AMERICAN ASSOCIATION OF WINE ECONOMISTS

AAWE WORKING PAPER
No. 243
Economics

THE COST OF IGNORANCE: REPUTATIONAL MARK-UP IN THE MARKET FOR TUSCAN RED WINES

Maja Uhre Pedersen, Karl Gunnar Persson and Paul Sharp

www.wine-economics.org

Oct 2019

The Cost of Ignorance:
Reputational Mark-up in the Market for Tuscan Red Wines[1]

Maja Uhre Pedersen [a], Karl Gunnar Persson [b], and Paul Sharp [c]

Abstract

This paper argues that imperfectly informed consumers use simple signals to identify the characteristics of wine. The geographical denomination and vintage of a wine as well as the characteristics of a specific wine will be considered here. However, the specific characteristics of a wine are difficult to ascertain *ex ante* given the enormous product variety. The reputation of a denomination will thus be an important guide for consumers when assessing individual wines. Denomination reputation is a function of average quality as revealed by the past performance of producers. The impact of past performance increases over time, since producers consider improved average quality to be an important factor in enhancing the price, but this necessitates monitoring of members in the denomination. The market for and pricing of Tuscan red wines provide a natural experiment because there are a number of denominations characterized by different type, age and quality standards. Furthermore, Tuscan red wines are easily comparable because of great similarities in climate and choice of grape varieties, soil and exposure to sun etc. We show that some denominations have a lower average quality score and that price differentials between denominations are linked to differences in average quality, although consumers tend to exaggerate the quality gap between prestige denominations and others. Thus, a producer in a prestigious denomination benefits from a substantial mark-up relative to an equally good producer from another denomination. We further show that denomination neutral wines have a stronger price-quality relationship than denomination specific wines. (JEL Classification: L15, L66)

Keywords: wine, Tuscany, price-quality relationship

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[1] We would like to thank participants at the First Annual Meeting of the American Association of Wine Economists in Trier (Mosel), Germany as well as Karl Storchmann and Victor Ginsburgh for valuable comments and suggestions.

[a] Department of Business and Economics, University of Southern Denmark, mup@sam.sdu.dk

[b] Department of Economics, University of Copenhagen; Karl Gunnar Persson sadly passed away during the writing of this paper. He is greatly missed.

[c] Department of Business and Economics, University of Southern Denmark, CAGE, CEPR, pauls@sam.sdu.dk (corresponding author)

1. Introduction

The wine economics literature indicates that what is *on the label of the bottle* often has an impact on price much larger than the impact of what is *within the bottle* (Oczkowski 2001, Combris, Lecocq and Visser 1997, and Cardebat and Figuet 2004). There are, however, national and even regional differences. For example, the rigid classification systems applied in France seem to be particularly biased against the ability of quality and sensory aspects to have an impact on price. On the other hand, studies of wine prices in nations which do not use denominations give sensory characteristics and/or jury grades significant explanatory power (Schamel and Anderson 2003, although this result is disputed by Haeger and Storchmann 2006). Since collective reputation is a quasi-public good, a rigid classification system, as practiced in Bordeaux, might be expected to lead to more free-riding on the collective reputation than it would in Burgundy, where the classifications are evaluated every year and de-classification is practiced. Indeed, Combris et al (2000) show that sensory characteristics have a larger impact on price in the latter than in the former.[2]

In the present work, we turn our attention to Tuscany, Italy, which enjoys a mixture between rigid and more liberal classifications and investigate which types of wine enjoy the strongest relationship between quality and price. To our knowledge this is the first study to investigate the price-quality relationship on Tuscan wines. Benfratello, Piacenza and Sacchetto (2009) investigate factors influencing the prices of two Italian premium quality wines produced in the region of Piedmont (Barolo and Barbaresco) over a four-year period. They find that reputation, as measured by experts, is more important for price determination than the sensory characteristics. Brentari, Levaggi and Zuccolotto (2015) studies price formation on the Italian domestic wine market, by including several sensory and objective characteristics. Finally, Corsi and Strøm (2013) use a Heckman model to control for self-selection bias in the production of organic wines in the Italian region of Piedmont. We contribute to the existing wine literature covering Italy, by studying the price-quality relationship in a fairly homogenous geographical area where a large number of wine types is present. This allows us to concentrate on both the quality of wines and the reputation of wines produced with grapes all produced under similar geographical and climatic conditions.

The fact that quality (as revealed by the evaluation of experts) and sensory characteristics often play a minor role in determining the price of a commodity is disturbing and is not immediately

[2] See also Rahmani, Loureiro, Escobar and Gil (2019), who use the results of a labelled discrete choice experiment among Catalan red wines to assess the willingness to pay for conventional and organic wines.

compatible with the postulate that consumers are well informed. There is of course the argument that experts' evaluations or other estimates of sensory characteristics do not correspond strongly to consumers' tastes and preferences. However, we take the view that consumers and experts share similar preferences, but that consumers differ from experts in that they have imperfect information on individual wines. This is understandable given the product variety on the wine market. For this paper alone, we look at more than 2000 different red wines produced in a period of just four years in only one Italian region.

Facing this product variety, consumers may learn about individual wineries and vintages, but they will use the ranking of denominations as an important indicator of the quality of a particular wine. Indeed, it might well be the case that, although consumers have knowledge about the average quality of well-established denominations, they infer that denominations that they do not know must be of an inferior rank. We propose that the average quality of the denomination of a wine will have an impact on the price of individual wines in that denomination which is independent of their individual quality. The average quality of a denomination is a function of time and monitoring regimes in the denomination. Since an increase in the average quality enhances the price members of a denomination can receive for their product, members will try to purge other members which are below average in terms of quality. There is also a tendency within a denomination to gradually introduce stricter rules in the winemaking process. Furthermore, it takes time for new denominations to get the media coverage that is necessary for building a reputation. A recent Google search for two denominations included in this study gave almost 5 million hits for one of the well-established denominations, *Brunello di Montalcino,* but under 5,000 for a recently formed denomination, *Rosso di Sovana*.

