Components of Wine Prices for Australian Wine: How Winery Reputation, Wine Quality, Region, Vintage, and Winery Size Contribute to the Price of Varietal Wines

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Abstract

Australian wines are identified by the varietal names of the grapes rather than the regions as in France and other traditional wine producing countries. This paper uses the concept of hedonic price theory to investigate a range of extrinsic characteristics' ability to predict prices for different climate regions (warm and cool) and four major wine varieties of Australian wines, two reds (shiraz and cabernet) and two whites (chardonnay and riesling). The effects of winery reputation (wine company/brand), winery size (production scale), age of the wine, and region of origin (wine grape source) contributing to the relationship between price and quality attributes of Australian wines are investigated, based on 1880 observations of bottled wines. Wine quality rating and winery/brand reputation have major effects on the price, while region and size of winery have differential effects depending on the variety of grape. Vintage has only a minor effect.

Keywords: Australian wine, Wine attributes, Wine brand, Wine price, Hedonic price analysis

1. Introduction

The vibrant nature of the Australian wine sector is typified by the compound annual growth rate of exports of over 18% from 1988 to 2001. This compares to a world growth rate of just 3.6% over the same period (AWBC, 2001). Australian wines have increased from just over one percent of world wine export value to 5.5% in the same period. The growth in volume and value of exports has been accompanied domestically with an increase in the consumption of bottled wine compared to the consumption of cask (or bag in the box) wine (Anderson et al., 2001). Both of these trends have raised the price of the average bottle of Australian wine over the same 13 year period.

Australian wine production practices have differed in many key ways from those of the traditional European wine producing countries (Halliday, 1999). Wines are identified by the varietal names of the grapes rather than the regions as in France and other traditional wine producing countries. Also, wines are often blended across regions. Brands are important identifiers for the wines, and like in Europe, some producers have better reputations than others for wine quality. But there is a trend to single region wines and the establishment of the Australian-EU trade agreement for wine has resulted in the formal identification of regions, now called geographic indicators (AWBC, 1994; Ryan, 1994). This has awakened interest in the value of regions compared to wine brands (Tustin and Lockshin, 2001). Also wine companies have merged and created multiple wines under specific brand names, so the reputation that accrues to a brand may be related to a number of different wines at different price points. This vertical ranging is similar to how automobile brands seek to establish a halo effect from the higher priced models to the lower end of the range.

Hedonic price analysis has been used to measure the marginal value or contribution to the price for a number of different products. Wine is one product well suited to this type of analysis, due to its highly differentiated forms and the difficulty in objectively assessing quality (Oczkowski 2001). This paper uses hedonic price analysis to measure the impact on price of winery brand name, wine quality, region, size of the winery

(processing capacity), and vintage date. These objective elements are available to consumers when making a choice of wines. The quality rating of the wine is available to consumers through ratings published by various wine writers and critics. Often these are displayed on the retail shelf. Understanding the value of each of these elements is useful for wine marketing managers. Knowledge of the relative importance of brand or region to consumers would allow marketing managers to decide how much each should be emphasized in promotion or even how to organize products on the shelves. Small producers need to know whether region is an important component, because with limited funds to spend, they could band together to promote regions rather than their own brands. Though the quality of the wine is a subjective judgment, wine writers are believed to influence consumer perceptions. Hedonic price research, using wine critics' evaluations, can estimate the value of these judgments. The results then are useful for allocation of scarce resources to the most efficient factors in informing consumers and maintaining or increasing prices.

The major difference between this paper and the previous use of the hedonic price function for Australian wines (Combris et al., 1997, 2000; Oczkowski, 1994, 2001; Schamel and Anderson, 2001) is the specification of an equation for each variety. This allows us to measure the value of the independent variables separately for each type of wine. This makes sense, as the reputations of different regions for wine quality are linked to specific varieties, and this is usually related to the climate as either cool or warm (White, 1995). One can add regions and varieties to a single equation to find the partial value of each, but this method does not allow differential values to be estimated for each variety, and therefore, we don't know if all varieties behave similarly. Following Oczkowski (2001), we also used two stage least squares (2LS) in order to first estimate the quality rating before including it in the hedonic price equation. This methodology takes explicit account of the fact that quality itself is subjective and even in the mind of the quality rater (James Halliday here) it is often influenced by the reputation (brand) and price of the wine.

We present our work in several sections. First we review the literature on hedonic pricing and follow that with the model specification and data. We present the results next along with the discussion. We conclude with implications and some ideas for future research.

2. Review of Literature

Hedonic price analysis is based on the hypothesis that any product represents a bundle of characteristics that define its quality and therefore price. The theoretical foundation for this type of research was first examined by Rosen (1974). The observed price for a good is the sum of the implicit prices for the attributes. Various independent variables, often quality indicators, are regressed on the retail price. The major issue with this type of analysis is that supply and demand factors are part of the price as well as the quality attributes (Unwin, 1999). The solution proposed by Arguea and Hsiao (1993) is to pool cross sectional data specific to a particular side of the market rather than measure a single product. We follow their recommendation.

Wine is a product that varies with vintage year, producer, region, and production technique among other factors. Consumers often find it difficult to judge the quality of wine before actually drinking the wine (Charters et al., 1999). They use label information to help make an informed choice. These extrinsic factors (Olson and Jacoby, 1972) are typically the major source of quality determination before purchase. The reputation of the winery (brand), the region of origin, the variety, and even third party quality ratings can be used by the consumer to help make the purchase decision. Shapiro (1983) modeled the reputation effects for high quality products. He showed that reputation allows some producers to sell their products for a premium, and he based this on the interpretation that these reputation effects are the outcome of investments in building that reputation. He also stated that it is costly for consumers to gain information in some environments and that learning about reputations is an effective way to reduce their decision making costs.

