

# HEDONIC PRICE FOR THE ITALIAN RED WINE: A PANEL ANALYSIS

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## ABSTRACT

Italian wine is one of the most famous products worldwide and yet very little is known about the main determinants of its price, especially on the domestic market.

In this article we show the main determinants of price for Italian red wine sold on the domestic market through the estimation of an hedonic price function for the period 2006-2008. For each bottle considered, our dataset contains several characteristic such as the price by retail channel (price in supermarkets and in wine shops), label characteristics, chemical analysis, sensory characteristics and experts' evaluations. The unique features of the dataset allow to study the market strategies of producers as concerns market segmentation and price discrimination.

The analysis shows that the price mainly depends on the label characteristics of the wine sold, especially when it is sold through the large distribution. In this case label characteristics explain about 90% of the price variance. Sensory variables are more relevant for wine sold through wine shops

**Keywords:** Hedonic pricing, Italian red wine, Sensory characteristics; Reputation;

**JEL Classification:** C52; D43; L66

## 1. Introduction

The Italian wine market is one of the largest in Europe. According to ISMEA-Nielsen (2011) estimations, the market for still wine in Italy has grown until 2009. Only in the past year prices and volumes have sharply decreased, mainly because of a reduction in the consumption of generic table wine. The Italian domestic wine market has very specific characteristic that influence price and distribution strategies. The production side is very fragmented: according to FederVini, the first 100 producers represent about 30% of total production. The rest is made up by small, scattered wine makers that sometimes join in consortia (*cantine sociali* or *consorzi*) for the distribution of the product. As concerns outlays, about 83% of purchases are made through the large distribution (70% through supermarkets and 13% through hard discounts). This fragmentation is an important hurdle to the development of marketing and distribution strategies for small producers who find it difficult to access the large distribution because of the relatively small quantity and the variance in production from year to year. This means that through the distribution channel a selection is made among producers. This influences the observed price in two channels, but the difference does not simply depend on quality: selling strategies are also important.

On the consumers' side the picture is quite heterogeneous. Alcohol consumption, even among teenagers is increasing, but this usually means a reduction in the average level of "education" of the consumers who may become more and more interested in the alcoholic content of what he drinks rather than its quality. According to Ismea (2008) several types of consumers coexist in the market and make their purchase using the large distribution and use the same information, but for different purposes. The less educated one use information on the label as a proxy for quality, the more sophisticated consumers have often tried the wine, know its characteristics and buy it through the large-scale retail trade for reasons of time or price; they use the information on the label as a way to make a repeated purchase. These specific characteristics of the market call for strategic decisions by producers in order to identify the best option to sell their product.

In our paper, using a unique dataset that very well represent the production and sale of Italian wine in Italy we want to answer to the following questions:

- Which are the most important characteristics in determining the price of wine?
- The role of the distribution process. Can producers play strategically?

To answer both questions two hedonic price functions for Italian still red wine sold in Italy will be estimated. The first one relates to the price of wine sold using the large distribution channel (GDO), the latter refers to the price of the wine sold in wine-shops (ENO). The plan of the paper is as

follows: in the following section we present a brief review of the literature; in Section 3 we present our database; in Section 4 the results of our analysis. Finally, Section 5 concludes.

## 2. Review of the literature

The literature on the determinants of wine prices is rather extensive. Most contributors concentrate on the consumers' side and have explored which variables affect consumers' willingness to pay. Since Combris (1997) seminal paper, several authors have attempted to estimate the influence of the different characteristics on the price of wine and have tried to determine how quality is perceived by the consumer. One of the most important questions addressed by the literature relates to the relative influence of label, reputation, and sensory characteristics on the price of the wine. The formers can be inferred by the label of the wine or by the ranking on wine guides, the latter requires tasting the wine, something that most consumers do after having bought the wine<sup>1</sup>. Another important part of the literature concentrates on the importance of the distribution channel, on market segmentation, and on the influences of specific variable through time.

The literature seems to conclude that what matters most is what is written on the label. Sensory variables and jury grades have usually a rather limited explanatory power. The large distribution sell own brand of a specific appellations at a significantly different price (Steiner, 2004), and market segmentation seems to exist (Costanigro and McCluskey, 2007).