We expect that there is a positive relationship between quality (as revealed by scores given by experts) and price, but that there are strong denomination effects, explained by the fact that average quality differs between denominations. That is, an individual wine from a well-established denomination will receive a price premium, linked to its average quality, which is independent of the quality of the individual wine. Conversely, the price of a wine from a new denomination will be affected by its quality (sensory characteristics summed up by the score given by an expert) but will suffer from price discrimination linked to the perceived average quality of its denomination. Consequently, wines of equal quality from different denominations will command significantly different prices. We call the price premium obtained by denomination alone a reputational rent or mark-up, and we attempt to estimate the magnitude of it. We conjecture that the perceived quality

difference is larger than the actual or objective difference because consumers have distorted access to information. We also investigate the nature of price formation in the market for Tuscan red wines which do not rely on strong denomination attachments – the so called IGT (*Indicazione Geografica Tipica*) discussed below. Although IGT carries a vague geographical connotation, the major signal of IGTs is that these wines have a much larger variance in quality than traditional denominations. The implication is that consumers must learn about the specific characteristics of the individual wines. Since they are much more reliant on linking quality to brand name reputation, rather than strict geographical denomination, we expect these wines to show a stronger link between price and quality.

The rest of the paper is organized as follows. The following section presents the classification principles in Italy along with a presentation of the Tuscan denominations and section 3 presents the data used in the analysis. Section 4 presents the underlying theoretical framework, while section 5 presents our analysis. Finally, section 6 concludes.

2. The Italian classification principles

The Italian legislation regarding the classification of wines follows European standards with a total of five categories of which the last two have strong geographical attachments. The system is authorized by the Ministry of Agriculture (*Ministero delle politiche agricole e alimentari e forestali*), although the body that monitors members, the *consorzio* (consortium), is elected by members. The most rigorous denomination is DOCG (*Denominazione di Origine Controllata e Garantita*, "designation of origin and guaranteed") followed by DOC (*Denominazione di Origine Controllata*). Both denominations are at the European PDO (protected designation of origin) level. DOCG wines are differentiated from DOC wines in that the former must be tasted and approved by an authorized committee before bottling. Members of the denominations sustain the costs of this procedure as well as other costs of membership, although reputational benefits of membership are likely to be more important than the costs of being a member. A particular denomination covers a restricted geographical territory and prescribes through its *disciplinare di produzione* (product specification) the grapes which are permitted and in what proportions they are to be used, as well as a number of conditions for the winegrowing and production procedures. These rules include among others the permitted yield and the properties of the grapes at harvest. A denomination typically starts by obtaining DOC status and then strives after the DOCG status, which is essentially a process of increasing the average quality. Members need to obey the rules established by the *consorzio* and can be subject to disciplinary action in case of negligence.

In addition to the two denomination categories there are two "wine" categories and the IGT (*Indicazione Geografica Tipica*) all covering wider territorial units, and with much less rigorous rules. The "wine" categories are the lowest and cover generic varieties with no geographical attachments at all and are thus not included in this study. The IGT wines have some geographical attachment but are however subject to a much larger variance in quality and wine making procedures than DOC(G). In fact, some of the best wines in Tuscany are in the IGT category – as well as some of the worst. Thus, this denomination does not confer a direct signal as to the quality, and these wines must rely more on brand-name impact. Typically, large established producers use IGT to experiment with grape varieties not permitted in DOC and DOCG and to enhance the price-quality link through brand-name promotion. In most cases, producers are both members of a DOC or DOCG and devote part of their land to the production of IGT wines.

We argue that producing IGT wines is a way for high quality producers in new denominations to get a better deal, since denomination-neutral wines can be expected to give a better price-quality relationship. It is also worth noting that denominations that enjoy high reputational mark-ups, such as Barolo in Lombardy or Montalcino in Tuscany, are less inclined to produce IGT wines. Producing IGT wines is open only for medium to large producers because of the elevated fixed costs involved in establishing brand name reputation.

2.1 Tuscany

In this study we concentrate on red wines from the region of Tuscany.[3] Tuscany is located at the top of the Italian peninsula on the west coast and the denominations in our sample are within a fairly homogenous geographical area. Currently, Tuscany has 11 DOCG's and 41 DOC's (the second highest of any Italian region, after Piedmont) with the result that almost two thirds of the entire wine production is at the PDO level. Furthermore, it has the greatest proportion of red wines of any region, amounting for 85 percent of total wine production. The amount of IGT wines produced in Tuscany is also very large, making it possible to compare wines with a strong denomination attachment to the IGT category. The dominant grape variety is Sangiovese which is used in many of the denominations. Apart from Sangiovese other grape varieties such as Merlot, Syrah, Cabernet Sauvignon and Cabernet Franc are also fairly important for the production of red wine.

[3] Our discussion of the Italian classification principles is based on information taken from www.italianwinecentral.com.

