The Hedonic Price for Italian Red Wine: Do Chemical and Sensory Characteristics Matter?

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ABSTRACT

In this article, we study the main determinants of price for Italian red wine sold on the domestic market via the estimation of a hedonic price function for the period 2005–2009. For each bottle considered, our dataset contains several characteristics, such as the price by retail channel (price in supermarkets and in wine shops), label characteristics, chemical analysis and sensory and experts' evaluations. The unique features of the dataset allow us to study the price formation in the different market segments. The analysis shows that in the large-scale retail trade consumers value most what is written on the label, but only if it is a verifiable characteristic; label characteristics are also important in wine shops, but a selection process exists to enter this market. Finally, selling wine via both channels appears to be a winning strategy: it allows the price to be increased in the large-scale retail trade, but it does not reduce the price in wine shops. [EconLit citations: C52; D43; L66]. © 2014 Wiley Periodicals, Inc.

1. INTRODUCTION

The Italian wine market is one of the largest in Europe. According to ISMEA's (2011) data estimations, the market for still wine in Italy grew until 2009. Only in the past year have prices and volumes decreased, mainly because of a reduction in the consumption of generic table wine (Mediobanca, 2012).[1] The Italian domestic wine market has very specific characteristics that influence its price and distribution strategies. The production side is very fragmented: according to FederVini, the top 100 producers represent about 30% of the total production. The rest is made up of small, scattered winemakers who sometimes form consortia (*cantine sociali or consorzi*) for product distribution (ISMEA, various years). As regards outlets, about 83% of purchases are made through the large-scale retail trade (70% through supermarkets and 13% through hard discounts) (Mediobanca, 2012). This fragmentation is an important hurdle for the development of marketing and distribution strategies for small producers, who find it difficult to sell through the large-scale retail trade because of the relatively small quantity they offer and the variance in production from year to year. This means that the distribution channel acts as a selection mechanism among producers. This influences the price observed in the two channels, but the difference does not simply depend on quality: selling strategies are also important.

On the consumer side, the picture is fairly mixed. According to ISMEA (2008), several types of consumers coexist in the market; a large majority make their purchases via the large-scale retail trade and use the information on the label, but for different purposes. The less educated consumers use the information on the label as a proxy for quality. The more sophisticated ones 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

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[1]This market grew until 2009 at a rate of 2–3%, but since 2008 the growth was due to an increase in price rather than quantity. In 2009 the price–quantity mix decreased by 7.8% and in 2010 by 2.8%. See http://www.inumeridelvino.it/ for more information.

purchase. These specific market characteristics call for strategic decisions by producers in order to identify the best option for selling their product.

The literature on the determinants of wine prices is extensive. Since the seminal article by Combris, Lecocq, and Visser (1997), several authors have attempted to estimate the influence of different characteristics on the price of wine. One of the most important questions addressed by the literature relates to the relative influence of the label, reputation and sensory characteristics on the price of the wine. The former can be inferred from the wine's label, from its ranking in wine guides and through repeated purchases; the latter require tasting of the wine, usually after purchase. Another important part of the literature concentrates on the importance of the distribution channel, on market segmentation and on the influence of specific variables through time.

The most recent literature seems to conclude that the information on the label and the appearance of the product are among the most important price determinants.[2] Sensory variables usually have a fairly limited explanatory power, whereas jury grades have a significant, but limited impact on the price. These analyses have been performed for specific appellations, for wines produced in a specific region or nation (Cardebat & Figuet, 2004; Combris et al., 1997 and 2000; Fogarty, 2006; Landon & Smith, 1997; Lecocq & Vissier, 2006; Lima, 2006; Lutzeyer, 2008; Schamel & Anderson, 2003), for wines sold in a specific market (Nerlove, 1995) and for wines produced in a specific region and sold in a foreign market (Schamel, 2006; Steiner, 2004).