These analyses have been applied to specific varieties of wines (champagne), to wines produce in a specific region or nation (Combris *et al.*, 1997 and 2000; Lima, 2006; Lutzezyer, 2008; Fogarty, 2006; Schamel and Anderson, 2003; Landon and Smith, 1997; Lecoc and Vissier, 2006; Cardebat and Figuet, 2004), to wines sold in a specific market (Neverlove, 1995), to wines produced in a specific regions and sold in a foreign market (Steiner, 2004; Schamel, 2004).

Despite the importance of the market in terms of bottle produced and consumed, few studies are available on the hedonic price of Italian wine, and they usually focus specific market segments.

Benfratello *et al.* (2009) use a hedonic price approach to study price formation of Barbaresco and Barolo, two high quality wines produced in Piedmont; Galizzi and Miniaci (2009) propose a similar analysis for Franciacorta Bollicine while Corsi and Strom (2009) use a hedonic price function approach to see whether organic wines benefit from a price premium.

The estimation of hedonic price functions require significantly large dataset as concerns the information on each single wine; furthermore, as pointed out by Combris (1997) these dataset must meet specific requirements, namely:

- a) all the wine tasted should be included in the dataset, regardless of the jury's judgement;

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<sup>1</sup> For a review on this point, see Benfratello *et al.* (2009)

- b) bottle specifically prepared for wine contest should be avoided;
- c) bottle should be tasted by independent experts;
- d) tasting must occur blindly.

In this article we propose the estimate of a hedonic price function using a dataset that has exactly these characteristic as shown in the following section. As in Combris *et al.* (1997) we will assess which are the determinants of the price of wine and we will then see which sensory variable affect jury grade. The analysis we propose is innovative for several aspects:

- a) our sample allows us to evaluate the impact of label variables, sensory characteristics, jury grades, and chemical variables;
- b) we can test for market segmentation using a more objective and general approach than Steiner (2004) and Costanigro and McCluskey (2007). The former tests the existence of reputation effect at supermarket level using own brand of the same variety instead of the same wine. The latter arbitrarily segment the market according to the price. We will instead follow a completely different approach. Given that our sample reports for the same bottle the average price in a supermarket and in wine-shops<sup>2</sup>, we find price determinants for wine sold in *GDO* and we can compare the results with price determination in *ENO*.

### 3. Description of the dataset

In this study we work the unique dataset that the Altroconsumo, an Italian Independent Consumers' Association, uses for its guide (Guida Vini 2006-2008). Each year about 300 wines (red and white) are bought and their characteristics are evaluated using a panel of experts. The market studied is the low to medium/high since Altroconsumo excludes the wine that cost more than 15-16 euro. Within this range wines are chosen in order to represent the variety of Italian wines as regards vineyards, producers and region of origin. The sensory analysis is made using a detailed protocol and the price of each wine is estimated using a specific market analysis. For our estimation we use the prices for red wines only for the period 2006-2008. Our database comprises 434 observations (139 for 2006; 147 for 2007 and 148 for 2008)<sup>3</sup>.

This dataset allows to obtain information on several characteristics of the wine; in what follows we describe for each category the variables available while in Table 1 we have recorded the most important statistical descriptors of each variable.

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<sup>2</sup> If the wine is sold using both distribution channels. When the wine is sold using only one of the two distributive channels, this information is recorded using price equal to 0.

<sup>3</sup> The authors thank *Altroconsumo* for the allowance to use the dataset of this work.

### 3.1 Label characteristics

Several general characteristics of the wine do not require tasting to be inferred since they can be derived from the label. Our database allows us to obtain information on the following characteristics:

- 1) three different appellation levels (*DOC, Denominazione di Origine Controllata*, Controlled Designation of Origin: *DOCG, Denominazione di Origine Controllata e Garantita*, Controlled and Guaranteed Designation of Origin: *IGT, Indicazione Geografica Tipica*, Geographical Denomination).