Oczkowski (1994) did the first hedonic pricing study of Australian wine. He showed that the log linear form was the best function to model retail prices for six wine attributes. Reputation effects were significant, but quality effects were not. Nerlove (1995) examined the Swedish wine market, a government monopoly, which allowed him to assume totally exogenous prices. His form of the equation was similar to Oczkowski with similar results. Combris et al. (1997) estimated a hedonic price equation for Bordeaux wines using intrinsic wine quality judgments of acid, fruit, palate by expert tasters, as well as the extrinsic factors of reputation and vintage. There most of the variance in price was explained by extrinsic factors, especially the reputation as measured

by the classification of the winery (first growth, second growth, etc.). The same authors recently published a paper using the same methodology for Burgundian wines rather than Bordeaux wines (Combris et al 2000). The same effects were noted, with reputation as measured by ranking (rather than classification) and vintage having the largest effect, but some of the sensory measures 'boosted' these objective quality effects, because the sensory characteristics were correlated with the ranking of the wineries. Landon and Smith (1997, 1998) added extrinsic factors and intrinsic factors to their hedonic price analysis for Bordeaux wines. They found that reputation factors were most significant in explaining the price consumers were willing to pay for Bordeaux wines, but the estimated coefficients varied over vintages.

Schamel and Anderson (2001) used two separate wine quality rating sources to analyse Australian and New Zealand wines. Their method pooled all the wines and regions in a series of equations for each year. They showed that winery reputation, region, variety, and quality estimation were all significant in some of the equations using Barossa shiraz as the relative comparison point in the dummy variable estimation. The trends were similar in both data sets. They also showed that region has become more important over the 10 year period of their data.

One of the major issues in using hedonic price techniques with wine is the subjective measure of quality (Oczkowski 2001). The objective characteristics on the label are easy to define and easy for consumers to view. However, ratings or reputations of wineries and ratings of individual wines by wine writers are purported to carry weight with the consumer, but little empirical evidence exists as to their effects. The two papers by Combris et al. (1997, 2000) demonstrate that the reputation as measured by the classification of Bordeaux wineries, or the ranking of Burgundian wineries has a major effect on the price, while quality assessments by tasters have little effect. Oczkowski's paper (2001) uses multiple reputation ratings by different wine writers to demonstrate this factor has the largest effect on wine prices as well.

Oczkowski (2001) incorporated the error rates in his analysis by using multiple wine writer ratings in a confirmatory factor analysis prior to the regression. He then goes on to use 2SLS to measure both quality and reputation as attributes containing measurement error. The fit statistics and error rates show that 2SLS is superior to OLS using this specific data set. He also shows that when combined reputation and quality measures are used in the same equation, there is little price variance explained by quality added to reputation. One of the major issues with the analysis is that in order to utilize multiple indicators of quality and reputation, Oczkowski could only find 276 wines in common across the four datasets, as compared to over 1200 in his previous paper (1994). This small sample size made measuring the effects of regions or varieties with separate equations impossible. This also may have impacted the measurement of reputation and quality. We use reputation (brand name) to help predict quality and then do not use reputation in the second stage.

We are most interested in the effect of different regions on the prices of selected varieties. We use the same Halliday (1999) data set as Schamel and Anderson (2001) to investigate a range of extrinsic characteristics' ability to predict retail prices for four major varieties of grapes. We understand the criticism of using only a single wine writer's subjective measures or wine quality (Oczkowski 2001), however we strongly believe that consumers are unlikely to compare different wine writer's evaluations before buying wine. Our experience also shows that wine stores in Australia may use a single score from one writer on the edge of the shelf below a bottle of wine (shelf talker), but never use multiple writer's scores. We run equations for each variety separately in order to be able to see the effect of region and winery reputation by variety. Previous hedonic research has used interaction terms to measure the impact of region and variety (Schamel and Anderson 2001; Oczkowski 1994, 2001). However, we feel that both regions and wineries have gained reputation for specializing in a few varieties, so our method separates the effects along the lines of four major grape varieties. We also use winery size, age of winery and vintage to see how these influence price for each variety.

3. Model Specification

Several studies have attempted to estimate the relationship between the price of a wine and its various characteristics and hedonic wine functions by using the ordinary least squares (OLS) technique in recent years. Oczkowski (2001) first addressed the measurement error issue on the previous hedonic wine studies when the OLS regression was used to estimate the single measures of wine quality and reputation given the presence of regressors which contain measurement error. According to Johnson (1987) and Greene (1993), when explanatory variables are endogenous in the equation, applying OLS

may lead to biased estimates of the coefficients, which are correlated with the error term. The essence of two stage least squares (2SLS) is the replacement of endogenous variables by the predicted values, which could be purged of the stochastic elements. The consistent 2SLS estimator is obtained by OLS regression of the dependent variable on predicted endogenous variables and predetermined variables in the equations.

Due to the concern that the reputations for wine quality of different wine-growing regions are linked to specific varieties, we estimate a separate equation for each type of climate region (warm vs. cool) and wine variety (red vs. white) and then make a comparison of price-quality relationships between the different equations. Our model, to be estimated by 2SLS regression for the hedonic price function for Australian wines, assumes that wine price is influenced by quality and the objective characteristics of attributes as follows in Equation 1.

