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The grapes in Italian wines: assessing their value

Anna Carbone*, Luisangela Quici, Luca Cacchiarelli

DIBAF - University of Tuscia, Via San Camillo De Lellis snc, 01100, Viterbo, Italy
E-mail: acarbone@unitus.it; luisangela.quici@studenti.unitus.it; cacchiarelli@unitus.it
*Corresponding auhor

Abstract. The goal of this work is to assess the impact of grape varieties on the prices of Italian wines. As an important share of this wine is exported worldwide, we look at international markets. We gauge this influence by estimating a hedonic price model based on a sample of 2315 Italian still wines reviewed in Robert Parker's Wine Advocate. The work expands results offered in literature so far as it considers quite a large number of international national and autochthonous varieties used for producing both red and white wines. Moreover, we propose an original perspective by exploring the different impacts of ageing on wine prices according to the different grape varieties utilized. Results show that, besides the well-known Italian geographical divide, many grape varieties significantly associate with different price levels. Overall, this impact is larger in the case of red wines than for the white ones. Furthermore, for the formers there are few well known varieties associated with positive price premiums, while for white wines, less widespread autochthonous varieties gain higher prices. Last, we found that successful ageing process involve both native varieties of northern and southern Italy as well as international ones.

Keywords: Italian wine, grape variety, hedonic price model, Price Premium.

1. INTRODUCTION

Wine is a hedonic good for which many quality attributes influence consumers' choice and willingness to pay [1]. These quality attributes are both intrinsic and extrinsic and some of them are search while others are experience or credence [2,3]. As a result, the market is deeply segmented and quite complex making it not trivial for producers to select an effective and coherent basket of quality features that fits each market segment. Furthermore, demand is influenced by fashion trends thus evolving very fast, while supply is much slower as it faces important constraints and rigidities. One of them is actually represented by the time length required for changing grape varieties in order to meet quick changes in consumers' taste. Grape varieties deeply interact with the place of production. As a matter of fact, grape variety is often embedded in the concept of terroir, especially in the so-called Old Wine World (OWW), and in countries where wine identity and unicity converge to form its typicity communicated to consumers via Geographical Indications (GIs). This is especially true in the case of autochthonous grapes

usually cultivated in small areas for producing niche wines [4-7]. Differently, in the New Wine World countries, international varieties are more widespread in order to meet more globalized consumer preferences.

Italy is one of the main traditional producing and exporting countries of the OWW. Here, thank to climate, geography and history, an extremely large number of grape varieties evolved and are still used for producing wine [8]. As a consequence, here market segmentation and product identity are largely based on grape varieties, some of which are spread all over the country while others are locally based and contribute to form the uniqueness of its many terroirs; besides, in the last decades, also international varieties are largely cultivated following global consumers' trends [9].

In any case, grape variety is at the very base of wine nature and is one of the main features on which consumers' choices are made [10]. The grape(s) with which the wine is made contributes to its sensorial quality and as such represents an experience attribute [11]. This is true in both cases of the so-called monovarietal and varietal wines, as well as for blended ones[1].

Disclosing grape variety(ies), hence, plays a key role in the functioning of the market. The variety(ies) used shall be indicated on the label in the case of monovarietal and varietal wines while for Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) wines this information is optional and subject to indications provided by the Rule of production[2].

All this said, it is clear that wine makers (should) base their choice on the grape variety(ies) looking at consumers' preferences while respecting the environmental constraints posed by the place of origin. It is, hence, clear that information about the value of grape varieties is a key input in any marketing strategy, from product design to pricing and for decisions on target markets and distribution channels and so on and so forth.

Wine literature provides some knowledge relative to the value of grape varieties. Some authors confirm that, generally speaking, the grape blend has a major impact on price [6,12,13]. Others found positive price premiums (PPs) for international varieties compared to national ones when used for producing Italian wines [14-16]. Seccia et al. (2017) [8] also found higher price rewards for wines produced with minor autochthonous grape varieties compared to widely used autochthonous grape varieties; however, they did not find price differences between international and autochthonous varieties. Schamel and Ros (2021) [17] also studied the influence on price of some varieties from Friuli Venezia Giulia. According to these authors, the only variety which receives a positive PP, thanks to its unique indigenous character, is Picolit; on the contrary, other monovarietal wines, made with Friulano, Malvasia, Chardonnay and Pinot Grigio grapes, get lower prices.

The analysis presented in this paper estimates the PPs associated to a large number of grape varieties used for Italian wines and, as such, expands the results of the previous works done in this field which offer estimations limited to one or few varieties. We build a hedonic price model (HP) and estimate coefficients relative to a large sample of red and white Italian wines reviewed by Robert Parker's Wine Advocate website. Furthermore, for red wines we estimate an additional hedonic price model that takes into account the interaction between the single grape variety and the vintage in order to detect the price impacts of ageing on different grape varieties.

The paper is organized as follows: Section two gives methodological information. Section three presents results while some comments and the concluding remarks are in Section four.

2. METHODOLOGY

The evaluation of the market values of grape varieties used for making wines relies on the hedonic price model. This is a well assessed and largely used methodology for evaluating the contribution of different product attributes on the final market value. The methodology has been applied in different sectors including a variety of food products [18,19] as well as wine [20-23]. The formalization of the method is due to Rosen (1974) [24]. The core idea follows Lancaster intuition that any good is a basket of attributes each of which contributes to satisfy consumers' needs [25]. The final price of the good is, hence, conceived as the sum of the implicit partial prices associated to its attributes.

A vast array of wine attributes has been employed in previous estimates of hedonic price functions in order to explain wine prices [26]. Outreville and Le Fur (2020) [27] provide a classification and summary description of most previously estimated hedonic price models for wine, while Oczkowski and Doucouliagos (2015) [28],

[1] According to the Italian law the definition of monovarietal wine is reserved to wines produced using only one among the seven varieties listed in annex 4 of the Ministerial Decree of August 13, 2012: namely Cabernet franc, Cabernet Sauvignon, Cabernet, Chardonnay, Merlot, Sauvignon and Syrah. As for the definition of varietal wine, this is reserved to wines produced with one or more of the seven varieties indicated above and without any certification of origin.