Such variable represent both a reputation variable and a cost variable. For an appellation being attributed to a wine, the producer has to fulfil specific production rules (including limitations in yields). This process increases cost, but it may also be interpreted as signal to the consumer of superior quality<sup>4</sup>. About 60% of the wines have a DOC appellation, 18.5% are DOCG and 20% IGT. Our sample is a good approximation of the market for wine in Italy. According to Ismea (2009) about 2/3 of wines are DOC, 25% IGT and 9% DOCG. In our sample DOCG are overestimated and IGT underestimated. However such data refers to white and red wines, while in our sample we have considered only red wines where the DOCG appellation is more frequent;

- 2) some less verifiable elements related to quality such as “superiore” (*Superior*) and “riserva” (*Reserve*). Only DOC wines can use this further appellation and very few wines in our sample present this indication on the label (about 0.3% and 1% respectively);
- 3) the appellation (*AP*) on the bottle which may represents the type of grape used to produce the wine (*Nebbiolo*), a blend (*Rosso di Montalcino*) or maturation before being sold<sup>5</sup>. In our sample we have 47 different appellations that have been modelled as binary variables;
- 4) the Region of production (*REG*). In our sample we have wine from 18 Italian Regions; the most represented is Tuscany, followed by Piedmont, Lombardy and Veneto. The regional distribution of the sample basically reflects the production of red wine in Italy;
- 5) the declared alcoholic content (*Alcdic*).

### 3.2 Chemical variables

This is a set of variables that measure objective characteristics of the wine and it is aimed at checking that wine making has been made according to rules, and that the wine is well preserved.

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<sup>4</sup> For more details and a presentation of the denomination of origin used in Italy, see Corrado and Odorici (2007).

<sup>5</sup> Barolo and Barbaresco are both made with Nebbiolo grape. The main difference between the two is that the Disciplinary text imposes at least two years maturation for Barbaresco and two years for Barolo.

Some of these characteristics also determine the flavour, taste and finish of the wine. In our database the following variables have been recorded for each bottle:

- 1) the verified alcoholic content (*Alcver*). This variable is very similar to the declared content. It is a more continuous variable given that on the label the content is expressed in grades and half grades. In line with the literature, we note a downward estimation of the alcoholic content since the sample mean of the verified alcoholic content is higher than for the declared content;
- 2) residual sugar (*Sugar*) which measures the presence of glucose, fructose and other sugars. It determines the organoleptic characteristics of the wine;
- 3) volatile acidity (*Acivol*) determined by the quantity of acetic acid. It is a quality index which signals how well the wine is preserved and how it fermented<sup>6</sup>;
- 4) total acidity (*Acitot*) which by convention is expressed in terms of grams of tartaric acid. It influences the flavour of the wine (for a well preserved wine total acidity should be in the range 4,5-7 g/l);
- 5) sulphur anhydrides ( $SO_2$ ) It is an additive used in the wine making process which alters the characteristic of the wine. It helps in the wine making process, but it is dangerous and the law fixes a maximum level of 160mg/l for this additive;
- 6) the ratio between free sulphur anhydrides and total ( $RSO_2$ ). The former has an antiseptic and antioxidant action. Such index allows to infer the quality of the technology used for wine making.

### **3.3 Sensory variables**

The Altroconsumo guide takes into account also the sensory aspect. In order to achieve this goal it relies on the collaboration of Brescia's *Centro Studi Assaggiatori*<sup>7</sup>.

Each year the Centro Studi Assaggiatori assesses the sensory characteristics of the wine selected by AltroConsumo. An average of 21 judges divided in three panels evaluated the sensory characteristics of wines of our sample. They all are experienced judges with several specific qualifications which have been divided in panels balanced for age, sex, and experience. The tasting was blind with replication. The judges have been asked to give a grade to the most important sensory variables used, such as:

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<sup>6</sup> The wine can be sold only if the volatile acidity is below 1,2g/l.

<sup>7</sup> For more information, see <http://www.assaggiatori.com>. The authors thank Luigi Odello, chairman of *Centro Studi Assaggiatori*, for to make available the dataset.

