Short communication. Price determinants of Chilean wines in the US market: a hedonic approach

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Abstract

A hedonic function relating the retail price of Chilean wine in the US market to a number of relevant variables was estimated. The variables were: quality ratings, aging, grape variety, valley of origin and membership to an association. Estimates for the percentage impact and marginal prices of these variables are provided. The overall conclusion is that variety and location are more influential in the commercial success of wines than quality ratings and aging, suggesting that oenological practices cannot outweigh judgemental errors in these long-term choices.

Additional key words: hedonic function, marginal price, percentage impact.

Resumen

Nota corta. Determinantes del precio de los vinos chilenos en el mercado de Estados Unidos: un enfoque hedónico

Se estimó una función de precios hedónicos asociando el precio al detalle del vino chileno en el mercado estadounidense a los siguientes atributos visibles: nota de calidad, envejecimiento, cepa, valle de origen y pertenencia a alguna asociación de productores. Se estimó el impacto porcentual y el precio marginal de cada uno de estos atributos. La conclusión general de este estudio fue que la cepa y el valle de origen («terroir») son considerablemente más influyentes en el éxito comercial de un vino que la calidad, medida por juicios expertos, y el envejecimiento. Ello es importante porque indica que malas decisiones de largo plazo no pueden después modificarse mediante tratamientos enológicos (envejecimiento).

Palabras clave adicionales: función hedónica de precios, impacto porcentual, precio marginal.

The Chilean wine industry has experienced a remarkable expansion over the past decade, based primarily in the advantages offered by the international markets. Thus, while in 1990 most of the wine produced in Chile was consumed domestically and exports accounted for only 7% of total production, in 2002 about 60% of the Chilean wines were sold in the export market. In the same period of time the industry more than doubled production, passing from 2.6 to 5.9×10^6 hl, and the value of exports grew from US$ 80 million, in 1990, to US$ 608 million, in 2002 (Foster and Valdés, 2001; SAG, 2003). Wine is now one of the most important single export commodities in Chilean trade, as it contributes with about 11% of all forestry and agricultural exports.

In economic theory, consumer demand is normally derived from a utility function, a theoretical construct that defines preferences over the array of commodities placed at the consumer's disposal. These preferences are based on the ordinal utility (i.e. satisfaction) obtained from the quality attributes of each commodity, as perceived by an ordinary consumer. Thus, it can be hypothesized that prices are the value that consumers attach to the bundle of quality attributes of each commodity, given certain budget restrictions and limited commodity supplies. The determination of market values based on commodity attributes can be carried out through the estimation of a hedonic price

function. A 'hedonic price function' relates the price of a commodity to its various attributes or characteristics. The theoretical foundations of hedonic price functions were provided by Rosen (1974), who posited that competitive markets define implicit prices for the embodied commodity attributes, and that consumers evaluate these attributes when making a purchase decision.

Class of wine, vintage year and region of origin are attributes that significantly influence the price of wine (Combris *et al.,* 1997, 2000; Cardebat and Figuet, 2004). This means that Spanish consumers attach a price premium to the wines from La Rioja as well as French consumers are prepared to pay more for a 'grand cru' from Saint Emilion, a highly reputed Bordeaux appellation. Attributes such as olfactory (aromatic intensity, finesse, aromatic complexity) and gustatory (firmness of attack, suppleness, flatness, fat, harmony of components, finish) traits, influence the quality assessments of juries, but, because they are less evident to the consumer, have a weak or no influence on price. As Oczkowski (1994) and Combris *et al.* (1997) have shown, the price of wine is essentially determined by the objective characteristics of the bottle, i.e. those characteristics that can easily be identified by consumers.

Recent quality improvements have a weak influence on price, as consumers are slow to incorporate product quality changes in the reputation of a particular wine. On the contrary, long term reputation, meaning 'quality based on repeated past history', has a very strong influence on price (Landon and Smith, 1997, 1998). In a study conducted on 302 Bordeaux wines, Landon and Smith (1998) have shown that 'expected' quality (i.e. long term reputation) has an influence 17 times larger than current quality ratings of wines and is by far the most influential variable of all tested. These authors also found that collective reputation (e.g. based on regional appellations) is as important as individual firm reputation, since consumers value these indicators as predictors of product quality. Similar results were obtained by Schamel and Anderson (2003) for Australian and New Zealand wines, who found significant price premia based on brand and regional reputations.

