

Galletto, Luigi; Rossetto, Luca

Article

A hedonic analysis of retail Italian vinegars

Wine Economics and Policy

Provided in Cooperation with:

UniCeSV - Centro Universitario di Ricerca per lo Sviluppo Competitivo del Settore Vitivinicolo,
University of Florence

Suggested Citation: Galletto, Luigi; Rossetto, Luca (2015) : A hedonic analysis of retail Italian vinegars, Wine Economics and Policy, ISSN 2212-9774, Elsevier, Amsterdam, Vol. 4, Iss. 1, pp. 60-68, <https://doi.org/10.1016/j.wep.2015.02.001>

This Version is available at:

<https://hdl.handle.net/10419/194494>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by-nc-nd/4.0/>



A hedonic analysis of retail Italian vinegars

Luigi Galletto*, Luca Rossetto

TeSAF Department, University of Padova, Italy

Received 29 July 2014; received in revised form 2 December 2014; accepted 6 February 2015

Available online 27 February 2015

Abstract

Vinegar's contribution to the Italian wine industry is significant, and Italy is the world's largest exporter of wine vinegar. Nevertheless, the features of the vinegar market have received little scholarly attention, and hedonic price analysis has not yet been applied to vinegar. Thus, through a sample survey of supermarkets, this study makes an initial attempt to investigate the most important features influencing the price of vinegar.

The study reports results of a hedonic price analysis conducted on a vinegar survey that collected information about intrinsic and extrinsic cues, brand, point of sale and merchandising.

Although they influence the vinegar price, bottle size and packaging features appear to mask the effects of other attributes. Modena Balsamic vinegar is a geographical denomination and commands a premium price compared with other vinegars, and vinegar prices decrease as the acidity of the content increases. Brands, bottle features and shelf display significantly affect vinegar price.

Knowledge about factors affecting the vinegar price can help producers make decisions about what vinegars should be produced and how to price them, which will benefit a consistent proportion of wine and grape producers.

© 2015 UniCeSV, University of Florence. Production and hosting by Elsevier B.V. All rights reserved.

Keywords: Vinegar; Hedonic price; Merchandising

1. Introduction

Vinegar is a condiment and preservative that is produced through acetic bacteria activity on dilute solutions of ethyl alcohol from previous yeast fermentations in sugar solution. In Italy, the solutions are mainly wine and apple cider, whereas other countries use solutions from a wide variety of other food products.

In Italy, vinegar is the second most important dressing after olive oil, but its relevance is increasing in the world market, where Italy acts as the largest exporter, followed by Germany (Berry, 2011). Approximately two million hectoliters of vinegar are produced in Italy, and according to data from Federvini (2014), Italian vinegar exports reached 1.08 million hectoliters, corresponding to 237.7 million euros in 2013, with a threefold increase since 2000.

Although twenty times less vinegar is exported than wine, vinegar exports are more important than exports of products derived from wine, such as spirits (brandy and grappa) or aromatized wines. Exports are almost equally divided between European Union (EU) and extra-EU countries. The main markets for Italian vinegars are the United States, Germany and France, respectively, where average prices per liter range between 1.7 and 2.1 euros.

Annual Italian vinegar consumption is stabilized at approximately 1.5 liters per capita. Although the vinegar market is mature, the market's value has grown significantly in the last five years because of an increase in the market share of Modena Balsamic vinegar. This vinegar's status as a protected geographical indication (PGI) of origin has played a key role in expanding its international appeal. The vinegar market is driven by a few oligopolistic companies that are well-known brands among Italians. In particular, vinegar sales are concentrated in the following brands: Ponti earns more than half of sales by volume in hypermarkets and supermarkets, followed

Peer Review under the responsibility of UniCeSV, University of Florence.

*Corresponding author.

E-mail address: luigi.galletto@unipd.it (L. Galletto).

by Cirio, Fini and Monari Federzoni. Private labels are also aggressively priced, and their sales account for approximately 19% of the Italian market (MassMarket, 2010).

These figures and the closeness with the wine industry (apple vinegar has a limited market share compared with wine) reveal the importance of this market and, consequently, the demand for improving understanding of economic and trade aspects of the vinegar industry. This need appears rather critical, given that the vinegar market has received little attention from researchers, who have mostly focused on special vinegars. For instance, Mattia (2004) analyzes the market features, competition, structure and critical management areas of Modena Traditional Balsamic vinegar supply chain, and Radman et al. (2005) examine Zagreb consumers' perceptions and behavior of apple vinegar. However, studies of price issues cannot be found.

The Italian market includes a wide variety of vinegars, which differ according to raw material, geographical origin, production method, packaging features, acidity and other aspects. Although vinegar is not as highly differentiated as wine, it is sold and purchased at prices that range fairly widely (De Bac and Sarcina, 2010; Altroconsumo, 2011). However, no previous studies have analyzed the relationship between market prices and vinegar attributes that affect consumer behavior when buying vinegar.

Therefore, this study aims to analyze the implicit value of vinegar attributes, i.e., to identify the vinegar price structure. How consumers evaluate these attributes has important implications for retailers and for producers' long-term investment decisions. For the former, price information is helpful in supporting purchase decisions and designing marketing campaigns. This goal is accomplished through the estimation of a hedonic price function, where price effects of different attributes are evaluated using data collected in a sample survey conducted on large scale retail (LSR) outlets.

The study is organized as follows. The first section briefly reviews the literature of hedonic price about wine and olive oil and summarizes the main features of the approach. The second section describes the data and the hedonic price methodology. The third section describes outcomes and findings of the model. Final remarks conclude the paper.

2. Literature overview

A preliminary review of previous studies indicates that hedonic price analysis has frequently been applied to beverages and food products, which are characterized by a high level of differentiation. Since the pioneering paper by Waugh (1928), who studied the effect of quality factors (color, size and uniformity of spears) on vegetable price, his method has been applied in many ways to a broad range of agricultural and food products.