- the appearance of the wine which is described by: the intensity of the colour (*Colour*); for red wines by the presence of orange and violet reflections (*Orange – Violet*); the attractiveness (*Attractancy*) which measures how pleasant is the aspect of the wine;
- the bouquet which is represented by the intensity of the bouquet (*Intensity*) and by the several perfumes that can be perceived in the wine (*Floral, Fruits, Vegetal, Spicy*), how well they are perceived (*Clean*) and how well they are harmonized (*Quality*);
- the flavour which is described by its structure (*Structure*); the harmony of the different components (*Roundness and Harmony*), the taste and mouth feel (*acidity, bitterness, astringency*) and finish (*AromaRich, Persistency, CleanRet, QualityRet*);
- eventually, an overall evaluation of the wine (*Overall*).

The perception of each descriptor has been registered using a 0-9 scale where 0 denotes the lowest and 9 the highest score.

The scores of the sensory analysis have been summarized in three indicators:

1. *Hedonic Index* (IE) that determines the score as the average of *Attractancy, Clean, Quality, Harmony, CleanRet, QualityRet* and *Overall*.
2. *ZOB Index* that determines the score as the average of the following quality parameters: colour, roundness, structure, flower, fruit, spicy (Zironi *et al.*, 2003)
3. *Competition Index* (IC) which determines the quality level as the average of the scores obtained on structure, finish, attractiveness, cleanliness, harmony.

Given that these indices do not use the same scale, they have been harmonized in a 0-5 score (*Puzob, Puie, Puic*).

### **3.4 Prices and other variables**

For each bottle of wine in the sample we have recorded both the average price when sold in the large distribution ( $p_{GDO}$ ) and in wine shops ( $p_{ENO}$ ). If that specific wine is sold using only either channel the price for the missing channel is equal to zero. For GDO the *IRI Infoscan price* (<http://www.symphonyiri.it/>) is used, for wine shop Altroconsumo has undertaken an *ad hoc* market analysis. Finally, current prices in euro have been deflated using the appropriate Retail Price Index.

Finally for each observation we have created the following binary variables:

- $S_{07}$  which takes the value of 1 if the price is recorded for 2007 and zero otherwise;
- $S_{08}$  which takes the value of 1 if the price is recorded for 2008 and zero otherwise;
- $S_{GDO}$  which takes the value of 1 if that specific bottle is sold using large distributors;
- $S_{ENO}$  which takes the value of 1 if that specific bottle is sold using wine-shops.

The first two variables are used to check for significant changes in the price formation in the different years we have considered, the other two variables are used to check for the influence on price of selling the wine using the double channel.

#### 4. The Model

Although various approaches could be used to estimate the price of wine, the vast majority of the literature adopts the hedonic price approach. The general specification of a hedonic price function is given by:

$$p = g(\mathbf{Z})$$

where  $p$  is the price and  $\mathbf{Z}$  is a vector of observable characteristics which for our analysis can be written as:

$$p = g(L, C, S, D)$$

where  $L$  groups the characteristics of the wine that can be inferred from the label,  $C$  its chemical characteristics,  $S$  the sensory ones characteristics and  $D$  the variables that describe the distribution process.

Under specific conditions on the shape of the utility function (Diewert, 2001) it is possible to link such function to utility maximisation, although it is not possible to make a specific link between the functional form of utility and hedonic price function. This implies that the functional form to be estimated is a matter of empirical investigation. Nerlove (1995) compares log linear, log-log and Box Cox transformation; Landon and Smith (1997), choose the reciprocal square root form, other studies point towards the use of a log-linear form (Oczkowski, 1994; Nerlove, 1995; Combris *et al*, 1997; Schamel and Anderson, 2003). In our work we have decided to restrict the choice to functional forms that allow a straightforward interpretation of the estimated parameters in terms of price elasticity. For this reason we have restricted the choice to linear and log linear equations and have performed a *RESET* test. The results, presented in Table 2, show that a log-linear form should be preferred.

The characteristic of our dataset allows us to run separate regression for price formation in supermarkets and wine shops.

##### 4.1 Price formation in the large distribution

Before running the regression several statistical checks have been performed in order to avoid multicollinearity problems. A first screening has shown the presence of few cases of perfect multicollinearity. For example, in our sample, Montepulciano is produced only in Abruzzo and this is the only wine produced in that Region. We have deleted from the explicative variables the



Region (Abruzzo). For analogous reasons Basilicata, Calabria, Marche, Lazio and IGT have been deleted. The remaining variables have proved to have a very low degree of multicollinearity.

