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

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Abstract

We separate the budgetary and non-budgetary effects of price on demand using choice data from wine tasting experiments in which consumers tasted wines of different quality accompanied by fictitious price information. The non-budgetary 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 consumer 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.

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1 Introduction

We use experimental data to separate the budgetary from the non-budgetary effect of prices on consumer demand. The consumers who participate in the experiment are non-professional wine tasters who choose a preferred wine and the wine they would buy after tasting four different wines. We find that non-budgetary effects are driven by signaling of the quality of the product, rather than by determination of status.

Product quality is, indeed, often hard to assess, even after a product has been consumed or experienced. 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, the whole process taking sometimes up to 10 years. 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 influences the demand for wines and their prices (see also Ali and Nauges (2007) and Dubois and Nauges (2010)). 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, firms might use a variety of tools to signal quality, such as advertising or even prices. The issue when using prices as signals is that "for a signal to be effective, it must be unprofitable for sellers of low-quality products to imitate it" (Spence, 1976). Spence (1976) 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.

There is a vast amount of theoretical literature on the signaling value of prices and advertising (see Bagwell, 2007, for an overview) but, given the joint determination of product quality, prices and advertising, most empirical evidence is just descriptive and provides little information on the causal mechanisms at work. For example, local variation in the exposure to advertising often reflects prior information that firms may have about the effectiveness of advertising on demand.

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. Further, since in non-experimental data quality is typically correlated with price, and is also hard to measure, it is very difficult to isolate the signaling value of prices, namely the change in perceived quality associated with a price change from the pure price effect on demand, namely the change in demand associated with a price change holding quality constant. Following Heffetz and Shayo (2009) we refer to this second component as the budgetary effect.

This is perhaps why, despite several contributions to the theory of the signaling value of prices in the economic literature (among others Judd and Riordan, 1994, Milgrom and Roberts, 1986, Scitovszky, 1944, Wolinsky, 1983), most available empirical papers have been published in marketing journals. There are three notable exceptions, namely Plassmann et al. (2008), Oxenfeldt (1950), and Heffetz and Shayo (2009).

The earliest paper by Oxenfeldt (1950) focuses on the correlation between price and quality and is more similar to the studies available in the marketing literature, finding evidence of a positive correlation, although later studies find that the correlation at times is negative.[1]

Plassmann et al. (2008) use brain imaging to show that artificially increasing the price of wines told to subjects who are tasting them not only increases the subjects' reported

[1] Tellis and Wernerfelt (1987) and Rao and Monroe (1989) provide a meta-analysis of these studies, where quality is usually measured using *Consumer Reports*. The main result from the meta-analysis is that superior quality typically commands higher prices, and that the price-quality correlation increases with information. In the non-experimental part of our study we follow the tradition of correlating price and quality, but with some qualifications.

pleasantness, but also activates a part of their brain (the medial orbitofrontal cortex) that has been shown to be associated with experienced pleasantness. The correlation between the reported pleasantness of the wine and increased activity in the medial orbitofrontal cortex is 60 percent.

Heffetz and Shayo (2009), the paper most closely related to ours, performs a lab experiment in which subjects 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.

In this paper we use data on stated choices by a sample of nonprofessional wine tasters in a set of wine tasting experiments. Because of the experimental design, these data allow us to isolate in an intuitive and simple way the non-budgetary value of price. Research has often found contrasting results that seem to depend on the nature of the products under investigation and how well informed the consumers are. For goods that are simple to evaluate, the price-quality relationship is likely to be strong. Wine, however, is a complex "experience good" (Ali and Nauges, 2007), whose quality depends on many different attributes (appearance, in glass aroma, in mouth sensations, aftertaste, etc.) which are typically revealed by the various stages of wine tasting. Our data allow us to test whether variability of prices for a given level of perceived quality reduces the signaling value of prices, and whether such effect is particularly strong for uninformed consumers.