[2] More in details, for these wines the variety can be disclosed in the label only when at least 85% of the wine comes from the mentioned vine. In case two varieties are used, the label must show both in order of importance. Furthermore, GIs are allowed to disclose the variety(ies) even if this (these) is (are) different from the ones listed above.

through a meta-regression analysis, examine the empirical support for the hypothesized hedonic theoretical relation between the price of wine and its quality. Since the quality of a bottle is unknown until it is uncorked and the wine drunk, consumers' choices and willingness to pay depends on the reputation of that wine which is strictly related to various quality clues [29,30]. As one of the major features affecting quality, this analysis focuses on the grape with which the wine is made of. The previous Section of this papers reports on the contributions made so far by other authors on the role of the grape in the generation of wine value, here we add that different tendencies are identified in consumers' appreciation for international, national and local varieties [31,32] and that their price impact appears to differ across markets [26].

The place of origin, defined at different levels (Country, Region, area), is also a valuable quality clue. Several authors [33] [34], in estimating implicit prices for Italian wines, have taken into account the following three levels (from the higher to the lower) of quality/typicality which are identified by the Italian Law: designation of origin controlled and guaranteed (DOCG), controlled denomination of origin (DOC) and typical geographical indication (IGT). Two additional recent papers also explore the role and value of the place of production and of the GI: Fedoseev et. al (2023) and Souz Gonzaga et al. (2022) [35,36]. Information conveyed by GIs span from the place of production, the grapes used, the production method, the reputation associated to the GI name and established through times. These different layers of information are often intertwined one to each other, so that it is not easy to disentangle the role of each one.

Despite the difficulty in objectively and consistently assessing the sensory quality of wine, a favourable rating assigned by wine experts might generate a price premium [28,26]. Many studies include experts' evaluations among the explanatory variables of HP models [7,37,15]. Schamel and Ros, 2021 [17] confirm the important role of current quality ratings and of individual wine reputation in determining wine prices. Oczkowski (2016) [38] shows for Australian wines that prices are better explained by quality ratings than by measures of weather fluctuations, so that the weather impact on prices is better captured through quality ratings. However, even if experts' tasting is usually blind, the causal relation between evaluation and prices remains ambiguous and other authors estimate the reverse relationship [39].

Moreover, the vintage is often included in hedonic price estimates [22,35]. Its influence on wine quality and prices is double; first, the vintage expresses climate variables, second, it brings quality transformation through ageing. Both are, to some extent, wine specific and, as such, are related to the production area and to the grape variety and to the production method.

Oczkowski (2022) [26] recommends that quantity sold and producer size should not be included in hedonic price functions as these variables, affecting production costs and not consumer's utility, are inconsistent with the Rosen framework [24]. Although some counter arguments have been proposed to justify their inclusion in the hedonic price model, Oczkowski (2016) [38] and Cacchiarelli et al. (2016) [30] argue that consumers might perceive production from small producers desirable for its sense of rarity, exclusivity and status. However, these arguments are not supported by explicit theoretical developments [26].

We propose a hedonic model in which the price of a given wine (P) is a function of product attributes xj as follows:

$$P=f\,(x_1\ldots,\, x_j) \tag{1}$$

Here, the model specification was carried out by considering: the focus variables, the type of wine (i.e., red and white), results obtained with preliminary analyses on the functional form of the equation, multicollinearity as well as heteroskedasticity. Through Ramsey RESET (Regression Equation Specification Error Test), we explored a series of possible transformations of the dependent variable (e.g., log, inverse square root). The results of the test indicated that the semi-logarithmic functional form was suitable. The semi-logarithmic form allows us to interpret the $100^{*}(\exp^{Coef} - 1)$ percentage variation of the price as associated to a one-unit increase of each quality attribute, independently from all the others [30,40].

Based on price distribution for red and for white wines (e.g., see Table 1) and, above all, considering a likelihood ratio test for the equality of the coefficients for this dataset, which easily rejected the hypothesis of no differences by wine color, the analysis was conducted separately for red and white wines. Multicollinearity was checked through the VIF (Variance Inflation Factor). Heteroskedasticity proportional to the predicted values was tested via Goldfeld–Quandt statistics [41], and afterwards White's robust estimation strategy to obtain the parameter standard errors was used to solve this problem.

The selected model has been formulated as follows:

$$\log P = \alpha_0 + \alpha_1 \mathrm{Col} + \alpha_{2m} Var_m + \alpha_3 Mono + \alpha_{4k} Vint_k + \alpha_5 WASc + \alpha_{6z} GI_z + \varepsilon \tag{2}$$

where:

- P: is the final market price.

- *Col*: is wine color. As two different models have been estimated separately for white and red wines, the dummy variable Col is only present in the red wine model in order to distinguish red and rosé wines, these last ones have been included in the red wine model as grape varieties are the same for both red and rosé wines. Red is the benchmark.
- Var_m: is a group of dummy variables indicating the main grape variety used for making the wine. Only wines where one variety represents at least 85% of the wine are considered while more blended wines are excluded from the analysis as in these cases the variety does not represent a remarkable feature of the wine and it is not disclosed in the label (see footnote 2). For red wines the following varieties have been considered: Sangiovese, Nebbiolo, Barbera, Aglianico, Primitivo, Nerello mascalese, Pinot nero, Nero d'Avola, Cabernet (includes both Cabernet Franc and Cabernet Sauvignon), Dolcetto, Merlot, Negroamaro, Lagrein, Montepulciano, Syrah. Less common varieties (i.e. less frequent in our sample) have been aggregated in one variable called "others" which serves as benchmark[3]. The white wine varieties included in the analysis are Pinot grigio, Chardonnay, Vernaccia di San Gimignano, Vermentino, Fiano, Sauvignon, Greco bianco, Falanghina, Pinot bianco, Garganega, Grillo, Carricante, Arneis, Friulano, Trebbiano d'Abruzzo; again, a variable "other" has been added aggregating the remaining varieties and acting as benchmark[4] .
- *Mono*: is a dummy indicating whether the wine is monovarietal. This has been inserted to see whether monovarietal wines per sè, irrespective of the specific variety used, get higher prices.
- $Vint_k$: are the dummies for the three vintages considered (2013, 2014 and 2015 that is the benchmark). As the vintage usually has an impact on price and this may be related to some varieties more than to others, we also seek at disentangling the value of ageing from that of the variety by building an additional model (see below).
- *WASc*: is the score assigned to each wine by Wine Advocate. WA evaluations are provided by experts after blind tastings. We assume that the score reflects the sensorial quality of the wine; this means that the model provides estimates of the PP associated to the variety, quality being equal. Furthermore, all variables other than the variety provide reference values which help to interpret results for the interest variables. WA scores span from 59 to 100[5].
- GI_z: denotes the certification of origin. The different certifications form the so-called Quality Pyramid and, hence, set an explicit vertical differentiation [42]. The GI carries different valuable information to consumers which we include the three levels established by the Italian law, from the higher to the lower level of quality/typicality: Controlled and Guaranteed Designation of Origin (DOCG), Controlled Designation of Origin (DOC) and Typical Geographical Indication (IGT), which here serves as the benchmark.