The equation that has been estimated will then be as follows:

$$\ln p_{GDO} = k + aDOC + bDOCG + cUP + dRESE + \sum_{i=1}^{47} e_i AP_i + \sum_{i=1}^{13} f_i REG_i + \sum_{i=1}^6 g_i C_i + \sum_{i=1}^{28} l_i S_i + mS_{ENO} + nS_{07} + oS_{08} + \varepsilon_i$$

To answer the first question namely which is the influence of each single set of variables on the price, we have run several estimations using the relevant subset of explanatory variables. The results are presented in Table 3 where we have reported the  $R^2$  (unadjusted and adjusted) of the complete regression and of a stepwise regression (forward and backward) which includes only of the significant variables in each set.

For GDO about 86% of the total variance in price is explained by the model, thus suggesting a stable relationship between the independent variables and price formation. The model that includes only label characteristics explains 78% of the total variance; the one that includes only sensory characteristics explains about 35% of total variance. This allows drawing two first conclusions:

- consumers value wine on the basis of what is written on the label;
- sensory characteristics are not very important in price formation since they explain about 1/3 of the total variance.

This result is confirmed by the findings of the literature (Mueller and Szolnoki, 2010) which shows the very important role that label and packaging have on price formation. It should however be pointed out that this result does not imply that consumers do not care about quality.

Consumers' research analysis (Ismea, 2008) shows that several types of consumers coexist on the market and that purchases made in the GDO are made by less educated consumers and more experienced ones. The former choose the wine on the basis of the alcoholic content, and they interpret the appellation level as a proxy for the quality of the wine. The latter know the brand, have tasted the wine before or may even have purchased it through the advice of a wine dealer. These consumers value quality but also convenience and if they find a wine they like in the GDO they are open to pay a premium for quality, but they are not open to travel more for such quality.

This process is well explained in Table 4 where the results for the hedonic price estimation using all the variables are presented. A stepwise procedure (forward and backward) has allowed to identify the most significant variables. Several tests have been run for homoscedasticity and normality of residuals. They are all satisfactory and suggest that both hypotheses cannot be rejected.

Labels characteristics mainly related to alcohol content<sup>8</sup>, appellation and grape determine the price of wine. DOCG appellation is significant in determining the price of the wine while other denominations (Reserve, Superior) are not significant. Given that for GDO the functional form chosen is log-linear, the coefficients referred to the dummy variables can be interpreted in terms of price variation using the procedure described in Halvorsen and Palmquist (1980).<sup>9</sup> This means that DOCG adds about 45% to the price of the wine. The appellation affects the price as expected; the wine that are mostly known and that the consumer probably perceive as “better quality” (Rosso di Montalcino, Terre di Franciacorta). The highest mark-up as concerns the price is for Rosso di Montalcino (+66%) while the highest price reduction is for Primitivo di Manduria (-0.5%). It is interesting to note that, at least in price formation, the Region of provenience is usually not important, probably because consumers identify the appellation with a Region.<sup>10</sup> The only remarkable exception is Piedmont that seems to have a positive influence on price (+17%). The use of the double channel (selling wine in GDO and ENO) has a positive effect on the price of wine (an increase by about 21%). This result may be interpreted in several ways: it may represent a marketing strategy aimed at making consumer perceive their wines as of a better quality through the double distribution; on the other hand it may also be a way to capture those consumers that are not regular buyers in wine shops and that prefer “convenience” to “quality”. This type of consumers are choosing a wine from the selection offered by the large distribution in order to minimize the time devoted to shopping; if they find a bottle they have previously bought in a wine shop they may pay a little more than the average price for wine in the large distribution, but they are not so keen on quality to go to wine shops regularly. It is interesting to note that for the wine sold in 2007 and 2008 there seems to be a reduction in the real price of the wine. Other thing being equal, in fact the price in 2007 is about 16% lower and in 2008 the price is 18% lower.

