the auction and to the bid they are placing.

There is another huge factor that influences the outcome of the evaluation that must be taken into consideration. Individuals might place a higher value on a good if they possess it than if they do not. This principle is an effect that is thought to arise from loss aversion: hence losses are valued more highly than gains. The reference-dependent preferences demonstrate that the value estimates for a novel product depend on the individual's first initial reference point. Whether or not they initially possess the good dramatically clouds their thought and WTP.

Multiple-good valuation

When planning and conducting such experiments, there is a relatively high degree of fixed costs associated with recruiting subjects and conducting the auction itself. For little additional costs, researchers can get more data if they use multiple goods in the auctions versus a single-good valuation.

Despite all of the advantages present within the multiple-good valuation, some disadvantages are also present. The first key point is that the experimental design has to be properly constructed, if not valuations will be affected by demand reduction or wealth effects. In more practical terms, this means that if an individual purchases a good in one round of the experiment, their demand for the next good in another round of the experiment may fall in a subsequent treatment due to the normal progression of the demand curve, not due to a treatment effect. By properly constructing an experimental auction, it is meant that by randomly selecting a binding round and good, this effect may be significantly reduced.

Another disadvantage of the multiple-good valuation is that a good image could be altered by the presentation of the other available solutions. This could also be resolved if the random presentation of goods is planned ad-hoc, reasonably reducing this effect.

The alternatives with which a good is compared also can play a role in determining the WTP price of the initial good. This factor however still needs some further research, as neoclassical economic theories account for such effect, while more modern views don't consider it an empirical matter.

Experimental auction and hedonic measurements

Economists rely mainly on WTP assessment as the principal method to elicit preferences, while hedonic rating is used normally by sensory scientists. Basic economic theory states that differences in WTP reflect the differences in preferences, the same that should be observed with hedonic ratings. Hence, the bidding of prices each participant is evaluating is a monotonic transformation of the preferences expressed in their hedonic ratings.

Both techniques offer some advantages over the other, suggesting that the coexistence of these two elicitation methods can be a useful method to express the truth about the thought of the consumer.

Several papers in economic literature have used both measurements and tried to compare them, discussing the main differences between the two, however, revealing an overall consistency in variant ranking between WTP and hedonic measurements. To this reference, Lange et al. (2002),

who studied WTP for champagne, recorded that external and sensory information had the same impact on the champagne evaluation as using hedonic scores. Nevertheless, some main differences between the two approaches came out, showing that the methods could be adopted differently according to the specific objective of the experiment.

The main aspect which differs between the two methods is based on the information given on the analyzed goods. WTP experiments are more sensitive in detecting product differences when the value of a brand is researched under labeled conditions, on the contrary, hedonic measurements under blind conditions are more valuable for understanding what is the real value of a product. In other words, in the experimental auction method, WTP accounts for more value components than hedonic scores, if the presence of symbolic and affective components of value is given to the consumers.

There is the existence of two main sources of inconsistencies between auction and hedonic scores, as analyzed by Noussair et al. (2004) in his paper. The first main reason is attributed to the different natures of liking and purchasing intention, which are two different constructs. The second reason is that in most cases auctions do not reveal the whole range of preferences, specifically if the value of a good is low or negative for some participants. Another key claim which arose in this study that demonstrates how WTP led to higher discrimination between variants than hedonic measurements, is based on the demonstration that hedonic score distribution does not reveal a point below which consumers chose not to buy the good. Instead, it is of fundamental interest in an auction to detect the maximum price an individual is willing to pay for the experimented good. This cut-off point largely depends on the nature of consumers and the products analyzed, along with the information given which plays a far-reaching role in consumers' heads.

BDM experimental auction method

Having introduced four main experimental auction techniques, it is evident that over the years there has been a crafting, a modification, and an application of these in different fields. The majority of studies applied however one specific mechanism: the BDM mechanism (acronym for Becker, DeGroot, and Marschak). To prove this choice there are the many advantages that this auction has

over the other types. In this part of this experimental paper, there will be a detailed explanation of the BDM mechanism and its main advantages and disadvantages.

In the BDM auction, individuals are asked to place a bid for one or more goods that reflects how much they would be willing to pay for those goods. The price, randomly chosen from a uniform distribution of prices, sets the buying price of the goods. Since the price is chosen at random, participants are asked to give the real price they would be willing to pay for the goods it is in their interest to submit a bid equal to the price they are willing to pay for the product in the real world. If the bade price from the individuals is equal or superior to the drawn price, individuals buy the product at the drawn price, if instead, their bid is lower than the drawn price, they don't win the auction, thus not buying the product.

Subjects using this mechanism have no motivation to understate their true WTP because the price is not determined by their bid but by the drawn price. Their bid just allows them to buy the auctioned good. Indeed, if a buyer bids higher than the true value of that good, he/she could end up paying a higher price than the true value. Conversely, if a participant bids lower than its true value, he/she could lose on a profitable purchase.

In the case of having multiple goods in the auction, to avoid diminishing marginal utility and welfare effects, just one product is randomly chosen and sold. This also stands in the scenario of multiple rounds, just one round is chosen.

BDM mechanism can be performed in a group session, with the number of participants depending on the number of goods and rounds present. One of its core advantages is its suitability for the individual experiment, specifically inside the marketplace (for example restaurants or stores), allowing whoever is organizing the experiment to apply the random sampling method.

Another important aspect to consider which favors this mechanism is the fact that people are not competing one versus the other. People participating in auctions against other participants tend to deviate from their true WTP, hence the mechanism loses validity.

The main drawback of this auction method is the risk of the anchoring effect of the distribution. Participants can use the information given to form their valuations. Therefore, it is fundamental for experimenters not to provide a uniform distribution of prices to the individuals bidding, resulting in

a random-price sale mechanism. In Appendix 2 twelve practical suggestions for running an experimental auction study are presented.

Choice of the BDM method and its relevance

Nowadays BDM experimental auction is used around the world in a multiple range of fields by economists, psychologists, marketers, and sensory scientists. All of them have an aim to develop and value new products or new technologies. Especially in the food and drinks field, the BDM method has been highly adopted, in fact over 100 academic studies have been published in fields ranging from food safety (specific pathogens, biotechnology, pesticides), food attributes (fat content, packaging), a variety of drinks (wine, beer, spirits), new production methods (biological products, sustainable production) and new technologies (new machinery).

The immense relevance BDM experimental auction method uses to elicit consumer WTP and hedonic liking for new goods or services designates this method for this investigation. Here below a list of key relevant points to keep in consideration.

First of all, this method allows each individual to bid, precluding the need to make parametric assumptions regarding the shape of the market demand curve.

Secondly, BDM experimental auction involves the exchange of goods and real money with individuals. This is a huge incentive for consumers to participate and helps the auction mechanism gain importance.

Third, given the continuous nature of the dependent variable, it is straightforward and practical to model determinants of WTP and hedonic liking.

Fourth, consumers who take part in the auction mechanism can incorporate into their elicitation feedback from the experimental market, as they might do in an actual market setting outside of the experiment environment.

A fifth relevant aspect of this method is the possibility to provide participants with a questionnaire to understand better each of them. Detailed questions related to the field of investigation are asked to individuals participating, allowing a wider overview of each one and determining in a second moment particular correlations between people and elicitation.

Finally, this method has a wealth of theoretical literature which allows researchers in designing appropriate experiments to provide hypotheses to the test and verify them in the final phase.

Although this mechanism has a list of secure advantages that strongly advise it as the method to adopt, some drawbacks and threats are also present.

First, subjects have to be recruited and paid participatory fees to be part of the experiment. This method potentially can introduce some bias into the resulting bids and can limit sample sizes.

Second, bids could be truncated by outside alternatives which are not present in the investigation. This could increase bias in the investigation which is hardly removable.

Third, the participant's elicitation could be or become affiliated. This degrades the incentive compatibility of the auction itself and the results will be flawed.

Fourth, this is not just in the BDM mechanism, it is not uncommon to obtain a large frequency of zero bidding. This could be deriving from participant disinterest or because of operational neglect of some questions.

Mostly all of the drawbacks and threats can be mitigated by conducting the auction in an experimental field rather than in a lab setting. By moving the valuation setting to more familiar territory, as shown in an experimental work done by Bohm, List, Lucking-Reilly, and Lusk et al. 2001a, it was demonstrated that researchers were better able to target the population of interest, reduce the cost of experimental work because of reduced compensatory fees, decrease general bias and most importantly, put subjects in a context where they would normally do their purchasing decisions. This is because eliciting values in a field setting relaxes the restriction a lab can create, reducing this bias and giving less pressure to the single participants. Participants feel in a more normal environment, even sometimes forgetting they are being analyzed, and can provide researchers with the truest and most careful results.

Example of previous research adopting the BDM method

Subsequently, the introduction of the different auction typologies with a particular focus on the BDM mechanism to elicit WTP and hedonic liking, a few scenarios which adopted this method will be outlined, to gain knowledge on previous related studies.

In 2014 a study based on the “Willingness-to-pay for sustainability-labeled chocolate: an experimental auction approach”, directed by Riccardo Vecchio and Azzurra Annunziata is a perfect example to perceive this field. This study evaluates young consumer’s attitudes towards sustainable food, in this scenario chocolate. It analyzes the determinants of their willingness to pay for chocolate bars with different sustainability labels. Data were collected with the BDM experimental auction mechanism in Italy assessing respondents’ WTP for three selected labels chocolate bars: Fair Trade, Rainforest Alliance, and Carbon Footprint. The econometric outcomes of the research reveal that different socio-demographic factors exert a positive and statistically significant effect on the willingness to pay for all three selected bars. The factors were age (older), gender (female), and household income (high). The final bids were also influenced by the food consumption and the lifestyle of the respondents. This study analyzed individuals aged 18 to 35 and obtained a total amount of 80 people, not considering elderly people.

In this experiment the BDM auction was chosen compared to the other auction typologies, as it allowed researchers to elicit WTP directly at the point of purchase, therefore external validity was enhanced.

A more recent study in the wine world “Do consumers really recognize a distinct quality hierarchy amongst PDO sparkling wines? The answer from experimental auctions”, directed by Luigi Galletto, Francesco Caracciolo, Vasco Boatto, Luigino Barisan, Deborah Franceschi, and Marica Lillo analyzed the consumer likeability and WTP for two Italian sparkling wines: Conegliano Valdobbiadene Prosecco DOCG and Prosecco DOC. The purpose of the paper is to estimate individual WTP and likeability for both wines, with and without supplying additional information on their characteristics. This study analyzed individuals from northern Italy for a total of 99 consumers in May-June 2019 using the BDM auction mechanism in a wine-tasting room.