We see our contributions as complementary to those of Heffetz and Shayo (2009). First, although our data measure stated preferences as opposed to actual choices, this appears to be less troublesome because in the experiment preferences are elicited in a way that allows one to easily separate the signaling from the budgetary effects of prices: individuals in our sample first taste the wines, then choose the one they prefer, and finally choose the one they would actually buy.[2] Variation in prices for the same wine allows us to separate the signaling from the budgetary effect.

The experiment in Heffetz and Shayo (2009) elicits instead both stated and revealed preferences: consumers first rate the quality of the candies (on a scale from 1 to 4), then state their willingness to pay for the candies (in shekels), and finally pay for the chosen candies. Revealed choices are necessary in their study because stated and revealed preferences are measured on different scales, which would make it impossible to isolate the signaling effect of prices.

The fact that they find small signaling effects might reflect the very nature of their good (candies), which is the second reason we believe our studies are complementary.

Third, Heffetz and Shayo (2009)'s sample of 186 students is fairly homogenous in terms of age and experience, while our sample of wine tasters shows substantial variability in age and consumption habits, which allows us to test whether the non-budgetary effect of prices depends on the background characteristics of consumers. We find large non-budget constraint effects for lower priced wines, while for higher priced wines the dominating effect is the budget constraint effect. Such non-linearity in the effect goes against a "status" effect of prices and in favor of a signaling effect. Moreover, the non-budgetary effect is significantly larger among younger and presumably less experienced tasters, which we view again as evidence in favor of signaling as opposed to status.

Fourth, we collect additional data on quality and prices for nearly two thousand Italian wines. These data allow us to link the experimental evidence to the price-quality relationship that is observed in the Italian wine market. We find that the non-budgetary effect

[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 non-budgetary effect along price levels and informedness of consumers we later describe.

of price in our experiment is stronger for the range of prices at which the price-quality relationship in the market is steeper. Again evidence that signaling is the main driver of such an effect.

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 describes our methodology. Section 5 presents our empirical results. Section 6 presents some supporting evidence on the relationship between price and quality. Finally, Section 7 concludes.

2 Conceptual framework

Let us introduce a simple demand model where quality is not perfectly observable and prices have a non budgetary effect on demand. Demand of a good, in our case wine, is assumed to be a smooth function

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

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, $f_P = \partial f/\partial P \leq 0$. We also expect demand to respond positively to an increase in perceived quality, that is, $f_Q = \partial f/\partial Q \geq 0$.

Perceived quality is assumed to be a smooth function

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

of individual characteristics X, price P 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, $g_P = \partial g/\partial P \geq 0$, and we shall henceforth refer to g_P

as the signaling value of price. We also define signals in such a way that $g_{S_j} = \partial g / \partial S_j > 0$, $j = 1, \ldots, m$.

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

$$D = f(X, P, g(X, P, S_1, \ldots, S_m)) = h(X, P, S_1, \ldots, S_m).$$

Data typically reveal

$$h_P = \frac{\partial h}{\partial P} = f_P + f_Q \, g_P.$$

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

We use data that offer the unique opportunity of separately learning about f_Q and g_P. Along with knowledge of h_P, this allows us to recover f_P. To get f_Q, we exploit the set of exclusion restrictions coming from the fact that signals $S_1, \ldots, S_m$ do not enter the demand equation (1), so $h_{S_j} = f_Q \, g_{S_j}$, implying that $f_Q = h_{S_j} / g_{S_j}$ for all j. If there is more than one signal other than price (that is, $m > 1$), the model is actually over-identified.

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 at the University of Padua. Each experiment was devoted to one of the typical wines from Eastern Veneto: the first (52 tasters) to Prosecco of Conegliano-Valdobbiadene (henceforth Prosecco for simplicity), the second (59 tasters) to Merlot of Piave (henceforth Merlot), and the third (72 tasters) to Tocai Italico of Lison-Pramaggiore (henceforth Tocai). None of the tasters 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 taster. In each choice task, tasters 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: intrinsic wine quality and fictional 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 by a panel of eleven wine experts to three attributes (olfactory, gustatory-tactile, and retro-olfactory). The expert information on wine quality was not available to tasters, but they could make their own quality judgement by tasting the wine.

