Mastrobuoni, G., Peracchi, F., & Tetenov, A. (2014). Price as a Signal of Product Quality: Some Experimental Evidence. Journal of Wine Economics, 9(2), 135-152. DOI: 10.1017/jwe.2014.17

Peer reviewed version

Link to published version (if available):
10.1017/jwe.2014.17

Link to publication record in Explore Bristol Research
PDF-document

This is the accepted author manuscript (AAM). The final published version (version of record) is available online via Cambridge University Press at http://dx.doi.org/10.1017/jwe.2014.17. Please refer to any applicable terms of use of the publisher.

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Price as a signal of product quality: Some experimental evidence*

Giovanni Mastrobuoni[†], Franco Peracchi[‡] and Aleksey Tetenov[§]

This version: April 2014

Abstract

We use experimental data to disentangle signaling and budgetary effects of price on wine demand. The experimental design allows us to isolate in a simple and intuitive way the two effects. The signaling effect is present and nonlinear: it is strongly positive between €3 and €5, and undetectable between €5 and €8. We find a similar nonlinear price-quality relationship in a large sample of wine ratings from the same price segment, supporting the hypothesis that taster behavior in the experiment is consistent with rationally using prices as signals of quality. Price signals also have greater importance for inexperienced (young) consumers.

Keywords: Pricing; signaling; product quality; wine ratings
JEL classification codes: D11; D12; D82.

*We thank Karl Storchmann and two anonymous reviewers for their comments. We also thank Iván Fernández-Val, Ignacio Monzón, Andrea Pozzi and participants at the 2011 AAWE Annual Conference for helpful discussions. Finally, we are grateful to Diego Tomasi, Rosa Arboretti Giancristofaro, Vasco Boatto, Livio Corain, Luigi Salmaso, and Tiziano Tempesta for providing their experimental data and to Altroconsumo for the data from their 2006–2012 wine guides.

[†]Department of Economics, University of Essex and Collegio Carlo Alberto; gmastrob@essex.ac.uk.
[‡]Tor Vergata University and EIEF, Rome, Italy, franco.peracchi@uniroma2.it (corresponding author).
[§]Collegio Carlo Alberto, Moncalieri, Italy, aleksey.tetenov@carloalberto.org.

1 Introduction

We use experimental data to disentangle signaling and budgetary effects of price on wine demand. The first is the change in perceived quality associated with a price change, the second is the change in demand associated with a price change holding quality constant. The participants in the experiment are non-professional wine tasters who choose a preferred wine and the wine they would buy after tasting four different wines. Because of the experimental design, their stated choices allow us to isolate in a simple and intuitive way the signaling effect of price.

Wine is an interesting product to study because price and quality are subject to a large variation. It is also a complex "experience good" (Ali and Nauges, 2007) whose quality depends on many attributes (appearance, in glass aroma, in mouth sensations, aftertaste, etc.) and may be fully revealed only by following the complicated protocols of wine tasting. For non-professional wine tasters quality may be difficult to assess even after consumption. This has two consequences. First, prices adjust slowly as consumers learn. For example, Ashenfelter (2008) shows that weather conditions help predict the quality of Bordeaux wines, but market prices of "negatively" shocked vintages adjust only very slowly over time. Were quality perfectly observable, the process would be instantaneous. Second, there is scope for experts. For example, Ali et al. (2008) find that with his oenological grades Robert Parker, perhaps the best-known wine expert, is able to influence the demand for wines and their prices. Again, with perfectly observable quality, there would be no need for experts to measure it.

Whenever consumers cannot pin down the value of a product prior to purchase, firms might use a variety of tools to signal quality, including advertising and prices. This implies that product quality, prices and advertising are jointly determined. Of course, "for a signal to be effective, it must be unprofitable for sellers of low-quality products to imitate it" (Spence, 1976). Spence (1976), Tellis and Wernerfelt (1987), and Mahenc (2004) show that prices signal quality, unless there are too many uninformed buyers in the market and a pooling equilibrium with just one price prevails. Shapiro (1983) shows that when buyers cannot observe product quality there is an incentive for sellers to reduce quality and take short-run gains before buyers catch on. To forestall such quality cutting, the equilibrium price-quality schedule involves high quality items selling at a premium above their cost. This premium also compensates sellers for their investment in reputation.

