Segmenting Wine Market: California Red and White Wine Retail Prices in British Columbia

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Abstract

Previous hedonic wine studies have employed conventional regression models to show the effects of objective and subjective attributes such as sensory characteristics, expert quality panel assessments, and regional reputation on wine prices. This paper employs a market segmentation approach based on price to show how lower, mid-priced and higher priced California red and white wines sold in British Columbia (BC) are influenced by objective attributes including geographical origin, grape variety, family brand names, alcohol content, and volume sales. Results show that red and white wine prices are segmented differently and the price segments for either wine type vary from those reported by earlier studies. Also, the effects of numerous attributes on wine prices vary significantly across wine types and price segments. The study findings show higher priced California Cabernet Sauvignon wines fetch a sizeable price premium compared to similar priced varietal wines like Merlot. Higher priced California white wines from Napa are discounted relative to wines labeled with a generic California appellation, whereas higher priced California red wines from Sonoma, Central Valley and Central Coast earn a price discount. Moreover, alcohol content is negatively related to higher priced California red wines, while positively associated with prices of mid-priced and higher priced California white wines.

Keywords: Attribute, hedonic pricing, panel data, varietal wines, log-likelihood test

JEL: Q11, D12, L66

1 Introduction

Wine is generally considered an experience good differentiated by price, geographic origin, grape variety, winery name, vintage, expert ratings, and producer/regional reputation. Price can be used to stratify the wine market into different wine segments with prices signaling wine reputation in the consumer market hierarchy (Zhao 2008). Wine consumers from segmented markets (e.g., connoisseur) can use price and wine labeling information such as alcohol content, grape variety, and geographic origin as cues to assess the quality of a product. Such extrinsic attributes act as risk reducing agents in helping consumers to choose and increase the likelihood of repeated purchases of a product (Lockshin 2002).

Multiple analytical techniques have been applied to improve understanding of how consumers employ labelling and packaging information to make wine purchase decisions. Frequently, the hedonic approach has estimated implicit quality signal prices or the implicit value consumers are willing to pay for the attribute. Hedonic technique uses various functional forms and estimation methods to establish a relationship between prices and quality signals or product attributes. Most of the wine studies employing the hedonic approach have not recognized that wine can be a heterogeneous product and the existence of different consumer segments can respond differently to principal attributes, wine styles, and price categories. California red wine price segments or products of different classes were

first analyzed by Costanigro et al. (2007). The authors found that when the wine market is differentiated consumers value California red wine product attributes differently across wines of different product classes. The current study differs from the Costanigro et al. (2007) study in several respects. First, this study estimates the implicit value of objective characteristics for both red and white California wines sold in British Columbia (BC) to ascertain if there are differences in the implicit values for attributes of red and white wines for different product classes or price segments. Second, the examination accounts for the effects of two variables that have not previously been scrutinized extensively in the literature, namely alcohol content and varied elements of the wine brand such as family brand name to ascertain how they are affected by wine types of different price segments. Third, the current hedonic model endogenously determines the total number of market segments by utilizing data fitting information. Fourth, the number of identified price categories varies by wine type: two ($<=14 and >$14) in the red wine market and three (<$16, $16-$30, >$30) in the white wine market.

2 Determinants of wine prices in hedonic studies

The hedonic price function has been applied in multiple demand studies to measure the contribution of individual quality attributes to prices. Since wine products consist of multiple attributes, empirical applications have analyzed the contribution of objective and subjective factors such as sensory quality characteristics that are

measurable in explaining wine prices. Wine bottle labels in New World countries were meant to be a true declaration of wine content information and conveyed quality signals in terms of the vintage, geographic origin, and the grape variety. The research emphasis of New World wines has been placed on the relationship between brand proxies (e.g., geographic region, variety, vintage, name of winery), expert quality rating scores of sensory traits, specialty labels (e.g., vineyard, estate, reserve), and wine prices or price sub-classes in hedonic model specifications (e.g., Costanigro et al. 2007; Kwong et al. 2011).

In contrast, empirical studies of Old World wines have concentrated on quantifying the effects of reputable production regions (e.g., Landon and Smith 1998) and sensory attributes (e.g., Cardebat and Figuet 2004; Lecocq and Visser 2006) on consumers' valuation of wine. Recent research has shown the relative unimportance of sensory quality ratings relative to wine reputation variables in affecting prices, which may suggest that consumers rely on wine reputation as quality cues to make purchase decisions (Oczkowski and Doucouliagos 2014).

California wine brands have expanded over the years and offer consumers a range of wine styles and attribute choices. Wine branding can be considered a multi-faceted (e.g., family brand, vintage, country of origin, regional appellation) hierarchical concept employed by wineries to differentiate their product, while providing consumers with invaluable quality information to recognise a wine label

and make a rational product choice (Lockshin et al. 2000). Lockshin et al. (2006) measured the importance of wine region, corporate brand name, awards won, and prices and found low involvement consumers used price and wine awards, while high involvement consumers used geographic origin to make their purchase decisions.