Since the impact of quality attributes on price may differ across price levels, as confirmed in previous works [43,44,14], we investigated the price distributions for both red and white wines. Figures 1a and 1b show the distributions of prices through a probability density function, which is a powerful tool to describe several properties of a variable of interest [45]. Although these functions seem basically unimodal (at 20 and 14 euros, respectively), they also present a few additional, much less pronounced, modes (see in the higher quantiles) and a stretched shape of the right-side tail of the distribution. Such distributions suggest exploring the relationships between price and the selected quality clues along the different quantiles, and particularly at the two extremes, as they might change significantly. As a consequence, both an OLS and a QR model were run to go deeper into the analysis of market segmentation. While the former shows how the various quality clues affect prices, on average; the latter detects additional patterns (location, scale and skewness shifts) related to the effects of the covariates and, thus, allows to investigate consumers' behavior at different price levels [46]. Quantile regression, which is not affected by outliers of the

[3] The list of the benchmark varieties for the red subsample is as follows: Alicante bouschet, Bombino n., Bovale, Calabrese montenuovo, Cannonau, Carignano, Casavecchia, Cesanese, Ciliegiolo, Cinsault, Croatina, Frappato, Freisa, Gaglioppo, Graciano, Greco n., Grenache, Grignolino, Magliocco, Malvasia nera, Marcigliana, Marzemino, Monica, Nerello cappuccio, Nero di Troia, Nocera, Pallagrello n., Pelaverga, Perricone, Petit verdot, Piedirosso,Pinot grigio, Pugnitello, Refosco, Rossese, Ruchè, Sagrantino, Schiava, Susumaniello, Teroldego, Tintilia, Uva di Troia, Vespolina.

[4] The list of the benchmark varieties for the white subsample is as follows: Aglianico, Albana, Ansonica, Asprinio, Bellone, Biancolella, Bombino b., Catarratto b., Coda di Volpe, Cortese, Forastera, Gewurztraminer, Grechetto, Gruner Veltliner, Guardavalle, Incrocio Manzoni, Inzolia, Kerner, Malvasia, Malvasia istriana, Malvasia puntinata, Mantonico, Manzoni bianco, Moscato giallo, Muller Thurgau, Nascetta, Nasco, Nero d'Avola, Nosiola, Nuragus, Pallagrello b., Passerina, Pecorello, Petite Arvine, Pigato, Ribolla gialla, Ribona, Riesling, Roscetto, Sylvaner, Torbato, Trebbiano Toscano, Verdeca, Verdicchio, Verduzzo friulano, Vernaccia, Viognier, Vitovska, Zibibbo.

[5] Grades also include half points (0.5). In some cases, a "+" is added which in our analysis leads to 0.5 points upward shift. We are aware that this somehow distorts the evaluation. However, the distortion is minimum and the "+" were very few in our sample

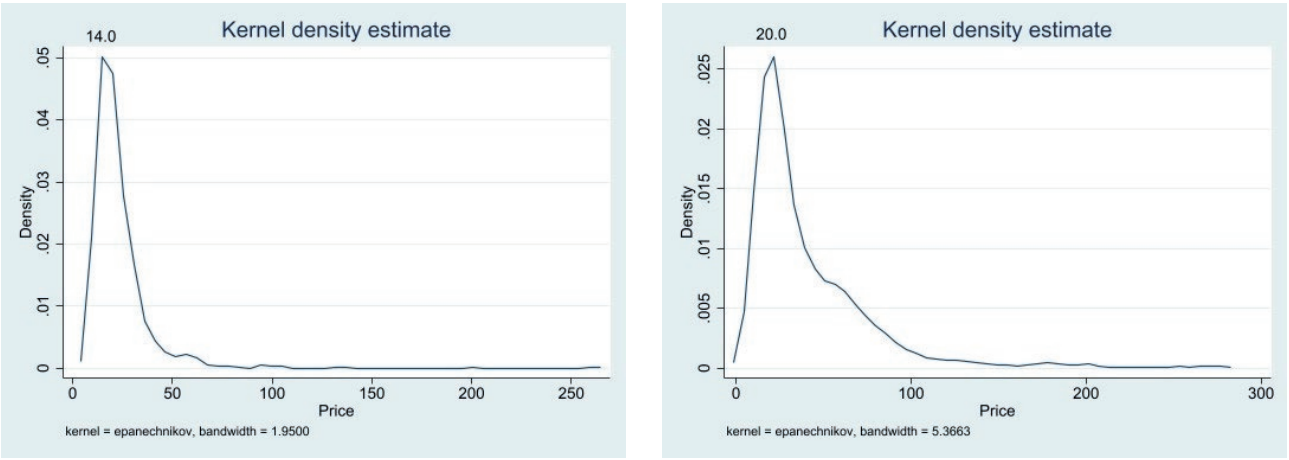

Figure 1. a) Prices distribution for red wines. b) Prices distribution for white wines. Source: elaborations on data from Wine Advocate by Robert Parker.

dependent variable, provides robust estimates of coefficients, and, in case of not-normal distribution of the errors, more efficient estimators compared to the OLS ones [47].