Grapevines are highly sensitive to climate conditions, which explain why the same oenology and grape variety can lead to different quality wines when the fruit comes from different regions. Jones and Storchman (2001) studied the influence of climate on Bordeaux wines and concluded that warm dry summers result in high sugar and low acid levels at harvest which, in turn, lead to higher quality wines. These authors found that Merlot-dominated blends are more sensitive to climate than Cabernet Sauvignon-dominated blends, suggesting that the influence of climate varies with the cultivar. They also conclude that aging has a positive effect on wine pricing, effect which is inversely related to scarcity. Because the scarcity of a particular wine depends on the size of the winery, this last conclusion allows inferring that aging is more profitable in the smaller wineries.

Despite the importance of the wine industry for the Chilean agricultural economy, little research has been carried out on the consumers' quality perceptions of the Chilean wine and the value that different attributes add to the final price. This study addresses these questions. More specifically, the study aims at determining a hedonic price function for Chilean wines in the US market and the marginal prices of a number of perceived attributes of Chilean wines.

The data were obtained from the database of the electronic magazine *Wine Spectator,* which contains ratings for more than 110,000 wines from many countries over the world. All the Chilean wines in the database were selected, obtaining thus an initial group of 2,695 observations. However, the breach in the assumption of normality of residuals caused by the presence of outliers obliged to drop a number of observations. The data analysed comprised 2,603 observations of red and white wines of vintages from 1979 to 2002. For each observation, the database provides a quality rating, variety, vintage year, valley of origin and recommended retail price. In addition to these variables, a sixth variable, 'aging', was estimated for each wine, as the difference between the year of marketing and the vintage year.

Two important vineyard associations exist in Chile, namely *Viñas de Chile,* that groups the largest vineyards of the industry, and *Chilevid,* an association of family medium-sized firms known in the country as «boutique vineyards», alluding to their strategy of producing unique high-quality wines. The first group includes big corporations with plantations of over 1,000 ha; the most powerful firm of this association is «Concha y Toro», with about 5,000 ha of plantations. The second group comprises firms with plantations of less than 1,000 ha, typically represented by farms in the

range of 100-300 ha planted. The membership to *Viñas de Chile* or to *Chilevid* allows indirect distinction of big from medium-sized firms, a factor that can be associated with quality. Both associations essentially pursue the representation of their members in the policy-making government institutions, but they have also in some instances participated in commercial operations, such as a salesroom in London for their members' wines, the financing of the participation of member vineyards in wine fairs in Europe, and, most importantly, jointly financing generic campaigns to promote the wines of Chile.

For the reasons given above, each wine was identified with respect to membership of any of these associations. The vineyards that do not belong to any association were grouped under the label of 'Non-associated vineyards'.

In summary, each observation provided values for the following variables: 1) price (recommended, retail) in US$ per bottle; 2) quality ratings in a scale from 1 to 100, the highest score meaning the highest quality; 3) aging, in years; 4) grape variety; 5) valley of origin; and 6) membership of an association. The first three are continuous variables, while the last three are binary ('dummy') variables. Note that aging, grape variety and valley of origin are objective characteristics that can be identified by the consumer in the bottle.

Following the general hedonic functions model, it was assumed that the price of the *i*-th bottle of wine, P_i, is a function of the value attached by the consumer to its attributes Z_{ij} ($j = 1,..., m$). Thus,

$$P_i = f(Z_{i1}, Z_{i2}, ..., Z_{ij}, ..., Z_{im})$$

It is also assumed that the market is in equilibrium, that is, that all consumers have made their utility-maximising choices, given their budget constraints and knowledge of the prices and characteristics of alternative goods. Moreover, all firms have made their profit-maximising decisions taking into account their production costs, and that the resulting prices and quantities have been set at market-clearing levels.

The following log-linear model was specified:

$$\ln P = \beta_0 + \sum_j \beta_j Z_j + \sum_w \beta_w Z_w \qquad [1]$$

where P (in logs) is price and Z_j and Z_w represent the *j*-th continuous variable and the *w*-th dummy variable respectively. As in the initial runs the presence of autocorrelation and heteroskedasticity were detected, the parameters of [1] were estimated using the Cochran-Orcutt method and weighed least squares (Greene, 1999; Gujarati, 2004).