#### **4.2 Price in wine-shops**

This distributive channel is not used by all the producers. In general, only medium to high quality wines are distributed in this way. For this reason, the following appellations have been deleted from the set of the explanatory variables: Bardolino, Bonarda, Castel del Monte, Castelli Romani, Rosso Piceno, Sansevero, Valpolicella that in our sample are not sold in wine-shops and the binary

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<sup>8</sup> The stepwise procedure insert the verified alcohol content instead of the one declared. As noted above the former variable is more continuous and this is the reason why it is preferred. But the two variables are very strongly related.

<sup>9</sup> Halvorsen and Palmquist (1980) describe how to estimate the effect of a binary variable on price. In % of the price, such effect is equal to  $g = \exp(c) - 1$  where  $c$  is the coefficient of the parameter obtained through OLS. When two variables interact, their combined effect can be evaluated as follows:  $g = \exp(c+d) - 1$

<sup>10</sup> A good example is Cabernet that is produced in Veneto, Friuli Venezia Giulia and Trentino, but that most consumers in Italy identify simply with Veneto.

variables representing Abruzzo, Calabria, Lazio, Marche, Sardinia, Sicilia, Umbria either because wines from these regions are not sold using this channel or because of perfect multicollinearity with one of the appellations. The equation to be estimated can be written as:

$$\ln p_{ENO} = k + aDOC + bDOCG + cUP + dRESE + \sum_{i=1}^{40} e_i AP_i + \sum_{i=1}^{11} f_i REG_i + \sum_{i=1}^6 g_i C_i + \sum_{i=1}^{28} l_i S_i + mS_{GDO} + nS_{07} + oS_{08} + \varepsilon_i$$

To answer the first question namely which is the influence of each single set of variables on the price, we have run several estimations using the relevant subset of explanatory variables. The results are presented in Table 3 where we have reported the  $R^2$  (unadjusted and adjusted) of the complete regression and of a stepwise regression (forward and backward) which includes only of the significant variables in each set<sup>11</sup>.

The variance explained by the set of exogenous variables is sensibly different in this case, since it about 70%; the market power of producers in making the price using this channel is then significantly different. Only 60% of the total variance is explained by label characteristics while about 20% is explained by sensory one. This allows to draw these conclusions:

- label characteristics are less important than in the large distribution. The price at which the wine is sold depends on its characteristics;
- sensory variables explain about 20% the total variance, and this result is rather unexpected.

We might have expected that sensory characteristics to have a greater explanatory power for wine sold through wine shops. However, it must be noted that a pre-selection exists in this channel. Some wines are not sold in wine shops either because producers prefer to address themselves to the large distribution where most of the wine is sold or because the dealers prefer to sell a choice of higher than average quality. In our sample, representative of the wine sold in the domestic market in Italy, only medium to high quality wine are sold using this channel, hence we can expect their marks as concerns sensory characteristics and indices to be rather high and with reduced variance.

Table 4 shows the influence of each variable on the price Labels characteristics, mainly related to alcohol content, appellation and vineyard determine the price of wine. DOCG adds a 27% mark up while Reserve has a slightly lower impact (25%). If both characteristics are on the label, the price goes up by about 53%. The appellation affects the price as expected; the wine usually perceived as “better quality” (Rosso di Montalcino, Terre di Franciacorta) have a positive mark-up on wines that are perceived as more standard (Cirò). Also in this case the Region is not very important, with the exception of Piedmont and Veneto which add about 17% and 29% to the price. The use of the

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<sup>11</sup> Again several tests have been run for homoscedasticity and normality of residuals. They are all satisfactory and suggest that both hypothesis cannot be rejected.

double channel has no impact on the price. This reinforces the hypothesis that two distributive channels form price in very different ways and that they are somehow quite different. When the producer has an interest in using the “double channel argument” to its advantage, it probably does so to claim that his wine is of better quality, but the contrary is not true. Selling the wine also through large distribution outlays does not seem to reduce the price in wine-shops.

## 5. Conclusions

Despite the importance of the market, only few attempts have been made to estimate the determinants of the price for wine in Italy. In this article we have tried to fill this gap by proposing the estimation of the hedonic price functions for the price of Italian wine sold in Italy using two different distribution channels, namely large distribution and wine-shops. Our database possess a wide range of information on the characteristic of each bottle, both observable (*i.e.* information that can be read from the label).

