

18 **Abstract**

19 This article focuses on the emerging bottled Chilean red wine market and studies the main
20 determinants of the consumer price of wine sold on the domestic market. A hedonic price
21 function was estimated for a sample of 810 wines using a quantile regression (QR) model.
22 The database contains three variables groups to explain price: objective variables (national,
23 international, and vine quality designations), subjective variables (wine score), and business
24 strategies used by wine producers. Results show that some objective variables have a greater
25 impact on price than the wine score (a subjective variable) and business strategies, which
26 vary for each quartile of prices analyzed. Finally, this information will allow companies to
27 design and implement marketing strategies to inform the consumer about the importance of
28 some variables in the price of their product.

29 **Keywords:** Red wine, Chile, Business strategy, Hedonic price, Quantile regression

30 **1. INTRODUCTION**

31 The average annual world wine production between 2012 and 2016 was 272 million
32 hectoliters (MMhl). Europe leads market participation for both production and consumption,
33 with 65% and 58%, respectively (International Organisation of Vine and Wine, OIV, 2017).
34 Traditional or “Old World” European countries (Estrella et al., 2012) that lead production
35 are Italy (19%), France (16%), and Spain (15%). As regards world consumption (241 MMhl),
36 France is ranked first with 11%, followed by Italy (9%) and Germany (8%).

37 In recent years, “non-traditional” or emerging countries have become relevant for both
38 production and consumption. This group of countries includes the United States, which leads
39 production with a 9% market share, followed by Australia (5%) and China (4%). As regards
40 consumption, the market share of the United States is 13%, followed by China (7%) and the
41 United Kingdom (5%) (OIV, 2017).

42 Chile has positioned itself as a relevant emerging market in the last few years because
43 of its exceptional natural conditions for wine production, such as the stability of the political
44 and economic environment (Giuliani & Bell, 2005; Visser & De Langen, 2006; Felzensztein
45 & Deans, 2013). This market represents 3% of the worldwide wine-growing area, 4% of wine
46 production, and 1% of world consumption. It ranks as the fourth largest exporter (8%) (OIV,
47 2017) and has the sixth highest per capita consumption rate with 14 liters annually.

48 The evolution of the wine sector in Chile has undergone two major stages, which have
49 influenced its development. The first stage, in the 1970s and '80s, was aimed at the internal
50 market, and there was a radical change in the '90s because of investments in the sector,
51 political changes, and external market opportunities (Troncoso & Aguirre, 2006; Gwynne,
52 2006). The second stage begins in the '90s in Chile, in which Chile began being recognized
53 internationally for the quality of its wines even though the sector's business strategy was

54 focused on the low-priced wine segment (Giuliani & Rabellotti, 2012). International market
55 competition in these segments prompted companies to implement business strategies to
56 strengthen the internal market while simultaneously continuing to serve the international
57 market (Melo et al., 2005). The Chilean wine market consists of approximately 400 firms,
58 many of which currently use this double business strategy and are highly competitive wine
59 producers that vie for market niches (internal and external) with wines of greatly differing
60 species, quality, and sophistication. This has generated a diverse range of products, with
61 varied price ranges and different objective and subjective attributes to serve a highly
62 segmented market. The successful development of the domestic market sector largely
63 depends on knowledge of the relationship between price and the implicit value of the various
64 product attributes. Wine price plays a determining role in the exchange relationship between
65 economic agents and the quantity demanded.

66 In this context, the price formation of wine bottled in the Chilean market is not only
67 defined by different product attributes but also by the strategy adopted by the companies.
68 Given the wide range of bottled wines available on the local market, product attributes and
69 business strategies alike have a varying effect on the final price, depending on the analyzed
70 price range. In this type of market, which has a wide heterogeneity of product categories
71 (Costanigro et al., 2009; Rebelo et al., 2019), it is necessary to use a model that allows relating
72 the implicit price to its attributes, and that determines how this varies at different price levels.
73 The quantile regression (QR) model is able to make estimations in this framework
74 (Costanigro & McCluskey, 2011) because it provides detailed information about the
75 attributes for specific price ranges; for this reason, the model is used in the present study.