Because wine and condiments are similar products to vinegar, a brief review of the hedonic price analyses for these products can be relevant our study about vinegar.

Wine was undoubtedly the most studied product among beverages and food products. Data collection relies mostly on

wine guides and less on retail shelf surveys (scanner data and direct observations). Product quality is one of the attributes employed most frequently to determine wine price, and it is either approximated by sensorial cues (Nerlove, 1995; Combris et al., 1997) or jury grade (e.g., Schamel and Anderson, 2003; Oczkowski, 2001). However, results are not always clearly understood. In fact, sensory characteristics are often difficult and costly to identify because they can only be detected through tasting, learning and the use of expert wine guides. Although Landon and Smith (1997) and Lecocq and Visser (2006) demonstrate that wine ratings performed by specialized agencies or magazines affect wine prices, the role or importance of ratings vary by market. For example, San Martin et al. (2008) demonstrated that the scores of Argentinean wines sold in UK market were not very important, but Bentzen and Smith (2008) found that Champagne ratings had considerable impact in the Scandinavian market. Many authors also included objective features such as vintage, variety and chemical attributes (alcoholic content and acidity) as significant factors. In their study on Porto prices, Couto Viana and Rodrigues (2007) emphasized the type and age of wine. Another attribute that wine price studies frequently analyze is the geographical indication (Landon and Smith, 1997; Combris et al., 2000 and Oczkowski, 1994). More recently, Mueller Loose and Szolnoki (2012) emphasized the role of packaging features such as labels and closures. Boatto et al. (2011) demonstrated the impact of retailers' information and was the first study to explore the effect of shelf display on wine price.

Among condiments, only olive oil received attention by Cadima Ribeiro and Freitas Santos (2005) and Karipidis et al. (2005a). The former study, based on olive oil items available on Portuguese outlet chains, found that acidity, organic certification and the addition of aromas are more relevant attributes than the regions of origin. Karipidis et al. (2005a) analyzed retail price data from two Greek cities (Athens and Thessaloniki) and found that the packaging size, natural features and type of outlet, respectively, are the most important features affecting the olive oil price.

This review of previous studies suggests that some features employed in wine and olive oil hedonic price models can also be applied to a vinegar model. However, wine and olive oil are quite different than vinegar. For example, quality scores do not exist for vinegars, and only one geographic indication exists for vinegar in the Italian supermarket channel. Given that our research is the first of its type, we have drawn only a few broad precedents from the studies described above.

3. Methodology and data

This study was conducted by collecting data about vinegars sold in supermarket chains through a questionnaire and then analyzing data using a hedonic price model. The questionnaire was designed in a basic format to collect information about the outlet (location, type, store brand), the type of vinegar, brand, acidity, bottle features (size, packaging, glass color, back label) as well as merchandising attributes such as shelf display and stock facings for each observation (i.e., each bottle of vinegar).

The final dataset includes 1036 records (i.e., data for 1036 vinegar bottles).

The sample survey was performed at 46 points of sale of different sizes and formats and included 27 store brands that are located in 21 main towns of Verona province (Western Veneto). The survey was performed between July and November 2012. This area, which is also a strategic commercial point in northern Italy, reports a high concentration of outlets belonging to different store brands whereas major vinegar production areas (Modena and Reggio Emilia provinces) are quite far away. The research design may suffer some limits of generalizability, particularly for the sampling process. The sample units were not randomly chosen, but all store brands have been recorded within the case study area. However, the oligopolistic features of the vinegar market, where a few large brands earn the most sales in Italy and the fact that vinegar still lacks the amount of differentiation of wine increase the reliability of the survey. Consequently, the variability of producers' brands may not change significantly from area to area or from store to store. Conversely, other sources of variability from regional store brands or small regional vinegar brands were excluded from the sample survey because they may reduce data reliability and the generalizability of results. Definitively, the high number of samples collected and the fact that the same samples were collected in different stores increase the data reliability and the validity of the research.

The hedonic price approach is then summarized as formal specification whereas the model applied to vinegar is explained in the next paragraph. The literature about hedonic price methodology is well known. Specifically, a hedonic price analysis conducts a regression of price over certain product attributes. Lancaster (1966) and Rosen (1974) suggested that the price reflects all relevant characteristics exhibited by any differentiated product. Because consumer preferences are based upon product characteristics or quality attributes, each consumer derives his/her utility from these attributes. The consumer utility function is then explained by the vector of its underlying attributes instead of product itself. A strong assumption is that consumers independently address attributes.

Consequently, the retail price can be seen as the sum of the price components associated with each attribute; these components can be estimated through a regression analysis where the price is a function of the product attributes. Formally, a hedonic price model can be expressed

$$P_j(X) = P(x_1, x_2, \dots, x_i, \dots, x_n, u_i) \quad (1)$$

where P_j is the price of product j , $X = x_1, x_2, \dots, x_i, \dots, x_n$ is a vector of n attributes that describe product quality and u_i is the error term.

The partial derivative, $\partial P(X)/\partial x_i$, of the hedonic price function with respect to attribute i can be seen as the implicit or shadow price of the specific attribute i . In the long run, it represents the lowest price at which an attribute can be purchased and supplied. Thus, it may reflect not only consumer preferences but also decisions of producers and retailers (Mueller Loose and Szolnoki, 2012). Attribute effects

on a product or service can be either positive or negative, affecting the price structure and product differentiation.

Although this theory has addressed types of explanatory variables, it does not provide specific guidance in selecting functional form. However, the simple linear form, the log-linear and the double log are tested or adopted in most empirical studies of hedonic price.

A descriptive statistics of survey data are reported next, which can supply useful hints about the hedonic price analysis (Tables 1 and 2).

First, price is explained. Because bottles are sold in a wide range of sizes, prices have been adjusted by calculating the value per liter. Generally, 87.7% of bottles collected were priced below or equal to 5.00 euros and 27.5% below 1.00 euro, but prices over 15.00 euros are often reported. The price distribution reveals a high variability, indicating positive asymmetry (significant difference between mean and median).