The results show that the main determinants of the price, especially in the large distribution are the label characteristics. This may explain why producers of wines that are perceive as average quality have tried to differentiate their product through a different appellation. For Chianti this seems a winning strategy. The appellation Chianti suffers a slight (although statistically significant) price reduction in the hedonic price function, something that it is not true for Chianti Classico. The two wines are quite different on the alcohol content (Chianti Classico is stronger), but they are quite similar as concerns their sensory scores. The difference in appellation seems pay in this case and other producers may try to replicate this strategy. For wines sold in wine shops their sensory characteristics play a role and this suggests that wines with exceptional characteristics should be sold using this channel. In both cases however, sensory variables do not seem to play an important role in price formation. The producers of more ordinary wines usually do not prefer to use this channel. A pre-selection on the type of product that can be sold exists.

The analysis presented in this paper refers to still red wines. Our dataset comprises also white and sparkling wines, and in this direction we are going to pursue our analysis.



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Table 1: *Descriptive statistics*

Binary variables (1 = presence of the specific characteristic)				Other variables			
	Mean		Mean	Mean	Min	Max	
<b>AP</b>							
Aglianico	3.01E-02			PENO	8.60	3.78	28
Amarone	9.26E-03	Superior	3.24E-02	PGDO	5.60	1.6	16
Barolo	1.62E-02	DOC	0.60648	Alcdic	12.735	11	15
Barbaresco	6.94E-03	DOCG	0.18056	Alcver	12.77	10.77	14.98
Barbera	5.56E-02	IGT	0.20602	Sugar	3.4819	1.2	10.5
Bardolino	2.78E-02	Reserve	1.16E-02	Acitot	5.4564	4.45	7.52
Bonarda	2.31E-03			Acivol	0.47215	0.17	0.95
Castel del Monte	4.63E-03			RSO <sub>2</sub>	0.2315	0	1.44
Cabernet	1.16E-02	<b>REG</b>		SO <sub>2</sub>	76.414	12	151
Cabernet Sauvignon	1.85E-02	Abruzzo	4.86E-02				
Cannonau	1.16E-02	Basilicata	1.62E-02	Colour	6.8218	4	9
Castelli Romani	1.62E-02	Calabria	1.62E-02	Violet	4.7419	0	7
Chianti	6.94E-02	Campania	1.39E-02	Orange	2.1528	0	6
Chianti Classico	3.94E-02	Emilia Romagna	4.86E-02	Intolf	6.7419	5	8
Cirò	1.62E-02	Friuli VG	2.55E-02	Floral	3.7037	1	5
Dolcetto	5.79E-02	Lazio	2.78E-02	Fruits	5.0972	3	7
Grignolino	2.78E-02	Lombardia	7.64E-02	Spicy	3.7407	1.5	6.5
Isola dei Nuraghi	4.63E-03	Marche	2.55E-02	Vegetables	2.7905	0	5
Lagrein	6.94E-03	Molise	4.63E-03	Structure	6.5116	5	8
Marzemino	9.26E-03	Piemonte	0.1713	Roundness	5.8009	4	8
Merlot	3.24E-02	Puglia	6.71E-02	Acidity	4.0058	2.5	6
Monica di Sardegna	9.26E-03	Sardegna	2.55E-02	Bitterness	1.9722	0.5	5
Montefalco Rosso	4.63E-03	Sicilia	9.26E-02	Astringency	4.2951	2	6.5
Rosso di Montalcino	3.01E-02	Toscana	0.21065	AromRich	6.2384	4	8
Montepulciano d'Abruzzo	5.56E-02	Trentino A A	4.63E-02	Persistency	6.2245	4	9
Morellino di Scansiano	2.08E-02	Umbria	6.94E-03	Attraency	6.7778	5	8
Nebbiolo	2.78E-02	Veneto	7.64E-02	Clean	6.5914	4.5	8
Negramaro	9.26E-03			Quality	6.5891	4.5	8
Nero D'Avola	5.56E-02			Harmony	6.25	5	7.5
Oltrepò Pavese	6.94E-03			CleanRet	6.713	5	8
Primitivo di Manduria	1.16E-02			QualityRet	6.4144	5	8
Refoscolo	1.62E-02			Giuglo	6.4479	4	8
Rosso del Conero	1.39E-02			Zob	0.54234	0.413	0.679
Rosso Toscano	2.31E-03			Puie	2.7627	0.5	5
Rosso Piceno	1.16E-02			Puzo	2.9329	0.5	5
Salice Salentino	1.39E-02			Puic	2.647	0.5	5
Sangiovese	4.63E-02			Pfin	2.7811	0.67	5
Sansevero	4.63E-03						
Sicilia	3.70E-02						
Syriah	1.39E-02						
Teroldego	1.85E-02						
Terre di Franciacorta	2.08E-02						
Valtellina	2.78E-02						
Valpolicella	4.17E-02						