The hedonic wine price equations for different climate (warm vs. cold) regions and wine varietals (two whites vs. two reds) are postulated in Equations 2 and 3, respectively.

where:

PRICE: the natural logarithm of wine retail price, recommended in the Halliday's wine guide (1999), and sourced from each wine producer.

$QUALITY_{PRED}$: the predicted values of the quality rating score of the wine (by Halliday on a 100 point scale), which is obtained from the 1st stage of 2SLS by the OLS regression of wine quality rating score (*QUALITY*) on the recommended retail price (*PRICE*) and the subjective characteristics - its associated producing winery (including wine group) reputation rating score (*WINERY*). These variable values are all subjectively judged by wine expert James Halliday.

Objective characteristics of wines:

$VARIETAL_K$: the dummy variable for wine varietal *k*, including two whites (chardonnay and riesling) and two reds (shiraz and cabernet sauvignon).

$SIZE_1$: the dummy variable for the wine producer size (tonnes of wine grapes crushed) class l, including very small size (under 100 tonnes); small size (100~499 tonnes); medium size (500~2,499 tonnes); large size (2,500~9,999 tonnes); and very large size (over 10,000 tonnes).

$$PRICE = f(QUALITY_{PRED},\ Objective\ characteristics\ of\ wines) \qquad (1)$$

$$PRICE^{CLIMATE} = \alpha + \beta_q QUALITY_{PRED} + \sum_{k=1}^{K} \beta_k VARIETAL_k + \sum_{l=1}^{L} \beta_l SIZE_l + \sum_{m=1}^{M} \beta_m AGE_m + \sum_{n=1}^{N} \beta_n ORIGIN_n + \mu \qquad (2)$$

$$PRICE^{VARIETAL} = \alpha + \beta_q QUALITY_{PRED} + \sum_{l=1}^{L} \beta_l SIZE_l + \sum_{m=1}^{M} \beta_m AGE_m + \sum_{n=1}^{N} \beta_n ORIGIN_n + \mu \qquad (3)$$

Table 1:
Means, standard deviations (S.D.) and correlations of retail price (*PRICE*) and quality rating score (*QUALITY*) for Australian wine

Classification	Sample Size	PRICE Mean	PRICE S.D.	QUALITY Mean	QUALITY S.D.	Correl. P and Q
All samples	1880	25.96	20.05	87.99	4.75	0.338
Climate of region						
Warm regions	1262	26.47	23.18	87.86	4.84	0.358
Cool regions	618	24.92	11.17	88.26	4.55	0.321
Variety of wine						
Chardonnay	637	23.25	9.66	87.31	4.95	0.501
Riesling	326	16.17	4.19	88.21	4.47	0.454
Shiraz	531	32.94	31.50	88.57	4.64	0.352
Cabernet Sauvignon	386	29.08	16.05	88.14	4.69	0.428
Rating of winery reputation						
Typically good (3 star)	90	17.40	5.47	82.50	5.02	0.302
Good (3.5 star)	257	20.68	8.33	85.53	4.30	0.329
Very good (4 star)	590	20.62	7.16	87.19	4.30	0.162
Extremely good (4.5 star)	501	28.79	17.85	88.94	4.29	0.312
Outstanding (5 star)	442	34.68	32.91	90.53	4.10	0.347
Size of wine producer						
< 100 tonnes (very small)	369	21.73	8.96	88.00	4.45	0.292
100 ~ 499 tonnes (small)	454	24.52	12.02	87.59	4.73	0.296
500 ~ 2,499 tonnes (medium)	449	30.97	23.67	88.40	4.87	0.388
2,500 ~ 9,999 tonnes (large)	188	22.67	12.42	86.92	4.84	0.288
> 10,000 tonnes (very large)	420	27.34	29.28	88.45	4.76	0.397

AGE_m: the dummy variable for the wine age class m where m = under 3 years (vintage year after 1997); m = 3~4 years (1996 and 1997); m = 5~6 years (1994 and 1995); m = 7~8 years (1992 and 1993); and m = over 8 years (before 1992). Although previous research (Combris et al., 1997; Landon and Smith, 1997 and 1998) used vintage date as a variable, according to the Australasian Wine Exchange (2000), vintage is not as important in Australia as brand and specific wine.

$ORIGINAL_n$: the dummy variable for the wine region of origin class n, which is classified into two groups - warm climate regions (including Barossa Valley, Clare Valley, Great Southern, Hunter Valley, Margaret River and McLaren Vale,) and cool climate regions (including Adelaide Hills, Coonawarra, Mornington Peninsula, Tasmania and Yarra Valley).

The parameters ($ß_q$, $ß_k$, $ß_l$, $ß_m$ and $ß_n$) are to be estimated for forming the price contribution of the product characteristics of Australian wines. The structure of hedonic price (*PRICE*) is hypothesized to be positively related to the wine quality rating score ($ß_q > 0$). According to the different objective characteristics of the wines, the positive/negative values of coefficients for dummy variables reflect relative price

premiums/discounts, as compared with the dummy base variable. Moreover, the degrees of $ß_k$, $ß_l$, $ß_m$ and $ß_n$ and values respectively, represent the effects of wine varietal, production scale (producer size), age of the wine, and region of origin (wine grape source) contributing to the relationship between retail price and quality attributes of Australian wines.