The results of this research show that supplying information to individuals significantly shapes their WTP, increasing the gap between the two geographical indications of Prosecco, while blind tasting narrows this gap. The advantage and superiority that the Conegliano Valdobbiadene Prosecco DOCG has was confirmed in this study, however, it relies more on its reputation than the actual taste itself.

The BDM procedure allowed participants to simultaneously present offers in closed envelopes. A sale price was then drawn at random from a uniform distribution of prices, ranging from three to

ten euros, incrementing each time by 50 cents. The range of prices in this uniform distribution was unknown to participants, therefore it was in their interest to offer the real price that they were willing to pay for such wines.

Any participant who bade an offer price greater or equal to the drawn price received the product by paying the sale price, if their bade price was lower participants just received the price for participating in the auction.

This BDM mechanism is incentive-compatible since bidders have no reason to overestimate or underestimate the real WTP since the sale price is determined by a random drawing and not by the participants themselves.

In this scenario a huge disadvantage could be present: the anchoring effect. This distortion will lead individuals to deviate from their true WTP as they can refer to other people's WTP, using such information to adjust their evaluations. Researchers to avoid such an effect have to avert any price reference and try to prevent people from speaking with each other, correctly placing their seats in a manner that stops them conversating.

Materials and methods

Product characteristics

In the period between the beginning of February and the beginning of April, the wines adopted in the experimental auction have been selected. A combination of interviews with industry experts as well as two tasting sessions with professional tasters were organized.

A long selection process whose final objective was to identify wine varieties of V. Vinifera, PIWI, and biological wines that were similar in terms of aroma and taste to each other was undertaken. The chosen wines had to be very representative of their grape variety and the challenge which appeared to be the most arduous was to reduce all the other variables associated with a bottle of wine.

The first of the activities carried out involved a series of interviews with technicians, oenologists, and agronomist consultants who have been cultivating vines or producing wines from resistant varieties for years, to have a complete picture of the current context of resistant varieties both in the regional and international field. The interview people are the following:

1. An expert nurseryman and the President of PIWI International
2. A consultant winemaker and producer of PIWI
3. An agronomic and wine consultant of the Extenda Vitis agronomic study

After a full overview of all the possible grape varieties which could have been used in the investigation, followed by detailed research of the available options on the market, one white grape variety and one red grape variety have been chosen, respectively:

1. Chardonnay (for conventional and biological wines) and Bronner (for PIWI wine)
2. Merlot (for conventional and biological wines) and Merlot Khorus (for PIWI wine)

With the wines grape variety decided the research for the desired bottles started. This was the second activity of the whole process, which at first sight might have appeared as an easy task, but turned out to be one of the most challenging.

The selection was accomplished in local shops around the University area, Conegliano (Treviso, Italy). This election was complicated, mainly because the desire was to reduce the different variables which could have been reported. This is why the following aspects have been curtailed:

1. Different vintage
2. Different production area
3. Different production method
4. Different grape variety
5. Different enologist and winery style
6. Different bottle price

With the first sample of wine bottles obtained, a first tasting has been organized with a few wine experts to judge the selection. This was very informal and rapidly organized; however, the outcome was very clear. The wines were very different from each other in terms of production style, therefore not right for the objective of the investigation. This being clear also to non-expert wine consumers in the experimental auction, would have resulted in a biased experiment. Therefore, the third activity in this process was to find wines from the same winery with very similar characteristics in terms of production area, terroir, age of plants, production method, vintage, style, and wine price. This task ended up being very hard to accomplish, as no winery in the area had a production of a conventional, a biological, and a PIWI wine whose characteristics were similar.

Consequently, the second sample of wine bottles was with products from the same winery, where possible.

Regarding this, the white wines chosen were a PIWI and a biological wine from the same winery (this winery did not produce a traditional Chardonnay). They have been compared in a second tasting, with three traditional Chardonnay from other producers, but with the same characteristics, hence the same price range, same production area, same production method, and same vintage. Analyzing red wines, three biological Merlot from different producers were compared with a traditional and a PIWI wine from the same producer. Also, in this case, the characteristics of the wines were the same, hence the same price range, same production area, same production method, and same vintage.

To that end, a tasting was organized on Monday 28 February with a panel of experts, which had as its ultimate goal the identification of the biological reference for Merlot and the traditional one for Chardonnay. The outcome of the tasting allowed to obtain three wines with overlapping similarities through the construction of a spider plot for a synthetic definition of the aromatic profile, to reduce

this important tasting variable. For this reason, these wine experts were asked to express their organoleptic judgment on the wines, along with an indication of which of the three options given was the best wine to combine with the two already chosen. References were randomly distributed and were not provided information on the varieties and methods of production of wines.

In Appendix 3 the spider plot of the chosen white wines and in Appendix 4 the spider plot of the chosen red wines are reported. In Table 1 a display of a small summary of the technical sheet for each chosen wine is present.

Table 1 *Summary of the technical sheet for the six chosen wines*

Grape variety	Winery	Biological wine	Conventional wine	PIWI wine	Vintage	Production area	Production method	Price (per bottle)
Chardonnay	Pizzolato	Yes			2021	North-East Italy	Yeast contact No FML	5.2€
Bronner	Pizzolato			Yes	2021	North-East Italy	Yeast contact No FML	5.5€
Chardonnay	De Stefani		Yes		2021	North-East Italy	Yeast contact No FML	8€
Merlot	Ca' Peruzetto		Yes		2020	North-East Italy	Long skin maceration	5€
Merlot Khorus	Ca' Peruzetto			Yes	2020	North-East Italy	Long skin maceration	15€
Merlot	Tenuta del Giaj	Yes			2020	North-East Italy	Long skin maceration	6€

Participants characteristics

Overall, more than 160 wine consumers were recruited to participate in the BDM experimental auction. Participants have been gathered through different communication techniques adopted in

the two weeks before the first tasting. The main methods adopted were newsletters, word of mouth, flyers, and social platforms, with the highest registration achieved with the newsletter.

In the enrollment phase, non-wine drinkers have been avoided by some questions which were able to captivate their wine consumption habits.

The sample was mostly formed of participants living in the Veneto region, more than 80%, with the remaining 20% divided across all other Italian regions. The majority of them were from the region of Treviso and Venice. The experimental auction was conducted between April and May 2023.

Among participants, there was a higher proportion (39% of the total) of people aged 26 to 50, 32% (aged 18 to 25), and 29% (older than 50 years), respectively (Table 2). In the sample, the total amount of men to women was higher, with 63% being male and 37% being female. The cohort of frequent wine buyers was the lowest: 2% bought wine habitually (every day), 20% two or three times per week, and 7% seldom; whereas the majority of buyers purchased wine two or three times per month (71%).

Speaking of wine consumption, a greater amount of the sample consumed wine two or three times per week (55%); everyday consumption counted 20%, while two or three times per month were more frequent (25%). The infrequent drinkers accounted for a much lower percentage (2%); in fact, it was just registered in three cases. Having a look at the percentages related to the price range usually spent by people for wine bottles, most people spend 10-15€ per bottle (39%), 30% spend 5-10€ per bottle, 21% spend 15-30€ per bottle, 5% spend more than 30€ per bottle and 4% less than 5€ per bottle.

Reflecting regarding prevailing channels used by participants to buy their wine, 45% of them stated they do it at the winery, 23% at the supermarket, leaving lower percentages to wine shop-bar (17%), restaurant (8%), and online (7%).

To have a fuller idea of the consumer involved in this experiment, questions on the relevance different factors play in their wine-buying choice have been asked. The drivers which the survey focused on, were: the relevance of Controlled Designation of the Origin of Wine, the relevance of the grape variety, the relevance of the brand, the relevance of a sustainability certificate, and the relevance of a biological certificate. The full results are displayed in Appendix 5, here just the major percentages are exposed.

The relevance of the Controlled Designation of the Origin of wine plays in the wine-buying choice is of very strong importance for consumers (32%). The grape variety for 35% of participants is of strong importance when choosing which wine to buy, but of strong importance, it is also the brand of wine for 30% of the bidders and the relevance of a sustainability certificate for 27% of them. It is of lower importance the biological wine certificate, as 27% of the consumers stated it is of moderate importance.

An insight into participants' knowledge of wine has also been inserted in the survey individuals had to complete before starting the experimental auction. Four queries based both on the production side and the tasting side of wine have been asked. For all the questions bidders could choose the "I don't know" option, which showed they were not sure about the answer or simply did not know it. This option was chosen by 15% in the first question (Negroamaro production region), 18% in the second and third one (Prosecco production method and demi-sec tasting notes, respectively), leaving the fourth question with the biggest percentage, 58% (flint notes present in wine). The correct answers have been guessed 75%, 53%, 15%, and 12% of the time, respectively. Detailed results can be seen in Table 2.

These results point out that participants who took part in this investigation were more expert on the production side (first two questions, 75%, and 53%), compared to the tasting side of wine (third and fourth questions, 15% and 12%). This could indicate that the WTP in the experiment could have been affected by this knowledge. These percentages could play a significant effect in the WTP for the wines tasted if bidders knew before this test the production mechanisms for PIWI wines. This could have biased their bids, as their awareness would be added to the information which has been provided to them regarding this particular breed of *Vitis Vinifera* at the beginning of the second round.

To complete the overview of participants of the experimental auction, three key questions have been asked in the final part of the survey. These questions were more delicate, but informing bidders that the survey results were anonymously reduced their sense of fear of being judged.

More than half of the individuals were single (58%), with another 32% being married, leaving just 2% of them being widowed and 9% having selected the "other" option.

In terms of instruction level, a vast majority of them had a bachelor's or further degree (55%). The second highest percentage of people were those with a diploma (32%), with another 13% of them

who stopped at the secondary school. Just 1% of the bidders had only completed the primary school.

The query regarding the monthly family income of participants gave more balanced results. Around one-third of them had an income of more than 4000€ (35%), with the highest percentage of people, however, lying in the range between 2000€ to 4000€ (44%). The lowest percentage for the monthly family income was in the option of 2000€ or below (21%).

