Journal of Agribusiness 29, 1 (Spring 2011)
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Factors that Influence Prices for Cool-Climate Wines: A Hedonic Analysis of the Market for Riesling

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The price of wine represents various characteristics that differentiate each bottle, assuming that the majority of consumers use price as a signal of quality. The objective of this study is to analyze the drivers of Riesling prices, since this varietal continues to gain popularity and can be grown in all climates, including cool-climate regions. We expand the use of quality ratings by including interaction terms to express wine-quality and price-quality relationships. The results suggest that higher price premiums are associated with wines that earned high expert rating scores, and this emphasizes the importance of market-perceived quality signals.

***Key words**:* cool-climate wine; Hedonic analysis; Price; Quality; Riesling; *Wine Spectator*

Despite similar attributes such as quality expert ratings, wine prices vary greatly. Price remains a key factor that influences a consumer purchasing decision, especially given the economic uncertainty and increasing competitive pressures of wine production. Since consumers are uncertain or do not have sufficient information about the overall quality of the wine they are purchasing, they might be willing to pay a higher price for a certain wine from a well-known region and producer. Especially for traditional Old World wines, the reputation of producers and regions strongly impacts the price of wine (Schamel, 2002; Troncoso and Aguirre, 2006; Guillermo, Brummer, and Troncoso, 2008; Heslop, Cray, and Armenakyan, 2010).

However, there is little research that focuses on New World wine, and in particular on cool-climate wines (Brunke, Rickard, and Schroeter, 2010). One important influence on the growth of New World wines is the success of commercial vineyards in cool-climate areas such as Washington; New York State; New Zealand; and Ontario, Canada. Cool-climate wines are produced from various hybrid varieties and selected *vitis vinifera*

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We are appreciative of the anonymous reviewer comments. The authors gratefully acknowledge partial funding by USDA, Payments to Agricultural Experiment Stations under the Hatch Act. "Examining the Competitiveness of Key Fruit and Vegetable Sectors in California."

varietals, such as Riesling. Sales of Riesling wine have grown by 50% between 2004 and 2009 (Wine Institute 2009).

Given the growing importance of these wines in the U.S. market place, there is a need to study the price determinants of cool-climate wines. The objectives of this study are (1) to analyze the market for Riesling wines produced in California, Oregon, Washington, New York, Canada, France, Germany, Austria, and New Zealand; and (2) to estimate how regional reputations, expert quality scores, producer size, vintage, and label information impact the price of Riesling.

The contribution of this study lies in the analysis of quality ratings via interaction terms to examine wine-quality and price-quality relationships. The analysis expands the framework by Costanigro, McCluskey, and Mittelhammer (2007) that showed how the wine market is segmented into several product classes based on price. Thus, multiple wine classes or market segments exist. However, since many cool-climate wines are associated with lesser known producers and wine regions, expert quality ratings might be even more important determinants of the price (Troncoso and Aguirre, 2006; Guillermo, Brummer, and Troncoso, 2008; and Schamel, 2009). This suggests that quality classes by quality expert scores might lead to an additional segmentation of the wine market. In order to address the relationship between wine quality and its associated price, the development of an empirical framework to study prices for cool-climate wines is needed.

Theoretical Background

Hedonic price analysis has its origins in agricultural economics. The pioneer of hedonic price analysis, Waugh (1928), studied the relationship between quality factors influencing vegetable prices in order to determine consumers' relative valuations of these characteristics. Court (1939) and Griliches (1961) employed hedonic regressions to discover purchasing preferences with the goal to construct an appropriate, quality-adjusted measure of automobile price changes over time. Similarly, the impact of quality characteristics on computer prices was investigated by Chow (1961) and Cole et al. (1986). Nerlove (1995) also provides a nice summary of work in this arena.

The hedonic regression approach has become a routinely utilized tool to estimate how a bundle of quality attributes influences the price of a product. Hedonic price models define the product price in terms of the qualities of a product by using measures of the quality as independent variables. These models are most often used when the product is heterogeneous. Hedonic analysis establishes an equilibrium price relationship that considers demand and supply influences on price. For wine, it provides a nice approach to show implicit values of quality characteristics for which consumers are willing to pay (Florkowski, Carew, and He, 2008).

Hedonic price analysis is advantageous for many reasons. A primary reason is that it helps economists to define and study price-product relationships (Rosen, 1974 and 2002). Products are valued by consumers for their utility-generating attributes, which are considered by potential consumers before making product-purchasing decisions. This suggests that quality has an influence on a product's price. Overall, hedonic price studies have been motivated by two main concerns: to identify implicit prices of attributes and to examine welfare impacts by analyzing the structure of demand for attributes (Steiner, 2002). The most common use of hedonic price analysis deals with the first concern, trying to identify and estimate implicit prices of attributes of a good and its influence on the product's overall price (Rosen, 1974 and 2002).

Methodology, Data, and Procedures

Theoretical Context

To determine what characteristics have the greatest influence on Riesling price, a conventional form of hedonic price analysis was performed. Wine is considered a heterogeneous good, which is defined as aggregations of attributes and economic behavior that relates to these attributes (Gorman, 1980; Schamel, 2002; and Neeley, Min, and Kennett-Hensel, 2010).