The bulk of empirical studies investigating the relationship between wine prices and quality cues such as grape variety, alcohol content, vintage, region or country of origin, and producer reputation employed an array of data sets. The distinct characteristic of wine pricing studies applying the hedonic approach is the use of three-series data sets. Table 1 shows summary highlights of selected hedonic wine pricing studies. The use of hedonic models shows that California wine prices were impacted significantly by expert quality assessments even after adjustments for grape varieties and appellation regions (Schamel 2002). A study of 63 appellations across diverse wine growing areas in California showed the interaction of grape variety and appellation influenced wine prices even after accounting for vintage and tasting scores (Sang-Kwon et al. 2008). Specifically, the authors found Cabernet Sauvignon wines from Napa commanded relatively high price premiums which is consistent with recent evidence showing grape variety is the principal dimension in the classification system of California wines and consequently exerts a significant impact on its price (Zhao 2008). Wine prices

in major wine regions throughout the world were influenced primarily by geographic region in addition to grape variety, expert wine quality ratings, and age of the judged wines (e.g., Schamel 2006, 2009).

Another strand of the wine literature relates to choice experiments. The combination of multiple wine attributes, varied consumer characteristics, and frequency of wine consumption have forced researchers to adopt other methodological approaches to understand how consumers value prices and other extrinsic cues in making their wine selections (e.g., Lockshin et al. 2006; Gustafson et al. 2011). Lockshin et al. (2006) found, from a choice experiment survey of shoppers in Adelaide wine stores, that regional awareness (in terms of where the wines were produced) increased the quantum of retail sales of small and large corporate brands. However, the effect differed for low and high involvement consumers. The latter were willing to increase their purchases of premium wines (priced more than $17 per bottle) from reputable wine regions. These results are consistent with an earlier study that showed California consumers, who were highly involved with red wines, placed less emphasis on the price cue in evaluating alternatives when compared to low involvement consumers (Zaichkowsky 1988). Ontario consumers were influenced to a smaller degree by region of origin or gold medal awards in making their wine purchase selections (Lockshin and Halstead 2005). Gustafson et al. (2011), using data from a laboratory experiment, showed

California consumers were willing to pay more for Cabernet Sauvignon wines from Napa and Sonoma than wines labeled with the generic California appellation. Gustafson (2011) suggests that appellation is a highly valued attribute in California consumer valuation of wine choices and that some of the positive values attributed to the Napa appellation could be attributed to vineyard and winery management practices that can influence grape and wine quality.

3 British Columbia wine market

British Columbia is the second largest wine market in Canada, after Ontario, with British Columbians drinking more wine today than in the past because of growing affluence and changing life styles. The average per capita annual consumption increased by 42.3% from 14.9 litres in 2000 to 21.2 litres in 2013 in the province (Statistics Canada 2015). The trend is consistent with the continuing shift towards the consumption of premium quality wines, especially by an aging population who has the wealth to purchase more expensive wine brands (Goertzen 2012). The wine economy in BC is a significant sector creating more than 10,000 jobs in about 280 wineries and generating winery sales of 3.9 million cases (9 liter equivalent) with the total economic contribution to the BC economy of about $2 billion in 2011 (Rimerman & Company LLP Report 2013).

Despite the sizable province-based wine industry, most of the wine British Columbians drink is imported from the United States, followed by imports from

Italy and France. Table 2 shows BC wine imports from California increased in both value and volume over time. Import value increased from CAD $26.1 million in 2000 to $51.9 million in 2014 (98%). However, the sales volume experienced a slower growth (8%). In contrast, British Columbia Vintners Quality Alliance (BCVQA), which requires wine to be made exclusively from BC grown grapes, has grown in popularity over the years and its domestic market share accounted for 20.2% and 14.6% of value and volume, respectively, at the end of the 2014 fiscal year (BC Wine Institute Annual Report 2013/14). Other BC wine (non-VQA "Cellared in Canada" and made mostly from imported grapes) market shares totalled 23.9% in value terms. Among imported wines, the market share of those imported from the United States (mostly from California) was 12.6%, considerably larger than that of imports from Italy and France, 7.6% and 7.3%, respectively (BC Wine Institute Annual Report 2013/14).

Most BCVQA wines are red wines with Merlot, Cabernet Sauvignon, and Pinot Noir the top three planted varietals. The domestic red wine varieties are often the same as those imported from California. The domestic marketing of BCVQA wines occurs through several marketing channels. BC winery direct sales and BC Liquor Distribution Branch represent the two main marketing channels with retail sales of $60 and $50 million, respectively, in 2013/2014 (BC Wine Institute Annual Report 2013/14). Other market channels include Licensee Sales through

restaurants and pubs ($45 million), Licensee Retail beer and wine stores ($42 million), and BCVQA Store Sales ($20 million) (BC Wine Institute Annual Report 2013/2014). The latter represents VQA wine sales of roughly 20 VQA stores located throughout the province.