Producers and distributors use consumer-targeted pricing strategies. The large-scale retail trade sells its own brand of specific appellations at significantly different prices (Steiner, 2004) and market segmentation seems to exist (Costanigro & McCluskey,). Despite the importance of the market in terms of the bottles produced and consumed, few studies are available on the hedonic price of Italian wine, and they usually focus on specific market segments.

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

In our article, using a unique dataset that effectively represents the production and sale of Italian wine in Italy, we aim to answer the following questions:

- What are the most important characteristics in determining wine prices?
- What is the optimal strategy for producers to sell their wine?

To answer both questions, two hedonic price functions for Italian still red wine sold in the Italian domestic market will be estimated. The first one relates to the price of wine sold via the large-scale retail trade (GDO); the latter refers to the price of wine sold in wine shops (ENO) using a large dataset of average-quality Italian red wines. The analysis we propose is innovative in several respects:

a)   Our sample allows us to evaluate the impact of label variables, sensory characteristics, jury grade,s 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 the reputation effect at the supermarket level using the own brand of the same variety instead of the same wine. The latter arbitrarily segment the market according to the price. We will follow a completely different approach. Given that our sample reports for the same bottle the average price in a supermarket and in wine shops, we find the price determinants for

wine sold in the large-scale retail trade (*GDO*) and we can compare the results with the price determination in wine shops (*ENO*).[3]

The plan of the article is as follows: in the following section, we present our database and in Section 3, the results of our analysis. Finally, Section 4 discusses the results and concludes.

2. DESCRIPTION OF THE DATASET

In this study, we use the unique dataset that Altroconsumo, an Italian independent consumer association, uses for its guide (Guida Vini 2006–2010). 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 medium/high end of the market because Altroconsumo excludes wines that cost more than 34 euros (large-scale retail trade) and 45 euros (wine shops). Within this range, wines are chosen in order to represent the variety of Italian wines as regards vineyards, producers and regions of origin. The sensory analysis is performed 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 for the period 2005–2009. Our database comprises 770 observations (139 for 2005; 147 for 2006; 141 for 2007; 147 for 2008; and 196 for 2009).[4] This dataset allows information to be obtained on several characteristics of the wine; below, we describe the variables available for each category, whereas in Table 1, we record the most important statistical descriptors of each variable.

2.1 Label Characteristics

Many wine characteristics do not require tasting because 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 Denomination of Origin: *DOCG*, *Denominazione di Origine Controllata e Garantita*, Controlled and Guaranteed Denomination of Origin: *IGT*, *Indicazione Geografica Tipica*, Geographical Denomination).

Such variables represent both a reputation and a cost variable. An appellation is attributed to a wine if the producer has to comply with specific production rules (including limitations in yields). This process increases the cost, but it may also be interpreted by the consumer as a sign of superior quality.[5] About 60% of 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 two-thirds of wines are DOC, 25% IGT and 9% DOCG. In our sample, DOCG are overestimated and IGT underestimated. However, such data refer to white and red wines, whereas in our sample we consider only red wines, for which the DOCG appellation is more frequent.

2) Some less verifiable elements related to quality, such as "Superiore" (*Superior: Up*) and "Riserva" (*Reserve: Rese*). Only DOC wines can use this further appellation and very few wines in our sample show this indication on the label (about 0.3% and 1%, respectively).

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[3]Our sample also allows us to determine the wines that are sold using only one channel (either the large distribution or the wine shops), but this information is not explicitly used in this article.

[4]The authors thank Altroconsumo for allowing us to use the dataset for this work.

[5]For more details, see Corrado and Odorici (2007).