First, it is assumed that consumer preferences are based on various wine attributes. This would indicate that two bottles of identical wines should have the same price. Conversely, if one of the bottles has a specific attribute valued by consumers, then the difference in price between these two bottles should represent the consumers' willingness to pay for that specific attribute (Rosen 1974). This study suggests that each bottle of wine contains a bundle of attributes, represented by a vector z, resulting in an implicit price function. This function, P (z), outlines the relationship between various attributes that are deemed to influence demand for wine, supply, and the resulting equilibrium price; it is defined as $P(z) = f(z_1, z_2 \ldots z_n)$

To assess the consumers' willingness to pay, the study assumes wine markets are perfectly competitive. This is a reasonable assumption given the variety of wine products available in the market, the amount of trade in this sector, and the number of sales outlets distributing wine in any given region. In addition, it is presumed that all consumers have made utility-maximizing choices in their wine purchases, given a specific budget constraint.

Data

The data consists of 2,809 Riesling wines from key wine-producing regions between 1997 and 2009. It was collected from the Digital Archives Database from *Wine Spectator Online*. The data set is composed of 537 different wine producers; in some cases, the same wines from different vintages are included in the sample. Two key variables are non-binary: (1) Riesling release prices adjusted to 2001 values by the consumer price index (CPI) for alcohol, and (2) the number of cases of each Riesling wine produced. Descriptive statistics of these continuous variables are shown in Table 1. The wines in the sample mainly fall between the $20 and $80 range, but there is a long-tailed distribution on the wine prices used. A plot of the number of cases produced against price adjusted by CPI showed that the study's findings are better approximated using a double log function. These results mirror the findings of the study by Nerlove (1995) that used a double log function to explain the influence of the amount of liters sold on price.

Table 1: Descriptive Statistics of the Continuous Variables

Variable Name	Definition	Mean	Median	Minimum	Maximum
Riesling Price	Price adjusted by 2001 CPI index for alcohol	$51.41	$27.54	$5.51	$991.24
Cases produced	Number of Riesling cases produced	4,374.30	494	1	669,400

Given the availability of the data, we collected information describing region of production, product quality as presented by the *Wine Spectator* score, producer size, vintage, and label attributes. With regard to the production region, consumers might value wines from certain U.S. states, such as from California or from individual countries such as France. Figure 1 shows the frequency of wines collected by region including California, Oregon, Washington, New York, Canada, Austria, France, Germany, and New Zealand. The majority of the Riesling wines examined, 23.5%, were from Germany, followed by Austria, New York, and France.

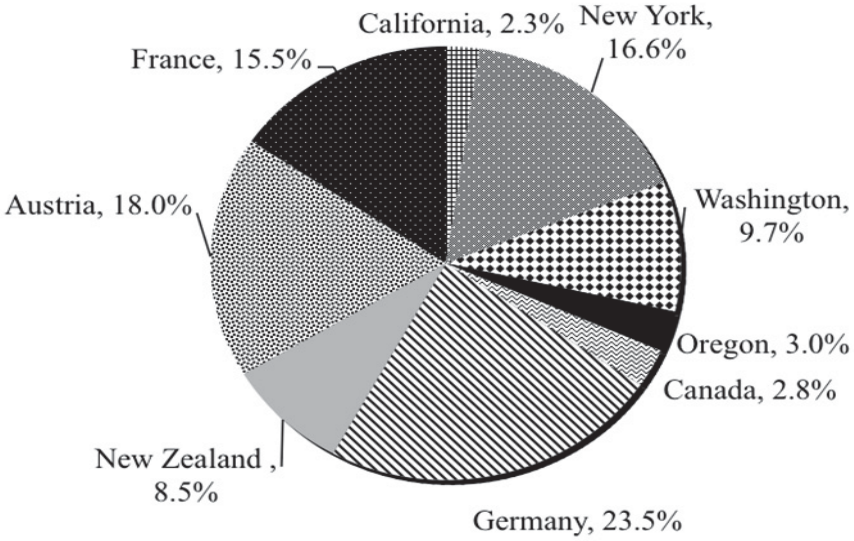

Figure 1. Distribution of Riesling Wines by Region in our Sample.

Based on the price categories suggested by Costanigro, McCluskey, and Mittelhammer (2007), dummy variables representing the four main price categories were formed: (1) commercial wines priced below $13, (2) semi-premium wines priced between $13 and $21, (3) premium wines priced between $21 and $40, and (4) ultra-premium wines priced above $40. Figure 2 shows the distribution of Riesling wines by wine price category. The sample sizes associated with these price segments are 527, 890, 827 and 1,077 observations, respectively.