Table 2: Choice of the functional form

PGDO		Lin	Loglin
	RESET	28.54**	0.300
	R <sup>2</sup>	0.865	0.863
BP		119.118**	25.10
PENO		Lin	Loglin
	RESET	10.65**	0.0085
	R <sup>2</sup>	0.768	0.813
BP		102.92**	16.09

Note: R<sup>2</sup> not adjusted for the degrees of freedom

\*  $p < .05$

\*\*  $p < .01$

Table 3: Explicative power of the single group of variables.

Dependent variable	Complete	Label	Chemical	Sensory	Label+ Chem	Label+ Sensory	Chem. + Sensory
PGDO	0.863	0.783	0.504	0.358	0.827	0.808	0.593
	(0.848)	(0.738)	(0.496)	(0.311)	(0.787)	(0.747)	(0.556)
PENO	0.813	0.716	0.416	0.240	0.762	0.769	0.416
	(0.649)	(0.599)	(0.339)	(0.123)	(0.646)	(0.599)	(0.339)

Table 4: *Stepwise regression. Prices in large distribution and in wine-shops*

	P <sub>GD0</sub>	P <sub>ENO</sub>
Constant	-3.77 (13.22)	-0.918 (2.32)
Docg	0.374 (8.25)	0.239 (5.14)
Reserve		0.226 (2,29)
Barbera	-0.349 (6.39)	
Bardolino	0.267 (3.68)	
Castel Del Monte	-0.487 (3.13)	
Castelli Romani	-0.451 (5.18)	
Chianti	-0.267 (4.55)	
Cirò	-0.438 (4.37)	-0.396 (3,90)
Lagrein		0.509 (4.03)
Monica Di Sardegna	-0.312 (2.75)	
Rosso Montalcino	0.507 (7.14)	0.426 (6.41)
Montefalco		0.467 (2.21)
Montepulciano	-0.370 (6.83)	
Negramaro	-0.258 (2.29)	-0.376 (2.45)
Nero D'avola	-0.266 (5.13)	
Primitivo	-0.842 (6.37)	
Rosso Di Conero	-0.235 (2.34)	
Salice del Salento	-0.310 (3.09)	
Sangiovese	-0.195 (3.54)	
Syriah	-0.412 (4.49)	
Terre Di Franciacorta	0.417 (4.55)	0.577 (5.82)
Piedmont	0.155 (4.14)	0.252 (4.95)
Veneto		0.323 (2.87)
Alcver	0.341 (14.2)	0.188 (6.02)
Zuch		-0.05 (4.00)
Acivol	0.711 (5.38)	0.463 (3.10)
Rso <sub>2</sub>	0.372 (3.91)	
S <sub>Eno</sub>	0.190 (6.50)	
Viola		-0.041 (3.49)
Acido	0.037 (2.01)	
Persi	0.086 (4.33)	0.082 (3.10)
S07	-0.175 (5.48)	
SO8	-0.197 (5.92)	
R <sup>2**</sup>	0.822 (0.808)	0.682 (0.655)
BP	25.34	16.07
N	367	189
LL	57.32	35.28
LM	1.864	0.292
JB	0.489	6.51

\* in brackets Student's *t* statistics

\*\* in bracket the adjusted R<sup>2</sup>