Table 2 Data of the EA survey showing the frequency and the relative percentage per field

Survey results	Frequency	Percentage (%)
Age group		
18-25	52	31.52
26-50	65	39.39
More than 50	48	29.09
Gender		
Male	104	63.03
Female	61	36.97
Wine buying frequency		
Every day	3	1.82
2-3 times per week	33	20.00
2-3 times per month	117	70.91
Almost never	12	7.27
Wine consumption frequency		
Every day	30	18.18
2-3 times per week	90	54.55
2-3 times per month	42	25.45
Almost never	3	1.82
Wine purchase price range		
Less than 5€ per bottle	7	4.24
5-10€ per bottle	49	29.70
10-15€ per bottle	65	39.39
15-30€ per bottle	35	21.21
More than 30€ per bottle	9	5.45
Purchase of wine by prevailing channel		
Restaurant	14	8.48

Wine shop-Bar	28	16.97
Online	11	6.67
Supermarket	38	23.03
At the winery	74	44.85
Negroamaro production region		
Puglia	124	75.15
Campania	9	5.45
Tuscany	7	4.24
I don't know	25	15.15
Prosecco production method		
Classico	47	28.48
Martinotti	87	52.73
I don't know	29	17.58
Demi-sec taste		
Dry	31	18.79
Medium sweet	80	48.48
Sweet	24	14.55
I don't know	30	18.18
Flint note present in wine		
Incrocio Manzoni	19	11.52
Sauvignon Blanc	30	18.18
Tempranillo	21	12.73
I don't know	95	57.58
Marital status		
Single	95	57.58
Married	52	31.52
Widowed	3	1.82
Other	15	9.09
Instruction level		
Primary school	2	1.21
Secondary school	21	12.73
Diploma	51	30.91
Bachelor or beyond	90	54.55
Monthly family income		
Below 2000€	35	21.21
Between 2000€ and 4000€	73	44.24
Above 4000€	57	34.55

Delving more in-depth on the survey results, some interesting correlations between results have been observed. Both these correlations comprehend the wine purchase price range stated by people, connected with the relevance biological certification (in the first scenario) and sustainability certification (in the second scenario) play on the wine choice of consumers.

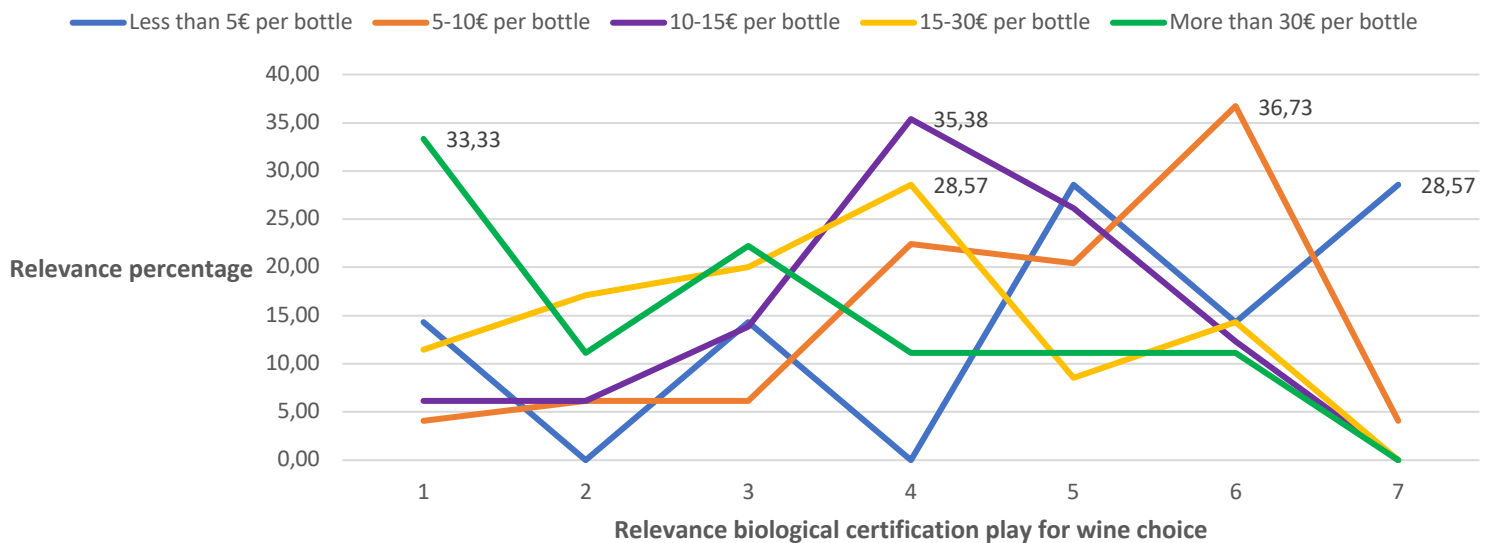
Screening the first scenario, a strong correlation can be seen between the relevance biological certification play for wine choice and the average price range a bottle of wine is purchased. As shown in Graph 1, which reports the information from the table in Appendix 6, consumers who are more likely to spend more money on a wine bottle are less interested in a biological certification. On the contrary, consumers who are buying more economical wine are more interested in a biological certification when buying wine. This correlation is clear in the graph, as it shows how by increasing the price of wine consumers buy, the interest consumers have in biological certification decreases.

This inverse correlation, which has a statistically significant relationship, as shown in Appendix 7 where the chi-square test has been performed, can be explained by the attitude buyers have towards more expensive wine. Individuals when purchasing a bottle of wine with a higher price, are more interested in other factors in respect to the biological certificate. Those factors can be the brand, the grape variety, the region of production, or the storytelling behind it, but the biological certification is sent to a second place. This is because these factors play a stronger role in determining the higher WTP from consumers.

Adversely, when the price of a wine bottle is lower, factors that can play a decisive role in inducing buyers to purchase can be certifications, such as biological ones. This has wide usage in the food and beverage field, with individuals highly aware of the benefits it confers to the atmosphere.

Graph 1 Correlation between the relevance biological certification play for wine choice and average price range a bottle of wine is purchased

Correlation between the relevance biological certification play for wine choice and average price range a bottle of wine is purchased

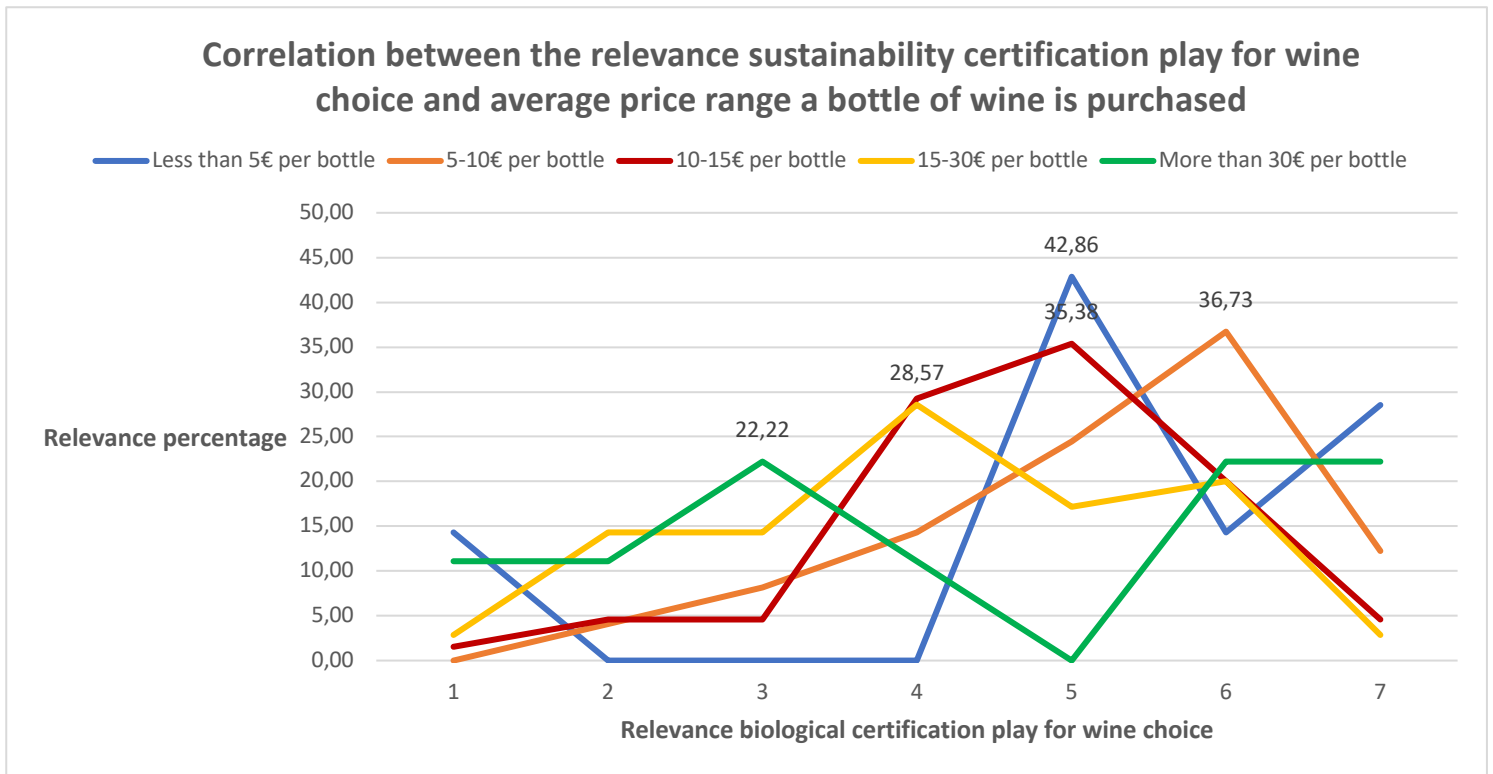


Exploring the second scenario, a similar correlation can be seen, this time between the relevance sustainability certification play for wine choice and the average price range a bottle of wine is purchased. As seen in Graph 2, which reports the information from the table in Appendix 8, the correlation this time is less strict but still observable.

What at first sight becomes relevant is how the relevance sustainability certification play for wine choice decreases, as the average price range of a bottle of wine purchased from participants increases. This inverse correlation, which has a statistically significant correlation as shown in the chi-square test appreciable in Appendix 9, could be explained by similar reasons to the previous correlation. These can be regarding the added value individual attributes to a higher-value good, which is not associated with sustainability certification. Factors such as area of production, method of production, brand, grape variety, and vintage play a drastic role in the price of a wine bottle.

Vice versa, when society pays less for a bottle of wine, it is presupposed the production method is classical, the production area is normal, the variety is a common one and the producer is medium level, therefore the added value of the product can be found in other factors, factors like certifications. Sustainability, which nowadays is an intriguing discussion, rises enough spotlight to be a powerful buying reason for the majority of wine drinkers.

Graph 2 Correlation between the relevance sustainability certification play for wine choice and average price range a bottle of wine is purchased



The study design

The study was based on a mixed within/between-subjects design without any unfaithful communication of information to participants. The philosophy of the study was based on what can influence consumers likeability, therefore the main assumption is that consumers' hedonic liking and WTP are based entirely on taste likeability and PDO information. For this reason, individuals joined two consecutive rounds, in each of which they were asked to elicit their hedonic liking and WTP on six different wines: a conventional Chardonnay, a Bronner (PIWI), a biological Chardonnay, a conventional Merlot, a Merlot Khorus (PIWI), a biological Merlot. In total the wines analyzed were six, but what differed from the first to the second round was the amount and type of information participants received.