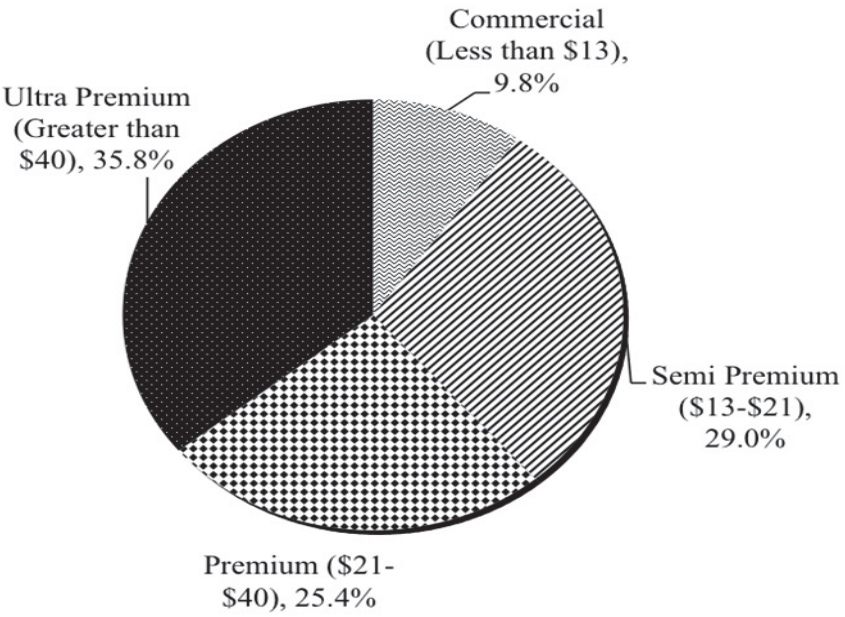

Figure 2. Distribution of Riesling Wines by Price Category in our Sample.

Each year, editors of the *Wine Spectator* perform a sensory review of more than 15,000 wines from a wide array of regions in blind tastings (*Wine Spectator,* 2010). Depending on the final *Wine Spectator* score, a wine belongs to one of six quality categories. Using these categories with our sample showed the following distribution: 11.7% of "Classic" wines (*Wine Spectator* scores between 95 and 100 points), 29.1% of 'Outstanding' wines (scores between 90 and 94 points), 43.6% of "Very Good" wines (scores between 85 and 89 points), 13.7% of "Good" wines (scores between 80 and 84 points), 1.5% of "Mediocre" wines (scores between 75 and 79 points), and 0.3% of "Not Recommended" wines (scores between 50 and 74). The majority of the wines, 43.6%, received *Wine Spectator* scores between 85 and 89, indicating that they were "very good" wines.

Due to the small amount of observations in the other quality categories, this study combined Classic and Outstanding wines into one category, as well as Good, Mediocre and Not Recommended wines into another category to ensure better distribution. Thus,

the quality representation is based on the combined *Wine Spectator* score categories: (1) Classic and Outstanding wines received *Wine Spectator* scores between 90 and100, (2) Very Good wines between 85-89, and (3) Good, Mediocre, and Not Recommended wines between 50 and 84. Figure 3 displays the frequencies of the wines belonging to each of these three quality categories: Classic and Outstanding (40.9%); Very Good (43.6%); and Good, Mediocre, and Not Recommended (15.5%).

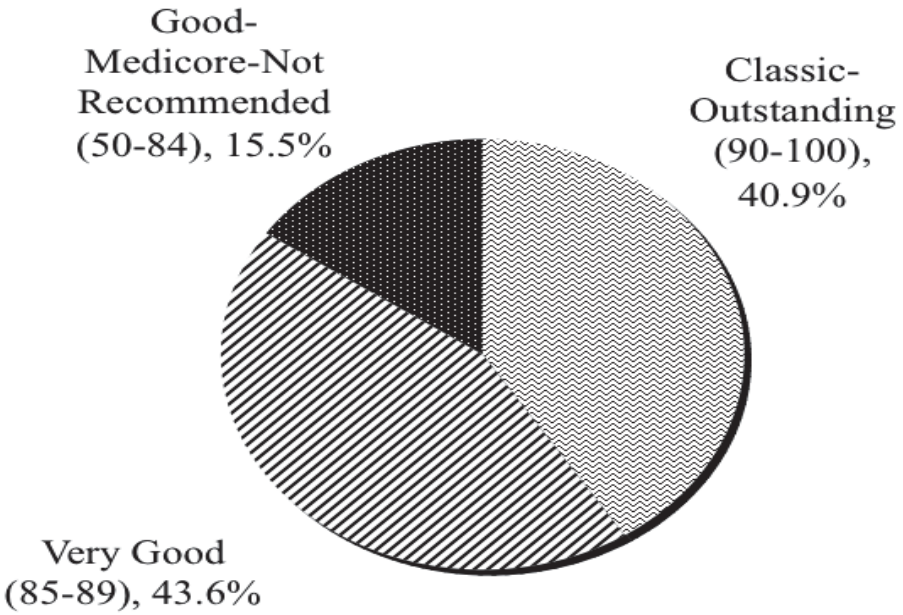

Figure 3. Distribution of *Wine Spectator* Scores by combined Quality categories from our Sample.

To further analyze the importance of reputation and quality, the *Wine Spectator* scores were examined by region for the three quality categories Classic-Outstanding, Very Good, and Good-Mediocre-Not Recommended. Figure 4 portrays how quality varies between regions, with Germany earning the most Classic-Outstanding scores for its production of Riesling.