76 Therefore, the objective of our study is to analyze the extent to which the objective and
77 subjective attributes of bottled wine and strategies adopted by the companies in this sector
78 determine the price charged to the consumer in the local market.

79 This article is structured as follows: Section 2 deals with the literature review, and
80 Section 3 includes the material and methods. Section 4 provides the main results and
81 discussion. Finally, the last section presents the conclusions of the study.

82

83 2. LITERATURE REVIEW

84 Most studies worldwide that analyze the relationship between price and the different implicit
85 wine attributes have used a hedonic price methodology because of the perfect competition
86 characteristics of the sector and because it is a product with multiple attributes that
87 significantly influences the final price of the product (Estrella et al., 2012). This analysis
88 originated in an agricultural economy, when Waugh (1928) published a study about the
89 quality factors that influence the price of certain vegetables in Boston's wholesale market.
90 Since then, the hedonic approach has been used to estimate the implicit price of product
91 attributes (Costanigro et al., 2010). This analysis is based on the premise that, in perfectly
92 competitive markets with heterogeneous products, the market price is the sum of the implicit
93 values of the product attributes (Rosen, 1974).

94 Wine is the most widely studied agri-food product using this methodology (Di Vita et
95 al., 2015). Research studies can be classified into two groups; the first considers the attributes
96 used in the studies, while the second uses applied econometric models. The studies in the
97 first group are generally undertaken in countries that have a scant tradition in the wine
98 market, such as Israel (Golan & Shalit, 1993), with Oczkowski (1994) analyzing the premium
99 wine market in Australia, and Nerlove (1995) examining the Swedish wine market. These
100 early studies began to define the first attributes that affect the final wine price. Some
101 attributes are objective variables (quality designation, vine, production region, harvest year),
102 subjective variables (color, aroma, bouquet, sweetness, acidity, astringency, mouth-feel,
103 body, typicity, and general evaluation), and chemical variables (sugar content, alcohol
104 content, density, volatile acidity, ethyl acetate, solid extract, and total acidity). Then studies
105 in traditional markets began to appear, based on attributes defined in those earlier studies.
106 Most of the studies developed between 1997 and 2010 were from France, and these mainly

107 incorporated objective and sensory variables. These studies focused on a price analysis of the
108 domestic market in the most prestigious wine-producing regions such as Burgundy (Combris
109 et al., 2000), Bordeaux (Combris et al., 1997; Landon & Smith, 1998; Cardebat & Figuet,
110 2004; Hadj & Nauges, 2007), and Alsace, Beaujolais, and Provence (Cardebat & Figuet,
111 2009). They also analyzed French wine prices in the British and Canadian markets (Steiner,
112 2004; Carew & Florkowski, 2010).

113 Between 2009 and 2017, the most complex studies in terms of attributes used in the
114 analyses were conducted primarily in the Italian wine market. The first studies initially used
115 the objective variables applied in earlier works (Benfratello et al., 2009; Boatto et al., 2011;
116 Caracciolo et al., 2013). Other attributes are then incorporated, such as the chemical variables
117 of wine (Brentari et al., 2011, 2015; Levaggi & Brentari, 2014). From 2013 onward, studies
118 have tended to include new attributes found in other links of the wine marketing chain in
119 Italy. These include attributes related to the producer (years in business, number of hectares,
120 whether or not they are cooperatives, type of ownership, and size of the vineyard), company
121 reputation, production process (participation of enologists or agronomists), and climatic
122 variables (temperature and rainfall) (Roma et al., 2013; Cacchiarelli et al., 2016; Caracciolo
123 et al., 2016). However, none of the above-mentioned applied business strategies have been
124 considered to be determining factors of wine prices, which is one of the primary benefits of
125 the present work as discussed in the Introduction.

126 As regards emerging countries, studies have been regularly conducted from 2001
127 onward, and publications alternate between the different markets of this group. These studies
128 mainly include some of the objective and subjective variables defined in earlier research,
129 which makes it necessary to conduct studies to deepen the knowledge of the attributes that
130 influence the final wine prices in these markets. There are three groups of analyzed markets.