As soon as participants entered the location in which the experimental auction took place, and see location characteristics to have a better understanding of it, they were widely introduced to the investigation and thanked for their participation. Throughout the various tastings, the number of

participants was divided into around 20-25 people per session, with a total duration of approximately 1 hour.

Individuals signed the informed consent model which exposed them to the risks associated with the tastings, the effect on the overconsumption of wine, and how their driving status would have been altered if they drank too much. After this crucial point determining people's participation or their withdrawal, the second auction phase started.

At this point, individuals completed a survey which was helpful for the investigation. The full survey in Italian can be found in Appendix 10, however, the main key points include:

1. Psychometric analysis of consumers' thoughts related to current global worldwide issues. These included topics such as wine, food, new technologies, climate change, and pollution.
2. Socio-demographic analysis on the consumer. These parameters gave us a better knowledge of the participants in the auction (age, gender, origin) and allowed us to notice possible limitations on the sample. Generic questions were asked regarding their wine consumption, their wine knowledge, their habits, and what influences them when they perform a wine-purchasing decision. Specifically, they were asked about their specific training in wine, any extracurricular knowledge, where they usually buy wine, and their intention to improve their wine knowledge and tasting skills.

With the completeness of the survey, the first round of the BDM experimental auction could have begun. Before the first round, however, a demonstration with 3 chocolate bars was performed. This allowed individuals to have a better understanding of how the process was, authorizing them to ask questions regarding any doubts which would have an obstacle to their full participation in the experiment.

In the first round, participants were asked to indicate their hedonic liking and WTP on the wines they were tasting, without any information on what they had in front of them. The six wines had a code that did not allow individuals to understand which wine typology they were tasting (round 1: taste, no additional information).

In the second round, participants were asked to indicate their hedonic liking and WTP on the wines they were tasting, with additional information given. The six wines had been introduced by the

information shown in *Table 3*, with underneath each glass a text proving which wine was what (round 2: taste, additional information).

Table 3 Information given to participants in the second round

Wines	Description
The wines simply called "Chardonnay" and "Merlot" are obtained with the "Conventional production method"	This wine comes from grape varieties normally purchasable on the market, that is from varieties obtained from vines commonly used for the production of wine. To preserve the production from serious losses due to fungal and parasitic diseases, the protection of the vine however requires a certain number of treatments and the use of a considerable quantity of synthetic plant protection products (often also called pesticides). The use of these products is considered risky and such as to generate potential damage to the environment and to humans.
The wines called "Bronner PIWI" and "Merlot – Khorus" are obtained with the "PIWI production method (resistant to fungal diseases / parasites)"	These wines come from resistant vine varieties, i.e. from varieties that cross the vine species commonly used for the production of wine (<i>Vitis vinifera</i>) with other vine species having properties of resistance and tolerance to the main vine diseases. Compared to "conventional wines", they use vine defense techniques that allow both a significant reduction in the number of treatments and in the quantity of synthetic plant protection products used (often also called pesticides). This leads to a significant reduction in the potential damage to the environment and to humans.
The wines called "Organic Merlot" and "Organic Chardonnay" are obtained with the "Organic production method"	This wine comes from grapes obtained with the organic production method, i.e. grapes produced following a production method that excludes the use of synthetic products in viticulture (in particular plant protection products and fertilizers). Compared to "conventional wines", they use vine defense techniques which employ plant protection products such as sulfur, copper, plant extracts, etc. in the defense of the vine from fungal and parasitic diseases, or use living organisms that are antagonistic to the parasites. Organic viticulture aims to better safeguard and respect the environment and man.

To summarize, each participant submitted 12 bids (6 wines 2 rounds) and also gave while tasting the wines a hedonic liking in terms of overall liking. Their overall liking was measured through a 9-point hedonic categorial scale with the following anchors:

(1) “I find it extremely unpleasant”, (2) “I find it very unpleasant”, (3) “I find it unpleasant”, (4) “I find it slightly unpleasant”, (5) “It leaves me indifferent”, (6) “I find it slightly pleasant”, (7) “I find it pleasant”, (8) “I find it very pleasant”, (9) “I find it extremely pleasant”.

The final phase of the BDM experimental auction was the most exciting part for participants. This phase was the extraction of one round, one product, and one price. As explained above in the BDM experimental auction method section, two scenarios would have been possible at this moment:

1. If the bade price from the individuals was equal or superior to the drawn price for that product in that round, individuals bought the product at the drawn price.
2. If instead, their bid was lower than the drawn price for that product in that round, they did not win the auction, thus not buying the product.

To elicit the hedonic liking and WTP participants used tablets which were helpful in the practical aspect of results gathering. By uploading their bids, in just a couple of seconds, an Excel paper was formed with all of the results. This simplified the process and thanks to it times have been drastically reduced. To prevent collusion between participants, no form of communication was allowed amongst bidders during the outcome of the auction.

To avoid the affiliation effect, no price feedback was given to individuals in all the two rounds (Lusk and Shogren 2007). Each participant received 15€ for their participation. To prevent and minimize the windfall effect, a careful explanation that the money provided to the bidders was just a fee linked to the cost of participation has been provided (Carlsson et al., 2013). To avoid the first sample bias, therefore problems concerning the order of presentation of wines, randomization of each glass was undertaken.

This procedure was repeated 7 times and as shown in Figure 1 there were 7 steps which have been fundamental for the final goal.

Figure 1 Experimental procedure for the BDM experimental auction mechanism

1. Selection of wines

The three white wines and the three red wines have been chosen with very similar characters: production area, vintage, grape variety, price level, organoleptic characteristics.

2. Recruitment and selection of participants

Administration of a short questionnaire, in the recruitment phase, whereas wine consumption characteristics of participants was considered in sampling people.

3. Preparation of the BDM's auction

Administration of the consent form and survey. Organization and distribution of charged tablets. Preparation of economic incentive (15 euros) as compensatory fees for participating in the auction. Preparation of general procedure, wines and uniform format for the bidders.

4. BDM's auction training

The general procedure for the elicitation of WTP was explained to the participants so that they were fully aware of the method. The procedure and field context were made familiar to the individuals through a trial with a chocolate bar. Participants were asked not to communicate with each other, to be honest in the judgements and reasonable, as the given responses were checked during the auction.

5. BDM's auction rounds

In the first round participants were asked to indicate the maximum WTP and hedonic liking for the six wines without receiving information on them. In the second round each participant received more information about the six products and both hedonic liking and WTP was requested.

6. BDM's auction randomization

One round, one product and one price were randomly drawn as per bidding.

7. BDM's auction final phase: assignment of the incentives to the participants

Allocation of the economic incentives to participants (15€) and the bottle of wine to the winners.

Location characteristics

The location behind an experimental investigation plays a drastic role in its outcome. The idea behind a controlled experiment is to create a specific environment, laboratory, or room, in which the relevant variables are manipulated to measure those specific parameters of interest.

In the case of this investigation, to place consumers in their best conditions, those in which they would feel more at ease, and in a normal buying-wine environment, the tasting room of a winery was used. This tasting room allowed participants to enter the wine world and perform their decision-making in a more suited to normal space. This variable was kept constant throughout all the various tasting sessions.

The room was big enough to allow participants to have their space and not result in too crowded. There was the possibility of a toilette and an external room adjacent to the tasting room for the preparation of the wines following the randomization process.

Results

In Table 4 the results of HL and WTP in the first round within the wines are displayed. The three white wines and the three red wines have been analyzed comparing them self in respect to the mean HL and WTP given.

The column with the title “Mean 1” corresponds to the mean given to the product on the left. In the column with the title “Mean 2” instead, there is the mean given to the product on the right. The next column is the difference between the two means, leaving the last column to express the p-value calculated through a ttest among the different products. The “*” symbol indicates the level of significance. Level of significance: * p<0.10, ** p<0.05, *** p<0.01.

Table 4 with the HL and WTP in the first round within the wines

<i>HL and WTP in the first round within the wines</i>				
	Mean 1	Mean 2	Difference	P-value
Hedonic liking (HL)				
TXZ-NBV	5,90	5,39	0,51	0,001
NBV-HRE	5,38	5,15	0,22	0,098
TXZ-HRE	5,90	5,15	0,75	0,000
CDF-BLM	4,33	5,75	-1,42	0,000
BLM-FVS	5,75	5,56	0,19	0,270
CDF-FVS	4,33	5,56	-1,23	0,000
Willingness to pay (WTP)				
TXZ-NBV	7,24	6,52	0,72	0,001
NBV-HRE	6,66	6,43	0,23	0,270
TXZ-HRE	7,24	6,32	0,93	0,001
CDF-BLM	5,59	8,50	-2,91	0,000
BLM-FVS	8,50	7,63	0,87	0,011
CDF-FVS	5,59	7,63	-2,04	0,000

Table 5 exhibits the results of HL and WTP in the second round within the wines. The three white wines and the three red wines have been analyzed comparing them self in respect to the mean HL and WTP given, like it was done in round 1.

The column with the title “Mean 1” corresponds to the mean given to the product on the left. In the column with the title “Mean 2” instead, there is the mean given to the product on the right. The next column is the difference between the two means, leaving the last column to express the p-value calculated through a ttest among the different products. The “*” symbol indicates the level of significance. Level of significance: * p<0.10, ** p<0.05, *** p<0.01.

Table 5 with the HL and WTP in the second round within the wines

<i>HL and WTP in the second round within the wines</i>				
	Mean 1	Mean 2	Difference	P-value
Hedonic liking (HL)				
CHConv-BRPIWI	6,07	5,91	0,16	0,230
BRPIWI-CHBio	5,91	5,89	0,19	0,890
CHConv-CHBio	6,06	5,90	0,16	0,340
MEConv-MEPIWI	4,41	5,60	-1,19	0,000
MEPIWI-MEBio	5,58	5,67	-0,82	0,630
MEConv-MEBio	4,42	5,65	-1,23	0,000
Willingness to pay (WTP)				
CHConv-BRPIWI	7,18	7,20	-0,01	0,950
BRPIWI-CHBio	7,20	7,25	-0,05	0,820
CHConv-CHBio	7,17	7,26	-0,09	0,770
MEConv-MEPIWI	5,25	7,76	-2,51	0,000
MEPIWI-MEBio	7,74	7,48	0,27	0,420
MEConv-MEBio	5,25	7,48	-2,22	0,000

Table 6 shows the results of HL and WTP in both rounds between the wines. The three white wines and the three red wines have been analyzed comparing them self from round 1 to round 2 in respect to the mean HL and WTP.