Despite the large theoretical literature on the signaling value of prices or advertising (see Bagwell, 2007, for an overview), most of the empirical literature focuses on the observed correlation between price and quality in non-experimetal data. An early paper by Oxenfeldt (1950) finds evidence of a positive correlation, but later studies find that the correlation at times is negative. Tellis and Wernerfelt (1987) and Rao and Monroe (1989) provide a meta-analysis of these studies. The contrasting results may depend on either the nature of the products under investigation or how informed the consumers are. More importantly, because product quality, prices and advertising are jointly determined, most of the empirical literature describes statistical associations and provides little information on the causal mechanisms at work. Further, since in non-experimental data quality is typically correlated with price and is hard to measure, it is unable to isolate the signaling effect of prices from the its budgetary effects.

A few papers have tried to exploit supposedly exogenous variation in signals of product quality. For example, Ippolito and Mathios (1990, 1995) use variation in regulatory bans against producer advertising to show that consumers of ready-to-eat cereals extract information from advertising. One issue with their approach is that in non-experimental data it is hard to separate the effect of exposure to advertising from the effect of budgetary constraints, quality, brand loyalty or experience.

Plassmann et al. (2008) use brain imaging to show that artificially increasing the price of wines told to tasters not only increases their reported pleasantness, but also activates a part of their brain (the medial orbitofrontal cortex) that has been shown to be associated with experienced pleasantness.

Heffetz and Shayo (2009) perform a lab experiment in which participants choose between two candies with varying relative prices. They find that the pure price elasticities of demand, which they call the budget constraint (BC) price elasticities, are around -1, while the additional effects driven by signaling, which they call non-BC elasticities, are positive but much smaller in absolute value (between 0.09 and 0.18). They also find that these non-BC elasticities become significant only after the candy has been tasted, which is somehow puzzling. They perform an additional field experiment showing that measured non-BC effects are close to zero.

We see our contributions as complementary to those of Heffetz and Shayo (2009). First, we consider a different type of product (wine), for which the non-BC effect of price is likely to be strong. Since wine tasting is a noisy signal of wine quality, rational consumers should take higher price as a signal of higher quality if there is a positive price-quality relationship in the market. In fact, the data we collected on Italian wines show a strong positive relationship between price and quality over the price range relevant for our experiment. Second, unlike Heffetz and Shayo (2009)'s homogeneous sample of 186 students, our sample of wine tasters is more representative of the actual population of wine consumers and allows us to test whether the signaling effect of price depends on background characteristics of consumers.

We find that for lower priced wines the signaling effect of price dominates, so demand increases as price increases, while for higher priced wines the budgetary effect dominates. This signaling effect is driven by signaling of quality, not by determination of status. We show that these findings are consistent with the price-quality relationship observed in the Italian market, which is stronger for lower priced wines in the sense that consumers learn a lot about the quality of these wines from their price. Such non-linearity in the effect goes against a "status" effect of price. Moreover, the signaling effect is larger among younger and presumably less experienced consumers, which we view as further evidence for price signaling quality rather than status.[1]

Although our data contains only stated choices (without an exchange of money for the product), as opposed to actual choices, the typical concerns about stated preferences do not apply in our setting. Participants were not asked to state willingness to pay, which could be inflated if actual payments are not made.[2] The alternatives did not differ in "socially desirable characteristics", which could be overvalued in stated preferences. Wine quality was not revealed to respondents, but could only be learned through tasting.

There are some similarities between our identification strategy and the approach proposed in the marketing literature by Gautschi and Rao (1990) in order to separate the budgetary from the signaling price effect. Recently, Rao and Sattler (2003) and Völckner and Sattler (2005) have run similar experiments finding evidence of a signaling effect. The main difference is that our statistical model allows us to evaluate the statistical significance of the various components of the price effect and permits their effect to vary with the characteristics of the product and the consumers. We also closely link our empirical specification to an explicit model of consumer demand.

The remainder of this paper is organized as follows. Section 2 lays out our conceptual framework. Section 3 describes the experimental data we use. Section 4 presents our econometric specification. Section 5 illustrates our empirical results. Section 6 adds some supporting evidence on the relationship between price and quality. Finally, Section 7 concludes.

[1] Since higher priced wines are on average of better quality, this result is in line with the result by Goldstein et al. (2008) who find that when tasters are unaware of the price only the more experienced ones derive more enjoyment from more expensive wines. It is also in line with Schnabel and Storchmann (2010) who, in a non-experimental setting, show that the price signal decreases as the fraction of informed buyers increases.

[2] Ding et al. (2005) show that when consumers are asked to state their willingness to pay, subjects show less price sensitivity than when the choice is incentivised. While this might bias our results toward finding no budgetary effect, it would not explain the heterogeneity in the signaling effect along price levels and informedness of consumers we later describe.