131 The first is the Australian wine market, which analyzes the incidence of price on some
132 objective variables (region, variety, harvest year, and producer size and capacity) and
133 subjective variables (vineyard rating, quality score) (Oczkowski, 2001; Schamel &
134 Anderson, 2003; Oczkowski, 2010; Oczkowski, 2016). A second group focuses on analyzing
135 the American and Canadian wine market, using objective variables (region, vine, quality
136 designation, harvest year, quantity produced, and certification) and subjective variables
137 (sensory rating and producer quality) (Schamel, 2006; Rabkin & Beatty, 2007; Costanigro et
138 al., 2007; Costanigro et al., 2009; Kwong et al., 2011; Caudill & Mixon, 2016; Waldrop et
139 al., 2017). Finally, the literature shows a group of studies conducted in Chile, which includes
140 some attributes used in previous research, as well as some newer attributes such as bottle
141 weight and membership in a wine producer association. The latter attribute is used as a proxy
142 variable for the management efforts made by companies to promote the sector (Melo et al.,
143 2005; Troncoso & Aguirre, 2006; González & Melo, 2008; Ortuzar-Gana & Alfranca-
144 Burriel, 2010). The proxy variable is key for understanding price formation in a market
145 because the price of a product is not only determined by its attributes; business strategy is
146 also very important in the formation and determination of the market price as regards supply.
147 This is the first contribution of the present study to the state of the art of hedonic prices of
148 the bottled wine market.

149 The methodological approaches used are all based on estimating a regression between
150 the price of the product and the studied attributes. Most studies use a functional semi-
151 logarithmic form because it allows the analysis of percentage changes in the presence of
152 changes in the investigated attribute levels (Oczkowski, 1994; Combris et al., 1997; Schamel
153 & Anderson, 2003; Steiner, 2004; Carew & Florkowski, 2010; Levaggi & Brentari, 2014).
154 In some cases, more flexible functional forms have been used, such as the transformed Box-

155 Cox regression model, which allows the statistical selection of the most suitable functional
156 form (Benfratello et al., 2009; Panzone, 2011). The most frequently used estimation methods
157 are the ordinary least squares (OLS) or generalized least squares (GLS), depending on
158 heteroscedasticity. In some cases, in which the dependent variable is not continuous but
159 categorical, hedonic regression is specified as a multinomial logit model (Angulo et al., 2000;
160 Caracciolo et al., 2013; Cacchiarelli et al., 2016). Finally, non-parametric approaches such
161 as local polynomial regression clustering have been used marginally (Costanigro et al., 2009).

162 However, it is unlikely that prices are distributed according to a normal distribution
163 because most products are low- to medium-priced, and a significantly smaller proportion is
164 high-priced. It is possible that the impact of the different price attributes differs according to
165 price level, a question that would not be addressed in a traditional regression analysis (Davino
166 et al., 2015). The use of QR (Koenker & Bassett, 1978) has therefore become popular recently
167 in hedonic price studies. The application of QR to the wine sector has been scarce in the
168 literature, with only two applications in Italy as a traditional market (Di Vita et al., 2015;
169 Caracciolo et al., 2016), and two applications in the United States as an emerging market
170 (Rabkin & Beatty, 2007; Costanigro et al., 2010); this is the second contribution of the
171 present study.

172 3. MATERIAL AND METHODS

173 To achieve the objectives proposed in the present study, a unique database consisting of 810
174 bottled red wines available on the Chilean market and provided by the Wine Lovers' Club
175 (Club de Amantes del Vino, CAV) was used. The CAV has an excellent reputation among
176 wine buyers in Chile, and has become one of the most relevant wine retailers in the local
177 market, combining its own outlets in most important Chilean towns with sales on the Internet.
178 Data from CAV is relevant for this study for three reasons: 1) it has the largest number of
179 wine references among all retailers—clearly larger than in most important supermarkets; 2)
180 wine prices are identical among outlets (and on the Internet), while in most supermarket
181 chains, price discrimination is part of the business strategy (different prices for the same wine
182 in different locations); and 3) the database also provides wine ratings by experts.