4 Modeling approach

Following Rosen (1974), the empirical relationship between wine prices and wine product attributes is expressed as follows:

$$P(z) = P(z_1, \ldots, z_n), \tag{1}$$

where P is the actual transaction price and z is a vector of extrinsic and intrinsic attributes. Consumer wine choice is based on utility maximization which requires consumers' choosing ($z_1, z_2, \ldots, z_n$) and x (i.e., other goods) subject to the consumers' budget constraint (y). The partial derivate of the price function with respect to the ith wine attribute is denoted as

$$Pz_i = Uz_i / Ux, \; i = 1, \ldots, n, \tag{2}$$

where the marginal implicit price for z_i is equal to the ratio of the marginal utility, assuming the utility function given as U ($x, z_1, \ldots, z_n$) is strictly concave. In our study, the vector z includes objective measures of wine attributes (red or white type, name of winery or vineyard operator, grape variety, country, region, sub-region, and alcohol content) on the bottle's label when the wine is first purchased by the consumer. Estimating a hedonic price function, therefore, provides

information on the value that consumers are willing to pay for the objective label characteristics. Based on Costanigro et al. (2007), the wine market is segmented by price categories, and the conventional hedonic price modeling is employed to each set of segmented markets shown below:

$$P = P_m(z), \text{ for } P \in (L_m, H_m], \text{ m=1,…, s,} \quad (3)$$

where m denotes a market segment, L_m and H_m are the corresponding lower and upper price boundaries, and s denotes the total number of segments.

Gustafson (2011) argued that when the attributes of wine cannot be unbundled, the hedonic price function will likely be non-linear. In general, consumer theory does not provide any guidance on what functional form ought to be used in empirical hedonic model applications. Triplett (2004) argued that the choice of the functional form should be based on the data, which implies the application of the Box-Cox test to several functional forms. This study probed different functional forms (including linear, natural logarithm, and inverse square root) for both red and white wine price series. The Box-Cox test values indicate that the natural logarithmic function was preferred for the data.

5 Data sources and description

British Columbia wine importers have strong relationships with the large California wine industry. The latter offers great diversity in wine styles and wines

produced from varied regions and climatic conditions. California's premium wine sales have soared recently. Sales of table wines priced above $20 per bottle rose 17% by volume and 15% in terms of value (Shanken's Impact Newsletter 2013). Much of the growth was attributed to younger consumers entering the market segment earlier than the preceding generation.

The data refers to weekly British Columbia Liquor Distribution Branch (BCLDB) retail sales for selected California red and white brands in the period from April 1, 2009 to May 31, 2011. Wines retailed by the BCLDB are identified by SKUs (stockkeeping units). Each SKU corresponds to the description on the wine label such as the unit price, grape variety, producer brand name, country of origin, geographical region of production, sub-region (e.g., Napa in the case of California); and alcohol content. Alston et al. (2011) noted the alcohol content of California premium red wines has risen substantially since 1980 and this may be explained by a combination of vineyard management practices and wineries responding to changing consumer preferences for more intense and riper flavored wines.

The applied retail data include sales through BC liquor stores, restaurants, bars, private liquor stores, and independent wine stores. The data refer to the important California wine brands merchandized in BC coupled with a complete data set for each wine brand over the sample period. Table 3 shows the descriptive

statistics for red and white wine unit prices including the number of sold bottles and alcohol content. Retail wine prices are adjusted for inflation using the Canadian Consumer Price Index (CPI) for alcohol beverages purchased from stores (Statistics Canada, 2013). The average prices of white wines are relatively higher than those of red wines, while the red wine alcohol content slightly exceeds that of white wines.

Table 4 lists the main California wine regions. About 28% of red wines are from the Central Coast, while 30% originate from the North Coast, namely Napa and Sonoma. A relatively larger percent (46%) of white wines are from Napa and Sonoma, with another 20% being from the Central Coast. Wines from the Central Valley, including wines from the Lodi American Viticultural Area, account for a smaller percent of red and white wines in this study, a region best noted for inexpensive high volume wines. Napa is recognized for its Cabernet Sauvignon and Merlot which account, respectively, for 33% and 14% of the red wines in the sample used in this study (Table 5). The bulk of white wines are Chardonnay. It accounts for 61% of the white wines (Table 5). White grape varieties such as Chardonnay tend to thrive in the cooler Sonoma, while Cabernet Sauvignon grapes perform better in the warmer wine regions such as Napa. Table 6 reports the family brand names for both red and white wines. Beringer Vineyards have the largest share and account for 15% of the white wines and 11% of the red wines.

6 Estimation approach

Numerous approaches permit the separation of wine into different product categories or classes. Marketing researchers typically apply segmentation techniques and group consumers with similar socio-economic characteristics and patterns of wine purchasing behavior to target sales and develop advertising strategies (Santos et al. 2006; Kolyesnikova et al. 2008). Levaggi and Brentari (2014) separated Italian wines based on different retail outlets (wine shops vs. large scale retail stores) and found extrinsic attributes on the bottle label are the principal price determinants for wines sold by large-scale retail outlets. Costanigro et al. (2007) minimized the sum of squared error (SSE) and used the Wald test to detect and test breakpoints in the price distribution of their California red wine sample. Four different wine price categories (< $13, $13-$21, $21-$40, and > $40) were identified in estimating the optimal number of structural breaks. A similar market segmentation approach was adopted by Kwong et al. (2011) in the Ontario wine study. Two breakpoints separated the sample into lower (<$18) and higher (>$18) priced wines. However, the method Kwong et al. (2011) employ to separate Ontario red wines into lower and higher prices is somewhat ad hoc since it was based on the price ranges for ultra-premium wines reported by Wine Business Magazine. Separating Ontario higher price (>$18) and lower price (<$18) wine

categories appears too simplistic since it does not consider the range in prices on either side of the price distribution.