2 Conceptual framework

In this section we introduce a simple demand model where quality is not perfectly observable and prices have a non-budgetary effect on demand through their signaling value. The model is introduced to discipline the econometric specification in Section 4.

Demand of a good, in our case wine, is assumed to be a smooth function

$$D = D(X, P, Q) \tag{1}$$

of a set X of individual characteristics (income, demographics, etc.), the price of the good P, and its perceived quality Q. According to the "Law of Demand", we expect demand to respond negatively to a price increase, that is, $D_P = \partial D/\partial P \leq 0$. We also expect demand to respond positively to an increase in perceived quality, that is, $D_Q = \partial D/\partial Q \geq 0$.

Perceived quality is assumed to be a smooth function

$$Q = Q(X, S_P, S_1, \ldots, S_m), \tag{2}$$

of individual characteristics X, product price S_P (used as a signal of quality) and a set of signals $S_1, \ldots, S_m$ other than price, such as sensory evaluation and other information. We expect perceived quality to respond positively to a price increase, that is, $Q_{S_P} = \partial Q/\partial S_P \geq 0$, and we shall henceforth refer to Q_{S_P} as the signaling value of price. We also define signals in such a way that $Q_{S_j} = \partial Q/\partial S_j > 0$, $j = 1, \ldots, m$.

Substituting (2) back into (1) gives the following reduced-form relationship between demand and price

$$D = D(X, P, Q(X, S_P, S_1, \ldots, S_m)) = \widetilde{D}(X, P, S_P, S_1, \ldots, S_m).$$

In observational data $S_P = P$, that is, the market price P entering the demand equation is the same as the price signal S_P influencing consumer's perception of product quality. When P and S_P are identical, reduced-form demand is

$$D^*(X, P, S_1, \ldots, S_m) = D(X, P, Q(X, P, S_1, \ldots, S_m)).$$

Estimation of D^* reveals only the sum of the budgetary and signaling effects of price

$$D^*_P = D_P + D_Q Q_{S_P}$$

If demand does not depend on quality (that is, $D_Q = 0$), or prices have no signaling value (that is, $Q_{S_P} = 0$), then $D^*_P = D_P$. In general, however, $D_Q > 0$ and $Q_{S_P} > 0$. So D_P cannot be identified from knowledge of D^*_P alone. Without additional information (e.g. credible IV restrictions), we can only conclude that $D_P < D^*_P$. This may be useful if $D^*_P < 0$. However, if D_Q or Q_{S_P} are sufficiently large, we may have it that $D_P \leq 0 < D^*_P$.

We use data that offer the unique opportunity of separately learning about D_P and $D_Q Q_{S_P}$. In an experimental setting, consumers could be offered to buy the product at different prices P, holding fixed the product's market price S_P that influences perceived product quality. Variation of P, holding S_P fixed, identifies the budgetary effect of price $\widetilde{D}_P = D_P$. Variation of P and S_P together (holding them equal) identifies the reduced form effect D^*_P, and hence the signaling effect $D_Q Q_{S_P}$.

3 Data

The data that we use contain information on stated choices by a sample of 183 nonprofessional wine tasters who participated, between December 2007 and February 2008, in three blind wine tasting experiments held near Conegliano, in the North-Eastern Italian region of Veneto.

The experiments were jointly organized by the CRA-VIT, Dipartimento del Territorio e dei Sistemi Agro-Forestali at the University of Padua, and Dipartimento di Tecnica e Gestione dei Sistemi industriali also at the University of Padua. Each experiment was devoted to one of the typical wines from Eastern Veneto: the first (52 subjects) to Prosecco from Conegliano-Valdobbiadene (henceforth Prosecco for simplicity), the second (59 subjects) to Merlot from Piave (henceforth Merlot), and the third (72 subjects) to Tocai Italico from Lison-Pramaggiore (henceforth Tocai). None of the subjects participated in more than one experiment. In what follows we provide basic information on the experimental design and refer to Tempesta et al. (2010) for further details.

In each experiment, five choice tasks (tastings) were proposed involving wines of the same type but different intrinsic quality. Thus, the data from each experiment may be regarded as a balanced panel with repeated observations on each subject. In each choice task, subjects were asked to state their preferred wine profile among the four proposed (the precise wording was "Which one of the just tasted wines do you prefer?"), and the profile they would buy (the precise wording was "Which one of the just tasted wines would you buy?"). Since the none option ("none of the offered wines") was also allowed, the available choice set contains five alternatives.