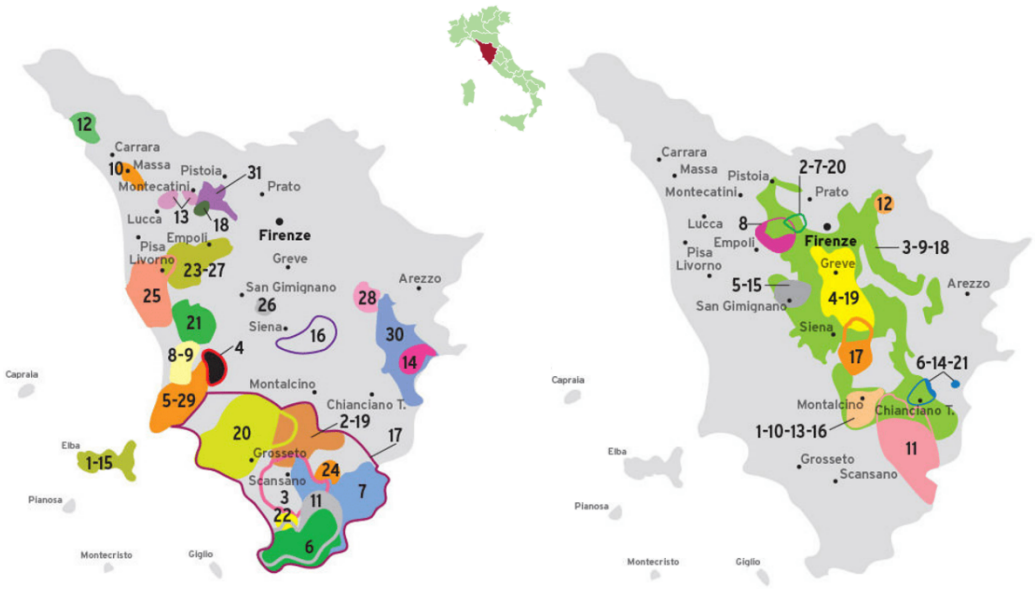

Figure 1: Zones of production of the Tuscan denominations

Source: www.italianwinecentral.com.

The colored areas in Figure 1 illustrate the zones in Tuscany where DOCG and DOC wines are produced. The left panel indicates production zones in more outlying areas, and the right panel shows the historical center of Tuscany. Both Brunello di Montalcino DOCG (no. 1 in the righthand panel) and Chianti Classico DOCG (no. 4 in the righthand panel) are produced in the historical center. In our sample, almost all the Tuscan denominations which produce red wines are represented, and in the analysis, we have controls for *Chianti Classico DOCG* and *Brunello di Montalcino DOCG* as well as for IGT.[4] We control for *Chianti Classico* and *Brunello di Montalcino* because they are the oldest, most well-known, and most widely produced DOCG wines in Tuscany, while we control for IGT as an indication of wines that do not rely on strong denominational attachments.

The most widely represented DOC and DOCG's in our sample, in order of appearance, are listed below, along with the proportion of Sangiovese or the main grape variety given in square brackets:

- *Brunello di Montalcino*: formed 1966 as DOC and received DOCG status in 1980. [100% Sangiovese]
- *Chianti Classico*: established as a subzone of the Chianti DOC in 1967 and received DOCG status in 1996. It is no longer a subzone of Chianti. [min. 80% Sangiovese]
- *Rosso di Montalcino*: formed as DOC in 1983. [100% Sangiovese]

[4] In the rest of the paper we will omit the "DOCG" in the names *Chianti Classico DOCG* and *Brunello di Montalcino DOCG*, but they always refer to these denominations.

- *Bolgheri*: formed as DOC in 1983. [max. 50% Sangiovese]
- *Vino Nobile di Montepulciano*: formed as DOC in 1966 and received DOCG status in 1980. [min. 70% Sangiovese]
- *Chianti*: formed in 1967 as DOC and received DOCG status in 1984. Includes various red wines with slightly different grape compositions. [min. 70% Sangiovese]
- *Maremma Toscana*: elevated from IGT to DOC in 2011. Various red wines with different grape compositions. [min. 85% Sangiovese in the *Maremma Toscana* Sangiovese variety]
- *Morellino di Scansano*: formed as DOC in 1978 and received DOCG status in 2006. [min. 85% Sangiovese]
- *Rosso di Montepulciano*: formed as DOC in 1988. [min. 70% Sangiovese]

In addition to the DOC and DOCG we also include IGT red wines produced in Tuscany in our study. When it comes to IGT wines, the grape composition varies from brand to brand and there is no obligation to include Sangiovese.

3. Data

We use information on wines produced in Tuscany in the period 2010-2013, collected from a large database of wines available on WineSpectator.com. Here, more than 15,000 widely available wines from all over the world are reviewed every year using blind tasting. Ferro and Amaro (2018) also use WineSpectator, even though they use the 100 top-rated wines for a 14-year period, including wines from all over the world. Another study to use the same database is Benfratello et. al. (2009), who uses WineSpectator to obtain information about two Italian wines from the region of Piedmont. The database divides the wine reviews into countries and regions and for some regions, such as Tuscany, also into different denominations. The reviews follow a 100-point scale with 50 being the worst score and 100 the best. The majority of the wines tasted are submitted by the individual wineries or their US importers and the tastings take place both in WineSpectator's offices and, in the case of European wines, directly in the region of origin. Furthermore, the winetasters each specialize in a particular wine region, with the implication that the same person has tasted almost all the wines in our dataset, and in this way, we avoid potential problems of bias related to the tasting process. Moreover, a greater expertise might be expected to give more reliable results in the reviewing process. To maintain consistency in the ratings, tastings always begin with a previously rated wine to use as a reference point, and the blind tasting also includes previously rated wines. We therefore expect the reviews to be a reliable source for representing the quality of each wine since it can be argued that wine guides

operate on a market for serious wine drinkers and thus, any systematic bias – as opposed to stochastic errors of judgement – would be penalized by market forces.

Our sample includes vintages from 2010 to 2013. The former has been selected because the Italian classification system was changed in 2010 and thus to maintain consistency in the classification and the denomination rules, we do not include wines from before the changes.[5] The end year has been chosen so as not to include too recent vintages. All wines must age, and this time period is set by the rules of each denomination. Even though they are sometimes present in the WineSpectator database, those wines which have been tasted before the imposed ageing cannot be evaluated in the same way as those already aged. Thus, we have decided to end our sample to have all denominations present for all vintages.[6] Other than the exact name and the score given to each wine, we also have information about the number of cases produced, or alternatively the number of cases imported into the US, the retail price in US dollars, the vintage, a brief description of sensory characteristics and sometimes the grapes used. The information about cases produced will be used in the analysis to control for the impact that the scale of production can have on the determination of the price. In the final dataset, we exclude those wines where only the number of cases imported is available, as there is no way to compare this number with actual production. Removing these wines, together with those where information on price is not available, we end up with a sample of 2,456 Tuscan red wines for which summary statistics for price and quality can be seen in Table 1.