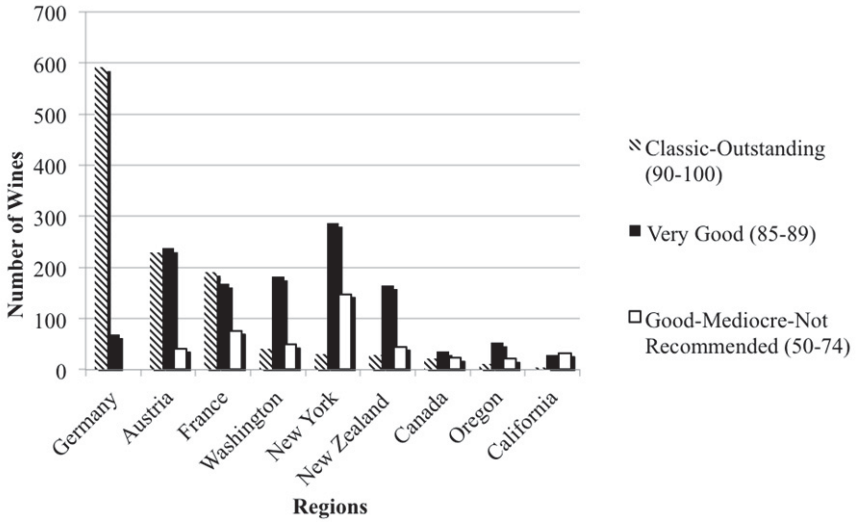

Figure 4. Number of Wines in each combined *Wine Spectator* Category by Region

Table 2 reports all variable names and definitions, while table 3 shows the respective frequencies and average prices. These tables show that with regard to the price-quality interaction terms, the majority of the sample, containing 29.1% of the wines, are ultra-premium and earned Classic-Outstanding scores, followed by semi-premium wines earning Very Good scores, and premium wines earning Very Good scores, 19.7% and 12.5%, respectively.

Table 2: Overview of Variable Names and Definitions

Variable	Description
Price	Price per bottle at the date it was released to market
Region	Wine produced in California, Oregon, Washington, New York, Canada, Austria, France, Germany and New Zealand
CommGMN	Commercial wines (<$13) receiving Good-Mediocre-Not Recommended *Wine Spectator* scores (50-84 points)
CommVG	Commercial wines (<$13) receiving Very Good *Wine Spectator* scores (85-89 points)
CommCO	Commercial wines (<$13)receiving Classic-Outstanding *Wine Spectator* scores (90-100 points)
SemiGMN	Semi-Premium wines ($13≥$21) receiving Good-Mediocre-Not Recommended *Wine Spectator* scores (50-84 points)
SemiVG	Semi-Premium wines ($13≥$21) receiving Very Good *Wine Spectator* scores (85-89 points)
SemiCO	Semi-Premium wines ($13≥$21) receiving Classic-Outstanding *Wine Spectator* scores (90-100 points)
PremGMN	Premium wines ($21≥$40) receiving Good-Mediocre-Not Recommended *Wine Spectator* scores (50-84 points)
PremVG	Premium wines ($21≥$40) receiving Very Good *Wine Spectator* scores (85-89 points)
PremCO	Premium wines ($21≥$40) receiving Classic-Outstanding *Wine Spectator* scores (90-100 points)
UltraGMN	Ultra-Premium wines (>$40) receiving Good-Mediocre-Not Recommended *Wine Spectator* scores (50-84 points)
UltraVG	Ultra-Premium wines (>$40) receiving Very Good *Wine Spectator* scores (85-89 points)
UltraCO	Ultra-Premium wines (>$40) receiving Classic-Outstanding *Wine Spectator* scores (90-100 points)
Cases produced	Number of cases of Riesling produced
150,000GalorLess	Production of 150,000 gallons of Riesling or less
150-250,000Gal	Production of 150-250,000 gallons of Riesling
250,000GalorMore	Production of 250,000 gallons of Riesling or more
Vintage	Production year of the Riesling
Estate	Indicating Estate on the label
Vineyard	Indicating Vineyard on the label
Reserve	Indicating Reserve on the label

Table 3: Descriptive Statistics of the *Wine Spectator* Data

Variable Name	N = 2,809	Frequency (Average Price $)
LnPrice	2,809	-3.47
Region		
California	65	0.023 (27.04)
Oregon	85	0.030 (19.18)
Washington	272	0.097 (25.36)
New York	466	0.166 (24.31)
Canada	80	0.028 (68.52)
Austria	507	0.180 (41.56)
France	435	0.155 (43.10)
Germany	660	0.235 (110.28)
New Zealand	239	0.085 (19.69)
Quality Descriptor by Price Category		
Commercial/Good-Mediocre-Not Recommended	118	0.042 (9.86)
Commercial/Very Good	153	0.054 (9.92)
Commercial/Classic- Outstanding	4	0.001 (10.46)
Semi-Premium/Good-Mediocre-Not Recommended	210	0.075 (16.12)
Semi-Premium/Very Good	552	0.197 (16.69)
Semi-Premium/Classic- Outstanding	52	0.019 (18.34)
Premium/Good-Mediocre-Not Recommended	88	0.031 (26.08)
Premium/Very Good	350	0.125 (28.71)
Premium/Classic- Outstanding	275	0.098 (30.43)
Ultra-Premium/ Good-Mediocre-Not Recommended	19	0.007 (66.02)
Ultra Premium/Very Good	171	0.061 (66.12)
Ultra Premium/Classic- Outstanding	817	0.291 (116.10)

Table 3: Descriptive Statistics of the *Wine Spectator* Data (continued)