Independent variables are then summarized. Outlet features can be seen as general service attributes linked to shopping. Records are almost equally divided between urban and rural points of sale. Following Carlucci et al. (2013), store chain features were collected in the sample survey. The sample outlets vary widely due to vinegar fragmentation among local,

Table 1
Descriptive statistics of sample survey—categorical variables ($N=1036$).

Variables	Items (%)	Variables	Items (%)
Store location:		Bottle glass color:	
In town	47.7	Dark	39.9
Out of town	52.3	Light	60.1
Store brand:		Aged vinegar	3.0
Top store brand	35.6	Organic vinegar	6.6
Other store brand	64.4	Vinegar variety:	
Points of sale:		Modena balsamic (PGI)	50.3
Hypermarkets	36.2	From apples	15
Supermarkets	43.1	From white wine	17.8
Minimarket	13.6	From red wine	14.7
Discount	7.1	Discolored	2.2
Vinegar brands:		Bottle closure:	
Ponti	22.1	Screw cap (b)	77.6
Cirio	3.7	Cork cap	18.5
Fini	3.5	Spray cap	3.9
Monari Federzoni	7.9	Shelf positioning	
Ortalli	8.3	High tier (uppermost)	21.4
Sasso	3.9	High tier (eye level)	22.3
All others	50.6	Middle tier	40.3
Bottle packaging:		Low tier (leg level)	6.8
Plastic bottle	4.1	Low tier (bottom)	9.2
Glass bottle	95.9		

Table 2
Sample survey descriptive statistics—continuous variables ($N=1036$).

	Median	Mean	St. Dev.	Min	Max
Price per bottle (€)	1.90	2.84	2.80	0.55	16.90
Price per liter (€)	3.90	6.74	8.48	0.11	67.60
Bottle size (liters)	0.50	0.56	0.33	0.20	5.00
Acidity (% acetic acid)	6.00	5.97	0.53	4.00	7.50
Facings (n . bottles)	3.00	3.88	3.44	1.00	44.00

regional, national, and international supermarket chains or among many individual stores. Because approximately 20 store brands were sampled and some account for very few vinegar bottles, the most widespread store chain—i.e., the top store brand—was selected and compared with the group of others. Among points of sale, the greatest share of observations occurred at supermarkets, and discount outlets offer little variety in vinegar brands. The number of items collected ranges from 4 in discount outlets to 137 in hypermarkets.

Within credence attributes, one geographic indication was reported: the Modena Balsamic Protected Geographical Indication (PGI) vinegar, which covered almost half of recorded bottles. The vinegar market includes two additional designations of origin: the Modena and Reggio Traditional Balsamic Protected Designation of Origin (PDO) vinegars, which were not recorded in the sample survey. These two vinegars are specialty foods sold in specialized shops at very high prices, i.e., they are a different market segment. For vinegar types, the following attributes were recorded: i) aged vinegars, representing a small portion of Modena PGI; ii) organic vinegars, including both PGI and not PGI varieties and iii) vinegars made from white or red wines or discolored vinegars where geographic indication is not reported. The PGI attribute was assumed to be baseline to estimate the price effects of the additional vinegar type of vinegars. The acidity (% of acetic acid by volume) indicates a sharply skewed distribution: 72% of the cases lie within the 5.1–6.0% range.

The survey suggests a fragmented vinegar market. We counted 113 different vinegar brands. Most are producer brands, and a few are private labels. The high number of brands may suggest a differentiated market. Most of the market is shared by leading companies, and marginal local or regional firms compete for the residual consumption. More specifically, 22.1% of bottles belonged to the most well-known brand (Ponti). The first six most common brands account for almost half of the sample, and each additional brand typically accounted for less than 1% of our sample. The Fini, Monari Federzoni and Ortalli brands supply mostly Modena vinegar, the Ponti brand supplies PGI and non-PGI vinegars, and Cirio and Sasso are focused on vinegars without geographic indication.

Many extrinsic characteristics easily perceived by looking at the bottle, such as back label or the bottle color (dark or light green), are quite balanced in the sample. The screw cap is the most prevalent type of closure, and less than one-fifth of the vinegars use a cork-type closure. Vinegars use different bottle closures than wines, which mostly use corks (Mueller Loose and Szolnoki, 2012). A few vinegar bottles use a spray cap, an innovative closure for food products. Glass bottles are used more frequently than plastic. Bottle sizes vary considerably: more than 70% of bottles range between 0.2 and 0.5 liter, approximately 22% have a volume of 1 liter and few bottles exceed 1 liter.

The final group of attributes analyzed includes two merchandising characteristics: shelf display in terms of vertical position (tier) and stock facings. The impact of shelf display on consumers has been widely recognized. Consumers are more likely to choose a product when it receives more shelf space (i.e., facings) or when the product is positioned on visible or

easily accessed shelf locations (Desmet and Renaudin, 1998; Drèze et al., 1994) that will attract consumers.

Campo et al. (2003) noted that an item is more likely to be purchased when it is placed at eye or hand level. Moreover, shelf effects are particularly important for consumers who are not very involved with the purchase decision, are rushed and/or face comprehensive shopping tasks (Hoyer, 1984). In such circumstances, consumers often pursue satisfactory rather than utility-maximizing purchase decisions, and shelf display features may not only catch shoppers' attention but also represent a signal that facilitates consumers' choices. Thus, shelf display arrangements can be seen as service attributes that may significantly affect the purchasing process. Shelf displays or facings are rarely evaluated in hedonic price models for food products (Boatto et al., 2011; Maguire et al., 2004; Nganje et al., 2008; Weemaes and Riethmuller, 2001). No studies of food or beverages have jointly analyzed these merchandising features. In particular, Boatto et al. approximated facings as bottle density in the shelf; Weemaes and Riethmuller analyzed shelf display as traditional five-shelf tiers; Maguire et al. (2004) and Nganje et al. (2008) measured facings as square and linear feet, respectively.