TABLE 1.   Descriptive Statistics

Binary variables (1 = presence of the specific characteristic)				Other variables			
AP	Sample composition				Mean	Min	Max
Aglianico	2.72E-02			p_{ENO}	11.212	3.8	45
Amarone	2.33E-02	Up	3.11E-02	p_{GDO}	6.41	1.5	34
Barolo	2.98E-02	DOC	0.5597	Alcdic	12.78	10	16.50
Barbaresco	1.29E-02	DOCG	0.2346	Alcver	12.85	10.25	16.84
Barbera	4.41E-02	IGT	0.2129	Sugar	3.76	1.1	27.6
Bardolino	2.20E-02	Rese	7.79E-03	Acitot	5.439	4.45	7.52
Bonarda	9.09E-03			Acivol	0.449	0.17	0.95
Castel del Monte	2.59E-03			RSO_2	0.217	0	1.44
Cabernet	1.03E-02	**REG**		SO_2	73.91	4	151
Cabernet Sauvignon	1.94E-02	Abruzzo	4.80E-02				
Cannonau	1.58E-02	Basilicata	1.29E-02				
Castelli Romani	1.81E-02	Calabria	1.29E-02	Color	7.017	4	9
Chianti	6.49E-02	Campania	1.29E-02	Violet	4.948	0	8
Chianti Classico	4.54E-02	Emilia Romagna	4.02E-02	Orange	2.774	0	8
Cirò	1.29E-02	Friuli VG	3.63E-02	Intolf	6.865	5	8
Dolcetto	4.93E-02	Lazio	3.76E-02	Floral	3.949	1	6
Grignolino	2.33E-02	Lombardy	7.79E-02	Fruits	5.213	3	7
Isola dei Nuraghi	2.59E-03	Marche	1.55E-02	Spicy	3.679	1.5	6.5
Lagrein	3.89E-03	Molise	3.89E-03	Vegetables	2.785	0	5
Marzemino	5.19E-03	Piedmont	0.158	Structure	6.655	5	8
Merlot	3.50E-02	Apulia	5.321E-02	Roundness	5.903	4	8
Monica di Sardegna	9.09E-03	Sardinia	2.72E-02	Acidity	4.263	2.5	6
Montefalco Rosso	7.79E-03	Sicily	8.44E-02	Bitterness	2.148	0	5
Rosso di Montalcino	3.37E-02	Tuscany	0.214	Astringency	4.481	0	7
Montepulciano d'Abruzzo	5.97E-02	Trentino A A	3.63E-02	AromRich	6.447	4	8
Morellino di Scansano	1.68E-02	Umbria	1.68E-02	Persistency	6.395	4	9
Nebbiolo	2.20E-02	Veneto	0.107	Attraency	6.934	5	8
Negramaro	7.79E-03			Clean	6.768	4.5	8
Nero D'Avola	5.97E-02			Quality	6.742	4.5	8
Oltrepò Pavese	3.89E-03			Harmony	6.413	5	8
Pinot Nero	7.79E-03			CleanRet	6.824	5	8
Primitivo di Manduria	1.42E-02			QualityRet	6.569	5	8.5
Refoscolo	1.94E-02			Giuglo	6.604	4	8.5
Rosso del Conero	1.16E-02			Zob	0.549	0.413	0.680
Rosso Toscano	1.29E-03			IE	73.72	57.77	88.89
Rosso Piceno	1.16E-02			IC	7.333	5.51	8.75
Salice Salentino	1.16E-02			Vintage		2003	2008
Sangiovese	4.54E-02						
Sansevero	3.89E-03						
Sicilia	2.46E-02						
Syriah	7.79E-03						
Teroldego	1.68E-02						
Terre di Franciacorta	1.94E-02						
Valtellina	4.02E-02						
Valpolicella	1.81E-02						

Note. The average price for wine shops (p_{ENO}) has been evaluated on the 285 wines sold through this channel; for GDO the price is the average of the 696 wines sold via this channel.

3) The appellation (*AP*) on the bottle, which may represent the type of grape used to produce the wine (*Nebbiolo*), a blend (*Rosso di Montalcino*) or maturation before being sold.[6] 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 wines 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 alcohol content (*Alcdic*).

6) The vintage (*VIN*).