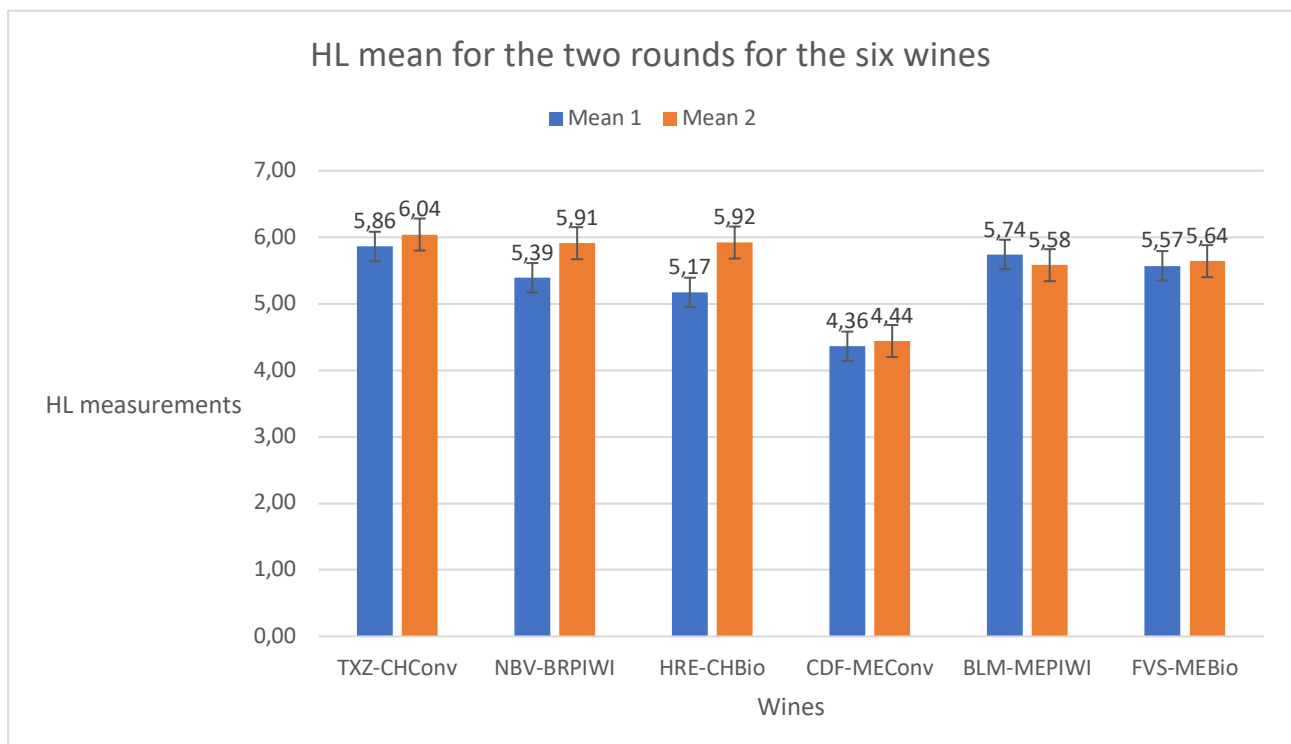
The column with the title “Mean 1” corresponds to the mean given to the product on the left. In the column with the title “Mean 2” instead, there is the mean given to the product on the right. The next column is the difference between the two means, leaving the last column to express the p-value calculated through a ttest among the different products. The “*” symbol indicates the level of significance. Level of significance: * p<0.10, ** p<0.05, *** p<0.01.

Table 6 with the HL and WTP in the both rounds for each product

HL and WTP in both rounds for each product				
	Mean 1	Mean 2	Difference	P-value
Hedonic liking (HL)				
TXZ-CHConv	5,86	6,04	-0,17	0,200
NBV-BRPIWI	5,39	5,91	-0,52	0,000
HRE-CHBio	5,17	5,92	-0,75	0,000
CDF-MEConv	4,36	4,44	-0,08	0,590
BLM-MEPIWI	5,74	5,58	0,16	0,340
FVS-MEBio	5,57	5,64	-0,08	0,620
Willingness to pay (WTP)				
TXZ-CHConv	7,24	7,03	0,22	0,460
NBV-BRPIWI	6,67	7,25	-0,57	0,016
HRE-CHBio	6,43	7,30	-0,87	0,002
CDF-MEConv	5,60	5,29	0,31	0,110
BLM-MEPIWI	8,52	7,77	0,75	0,066
FVS-MEBio	7,65	7,51	0,13	0,630

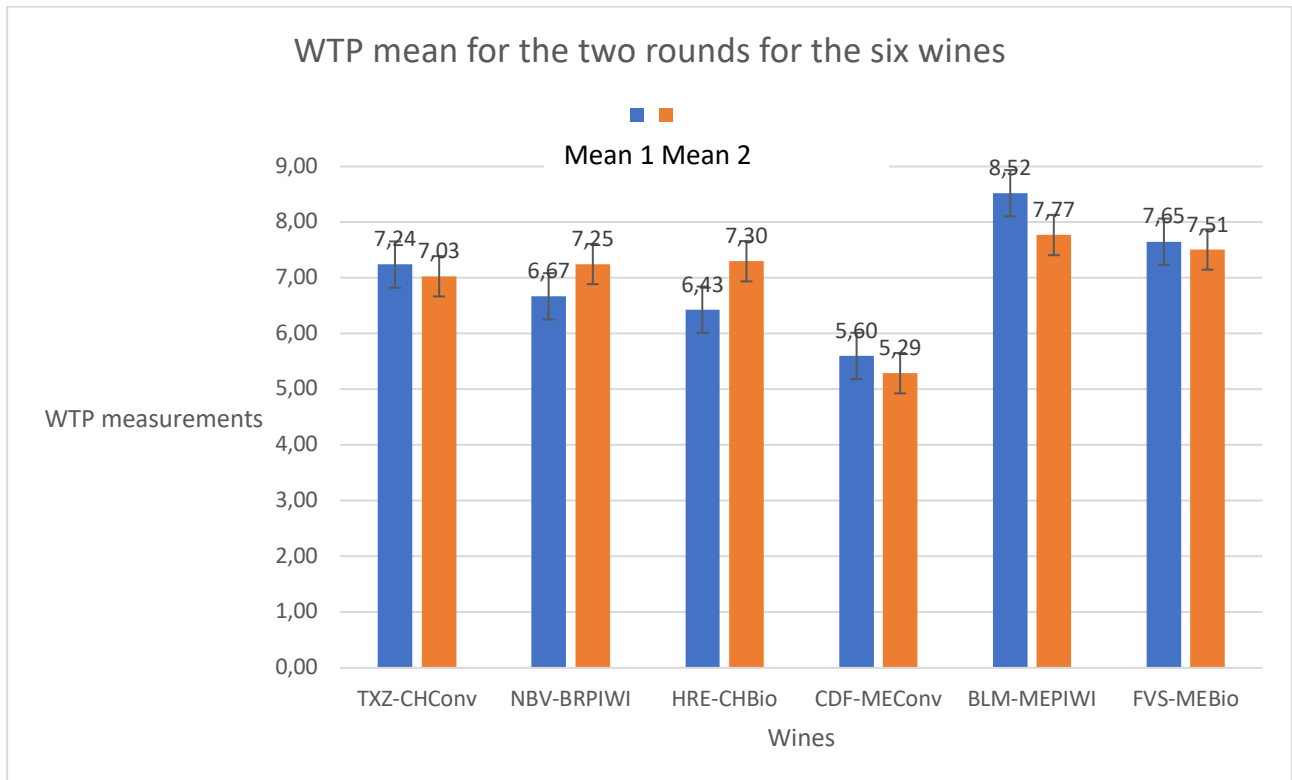
Graphs

Graph 3 HL mean for the two rounds for the six wines



Looking at graph 3 it is possible to detect increases or decrease in HL from round 1 to round 2 in all the wines. In graph 4 instead, it is shown the increases or decrease in WTP from round 1 to round 2 in all the wines.

Graph 4 WTP mean for the two rounds for the six wines



Discussion

The observations that may arise from the results found in the experimental auction can be divided into three sub-topics, which will help to discuss them and prove interesting correlations between results:

1. HL and WTP in the first round within the wines
2. HL and WTP in the second round within the wines
3. HL and WTP in both rounds for each product

HL and WTP in the first round within the wines

Beginning with analyzing the first topic, which reports what is in Table 4, the three white wines and the three red wines have been analyzed comparing them self in respect to the mean HL and WTP given, just considering round 1.

Wine TXZ (Conventional Chardonnay) has higher scores of HL compared to wine NBV (Bronner PIWI) and wine HRE (Biological Chardonnay), both in round 1 (Table 4) and round 2 (Table 5). This is further enhanced by the fact wine TXZ (Conventional Chardonnay) has a low number of low scores. In the first-round wine, HRE (Biological Chardonnay) has a higher number of low scores compared to wine NBV (Bronner PIWI).

HL for TXZ (Conventional Chardonnay) and for HRE (Biological Chardonnay) are statistically different in means at 1%. HL of TXZ is significantly higher at 1% (Table 4). HL for TXZ (Conventional Chardonnay) and for NBV (Bronner PIWI) are statistically different in means at 1%. HL of TXZ (Conventional Chardonnay) is significantly higher at 1% (Table 4). While comparing the HL of HRE (Biological Chardonnay) and NBV (Bronner PIWI) shows statistically different means at 10%.

Having a look at the red wines, it is possible to see how the situation is twisted. Both the BLM (PIWI Merlot Khorus) and FVS (Biological Merlot) have higher HL concerning the CDF (Conventional Merlot).

HL for CDF (Conventional Merlot) and for BLM (PIWI Merlot Khorus) are statistically different in means at 1%. HL of CDF is significantly lower at 1%. HL for CDF (Conventional Merlot) and for FVS

(Biological Merlot) are statistically different in means at 1%. HL of CDF is significantly lower at 1%. Comparing the BLM (PIWI Merlot Khorus) and FVS (Biological Merlot) shows no statistically significant difference.

Moving forward with the WTP, going back to the white wines, TXZ (Conventional Chardonnay) has a higher density in the higher values of around 10 euros. NBV (Bronner PIWI) has a higher WTP compared to HRE (Biological Chardonnay). This is also proven by the ttest, which shows that the WTP for TXZ (Conventional Chardonnay) and for NBV (Bronner PIWI) are statistically different in means at 1%. WTP of TXZ (Conventional Chardonnay) is significantly higher at 1%. The WTP of HRE (Biological Chardonnay) and NBV (Bronner PIWI) are not statistically significant. What is statistically significant is the WTP for TXZ (Conventional Chardonnay) and for HRE (Biological Chardonnay) in means at 1%. WTP of TXZ (Conventional Chardonnay) is significantly higher at 1%.