A proposed wine profile consisted of a unique combination of three attributes: objective wine quality and randomly assigned price and landscape type. Wine quality was classified into low, medium or high depending on the value of a hedonic index constructed using the numerical evaluations assigned to each wine by a panel of eleven wine experts to three attributes (olfactory, gustatory-tactile, and retro-olfactory).[3] We take the expert information as an objective attribute of the wine that is assessed by consumers through tasting. Expert evaluations were not revealed to participants in the experiment.

Three price levels were selected: Euro (€) 3, 5 and 8 (for a 0.75 litre bottle). Notice

[3] See Tempesta et al. (2010) for additional information on the composition of the panel of experts and the construction of the hedonic index.

that €5 is roughly the average retail price of nearly two thousand Italian wines reviewed between 2006 and 2012 by Altroconsumo, an independent consumer association. For Merlot, these prices roughly correspond to, respectively, the lower quartile, the median and the upper quartile of the distribution of retail prices per bottle in 2007–2008. For Prosecco, which is cheaper than Merlot, they instead correspond to the median, the upper quartile and the upper decile of the distribution of retail prices. The case of Tocai falls in-between these two extremes.

As for landscape, images were selected for each of four landscape types: evocative (in which a historic building is placed in the vineyard background), traditional (showing vineyards cultivated on small plots of land, with scattered hedges, meadows and trees), modern (showing large-scale vineyards cultivated on large plots), and degraded (in which industrial buildings are visible in the vineyard background). These images represented actual vineyards in the area of production of Prosecco (the hills between the towns of Conegliano and Valdobbianee) and the area of production of Merlot and Tocai Italico (the plains between the rivers Livenza and Piave). Tasters were led to believe that the price was the real price of the tasted wines, and that the landscape image represented the environment where the tasted wines were produced.

In practice, of the $3 \times 3 \times 4 = 36$ possible wine profiles, only $4 \times 5 = 20$ were randomly selected in each experiment. One feature of the experimental design is that, in each choice task, two of the proposed wines were of the same quality and two had the same price. This design makes it easier to identify the separate effect of quality and price on demand.

The experiments were mainly aimed at studying how wine preferences were linked to landscape features, the basic idea being that "the beauty of the landscape can positively affect the wine quality perception" (Tempesta et al., 2010). However, because of their design, they can also be used to study how perception of wine quality is linked to price. Notice that price and landscape are often used by producers to signal the quality of a good.

In typical observational studies, demand, price and quality are endogenous. The main advantages of our experimental setting is that, by design, price, landscape and intrinsic quality are orthogonal to each other and exogenous to demand.

The data also contain background information about the wine tasters, namely demographic information on age group (18–24, 25–39, 40–60, or 60+), gender, province of residence (Padua, Treviso, or other), and type of residential location (urban center, suburb, rural center, or rural area), plus information on wine consumption patterns including weekly wine consumption (do not drink, 1/2 liter or less, 1/2 to 1 liter, 1 to 3 liters, or more than 3 liters), type of shop where wine is bought (not mutually exclusive: wineries, wine shops, supermarket/food shops), and previous participation in wine tasting courses.

Table 1 summarizes individual characteristics of the wine tasters. The sample consists predominantly of men (73 percent), living in urban centers or suburbs (62 percent), with weekly wine consumption above 1 liter (65 percent), without previous wine course experience (74 percent), and buying mostly from wineries (80 percent). Tempesta et al. (2010) argue that the sample may be regarded as broadly representative of the wine drinking population in the Veneto region, an area of Italy where “wine culture” is very important and deeply rooted.

We find little evidence of inconsistency between preferred and buy choices. Tasters choose a less expensive wine as their buying choice in 15.7 percent of choice tasks, whereas they choose a more expensive wine to buy in only 3.6 percent of tasks. We do not remove these observations from analysis, instead, our specification allows random components of preferred and buying choices to differ.

4 Econometric specification

Labeling by $j = 0, \ldots, 4$ the five alternatives available in each choice task, with the alternative $j = 0$ corresponding to the none option, we interpret the stated preferred choice among the alternatives in choice task t as the result of maximizing the additive random utility

$$U_P^{jt} = \begin{cases} \varepsilon_P^{0t}, & \text{if } j = 0, \\ V(X, S_P^{jt}, S_Q^{jt}, S_L^{jt}) + \varepsilon_P^{jt}, & \text{if } j = 1, \ldots, 4, \end{cases}$$

where $V(X, S_P, S_Q, S_L)$ is the average utility that a consumer with observable characteristics X attributes to wine with quality signals (S_P, S_Q, S_L). In addition to the price S_P, we have two other quality signals: wine taste and landscape. S_Q is the wine tasting grade assigned to the wine by a panel of experts. This grade was not revealed to subjects in the experiment and we use it as a proxy for their own assessment of the wines through tasting. S_L is the signal provided by the landscapes.