2.2 *Chemical Variables*

This is a set of variables that measure the objective characteristics of the wine, with the aim of checking that the wine-making process has been performed according to good practice and that the wine is well preserved. Some of these characteristics also determine the flavor, taste and finish of the wine. In our database, the following variables have been recorded for each bottle:

1) The verified alcohol 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 alcohol content because the sample mean of the verified alcohol 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 that indicates how well the wine is preserved and how it fermented.[7]

4) Total acidity (*Acitot*), which by convention is expressed in terms of grams of tartaric acid. It influences the flavor of the wine (for a well-preserved wine the total acidity should be in the range 4.5–7 g/l).

5) Sulphur anhydride (SO_2). This is an additive used in the wine-making process that alters the characteristic of the wine. It helps in the wine-making process, but is dangerous and the law fixes a maximum level of 160 mg/l for this additive.

6) The ratio between free and total sulphur anhydrides (RSO_2). The former has an antiseptic and antioxidant action. This index indicates the quality of the wine-making technology used. If the quality of the process is good, this index should be above 0.3.

2.3 Sensory Variables

The Altroconsumo guide also takes into account the sensory aspect. In order to achieve this goal, it relies on the collaboration of Brescia's *Centro Studi Assaggiatori*.[8]

Each year, the Centro Studi Assaggiatori assesses the sensory characteristics of the wine selected by AltroConsumo. An average of twenty-one judges divided into three panels evaluated the sensory characteristics of the wines in our sample. They are all experienced judges with several specific qualifications and they were split into panels that were balanced in terms of age, sex and experience. The tasting was blind with replication. The judges were asked to give a grade to the most important sensory variables used, that is:

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[6]For example, Barolo and Barbaresco are both made with the Nebbiolo grape. The main difference between the two is that the production regulations impose maturation of at least two years for Barbaresco and three years for Barolo.

[7]The wine can be sold only if the volatile acidity is below 1.2 g/l.

[8]For more information, see http://www.assaggiatori.com. The authors thank Luigi Odello, chairman of *Centro Studi Assaggiatori*, for making the dataset available.

- the appearance of the wine, which is described by: the intensity of the color (*Color*); for red wines by the presence of orange and violet reflections (*Orange–Violet*); the attractiveness (*Attraency*), which measures how pleasant the aspect of the wine is;
- the bouquet, which is represented by the intensity of the bouquet (*Intolf*) 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 flavor, 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 the finish (*AromRich*, *Persistency*, *CleanRet*, *QualityRet*);
- an overall evaluation of the wine (*Overall*).

The perception of each descriptor was recorded using a scale from 0 to 9, where 0 denotes the lowest and 9 the highest score.

The scores of the sensory analysis are summarized by three indicators:

1. *Hedonic Index* (IE), which determines the score as the average of Attraency, Clean, Quality, Harmony, CleanRet, QualityRet, and Overall.
2. *ZOB Index*, which determines the score as the average of the following quality parameters: Color, Roundness, Structure, Flower, Fruit, Spicy (Zironi et al., 2003).
3. *Final score (IC)*, which determines the quality level as the average of the scores obtained for Structure, Finish, Attraency, Cleanness, Harmony.

2.4 Prices and Other Variables

For each bottle of wine in the sample, the dataset contains the average price when sold in the large-scale retail trade (p_{GDO}) and in wine shops (p_{ENO}). For GDO, the *IRI Infoscan* price (http:\\www.symphonyiri.it/) is used; for wine shops, Altroconsumo has undertaken an ad hoc market analysis. When a specific bottle is sold via only one channel, the price for the other outlet is reported as "-". This supplementary information allows us to determine that out of 770 wines, 484 are sold only in GDO, 73 only in wine shops and 212 through both channels. The current prices in euros have been deflated using the appropriate Retail Price Index.

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

- S_{06}, which takes the value of 1 if the price is recorded for 2006 and zero otherwise;
- 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_{09}, which takes the value of 1 if the price is recorded for 2009 and zero otherwise;
- S_{GDO}, which takes the value of 1 if that specific bottle is sold via the large-scale retail trade;
- S_{ENO}, which takes the value of 1 if that specific bottle is sold via wine shops.