In the sample survey, a high share of vinegar bottles were located on the middle tier, easily accessible for consumers, whereas fewer samples were located on lower shelves where they were less visible and more difficult to retrieve. Approximately 20–22% of collected items were located on the two upper shelves. In this study, facings are approximated based on the number of bottles placed on a shelf. The results typically ranged from 2 to 5 items (70.7%).

4. Results and discussion

As first step, a test was conducted on functional forms, and the heteroskedasticity was investigated. Following a Box–Cox procedure (Panzone, 2011), the log-transformation was performed for vinegar price and continuous independent variables. Heteroskedasticity was fixed through Box–Cox transformation and by removing items priced greater than 50 euros ($N=1030$). Multicollinearity was tested through the variance inflation factor (VIF) (O'Brien, 2007).¹ The general functional form of the hedonic price model is reported as follows (Table 3):

$$\begin{aligned} \text{LnPrice} = & \beta_0 + \beta_1 \text{town} + \beta_2 \text{TopStore} + \sum_{j=1}^4 \beta_j \text{Pos} + \beta_3 \text{Aged} \\ & + \beta_4 \text{Organic} + \sum_{k=1}^5 \beta_k \text{Type} + \sum_{l=1}^6 \beta_l \text{Brand} + \sum_{m=1}^3 \beta_m \text{Cap} \\ & + \beta_5 \text{Bottle} + \beta_6 \text{Backl} + \beta_7 \text{Dark} + \beta_8 \text{Size} \\ & + \sum_{n=1}^5 \beta_n \text{Shelf} + \beta_9 \text{LnFacing} + \beta_{10} \text{LnAcidity} + \varepsilon \end{aligned} \quad (2)$$

¹Following O'Brien (2007), the VIF is the reciprocal of tolerance, which is equal to $1 - R^2$. The VIF cut off values depend on both tolerance and aspects (sample size, variability, etc.). Generally, the VIF range is quite wide, ranging from 10 (serious multicollinearity) to 5 (multicollinearity problems) to a threshold of 3–4 (suspects of multicollinearity).

Table 3
Independent variables.

Qualitative information	Variable	Attributes
Outlet features	Town	Store location in a town (yes/no)
	TopStore	Local widespread brand store (yes/no)
	Pos ($j=4$)	Point of sale features (supermarket=baseline, hypermarket, discount, mini market)
Intrinsic features	Aged	Aged vinegar (yes, no=baseline)
	Organic	Organic vinegar (yes, no=baseline)
	Type ($k=5$)	Vinegar variety (balsamic=baseline, from apple, from white wine, from red wine, discolored)
	lnAcidity	Log of acidity (continuous variable)
Producer's brand	Brand ($l=6$)	Brand (Ponti, Cirio, Fini, Monari-Federzoni, Ortalli, Sasso, Others=baseline)
Extrinsic features	Cap ($m=3$)	Type of bottle closure (screw cap=baseline, cork cap, spray cap)
	Bottle	Bottle packaging (glass=baseline, plastic)
	Backl	Back label (yes/no=baseline)
	Dark	Dark glass bottle (yes, no=baseline)
	lnSize	Log bottle size (continuous variable)
Merchandising	Shelf ($n=5$)	Shelf positioning (high tier, eye level, middle=baseline, leg level, low tie)
	LnFacing	Log of Facing (continuous variable)

The performance of the model was then improved through three models to catch price effects from extrinsic to intrinsic attributes. The Levene test (Morton and Forsythe, 1974) did not indicate heteroskedasticity. However, all models suffer some endogeneity, particularly from facings, i.e., the shelf space allocated to a vinegar item. A two-stage least squares regression did not provide satisfactory results because facing cannot be explained by variables collected in the survey. In other words, instrument variables able to explain facing may come from marketing strategies such as promotional or discounting campaigns that are not known.

4.1. Model (1)

This model includes all independent variables (Appendix A). Price effects are mostly indicated by extrinsic attributes (3 brands, 3 shelf positions, facing, bottle size, acidity). For the bottle size, this result is also reported in Karipidis et al. (2005b) for olive oil and Carlucci et al. (2013) for yogurt. Even if half the price variance is explained, results are debatable because no price effect originates from intrinsic variables such as the type of vinegar or from other bottle features such as back label and bottle packaging. The VIF associated with bottle size, equal to 3.2, suggests multicollinearity with bottle features such as packaging and back label and intrinsic features such as type of vinegar.² In other words, the strong price effect of bottle size encompasses the effects of some other variables. The bottle size plays an important role in marketing strategies of outlet stores, other packaging choices and brand positioning.

²The bottle size indicates a negative correlation with bottle caps, back label and some vinegar brands (Sasso, Cirio) and a positive correlation with the bottle packaging, the type of vinegar (from white wine, from red wine, discolored), the Ortalli vinegar brand, the top outlet store brand and the discount stores.

4.2. Model (2)

In this model, the bottle size was removed to allow other vinegar attributes to emerge (Appendix A). Compared with the previous model, the overall significance decreased and the number of variables indicating a significant price effect increased despite the removal of the bottle size variable. Specifically, negative effects arise when vinegar is sold in the top brand stores or when vinegar is sold in plastic bottles, whereas positive price effects (premium price) occur in some vinegar brands (Ponti, Fini, Cirio) and for vinegars using a special cap closure (cork, spray) and the back label. However, the VIF still reveals some multicollinearity among back label and dark bottle color.³ Accordingly, we omitted these two extrinsic features from the regression.

4.3. Model (3)

Model (3) seems satisfactory ($R^2=0.451$; $F=33.449$). Attributes indicate a significant price effect whereas variables are uncorrelated as indicated by a low VIF range (from 1.28 to 1.72). The results from the model, summarized in Table 4, facilitate calculating the percent price impact of variables having a significant price effect. For continuous variables, this percentage is the price elasticity measured by regression coefficients, and for dummy variables, this impact (also called semielasticity) has been estimated using the formula proposed by Kennedy (1981).