The econometric package PcGive 9.0 (Doornik & Hendry, 1996) is used to generate the properties of the data and all 2SLS estimations for the study. Multicollinerity might be a potential problem when several linear relationships exist between a set of dummy variables in Equations 2 and 3. Using the Wald test statistics, the linear restrictions test on the variance-covariance matrix for the estimated parameters is performed and points to no serious problem of multicollinerity in the equation.

4. Data

The total final sample covered 1880 observations of bottled wines, including 1262 warm climate wines and 618 cool climate wines; 637 chardonnay wines, 326 riesling wines, 531 shiraz wines, and 386 cabernet sauvignon wines. Only wines from single regions and single varieties were used in our analysis; multi-region and multi-varietal blends were excluded in order to measure the impact of region on each chosen variety of wine. All basic data on technical specifications and retail prices of bottled wines selected were obtained from the database set provided by well-known Australian wine expert James Halliday (1999). The exception is that data on the production capacity of each wine company/group is collected from *The Australian & New Zealand Wine Industry Directory* (Winetitles, 2001).

Summary statistics of data on price of selected Australian wines categorized by the climate of region and wine variety are provided in Table 1. We can see that by separating the wines into varieties, quite different average prices are charged for each. Riesling has the lowest average price at AU$16.17 per 750ml bottle,

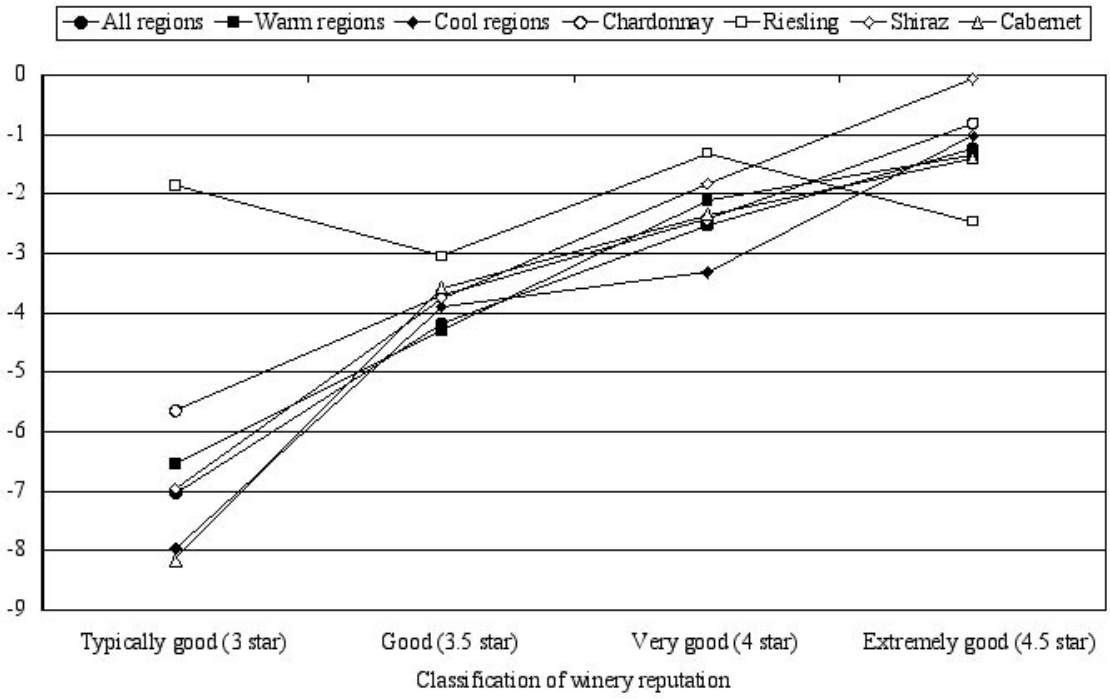

Figure 1: The impact of winery reputation on wine quality rating score

Notes: The dummy base is the five-star outstanding winery.

while the highest is for shiraz at AU$32.94. In addition, the correlation values of price and quality for chardonnay and riesling are 0.50 and 0.45 respectively, which are higher than other types of wine varieties. Overall, price does not count for a major portion of the variation in quality, even though it is positively correlated. The relatively high of standard deviation (S.D.) of wine price can be found for warm region wines, shiraz wines, and wine produced by outstanding wineries (5 star) and very large size wine producers (> 10,000 tonnes).

We can also see that even though there are fewer large wineries than small ones in Australia, the number of wines made by each size class is relatively similar. Large wineries produce many types of wines in each variety under different brand names. We should note here that the winery rating (reputation) is for the brand names, but the size class is for the parent company. For example, Southcorp is Australia's largest wine group and all brands made by that company are given a dummy variable for the largest size, but each brand has a different rating based on its long term reputation: Penfolds, Lindemans, Wynns, Seppelt, etc. We feel that the production practices (type of equipment, expertise of the wine maker, etc.) are best identified with the parent company, while the reputation effects accrue to the name the consumer sees on the bottle.

5. Results and Discussion

5.1 Winery Reputation

According to the winery star rating system of Halliday (1999), the Australian winery reputation is classified into five stars for an outstanding winery regularly producing exemplary wines; four and a half stars for an extremely good winery virtually on a par with outstanding one; four stars for a winery consistently producing high-quality wines; three and a half stars for a solid, reliable producer of good wine; and three stars for typically good producer, but may have a few lesser wines. Winery ratings are for the overall reputation of the winery, not for individual types of wines made. The impact of winery reputation on wine quality rating score, obtained from the 1st stage of 2SLS regression is shown in Figure 1. The five-star outstanding winery is used as the comparison for other four classifications of winery reputation.