The first four variables are used to check for significant changes in the price formation in the different years considered; the other two variables are used to check for the influence on the price of selling the wine using the dual channel.

3. RESULTS

Various approaches could be used to estimate the price of wine; in this article, we have decided to adopt a hedonic price approach. The estimation of hedonic price functions requires a significantly large dataset in terms of the information needed for each single wine; furthermore, as pointed out by Combris et al. (1997), this dataset must meet specific requirements, namely:

TABLE 2. Choice of the Functional Form

	Lin		Loglin
p_{GDO}			
RESET	79.26***		2.06
R^2	0.877		0.868
Breush Pagan	687***		0.08
Box Cox		331	
p_{ENO}			
RESET	22.74**		1.37
R^2	0,883		0.881
BP	139.4***		2.62
Box Cox		117.24	

Note. For each estimated equation (p_{GDO} and p_{ENO}) we have recorded the following statistics:
RESET which is the Ramesey RESET (1969) specification test; R^2; BP: is the Breush–Pagan (1979) test for heteroschedasticity; Box Cox (1964) test
**means $p < 0.05$ ***means $p < 0.01$

a) all the wines tasted should be included in the dataset, regardless of the jury's judgement;
b) bottles specifically prepared for wine contests should be avoided;
c) bottles should be tasted by independent experts;
d) tasting must be blind.

The general specification of a hedonic price function is given by:

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

where p is the price, L groups the characteristics of the wine that can be inferred from the label, C is its chemical characteristics, S the sensory characteristics and D the variables that describe the distribution process. Under specific conditions for the shape of the utility function (Diewert, 2003), it is possible to link this function to utility maximisation, although it is not possible to make a specific link between the functional form of utility and the 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; and other studies indicate the use of a log-linear form (Combris et al., 1997; Nerlove, 1995; Oczkowski, 1994 and 2010; Schamel & 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 performed a Ramsey *RESET* test and a Box Cox test. The results, presented in Table 2, show that a log-linear form is preferable. The characteristic of our dataset allowed us to run separate regressions for price formation in the large-scale retail trade and in wine shops.

3.1 Price Formation in the Large-Scale Retail Trade

Several statistical tests were performed to check for multicollinearity. The first screening showed 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 deleted the region (Abruzzo) from the explicative variables. Basilicata, Calabria, Marche, and Lazio were deleted for similar reasons. The remaining variables proved to have a very low degree of multicollinearity.

TABLE 3.   Explicative Power of Each Single Group of Variables

Dependent variable	Complete	Label	Chemical	Sensory	Label+ Chem	Label + Sensory	Chem. + Sensory
p_{GDO}							
R^2	0.868	0.814	0.552	0.387	0.824	0.827	0.617
AR^2	(0.846)	(0.795)	(0.548)	(0.363)	(0.804)	(0.809)	(0.599)
F(label)	20.18***						
F(chemical)	31.21***						
F(chemical no alcver)	7.72***						
F(sensory)	1.604*						
p_{ENO}							
R^2	0.881	0.817	0.472	0.449	0.840	0.855	0.608
AR^2	(0.822)	(0.770)	(0.461)	(0.394)	(0.795)	(0.794)	(0.558)
F(label)	8.01***						
F(chemical)	9.09***						
F(chemical no alcver)	6.76***						
F(sensory)	1.89**						

Note. For several specifications of the estimated equation (p_{GDO} and p_{ENO}) we recorded the R^2 and the R^2 *adjusted* for the degrees of freedom (AR). *F* statistics tests were performed and recorded on the complete regression to test whether the parameter of each group was significant.