A brief discussion of model 3 follows: The attributes indicating the point of sale features do not appear to affect vinegar price except for a top store brand. This latter effect leads to a significant 9.87% reduction on the average price, likely due to a discount

³Dark bottle color is negatively correlated with vinegars from apple, white wine and red wine and discolored vinegars; the type of bottle closures (caps) and the Ponti brand, whereas it is positively correlated with back labels and with most vinegar brands (Fini, Monari Federzoni, Ortalli). The back label is correlated with almost all the previous variables plus the discount outlet, Sasso brand and plastic bottles.

Table 4
Hedonic model estimates.

Variables	B	Std error	t	p-value	VIF	Percent price impact
Constant	3.566	0.460	7.745	0.000		
Store location:						
In town=no (b)						
In town=yes	0.042	0.048	0.868	0.385	1.092	
Store brand:						
Top brand						
store=no (b)						
Top brand	−0.103	0.053	−1.952	0.051	1.202	−9.87
store=yes						
Point of sales:						
Supermarket (b)						
Hypermarket	−0.081	0.055	−1.469	0.142	1.321	
Discount	−0.180	0.099	−1.821	0.069	1.211	−16.86
Minimarket	−0.129	0.073	−1.769	0.077	1.166	
Aged vinegar	0.122	0.147	0.829	0.407	1.157	
Organic vinegar	0.014	0.099	0.139	0.889	1.171	
Vinegar varieties:						
Modena balsamic (b)						
From apples	−0.174	0.078	−2.236	0.026	1.461	−16.23
From white wine	−0.294	0.078	−3.763	0.000	1.702	−25.73
From red wine	−0.311	0.083	−3.766	0.000	1.660	−26.96
Discolored	−0.409	0.173	−2.368	0.018	1.094	−34.57
Log-Acidity	−0.863	0.259	−3.330	0.001	1.051	−86.30
Vinegar brands:						
All others (b)						
Ponti	0.264	0.064	4.154	0.000	1.337	29.94
Cirio	0.256	0.134	1.919	0.055	1.215	28.06
Fini	0.478	0.141	3.402	0.001	1.129	59.72
Monari Federzoni	0.073	0.099	0.738	0.461	1.309	
Ortalli	−0.092	0.098	−0.945	0.345	1.364	
Sasso	0.883	0.128	6.890	0.000	1.209	139.86
Bottle closure:						
Screw cap (b)						
Cork cap	0.747	0.073	10.239	0.000	1.495	110.54
Spray cap	0.916	0.131	6.973	0.000	1.145	147.84
Bottle packaging:						
Plastic bottle=no (b)						
Plastic bottle=yes	−0.504	0.125	−4.023	0.000	1.213	−40.07
Shelf positioning						
Middle tier (b)						
High tier	0.015	0.064	0.240	0.810	1.340	
(uppermost)						
High tier (eye level)	0.172	0.064	2.710	0.007	1.320	18.56
Low tier (leg level)	−0.144	0.093	−1.550	0.121	1.193	
Low tier (bottom)	−0.414	0.093	−4.445	0.000	1.196	−34.20
Log stock facings	−0.612	0.041	−14.797	0.000	1.165	−61.23
Dependent variable: Log of vinegar price per liter						
$R^2=0.451$; $F=31.544$; $N=1030$						
Levene's test of equality error variances: $F_{607,360}=0.959$ p-value=0.674						

price strategy aimed at maintaining high shopping rates. If the widespread urbanization of Veneto Region can explain the low price difference between rural and urban outlets, no price effect among outlet types is less straightforward. Previous studies on hedonic price of food products provide inconclusive results for this variable (Maguire et al., 2004; Karipidis et al., 2005b). A plausible reason is that a similar assortment of vinegars is found

in all outlet types. The low significance of the discount price effect is most likely due to the few sample observations for this outlet. However, we cannot exclude an approximately 16.86% negative price effect for vinegars sold in discount.

Although signs are consistent with expectations, among the intrinsic features only two attributes, aged and organic, indicate no price effects compared with the balsamic vinegar. This result may be explained by the fact that the aging process for vinegar is not yet appreciated by consumers as it usually happens for wines and spirits or the aging value is recognized in well-known long-aged Traditional Balsamic PDO vinegar, which is a specialty market. The lack of significance of organic certification is not new, as it emerges in hedonic price analyses on spaghetti and olive oil (Naspetti et al. 2009), where 81% of prices are from items sold in specialized shops, however. In the case of vinegar, this result can be partially explained by the fact that the EU regulation on organic wine is rather recent (2011). Among different vinegars, the price decrease for Modena balsamic vinegar reaches 16.23% in the case of a vinegar made from apples and approximately 25–26% for vinegars made from white and red wines. The lowest price decrease is actually indicated by the discolored vinegar, which is usually less fragrant and appealing. Consequently, the model offers indirect evidence that the Modena vinegar, though widely represented on LSR as a mass product, still deserves a premium price over other vinegars, i.e., the PGI certification is appreciated even if only one geographic indication is available on the market.⁴ The acetic acid also plays a noticeable role in affecting vinegar price, leading to approximately 9% price decrease for 10% increase in its content. High acidity can overshadow some positive sensorial aspects of vinegar, decreasing its value.

In terms of the brand effect, we observe that 4 of the 6 most popular brands have a price premium over the other 107 brands recorded in the survey. Sasso ranks first, with a 140% premium, even if no Modena balsamic vinegars are branded with this name. In this example, producer brand is definitely more influential than a geographic indication. The results suggest that Sasso's producer, which has acquired a well-known reputation in the olive oil market, was successful in extending its brand to vinegar, i.e., Sasso is a top brand among vinegars sold in outlet chains. The second most important brand is Fini enjoys a 59.7% premium price (a much lower premium rate than Sasso's), whereas Ponti and Cirio, two additional well-known brands, exhibit almost the same price premium of approximately 28–29%. However, although Ponti has built its brand reputation focusing only on the vinegar business, Cirio is a mature inclusive food product brand with value gained by marketing a wide range of food products. In particular, the Ponti brand offers a large vinegar assortment differentiated by quality and price with or without the PGI collective brand.