Three price levels were selected: Euro (€) 3, 5 and 8 (for a 0.75 litre bottle). These prices might seems low but €5 is roughly the average retail price of nearly two thousand Italian wines that have been 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 roughly 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). Tasters were led to believe that the price was the real price of the wine, and that the landscape image represented the environment where the grapes were grown and the wine 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 Methodology

Our strategy is to first use the information on stated preferred choices to identify the relationship $Q = g(X, P, S_1, S_2)$ between perceived quality, individual characteristics, price and $m = 2$ other signals, namely intrinsic quality (S_1) and landscape (S_2), and then use the information on stated buying choices to identify the reduced form relationship $D = h(X, P, S_1, S_2)$ between demand, individual characteristics, price and other signals. The price response of demand is then obtained as the difference $f_P = h_P - f_Q\, g_P$, where we recover f_Q from the fact that, due to the exclusion restrictions, $f_Q = h_{S_1}/g_{S_1} = h_{S_2}/g_{S_2}$.

There are some similarities between our identification strategy and our data and the approach proposed in the marketing literature by Gautschi and Rao (1990) in order to separate the budgetary from the non-budgetary price effect.[3] The main difference is that our model allows one to evaluate the statistical significance of the various components of the price effect and permits this effect to vary with the characteristics of the product and the consumers.

Labeling by $j = 0, \dots, 4$ 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 alternatives by subject i in choice task t as the result of maximizing the additive random utility

$$U_{ijt}^P = v_0^P + V_Q^P\left(\text{i\_qual}_{jt}\right) + V_L^P\left(\text{landscape}_{jt}\right) + V_P^P\left(\text{price}_{jt}\right) + \varepsilon_{ijt}^P,$$

where i_qual is the intrinsic (but unknown to the subject) quality of wine j offered in choice task t, v_0^P is the average value of the reference wine profile (€3, low quality, degraded landscape) when offered for free, V_Q^P is the signaling value of intrinsic quality (i.e. the change in value relative to the reference profile stemming from tasting the wine), and V_L^P and V_P^P are the signaling values of landscape and price respectively (i.e. the additional value changes derived from the signals conveyed by price and landscape). The average value of the none option is normalized to zero, so $U_{i0t}^P = \varepsilon_{i0t}^P$.

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

$$U_{ijt}^B = \begin{cases} \varepsilon_{i0t}^B, & \text{if } j = 0, \\ v_0^B + V_Q^B\left(\text{i\_qual}_{jt}\right) + V_L^B\left(\text{landscape}_{jt}\right) + V_P^B\left(\text{price}_{jt}\right) + \varepsilon_{ijt}^B, & \text{if } j = 1, \dots, 4, \end{cases}$$

where v_0^B is the average value of the reference wine profile when offered at €3. The

[3]Recently, Rao and Sattler (2003) and Völckner and Sattler (2005) have run similar experiments finding evidence of a non-budgetary effect.

difference $v_0^B - v_0^P$ may therefore be interpreted as the value of having to pay €3.

In our empirical specification, ε_{ijt}^P and ε_{ijt}^B 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 subjects. In calculating standard errors, we allow the error terms to be correlated across choice tasks for the same individual.

Our baseline specification assumes that $V_Q^B = V_Q^P$ and $V_L^B = V_L^P$, which allows pooling preferred and buying choices. These two assumptions can be tested by comparing the estimates from separate models for preferred and buying choices (see Section 5). We also reparameterize the model by setting $v_0^P = v_0$ and $V_P^P = V_P$ for the preferred choice, and $v_0^B = v_0 + \Delta v_0$ and $V_P^B = V_P + \Delta V_P$ for the buying choice. Thus, V_P is the discrete counterpart of g_P, ΔV_P is the counterpart of f_P, v_0 is the value of the baseline profile when offered for free, and Δv_0 is the value of paying €3. We expect $\Delta V_P < 0$ and $\Delta v_0 < 0$.