The red wines WTP is on the same line as the HL. Both the BLM (PIWI Merlot Khorus) and FVS (Biological Merlot) have higher WTP with respect to the CDF (Conventional Merlot).

WTP for CDF (Conventional Merlot) and for BLM (PIWI Merlot Khorus) are statistically different in means at 1%. WTP of CDF is significantly lower at 1%. WTP for CDF (Conventional Merlot) and for FVS (Biological Merlot) are statistically different in means at 1%. HL of CDF is significantly lower at 1%. Comparing the BLM (PIWI Merlot Khorus) and FVS (Biological Merlot) shows a statistical difference in means at 5%.

From this first topic evaluated it is possible to detect two major findings.

The first, which proves what was assumed at the beginning of the investigation, is that the HL and the WTP are on the same line and directly correlated.

The second is the fact that without having any information, as round 1 was with no information given, participants elicited the conventional Chardonnay (TXZ) as the best white wine in terms of HL and WTP. Regarding the red wines what was chosen as the best in terms of HL and WTP is the PIWI Merlot Khorus (BLM).

HL and WTP in the second round within the wines

The topic inspected in this section is reported in Table 5, where the three white wines and the three red wines have been analyzed comparing them self in respect to the mean HL and WTP given, just considering round 2.

In round 2 focusing on HL, the conventional Chardonnay is the product with the highest values. It is the product that has the highest mean value of likeness, while there is very little difference between Bronner PIWI and biological Chardonnay. No statistically significant difference between the HL of the white wines in round 2.

Concerning the red wines, it is possible to see how both the PIWI Merlot Khorus and the biological Merlot wine have higher HL with respect to the conventional Merlot. This may be for the quality of the wines present in the experimental auction. HL for the conventional Merlot and PIWI Merlot Khorus is statistically different in means at 1%. The HL of conventional Merlot is significantly lower at 1%. The PIWI Merlot Khorus and the biological Merlot are not statistically significant, while the conventional Merlot and the biological Merlot are statistically different in means at 1%. The HL of conventional Merlot is significantly lower at 1%.

The lowest mean value of WTP is shown from conventional Chardonnay, with values from Bronner PIWI and biological Chardonnay being very close to each other, however, people have shown more WTP for the biological wine. No statistically significant difference between the WTP of the white wines in round 2

Having a look at the red wines, it is possible to see how both the PIWI Merlot Khorus and the biological Merlot have higher WTP with respect to the conventional wine, proving what was shown in the HL. This may be for the quality of the wines present in the experimental auction.

WTP for the conventional Merlot and PIWI Merlot Khorus is statistically different in means at 1%. The HL of conventional Merlot is significantly lower at 1%. The PIWI Merlot Khorus and the biological Merlot are not statistically significant, while the conventional Merlot and the biological Merlot are statistically different in means at 1%. WTP of conventional Merlot is significantly lower at 1%.

Concerning this, it is clearly shown in this round, that while the white wines have very little difference in both the HL and WTP elicited by people, the red wines showed concerning results. The conventional Merlot was in terms of HL and WTP much lower assessed than the other wines. This has given results that are statistically different in means at 1% with both the PIWI Merlot Khorus and the biological Merlot, suggesting that the wine was exceedingly inferior to the other two.

Considering also the results found in round 1, the PIWI Merlot Khorus is the red wine that has the highest WTP in both rounds, implying that people are keener to spend more money on a PIWI wine in comparison to a biological or conventional wine.

HL and WTP in both rounds for each product

The last topic which is worth judging in this investigation is the comparison between the first and second round for each wine in terms of HL and WTP. The three white wines and the three red wines have been analyzed comparing them self from round 1 to round 2.

In the HL for the white wines, it is possible to see higher values for all three wines in the second round compared to the first round. The likeability of conventional Chardonnay (TXZ) is 6% higher. There is an increase of 12% from the first to the second round in the HL of the Bronner PIWI (NBV). However, the highest increase among the white wines is performed from the biological Chardonnay (HRE), with an increase from round 1 to round 2 of 14.8%.

TXZ and conventional Chardonnay are statistically different at 10%. TXZ is statistically lower at 5%. NBV and Bronner PIWI are statistically different at 1%. NBV is statistically lower at 1%. HRE and biological Chardonnay are statistically different at 1%. HRE is statistically lower at 1%. This shows that in terms of HL, the highest increase has been shown by PIWI and biological wines in comparison to the conventional Chardonnay.

Evaluating the red wines from the first round to the second round it is possible to see discording results. The conventional Merlot increased its mean HL in the second round. The PIWI Merlot Khorus showed a slight decrease in the mean HL, while the biological Merlot had a slight increase in its mean HL in the second round. However, in all cases, there are no statistically significant results.

Inspecting the WTP, there are higher statistically significant results in the second round compared to the first round for PIWI and biological wine, not for the conventional Chardonnay.

WTP for conventional Chardonnay decreased from round 1 to round 2, with no statistical significance, while the WTP for the PIWI Chardonnay increased from round 1 to round 2, more specifically of 10%, with statistical significance in means at 5%.

WTP for biological Chardonnay increased from round 1 to round 2, more specifically 13%, with statistical significance in means at 1%, resulting in the highest increase recorded in the investigation.

The red wines showed the opposite, a decrease in the mean WTP results from round 1 to round 2. The three wines decreased their WTP from round 1 to round 2, with no statistical difference for the conventional and biological Merlot. The PIWI Merlot Khorus had a high decrease with statistical significance in means at 10%.

In this scenario, where the two rounds have been directly compared concerning the six different wines, the HL and WTP showed some discording results. In some cases, there has been a positive correlation between the two, while in other cases the correlation has been proven negative.

In the white wines, there has been an increase for all the products from round 1 to round 2 in terms of HL and WTP, except a decrease of WTP for the conventional Chardonnay in round 2 compared to round 1. The highest increase was seen in the biological Chardonnay.

Apropos the red wines, the PIWI Merlot Khorus showed a decrease both in terms of HL and WTP, while the conventional Merlot and the biological Merlot showed an increase in HL and a decrease in WTP from round 1 to round 2. This decrease for both the HL and WTP in the PIWI Merlot Khorus could be justified by the impulsive decision making from the consumer. They tend to opt for the option which gives them the least error possible, the one that does not disorient them. This is why with the information given they are confused and tend to give lower HL and WTP to the PIWI Merlot Khorus in the second round.

Conclusion

This study focused on consumers' perceived differences between three different white wines and three different red wines in terms of hedonic liking and willingness to pay. Various observations can be detected from the outcome of the investigation; some general findings are present in all six wines, and some more detailed results consider just the white or the red wines.

A first consideration arises from comparing the WTP and HL in this study. HL has a direct influence on people's WTP. This positive direct correlation has been proven both within rounds and between rounds, proving why most of the time they are used together in this type of investigation. Hedonic liking refers to the subjective pleasure or enjoyment derived from a product, it reflects an individual's emotional response and overall satisfaction with the offering. On the other hand, willingness to pay (WTP) refers to the maximum amount of money or value that an individual is willing to give up to obtain a particular item or experience.

When individuals have a high level of hedonic liking for a product or experience, they tend to attribute more value to it and perceive it as desirable. As a result, they are more likely to be willing to pay a higher price to obtain it. This positive correlation occurs because the emotional enjoyment and satisfaction associated with hedonic liking increase the perceived value of the item or experience.

However, it is important to note that other factors can also influence willingness to pay, such as personal income, budget constraints, availability of substitutes, individual preferences, and participants' background knowledge. Additionally, the strength of the correlation can vary across different products or services, as well as among individuals with different motivations, tastes, or buying behaviors.

Concerning the white wines, the study has proved that in the second round, when participants performed their elicitation with information on the products they were tasting, they tended to increase both HL and WTP for biological and PIWI wines (Table 6), with a decrease WTP for the conventional Chardonnay. The highest increase was seen in the biological Chardonnay, dictated by the already strong presence of biological products (both foods and drinks) on the market in comparison to the PIWI products. Biological products have a huge impact on new spending trends and are shaping the habits of many European families. Consumers who prefer biological or organic

food and wine often do so for various reasons, such as health concerns, environmental sustainability, and supporting more ethical farming practices. However, it's important to note that the biological or organic label does not necessarily guarantee superior taste or quality.

A second part of the study to be stressed are the red wines, where strange and not linear results have been shown. PIWI Merlot Khorus exhibited a decrease both in terms of HL and WTP, while the conventional Merlot and the biological Merlot showed an increase in HL and a decrease in WTP from round 1 to round 2. This decrease for both the HL and WTP in the PIWI Merlot Khorus could be justified by the fact that judgement happens in few seconds. The consumer has neither time nor a precise idea: in this case the autopilot works in his head¹. He wants to minimize the risk of making a wrong decision. So-called key information is scanned into his head: the grape variety he knows. Ultimately, the consumer is more willing to pay what he knows or appears to know. And this is the huge dilemma for the PIWI. This reason suggests the necessity of performing further BDM auctions during wine-tasting experiments in different locations and with other wine sets. Therefore, these wines were not representative of the whole presence of PIWI and biological wines on the market. This leads to the next argument which is the quality of the red wines in the investigation.

While the white wines in this study have been chosen in a balanced manner, with very similar quality as shown by the HL results, it is self-evident that the red wines were slightly different in terms of quality. The conventional Merlot has been declared highly inferior in comparison to the PIWI Merlot Khorus and the biological Merlot (Table 4 and Table 5). On the other hand, the PIWI Merlot Khorus is the red wine that had the highest HL and WTP in both rounds (Table 4 and Table 5), implying that people enjoyed and are willing to spend more money in both rounds on this red wine in comparison to the other two.

Several limitations have been present in this investigation, shaping its outcome. Here is a list of errors with the relative improvements which were present in this study:

- Wine quality → as already mentioned in the paragraph above, the wine quality especially in the red trilogy was very different. The conventional wine was lower than the other two and the PIWI was of a very high quality. In a future experiment, a more balanced wine selection

¹ Usai, R. (2022). "I vini Piwi possono essere venduti solo con strategie innovative". Intervista al Prof. Dr. Gergely Szolnok. . . *wein.plus*. <https://rivista.wein.plus/i-vini-piwi-possono-essere-venduti-solo-con-strategie-innovative-intervista-al-prof-dr-gergely-szolnoki-dell-universita-di-geisenheim-sul-marketing-dei-vini-piwi>

should be performed to reduce this very important variable. The quality of the white wines was fine.