⁴Other hedonic price studies on food products (Boatto et al., 2011; Cadima Ribeiro and Freitas Santos, 2004) detected premium prices for geographic indications by taking into account more than one indication.

Although we have omitted three of six bottle features from the model, the packaging variables still assume a relevant role in fixing the vinegar price. The cork-type cap causes a strong price effect, and the spray cap ranks first among all dummies, leading to a price increase of approximately 148% above the screw cap closure. The cork-type cap claims to be a prestige product because it is also used in wines. However, spray caps demand a higher price premium because they are costly and innovative, facilitating the dispensing of the vinegar. The use of a plastic bottle leads to a significant negative premium.⁵

Finally, we draw our attention to the merchandising attributes. The number of bottles is used as a proxy for the facings (i.e., the shelf space allocated to an item). Regardless of this approximation, the significance of facings for price may hide an endogeneity issue that can hardly be managed because no variables analyzed in the survey can explain facings.

The facings are negatively correlated with the price, similar to the findings of Maguire et al. (2004) and Njanje et al. (2008) for other food products. The price elasticity of facings indicates that a 100% increase in the number of vinegar bottles results in a 61.2% price decrease.

As for shelf position, the model confirms the key role of the fourth tier, implying a 18.6% price premium for vinegars displayed in the most visible zone rather than the middle (baseline) tier. Similarly, bottles displayed in the lowest (bottom) tier, where visibility is scarce and items can be difficult for consumers to reach, experience a price reduction. No significant price effect was found for vinegars placed in the second or upper tier compared with those located at middle or hand level. The fact that Weemaes and Riethmuller (2001) found a different premium price pattern lead us not to extend our results about shelf positioning to other products or vinegars sold in different outlets. Indeed, both the facings and the shelf positioning strategies follow merchandising rules and communication strategies planned ad hoc by each store (e.g., more popular items or brands are afforded more shelf space and/or more attractive shelf positions). In our hedonic price model for vinegar, merchandising attributes display a very low degree of correlation with the other variables, and they explain 19.1% of the total price variance. In fact, the hedonic price regression without merchandising attributes only decreases R^2 from 0.451 to 0.260.

5. Final remarks

The hedonic price analysis provides information that is helpful to better understand the Italian vinegar market and strategies adopted by outlet chains and to note aspects of the price fixation process. This study represents the first attempt to illuminate the price mechanism for vinegar, complementing many contributions on this issue already available for wine. Accordingly, the relevance of results is directly linked to the increasing role of the vinegar sector within the wine industry.

Due to the lack of knowledge about factors affecting vinegar price, these results may also be useful for operators working in the vinegar supply chain by offering support for producers and retailers. More specifically, vinegar producers, who decide volumes and assortments of vinegars, can be better supported in pricing their portfolio, taking into account differentiation features and competition, or developing new vinegars that may include higher-priced features. This result will also benefit a consistent share of wine and grape producers, whose earnings rely mostly on the success of the vinegar industry.

The hedonic model for vinegar indicates similarities and differences to other hedonic price models of food products. First, the overall significance of our model is generally lower than other hedonic regressions, most likely, due to different product features, price and marketing strategies. Both the top store brand and other outlet chains or individual stores have their own price strategy to encourage the consumption of specific vinegars or brands or to increase the customer's store loyalty. Moreover, many brands (both producer's brands and private labels) are most likely responsible for unexplained price variability. Although the survey included many brands, many of them were represented with very few bottle observations to insignificant to be included in the model.

Likewise, brands with the largest share of vinegars also indicate a sizeable intra-brand price variability not fully explained by the intrinsic and extrinsic features we analyzed, particularly considering that taste and aroma seem to be the main attributes that consumers seek in a vinegar (Radman et al., 2005). However, the model has highlighted the role of extrinsic features in affecting the price, which is partially explained by the features of the vinegar market in which the only geographic indication is highly pervasive. Even when some bottle attributes such as size, back label and color are dropped from the model, other bottle features (particularly the type of cap) remain important. These results distinguish the hedonic price model for vinegar from models applied to wine or olive oil, where stronger price effects are detected for credence/experience attributes than bottle attributes. Consequently, producers could adopt a wide range of activities focused on these features to differentiate and promote their own vinegars.

An interesting outcome of this research is the high price effect associated with merchandising attributes. As a possible explanation, we could assume that many supermarket consumers are not fully aware of the intrinsic quality attributes of vinegar and their attention is driven by the shelf display in deciding which vinegar to buy. We should also remember that most vinegars are sold at prices ranging from 1.5 to 2.5 euros, and consumption is lower than other food products or wines. In other words, consumers may not spend much time shopping for vinegar. If ignoring these attributes is misleading in the hedonic price function for vinegar, we can debate whether these results are restricted to vinegar or whether they can be extended to wine and other food and beverage products. We believe that merchandising variables can impact the price of

⁵The plastic material premium price can be also significantly positive if the baseline is a non-glass container (Weemaes and Riethmuller, 2001).

many grocery or non-grocery products and to better explain this issue, we suggest that their effects be evaluated in empirical studies that apply hedonic price analysis.

Additional research is also required to test other outcomes of this work. In particular, a hedonic price function for vinegar should be extended to other points of sale such as specialized shops (e.g., specialty food shops) and to other areas in Italy and abroad.