The current study contributes to the literature on segmented hedonic models by allowing the number of market segments to be identified by the data fitting information rather than predetermined as reported in Costanigro et al. (2007) and Kwong et al. (2011). The detection of the total number of segments and examination of the breakpoints follow several steps. The starting point is the calculation of the log-likelihood values by using one breakpoint and two market segments - the simplest case. As the breakpoint changes over the price range, each price segment requires the calculation of the associated log-likelihood value. Based on the structure of observed price data, the price ranges of red and white wines used to locate the breakpoints are, respectively, [$8, $30] and [$11, $34]. The second step determines the number of market segments based on the pattern of log-likelihood values obtained from the previous step (i.e., monotonicity and the number of local maximum points). The number of local maximum points corresponding to the log-likelihood value is the optimal breakpoints in the data. If more than two market segments are identified in the data, then the log-likelihood value of the associated price grid (n dimensions for n breakpoints) needs to be examined to determine the location of the breakpoints. The third step involves the comparison of pooled versus segmented modeling. The likelihood ratio tests

whether the market segment modeling as identified above fits significantly better than the data from the pooled modeling method.

In the current study, the hedonic price function makes the assumption that wine is a heterogeneous product. Rosen's (1974) framework permits the consideration of demand and supply factors influencing the price of a bottle of California wine as explained by geographic region of origin, grape variety, family brand name, alcohol content, and rarity as proxied by number of bottles sold. The adopted approach follows earlier studies (Costanigro et al. 2007; Kwong et al. 2011; Roma et al. 2013) by including sales quantity in the hedonic price equation interpreted as the user attribute reflecting "rarity" availability.

The hedonic regression model is described as follows:

$$\text{Ln}(P_{it}) = \alpha + \beta_1 (\text{Geographic region}_{it}) + \delta_2 (\text{Grape variety}_{it}) + \gamma_3(\text{Family brand}_{it}) + \Gamma_4(\text{Color}_{it}) + \lambda_5(\text{Alcohol}_{it}) + \Phi_6 (\text{Quantity}_{it}) + \varepsilon_{it}, \quad (4)$$

where Ln (P_{it}) is the natural logarithm of the retail price for the ith wine (i=1,…, n) sold in time period t. The unknown parameters (α, β_1, δ_2, γ_3, Γ_4, λ_5, and Φ_6) correspond to wine objective attributes (geographic region, grape variety, family brand, wine color, and alcohol content), and ε_{it} is the error term that is independently distributed with mean zero. The continuous variables are retail unit prices, sales quantity, and alcohol content, while the discrete characteristics

defined as binary variables include geographic region, grape variety, and family brand name.

7 Results and discussion

This study identifies breakpoints of the price level in the red and white wine samples (both the total number and location) that could maximize goodness of fit (indicated by the value of log-likelihood value). The results indicate the existence of two product classes (=<$14, >$14) for red wines (Table 7a) and three product classes (=<$16, $16-$30, and > $30) for white wines (Table 8a). Tables 7b and 8b report the values of the log likelihood and the likelihood ratio test for each type. The wine data for California red and white wines are both modeled using a multivariate regression using STATA (StataCorp, College Station, Texas). Equations are estimated for each wine product class as well as the pooled model.

(i) California Red Wine Results

Table 9 shows the estimated coefficients and the goodness of fit measure represented by R^2 of both pooled and segmented models. The pooled model results indicate regional designation such as Napa (+52.8%), Sonoma (+10.7%), Central Valley (+6%), and Central Coast (+4.0%) fetched price premia relative to generic California appellation wines. The lower priced wines from Sonoma (+26.9%) and Central Coast (+12.0%) commanded the highest premium, whereas higher priced wines from Sonoma (-32.2%), Central Coast (-46.9%), and Central Valley (54.0%)

report larger price discounts. Such results differ from Costanigro et al. (2007) who reported Napa semi-premium red wines (between $13 and $21) earned higher premia than similarly priced wines from Sonoma or the Bay Area. Current results indicate the absence of significant differences between higher priced red wines from Napa and those labeled with the California generic appellation. Napa is one of the principal California wine regions producing the best quality Cabernet Sauvignon and dominates the list of top-rated tasted wines by the Wine Spectator (Laube 2012). Although Sonoma is also noted for producing some good quality Cabernet Sauvignon wines, they rarely approach the quality achieved by Napa wines.