Table 1: Summary Statistics

		All	Chianti Classico	Brunello	IGT	Others
Price	*Min*	7	12	32	9	7
	Mean	54.38	37.26	89.95	61.27	33.77
	Median	38	30	75	46	26
	Max	650	276	500	650	245
	SD	51.84	27.81	54.17	63.24	31.27
Score	*Min*	74	74	76	75	79
	Mean	89.72	89.26	92.21	89.38	88.56
	Median	90	90	93	90	89
	Max	98	95	98	97	95
	SD	3.2	3.01	2.51	3.06	2.77
No. observations		2456	503	524	706	723

[5] Before 2010 the classification system included the category *Vino da tavola*, which was changed to the generic "wine" category and, also in 2010, all IGT and IGP wines became equal. The system was changed in order to be comparable to the European classification system.

[6] The denomination with the longest imposed ageing is *Brunello di Montalcino*, which has to age at least four years, which in the case of *Riserva* becomes five years.

Figure 2 shows the relative frequencies of quality for each of the denominations of interest in this study, while Figure 3 illustrates the overall distribution.

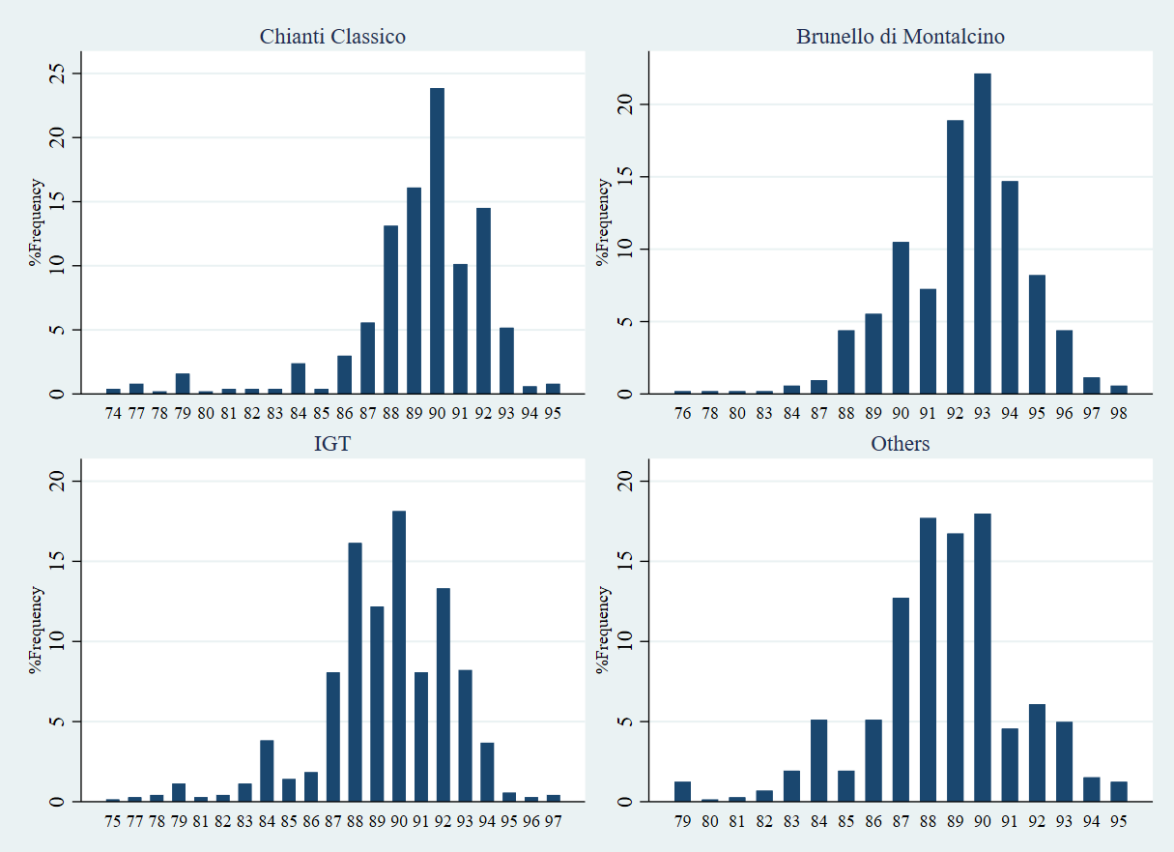

Figure 2: Relative frequencies of the quality for denominations of interest

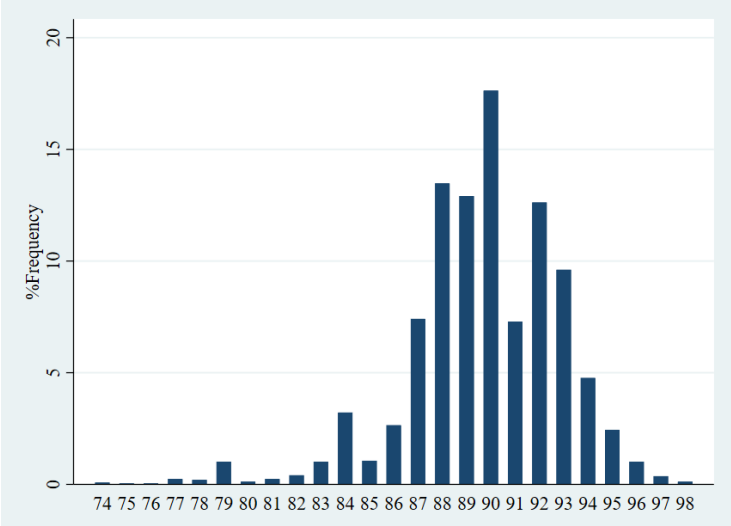

Figure 3: Relative frequencies for the entire sample

From both figures it is clear that the majority of the red wines in our sample are concentrated around a quality score of about 90, with only a few in the two tails of the distribution. The score and price of *Brunello di Montalcino* is on average higher than for other wines, while *Chianti Classico*, the other old and well-established denomination, is more similar to the other DOC(G) and IGT wines. However, it should be mentioned that the production of *Chianti Classico* is more than double that of *Brunello di Montalcino* and also larger than the production of IGT wines, and it might therefore be expected that it would receive lower prices.