Appendix A. Results of hedonic price models 1 and 2

References

- Altroconsumo, 2011. Agrodolce a tutti Available from. Altroconsumo 250 (4), 18–20 (www.altroconsumo.it).
- Bentzen, J., Smith, V., 2008. Do expert ratings or economic models explain champagne prices? *Int. J. Wine Bus. Res.* 20 (3), 230–243.
- Berry, B., 2011. The global vinegar market: opportunities for Canadian vinegar exporters. Government Report, agriculture and agri-food, Canada. Available from: (<http://www.ats-sea.agr.gc.ca/inter/4344-eng.htm>).
- Boatto, V., Defrancesco, E., Trestini, S., 2011. The price premium for wine quality signals: does retailers' information provision matter? *Br. Food J.* 113 (5), 669–679.

Variables	MODEL 1					MODEL 2				
	B	Std error	t	p-value	VIF	B	Std error	t	p-value	VIF
Constant	2.927	0.431	6.784	0.000		3.228	0.467	6.919	0.000	0.000
Store location:										
In town=no (b)										
In town=yes	0.033	0.044	0.755	0.450	1.093	0.038	0.047	0.812	0.417	1.092
Store brand:										
Top brand store=no (b)										
Top brand store=yes	−0.035	0.048	−0.732	0.464	1.216	−0.099	0.052	−1.902	0.058	1.203
Point of sales:										
Supermarkets (b)										
Hypermarket	−0.072	0.050	−1.445	0.149	1.322	−0.082	0.054	−1.519	0.129	1.321
Discount	−0.023	0.091	−0.251	0.802	1.236	−0.128	0.098	−1.309	0.191	1.226
Minimarket	−0.092	0.066	−1.382	0.167	1.170	−0.123	0.072	−1.707	0.088	1.168
Aged vinegar	0.070	0.134	0.519	0.604	1.161	0.117	0.145	0.806	0.420	1.160
Organic vinegar	0.006	0.090	0.062	0.951	1.171	0.021	0.098	0.219	0.827	1.171
Type of vinegar:										
Modena balsamic (b)										
From apples	0.029	0.090	0.321	0.748	2.333	0.007	0.097	0.070	0.944	2.333
From white wine	0.158	0.093	1.695	0.090	2.905	−0.111	0.098	−1.135	0.257	2.756
From red wine	0.137	0.094	1.459	0.145	2.599	−0.136	0.099	−1.372	0.170	2.465
Discolored	0.260	0.173	1.501	0.134	1.323	−0.171	0.184	−0.927	0.354	1.273
Log-Acidity	−0.952	0.237	−4.016	0.000	1.058	−0.821	0.256	−3.204	0.001	1.056
Vinegar brands:										
All others (b)										
Ponti	0.173	0.059	2.934	0.003	1.390	0.209	0.064	3.273	0.001	1.387
Cirio	−0.105	0.127	−0.829	0.407	1.324	0.325	0.133	2.448	0.015	1.231
Fini	0.403	0.131	3.070	0.002	1.185	0.489	0.142	3.449	0.001	1.182
Monari Federzoni	−0.038	0.093	−0.410	0.682	1.369	0.010	0.100	0.105	0.917	1.367
Ortalli	0.044	0.091	0.480	0.632	1.423	−0.142	0.097	−1.462	0.144	1.387
Sasso	0.521	0.123	4.245	0.000	1.336	0.962	0.128	7.533	0.000	1.231
Bottle closure:										
Screw cap (b)										
Cork cap	0.146	0.084	1.731	0.084	2.408	0.728	0.077	9.456	0.000	1.707
Spray cap	0.187	0.134	1.400	0.162	1.428	0.895	0.132	6.793	0.000	1.183
Bottle packaging:										
Plastic bottle=no (b)										
Plastic bottle=yes	−0.051	0.119	−0.425	0.671	1.323	−0.375	0.126	−2.974	0.003	1.263
Bottle features:										
Back label=no										
Back label=yes	0.113	0.067	1.692	0.091	2.546	0.359	0.069	5.176	0.000	2.335
Dark glass=no										
Dark glass=yes	−0.045	0.067	−0.680	0.497	2.445	−0.044	0.072	−0.614	0.539	2.445

Shelf positioning

Middle tier (b)

High tier (uppermost)	0.053	0.058	0.903	0.367	1.376	0.006	0.063	0.097	0.923	1.371
High tier (eye level)	0.173	0.058	2.978	0.003	1.320	0.176	0.063	2.805	0.005	1.320
Low tier (leg level)	−0.182	0.085	−2.141	0.033	1.202	−0.167	0.092	−1.816	0.070	1.202
Low tier (bottom)	−0.345	0.085	−4.047	0.000	1.202	−0.390	0.092	−4.233	0.000	1.200
Log stock facings	−0.614	0.038	−16.267	0.000	1.166	−0.607	0.041	−14.862	0.000	1.166
Log bottle size	−0.957	0.075	−12.774	0.000	3.220					

Dependent variable: log of vinegar price per liter

 $R^2=0.544$; $F=40.754$; $N=1030$ Levene's test of equality error variances: $F=0.986$ p -value=0.561

Dependent variable: log of vinegar price per liter

 $R^2=0.465$; $F=31.024$; $N=1030$ Levene's test of equality error variances:
 $F=0.946$ p -value=0.716