	Label Information	
Variable Name	N = 2,809	Frequency (Average Price $)
Ln (cases produced)	2,809	6.161 (51.41)
150,000 gallons or less	2,773	0.987 (51.93)
150,000-250,000 gallons	22	0.008 (10.91)
250,000 gallons or more	14	0.005 (10.70)
2009	153	0.054 (31.52)
2008	244	0.087 (38.04)
2007	346	0.123 (53.82)
2006	305	0.109 (46.90)
2005	328	0.117 (74.07)
2004	248	0.088 (46.24)
2003	171	0.061 (80.81)
2002	194	0.069 (70.27)
2001	217	0.077 (45.52)
2000	126	0.045 (38.46)
1999	173	0.062 (49.20)
1998	164	0.058 (37.48)
1997	140	0.050 (34.09)
Estate	521	0.185 (46.63)
Vineyard	835	0.297 (78.71)
Reserve	259	0.092 (42.26)

This study is unique as it not only examined the number of cases produced, but also considered small, domestic producer tax credits–which are based on production levels–by including variables based on production size. The first category of 150,000 gallons or less earns producers a $0.90 tax credit on their first 100,000 gallons; the second category of production between 150-250,000 gallons earns producers $0.89-$0.01 per gallon on their first 100,000 gallons; and the last category of production of more than 250,000 gallons earns producers no tax credit (U.S. Department of the Treasury-Alcohol and Tobacco Tax and Trade Bureau (TTB) 2010). With regard to production scale, 98.7% of the observations in our sample were produced in the category of 150,000 gallons or less.

At least one of the three label attributes–estate, vineyard and reserve–were indicated on 57.5% of the wine labels. "Vineyard" was the most commonly used label attribute, with 29.7% of wines specifying the vineyard in which the grapes were grown. Of all regions, German wines most commonly indicated "vineyard" on the label 56.8% of the time, followed by other European countries France and Austria using the term "vineyard" on 17.2% and 12.7% of the collected wines, respectively.

Specification

Unfortunately, little theoretical guidance exists regarding which functional form is best in the development for hedonic pricing models. This study used the log-linear form, as previous research by Oczkowski (1994); Nerlove (1995); Schamel (2002 and 2009); Schamel and Anderson (2003); and Guillermo, Brummer, and Troncoso (2008) followed this approach. Alternative functional forms increased the complexity of the model, but did not change the overall thrust of the results.

The hedonic price function is

$$
\begin{aligned}
ln\,(Pi) = {} & \beta 0 + \beta 1California + \beta 2Oregon + \beta 3Washington + \beta 4NewYork \\
& + \beta 5Canada + \beta 6Austria + \beta 7France + \beta 8Germany + \beta 9NewZealand \\
& + \beta 10CommGMN + \beta 11CommVG + \beta 12CommCO + \beta 13SemiGMN \\
& + \beta 14SemiVG + \beta 15SemiCO + \beta 16PremGMN + \beta 17PremVG \\
& + \beta 18PremCO + \beta 19UltraGMN + \beta 20UltraVG + \beta 21UltraCO \\
& + \beta 22ln\,(Cases\ produced) + \beta 23150{,}000GallOrLess \\
& + \beta 24150\text{-}250{,}000Gall + \beta 25250{,}000GallOrMore \\
& + \beta 26\text{-}37\ Vintage1997\text{-}2009 \\
& + \beta 38Estate + \beta 39Vinyeard + \beta 40Reserve
\end{aligned}
$$

for i =1, 2, 3....n, where n = 2,809, where *ln(Pi)* is the natural logarithm of the CPI-adjusted market release price of Riesling wine. Table 2 shows the variable names with their respective definitions. An Ordinary Least Squares (OLS) regression was used to estimate the model in equation (1) due to the consistency of the OLS estimator. Separability of Riesling wines from other types of wine varietals is assumed, based on

Nerlove's finding that an optimizing consumer will choose only one variety and not a combination (1995).

Endogeneity problems are common with this type of study. If the market release price is set after the *Wine Spectator* quality ratings are released, it is possible that the observed price variation reflects the retailer's markup as a response to the *Wine Spectator* rating. However, Riesling prices in the study are the suggested retail prices from each winery at the release time of the wine. The *Wine Spectator* obtains this price information before its sensory analysis; thus, there is little opportunity for an upward-shift in the wine prices after the rating. However, the issue of high-priced wines obtaining higher ratings still remains. Given that the sensory evaluation occurs following a blind tasting, price information is not available to reviewers. In addition, it can be assumed that the expert ratings are an unbiased quality measure and that, on average, they are consistent with consumers' quality assessments. Previous research supports this notion that expert scores are positively correlated with wine prices, independent of the country, wine magazine, or experts (Schamel and Anderson, 2003; and Costanigro, McCluskey, and Mittelhammer, 2007).

Results

Table 4 shows the regression results that included the primary wine-growing regions; the interaction terms of *Wine Spectator* scores with their price categories; the number of cases and gallons produced; and the vintages, estate and reserve as explanatory variables. The marginal effect depends on the values of the independent variables and its relationship to the mean of the dependent variable. Therefore, price premiums associated with each variable were estimated by multiplying the coefficient by the mean of the dependent variable, in this case price (Schamel and Anderson, 2003). Price premiums were calculated using both the overall mean price and the mean price for its individual category. Using both techniques for the marginal effects calculation is warranted, given the large variation in prices across the variables.