- Sample of people → The sample of people in the investigation was limited and with people from the same area (Veneto, Italy). The utilization of a small sample of participants in an experiment can introduce certain limitations that must be considered. One of the primary concerns is the issue of generalizability. With a limited number of participants, it becomes challenging to extrapolate the findings to the larger population. The sample may not adequately represent the diversity and variability present within the target population, leading to biased or skewed results. Moreover, the small sample size reduces the statistical power of the study, making it more difficult to detect small or subtle effects. This can undermine the reliability and validity of the findings, potentially limiting the robustness of any conclusions drawn. Additionally, small sample size may increase the susceptibility to outliers, as the impact of individual participants' responses can be more pronounced. In a future experiment, a higher number of participants with different nationalities would express in a better manner the worldwide population.
- Time → There was little time for the full analysis of the results of this experiment. The duration of the analysis can restrict the ability to observe long-term or delayed effects that may emerge over extended periods. Consequently, the timing of analysis should be carefully considered, ensuring it adequately captures the relevant correlations and tests performed. In a future experiment, a longer period of research with the results would provide better and more detailed findings. Further research might investigate, in other Italian regions and foreign countries, the importance of factors such as consumer socio-demographic characteristics, cultural features, and psychological attitudes in affecting both consumer preferences for PIWI wines and their purchasing behavior.

As final thoughts, this study titled "Sensory and economic evaluation of PIWI wines using the experimental auction method" provides valuable insights into the sensory attributes and economic value of PIWI wines, employing the experimental auction method as a means of evaluation. By combining sensory evaluation with economic analysis, the study sheds light on the potential market acceptance and willingness to pay for these wines, considering their unique characteristics and composition. The findings contribute to the understanding of consumer preferences and perceptions regarding PIWI wines, highlighting their sensory appeal and economic viability mostly

in white wines. The experimental auction method proves to be a valuable tool for assessing consumer behavior and decision-making in the context of wine purchases. Overall, this research adds to the body of knowledge in the field of wine marketing and offers practical implications for winemakers and industry professionals seeking to successfully navigate the market for PIWI wines.

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Appendices

Appendix 1

Experimental auction procedure: impact on valuation of quality differentiated goods by Jason L. Lusk, Ty Feldkamp and Ted C. Schroeder

Table 1. Incentive Compatible Auctions

	Auction Institution			
	Second Price	Random n th Price	English	BDM
Participant procedure	Simultaneously submit sealed bids	Simultaneously submit sealed bids	Sequentially offer ascending bids	Simultaneously submit sealed bids
Winning bidder	Participant with highest bid	All participants with bid greater than a randomly drawn (n th) bid	Participant who offers the last bid	All participants with bid greater than a randomly drawn price
Number of winners	1	$n - 1$	1	0 to all participants
Market price	Second highest bid	n th highest bid	Last bid offered	Randomly drawn price
Market feedback?	Yes, with multiple rounds	Yes, with multiple rounds	Yes	No
References	Vickrey, Shogren et al. (2001b)	Shogren et al. (2001b)	Vickrey; Coppinger, Smith, and Titus	Becker, DeGroot, and Marschak; Irwin et al.

Appendix 2

Experimental Economics to Evaluate Consumer Preferences by Riccardo Vecchio, Azzurra Annunziata

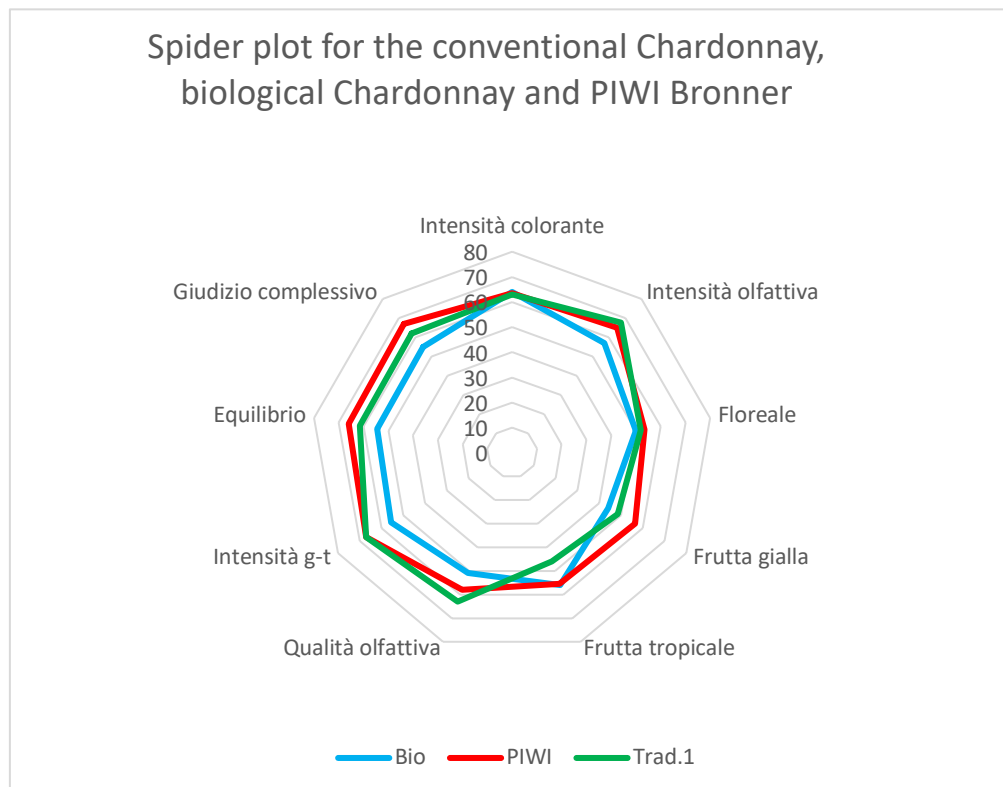
Practical Suggestions for Running an Experimental Auction Study

1. Be sure that all auction sessions are identical in all relevant aspects (beyond treatments).
2. Be sure that all participants understand the auction mechanism perfectly (provide written instructions and spend time in detailed explanations, allowing question time and training rounds).
3. Be sure that all participants clearly understand the weakly dominant strategy of experimental auctions (i.e., truth telling is always the best option).
4. To prevent explicit collusion, do not allow any form of communication between participants during the auction procedures.
5. Make it likely (and emphasize) that participants will be purchasers; i.e., allow a sufficient number of winners per session.
6. Let participants feel relaxed, not scrutinized, and do not involve in the auctions people that might affect their behavior (i.e., professors should not run experiments with their students!).
7. Provide a sufficient number of products to be auctioned.
8. Use representative consumers (if this is not possible, screen participants to avoid nonusers).

9. Do not deceive or lie to your participants (apart from morality, a practical reason is that you lose salience and dominance once subjects suspect that the instructions are not true).
10. (If the experiment is not in the field) Create the most realistic setting for participants, i.e., try to mimic the environment where the subjects undertake certain tasks.
11. Collect a sufficient amount of additional information on participants (socio- economics, lifestyle, attitudes, product knowledge, and familiarity).
12. Be an expert on the market that you are studying

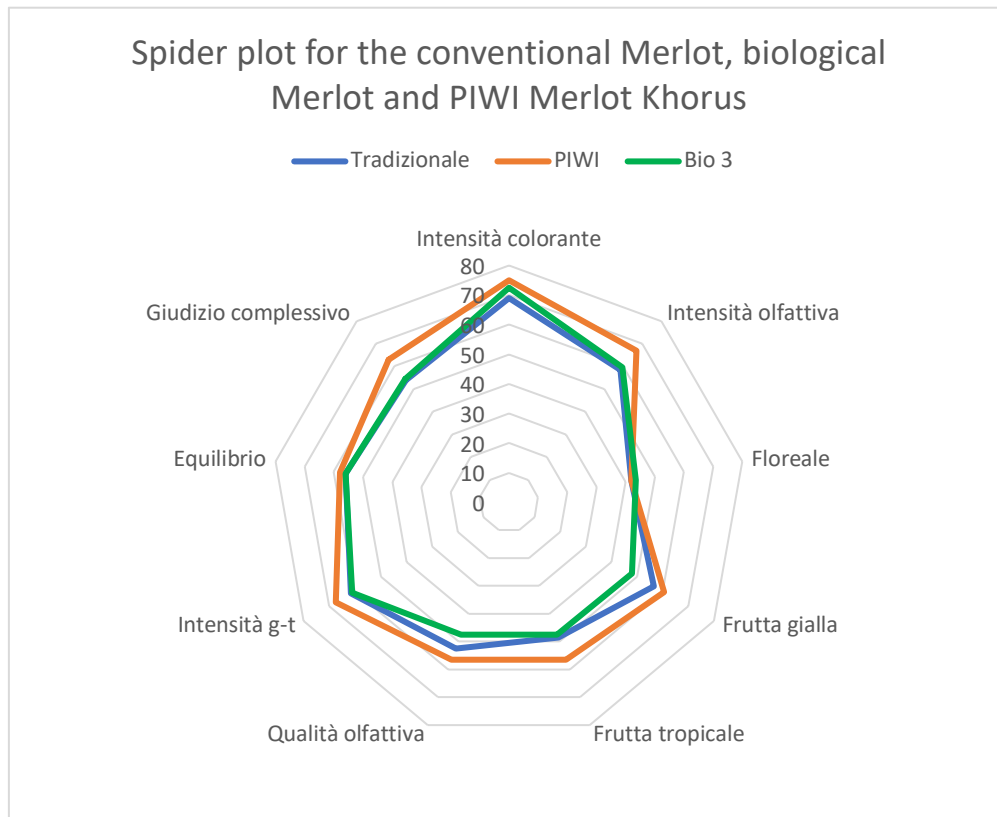
Appendix 3

Spider plot for the conventional Chardonnay, biological Chardonnay and PIWI Bronner



Appendix 4

Spider plot for the conventional Merlot, biological Merlot and PIWI Merlot Khorus



Appendix 5

Results showing the relevance different drivers have in consumers wine buying choices

Relevance table		Frequency	Percentage (%)
DOC relevance			
	not at all important	5	3.03
	2	1	0.61
	3	5	3.03
	4	23	13.94
	5	52	31.52
	6	52	31.52
	extremely important	27	16.36
Variety relevance			
	not at all important	1	0.61
	2	2	1.21
	3	9	5.45