For both preferred and buying choices, our basic specification treats the functions V_Q, V_L and V_P as linear combinations of binary indicators. Thus

$$V_Q\left(\text{i\_qual}_{jt}\right) = v_{Q1}\,\mathrm{I}\left[\text{i\_qual}_{jt} \in \{\text{medium, high}\}\right] + v_{Q2}\,\mathrm{I}\left[\text{i\_qual}_{jt} \in \{\text{high}\}\right],$$

where $\mathrm{I}[A]$ is the indicator function of the event A,

$$\begin{aligned} V_L\left(\text{landscape}_{jt}\right) = {} & v_{L1}\,\mathrm{I}\left[\text{landscape}_{jt} \in \{\text{modern,traditional,evocative}\}\right] + \\ & + v_{L2}\,\mathrm{I}\left[\text{landscape}_{jt} \in \{\text{traditional,evocative}\}\right] + \\ & + v_{L3}\,\mathrm{I}\left[\text{landscape}_{jt} \in \{\text{evocative}\}\right], \end{aligned}$$

and

$$V_P\left(\text{price}_{jt}\right) = v_{P1}\,\mathrm{I}\left[\text{price}_{jt} \in \{€5, €8\}\right] + v_{P2}\,\mathrm{I}\left[\text{price}_{jt} \in \{€8\}\right].$$

This specification is related to the so-called choice-based conjoint analysis used in the marketing literature (see e.g. Gustafsson et al. (2007)). The main difference is that we explicitly derive it from a random utility model. In the next section we also consider alternative specifications where the function V_Q is modeled as linear in intrinsic quality and is further allowed to vary depending on demographic characteristics and wine consumption patterns of a subject.

5 Empirical results

Baseline specification

Table 2 presents the results by pooling the data from all meetings (second column), and then separately for each meeting (Piave, Prosecco and Tocai).

The signaling value of price (V_P) appears to be nonlinear, as we observe a strong positive effect of increasing the price from €3 to €5 (especially for Prosecco), but no effect of increasing the price from €5 to €8. In this case, the effect is actually negative, although 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 price response of demand (ΔV_p), in line with the "Law of Demand", we observe a negative effect of increasing the price from €3 to €5 (statistically significant only for Merlot) and a strongly negative effect of increasing the price from €5 to €8.

As for the signaling value of landscape, we observe no statistically significant difference between degraded and modern landscapes (except for Prosecco), or between traditional and evocative landscapes (except for Tocai). On the other hand, we observe a strongly positive and statistically significant effect of varying the landscape from modern to traditional. Thus, it seems that the tasters only distinguish between two types of landscape:

degraded or modern on the one hand, and traditional or evocative on the other end.

As for the signaling value of intrinsic quality, we observe for all wines a positive and statistically significant effect of varying wine quality from low to medium. With the exception of Prosecco, this is also true for varying wine quality from medium to high.

Preference heterogeneity

Table 3 investigates the issue of heterogeneity in preferences. We first compare the results of our baseline specification (second column) with a specification that allows wine quality to enter linearly (third column). The fact that we observe little changes with respect to the baseline specification justifies treating V_Q as linear in intrinsic quality.

Next we consider a specification that allows the perception of quality to vary across demographic groups and to differ depending on wine consumption pattern. This is an important difference with respect to, on one side, the marketing literature, which tends to ignore preference heterogeneity or treats it as a purely random component (Rao and Sattler, 2003, Völckner and Sattler, 2005), and, on the other side, Heffetz and Shayo (2009) and Plassmann et al. (2008) who either have too homogenous a sample (students), or a sample that is too small (20 subjects) to enough variation in observed characteristics. Specifically, we interact the linear term in wine quality with the demographic characteristics of the taster (age group and gender) and their wine consumption patterns. In this case, we observe a sharp increase in the effect of intrinsic quality for older people and people living in rural areas, and a sharp decrease in the effect of intrinsic quality for those who buy from wine shops. We conclude that older tasters seem to be better able to appreciate quality, while the opposite is true for younger people, people living in urban areas and those who buy in wine shops.