183 The present study focused its analysis only on red wines and did not include white
184 wines. The first of two main reasons to choose red wines is that red and white wines have
185 different sensory characteristics and different price ranges, which excludes analyzing them
186 together (Durham et al., 2004). Secondly, red wines have the largest share of the domestic
187 market, that is, 80%. On this basis, it was relevant to consider the other attributes used in the
188 study. Oczkowski (1994) indicates that any variable that influences consumer decisions or
189 producer costs is a candidate to be included as a variable in the function. In this regard,
190 attribute selection in the present study considered attributes compiled in the literature, as well
191 as the specific attributes reported by Chilean producers on their bottles. This made it possible
192 to include objective attributes such as national quality designation (Melo et al., 2005),
193 international quality designation (Costanigro et al., 2009), vine (Waldrop et al., 2017), and
194 geographic origin (Caudill & Mixon, 2016). Some subjective attributes were also mentioned
195 such as the wine score provided by tasters (Oczkowski, 2016), the age of wine (Cacchiarelli

196 et al., 2016), and the vineyard's business strategy. Table 1 summarizes the attributes included
197 in the present study.

198 (Insert Table 1 around here)

199 As previously mentioned, one of the main contributions of this study is that it
200 considered the strategies adopted by the wine-producing companies among the explanatory
201 variables of wine prices. The classification of strategic groups proposed by Oliva, Chanqueo,
202 and Carrasco (2005) was used to define four business groups in the Chilean wine sector. The
203 first group is defined as “exclusive emerging” (30.2% of the sample), which is comprised of
204 companies characterized as being relatively new in the sector and identified as “young
205 emerging,” smaller-sized niche companies that have low production capacity and are focused
206 on the medium- to high-priced wine segment. The second group of companies is defined as
207 low- to medium-priced (18.4%). It consists of companies that are characterized by a longer
208 participation in the industry compared with the former group, which has allowed them to be
209 identified in the market; they are medium-sized companies with production and storage
210 capacities close to the industry average and are aimed at mainstream low- and medium-priced
211 wine segments. Companies included in this group follow an “intermediate” strategy because
212 they neither completely focus on exploiting the fine wine segment nor generate a segment
213 diversification strategy. The third group of companies is defined as “grand traditional”
214 (20.5%). They are characterized as being the stakeholders with the longest participation in
215 the sector, are large-sized and have the greatest production and storage capacity in the wine
216 industry, and are focused on market diversification. The companies included in this group
217 follow a strategy that allows them to diversify in different market segments. The fourth group
218 is defined as “other companies” (30.9%), and includes all the other companies not classified
219 in the other three groups.

220 Once the attributes to be used in the study were defined, the next step was to define the
 221 econometric model and its functional form to perform the estimation. For this analysis, a QR
 222 was estimated, as well as an OLS model, which was used as a benchmark to compare the
 223 results. The estimation of the QR models was based on econometrics from the stochastic
 224 formulation of the hedonic equation for the w^{th} wine estimate defined as:

$$225 \quad Qp_w(\tau | X_w) = \alpha(\tau) + X_w \beta'(\tau) + \varepsilon(\tau)_w \quad (1)$$

226 Equation 1 expresses the quantiles of the conditional distribution of wine prices,
 227 $Qp_w(\tau | X_w)$, as a linear function of the vector $X_w = \{x_w^1, \dots, x_w^R\}$ where $0 < \tau < 1$ represents the
 228 index of the respective quantiles.

229 The τ^{th} estimator $\beta(\tau)$ minimizes the following objective function by the Barrodale and
 230 Roberts (1973) algorithm.

$$231 \quad \sum_w |p_w - \alpha(\tau) + X_w \beta'(\tau)| h_w \quad (2)$$

232 where h_w is a factor defined as:

$$233 \quad h_w = \begin{cases} 2\tau & \text{si } (p_w - \alpha(\tau) + X_w \beta'(\tau)) > 0 \\ 2(1-\tau) & \text{other case} \end{cases} \quad (3)$$

234 The functional form defined to estimate the model is the semilogarithmic form. It is
 235 appropriate when the distribution of the dependent variable is heterogeneous and there is a
 236 wide price distribution (Caracciolo et al., 2016). Moreover, this functional form allows the
 237 interpretation of coefficients such as the percentage change in price for a specific attribute
 238 (Rabkin & Beatty, 2007).