	4	20	12.12
	5	57	34.55
	6	50	30.30
	extremely important	26	15.76
Brand relevance			
	not at all important	5	3.03
	2	7	4.24
	3	18	10.91
	4	29	17.58
	5	49	29.70
	6	39	23.64
	extremely important	18	10.91
Sustainability certificate relevance			
	not at all important	4	2.42
	2	11	6.67
	3	14	8.48
	4	37	22.42
	5	44	26.67
	6	41	24.85
	extremely important	14	8.48
Biological certificate relevance			
	not at all important	14	8.48
	2	14	8.48
	3	22	13.33
	4	45	27.27
	5	33	20.00
	6	33	20.00
	extremely important	4	2.42

Appendix 6

Table between the relevance biological certification play for wine choice and average price range a bottle of wine is purchased

Price range								
	1	2	3	4	5	6	7	Total
Less than 5€ per bottle	14,29	0,00	14,29	0,00	28,57	14,29	28,57	100.00
5-10€ per bottle	4,08	6,12	6,12	22,45	20,41	36,73	4,08	100.00

10-15€ per bottle	6,15	6,15	13,85	35,38	26,15	12,31	0,00	100.00
15-30€ per bottle	11,43	17,14	20,00	28,57	8,57	14,29	0,00	100.00
More than 30€ per bottle	33,33	11,11	22,22	11,11	11,11	11,11	0,00	100.00

Appendix 7

Table with the chi-square test of the the relevance biological certification play for wine choice and average price range a bottle of wine is purchased

Price range							
	1	2	3	4	5	6	7
Less than 5€ per bottle	0.61	0.00	0.61	0.00	1.21	0.61	1.21
5-10€ per bottle	1.21	1.82	1.82	6.67	6.06	10.91	1.21
10-15€ per bottle	2.42	2.42	5.45	13.94	10.30	4.85	0.00
15-30€ per bottle	2.42	3.64	4.24	6.06	1.82	3.03	0.00
More than 30€ per bottle	1.82	0.61	1.21	0.61	0.61	0.61	0.00
Pearson	chi2(24)		=	585.233	Pr	=	0.000

Appendix 8

Table between the relevance sustainability certification play for wine choice and average price range a bottle of wine is purchased

Price range								Total
	1	2	3	4	5	6	7	Total
Less than 5€ per bottle	14,29	0,00	0,00	0,00	42,86	14,29	28,57	100,00
5-10€ per bottle	0,00	4,08	8,16	14,29	24,49	36,73	12,24	100,00
10-15€ per bottle	1,54	4,62	4,62	29,23	35,38	20,00	4,62	100,00
15-30€ per bottle	2,86	14,29	14,29	28,57	17,14	20,00	2,86	100,00

More than 30€ per bottle	11,11	11,11	22,22	11,11	0,00	22,22	22,22	100,00
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Appendix 9

Table with the chi-square test of the the relevance sustainability certification play for wine choice and average price range a bottle of wine is purchased

Price range	1	2	3	4	5	6	7
Less than 5€ per bottle	0.61	0.00	0.00	0.00	1.82	0.61	1.21
5-10€ per bottle	0.00	1.21	2.42	4.24	7.27	10.91	3.64
10-15€ per bottle	0.61	1.82	1.82	11.52	13.94	7.88	1.82
15-30€ per bottle	0.61	3.03	3.03	6.06	3.64	4.24	0.61
More than 30€ per bottle	0.61	0.61	1.21	0.61	0.00	1.21	1.21
Pearson $\chi^2(24) = 424.617$ Pr = 0.011							

Appendix 10

Experimental auction survey for participants in italian

Età (indicare)	_____
Sesso	<ul style="list-style-type: none"> • Maschio • Femmina • Preferisco non rispondere
Comune e Provincia di residenza	_____ (____)
Con quale frequenza acquista il vino?	<ul style="list-style-type: none"> • Tutti i giorni • 2-3 volte alla settimana • 2-3 volte al mese • Quasi mai
Quante volte consuma vino?	<ul style="list-style-type: none"> • Tutti i giorni • 2-3 volte alla settimana • 2-3 volte al mese • Quasi mai

In quale fascia di prezzo si colloca il tuo acquisto di vino solitamente?	<ul style="list-style-type: none"> • Inferiore a 5€ a bottiglia • 5-10 € a bottiglia • 10-15 € a bottiglia • 15-30 € a bottiglia • Maggiore di 30 € a bottiglia 														
Dove acquista abitualmente il vino?	<ul style="list-style-type: none"> • Ristorante • Enoteca/bar • Online • Supermercato • Cantina 														
Rilevanza della Denominazione di Origine Controllata nella scelta d'acquisto del vino	<table border="1"> <tr> <td>Per nulla importante</td> <td colspan="5"></td> <td>Estremamente importante</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> </table>	Per nulla importante						Estremamente importante	1	2	3	4	5	6	7
Per nulla importante						Estremamente importante									
1	2	3	4	5	6	7									
Rilevanza della varietà nella scelta d'acquisto del vino	<table border="1"> <tr> <td>Per nulla importante</td> <td colspan="5"></td> <td>Estremamente importante</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> </table>	Per nulla importante						Estremamente importante	1	2	3	4	5	6	7
Per nulla importante						Estremamente importante									
1	2	3	4	5	6	7									
Rilevanza del brand del produttore nella scelta d'acquisto del vino	<table border="1"> <tr> <td>Per nulla importante</td> <td colspan="5"></td> <td>Estremamente importante</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> </table>	Per nulla importante						Estremamente importante	1	2	3	4	5	6	7
Per nulla importante						Estremamente importante									
1	2	3	4	5	6	7									
Rilevanza della certificazione di sostenibilità nella scelta d'acquisto del vino	<table border="1"> <tr> <td>Per nulla importante</td> <td colspan="5"></td> <td>Estremamente importante</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> </table>	Per nulla importante						Estremamente importante	1	2	3	4	5	6	7
Per nulla importante						Estremamente importante									
1	2	3	4	5	6	7									
Rilevanza della certificazione biologica nella scelta d'acquisto del vino	<table border="1"> <tr> <td>Per nulla importante</td> <td colspan="5"></td> <td>Estremamente importante</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> </table>	Per nulla importante						Estremamente importante	1	2	3	4	5	6	7
Per nulla importante						Estremamente importante									
1	2	3	4	5	6	7									
In quale regione è prodotto il Negroamaro?	<ul style="list-style-type: none"> • Puglia • Campania • Toscana • Non so 														
Quale metodo di produzione è utilizzato nella produzione del Prosecco?	<ul style="list-style-type: none"> • Classico (o Talento) • Martinotti • Non so 														
In bocca, lo spumante demi-sec è:	<ul style="list-style-type: none"> • Secco • mediamente dolce • dolce • Non so 														

Al naso, la nota di pietra focaia caratterizza in particolare la qualità dei vini:	<ul style="list-style-type: none"> • Incrocio Manzoni • Sauvignon blanc • Tempranillo • Non so
Stato civile	<ul style="list-style-type: none"> • Celibe/nubile • Coniugato/a • Vedovo/a • Altro
Potrebbe indicare il Suo livello di istruzione?	<ul style="list-style-type: none"> • Scuola primaria • Scuola secondaria • Diploma • Laurea o post – laurea
Potrebbe indicare il Suo reddito familiare mensile?	<ul style="list-style-type: none"> • Inferiore a 2.000 € • Tra 2.000 € e 4.000 € • Maggiore di 4.000 €

Ti chiediamo di indicare il tuo livello di accordo con le seguenti affermazioni, usando una scala da 1 a 7 (1 = totalmente in disaccordo; 7 = totalmente d'accordo).

	1	2	3	4	5	6	7
Ho un forte interesse per il vino							
Il vino è molto importante per me							
Per me, il vino conta molto							
Scelgo con molta attenzione il mio vino							
Assegno molta importanza alla scelta del vino da comprare							
Decidere quale vino comprare conta molto per me							

Ti chiediamo di indicare il tuo livello di accordo con le seguenti affermazioni, usando una scala da 1 a 7 (1 = totalmente in disaccordo; 7 = totalmente d'accordo).

	1	2	3	4	5	6	7
I nuovi cibi non sono più salutarci di quelli tradizionali							
I benefici delle nuove tecnologie alimentari sono spesso esageratamente enfatizzati							
Esistono moltissimi cibi gustosi, quindi non abbiamo bisogno di usare nuove tecnologie per produrne altri							
Le nuove tecnologie diminuiscono la qualità naturale del cibo							
È improbabile che le nuove tecnologie alimentari abbiano effetti negativi di lungo termine sulla salute							
Le nuove tecnologie alimentari possono avere effetti negativi di lungo termine sull'ambiente							
Potrebbe essere rischioso sostituire troppo rapidamente le vecchie tecnologie alimentari con le nuove							
La società non dovrebbe dipendere eccessivamente dalle tecnologie per risolvere i suoi problemi alimentari							
Non ha senso provare prodotti alimentari ad alto contenuto tecnologico poiché quelli che mangio sono già buoni a sufficienza							

Ti chiediamo di indicare il tuo livello di preoccupazione verso i seguenti aspetti, utilizzando una scala da 1 a 7 (1 = per nulla preoccupato; 7 = estremamente preoccupato).

	1	2	3	4	5	6	7
L'uso di lavoro minorile nella produzione di cibo							
La deforestazione della foresta pluviale							
La fame e la malnutrizione nel mondo							
L'uso dei pesticidi nelle produzioni alimentari							
Il maltrattamento degli animali nelle produzioni alimentari							
I danni ambientali causati dall'utilizzo di terra e acqua da parte dell'uomo							
La quantità di rifiuti alimentari che viene normalmente prodotta							
L'utilizzo eccessivo di risorse naturali per la produzione di cibo							
Lo scarso livello delle condizioni di lavoro e dei salari dei produttori agricoli							
Gli imballaggi non riciclabili							
La quantità di imballaggi usata per i prodotti							
Le emissioni di carbonio causate dalle produzioni alimentari							
La quantità di energia usata nel trasporto dei prodotti alimentari							
La quantità di energia usata in cucina							

Ti chiediamo di indicare il tuo livello di accordo con le seguenti affermazioni, usando una scala da 1 a 7 (1 = totalmente in disaccordo; 7 = totalmente d'accordo).

	1	2	3	4	5	6	7
La salubrità del cibo è poco importante nelle mie scelte alimentari							
Sono molto attento alla salubrità del cibo che mangio							
Mangio quello che mi piace e non mi preoccupo molto della salubrità degli alimenti							
Per me è importante che la mia dieta sia povera di grassi							
Seguo sempre una dieta sana ed equilibrata							
Per me è importante che la mia dieta quotidiana contenga molte vitamine e minerali							
La salubrità degli snack non è importante per me							
Non evito di consumare determinati alimenti, anche se potrebbero aumentare il mio colesterolo							