The complete equation estimated is:

$$\ln p_{GDO} = k + aDOC + bDOCG + cUp + d\text{Rese} + \sum_{i=1}^{47} e_i AP_i + \sum_{i=1}^{13} f_i REG_i$$
$$+ \sum_{i=1}^{6} g_i C_i + \sum_{i=1}^{28} l_i S_i + \sum_{i=1}^{4} m_i Y_i + nS_{ENO} + qVIN + \varepsilon \tag{1}$$

where *AP* are the appellations, *REG* are the regional dummies, *C* are the chemical variables, S_i are the sensory variables and the grades, *Y* are the year dummies, S_{ENO} captures the sale through both channels and *VIN* is the vintage of the wine. To answer the first question, namely which variables are important in setting the price, we ran several estimations using subsets of the explanatory variables. The results are presented in Table 3, in which we report the R^2 (unadjusted and adjusted) for each regression. It can be used as a proxy for the explanatory power of each set of parameters because it measures the fraction of observed variance that is explained by the regressors. A series of F tests conducted on each subset of variables shows that sensory variables and jury grades have a low influence on price formation (as a group they are statistically significant only at 90%). For GDO, about 86% of the total variance in price is explained by the hedonic price function, thus suggesting a stable relationship between the independent variables and the price formation. The model that includes only label characteristics explains 82% of the total variance; the one that includes only sensory characteristics explains about 39% of the total variance. These results allow us to draw our first conclusions: consumers value wine mostly on the basis of what is written on the label.

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

Consumer 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, but also by more experienced ones. The former choose the wine on the basis of the alcohol 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; in this case, they use the label2007 information as a proxy for the quality of the

TABLE 4.   Stepwise Regression. Prices in Large-scale Retail Trade and in Wine Shops

	p_{GDO}	p_{ENO}
Constant	−2.670 (−12.74)	−1.150 (−3.24)
DOC	0.071 (2.84)	
DOCG	0.357 (9.10)	0.286 (7.88)
Rese		0.224 (2.42)
Amarone	0.537 (6.29)	0.527 (3.58)
Bardolino	0.179 (2.64)	
Barolo	0.646 (10.06)	0.320 (3.55)
Cabernet	−0.252 (−2.55)	
Castelli Romani	−0.300 (−4.63)	
Chianti	−0.196 (−4.19)	−0.324 (−3.37)
Cirò	−0.214 (−2.59)	
Dolcetto	0.299 (6.89)	
Grignolino	0.453 (7.64)	
Lagrein		0.436 (3.33)
Montefalco	0.347 (3.66)	0.400 (2.52)
Montepulciano	−0.233 (−6.00)	
Nebbiolo	0.396 (5.51)	
Oltrepò	0.446 (2.73)	
Primitivo	−0.386 (−4.76)	
Rosso di Montalcino	0.726 (12.17)	0.672 (12.41)
Terre Di Franciacorta	0.471 (6.84)	0.497 (6.08)
Valtellina	0.224 (3.90)	
Piedmont		0.279 (5.73)
Tuscany	0.147 (4.34)	
Trentino Alto Adige	0.205 (4.10)	
Veneto	0.181 (4.59)	0.328 (2.87)
Alcver	0.254 (14.62)	0.165 (5.69)
Zuch		−0.023 (−2.27)
Acivol	0.772 (7.08)	0.509 (3.87)
Rso_2	0.304 (3.57)	
Color		0.051 (2.55)
Spicy	0.032 (2.59)	
Violet		−0.030 (−2.75)
Persistency	0.045 (2.73)	0.081 (3.42)
S_{Eno}	0.267 (11.58)	
S_{07}	−0.121 (−4.73)	
S_{08}	−0.177 (−6.23)	
S_{09}	−0.205 (8.37)	
R^2	0.848	0.823
BP	0.02	2.48
N	696	285
LL	36.95	25.84
F test for excluded variables	1.09	0.73

Note. *in brackets Student's t statistic

wine. This process is confirmed by a stepwise procedure (forward and backward) that allows the isolation of the most significant variables; the results are presented in Table 4.[9]