As expected, each rating below five stars results in a decrease in wine quality rating score, except for riesling. The degrees of sensitivities are different for each of the regions and wine varieties. In terms of the climate for growing wine grapes, cool region wines have a relatively higher change in wine quality for each change in winery reputation than warm region wines. A one half star reduction in reputation from five to four and a half would result in a 2.5 point decrease in quality rating points (100 point scale) for riesling, 1.4 for cabernet, and only slight quality change for chardonnay (0.82) and shiraz (0.07). The effect of being a lower than four star winery becomes larger. The estimated coefficients across all four varieties are similar for being a three and one half star winery versus a five star. As the winery rating decreases to three stars, however, greater variation in the coefficients can be found, ranging from -8.2 (for cabernet), -7.0 (for shiraz), -5.7 (for chardonnay) to -1.9 (for riesling). Clearly, having a good winery reputation is relatively important for cabernet and shiraz but less so for riesling. Also, the quality effects of region (greater for cool regions than warm regions) seem to concur with the general viticultural situation; it is more difficult to achieve good quality in cool regions, due to the potential for frosts and poor ripening, but the results may warrant the difficulty.

5.2 Region: Warm vs. Cool

Table 2 presents the results of 2SLS regressions conducted based on the model in Equation 2, using the above definition for dependent variable (*PRICE*) and independent variables ($QUALITY_{PRED}$) and objective characteristics of wine. The coefficients for independent variables are directly interpreted as a percentage price effect. The regression for all regions together is shown in first column and then warm and cool region equations are reported in second and third columns. We first can look at the effect of the wine quality rating from Halliday's book (1999). The effect of the quality score out of 100 points represents an increase of 12.5% in price for each point increase in quality score for all regions and 14.5% for warm and 8.6% for cool climate regions. A larger quality effect on wine price is found for the warm climate regions. If a warm region wine increases in quality from 85 points to 90 points, we could expect a price increase of 72.5%. For a cool region wine the price increase would be only 43%. This may occur because Australian consumers prefer wines from warmer regions or perhaps because warmer regions were planted earlier and consumers have more knowledge of them and are therefore willing to pay higher prices for their wines.

Taking chardonnay as the comparative benchmark for wine variety, the coefficients for are highly significant in

Table 2:
Hedonic price equation for Australian wines by climate of region

	All regions		Warm regions		Cool regions	
$PRICE^{CLIMATE}$ (dependent variable)	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
$QUALITY_{PRED}$	0.125**	(39.00)	0.145**	(35.91)	0.086**	(19.03)
$VARIETY_k$						
Shiraz	0.181**	(9.35)	0.163**	(6.86)	0.183**	(5.72)
Cabernet	0.152**	(6.95)	0.112**	(4.10)	0.234**	(7.01)
Riesling	-0.245**	(-10.56)	-0.263**	(-8.81)	-0.209**	(-6.21)
Chardonnay	Base		Base		Base	
$SIZE_1$ [a]						
< 100 tonnes (very small)	0.168**	(6.27)	0.182**	(5.46)	0.104*	(2.21)
100 ~ 499 tonnes (small)	0.167**	(7.17)	0.163**	(5.72)	0.144**	(3.49)
500 ~ 2,499 tonnes (medium)	0.167**	(7.51)	0.149**	(5.93)	0.186**	(4.06)
2,500 ~ 9,999 tonnes (large)	-0.001	(-0.04)	0.019	(0.57)	-0.091*	(-1.60)
> 10,000 tonnes (very large)	Base		Base		Base	
AGE_m(vintage year)						
1 ~ 2 years (after 1997)	-0.136**	(-3.10)	-0.095*	(-1.77)	-0.164*	(-2.34)
3 ~ 4 years (1996 and 1997)	-0.093*	(-2.34)	-0.063	(-1.36)	-0.096	(-1.47)
5 ~ 6 years (1994 and 1995)	-0.078*	(-1.97)	-0.045	(-0.95)	-0.089	(-1.37)
7 ~ 8 years (1992 and 1993)	-0.066	(-1.60)	-0.032	(-0.64)	-0.082	(-1.22)
Over 8 years (before 1992)	Base		Base		Base	
$ORIGIN_n$ [b]						
Barossa Valley (W)	-0.053	(-1.57)	-0.040	(-1.14)		
Clare Valley (W)	-0.109**	(-3.02)	-0.098**	(-2.58)		
Great Southern (W)	-0.127**	(-3.43)	-0.122**	(-3.14)		
Hunter Valley (W)	-0.149**	(-4.20)	-0.142**	(-3.85)		
Margaret River (W)	Base		Base			
McLaren Vale (W)	-0.109**	(-3.32)	-0.090**	(-2.64)		
Adelaide Hills (C)	-0.054	(-1.36)			0.113**	(2.82)
Coonawarra (C)	-0.105**	(-2.88)			Base	
Mornington Penins (C)	-0.002	(-0.05)			0.178**	(4.04)
Tasmania (C)	-0.026	(-0.63)			0.122**	(2.91)
Yarra Valley (C)	-0.070*	(-1.89)			0.114**	(2.95)
Constant	-7.899**	(-26.86)	-9.592**	(-26.19)	-4.597**	(-11.15)
R^2	0.592		0.640		0.524	
Wald test [c]	8853.2**	(0.000)	7227.4**	(0.000)	5450.1**	(0.000)

Notes: * Significantly different from zero at the 5% level and ** at the 1% level.