Furthermore, based on the idea that quality performance may vary over time [29[6]], we estimate a further HP model where grape varieties interact with ageing. This allows to see for which varieties the ageing process brings more value. This model, referred only to red wines for which ageing is more common and relevant, is as follows:

$$\log P = \alpha_0 + \alpha_{1mk}\, Var_{m^*}\, Vint_k + \alpha_{2zk}\, GI_{z^*}\, Vint_k + \varepsilon \qquad (3)$$

in which, again: *m*= the name of grape variety; *k*=the vintage; and *z*=the kind of GI. The interaction terms between variety and vintage allow us to estimate whether and to what extent ageing is a successful selective process associated to specific varieties. We also included interaction terms between the different certifications of origin and the vintage which allows us to assess how ageing affects the value of GIs. Equation (3) was estimated via OLS.

Information used for estimating the models have been drawn in 2019 from the online guide Wine Advocate (WA) by the world-famous wine guru Robert Parker. The website is based in the USA but it is active in more than 37 countries around the world and accounts for more than 50 thousands subscriptions.

Wine Advocate provides users with many info on the reviewed wines, such as: the name of the wine, the color, the typology (sparkling, still, sweet, etc.), the country of production, the certification of origin, the grape variety(ies), the vintage, the score obtained according to the guide experts testing, main markets where the wine is present, the name of the producer, the final price in US dollars (VAT included)[7] . The prices disclosed by the guide are quite reliable and stable as they are neither influenced by the kind of retailer nor by seasonality [48].

At the moment when we took the data, the guide reviewed about 37thousands Italian wines. From these we selected a sample of 2315 still wines made out of the main Italian grape varieties. All sparkling wines have been excluded. The sample includes 1506 red and 54 rosé wines – these have been pooled together in one subsample referred to as the "red sample" – plus, it includes also 755 white wines that are kept in a separate sub-sample. Blended wines (i.e. wines with no individual variety accounting for at least 85% of the wine) were excluded due to the minor role played by the variety for such wines. Wines for which information about the grape varieties used was not available and/or easily visible to the consumer were excluded. All the wines considered are GIs. Italian territories are all well represented in the sample, however, among white wines northern Regions are more frequent, while the red ones come mainly from central Italy. Vintages considered are 2013, 2014 and 2015; the selection follows the criterion of the most possible balanced presence of the three different years, also considering the different attitude to ageing of red and white wines.

[6] The author calculated regional reputation indicators based on their relative quality performance through time for three vintage periods in order to examine how different regions performed over time.

[7] In some cases, exact prices were available, while in some others the average value of the available range has been calculated.

3. RESULTS AND DISCUSSION

3.1 The sample

Table 1 shows the distribution of the wines by price classes and the average value in each class. It emerges that average prices differ significantly (41.5$ for the reds and 23.0$ for the whites), furthermore the red ones are more concentrated in higher price segments while the whites are relatively more present in lower price segments, adding scope for keeping the two models separate (a similar approach and results can be found also in [14,8]).

As for WA evaluations, Table 2 shows that the wines included in the sample obtained a minimum score of 78/100 and concentrates in the 87/88 points class. However, the red wines gained on average a higher appreciation (89.7 vs 88.7) and are more concentrated in the upper score classes compared to the whites, none of which reaches the so-called excellence (corresponding to the 96-97 score class).

Table 3 presents the descriptive statistics relative to the grape varieties; in each subsample there are 15 varieties divided in international[8], national[9] and autochthonous[10].

First, it must be noted that Sangiovese and Nebbiolo, respectively a national (N) and an autochthonous (A) variety, together account for more than one half of the red sub-sample while in the white wine sub-sample the distribution of the varieties is much smoother. The large presence of Sangiovese wines reflects the major role of this grape in Italy, while the presence of many wines made with Nebbiolo grapes reflects the bias of the guide in favor of these wines. Similarly, it must be noted that the small presence of Montepulciano grapes, a variety well widespread in Italy, reflects the poor appreciation of the guide for these wines. International varieties (I) altogether are much more widespread in white wines than in red ones (28% vs 9%). Autochthonous varieties are well present in both sub-samples with many different grapes, each one with a limited number of wines, with the only exception of Nebbiolo recalled above and for which it is worth pinpointing the extremely high average prices.

Descriptive statistics related to the vintage are presented in Table 4. Wines produced in 2013 are the majority for the red wines subsample, while younger wines (2015 vintage) are prevalent in the case of white wines[11]. Average prices of red wines for the vintages 2013 and 2014 are much higher than those of white wines (respectively 49$ vs 20$ and 41$ vs 24$) while for the vintage 2015 the gap is smaller (29$ vs 23$).

Table 5 shows the distribution of wines in the sample according to the kind of GI. DOCGs are more frequent for red wines and much less for the whites where, instead, DOCs prevail. The share of IGTs is lower in both sub-samples but still significant. It is also interesting to notice that the price range is wider for red wines compared to that of the whites. Average price of DOCG wines is very high for red wines, but it is not so for the whites where both DOCs and IGTs gain higher prices basically thanks to the wines made with international grapes among which there are not DOCG. Lastly, as it has been observed also in other studies, red IGT bottles are worth much more than DOC, thus, somehow reversing the so-called quality pyramid [14,49].