Table 4: *Wine Spectator* Regression Results and Marginal Effects (N=2,809)

Variable	Description	Regression Results		Marginal Effects (ME)		
		Coeff.	t-Stat.	% Change	ME ($) Overall	ME ($) by Category
	Constant	4.179***	34.275			
Region	California	0.108**	2.167	10.8	5.58	2.93
	Oregon	-0.071	-1.58	-7.1	-3.65	-1.36
	Washington	0.066*	1.873	6.6	3.41	1.68
	New York	-0.045	-1.52	-4.5	-2.32	-1.1
	Canada	0.355***	7.595	35.5	18.26	24.33
	Austria	-0.024	-0.812	-2.4	-1.24	-1
	France	0.112***	3.757	11.2	5.78	4.84
	Germany	0.121***	3.689	12.1	6.23	13.37
Quality Descriptors by Price Category	Commercial/Good-Mediocre-Not Recommended	-0.462***	-12.113	-46.2	-23.73	-4.55
	Commercial/ Very Good	-0.402***	-10.635	-40.2	-20.68	-3.99
	Commercial/Classic-Outstanding	-0.366**	-2.083	-36.6	-18.81	-3.83
	Semi-Premium/ Good-Mediocre-Not Recommended	-0.050*	-1.747	-5	-2.57	-0.81
	Semi-Premium/ Classic-Outstanding	0.062	1.224	6.2	3.21	1.14
	Premium/Good-Mediocre-Not Recommended	0.296***	7.178	29.6	15.24	7.73
	Premium/ Very Good	0.420***	16.25	42	21.59	12.05
	Premium/ Classic-Outstanding	0.454***	15.779	45.4	23.33	13.81
	Ultra-Premium/ Good-Mediocre-Not Recommended	1.153***	14.022	115.3	59.27	76.11
	Ultra-Premium/Very Good	1.100***	32.835	110	56.56	72.75
	Ultra Premium/ Classic-Outstanding	1.306***	47.657	130.6	67.16	151.67

Table 4: *Wine Spectator* Regression Results and Marginal Effects (N=2,809) (continued)

Variable	Description	Regression Results		Marginal Effects (ME)		
		Coeff.	t-Stat.	% Change	ME ($) Overall	ME ($) by Category
Producer Size	Ln (cases produced)	-0.129***	-22.641	-12.9	-6.62	-6.62
	150,000 gallons or less	-0.566***	-5.688	-56.6	-29.1	-29.39
	150,000-250,000 gallons	-0.189	-1.586	-18.9	-9.72	-2.06
Vintage	2009	0.016	0.38	1.6	0.83	0.51
	2008	0.071*	1.846	7.1	3.66	2.71
	2007	0.120***	3.346	12	6.17	6.45
	2006	0.097***	2.654	9.7	4.99	4.55
	2005	0.132***	3.684	13.2	6.79	9.79
	2004	0.126***	3.359	12.6	6.47	5.82
	2003	0.207***	5.162	20.7	10.66	16.76
	2002	0.153***	3.915	15.3	7.87	10.76
	2001	0.072*	1.892	7.2	3.72	3.3
	2000	0.125***	2.906	12.5	6.44	4.82
	1999	0.071*	1.787	7.1	3.66	3.5
	1998	0.063	1.579	6.3	3.26	2.38
	Vineyard	-0.070***	-3.885	-7	-3.57	-5.47
	Reserve	-0.066***	-2.837	-6.6	-3.41	-2.8
	Adjusted R-squared			0.842		

***Significant at the 1% level**Significant at the 5% level*Significant at the 10% level
Omitted variables: New Zealand, semi-premium very good, 250,000 gallons ore more, 1997, Estate.

Overall, this model explained 84.2% of variation in the price of Riesling. The coefficients captured the difference in prices relative to a 1997 Semi-Premium/Very Good Estate Riesling from New Zealand, of which was produced 250,000 gallons or more. The coefficients associated with the region variables captured the difference in prices relative to the New Zealand region. Therefore, the coefficients described the price premiums or price discounts that Rieslings from other regions would earn compared to a Riesling from New Zealand. In comparison to New Zealand Rieslings, California Rieslings received price premiums up to 10.8% ($5.58), Washington Rieslings received

price premiums up to 6.6% ($3.41), Canadian Rieslings received price premiums up to 35.5% ($18.26), French Rieslings received price premiums up to 11.2% ($5.78), and German Rieslings received price premiums up to 12.1% ($6.23). Results indicated that the regions of Oregon, New York and Austria had no significant impact on prices.

In regards to quality ratings by price category, the coefficients associated with these variables captured the difference in prices relative to the category Semi-Premium/Very Good, which includes wines priced between $13 and $21 that earned *Wine Spectator* scores between 85 and 89. In comparison to Semi-Premium/Very Good wines, all of the commercial wine categories received price discounts, whereas Premium and Ultra-Premium wine categories earned price premiums.

Regarding production scale–increasing the number of cases by 1% while holding all other variables constant–the price of New Zealand Riesling would earn price discounts of 12.9% ($6.62). In comparison to the base variable which is wine production of 250,000 gallons or more, the production of 150,000 gallons or less had a significant impact on price, earning price discounts of 56.6 % ($29.10).