To further investigate the role of heterogeneity in preferences across age groups, we estimate our model separately for younger people (aged 18–39) and older people (aged

40+). Given that the variance of the error term is normalized to be the same in the two regressions one cannot compare the levels of the coefficients. But the ratio of the coefficients on price (€5 vs. €3) and quality (medium vs. low) is much lower for younger people, whereas only older people appear to be able to distinguish between high and medium quality. This means that, in relative terms, the non-budgetary 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.

Robustness checks

Table 4 presents the results of some robustness checks. We first compare the results from our baseline specification (second column) to the results obtained by fitting separate models for preferred choices (third column) and buying choices (fourth column) without interactions between quality and wine type. We do not reject the restrictions implied by pooling preferred and buying choices.

In the fifth and sixth column we present the results obtained by fitting separate models for preferred and buying choices, this time with interactions between quality and wine type. Again, we do not reject the restriction implied by pooling preferred and buy choices.

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. 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 5 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.

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.

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 €3–€5 price range, the same 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.

7 Conclusions

Our paper isolates and measures the importance of the signaling value of price on wine demand by exploiting the experimental setting from which the data have been obtained. In line with Plassmann et al. (2008) we find larger non-budgetary effects of prices at lower priced wines. The signaling value 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 non-experimental price-quality data on the same price segment of the Italian wine market, we find a strong positive price-quality relationship for wines in the €3–€5 range, but not in the €5–€8 range. Lack of a strong positive price-quality relationship might, for example, be driven by differences in costs to market and distribute the wine without increasing its quality, resulting in higher prices. Though it might also depend on more complicated price strategies over the product-cycle, which might even interact with the reputation of producers. Without product-level time-series data on wines we leave such questions open for future research.

We also find that older tasters seem to be better able to appreciate the actual quality over the signaling than young tasters, which gives more weight to the signaling effect than to the prestige effect (unless we think that the prestige effect 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: Baseline specification.

	All	Merlot	Prosecco	Tocai
V_P: €5 vs €3	.702***	.656***	.902***	.660***
	(.115)	(.193)	(.241)	(.179)
V_P: €8 vs €5	-.0838	-.0758	-.00816	-.145
	(.0774)	(.138)	(.142)	(.127)
ΔV_P: €5 vs €3	-.0933	-.324***	-.0568	.0947
	(.0754)	(.101)	(.148)	(.132)
ΔV_P: €8 vs €5	-.259***	-.249**	-.185*	-.323***
	(.0619)	(.0989)	(.110)	(.111)
Value of reference wine	.317	.442	-.262	.542
	(.218)	(.358)	(.439)	(.341)
Utility of paying €3	-.598***	-.275	-.603**	-.912***
	(.158)	(.278)	(.243)	(.289)
Landscape: Modern vs degraded	.0221	-.0952	.433*	-.113
	(.121)	(.207)	(.255)	(.181)
Landscape: Traditional vs modern	.455***	.419**	.442**	.523***
	(.110)	(.189)	(.195)	(.187)
Landscape: Evocative vs traditional	.125	.0836	-.0343	.256*
	(.0876)	(.166)	(.160)	(.136)
Quality: Medium vs low	.269***	.290**	.268	.297**
	(.0871)	(.145)	(.177)	(.138)
Quality: High vs medium	.221**	.357*	-.318*	.423***
	(.0946)	(.190)	(.177)	(.114)
# 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: Preference heterogeneity.