- Cadima Ribeiro, J., Freitas Santos, J., 2004. Region's reputation, the price of regional products: a hedonic analyses of Portuguese quality cheese. In: Proceedings of the 44th Congress of the European Regional Science Association Porto. Available from: <http://repositorium.sdum.uminho.pt/handle/1822/1731>.
- Cadima Ribeiro, J., Freitas Santos, J., 2005. Portuguese olive oil and the price of regional products: does designation of origin really matter. *Tékhnē – Polytech. Stud. Rev.* 2 (3), 61–76.
- Campo, K., Gijsbrechts, E., Nisol, P., 2003. The impact of retailer stockouts on whether, how much and what to buy. *Int. J. Res. Mark.* 20 (3), 273–286.
- Carlucci, D., Stasi, A., Nardone, G., Seccia, A., 2013. Explaining price variability in the Italian yogurt market: a hedonic analysis. *Agribusiness* 92 (2), 194–205.
- Combris, P., Lecocq, S., Visser, M., 1997. Estimation of hedonic price equation for Bordeaux wine: does quality matter. *Econ. J.* 107 (441), 390–402.
- Combris, P., Lecocq, S., Visser, M., 2000. Estimation of a hedonic price equation for Bordeaux Wine. *Appl. Econ.* 32 (8), 961–967.
- Couto Viana, R., Rodrigues, L.L., 2007. What Determines Port Wine Prices? *J. Wine Econ.* 2 (2), 203–212.
- De Bac, M., Sarcina, G., 2010. La Battaglia Dell'aceto Balsamico—Tradizionalisti Contro Industriali. *Corriere Della Sera*, 13 Agosto.
- Desmet, P., Renaudin, V., 1998. Estimation of product category sales responsiveness to allocated shelf space. *Int. J. Res. Mark.* 15 (5), 443–457.
- Drèze, X., Hoch, S.J., Purk, M.E., 1994. Shelf management and space elasticity. *J. Retail.* 70 (4), 301–326.
- Federvini, 2014. Relazione del Presidente. Available from: www.federvini.it.
- Hoyer, W.D., 1984. An examination of consumer decision making for a common, repeat-purchase product. *J. Consum. Res.* 11 (3), 822–829.
- Karipidis, P., Tsakiridou, E., Tabakis, N., 2005a. The Greek olive oil market structure. *Agric. Econ. Rev.* 6 (1), 64–72.
- Karipidis, P., Tsakiridou, E., Tabakis, N., Mattas, K., 2005b. Hedonic analysis of retail egg prices. *J. Food Distrib. Res.* 36 (3), 68–73.
- Kennedy, P.F., 1981. Estimation with correctly interpreted dummy variables in semilogarithmic equations. *Am. Econ. Rev.* 71 (4), 801.
- Lancaster, K.J., 1966. A new approach to consumer theory. *J. Polit. Econ.* 74 (2), 132–157.
- Landon, S., Smith, C.E., 1997. The use of quality and reputation indicates by consumers: the case of Bordeaux wine. *J. Consum. Policy* 20 (3), 289–323.
- Lecocq, S., Visser, M., 2006. What determines wine prices: objective vs. sensory characteristics. *J. Wine Econ.* 1 (1), 42–56.
- Maguire, K.B., Owens, N., Simon, N.B., 2004. The price premium for organic babyfood: a hedonic analysis. *J. Agric. Resour. Econ.* 29 (1), 132–149.
- MassMarket, (2010). Mass market Italy report food. Available from: www.massmarket.it/aceto.htm.
- Mattia, G., 2004. Balsamic vinegar of Modena: from product to market value: competitive strategy of a typical Italian product. *Br. Food J.* 106 (10/11), 722–745.
- Morton, B.B., Forsythe, B.A., 1974. Robust tests for the equality of variances. *J. Am. Stat. Assoc.* 69 (346), 364–367.
- Mueller Loose, S., Szolnoki, G., 2012. Market price differentials for food packaging characteristics. *Food Qual. Prefer.* 25 (2), 171–182.
- Naspetti, S., Hamm, U., Janssen, M., Zanolì, R., 2009. Quanto vale il marchio bio? Un'indagine econometria. in Crescimanno, M., Schifani, G. (eds.), *Agricoltura Biologica: sistemi produttivi e modelli di commercializzazione e di consumo - Atti del IV workshop grab-it palermo*. Available from: http://orgprints.org/17101/1/Naspetti-Zanolì_et_al_CERTCOST_GRABI_T_rev1.pdf.
- Nerlove, M., 1995. Hedonic price functions and the measurement of preferences: the case of Swedish wine consumers. *Eur. Econ. Rev.* 39 (9), 1697–1716.
- Nganje, W., Kaitibie, S., Wachenheim, C.J., Acquah, E.T., Matson, J., Johnson, G., 2008. Estimating price premiums for breads marketed as 'low-carbohydrate breads'. *J. Food Distrib. Res.* 39 (2), 66–76.
- O'Brien, M.R., 2007. Model-dependent variance inflation factor cutoff values. *Qual. Quant.* 41 (5), 673–690 RIVISTA.
- Oczkowski, E., 1994. A hedonic price function for Australian premium table wine. *Aust. J. Agric. Econ.* 38 (1), 93–110.
- Oczkowski, E., 2001. Hedonic wine price functions and measurement error. *Econ. Rec.* 77 (239), 374–382.
- Panzone, A., 2011. The lost scent of Eastern European wines in Western Europe: a hedonic model applied to the UK market. *Br. Food J.* 113 (8), 1060–1078.
- Radman, M., Blašković, D., Juračak, J., 2005. Zagreb consumes and apple vinegar: attitudes and perceptions. Available from: <http://www.agmrc-croatia.org/businessdevelopment/applevinegar.pdf>.
- Rosen, S., 1974. Hedonic prices and implicit markets: product differentiation in pure competition. *J. Polit. Econ.* 82 (1), 34–55.
- San Martin, G.J., Brummer, B., Troncoso, J.L., 2008. Determinants of Argentinean wine prices in the US market. AAWE working paper. (15). Available from: www.wine-economics.org.
- Schamel, G., Anderson, K., 2003. Wine quality and varietal, regional and winery reputation: hedonic prices for Australia and New Zealand. *Econ. Rec.* 79 (246), 357–369.
- Waugh, F.V., 1928. Quality factors influencing vegetable prices. *J. Farm Econ.* 10 (2), 185–196.
- Weemaes, H., Riethmuller, P., 2001. What Australian Consumers like about Fruit Juice: results from a hedonic analysis. In: Proceedings of the Paper selected for the World Food and Agribusiness Symposium, Sydney, June, pp. 27–28. Available from: <http://www.agrifood.info/AgriFood/members/Congress/Congress2001Papers/Symposium/Weemaes.pdf>.