Table 1. Wines by price classes.

price classes	red and rosè wines			white wines		
	number of wines	%	average price ($)	number of wines	%	average price ($)
< 9,99	21	1.3	7.7	25	3.3	8.2
10 - 14,9	150	9.6	12.4	155	20.5	12.4
15 - 19,9	265	17.0	17.0	203	26.9	17.1
20 - 25,9	230	14.7	21.9	149	19.7	21.8
25 - 29,9	142	9.1	26.6	86	11.4	26.8
30 - 39,9	187	12.0	34.0	81	10.7	33.2
40 - 49,9	120	7.7	43.6	25	3.3	44.3
50 - 75,9	258	16.5	60.8	22	2.9	59.0
76 - 99,9	95	6.1	85.1	4	0.5	86.5
> = 100	92	5.9	152.8	5	0.7	160.5
total wines	1560		41.5	755		23.0

Source: elaborations on data from Wine Advocate by Robert Parker.

Table 2. Wines by evaluations and prices.

evaluation classes	red and rosè wines				white wines			
	number of wines	%	average price ($)	average evaluation	number of wines	%	average price ($)	average evaluation
78-85	58	3.7	19.3	84.1	43	5.7	15.8	84.6
85.5-86.5	82	5.3	21.6	86.0	54	7.2	18.4	86.0
87-88	474	30.4	24.4	87.6	300	39.7	18.8	87.6
88.5-89.5	211	13.5	33.1	89.0	117	15.5	23.1	88.9
90-91	308	19.7	39.2	90.4	142	18.8	24.7	90.4
91.5-92.5	157	10.1	52.0	92.0	63	8.3	30.1	92.0
93-94	189	12.1	72.6	93.4	29	3.8	48.6	93.3
94.5-95.5	51	3.3	112.9	95.0	7	0.9	82.6	94.6
96-97	30	1.9	119.6	96.4	0	0.0	0.0	0.0
total wines	1560		41.5	89.7	755		23.0	88.7

Source: elaborations on data from Wine Advocate by Robert Parker.

[8] International varieties were originally imported from other countries and more recently started to be cultivated also in Italy. Among these, there are Merlot, Cabernet sauvignon, Chardonnay, etc.

[9] National varieties originate in a specific Italian region but afterwards spread in other regions or even throughout the Country. Examples are Sangiovese and Trebbiano.

[10] Autochthonous varieties are cultivated in limited areas and are deeply rooted in that place. Examples are Lagrein, Aglianico and Falanghina.

[11] Almost one fourth of the wines in the sample has been reviewed for different vintages; in such cases only the more recent vintage has been here considered.

Table 3. Wines by variety and price.

grape varieties	red and rosè wines: international (I)/national (N)/ authochtonous (A) grape varieties	number of wines	%	average price ($)	grape varieties	white wines: international (I)/national (N)/ authochtonous (A) grape varieties	number of wines	%	average price ($)
Sangiovese	N	553	35.4	40.1	Pinot grigio	I	66	8.7	19.4
Nebbiolo	A	330	21.2	67.9	Chardonnay	I	62	8.2	35.6
Barbera	A	87	5.6	26.5	Vernaccia di San Gimignano	A	59	7.8	15.4
Aglianico	A	62	4.0	22.9	Vermentino	A	53	7.0	21.1
Primitivo	A	54	3.5	23.2	Fiano	A	50	6.6	21.6
Nerello Mascalese	A	51	3.3	44.9	Sauvignon	I	50	6.6	29.8
Pinot nero	I	45	2.9	38.0	Greco bianco	A	47	6.2	22.3
Nero d'avola	A	42	2.7	19.0	Falanghina	A	34	4.5	16.4
Cabernet (Franc and Sauvignon)	I	39	2.5	52.3	Pinot bianco	I	34	4.5	30.2
Dolcetto	A	29	1.9	18.4	Garganega	A	26	3.4	20.3
Merlot	I	25	1.6	75.8	Grillo	A	25	3.3	19.2
Negroamaro	A	25	1.6	17.7	Carricante	A	24	3.2	28.3
Lagrein	A	22	1.4	31.5	Arneis	A	21	2.8	19.5
Montepulciano	N	21	1.3	13.1	Friulano	A	19	2.5	25.0
Syrah	I	19	1.2	50.5	Trebbiano d'Abruzzo	N	16	2.1	18.3
Altri vitigni	I/N/A	156	10.0	23.0	Altri vitigni	I/N/A	169	22.4	22.5

Source: elaborations on data from Wine Advocate by Robert Parker.

Table 4. Wines by vintage and price.

vintage	red and rosè wines: number of wines	%	average price ($)	white wines: number of wines	%	average price ($)
2013	713	45.7	49.1	176	23.3	19.9
2014	427	27.4	40.9	251	33.2	24.1
2015	420	26.9	29.2	328	43.4	23.2
total wines	1560	100.0	41.5	755	100.0	23.0

Source: elaborations on data from Wine Advocate by Robert Parker.

Table 5. Wines reviewed by GI and price.

GIs	red and rosè wines: number of wines	%	average price ($)	white wines: number of wines	%	average price ($)
DOCG	706	45.3	55.2	160	21.2	19.9
DOC	591	37.9	26.9	449	59.5	24.1
IGT	263	16.8	37.6	146	19.3	23.2
total wines	1560	100.0	41.5	755	100.0	23.0

Source: elaborations on data from Wine Advocate by Robert Parker.

3.2 Results of the estimations of the hedonic Price Model for red wines

Overall, the model seems to capture the price-variety relationship as witnessed by the R2 and pseudo R2 of the OLS and QR, respectively. The first equals 0.6141 and the second ranges from 0.357 to 0.4073 (Table 6). These are quite high values also compared with similar works reported in the literature [50,51].

OLS estimation shows that, on average, the grape variety has an impact on the price of the wine. This is true for most varieties included in the model. The quantile regression estimates indicate that these impacts differ in the different market segments, thus suggesting different behaviors and price formation patterns in the different segments. More in details, international varieties gain positive PP in all market segments and these are larger as price goes up; Merlot leads with a PP of+80% in the OLS. The only exception is Syrah which gains no PP. As for national varieties, Sangiovese grape gains a positive PP that goes from +15%, in the lowest quantile, to +25% in the highest quantile. Differently, Montepulciano grape has a strong negative influence on the price which increases in higher market segments (values range from -20 to -28%). Results for autochthonous varieties are more mixed with both positive and negative PPs. Generally, autochthonous varieties cultivated in northern regions associate with positive PPs (Nebbiolo and Lagrein and, partially, Dolcetto) even if in some cases the bias decreases as price increases, while in other cases the tendency is opposite.