To avoid collinearity between the dummy variables (the so-called 'dummy variable trap'), a reference variable was omitted in each group of dummy variables. These are: Cabernet Sauvignon, for cultivars, the Maipo Valley, for origins and 'non-associated vineyard', for associativeness. Hence, results should be interpreted as departures, in percentage terms, from the price a bottle of Cabernet Sauvignon from the Maipo Valley belonging to a non-associated vineyard, would obtain in the US market.

The measurement of the weight of the different variables on price varies with the type of variable being analysed. As Halvorsen and Palmquist (1980) have shown, in log-linear functions the coefficient of a continuous variable is a derivative and hence, multiplied by 100, it can correctly be interpreted as the percentage variation of the dependent variable in relation to a small change of the variable in question. Thus, the weights of the continuous variables quality rating and aging, were calculated as $100*\beta_j$ and interpreted as the percentage change of price with respect to a unit-variation of each of the variables mentioned. This method, however, cannot be applied to dummy variables, as their dichotomous form precludes interpreting the coefficients as derivatives. The percentage impact of the dummy variables were estimated here as

$$100 * [\exp(\beta_w - 0.5 \, var(\beta_w)) - 1]$$

which, as Kennedy (1981) has shown, is the appropriate interpretation of the coefficient of a dummy variable.

Table 1 describes the observed features of the wine used as reference. On average, a Cabernet Sauvignon from the Maipo Valley produced in a non-associated vineyard is a wine of 82 points of rating, with about three years of aging, and that sells in the US market for US$ 11.3 a bottle, retail price. Using the categories of the *Wine Spectator,* this is a 'good wine' [1].

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[1] A 'good wine' obtains ratings in the range of 80 to 85 points.

Table 1. Price, quality and aging of a Cabernet Sauvignon from the Maipo Valley, produced by a non-associated vineyard

	Price (US$/bottle)	Quality ratings (points)	Aging (years)
Average	11.3	82.1	3.3
Standard deviation	10.2	4.9	1.3
Minimum	4.0	61.0	1.0
Maximum	65.0	91.0	7.0

Number of observations = 92.

Table 2 reports the hedonic price function of Chilean wines in the US market and the percentage impact of each variable. With the exception of the coefficients of Curico and Cachapoal, all the estimates are highly significant. The Durbin-Watson statistic falls within the conclusive limits of the test, accepting thus the hypothesis of no autocorrelation at a significance level of 1%. Also, the homocedasticity of residuals has been ensured by using the Cochran Orcutt method combined with weighed least squares. The Variance Inflation Factor of all variables showed values below 10, proving thus the absence of multicollinearity in the

Table 2. Hedonic price log-linear model estimates

Variable	Coefficient	t-ratio	Probability	Percentage impact (%)
Constant	−0.64300	−13.0	0.000	
Quality	0.03446	42.4	0.000	3.4
Aging	0.05590	21.4	0.000	5.6
Red varieties				
Carmenère	0.24600	15.7	0.000	27.9
Malbec	0.09387	3.3	0.001	9.8
Merlot	0.04346	6.0	0.000	4.4
Pinot noir	0.33400	10.5	0.000	39.6
Syrah	0.32400	11.1	0.000	38.2
Red blends	0.42000	20.3	0.000	52.2
White varieties				
Chardonnay	0.06064	8.5	0.000	6.2
Sauvignon blanc	−0.05055	−5.9	0.000	−4.9
Semillon	−0.20800	−5.5	0.000	−18.8
White blends	0.09467	5.2	0.000	9.9
Valley of origin				
Aconcagua	0.19700	11.4	0.000	21.8
Casablanca	0.17300	11.1	0.000	18.9
Cachapoal	0.02895	1.7	0.093	2.9
Rapel	−0.07393	−6.5	0.000	−7.1
Colchagua	0.03827	3.9	0.000	3.9
Curicó	0.00171	0.2	0.861	0.2
Lontué	−0.12600	−10.8	0.000	−11.8
Maule	−0.03681	−3.3	0.001	−3.6
No appellation	0.02835	2.7	0.008	2.9
Association				
Viñas de Chile	0.12500	14.8	0.000	13.3
Chilevid	0.07882	7.7	0.000	8.2
Adjusted R^2	0.688			
SEE	0.505			
F	249.856			

model (Gujarati, 2004). Finally, the R-square is reasonably high, indicating that the functional form chosen closely describes the observed variance of the data.