Since we use a wine guide to obtain information about quality, this might raise the suspicion that we do not obtain an unbiased selection of producers but rather concentrate on the best in each denomination. We are however confident that this is not the case since we have a reasonably representative sample of wines, and our sample size is very large compared to other similar studies. From Table 1 it is very clear that the IGT wines are well represented in our sample, but also DOC(G) wines besides *Chianti Classico* and *Brunello di Montalcino* are well represented. Therefore, we do not find it necessary to follow procedures in the analysis to account for selection bias, unlike Corsi and Strøm (2013).

4. Econometric modelling

We follow the standard hedonic price model to explain how the price of a wine is determined. The price of a bottle of wine is assumed to be a function of the wine's objective and sensory characteristics, the first being characteristics such as vintage, place of origin and denomination/brand name, while the latter are the characteristics such as taste, scent and color. The sensory characteristics taken together constitute the quality of the wine and should to a large degree determine the consumer's willingness-to-pay. However, wine is an experience good, and as such, the quality can only be assessed after having tasted and thus purchased the bottle. Therefore, in wine economics, the objective characteristics often seem to have a larger effect on the price than the sensory characteristics. Thus, denomination might be expected to have a significant impact on the determination of the price independent of quality.

Our model can thus be summarized as follows. The price of a wine is determined by individual sensory characteristics as revealed by expert opinion. Furthermore, there is an independent positive denomination effect which is linked to the perceived average quality of a denomination. Newer vintages tend to have a negative impact on price, because buyers are imposed the cost of cellaring the

wines. Furthermore, we expect that IGT wines will have a stronger price-quality relationship because consumers cannot rely on denomination as a proxy for quality and must learn about the qualities of particular brands or vineyards. The baseline specification is as follows:

$$\ln P_i = \beta_0 + \beta_1 Score_i + \beta_2 X_i + \beta_3 Vintage_i + \beta_4 \ln Cases + \varepsilon_i \quad (1)$$

Where $\ln P_i$ is the natural logarithm of the price in US dollars of a bottle of wine, $Score_i$ is the quality assigned by experts (50 to 100), and $\ln Cases_i$ is the natural logarithm of cases produced. Finally, $X_{r,i} = (Chianti, Brunello, IGT, Riserva)'$ and $Vintage_i$ contain dummies for the categories and vintages included.[7] The β's are the coefficients of interest and ε_i is the error term.

In the full specification we introduce interactions between *Score* and the variables *Chianti*, *Brunello*, *IGT* and *Riserva*. We also implement two alternative specifications where we introduce dummies for being a DOC(G) instead of the denomination names *Chianti Classico* and *Brunello di Montalcino* in order to assess whether denominations influence the price differently from categories.

$$\ln P_i = \beta_0 + \beta_1 Score_i + \beta_2 X_i + \beta_3 X_i * Score_i + \beta_4 Vintage_i + \beta_5 \ln Cases_i + \varepsilon_i \quad (2)$$

Furthermore, we estimate an alternative specification to account for non-linearity in the data. This decision can be supported by Figure 4 which illustrates a binned scatterplot between price and quality after having controlled for the other variables. This provides a non-parametric way of visualizing the relationship between *Score* and *Price* without the graph being too crowded.

[7] A bottle of wine is 750 ml while a case contains 12 bottles of wine.

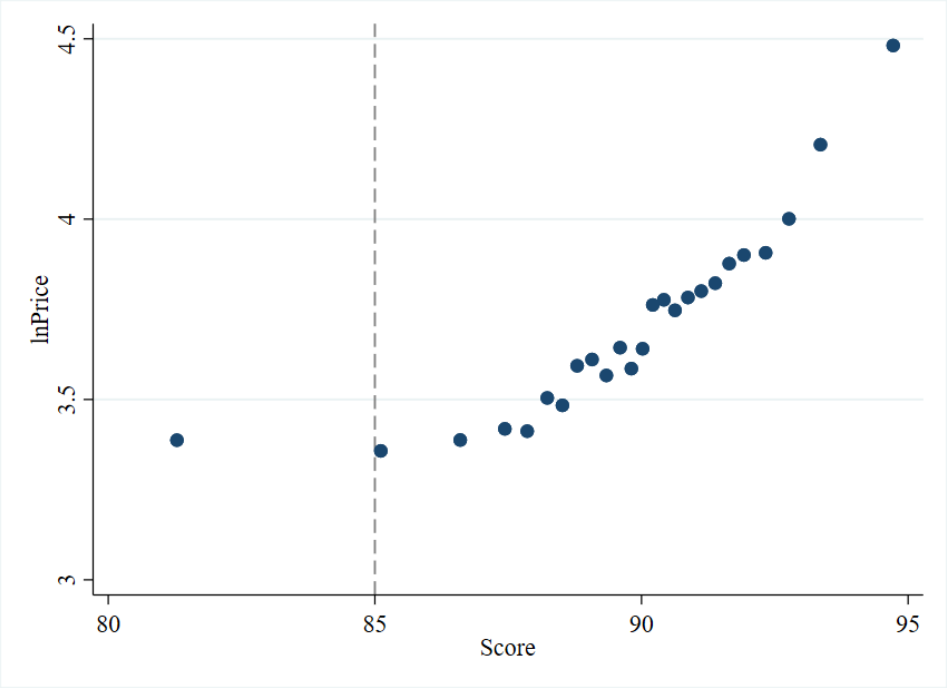

Figure 4: Binned scatterplot of *Score* and the natural logarithm of *Price*

Notes: We have controlled for *Chianti Classico*, *Brunello di Montalcino*, IGT, *Riserva*, vintage and the log of cases produced. The number of bins is set to 25 and the dotted line indicates the separating point in our analysis.