	Baseline	Linear quality	With interactions	Younger (18–39)	Older (40+)
V_P: €5 vs €3	.702***	.690***	.698***	.636***	.897***
	(.115)	(.112)	(.112)	(.149)	(.180)
V_P: €8 vs €5	-.0838	-.0815	-.0934	-.0622	-.13
	(.0774)	(.0768)	(.0786)	(.103)	(.122)
ΔV_P: €5 vs €3	-.0933	-.0948	-.0923	-.0262	-.201
	(.0754)	(.0754)	(.0759)	(.0971)	(.126)
ΔV_P: €8 vs €5	-.259***	-.259***	-.267***	-.280***	-.236**
	(.0619)	(.0620)	(.0630)	(.0833)	(.0952)
Value of baseline bottle	.317	.583***	.568***	.1	.635*
	(.218)	(.205)	(.205)	(.272)	(.367)
Utility of paying €3	-.598***	-.599***	-.600***	-.625***	-.598*
	(.158)	(.158)	(.158)	(.180)	(.310)
Landscape: Modern vs degrad.	.0221	.0392	.0207	.285*	-.388**
	(.121)	(.119)	(.118)	(.169)	(.162)
Landscape: Tradit. vs modern	.455***	.436***	.454***	.403***	.608***
	(.110)	(.106)	(.106)	(.128)	(.205)
Landscape: Evoc. vs tradit.	.125	.129	.137	.125	.107
	(.0876)	(.0863)	(.0880)	(.107)	(.156)
Quality: Medium vs low	.269***			.212*	.421***
	(.0871)			(.111)	(.135)
Quality: High vs medium	.221**			-.128	.676***
	(.0946)			(.115)	(.145)
Quality (linear)		.218***	-.0642		
		(.0543)	(.175)		
Qual x Age 25+			.212		
			(.152)		
Qual x Age 40+			.333***		
			(.121)		
Qual x Age 60+			.139		
			(.171)		
Qual x Female			.0324		
			(.120)		
Qual x Rural			.169*		
			(.0929)		
Qual x Attended tasting classes			-.00237		
			(.111)		
Qual x Buys from wineries			-.0713		
			(.123)		
Qual x Buys from wine shops			-.346**		
			(.172)		
Qual x Buys from supermarkets			-.226		
			(.145)		
Qual x Less than 1L/week			.0838		
			(.112)		
# Subjects	183	183	183	112	71

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: Robustness checks.

	Baseline	Preferred choice	Buy choice	Preferred choice	Buy choice
V_P: €5 vs €3	.702***	.707***	.605***	.710***	.612***
	(.115)	(.118)	(.118)	(.118)	(.117)
V_P: €8 vs €5	-.0838	-.0825	-.346***	-.0859	-.357***
	(.0774)	(.0781)	(.0938)	(.0782)	(.0946)
ΔV_P: €5 vs €3	-.0933				
	(.0754)				
ΔV_P: €8 vs €5	-.259***				
	(.0619)				
Value of baseline bottle	.317	.317	-.282	.314	-.288
(€3, low qual, degraded)	(.218)	(.222)	(.219)	(.222)	(.219)
Utility of paying €3	-.598***				
	(.158)				
Landscape: Modern vs degraded	.0221	-.0164	.0598	-.0187	.0549
	(.121)	(.129)	(.126)	(.129)	(.127)
Landscape: Traditional vs modern	.455***	.436***	.477***	.443***	.491***
	(.110)	(.116)	(.121)	(.115)	(.121)
Landscape: Evocative vs traditional	.125	.124	.127	.124	.127
	(.0876)	(.0929)	(.0945)	(.0932)	(.0949)
Quality: Medium vs low	.269***	.310***	.227**		
	(.0871)	(.0951)	(.0893)		
Quality: High vs medium	.221**	.249**	.191*		
	(.0946)	(.0996)	(.100)		
Quality: Medium vs low				.439***	.247*
(Merlot)				(.160)	(.148)
Quality: High vs medium				.305	.354*
(Merlot)				(.198)	(.187)
Quality: Medium vs low				.196	.164
(Prosecco)				(.172)	(.166)
Quality: High vs medium				-.0448	-.316
(Prosecco)				(.169)	(.195)
Quality: Medium vs low				.301**	.273*
(Tocai)				(.136)	(.140)
Quality: High vs medium				.396***	.372***
(Tocai)				(.118)	(.120)
# Subjects	183	183	183	183	183

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 5: 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.