We similarly interpret the stated buy choice among alternatives $j = 0, \ldots, 4$ in choice task t as the result of maximizing the additive random utility

$$U_B^{jt} = \begin{cases} \varepsilon_B^{0t}, & \text{if } j = 0, \\ C(X, P^{jt}) + V(X, S_P^{jt}, S_Q^{jt}, S_L^{jt}) + \varepsilon_B^{jt}, & \text{if } j = 1, \ldots, 4, \end{cases}$$

where $C(X, P)$ is the disutility of spending P for a consumer with observable characteristics X.

In our empirical specification, ε_P^{jt} and ε_B^{jt} are assumed to be drawn from the same Type I extreme value distribution (implying a conditional multinomial logit specification), and to be distributed independently across alternatives in the same choice task and across individuals. In calculating robust standard errors, we allow the error terms to be correlated across choice tasks for the same individual.

We can map the demand shares in the random utility model to the reduced-form demand function $\widetilde{D}$ in our conceptual framework. Consider a consumer choosing between

K alternative wines with attributes $(P^k, S_P^k, S_Q^k, S_L^k), k = 1, ..., K$ (not necessarily the same alternatives as offered in the experiment). Then the demand (market share) for alternative k among consumers with the same observable characteristics X equals

$$\widetilde{D}^k = \widetilde{D}(X, P^k, S_P^k, S_Q^k, S_L^k) = \frac{\exp(C(X, P^k) + V(X, S_P^k, S_Q^k, S_L^k))}{\sum_{j=1..K} \exp(C(X, P^j) + V(X, S_P^j, S_Q^j, S_L^j))}.$$

The derivatives of $\widetilde{D}^k$ with respect to attributes of product k are proportional to the derivatives of $C(X, P^k) + V(X, S_P^k, S_Q^k, S_L^k)$:

$$\begin{aligned} \frac{\partial \widetilde{D}^k}{\partial P^k} &= \widetilde{D}^k(1 - \widetilde{D}^k)\frac{\partial C(X, P^k)}{\partial P^k}, \\ \frac{\partial \widetilde{D}^k}{\partial S_P^k} &= \widetilde{D}^k(1 - \widetilde{D}^k)\frac{\partial V(X, S_P^k, S_P^k, S_L^k)}{\partial S_P^k}. \end{aligned}$$

When the functions $C(\cdot)$ and $V(\cdot)$ are linear in product attributes, derivatives of the demand function are proportional to their coefficients.

Our specification assumes that $C(\cdot)$ is linear in the product price and $V(\cdot)$ is additive in product attributes:

$$\begin{aligned} C(X, P) &= \beta_M P, \\ V(X, S_P, S_Q, S_L) &= \beta_0 + V_P(S_P) + V_Q(S_Q) + V_L(S_L). \end{aligned}$$

Our data contains three different values of price signal S_P, three different categories of intrinsic wine quality S_Q and four types of landscape S_L. We employ a fully nonlinear specification for V_P, V_Q and V_L using nested indicator functions for different values to facilitate comparisons:

$$\begin{aligned} S_P &\in [€3, €5, €8], \\ V_P(S_P) &= \beta_{P2}\,\mathrm{I}[S_P \in \{€5, €8\}] + \beta_{P3}\,\mathrm{I}[S_P \in \{€8\}]. \end{aligned}$$

In this specification, $\beta_{P2} = V_P(€\,5) - V_P(€\,3)$ and $\beta_{P3} = V_P(€\,8) - V_P(€\,5)$. Coefficient β_0 absorbs baseline values of $V_P(€\,3)$, $V_Q(\text{low})$ and $V_L(\text{degraded})$.