Clearly, the relationship is probably linear only for *Scores* higher than 85 and thus not taking this into account might lead to model misspecification. The exact separating point was chosen based on a number of trials, where it was found that separating the data at 85 gave the highest explanatory power. We thus introduce two alternative specifications, the first keeping the same interactions as in equation 2:

$$\ln P_i = \beta_0 + \beta_1 Score_i + \beta_2 D85_{100} + \beta_3 Score_i * D85\_100 + \beta_4 X_i + \beta_5 X_i * Score_i + \beta_6 Vintage_i + \beta_7 \ln Cases + \varepsilon_i \quad (3)$$

and the second introducing all interactions between *Score*, dummies and the break point dummy.

$$\ln P_i = \beta_0 + \beta_1 Score_i + \beta_2 D85_{100} + \beta_3 Score_i * D85\_100 + \beta_4 X_i + \beta_5 X_i * Score_i + \beta_6 X_i * Score_i * D85\_100 + \beta_7 Vintage_i + \beta_8 \ln Cases + \varepsilon_i \quad (4)$$

These differ from equation 2 in that we allow for different slopes and intercepts for different quality intervals. $D85\_100$ is a dummy controlling for whether an observation has a score in the interval $[85 - 100]$. In an alternative specification we employ a quadratic term. The complete list of variables and their descriptions can be seen in Table 2.

Table 2: Variables in the analysis

Variable	Description
$\ln P$	Natural logarithm of price in US$ pr. bottle
$Score$	Rating from WineSpectator (discrete or in intervals)
$Brunello$	= 1 if the wine is a *Brunello di Montalcino DOCG*
$Chianti$	= 1 if the wine is a *Chianti Classico DOCG*
IGT	= 1 if the wine is an IGT
$Riserva$	= 1 if *Riserva* is included in the name
$\ln Cases$	Natural logarithm of number of cases produced
$Vintage$	Vintage dummies for 2010-2013
$D85\_100$	= 1 if $Score \in [85; 100]$

Notes: We also include dummies for *DOC* and *DOCG* in specifications in the appendix, and vintage is included as the year dummies *2011*, *2012* and *2013*, making 2010 the reference year.

5. Results and interpretation

Table 3 presents the OLS estimation results of the four specifications representing equations 1-4.

Table 3: Estimation results

Dependent variable is:	ln*Price*			
	(1)	(2)	(3)	(4)
Score	0.081***	0.094***	0.003	0.003
	(0.005)	(0.009)	(0.019)	(0.019)
D85_100∗Score			0.137***	0.143***
			(0.018)	(0.017)
D85_100			−11.936***	−12.467***
			(1.497)	(1.444)
Chianti	0.110***	4.730***	2.997***	5.106***
	(0.027)	(0.977)	(0.843)	(1.255)
Brunello	0.660***	5.309***	7.377***	9.077***
	(0.031)	(1.034)	(1.067)	(1.163)
IGT	0.320***	−2.114*	−2.242**	−2.367*
	(0.031)	(1.143)	(0.914)	(1.264)
Riserva	0.076***	1.064	1.103*	0.528
	(0.025)	(0.726)	(0.629)	(0.848)
Chianti∗Score		−0.052***	−0.033***	−0.061***
		(0.011)	(0.010)	(0.015)
Brunello∗Score		−0.051***	−0.075***	−0.100***
		(0.012)	(0.012)	(0.014)
IGT∗Score		0.027**	0.028***	0.030**
		(0.013)	(0.010)	(0.015)
Riserva∗Score		−0.011	−0.011*	−0.004
		(0.008)	(0.007)	(0.010)
Chianti∗Score∗D85_100				0.005***
				(0.001)
Brunello∗Score∗D85_100				0.007***
				(0.002)
IGT∗Score∗D85_100				0.000
				(0.001)
Riserva∗Score∗D85_100				−0.001
				(0.001)
Vintage:				
2011	0.074***	0.050*	0.059**	0.055**
	(0.028)	(0.028)	(0.027)	(0.027)
2012	0.033	0.033	0.035	0.036
	(0.028)	(0.028)	(0.027)	(0.027)
2013	0.061**	0.056**	0.046*	0.043
	(0.028)	(0.028)	(0.027)	(0.027)
ln*Cases*	−0.171***	−0.169***	−0.158***	−0.159***
	(0.008)	(0.008)	(0.008)	(0.008)
Constant	−2.529***	−3.672***	3.983***	3.997***
	(0.446)	(0.814)	(1.554)	(1.560)
R^2	0.537	0.556	0.588	0.590

Column (1) is the estimation of equation 1, column (2) is the estimation of equation 2, column (3) is the estimation of equation 3 and column (4) is the estimation of equation 4. The total number of observations is 2456 in all specifications and the robust standard errors are given in parentheses. $*p < 0.10$; $**p < 0.05$; $***p < 0.01$

In all specifications the reference category is a DOC(G) wine from 2010 without the label "*Riserva*" and excluding *Chianti Classico* and *Brunello di Montalcino*, for which we have controls. It should of course be noted that we cannot claim causality for our results, since we are performing simple OLS regressions. Nevertheless, since the scores are the result of blind tasting, they are plausibly exogenous to the prices. Missing variable bias might however still be a concern.

The first results are of interest mostly to see whether the included explanatory variables are significant. Both *Score* and the four variables *Chianti*, *Brunello*, *IGT* and *Riserva* are highly significant, indicating that we can proceed with the other specifications. The size of production also clearly matters for the price, with a larger production decreasing the price. From column 1 we note that all the objective characteristics have a positive effect on the price, even though the effect of a Brunello is much higher than for the others, as can be seen from Table 3.