The coefficients for vintages refer to price differences relative to the excluded year 1997. Although not all vintages were significant, those that were had significant positive price impacts. In comparison to the 1997 New Zealand Riesling, the vintage 2003 was the largest in magnitude, earning a price discount of 20.7% ($10.66).

Lastly, the coefficients associated with the label-indication variables capture the differences in prices relative to the producer indicating "estate" on the bottle. In comparison to estate, indicating "vineyard" on the label decreases price by 7% ($3.57), whereas indicating "reserve" decreases price by 6.6% ($3.41).

Conclusions and Recommendations

Conclusions

Results confirm previously published studies indicating that region, reputation, price categories, and vintage have significant impacts on price (Combris, Lecocq, and Visser, 2000; Schamel and Anderson, 2003; Costanigro, McCluskey, and Mittelhammer, 2007; Costanigro, McCluskey, and Goemans, 2010; and Schnabel and Storchmann, 2010).

The regions of California, Washington, Canada, France, and Germany had a significant impact on the price of Riesling. In addition, each of these regions earned price premiums in comparison to a New Zealand Riesling. These results were similar to the many past studies that have examined regions' impacts on the price of wine, determining that origin significantly affects the price of wine (Steiner, 2002 and 2004; Troncoso and Aguirre, 2006; and Schamel, 2009). In particular, Troncoso and Aguirre (2006) results showed that cool-climate regions are preferred to other regions. For example, Schamel

and Anderson (2003) examined cool-climate regions of Australia and New Zealand, and their results showed strong upward trends for newly developing, ultra-premium, cool-climate regions, earning price premiums upwards of 31% in comparison to other regions.

Unlike past models, our study incorporates wine ratings as an interaction term to help capture the unique price-quality relationship of wine. Because expert ratings act as a signal of quality to the consumer, it is evident that the price of a wine will increase as its quality score increases. Past research (Oczkowski, 1994; Landon and Smith, 1997; and Schamel and Anderson, 2003) indicates that ratings are significant, earning wines significant price premiums. Costanigro, McCluskey, and Mittelhammer (2007) found that receiving an additional point in the *Wine Spectator* score would earn price premiums of 62.0%. In our study, quality ratings by category also had a significant impact on price, with commercial wines priced below $13 earning price discounts, and premium to ultra-premium wines earning price premiums in comparison to semi-premium wines that earned very good scores. These results can be explained by the idea that more expensive wines are likely to have received higher quality ratings. This confirms the results by Schamel (2002) who found that reputation had significant, positive impacts on prices. Results showed the relationship between *Wine Spectator* scores and prices. The perceived quality often depended on the consumers' prior knowledge of the wine or the assumptions they formed from quality rating scores. As producer and varietal reputations accumulate, consumers could pay more attention to the individual producer-specific and varietal quality signals and become less reliant on regional quality indicators (Costanigro, McCluskey, and Goemans, 2010).

However, the price-quality relationship appeared to be stronger in cool-climate regions than other regions. Results showed that Germany has earned the highest *Wine Spectator* scores for Riesling as 90-% of observations from Germany received Classic-Outstanding scores. Furthermore, of all regions, Germany had the highest mean price of $110.28. Given that Canada also received a high price premium, it was evident that numerous studies have examined Old World wine regions, but few have analyzed the New World cool-climate regions. This clearly portrays the relationship between price and quality; it is likely that higher prices mean higher quality ratings.

The number of cases produced proved to be significant. Di Vittorio and Ginsburgh (1995); Nerlove (1995); Costanigro, McCluskey, and Mittelhammer (2007); and Guillermo, Brummer, and Troncoso (2008) found that the quantity of cases produced had a statistically significant negative impact on price. The researchers suggested that the quantity should help capture a demand effect, which should be negative, and, indeed, it is, with a value at -0.129. This study confirms Costanigro, McCluskey, and Mittelhammer's (2007) findings that the number of cases negatively affects wine prices and approaches zero as the number of cases increases. The results show that, in

comparison to production of 250,000 gallons or more, producers of 150,000 gallons or less received price discounts of 56.6% ($29.10).

In regards to vintage, all significant vintages had positive price impacts in comparison to a 1997 Riesling from New Zealand, confirming results of numerous previously published studies (Combris, Lecocq, and Visser, 2000; Schamel and Anderson, 2003; and Costanigro, McCluskey, and Mittelhammer, 2007). Di Vittorio and Ginsburgh (1995) determined that vintage increased wine prices by approximately 3.7% per year of age, while Troncoso and Aguirre (2006) found that wine prices increased by 5.6%. Other hedonic price analysis studies incorporated vintage into their models because aging has been found to have a positive impact on price (Di Vittorio and Ginsburgh, 1995; Steiner, 2002; Schamel, 2002 and 2009; Troncoso and Aguirre, 2006; and Guillermo, Brummer, and Troncoso, 2008). Steiner (2002) claimed that the increasing valuation of older vintages reflects both interest rate differentials and cost of storage. Costanigro, McCluskey, and Mittelhammer (2007) found that the older wines had the highest price premiums. Results suggested that cool-climate varietals are not necessarily better when they are older since the vintage earning the highest price premium of 43.5% was in 2003.