Similarly, our specification for the signaling effects of intrinsic quality and landscape is:

$$
\begin{aligned}
S_Q \in & [\text{low, medium, high}], \\
V_Q(S_Q) = & \beta_{Q2}\,\mathrm{I}[S_Q \in \{\text{medium, high}\}] + \beta_{Q3}\,\mathrm{I}[S_Q \in \{\text{high}\}], \\
S_L \in & [\text{degraded, modern, traditional, evocative}], \\
V_L(S_L) = & \beta_{L2}\,\mathrm{I}[S_L \in \{\text{modern, traditional, evocative}\}] + \\
& + \beta_{L3}\,\mathrm{I}[S_L \in \{\text{traditional, evocative}\}] + \\
& + \beta_{L4}\,\mathrm{I}[S_L \in \{\text{evocative}\}].
\end{aligned}
$$

We first estimate the model on the pooled data. We then estimate the model separately by type of wine and by major demographic group. This allows full interaction between the price and signaling effects and the characteristics of the products and the consumers.

5 Empirical results

Table 2 presents the results by pooling the data for all wines (second column), and then separately by wine type (Merlot, Prosecco and Tocai).

In line with the "Law of Demand", the price response of demand (β_M) is negative and strongly statistically significant.

The signaling value of price (β_{P2} and β_{P3}) appears to be nonlinear, as we observe a strong and statistically significant positive effect of increasing the price from €3 to €5 but no effect of increasing the price from €5 to €8. In this case, the effect is actually negative, although very small in magnitude and not statistically significant. This is consistent with the finding in Plassmann et al. (2008) that the effect of a price increase on medial orbitofrontal cortex activity is larger at low (\$5) than at high prices (\$10).

As for the signaling value of intrinsic quality, we observe a positive and statistically significant effect of increasing quality. Interestingly, the incremental change from low to medium (β_{Q2}) is about the same as the incremental change from medium to high (β_{Q3}).

As for the signaling value of landscape, we observe no statistically significant difference between degraded and modern landscapes (β_{L2}), or between traditional and evocative landscapes (β_{L4}). On the other hand, we observe a strongly positive and statistically significant effect of varying the landscape from modern to traditional (β_{L3}). Thus, it seems that the consumers only distinguish between two types of landscape: degraded or modern on the one hand, and traditional or evocative on the other end.

These findings remain essentially the same when we consider each wine type separately. The budgetary effects are strikingly similar. The signaling value of price exhibits a similar strongly nonlinear profile for all wine types. The signaling value of intrinsic quality is the only dimension where a difference emerges between Merlot and Tocai on the one hand and Prosecco on the other hand. While the incremental changes from low to medium quality and from medium to high quality are always positive for the first two wine types, they actually have opposite signs and low statistical significance for Prosecco, so the incremental change from low to high quality ($\beta_{Q2} + \beta_{Q3}$) is close to zero. Thus, consumers appear to have a hard time distinguishing Prosecco quality at a tasting. Finally, the signaling value of landscape is generally consistent across wine types.

Table 3 investigates the issue of heterogeneity in preferences across major demographic groups. The first column reproduces the first column in Table 2 and contains the results from the pooled data. The next two columns compare younger (18–39 yy) and older consumers (40+ yy), while the last two columns compare men and women.

While the budgetary effects of prices are the same between younger and older consumers, and the signaling value of prices is similar, the signaling value of quality and landscape appear to be different. As for quality, the incremental change from low to medium is positive for both groups, but is much lower and less statistically significant for younger consumers. On the other hand, the change from medium to high quality only affects the demand of older consumers positively. Further, in relative terms, the signaling effect of prices is much more important for younger, and presumably inexperienced consumers than it is for the older ones. This is consistent with the effect of prices carrying some additional information about the quality that less-knowledgeable consumers appreciate more. Finally, younger and older consumers appear to rank landscapes categorized as modern and degraded differently.

As for the comparison between men and women, many coefficients are less precisely estimated for women because they only represent 27 percent of the sample. The main gender difference appears to be the signaling value of prices. While this has a nonlinear profile for both men and women, the incremental change from €5 to €8 is different, namely negative for women and positive for men.

6 Price-quality relationship in the market

There are two reasons why consumers may prefer higher-priced wines even after having a chance to test them. First, price could provide consumers with additional information about product quality even after tasting if they are correlated in the marketplace and tasting provides an imperfect signal of quality. Second, a higher price may have some intrinsic value for consumers (e.g. display social status when consumption is visible to others). In this section we use wine price-quality data for Italy to show that consumers' behavior in the experiment is consistent with the signaling theory.

We estimate the price-quality relationship using wine quality ratings provided to us by Altroconsumo, the main Italian consumer association. This dataset includes 1,950 wines reviewed between 2006 and 2012 in the annual wine guide published by the association and represents the most comprehensive source of price-quality data for commonly consumed

Italian wines. Although the guide is not a representative sample of wines from the Veneto region, it covers wines sold countrywide, and we see no reason why the slope of the price-quality relationship should systematically differ for the Veneto region relative to the rest of Italy. The median price in the sample is €4.70 and less than one percent of rated wines are priced above €15. The price range used in the experiment is covered particularly well: 74% of the rated wines have prices between €3 and €8 per bottle. Each wine received a degustation mark ranging from A to D, as well as a composite quality score on a 100 point scale. The composite score uses information from the chemical analysis of the wine in addition to the degustation results.