[a] Measured by the tonnes of wine grapes crushed of wine producers.

[b] W referring for warm climate region and C for cool climate region.

[c] Wald statistics show the linear restrictions test (Doornik and Hendry 1996, pp.241).

all three equations. The positive sign on the coefficient for shiraz and cabernet reflects that these two red wine varieties have price premiums as compared to chardonnay. However, a negative sign indicating a price discount is found for riesling. We also investigate the price effect of winery size, which has not been part of other hedonic price research papers for wine. Our results indicate that the largest size wineries (greater than 10,000 tonnes) have no effect on price compared to the 2,500 to 9,999 tonne wineries across all four varieties. As we move to the small and medium size (less than 2,500 tonnes) wineries, we find significant and positive coefficients for , indicating that smaller wineries charge more (and presumably consumers are willing to pay more) for their wines than the largest wineries. Most interestingly, the greatest price premiums are received by the smallest wineries (less than 100 tonnes) for producing warm region wine, while the medium wineries (500~2,499 tonnes) receive a premium for cool region wine.

As compared to wines from Bordeaux (Combris et al., 1997; Landon and Smith, 1997 and 1998), where older vintages often increase in price, we find little price effect of older vintages for Australian wines. Our results show that the values of coefficients on nearly approach to zero (except for less than 3-year-old young wine), indicating not much price change for different vintages of Australian wines for two reasons. First, there are not many older wines sold in Australia. Wines are mainly made for early drinking and only a small percentage are cellared commercially and resold (Halliday, 1999). Second, the prices of Australian wines have been rising over the last 10 years (Anderson et al., 2001) and any increase in price of older wines might be hidden by overall price rises.

For the past decade, many Australian wine companies have used region along with their brand names as a wine branding and marketing tool to differentiate the quality and type of wine from a specific region and generate awareness of the region itself. (Lockshin, 1997; Rasmussen and Lockshin, 1999) The coefficients of $ORIGIN_n$ reported in Table 2 represent the regional reputation effects on the price of the wines. Compared with Margaret River as a warm region, wines from the other warm regions receive a significant price discount, ranging from 9.0% for McLaren Vale and 9.8% for Clare Valley to 12.2% for Great Southern and 14.2% for Hunter Valley. On the other hand, while Coonawarra is thought of as the comparative benchmark for cool region red wines, our results show that all other cool regions have a significant price premium, ranging from 11.3% for Adelaide Hill to 17.8% for Mornington Peninsula. These summary effects may mask effects on price for specific wine varieties.

5.3 Wine Variety: Red vs. White

Table 3 details the results of separate hedonic price equations for each of four wine varieties. Our results show that the effect of the wine quality rating for shiraz and cabernet is a 14.1% and 13.1% price rise per rating point, whereas that of chardonnay and riesling reaches 10.9% and 9.3%. Furthermore, the largest size wineries have no effect on price for cabernet and riesling as compared to all other size of wineries. However, the coefficients for the small size (100~499 tonnes) and medium size (500~2,499 tonnes) winery dummy variables for shiraz and chardonnay are significantly positive, implying that the small and medium size wineries received a premium price compared to the largest sized wineries. In particular, the premium price (26.6% and 21.7%) in the case of chardonnay is greater than shiraz (11.5% and 18.3%). In comparison to the oldest vintage for wine, the younger chardonnay commands a decreasing price premium, but the younger shiraz commands a rising price. The differences in the vintage effect suggest the existence of unequal price behaviours according to the wine variety. As stated earlier, the prices of shiraz have increased dramatically over the last decade (Schamel and Anderson 2001), while those for chardonnay have not. The increases in the prices of shiraz may mask vintage effects.

Overall, for each variety there are regions that command a higher price than other regions, given the same quality score. In Table 3 we can easily see that the magnitude of the coefficient on the wine region effect ($ORIGIN_n$) for the red varieties (shiraz and cabernet) is statistically significant and larger than for white varieties (chardonnay and riesling). Barossa is often thought of as the comparative benchmark for shiraz. In general our results show that all the warm regions, which are significantly different from Barossa, have a negative coefficient; they all have a negative effect on the price of shiraz compared to Barossa. Barossa is classed as a warm region, but the regions which do not differ significantly from Barossa are all cool (Adelaide Hills, Mornington Peninsula, and Yarra), with the exception of Coonawarra. Because shiraz doesn't ripen as well in cool areas, the lack of a significant difference could be due to small samples from each of those regions or possibly