239 **4. RESULTS AND DISCUSSION**

240 As a step prior to model estimation, a graphic analysis of the database used in the study was
241 performed; it included the frequency distribution of the Chilean wine prices in the sample
242 (Figure 1). A significant portion of the distribution was concentrated in low-priced wines.
243 The average price (in Chilean pesos) was \$14,911, the median was \$8,545, and the maximum
244 price was \$160,000.

245 (Insert Figure 1 around here)

246 Table 2 displays the estimated results obtained by the QR model. Likewise, model
247 estimations by OLS were included as benchmarks. The estimation interpretation must
248 consider the coefficient sign, the magnitude, and the significance for each model of one of
249 the QR model quartiles. As regards quality, positive and significant values were obtained for
250 all the designations in the OLS estimation. The magnitude of the coefficients in this model
251 increased as it passed from one quality designation category to another, ranging from the
252 “Grand Reserve” designation, with a coefficient of 0.466 to the “Icon” category, with a
253 coefficient of 1.899.

254 The QR model estimation obtained results similar to those of the OLS estimation;
255 however, there were some differences in the coefficient magnitude of each model, depending
256 on the analyzed quartile. When the wines were in higher price ranges, the differential impact
257 of the first two quality designations (Grand Reserve and Premium) decreased. Quartile 1
258 (low-priced wines) obtained the highest coefficient values, which decreased from one
259 quartile to the other (as wine price increased). For the Super Premium and Icon designations,
260 there was a positive relationship between quality designation and price in the different
261 quartiles. The lowest coefficient values were for quartile 1 (low-priced wines), which
262 increased from one quartile to the other (as wine price increased). This positive and

287 There was a convex relationship between price and score, which indicates that the
288 importance of score decreases up to the point at which price starts to increase. As regards the
289 OLS estimation, the threshold was 85.6 points, while for the QR estimations it was 92.4,
290 88.5, and 84.5 points for quartiles 1, 2, and 3, respectively; this shows quite a significant
291 relationship between the score variable and wine price. Only two of the analyzed studies have
292 a negative and significant score (Landon & Smith, 1998; Brentari et al., 2011), while all other
293 studies, including those conducted in Chile, are positive. For the incorporation of the squared
294 score, this is recently reported in only one study with a positive and significant impact on the
295 United States market (Waldrop et al., 2017) and one study in Norway (Thrane, 2019). The
296 age variable was only relevant in the case of high-priced wines, and the relationship was
297 concave. That is, a positive relationship first existed between both variables, but past the age
298 threshold (9.4 years), the wine price started to decrease. The influence of age in other studies
299 is similar to that observed for score, that is, it is negative in only two studies (Carew &
300 Florkowski, 2010; Oczkowski, 2016). The incorporation of age squared is recently reported
301 in only one study of the United States market (Waldrop et al., 2017), in which it is positive
302 and significant.

303 One aspect to highlight is the heterogeneous impact of business strategies on wine
304 price. In the OLS model estimation, only companies classified as “grand traditional” had a
305 significant and negative effect on the final price of wine. The QR estimation indicated that
306 the effect of each business strategy on wine price was related to determined quartiles. In this
307 way, the “exclusive emerging” strategy showed a differential positive and significant effect
308 for wine prices located in the second quartile (medium-priced wines). For the “low- to
309 medium-priced” strategy, there was a positive and significant impact on wine prices located
310 in the first quartile (low-priced wines). The “grand traditional” strategy had a negative and

311 significant effect on the final price of wine for both the first and third quartiles (low- and
312 high-priced wines, respectively). These first results provide evidence that suggests that, in
313 emerging markets such as the Chilean market, objective variables have the greatest impact
314 on the final consumer price over other variables under consideration.

315 To obtain the differential impact on price of a variation of those categorical attributes
316 on price, the approach proposed by Halvorsen and Palmquist (1980) was used with the
317 following identity:

$$318 \quad 100 \times e^{[\hat{\beta}_j - 0.5\text{Var}(\hat{\beta}_j)]} - 1 \quad (4)$$

319 Table 3 shows the effect on price of a variation of some of the previously defined
320 categorical attributes. The greatest impact on wine price when going from a Reserve wine to
321 Grand Reserve was in quartile 1, which implies a price increase of approximately 68%; this
322 is replicated in the case of going from a Grand Reserve to Premium (145%), Super Premium
323 (224%), and Icon (599%). Wine produced in the Valle del Maipo has a limited effect on
324 price, whereas wine produced in the Valle de Colchagua has a negative effect, albeit a small
325 one. Once again, the impact of objective variables on the final price was greater than the
326 impact of other variables, such as valleys or business strategies.