Differently, the varieties linked to southern regions basically gain lower prices, even if the patterns of the size of the PPs is much varied. These are the cases of Nero d'Avola, Negroamaro, Aglianico and Primitivo for which negative PPs span from about 10% to 20%. The only notable exception is Nerello Mascalese, which gains quite large positive PPs at all price levels (19-35%). Our results confirm, at the same time, that both varieties and places of production (both at Regional and local level) play a relevant role in the creation of the value of

a wine and that they are intertwined one with the other so that it is not an easy task to disentangle the two features as well as that of the GI the wine belongs to. One more indication of the strong impact of the grape on red wines is also confirmed by the higher values associated to monovarietal wines: the coefficients for this variable are significant at all price levels and the positive PPs increase with price (from 24% to 33%).

Coming to the impacts of vintage and WA evaluation, both have significant impact on prices beside that of the variety. Older wines generally get higher prices, and the differentials are generally larger in higher market segments. As for the evaluation, better evaluated wines gain much higher prices: on average +13% every 0.5 increase in the score assigned. The differentials are slightly larger in lower market segments as if consumers rely more on the guide for relatively cheaper wines than for the expensive ones for which they spend more time for gathering information through different sources. The coefficient of the variable Color (Col) is not significant, indicating that red and rosé wines per sè do not gain different prices.

Finally, also the certification of origin affects final prices. Considering that the coefficients of the dummy variables (DOCG and DOC) are to be interpreted as a price premium compared to the reference wines (IGT), estimates confirm evidence emerged from the descriptive statistics: IGTs value more than DOCs in all market segments. Despite their high average price, DOCG wines are associated to larger positive price premium only in the low and medium segments, while this is not so in Q75, indicating that in the highest quantiles other attributes (e.g. producer, grape variety) play a more relevant role.

It is here worthwhile underlining that the variables included in the model generate impacts on price which are similar in magnitude, confirming that grape variety is a relevant and valued quality attribute among others.

Results of the estimates for the value associated to the ageing of red wines are reported in Table 7. In this regression the 2015 vintage has been chosen as the reference. Overall, the model captures a relevant share (R^2= 0.386) of price variability and several interaction terms between vintages and grape varieties (and GIs) are statistically significant, thus confirming that ageing plays an important role in the red wines market [52]. More specifically, this analysis shows clearly that ageing is idiosyncratic with respect to grapes, with some varieties gaining more value than others as time goes by. Wines produced in 2013 with Nebbiolo, Nerello Mascalese, Cabernet, Pinot Noir and Sangiovese are associated to PPs which range from 33% to 133% compared to the same grape varieties in the 2015 vintage. Successful ageing process involve native varieties of both northern (Nebbiolo) and southern Italy (Nerello Mascalese) as well as international grape varieties such as Cabernet and Pinot Noir. In some cases, only 2013 associates with larger PPs while 2014 coefficients are not significant. It is worth to pinpoint that, due to the short time series observed, the "vintage effect" may be interpreted as the consequence of specific climate outcomes rather than as the effect of ageing. This is, probably, the case of Nero d'Avola which has a negative significant coefficient only for 2014.

Table 6. HP estimations for red wines[1,2].

variables	OLS	Q25	Q50	Q75
Merlot	0.804*	0.732**	0.659*	1.524*
	(0.139)	(0.287)	(0.091)	(0.146)
Cabernet	0.531*	0.322*	0.423*	0.944*
	(0.099)	(0.069)	(0.105)	(0.085)
PinotNero	0.384*	0.219*	0.278***	0.461*
	(0.087)	(0.067)	(0.142)	(0.129)
Syrah	0,2312	0,0833	0,0986	0,6242
	(0.155)	(0.129)	(0.146)	(0.165)
Sangiovese	0.223*	0.151*	0.202*	0.254*
	(0.044)	(0.045)	(0.048)	(0.055)
Montepulciano	-0.216*	-0.197**	-0.228**	-0.277***
	(0.092)	(0.097)	(0.134)	(0.181)
Nebbiolo	0.594*	0.486*	0.531*	0.751*
	(0.048)	(0.051)	(0.053)	(0.074)
Barbera	0.174*	0,0747	0.155**	0.218*
	(0.055)	(0.049)	(0.065)	(0.074)
Lagrein	0.568*	0.537*	0.531*	0.579*
	(0.081)	(0.058)	(0.059)	(0.116)
Dolcetto	-0,0227	0,0534	0,0202	-0.109***
	(0.064)	(0.155)	(0.061)	(0.067)
Nerello Mascalese	0.347*	0.190*	0.266*	0.336**
	(0.085)	(0.040)	(0.075)	(0.138)
Nero d'Avola	-0.169*	-0.12***	-0.219*	-0.138**
	(0.067)	(0.080)	(0.077)	(0.073)
Negroamaro	-0.179**	-0.180*	-0.1983	-0.209***
	(0.084)	(0.078)	(0.175)	(0.143)
Aglianico	-0.115***	-0,0915	-0.173*	-0,1341
	(0.071)	(0.110)	(0.066)	(0.134)
Primitivo	-0,0924	0,0050	-0.087**	-0,1245
	(0.065)	(0.071)	(0.042)	(0.097)
Monovarietal	0.245*	0.237*	0.278*	0.331*
	(0.027)	(0.025)	(0.025)	(0.037)
Vint2013	0.220*	0.129*	0.218*	0.318*
	(0.028)	(0.033)	(0.030)	(0.040)
Vint2014	0.249*	0.198*	0.294*	0.262*
	(0.031)	(0.029)	(0.029)	(0.041)
WA Score	0.131*	0.135*	0.132*	0.122*
	(0.005)	(0.005)	(0.005)	(0.007)
Colour	0.135**	0.126***	0,0920	0,0629
	(0.065)	(0.064)	(0.078)	(0.124)
DOCG	0.122**	0.176*	0.150***	0.0171***
	(0.049)	(0.044)	(0.051)	(0.068)
DOC	-0.129*	-0,0392	-0.085**	-0.199*
	(0.041)	(0.034)	(0.041)	(0.058)
_cons	-0.999*	-0.999*	-0.999*	-0.999*
	(0.608)	(0.530)	(0.579)	(0.793)
R2	0,6141	0,357	0,4051	0,4073
Obs		1560		

[1] Table reports coefficients after their exponential transformation and standard errors (in brackets).