Table 3:
Hedonic price equation for Australian wines by wine varietal

	Shiraz		Cabernet	
$PRICE^{CLIMATE}$ (dependent variable)	Coeff	t-value	Coeff	t-value
$QUALITY_{PRED}$	0.141**	(18.55)	0.131**	(23.07)
$SIZE_1$ [a]				
< 100 tonnes (very small)	0.114	(1.64)	0.047	(0.85)
100 ~ 499 tonnes (small)	0.115*	(2.25)	0.065**	(3.13)
500 ~ 2,499 tonnes (medium)	0.183**	(3.82)	0.042**	(3.14)
2,500 ~ 9,999 tonnes (large)	0.089	(1.32)	0.024	(1.61)
> 10,000 tonnes (very large)	Base		Base	
AGE_m(vintage year)				
1 ~ 2 years (after 1997)	-0.282*	(-2.17)	-0.221	(-1.80)
3 ~ 4 years (1996 and 1997)	-0.187	(-2.09)	-0.103	(-1.91)
5 ~ 6 years (1994 and 1995)	-0.151	(-1.69)	-0.092	(-1.76)
7 ~ 8 years (1992 and 1993)	-0.160	(-1.75)	-0.117*	(-2.18)
Over 8 years (before 1992)	Base		Base	
$ORIGIN_n$ [b]				
Barossa Valley (W)	Base		-0.116**	(-2.71)
Clare Valley (W)	-0.172**	(-2.75)	-0.174**	(-3.02)
Great Southern (W)	-0.275**	(-3.37)	-0.214**	(-2.84)
Hunter Valley (W)	-0.281**	(-4.51)	-0.427**	(-4.78)
Margaret River (W)	-0.192**	(-2.13)	-0.018	(-0.35)
McLaren Vale (W)	-0.134**	(-2.60)	-0.114**	(-2.52)
Adelaide Hills (C)	0.049	(0.49)	-0.155	(-1.34)
Coonawarra (C)	-0.261**	(-3.67)	Base	
Mornington Penins (C)	-0.064	(-0.50)	n.a.	n.a.
Tasmania (C)	n.a.	n.a.	-0.115	(1.31)
Yarra Valley (C)	0.068	(0.76)	-0.119	(-1.73)
Constant	-6.855**	(-24.62)	-5.511**	(-23.97)
R^2	0.507		0.659	
Wald test [c]	2045.3**	(0.000)	3091.7**	(0.000)

Notes: * Significantly different from zero at the 5% level and ** at the 1% level.
[a] Measured by the tonnes of wine grapes crushed of wine producers.
[b] W referring for warm climate region and C for cool climate region.
[c] Wald statistics show the linear restrictions test (Doornik and Hendry 1996, pp.241).

higher demand due to lower availability. McLaren Vale and Hunter Valley are both thought to be good regions for shiraz, but both have a significant price discount in comparison to Barossa, 13.4% and 28.1% respectively.

The benchmark region for cabernet is Coonawarra. Our results reinforce this with all significant comparisons for cabernet from warm regions being negative, with the exception of Margaret River, which has a good reputation for cabernet wine. For instance, the price discounts range from 42.7% for Hunter Valley to 11.4% for Mclaren Vale and 11.6% for Barossa Valley. The regions that do not significantly differ in its effect on price with Coonawarra, like with shiraz and Barossa, are cool climate regions such as Adelaide Hills, Tasmania and Yarra Valley, probably for the same reason of small samples or limited availability.

Chardonnay is priced the highest from Margaret River, which is classed as a warm region, especially in comparison to Adelaide Hills, Yarra Valley and Tasmania. Surprisingly, we find that the coefficient on the regional effect ($ORIGIN_n$) for almost all other wine regions as compared to Margaret River is statistically insignificant (except for Clare Valley) and approach to zero, which can not support the existence of the regional reputation effect on the price of the Australian chardonnay wines. The story with riesling is not so clear. Clare Valley is thought by some to be Australia's premiere riesling region. But our analysis shows that Clare only receives a 13.9% premium by compared to Tasmania and is actually discounted by 10.6% ~ 12.7% in relation to riesling from Coonawarra, Margaret River and Yarra Valley.

6. Implications and Future Research

Our research has added to the use of hedonic pricing for wine by adding several new parameters: winery reputation and size and by calculating quality as a function of the other characteristics before using it in the hedonic pricing equation. We also derive equations for two climate regions and four major wine varieties separately, rather than treat all the regions or varieties as one. Keeping the varieties in one equation probably makes sense for European regions, where there are restrictions on which varieties can be grown, but it still mixes up white and red varieties. When a range of varieties are put into one equation for a country like Australia, we only can see the price effect of the varieties in general; we cannot untangle the effects of different varieties in each region.

Our first table shows that across three of the four varieties, Halliday's rating of winery reputation is highly correlated with quality. This gives credence to his rating system, that wineries with higher ratings do indeed produce better quality wine. This could be an artifact of his system, where he gives higher quality scores to his higher rated wineries, but the fact that reputation is significant in the hedonic price equations shows that wineries that have invested in better quality over the years command higher prices. Shapiro's (1983) observation of reputation effects does hold in the Australian wine industry. This should give heart and direction to wine marketing managers to keep investing in long term brand building at the same time as their wine making colleagues strive to make better quality wines. The analysis shows that wines from wineries with the highest (five star) reputations charge an average of $6.00 more per bottle than a comparable four and a half star winery, and an amazing $14 more than a four or three and a half star winery. This price differential when multiplied over the production capacity of the winery shows the value of a top reputation and gives some indication of how much a wine company could invest in both production and promotion to gain this level of status.

There is also a return to quality above winery reputation (Table 2). Each quality point increases the price of the wine between 9% and 14%, which again gives some measure of how much a winery could invest to improve quality and make a reasonable return for that investment. The word 'quality' is mentioned too often in the wine industry without regard to its costs or to its benefits. Our analysis puts some real numbers on quality as rated by James Halliday. For example, if a winery had done some small batch experiments and shown that by reducing yields on a certain shiraz vineyard from 6 tonnes per hectare to 3 tonnes would result in the quality rising from 88 points to 91 points, they should be able to raise their prices by 14% X 3 (points) or 42%. If their bottle price for shiraz was $18, they might be able to raise their price to $25. This would mean about $3.50 more per bottle at the winery wholesale price. If they made about 3000 cases of this wine, this would mean an increase in gross margin of $105,000, which could be compared to the cost of the reduced yields in the vineyard to see if this is a feasible investment.