The coefficient parameters regarding grape variety variables capture the premiums or discounts relative to Cabernet Sauvignon. Cabernet Sauvignon wines have the potential to express individual vineyard attributes better than other grape varietals and this may be the reason why most of them are produced in warmer regions such as Napa (Laube 2012). Pooled model results reveal Zinfandel (-6.5%) and Syrah (-10.8%) is price discounted, while Pinot Noir (+13.5%) varietals fetch price premia relative to Cabernet Sauvignon. Pinot Noir has become the signature grape varietal in Sonoma with diverse wine styles. Results from the current analysis are consistent with the higher price premia reported by Costanigro et al. (2007) for Cabernet Sauvignon and Pinot Noir relative to Zinfandel which is

known for producing fruity flavored brands such as “Gnarly Head”. There has been a shift in Cabernet Sauvignon and Pinot Noir production in California over the years towards higher priced and higher quality table wines (Volpe et al. 2010). The segmented price model results indicate higher priced wines made from varieties like Merlot (-5.5%) and Syrah (-7.3%) are discounted relative to Cabernet Sauvignon, whereas lower-priced Merlot (+13.6%), Pinot Noir (+23.9%), and Zinfandel (+18.9%) earned premia.

Over time, wine brand owners have educated consumers about wine attributes and have played a significant role in the marketing of New World wines in major industrial cities. Steiner (2004) has shown that British consumers consider jointly the grape variety and geographical region as brand proxies for Australian wines sold in the British wine market. The results from this study show family brand names like “Beringer” (+15.7%) and “Delicato” (+37.2%) earned price premia for lower priced red wines, but were discounted for higher priced wines. Also, “Gallo Family Vineyards” shows a price discount for wines in the lower priced category of red wines. Priilaid and Rensburg (2012) employed a range of modeling approaches to value wine brands in the South African wine industry and found brands to be a good proxy for measuring consumer loyalty and brand equity.

The alcohol content is shown to be negatively associated with higher-priced California red wines, while positively with lower-priced wines. The statistically

significant squared term of alcohol content indicates that the attribute has a nonlinear effect on the prices of higher priced wines. Such outcome suggests that increasing alcohol content leads to a price increase, but a continuing increase has the opposite effect. Previous studies (e.g., Thrane 2004; Roma et al. 2013) have shown the alcohol content is a favorably viewed attribute and has a statistically significant positive effect on the prices of red French and Italian wines. Interestingly, label claims of California red wine alcohol content sold in Ontario have been underreported when compared to the actual alcohol percentage and the drivers for this discrepancy may have been tax avoidance by wineries combined with the perception that higher alcohol content diminishes consumer value for certain wines (Alston et al. 2015).

The quantity variable and evidence of how consumers value rarity reflected in the negative association of wine prices for all wine price segments. The magnitude of the coefficients is slightly higher in the case of lower priced wines. Results from the current study support those reported by Costanigro et al. (2007), where the relationship between wine prices and the number of cases produced was negative for both premium and non-premium California wines.

(ii) California White Wine Results

The hedonic white wine price model results from the pooled and segmented models are shown in Table 10. The pooled model results reveal large price premia for white wines from Napa (+54.1%), Sonoma (+28.7%), and Central Coast (+18.7%) relative to the generic California appellation. The higher-priced wines from Napa are discounted similarly to wines from Central Valley (-11.4%). But the lower-priced wines from Central Coast (+19.7%) fetch a price premium. Most of the mid-priced wines from Sonoma (-9.1%) and the Central Coast (-23.2%) are discounted, whereas mid-priced wines from Napa (+10.3%) earn a price premium.

Grape varietal wines such as Pinot Grigio fetch a price premium relative to Chardonnay in both the pooled and the lower-priced segmented models. Mid-priced (-10.3%) and higher-priced (-30.8%) Sauvignon Blanc wines are discounted as compared to the benchmark Chardonnay. In contrast, lower-priced Sauvignon Blanc (+40.9%) wines earn a price premium.

All coefficients depicting family brand names are statistically significant in the pooled model. Family brands like “Beringer” with wine styles for different consumer segments are evident in the lower, mid-priced, and higher-priced product categories. “Beringer” earns a price premium in both lower- and higher-priced wines, while they fetch a discount in the mid-priced wines. Robert Mondavi, the well-known family brand, caters to consumers of different price segments. Certain brands such as “Cakebread Cellars” and “Mirassou” are only available in one price

category. The former gains a price premium in the higher-priced wines, while the latter earns a price premium in the lower-priced wines.

The alcohol content of wines positively influences prices of higher- and mid-priced wines in the segmented models, but negatively in the pooled model. The indicator of wine scarcity (variety) reflected in the number of bottles sold is negative and significant in the pooled lower-priced and higher-priced white wine hedonic models.

8 Conclusion

California wines have gained a significant share in the BC wine market over the last decade despite the domestic wine policy reforms to permit the sales of BCVQA wines in grocery stores. This study expands the contribution of Costanigro et al. (2007) and Levaggi and Brentari (2014) showing that hedonic price functions specific to red and white wines differ, and within each wine type product classes are differentiated by price segments. This study employs BCLDB retail stores wine data for California wine sales to investigate how British Columbian consumers value attributes of red and white wines categorized in different price segments and highlight the principal objective attributes that provide a comparative assessment of California red and white wines, namely geographic region, grape variety, winery/vineyard operator brands, alcohol content, and number of bottles sold.