Table 3: Percentage effect of each denomination on the price in the baseline specification

Denomination	Effect (%) (1)
Chianti	11.59
Brunello	93.39
IGT	37.65

Note: The effect has been computed using the approximation for dummies in a semilogarithmic equation as proposed by Kennedy (1981): $\%effect = 100 * \left(\exp\left(\hat{\beta} - 0{,}5 * se(\hat{\beta})^2\right) - 1\right)$.

In all the other specifications (2)-(4) *Score* remains significant as well as *Chianti*, *Brunello* and *IGT* both with and without their interaction with *Score*. Furthermore, they keep their sign and the magnitudes are fairly stable throughout the specifications. On the other hand, *Riserva* becomes insignificant, and thus seems less important for the price determination. In all specifications, the vintages are only in part significant while cases are always highly significant.

The positive sign on *Chianti* and *Brunello* indicates that being part of these denominations has a positive effect on the price, everything else equal, while IGT has a negative effect on the price. This indicates the presence of a reputational mark-up for these denominations. Furthermore, we find that the sign on the interactions for *Chianti* and *Brunello* are both negative, indicating that the price-quality relationship is less strong for these denominations with respect to other DOC(G)'s. The sign on the interaction between *Score* and *IGT* is on the other hand positive, indicating a stronger price-quality relationship for these wines.

In Table 4 we calculate the effect on the price implied by the estimates for the three denominations for (2)-(4) and for different values of *Score*. Particularly noticeable is the effect when the score is very low or very high. In the first case *Brunello* clearly increases the price (more than 700% higher than the reference wine) but also *Chianti* has a positive effect, while the IGT decreases the price. In these cases, there is a clear advantage for the producers of being part of a denomination, while for consumers there will be a loss due to the extremely high mark-up. For very high scores the picture inverts, however, and *Chianti* and *Brunello* both have negative effects on the price, -33 percent and -5 percent respectively, while IGT now increases the price by about 70 percent.

Table 4: Percentage effect of each denomination on the price

Denomination	Effect (%)		
	(2)	(3)	(4)
		at median	
Chianti	5,61	3,78	4,43
Brunello	107,77	94,81	100,64
IGT	39,12	34,80	34,02
		at max	
Chianti	−30,30	−20,23	−33,41
Brunello	38,31	7,29	−4,74
IGT	72,88	68,96	69,77
		at min	
Chianti	142,49	75,63	156,88
Brunello	368,84	542,22	790,11
IGT	−9,91	−14,20	−16,48
		at mean	
Chianti	7,16	4,74	6,09
Brunello	110,75	98,92	105,94
IGT	38,07	33,74	32,92

Note: The effect has been computed using an approximation for semilogarithmic equations: $100 * \left(\exp(\hat{\beta}) - 1\right)$. The min, mean, median and max value of *Score* refer to all the data and the numbers in parentheses indicate the corresponding equation in the estimation table.

In addition, we consider alternative specifications in Appendix 1 where we account for the non-linearity in the data described above, first with a discontinuity at a score of 85 (Table A1.1), and second with a quadratic term for *Score* (Table A1.2). Neither changes the qualitative nature of our results. Finally, Appendix 2 reports alternative specifications where we introduce dummies for being a DOC(G) rather than the denomination names *Chianti Classico* and *Brunello di Montalcino*, both

with the cutoff at a score of 85 (Table A2.1) and with a quadratic term (Table A2.2). The significance of our results falls, implying that the denomination names have a greater predictive power than the categories.

All in all, our results demonstrate that prices of wine do indeed respond positively to quality differences as revealed by experts' evaluations. However, consumers use the denomination as a measure of quality, being willing to pay more for the more well-established denominations, indicating that the denomination affiliation for a wine can disturb a consumer's assessment of quality and willingness-to-pay. The price-quality effect on IGT wines is stronger than for all DOC(G) wines. However, the denomination effects on *Chianti Classico* are much smaller than for *Brunello di Montalcino*. One possible interpretation is that *Chianti Classico* producers rely more on consumers identifying quality through producers' characteristics as opposed to denomination. Indeed, anecdotal evidence suggests that *Chianti Classico* labels downplay the denomination and rather stress producer identification.

6. Conclusion

The expectations spelled out in the introduction were confirmed by our empirical analysis. There is a significant correlation between price and quality as measured by the scores given by experts. The reputational mark-up for *Brunello di Montalcino* is substantial whereas for *Chianti Classico* it is lower but still present. Furthermore, we showed that wines that do not have a strong denominational affiliation (IGT wines) enjoy a stronger impact of quality on price. It has been argued that large mark-ups can be compatible with the assumption of rational consumer behavior, given that there are high search costs involved in the process of choosing a wine. We have demonstrated, however, that consumers pay a high price for their ignorance. Serious and rational wine drinkers should thus consult a wine guide before making a purchase.

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Appendix 1: Robustness checks

Table A1.1: Additional specification using D85_100

Dependent variable is:	ln*Price*
	(A1.1)
Score	−0.011
	(0.016)
D85_100∗Score	0.137***
	(0.017)
D85_100	−11.888***
	(1.395)
Chianti	0.178***
	(0.068)
Brunello	1.142***
	(0.177)
IGT	0.0667
	(0.081)
Riserva	0.263***
	(0.071)
Chianti∗Score∗D85_100	−0.001
	(0.0019)
Brunello∗Score∗D85_100	−0.007***
	(0.002)
IGT∗Score∗D85_100	0.0027***
	(0.001)
Riserva∗Score∗D85_100	−0.002***
	(0.001)
Vintage:	
2011	0.083***
	(0.027)
2012	0.028
	(0.027)
2013	0.056***
	(0.027)
ln*Cases*	−0.161***
	(0.008)
Constant	5.207***
	(1.311)
No. observations	2,456
R^2	0.572