[2] Statistically significant respectively at: * < 0.01, ** <0.05, ***, <0.10.

Source: elaborations on data from Wine Advocate by Robert Parker.

Table 7. HP estimations for red wines ageing[1,2].

variables	OLS	Std. Err.
Nebbiolo14	1.745*	(0.143)
Nebbiolo13	0.937*	(0.081)
NerelloMascalese14	0.978*	(0.127)
NerelloMascalese13	1.339*	(0.286)
Sangiovese14	0.130	(0.141)
Sangiovese13	0.326*	(0.075)
Cabernet14	0.102	(0.300)
Cabernet13	1.357*	(0.158)
PinotNero14	0.289	(0.307)
PinotNero13	0.705*	(0.112)
NerodAvola14	-0.171***	(0.097)
NerodAvola13	0.122	(0.156)
Barbera14	0.246	(0.135)
Barbera13	0.052	(0.110)
Aglianico14	-0.088	(0.094)
Aglianico13	-0.105	(0.151)
Primitivo14	-0.168	(0.157)
Primitivo13	0.139	(0.142)
DOCG14	-0.039	(0.142)
DOCG13	0.453*	(0.080)
DOC14	-0.224*	(0.064)
DOC13	-0.269*	(0.061)
IGT14	0.008	(0.111)
IGT13	-0.079	(0.077)
cons	23.395	(0.028)
R2	0.386	

[1] Table reports coefficients after their exponential transformation and standard errors (in brackets).
[2] Statistically significant respectively at: * < 0.01, ** <0.05, ***, <0.10.
Source: elaborations on data from Wine Advocate by Robert Parker.

Finally, the interaction terms between vintage and the different types of GIs show that ageing exclusively plays a positive relevant role for DOCG wines, while increasingly negative PPs emerge for DOCs, probably due to their lower average quality which may be not well suited for wine ageing.

3.3 Results of the estimations of the hedonic Price Model for white wines

Despite the lower variability of prices, the HP model estimated on the 755 white wines provides a sound picture of the price-variety relationship and confirms the presence of a significant impact on prices of the grape variety. Values of the R2 and pseudoR2s (Tab. 8) are lower than for red wines, but still well acceptable, being respectively 0.325 in the OLS and in the range 0.161-0.189 in the QR [45,51].

Overall, estimated PPs are lower for white wines than for the red ones for all the variables observed. However, concerning grape varieties there are many which have significant impacts on price. Chardonnay and Sauvignon, two international varieties, gain positive PPs, while the third one, Pinot Grigio, associates with lower prices. The first gets larger PPs in higher market segments, while the second gets higher positive differentials in lower market segments. Negative PPs estimated for Pinot Grigio are significant for medium to high prices. The only white national variety included in the sample, Trebbiano di Abruzzo, gets, on average, large negative PPs. Autochthonous white varieties generally are less worth than the benchmark wines with the only exceptions of Carricante, whose prices are higher, and of Vermentino and Arneis, whose coefficients are not statistically significant. All in all, results say that the market for white wines is more fragmented as it tends to attach more value to minor autochthonous varieties as compared to more common ones included in the benchmark.

As observed for red wines, also in the case of white ones, we observe that those from southern regions associate with lower prices. The tendency of white wines to differentiate less their prices is also confirmed, respectively, by DOCG and DOC which are not more valuable than IGT and by the PP associated to Monovarietal wines; that is still positive but smaller and only significant at Q50 (+5.5%). Following the tendency, recently established also for Italian white wines, to being aged, at least to some extent, PPs are observed also for this variable. However, these are more limited and with mixed signs (here also the benchmark is 2015): they are positive for 2013 but negative for 2014, probably also due to the mixed impact of the weather in that year, that Wine Spectator defined as "challenging" especially for white wines (www.winespectator.com) [53]. Last, the WA evaluations affect prices also for white wines but, again, to a lesser extent (on average +9% for each additional 0.5 score), furthermore, in this case the impact is larger in higher market segments indicating that reviews impact in a different way for red wines than for white ones.

Table 8. HP estimations for white wines[1,2].