Generally, there is a positive relationship between wine prices and Altroconsumo ratings in the sample. Figure 1 shows a nonparametric regression estimate (LOWESS) of the relationship between price and two quality measures: the average composite score and the probability of getting a high (A or B) degustation grade (the last panel shows the frequency of wine prices). This relationship seems particularly strong for lower prices.

Since the ratings are available for a large number of wines in the price range between €3 and €8, we could directly measure the price-quality relationship at the price points in our experimental data. The upper half of Table 4 shows the average composite score and the probability of A or B degustation marks for wines with prices exactly equal to €3, €5, and €8. The bottom half of the table compares average quality measures for larger samples of wines whose rounded prices are equal to the price points in our experimental data. The results using the composite quality score match experimental findings most closely: the average scores of €5 wines are significantly higher than those of €3 wines, while there is only a negligible difference between the average scores of €5 and €8 wines. The probability of getting an A or B degustation mark is also significantly higher for €5 wines than for €3 wines. This probability rises less when moving from €5 to €8.

The strength of the price-quality relationship could also be measured through their correlation. The correlation between price and composite score equals 0.1087 for prices between €3 and €5. For the €5–8 price range, the correlation is only 0.0253. The correlations between price and an indicator of A/B degustation mark equal 0.0963 for the lower price range and 0.0392 for the higher price range.

Assuming that Altroconsumo wine ratings are aligned with consumer preferences, rational consumers should take €5 as a signal of higher quality than €3, but treat €5 and €8 as signals of fairly similar quality. Their behavior in the wine tasting experiment is thus consistent with using price as a signal of quality. Notice that Altroconsumo reviews many more wines in the €3–5 range than in the €5–8 range (this is very visible in Figure 1), which may be one of the mechanisms by which consumers are more informed about quality in this segment of the market, and producers have to set prices more in line with the quality. This relationship may reverse at higher prices, since wine critics are particularly interested in reviewing the best wines.

7 Conclusions

Our paper isolates and measures the signaling effect of price on wine demand by exploiting the experimental nature of our data. In line with Plassmann et al. (2008) we find a larger signaling effect of price for lower priced wines. The signaling effect is positive when going from a low (€3) to a medium price (€5), but is essentially zero when going from a medium to a high price (€8).

Consumers are rational in responding to price signals in this way. In data on price and quality for the Italian wine market, we find a strong positive price-quality relationship for wines in the €3–5 price range, but not in the €5–8 price range. Lack of a strong positive price-quality relationship at higher prices may be driven by differences in the costs of marketing and distributing wine of different quality. It may also depend on more complicated price strategies by the producers, which might even interact with their reputation. Since we lack product-level time-series data on wines, we leave such questions open to future research.

We also find that older consumers appear to be better able to appreciate actual quality than young consumers, which gives more weight to the signaling of quality rather than status (unless we think that the desire to signal status decreases with age).

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Table 1: Summary statistics.

	Subjects	Percent
Wine tasting:		
Merlot	59	32
Prosecco	52	28
Tocai	72	39
Age group:		
18–24	22	12
25–39	90	49
40–60	61	33
60+	10	5
Gender:		
Female	50	27
Male	133	73
Type of residence:		
Urban center	59	32
Suburb	54	30
Rural center	19	10
Rural area	51	28
Weekly wine consumption:		
None	2	1
Less than .5L	24	13
.5L–1L	37	20
1L–3L	103	56
More than 3L	17	9
Attended wine tasting courses:	48	26
Buy wine?	167	91
Buy from wineries?	147	80
Buy from wine shops?	23	13
Buy from supermarkets?	29	16
Total	183	100

Table 2: Results by wine type.