Table A1.2: Specification including the square of *Score*

Dependent variable:	ln*Price*		
	(A1.2)	(A1.3)	(A1.4)
Score	−1.032***	−1.285***	−2.242***
	(0.118)	(0.148)	(0.262)
Score^2	0.006***	0.008***	0.013***
	(0.001)	(0.001)	(0.002)
Chianti	0.098***	2.584**	−64.929***
	(0.025)	(0.840)	(14.613)
Brunello	0.559***	8.874***	−75.870***
	(0.032)	(1.339)	(14.478)
IGT	0.299***	−2.142**	−31.265**
	(0.030)	(0.924)	(16.219)
Riserva	0.051**	1.373**	12.546
	(0.025)	(0.646)	(8.519)
Chianti∗Score		−0.028***	1.519***
		(0.010)	(0.337)
Brunello∗Score		−0.091***	1.816***
		(0.015)	(0.329)
IGT∗Score		0.027***	0.691*
		(0.010)	(0.371)
*Riserva*Score*		−0.014**	−0.268
		(0.007)	(0.193)
Chianti∗Score^2			−0.009***
			(0.002)
Brunello∗Score^2			−0.011***
			(0.002)
IGT∗Score^2			−0.004*
			(0.002)
Riserva∗Score^2			0.001
			(0.001)
Vintage:			
2011	0.098***	0.064**	0.054**
	(0.028)	(0.028)	(0.027)
2012	0.030	0.038	0.037
	(0.028)	(0.027)	(0.027)
2013	0.057**	0.048*	0.041
	(0.028)	(0.027)	(0.027)
ln*Cases*	−0.164***	−0.159***	−0.160***
	(0.008)	(0.008)	(0.008)
Constant	46.230***	56.655***	98.628***
	(5.164)	(6.478)	(11.347)
No. observations	2,456	2,456	2,456
R^2	0.559	0.585	0.591

Appendix 2: Alternative specifications using DOC and DOCG dummies instead of denomination names

Note: The reference category is now an IGT wine from 2010.

Table A2.1: Estimate results

Dependent variable:	ln*Price*				
	(A2.1)	(A2.2)	(A2.3)	(A2.4)	(A2.5)
Score	0.109***	0.118***	−0.009	−0.024	−0.011
	(−0.005)	(0.009)	(0.017)	(0.016)	(0.018)
Score∗D85_100			0.188***	0.188***	0.189***
			(0.016)	(0.017)	(0.016)
D85_100			−16.277***	−16.181***	−16.349***
			(1.336)	(1.389)	(1.366)
DOCG	−0.063**	0.040	1.135	−0.035	1.569
	(0.029)	(1.014)	(0.766)	(0.085)	(1.025)
DOC	−0.172***	1.640	1.829	0.115	0.512
	(0.036)	(1.497)	(1.117)	(0.093)	(1.635)
Riserva	0.030	3.034***	2.456***	0.394***	1.669*
	(0.030)	(1.164)	(0.722)	(0.109)	(0.973)
DOCG∗Score		−0.001	−0.014		−0.020
		(0.011)	(0.009)		(0.012)
DOC∗Score		−0.020	−0.022*		−0.005
		(0.017)	(0.013)		(0.020)
Riserva∗Score		−0.033***	−0.027***		−0.016
		(0.013)	(0.008)		(0.012)
DOCG∗Score∗D85_100				−0.001	0.001
				(0.001)	(0.001)
DOC∗Score∗D85_100				−0.003***	−0.003
				(0.001)	(0.002)
Riserva∗Score∗D85_100				−0.004***	−0.002
				(0.001)	(0.002)
Vintage:					
2011	0.049	0.044	0.070**	0.071**	0.067**
	(0.031)	(0.032)	(0.030)	(0.030)	(0.030)
2012	0.035	0.036	0.030	0.028	0.030
	(0.031)	(0.031)	(0.029)	(0.029)	(0.029)
2013	0.023	0.019	0.016	0.020	0.015
	(0.030)	(0.030)	(0.029)	(0.029)	(0.029)
ln*Cases*	−0.195***	−0.194***	−0.176***	−0.176***	−0.176***
	(0.009)	(0.009)	(0.008)	(0.0089	(0.008)
Constant	−4.572***	−5.378***	5.297***	6.501***	5.404***
	(0.476)	(0.839)	(1.450)	(1.335)	(1.520)
No. observations	2,456	2,456	2,456	2,456	2,456
R^2	0.451	0.454	0.514	0.513	0.514

Table A2.2: Estimation results

Dependent variable:	ln*Price*		
	(A2.6)	(A2.7)	(A2.8)
Score	−1.515***	−1.528***	−1.541***
	(0.115)	(0.111)	(0.262)
Score²	0.009***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)
DOCG	−0.098***	1.237	−9.985
	(0.028)	(0.792)	(13.791)
DOC	−0.150***	1.896*	50.656***
	(0.034)	(1.134)	(18.957)
Riserva	0.014	2.951***	10.250
	(0.028)	(0.722)	(9.634)
DOCG∗Score		−0.015*	0.239
		(0.009)	(0.313)
DOC∗Score		−0.023*	−1.134***
		(0.013)	(0.435)
Riserva∗Score		−0.032***	−0.197
		(0.008)	(0.218)
DOCG∗Score²			−0.001
			(0.002)
DOC∗Score²			0.006**
			(0.002)
Riserva∗Score²			0.001
			(0.001)
Vintage:			
2011	0.091***	0.082**	0.076**
	(0.030)	(0.030)	(0.030)
2012	0.031	0.032	0.033
	(0.029)	(0.029)	(0.029)
2013	0.026	0.021	0.019
	(0.029)	(0.029)	(0.029)
ln*Cases*	−0.178***	−0.178***	−0.178***
	(0.008)	(0.008)	(0.008)
Constant	66.765***	66.562***	67.138***
	(5.051)	(4.914)	(11.511)
No. observations	2,456	2,456	2,456
R^2	0.502	0.507	0.510