Results identified two red wine and three white wine pricing classes. Overall, the implicit values for attributes of red and white California wines differ by grape varietals and geographic region. Moreover, California red wines from different geographic regions fetch a sizable premia in contrast to similar appellation measures associated with white wines. Also, the premium for Pinot Noir and Merlot in the case of lower-priced California wines was substantial as compared to Cabernet Sauvignon, while higher-priced Cabernet Sauvignon also more often fetches a premium for geographical regional attributes. California lower-priced red wines and mid-priced and higher-priced white wines also fetch a considerable premia with regard to alcohol content. The study results provide insights regarding the development of advertising and brand marketing strategies to enhance the market share of wines of different price segments and wine styles in an environment characterized by growing imports from New World producers.

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Table 1. Literature review of hedonic wine quality studies.

Authors	Method	Sample coverage	Type of wines/regions	Data source	Research highlights
Schamel (2002)	Hedonic method (pooled)	Wine judging years:1990-2001	Major wines (Cabernet Sauvignon, Zinfandel, Chardonnay) and regions (Napa, Sonoma, South Central) in California	California Wine Winners publication	Premium wine prices influenced by expert quality assessments and producer/regional reputation
Costanigro et al. (2007)	Hedonic method (retail price segmentation)	California and Washington red wines, 1991-2000	California red wines from principal wine regions	Wine Spectator	Consumers valued wine attributes differently in segmented markets based on price
Benfratello et al. (2009)	Hedonic method (pooled)	1995-1998 vintages	Italian premium quality wines: Barolo and Barbaresco	Wine Spectator and the 'Duemila Vini' Italian Guide	Reputation factors are more superior than sensorial attributes in explaining Italian wine prices
Roma et al. (2013)	Hedonic method (pooled)	2010 editions of Italian wine guides, 2004-2008	Sicilian wines (excluding sparkling and reserve wines)	Two Italian guides: 'Duemila' and 'Vini d'Italia'	Geographical region, grape variety, vintage and alcohol have significant influence on price
Levaggi and Brentari (2014)	Hedonic method (retail channel segmentation)	2005-2009	Italian red wines sold in wine shops and large-scale retail trade	Independent consumer association (Guida Vini)	Wine label characteristics are the main determinants of wine prices sold in large-scale retail trade

Table 2. British Columbia wine imports (value and volume) from selected countries, 2000-2014.

	California		Rest of United States		France		Italy		Spain		South Africa		Argentina		Chile		World	
Year	CA D$ Million	Million Ltr.	CA D$ Million	Million Ltr.	CA D$ Million	Million Ltr.	CA D$ Million	Million Ltr.	CA D$ Million	Million Ltr.	CA D$ Million	Million Ltr.	CA D$ Million	Million Ltr.	CA D$ Million	Million Ltr.	CA D$ Million	Million Ltr.
2000	26.1	11.9	1.8	0.6	17.1	3.4	11.4	3.1	3.8	0.7	2.4	1.1	1.4	0.4	12.7	5.8	101.0	32.9
2001	23.9	12.3	1.3	0.3	13.7	2.8	10.7	2.8	3.2	0.7	2.3	1.1	1.2	0.3	11.4	6.7	90.5	32.5
2002	24.5	13.2	1.0	0.2	16.7	3.4	13.6	3.5	3.2	0.7	3.1	1.5	1.3	0.3	10.9	7.0	103.8	36.5
2003	22.8	12.7	1.3	0.3	16.4	3.1	15.0	3.9	3.5	0.8	2.9	1.5	1.4	0.5	10.8	7.2	109.7	37.5
2004	25.3	14.3	1.3	0.2	16.6	2.8	13.3	3.0	3.9	0.8	5.1	1.6	2.2	0.7	11.7	7.1	124.5	39.9
2005	26.0	13.3	1.6	0.3	17.8	3.2	13.9	3.2	4.5	1.4	5.7	2.9	3.3	2.1	10.8	6.2	138.4	44.3
2006	28.6	13.6	1.6	0.2	22.6	3.7	17.2	3.9	5.4	1.2	6.3	2.4	4.1	2.1	12.6	5.4	162.1	47.1
2007	33.2	14.9	2.1	0.4	24.6	3.5	20.1	4.4	6.1	1.2	5.2	2.3	6.9	3.6	17.4	9.2	189.2	54.9
2008	41.4	18.6	2.3	0.6	32.9	3.9	22.9	4.7	6.9	1.4	6.2	2.8	8.9	4.3	20.7	10.9	216.3	62.4
2009	34.4	13.1	1.3	0.3	22.1	2.7	20.1	4.9	6.1	1.2	4.7	1.6	12.1	4.3	18.1	11.2	172.7	53.2
2010	34.9	12.7	1.9	0.3	23.7	3.6	21.3	5.1	7.9	3.7	5.1	1.7	11.9	3.2	16.6	8.1	178.4	57.2
2011	35.8	12.2	2.2	0.5	24.5	3.4	22.1	6.4	12.4	9.3	5.1	2.4	11.9	3.7	14.1	5.2	179.3	58.0
2012	40.3	9.9	2.7	0.3	38.6	4.4	24.3	6.3	14.0	11.5	7.7	6.4	14.4	5.4	14.2	4.7	197.6	61.8
2013	45.2	9.6	2.8	0.5	31.9	4.5	24.4	5.4	12.2	5.5	7.9	7.1	14.5	5.2	16.4	8.6	202.8	58.6
2014	51.9	12.9	3.1	0.6	31.6	3.3	27.3	5.1	13.8	5.7	7.8	5.3	15.0	3.6	19.7	12.5	230.0	67.2