Our research has shown that winery size can have an effect on the price of the wines sold. Wineries crushing greater than 2,500 tonnes of grapes get substantially less for each bottle of wine than smaller sized wineries, and the effect is fairly constant down to the smallest size

(Table 2). Large wineries are more efficient and probably charge lower prices as a competitive measure (Wollan, 1998). Smaller wineries are not as efficient, but may charge prices. Small and medium sized wineries most likely must charge a higher price for their wines in order to make a profit, and yet they also must use distributors rather than sell direct. We have no evidence that the wines from small and medium sized wineries are perceived to be better than the wines from large wineries, but it may be that these sized wineries are large enough to develop a national reputation and yet are perceived as relatively small or as boutique by consumers. If this is the case, then wineries within these size groups can benchmark their prices against others and some of them may find that they are undercharging and can raise prices and profits. The price premiums are substantial at between 10 and 18% across the various sizes compared to the largest two categories of wineries. Also, wineries that are larger cold take advantage of consumer's perceptions by positioning individual brands as coming from boutique-style wineries.

One of the key areas of interest is the effect of region on wine price. We decided to separate the varieties and run an equation for each, so that we could see what effect regional reputation has on the wines by variety. Even though there are no restrictions of what can be grown where in Australia, anecdotally, different regions have better reputations for different varieties of wines. Our research gives weight to that observation. Barossa for shiraz, Coonawarra for cabernet and Clare Valley for riesling all show increased value compared to other regions producing that variety. Along with Schamel and Anderson's observation (2001) that region is gaining in importance in Australia, we find that different regions certainly are valued more highly for different grape varieties than others.

From a marketing manager's point of view our results provide some direction for both promotion and pricing. There certainly is evidence that region can add to the price consumers are willing to pay for wine. Wineries from regions with a comparably positive price impact should utilize that fact on the label and in promotions. Probably the most important advice is for wineries in each region to keep working together. This collaborative effort is relatively unique in Australia, but seems to have borne fruit and can continue to do so. Wineries with strong reputations for specific varieties can emphasize this fact in group promotions.

More importantly, regions where the wine quality is good, but suffer from lower prices need to engage in activities to build the reputation for their regions wines, and consequently be able to raise prices. McLaren Vale is a good example. Here the shiraz wines have won many awards and are highly demanded within Australia. However, the reputation for the region is lower than for Barossa, and this is especially true in export markets (Murphy 2001). Some idea of the price increase can be predicted, which would help decide what a regional promotional budget might be over a period of years. McLaren Vale wineries have begun to promote their wines in Australia with festivals, dinners, and a new visitor's center. However, the prices paid domestically for Australian wines are partly determined by their international value, and obviously McLaren Vale needs to do more international promotion. At the beginning of the 1990s, Barossa Valley wineries made several trips as a group to the UK market to conduct tastings, dinners, music and wine events, and Barossa food and wine events. McLaren Vale should follow in this same mode. With prices 13% lower than Barossa, but similar climate and quality, wineries in McLaren Vale can calculate the returns to improving their reputation through promotional activities. Although these are not as high as those returns to winery reputation, they are substantial. The same advice can be given to the other newer regions with good quality, but relatively lower prices. Regional promotions are less expensive per winery than individual wineries conducting the same events and over a period of time, raising the regional reputation will help all the wineries achieve higher prices.

Of course hedonic price analysis does have some shortcomings. We must assume that the quality and reputation ratings have validity, since they are subjective judgments. We used James Halliday (1999), one of the foremost authorities on Australian wine. We could use the same logic as Schamel and Anderson's (2001) and accord Halliday influence status, so that his wine and winery ratings actually help create the prices charged. In our opinion, the quality of the wine and the winery reputation do have a relationship with price, regardless of which is cause and which is effect. We also must assume a balance of supply and demand for the equations to have meaning.

There is scope for future research. In the area of hedonic price analysis, a simple but powerful confirmation would be to use a different set of quality and reputation indicators, like Schamel and Anderson (2001) did, which showed similar relationships. One might also use

separate equations for each variety over a historical period in order to confirm Schamel and Anderson's observation that overall region is gaining in importance in Australia. Outside of hedonic price analysis, conclusions on the various indicators of value, like winery reputation, wine quality, and region could be tested with different techniques. Preliminary research by Tustin and Lockshin (2001) showed that region and brand did have a significant impact on consumer choice, but the pattern differed for low and high involvement consumers. A well known wine region added about $5.00 to the price consumers were willing to pay for a bottle in a choice-based conjoint experiment. More research using actual choice situation experiments could confirm the effects of the variable found significant in this analysis. This is important for wineries, so management can decide whether focusing on the brand or the region has the largest payback in price received.

It is also important to know what consumers actually have in their minds when choosing wine. Do they have Halliday or other quality ratings in their mind when buying wine? What is the effect of putting those ratings on the shelf? This is done more regularly in the US with Wine Spectator ratings than in Australia. How many consumers use winery reputation as part of their decision process? Looking at the process a different way, does price act as a signal, rather than as an outcome of the other factors? Does merely setting a higher price result in greater sales or a higher reputation? These are just a few of the useful questions remaining to be answered in future research.

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