Verifiable characteristics, such as the alcohol content, the appellation and the grape variety, are significant in determining the price of the wine, whereas other attributes (Reserve, Superior)

[9]Given that prices are non-negative, it would be appropriate to use a censored variables model. However in our case observations are well above 0. We have run a censored stepwise model, and we obtained the same results.

are not significant. This result is interesting: consumers value what is written on the label, provided that it may be related to a variable that can be verified (the alcohol content, the appellation). Variables related to less verifiable characteristics (Reserve, Superior) do not have a significant value. Given that the functional form in equation 1 is log-linear, the coefficients referring to the dummy variables can be interpreted in terms of price variation using the procedure described by Halvorsen and Palmsquit (1980).[10] This means that DOCG adds about 43% to the price of an IGT wine, whereas *DOC* adds only 7%. The appellation affects the price as expected; popular wine that consumers probably perceive as "better quality" (Rosso di Montalcino, Terre di Franciacorta) can be sold for a higher price. The highest mark-up with reference to our baseline wine is for Rosso di Montalcino (89%), whereas the largest price reduction is for Primitivo di Manduria (−32%). It is interesting to note that, at least in price formation, the region of origin is usually not important, probably because consumers identify the appellation with a region.[11] The only remarkable exceptions are Tuscany, Trentino Alto Adige, and Veneto, which seem to have a positive influence on price (from 16 to 23%). The use of the dual channel (selling wine both in GDO and in ENO) has a positive effect on the price of the wine (an increase of about 33%). This result may be interpreted in several ways: it may represent a marketing strategy aimed at making consumers perceive their wines as being of better quality through the dual distribution; on the other hand, it may also be a way to capture those consumers who are not regular buyers in wine shops and who prefer "convenience" to "quality." These types of consumers choose a wine from the selection offered by the large-scale retail trade 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-scale retail trade, but they are not keen enough on quality to visit wine shops regularly. It is interesting to note that for wines sold in 2006–2007–2009, there seems to be an overall reduction in the gap between the price of the "average" and the price of the baseline wine.

3.2 Price Formation in Wine Shops

This distribution channel is not used by all producers. In general, only medium- to high-quality wines are distributed in this way. For this reason, the following appellations were deleted from our set—Bardolino, Bonarda, Castel del Monte, Castelli Romani, Rosso Piceno, Sansevero, Valpolicella, Pinot Nero, and Sangiovese, which in our sample are not sold in wine shops – as well as the binary variables representing Abruzzo, Calabria, Lazio, Marche, Sardinia, Sicily, and Umbria, either because wines from these regions are not sold via this channel or because of perfect multicollinearity with one of the appellations. The equation to be estimated can be written as:

$$\ln p_{ENO} = k + aDOC + bDOCG + cUp + dRese + \sum_{i=1}^{40} e_i AP_i + \sum_{i=1}^{11} f_i REG_i$$
$$+ \sum_{i=1}^{6} g_i C_i + \sum_{i=1}^{28} l_i S_i + \sum_{i=06}^{09} m_i Y_i + oVIN + \varepsilon \qquad (2)$$

To answer the first question, namely what is the influence of each single set of variables on the price, we ran several estimations using the relevant subset of explanatory variables. The results are presented in Table 3, which reports the R^2 (unadjusted and adjusted) of each estimated

[10]If we define $p(C)$ as the price of a wine with characteristic C and p as the price of a wine without characteristic C, we can define the (percentage) increase in price due to characteristic C as: $\frac{p(C)-p}{p} = g$. From the estimation procedure, g can be obtained as follows: $g = exp(C) - 1$, where C is the coefficient of the parameter obtained through OLS.

[11]A good example is Cabernet, which is produced in Veneto, Friuli Venezia Giulia, and Trentino, but which most consumers in Italy identify simply with Veneto.

equation.[12] The variance explained by the exogenous variables is about the same as for the GDO; in the complete regression, the sensory characteristics are slightly more significant (5% against 10%), but they do not seem to play an important role.