		Pooled	Merlot	Prosecco	Tocai
β_M	Budgetary effect (per €1)	-0.101***	-0.109***	-0.0902***	-0.105***
		(0.0141)	(0.0251)	(0.0235)	(0.0243)
Signaling effect of price:					
	Baseline: €3				
β_{P2}	€5 vs. €3	0.761***	0.600***	0.967***	0.818***
		(0.111)	(0.186)	(0.229)	(0.175)
β_{P3}	€8 vs. €5	-0.0631	-0.0388	0.0320	-0.151
		(0.0778)	(0.142)	(0.139)	(0.127)
Intrinsic quality:					
	Baseline: low				
β_{Q2}	medium vs. low	0.269***	0.289**	0.267	0.298**
		(0.0873)	(0.145)	(0.177)	(0.138)
β_{Q3}	high vs. medium	0.221**	0.358*	-0.318*	0.423***
		(0.0946)	(0.189)	(0.177)	(0.115)
Landscape:					
	Baseline: degraded				
β_{L2}	modern vs. degraded	0.0231	-0.0963	0.434*	-0.111
		(0.121)	(0.207)	(0.255)	(0.181)
β_{L3}	traditional vs. modern	0.456***	0.420**	0.443**	0.524***
		(0.110)	(0.188)	(0.196)	(0.188)
β_{L4}	evocative vs. traditional	0.124	0.0837	-0.0349	0.255*
		(0.0877)	(0.166)	(0.160)	(0.137)
β_0	Value of baseline bottle	0.138	0.472	-0.456	0.179
		(0.199)	(0.345)	(0.394)	(0.317)
# Subjects		183	59	52	72

Notes: For each subject we have 5 tastings, with 4 wine alternatives and the choice of none. Standard errors in parentheses (clustered by individual): *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Results by demographic group.

		Pooled	18–39 yy	40+ yy	Male	Female
β_M	Budgetary effect (per €1)	-0.101***	-0.100***	-0.108***	-0.0936***	-0.120***
		(0.0141)	(0.0185)	(0.0218)	(0.0157)	(0.0294)
Signaling effect of price:						
	Baseline: €3					
β_{P2}	€5 vs. €3	0.761***	0.727***	0.907***	0.739***	0.842***
		(0.111)	(0.149)	(0.163)	(0.125)	(0.234)
β_{P3}	€8 vs. €5	-0.0631	-0.0537	-0.0891	-0.225**	0.335**
		(0.0778)	(0.102)	(0.126)	(0.0921)	(0.135)
Intrinsic quality:						
	Baseline: low					
β_{Q2}	medium vs. low	0.269***	0.212*	0.421***	0.286***	0.209
		(0.0873)	(0.111)	(0.136)	(0.106)	(0.148)
β_{Q3}	high vs. medium	0.221**	-0.128	0.677***	0.186*	0.337*
		(0.0946)	(0.115)	(0.145)	(0.109)	(0.186)
Landscape:						
	Baseline: degraded					
β_{L2}	modern vs. degraded	0.0231	0.287*	-0.388**	0.0462	-0.0550
		(0.121)	(0.169)	(0.162)	(0.142)	(0.232)
β_{L3}	traditional vs. modern	0.456***	0.403***	0.610***	0.494***	0.378*
		(0.110)	(0.128)	(0.205)	(0.132)	(0.202)
β_{L4}	evocative vs. traditional	0.124	0.125	0.107	0.128	0.111
		(0.0877)	(0.107)	(0.156)	(0.106)	(0.158)
β_0	Value of baseline bottle	0.138	-0.0916	0.458	0.206	-0.0560
		(0.199)	(0.252)	(0.338)	(0.222)	(0.426)
# Subjects		183	112	71	133	50

Notes: For each subject we have 5 tastings, with 4 wine alternatives and the choice of none. Standard errors in parentheses (clustered by individual): *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Price-quality relationship in Altroconsumo wine ratings.

Exact prices used in the experiment	Price = €3	Difference	Price = €5	Difference	Price = €8
Average composite score	60.80	2.19	62.99	.003	62.99
Standard errors	(1.0)	(1.44)	(1.04)	(1.58)	(1.07)
N	61		64		38
Probability of A or B degustation mark	.5072	.1159	.6232	.0673	.6905
Standard errors	(.0606)	(.0844)	(.0588)	(.0941)	(.0722)
N	69		69		42

Prices that round to €3/5/8	Price ≈ €3	Difference	Price ≈ €5	Difference	Price ≈ €8
Average composite score	59.43	2.52***	61.94	.33	62.27
Standard errors	(.54)	(.71)	(.47)	(1.05)	(.96)
N	247		299		74
Probability of A or B degustation mark	.4141	.1411***	.5552	.0903	.6456
Standard errors	(.0286)	(.0395)	(.0272)	(.0619)	(.0542)
N	297		335		79

Figure 1: Relationship between wine price and Altroconsumo quality measures. Lowess smoother, 50% bandwidth.