The results reported in Table 2 shows that, with a few exceptions, grape cultivars, valley of origin and association are far more influential on price than quality and aging. Thus, while the percentage impact of the former group of variables generally has two digits, the latter group has only one. This has an important policy implication, as it indicates that long-term choices such as grape variety and vineyard location have a significant influence on the market success of wines, greater than a cellaring procedure such as aging. Thus, a wrong decision regarding cultivar and/or location can hardly be corrected by the oenologist. It also shows that expert ratings have a smaller influence on price than the consumers' preferences of cultivars and regions of origin. This result is coincident with the notion that consumers attach a greater weight to observable characteristics such as grape variety and origin, than to quality assessments made by experts.

All red cultivars have a positive impact on prices. 'Red blends', a generic name given to wines that combine the finest traits of different cultivars to obtain a product of selection, have the highest impact, followed by Pinot Noir, Syrah, Carmenere, Malbec and Merlot. It is noteworthy that Carmenere is fourth in this ranking, despite the fact it is an almost extinguished cultivar in the world. White cultivars can have negative impacts on price, as is the case of Semillon and Sauvignon Blanc, and when this is not the case, their impact is modest, below 10%. Again, the highest impact belongs to 'blends' followed by Chardonnay. These results suggest that Chile's reputation lies more on red than on white wines.

The valley of origin can have a positive or a negative influence on price, a result which is consistent with the

Table 3. Marginal prices of Chilean wine attributes

Variable	Marginal price (US$/bottle)
Quality (per additional point)	0.39
Aging (per additional year)	0.63
Red varieties	
Carmenère	3.15
Malbec	1.11
Merlot	0.50
Pinot noir	4.47
Syrah	4.32
Red blends	5.89
White varieties	
Chardonnay	0.71
Sauvignon blanc	−0.56
Semillon	−2.13
White blends	1.12
Valley of origin	
Aconcagua	2.46
Casablanca	2.13
Cachapoal	0.33
Rapel	−0.81
Colchagua	0.44
Curicó	0.02
Lontué	−1.34
Maule	−0.41
No appellation	0.32
Association	
Viñas de Chile	1.50
Chilevid	0.93

findings of other studies (Oczkowski, 1994; Schamel and Anderson, 2003). Thus, Aconcagua, Casablanca and Colchagua add value to the price of Cabernet Sauvignon of the Maipo Valley, especially the first two mentioned, while Maule, Rapel and Lontue, subtract. This result is spatially consistent as it implies moving from centre north to centre south in the country and it suggests that the best combinations of soil and climate (the best 'terroirs', to use the jargon of oenologists) are located in the northern part of central Chile. It is noteworthy that the climate in central Chile varies markedly from north to south, from mild warm and dry in the north to cool and humid in the south.

Finally, results show that the wines produced by the vineyards that belong to an association obtain higher prices than those that do not. Thus, members of *Viñas de Chile* and of *Chilevid* sell at prices 13% and 8% higher than non-associated vineyards, respectively. This result is probably related to the marketing campaigns financed by these associations in Europe and the United States, in order to build up a collective reputation.

Table 3 reports estimates for the marginal prices of the different attributes of Chilean wines. These prices have been calculated by multiplying the average price of a Cabernet Sauvignon wine from the Maipo Valley produced by a non-associated vineyard, by the percentage impact of each attribute, and they provide estimates of the price premia associated with each attribute.

The above results confirm that the greatest positive or negative influence on price comes from the choice of cultivars and valley and secondarily, from oenological practices such as aging or the reputation earned from expert judgement. For example, a bottle of Syrah wine earns a price premium of US$ 4.32 in the US market, a value equivalent to 6.8 additional years of aging, a very costly cellaring time, or 11 additional quality points (over the 82 points of the reference wine), a standard hard to achieve.

The main conclusion that can be drawn from this study is that commercial success in the wine industry is more related to the choice of the right variety and location than to the application of the best cellaring procedure. It is noteworthy that an origin is a non-replicable attribute shared by the wineries of a particular valley and hence, it can be employed by those wineries as a differentiation factor to compete in the global markets of today (Anderson, 2001). This calls for a careful study of the alternative 'terroirs' and varieties at the moment of plantation. A secondary conclusion is that there are advantages in joining an association, as a collective reputation can be earned from it; hence, it is in the best interest of each firm to associate when attempting to export its produce.

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