Notes: Wine imports include table wine, fortified wine (e.g., Sherry, Port), Icewine, Sparkling wine and Champagne
Source: Gervais, M. 2015. Statistics Canada trade data tabulation request. Agriculture and Agri-Food Canada, global Analysis Division.

Table 3. Descriptive statistics for California red and white wine retail prices, alcohol content and bottles sold.

Characteristic	Mean	Std dev	Min	Max	Count	Median
			Red wine			
Price ($/bottle)	17.72	9.92	3	61.94	3707	15.68
Alcohol content (%)	13.78	0.58	12.5	15	3707	13.6
Average weekly bottles sold	386.57	383.07	1	2781	3707	275
			White wine			
Price ($/bottle)	20.44	11.37	3	56.63	4112	17.54
Alcohol content (%)	13.49	0.63	12	15	4112	13.5
Average weekly bottles sold	204.93	337.48	1	2491	4112	80

Table 4. Descriptive statistics for California red and white wines by wine regions.

Wine region	Red wines		White wines	
	Frequency	Percentage	Frequency	Percentage
California	1214	32.7	1101	26.8
Central Coast	1050	28.3	825	20.1
Central Valley	315	8.5	295	7.2
Napa	630	17	1218	29.6
Sonoma	498	13.4	673	16.4
Total	3707	100.0	4112	100.0

Note: Notable wines from the Central Valley include wine labels from the Lodi region.

Table 5. Descriptive statistics for California red wine and white wine grape varieties.

Variety	Frequency	Percentage
	Red wine	
Cabernet.Sauvignon	1233	33.3
Merlot	525	14.2
Pinot.Noir	618	16.7
Syrah	600	16.2
Zinfandel	731	19.7
Total	3707	100.0
	White wine	
Chardonnay	2521	61.3
Pinot Grigio	715	17.4
Sauvignon Blanc	876	21.3
Total	4112	100.0

Table 6. Descriptive statistics for the family brand name of winery/vineyard producing red or white wine.

Family brand name	Frequency	Percentage
	Red wine	
Beringer Vineyards	420	11.3
Delicato Family Vineyards	194	5.2
Gallo Family Vineyards	198	5.3
J.Lohr Vineyards	420	11.3
Other	2475	66.8
Total	3707	100.0
	White wine	
Beringer Vinyards	622	15.1
Cakebread Cellars	210	5.1
Mirassou Winery	185	4.5
Robert Mondavi	301	7.3
Other	2794	67.9
Total	4112	100.0

Table 7a. Break points and associated total log-likelihood (two groups).

Breakpoints	nlow	nhigh	llk_total
8	303	3404	1679.86
9	303	3404	1679.86
10	303	3404	1679.86
11	685	3022	1789.49
12	888	2819	2331.11
13	1134	2573	2619.26
14*	1441	2266	2933.88
15	1704	2003	2507.97
16	2027	1680	2140.27
17	2132	1575	2105.20
18	2552	1155	2049.84
19	2552	1155	2049.84
20	2640	1067	1679.38
21	2845	862	1418.96
22	3061	646	1290.61
23	3077	630	1284.00
24	3077	630	1284.00
25	3287	420	1181.42
26	3323	384	1177.14
27	3392	315	1174.54
28	3392	315	1174.54
29	3392	315	1174.54
30	3392	315	1174.54

* Denotes the optimal breaking point.

Table 7b. Likelihood ratio test, degrees of freedom, and p-value for segmenting California red wine using cutting point 14.

Likelihood ratio statistics	Degrees of freedom	P-value
4498.52	14	<0.0001

Note: The null hypothesis is “the pooled modeling fits the data better than the segmented model.” The likelihood ratio test indicates the rejection of the null hypothesis.

Table 8a. Breakpoints and associated total log-likelihood (three groups).

Lower breakpoint	Upper breakpoint	nlow	nmid	nhigh	llk_total
13	30	1362	2044	706	5015.22
13	31	1362	2136	614	4836.09
13	32	1362	2136	614	4836.09
13	33	1362	2175	575	4698.02
14	30	1502	1904	706	4867.24
14	31	1502	1996	614	4685.64
14	32	1502	1996	614	4685.64
14	33	1502	2035	575	4552.81
15	30	1587	1819	706	4962.58
15	31	1587	1911	614	4794.76
15	32	1587	1911	614	4794.76
15	33	1587	1950	575	4675.51
16*	30*	1685	1721	706	5243.92
16	31	1685	1813	614	5058.56
16	32	1685	1813	614	5058.56
16	33	1685	1852	575	4925.41
17	30	1790	1616	706	5124.71
17	31	1790	1708	614	4937.53
17	32	1790	1708	614	4937.53
17	33	1790	1747	575	4810.38

* Denotes the optimal breaking point.