We might have expected sensory characteristics to have a greater explanatory power for wine sold through wine shops. However, it should be noted that pre-selection exists in this channel and the wine represents 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 wines are sold via this channel, hence their marks as regards sensory characteristics and indices are in general high and the variance is fairly small.

Table 4 shows the influence of each variable on the price. The label characteristics, mainly related to alcohol content, appellation and vineyard, influence the price of wine. *DOCG* adds a 33% mark-up, whereas Reserve has a slightly lower impact (25%). If both characteristics appear on the label, the price increases by about 67%. The appellation affects the price as expected: the wines usually perceived as "better quality" (Rosso di Montalcino, Terre di Franciacorta) have a positive mark-up compared with the wines that are perceived as more standard. In addition, in this case, the region is not particularly important, with the exception of Piedmont and Veneto, which add about 32% and 39% to the price. The use of the dual channel has no impact on the price, i.e. selling the wine via the GDO as well does not seem to be interpreted in wine shops as a sign of lower than average quality. This reinforces the hypothesis that the two distribution channels form prices in very different ways and that they are somehow quite different. When the producer has an interest in using the "dual channel argument" to its advantage, it probably does so to claim that its wine is of better quality, but the contrary is not true. Selling the wine through large-scale retail outlets also does not seem to reduce the price in wine shops. The sensory variables are surprisingly not especially important in price formation, with the exception of the intensity of the color and the persistency of the flavor, both of which add about 6–8% to the price of the wine. Finally, the price of wine sold in wine shops does not seem to be decreasing in real terms, something that we observed for the bottles sold in GDO. In general, the quantitative impact of the variables is lower for wine sold in wine shops; this may be because of the channel selection, which makes the sample of wine reaching wine shops more uniform.

4. DISCUSSION AND CONCLUSIONS

Despite the importance of the market, only a few attempts have been made to estimate the wine price determinants in Italy. In this article, we have tried to fill this gap by proposing an estimation of the hedonic price functions for the price of Italian wine sold in Italy using two different distribution channels, namely large-scale retail trade and wine shops. Our database contains a wide range of information on the characteristics of each bottle, both observable (i.e., information that can be read on the label) and unobservable (i.e., information that can be obtained either through a chemical or through a sensory analysis).

The results show that in the large-scale retail trade the main determinants of price formation are the label characteristics. However, it is important to point out that consumers seem to value only verifiable characteristics as a proxy for quality attributes (*DOCG*, the appellation, the alcohol content). Generic attributes (Reserve, Superior) do not add anything to the price. In this market segment, if producers wish to differentiate their product to indicate a higher quality level, they need to use these characteristics. This may explain why producers of wines that are perceived as average quality have tried to differentiate their products via a different appellation. For Chianti, this seems to be a winning strategy. The appellation Chianti suffers a slight (although statistically significant) price reduction in the hedonic price function, which does not apply to Chianti Classico. The two wines differ in their alcohol content (Chianti

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[12]Several tests have been run for homoskedasticity and normality of residuals. They are all satisfactory and suggest that both hypotheses cannot be rejected.

Classico is stronger), but they are quite similar as regards their sensory scores. The difference in appellation seems to pay off in this case and other producers may try to replicate this strategy. Finally, we can observe that using the "dual channel" (selling via GDO and wine shops) has an asymmetric effect on price: it has a positive impact only on the price in GDO, but it does not affect the price in wine shops. The first effect is confirmed by other studies; the second one has more interesting implications for the distribution strategies. Producers that can follow this strategy may use the reputation effect of selling through wine shops without suffering a price reduction in the top-price market. To study these selling strategies, we would need to have information on the quantity sold, which our database does not contain; as a further step in our analysis, we are planning to merge our data with other datasets that do contain this information.

Finally, the analysis presented in this article refers to still red wines. Our dataset also comprises white and sparkling wines; the next step in our analysis is to study the price formation for white wines to determine the differences from and similarities to red wine.

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