variables	OLS	Q25	Q50	Q75
Sauvignon	0.184**	0.134***	0.147***	0,137
	(0.072)	(0.075)	(0.074)	(0.109)
Chardonnay	0.188**	0,172	0,063	0.302***
	(0.072)	(0.105)	(0.048)	(0.149)
Pinot grigio	-0,043	-0,032	-0.090***	-0.129***
	(0.047)	(0.054)	(0.055)	(0.074)
Pinot bianco	0,010	-0,128	-0,007	-0,031
	(0.092)	(0.161)	(0.089)	(0.141)
Trebbiano d'Abruzzo	-0.248**	-0,229	-0.293*	-0,199
	(0.113)	(0.290)	(0.061)	(0.304)
Vernaccia di San Gimignano	-0.347*	-0.338*	-0.386*	-0.341*
	(0.085)	(0.087)	(0.112)	(0.071)
Fiano	-0.121***	-0.131***	-0,141	-0,168
	(0.075)	(0.081)	(0.099)	(0.141)
Falanghina	-0.221*	-0.161*	-0.216*	-0.320*
	(0.067)	(0.050)	(0.053)	(0.096)
Carricante	0.138***	0.166*	0,188	0,045
	(0.078)	(0.054)	(0.109)	(0.108)
Grecobianco	-0,087	-0,072	-0,110	-0,060
	(0.081)	(0.087)	(0.103)	(0.084)
Grillo	-0.154**	-0.155*	-0,125	-0.145**
	(0.079)	(0.046)	(0.132)	(0.069)
Friulano	0.174***	0.192*	0.189*	0,103
	(0.074)	(0.057)	(0.063)	(0.063)
Garganega	-0.132**	-0,036	-0.156*	-0.258*
	(0.060)	(0.079)	(0.058)	(0.057)
Vermentino	0,014	-0,003	-0,085	0,021
	(0.065)	(0.076)	(0.079)	(0.090)
Arneis	-0,074	0,051	-0.199**	-0,069
	(0.095)	(0.101)	(0.102)	(0.171)
Monovarietal	0,035	0,034	0.055***	0,008
	(0.033)	(0.029)	(0.029)	(0.043)
DOCG	0,055	0,041	0,123	0,052
	(0.073)	(0.067)	(0.075)	(0.066)
DOC	-0,030	0,029	-0,029	0,006
	(0.042)	(0.042)	(0.037)	(0.055)
Vintage2013	0,031	0,060	0.093**	0,052
	(0.037)	(0.042)	(0.037)	(0.038)
Vintage2014	-0,010	-0.063***	0,015	0,043
	(0.038)	(0.037)	(0.036)	(0.045)
WA Score	0.099*	0.071*	0.093*	0.103*
	(0.008)	(0.007)	(0.007)	(0.008)
_cons	-0.995*	-0.964*	-0.993*	-0.996*
	(0.751)	(0.632)	(0.631)	(0.707)
R2	0,325	0,161	0,173	0,189
Obs		755		

[1] Table reports coefficients after their exponential transformation and standard errors (in brackets).
[2] Statistically significant respectively at: * < 0.01, ** <0.05, ***, <0.10.
Source: elaborations on data from Wine Advocate by Robert Parker.

4. DISCUSSION AND CONCLUSIONS

The value added of the analysis presented in this paper consists in assessing the market value of a large number of grape varieties used for making Italian wines.

The estimated HP models show that grape varieties impact on the prices of both red and white wines and that these impacts are, overall, comparable to that of other quality attributes and in some cases are even larger. The observed PPs are mixed, indicating that some grapes increase prices while others have a negative effect. Furthermore, results of the QR models signal that the impacts of the grape varieties are different at different price levels, with some grapes that are comparatively more valued in the higher market segments while for others the opposite holds.

Overall, the market for red wines is more differentiated with some grapes that get higher prices and associate with larger PPs than that used for making white wines.

On average, international varieties gain large positive PPs which increase with price; the differentials are particularly large for white wines, with the notable exception of Pinot Grigio which gets negative PPs. Among national varieties, only Sangiovese, the most reviewed grape variety in WA, is associated to positive PPs; while prices for Montepulciano and Trebbiano d'Abruzzo gain negative PPs. Many autochthonous varieties gain positive price premiums, especially in the case of red wines from northern regions, while for white wines and for many varieties rooted in southern regions results are more mixed and are often in favor of less common varieties included in the group used as benchmark. The well-known divide between Italian southern and northern-central regions is here confirmed even if southern wines are improving their market positioning. All in all, the market seems to be somehow polarized between international and autochthonous varieties while the only rewarding nationwide grape is Sangiovese.

Our results confirm that both varieties and places of production (at Regional as well at local level) play a relevant role in the creation of the value of a wine. Varieties and places of production are strictly intertwined one with the other. Hence, to disentangle the two features, as well as that of the GI the wine belongs, it is not an easy task. In particular this is true in our sample that includes many wines where the grape and the region/area of production are strictly associated. More efforts will be required on this by future research in terms of sample selection and estimation techniques.

The analysis also confirms that the certifications of origin are worthy to consumers even if the so-called quality pyramid is reversed for red DOC and IGT wines. This result is well consistent with the many cases of IGTs that have taken advantage of flexibility in terms of grape content, image and geographical identity, adjusting quicker and better to changes in the consumers' preferences, fashion trends and strategies of competitors worldwide [49,30].

One additional insight provided by the analysis is that ageing, on average, adds value to wines even if it is, as expected, idiosyncratic with respect to grapes. In fact, as time goes by some red varieties gain more value than others. Successful ageing process involve native varieties of both northern and southern Italy, as well as international grape varieties. In some cases, more than one year is required for value to arise, and this holds both for varieties and for GIs. Interacting age with grape variety helped in getting more insights. However, look-

ing only at three vintages does not allow to disentangle the effect of ageing to that of climate at regional level in each specific year. More meaningful results on this point will require exploring a longer time span and expressing climate with regional/local variables.

Last, our results indicate that evaluations provided by experts (WA scores) are valuable to consumers but that this value is not smooth in the different market segments. Comparing the PPs associated to the white and to the red wines in the different quintiles, and considering their different price levels, we see a nonlinear relation. In particular, PPs associated to the experts' evaluations are lower for the cheapest wines (Q25 and Q50 in the white wines sample), then increase (Q75 for whites and Q25/Q50 for the reds) and afterwards they decrease again at the highest price levels (Q75 for the red wines).

Our suggested interpretation of this nonlinear relation is paved in different strands of the literature and starts from acknowledging that obtaining information costs money and, under this respect, it is a typical transaction cost [54]. So that for the purchase of low-priced wines it is not worth incurring in these costs (even consulting/paying the guide represents too high a cost); as the price range increases, the transaction cost represented by consulting the guide reduces in relative terms and it is therefore worth sustaining (and in fact the PP of the score increases); finally, for even more expensive wines it is not only worth referring to the guide but it becomes possible and convenient to incur in further costs to collect additional information from other sources so that the PPs associated to WA reduce a little [55,56].

The results here presented contribute to a better understanding of the wine market with respect to the values associated to different grape varieties some of which are highly appreciated by consumers while others are not. This is a core variable in the firms' decision process both for farmers and wineries. In fact, selecting the grape varieties for making wine has long lasting implications for the whole production process that leads to wine supply. Last but not least, it involves many different actors along the chain (from nurseries to retailers) that shall coordinate altogether their strategies.

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