Table 8b. Likelihood ratio test, degrees of freedom, and p-value for segmenting California white wine using cutting point 16 and 30.

Likelihood ratio statistics	Degrees of freedom	P-value
10157.14	18	<0.0001

Note: The null hypothesis is “the pooled modeling fits the data better than the segmented model”. The likelihood ratio test indicates to reject the null hypothesis.

Table 9. Pooled and segmented estimation results for California red wine.

Y=Ln(P)	Pooled	Price segments Lower priced P<=14	Higher priced P>14
(Intercept)	34.814***	-6.032*	37.488***
	(1.949)	(3.616)	(2.590)
	Region (Baseline=California)		
Central Coast	0.040***	0.120***	-0.469***
	(0.015)	(0.008)	(0.032)
Central Valley	0.060***		-0.540***
	(0.019)		(0.027)
Napa	0.528***		-0.039
	(0.017)		(0.032)
Sonoma	0.107***	0.269***	-0.322***
	(0.016)	(0.008)	(0.032)
	Grape variety (Baseline=CabernetSauvignon)		
Merlot	-0.011	0.136***	-0.055***
	(0.014)	(0.008)	(0.018)
Pinot Noir	0.135***	0.239***	0.014
	(0.016)	(0.012)	(0.024)
Syrah	-0.108***	-0.076***	-0.073***
	(0.015)	(0.010)	(0.025)
Zinfandel	-0.065***	0.189***	-0.008
	(0.013)	(0.011)	(0.025)
	Brand (Baseline=other)		
Beringer	0.014	0.157***	-0.306***
	(0.015)	(0.012)	(0.032)
Delicato	0.006	0.372***	-0.588***
	(0.019)	(0.010)	(0.034)
Gallo Family Vineyards	-0.846***	-0.916***	
	(0.020)	(0.012)	
J.Lohr	0.307***	-0.135***	0.295***
	(0.015)	(0.014)	(0.018)
Alcohol.Percent	-4.903***	1.515***	-5.200***
	(0.284)	(0.538)	(0.377)
Alcohol.Percent2	0.187***	-0.067***	0.198***
	(0.010)	(0.020)	(0.014)
Bottles sold	-0.042***	-0.016***	-0.056***
	(0.001)	(0.001)	(0.001)
No of observations	3,707	1,441	2,266
Adjusted R^2	0.840	0.977	0.767

***p<0.01, ** p<0.05, * p<0.1;

Note: Standard errors in parentheses.

Table 10. Pooled and segmented estimation results for California white wine.

Y=Ln(P)	Pooled	Price segments		
		Lower priced group (p<=16)	Mid-priced group (p>16 & <=30)	Higher priced group (p>30)
(Intercept)	20.509***	3.331	-14.771***	-1209.928***
	(1.085)	(7.390)	(0.798)	(2.365)
Region (Baseline=California)				
Central Coast	0.187***	0.197***	-0.232***	
	(0.014)	(0.019)	(0.008)	
Central Valley	-0.143***	-0.114***		
	(0.019)	(0.021)		
Napa Valley	0.541***		0.103***	-1.878***
	(0.014)		(0.007)	(0.004)
Sonoma County	0.287***	0.029	-0.091***	
	(0.016)	(0.031)	(0.009)	
Grape variety (Baseline=Chardonnay)				
Pinot Grigio	0.066***	0.295***		
	(0.015)	(0.015)		
Sauvignon Blanc	-0.074***	0.409***	-0.103***	-0.308***
	(0.011)	(0.036)	(0.004)	(0.001)
Brand (Baseline=other)				
Beringer	-0.219***	0.099***	-0.380***	9.007***
	(0.012)	(0.018)	(0.006)	(0.018)
Cakebread Cellars	0.416***			0.605***
	(0.012)			(0.001)
Mirassou	-0.249***	0.044**		
	(0.020)	(0.019)		
Robert Mondavi	-0.293***	-0.249***	-0.219***	
	(0.017)	(0.045)	(0.007)	
Alcohol.Percent	-2.858***	-0.178	2.591***	176.345***
	(0.163)	(1.160)	(0.120)	(0.344)
Alcohol.Percent2	0.114***	0.008***	-0.093***	-6.394***
	(0.006)	(0.045)	(0.004)	(0.012)
Bottles sold	-0.074***	-0.048***	-0.003	-0.004***
	(0.001)	(0.001)	(0.002)	(0.002)
No of observations	4112	1685	1721	706
R-square	0.82	0.72	0.86	0.99

*** p<0.01, ** p<0.05, * p<0.1; numbers in parentheses are standard errors.