327 (Insert Table 3 around here)

328 Figure 2 shows the behavior of the coefficients over the entire price distribution. The
329 differential impact of the Grand Reserve quality designation loses influence on price to the
330 extent that the consumer finds wines that are more expensive. A similar phenomenon
331 occurred with Premium category wines, although the relationship was inverted for wines in
332 the higher price range. The quality designation with the highest valuation as wine becomes
333 more expensive is the Icon category. Furthermore, all the quality designations are significant

334 for all the analyzed price distributions. On the other hand, for wines in the low- to medium-
335 priced category, a higher valuation in the lower price range was observed, but the significance
336 of impact decreases as price increases. A similar phenomenon occurred in the case of
337 “exclusive emerging,” although for intermediate-priced wines. Score also had the most
338 important growth rate as wine became more expensive, which indicates that the valuation of
339 this attribute is more relevant. Regarding age, the attribute valuation was predominantly
340 linear to the extent that price increased, which indicates that a higher age is synonymous with
341 a higher price.

342 (Insert Figure 2 around here)

343

344 5. CONCLUSIONS

345 The objective of this study was to analyze to what extent the objective and subjective
346 attributes and strategies adopted by bottled wine companies determine the final consumer
347 price in the local market. The present study contributes to the existing literature from three
348 viewpoints: 1) the incorporation of business strategies to determine prices in the winemaking
349 sector, 2) the limited QR applications to estimate the implicit prices of wine attributes, and
350 3) the lack of empirical work on this topic in Chile. The methodological approach was based
351 on the estimation of a hedonic price model using data provided by a prestigious wine retailer
352 in Chile. Given that price dispersion was high, a quartile regression was estimated because
353 price drivers can differ depending on the quartile under consideration.

354 The results indicate that there are certain differences when comparing results from
355 previous studies in traditional markets with those in emerging markets such as the Chilean
356 market. The main reason is that the degree of consumer knowledge about product attributes
357 is still limited in emerging markets. Objective attributes, such national and international
358 quality designations, have a greater impact on the final price. Some attributes that are relevant
359 in traditional markets, such as the designation of origin or production valleys, have a null or
360 negative impact on the Chilean market. This result is consistent with Chile being an emerging
361 market. Promotion campaigns have been based on the country of origin to position Chilean
362 wines in the domestic market. As the market is becoming more mature, public policies and
363 private investments will start to differentiate wines based on regions or valleys, especially in
364 the segment of premium wines. Some consumer studies have shown that this trend is
365 becoming increasingly important.

366 As regards business strategies—one of the main contributions of the present study—
367 these explain the formation of wine price, but their importance varies depending on the type

368 of strategy used by the companies and the analyzed price level. At this point, the vineyards
369 can generate marketing strategies that strengthen the reputation of the brand, especially in
370 younger vines, to compete in high price segments.

371 The model has proven to be appropriate, with good performance, for analyzing the
372 incidence of many different attributes in different price levels. Therefore, when comparing
373 the results obtained with the ordinary least squares (OLS) model, it can be observed that,
374 with the quantile regression (QR) estimation, the magnitude of the coefficients changes for
375 different price levels, with some coefficients being significant even though the OLS model
376 does not report them.

377 The obtained information can be relevant for companies of the sector to conduct
378 marketing campaigns that reveal some important attributes such as vine and, above all, the
379 designation of the grape's origin or the valleys in which they are located, which has had a
380 negative impact on price. Other variables such as environmental certifications, sensory
381 scores, and some climatic variables can be included in future studies.

382 To remove the limitations in this work, future studies should consider some taking
383 the following approaches: 1) increase wine sample size, especially in the high-priced wine
384 segment; 2) analyze white and sparkling wine together, to determine if the results can be
385 generalized to the entire wine market; and 3) include other attributes in the study, such as
386 label color and design or organic attributes of the product. This would offer a more global
387 view of the different attributes affecting the final price of wine.

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