Confirming previous results, the label indicators "estate," "vineyard" and "reserve" seem to be somewhat valuable in determining the price of wine (Costanigro, McCluskey, and Mittelhammer, 2007). However, indicating "vineyard" on the label seems to be the most commonly specified term, with 29.7% of the wines collected specifying "vineyard" on the wine label. The majority of Riesling wines that indicated "vineyard" were from Europe, including the regions of Germany (56.8%), France (17.2%), and Austria (12.7%). Results suggest that European wine producers are more likely to specify "vineyard" on the wine label, indicating that Old World wine producers value the importance of indicating vineyard. In addition, they emphasize the quality of their wine to consumers by stressing its relationship to a particular vineyard site where the grapes are produced. However, in comparison to "vineyard," indicating "estate" or "reserve" significantly influenced the price of Riesling.

Recommendations

Estimation results deliver information on wine consumer preferences for attributes contained on the bottle, as well as the value consumers place on region, varietal, price categories, vintage, number of cases produced, and various label attributes. The dataset contains Riesling prices and information for wines from the United States West Coast regions of California, Oregon, and Washington; the United States/Canadian East Coast regions of New York and Ontario; European regions of Austria, France, and Germany; and the Oceania region of New Zealand. Results indicated that prices were responsive with regard to region, *Wine Spectator* score, number of cases produced, and vintage.

Overall, the results confirmed that prices are higher for Rieslings that are associated with higher expert rating scores, which could be assumed to indicate higher quality wines. Thus, the rating scores have the strongest influence on the price of Riesling.

The results suggest a difference between the valuation of Old World and New World wine consumers. For instance, it appears that consumers of Old World wines are more educated on the importance of region and vintage, whereas New World wine consumers are not as aware of the importance of certain attributes. Therefore, when consumers are new or inexperienced, they often look for guidance before purchasing wines, such as the *Wine Spectator* score. This solicits the question as to how expert ratings, in addition to the other variables related to quality, affect the price of wine. Since the quality of a particular bottle of wine cannot be known until it is consumed, consumers' willingness to pay depends on reputations associated with the wine. In addition to quality ratings, consumers' perceptions of a wine's quality depend on producer reputation, region reputation, and the grape variety (Schamel and Anderson, 2003). Therefore, it will be important for producers to analyze the wine consumer market and to figure out what these new wine consumers truly value when making wine purchasing decisions.

A decrease in wine consumption in parts of the Old World has resulted from consumers being less predictable, more conscientious of the negative effects of alcohol, and having more beverage choices than they had in the past. Consumers used to be primarily driven by their loyalty to certain vintages, wine producers, grape varieties, blends, and brands. Research suggests wine consumption is as much a social transmission as an economic transaction (Mora and Moscarola, 2010), which indicates that wine purchasing patterns are different from consumption behavior for other products. Furthermore, the price of a wine can be influenced by many factors, and our research sheds some new light on the drivers of prices for cool-climate wines from various regions.

Although the sample size is large with 2,809 observations, it may not be a fully representative sample of Riesling production. Due to the nature of the data and the inclusion of several dummy variables to isolate specific factors that cannot be described with other data, it may not be possible to fully quantify all of the influences on wine prices. However, earlier studies have already shown that such constraints may not be overly limiting.

The goal of this study was to determine the relationship between the price of wine and different variables that other people have analyzed in similar studies, yet it extends earlier work to examine cool-climate wines. Various countries and regions are included in order to represent the market for Riesling wines. This study could be useful for current cool-climate wine producers, as well as others who are considering planting cool-climate wine varietals. In addition, the information could be important for the many different sectors of

the wine industry, including companies specializing in growing, harvesting, fermenting, bottling, marketing, branding, buying, and selling grapes. The information could enable them to understand what qualities affect the price of cool-climate wines, and the attributes which consumers highly value.

References

Brunke, H., B. Rickard, and C. Schroeter. (June 25-28, 2010). "Examining Wine Grape Acreage Response in Selected Cool Climate Regions." Selected paper presented at the 4th Annual Meeting of the American Association of Wine Economists, Davis, Calif.

Chow, G.C. (1967). "Technological Change and the Demand for Computers." *American Economic Review* 57, 1117-1130.

Cole, R., Y.C. Chen, J. Barquin-Stolleman, E. Dalberger, N. Helvacian, and J.H. Hodge. (1986). "Quality-adjusted Price Indexes for Computer Processors and Selected Peripheral Equipment." *Survey of Current Business* 66, 1-50.

Costanigro, M., J.J. McCluskey, and R.C. Mittelhammer. (2007). "Segmenting the Wine Market Based on Price: Hedonic Regression when Different Prices mean Different Products." *Journal of Agricultural Economics* 58(3), 454-466.

Costanigro, M., J.J. McCluskey, and R.C. Mittelhammer. (2010). "The Economics of Nested Names." *American Journal of Agricultural Economics* 92(5), 1339-1350.

Court, A.T. (1939). "Hedonic Price Indexes with Automotive Examples." In: *The Dynamics of Automobile Demand* (pp. 99-117). New York: The General Motors Corporation.

Di Vittorio, A. and V. Ginsburgh. (April 1995). "Pricing Red Wines of Medoc: Vintages from 1949 to 1989 at Christie's Auctions." Journal de la Societie Statistique de Paris 137, 19-49.

Florkowski, W.J., R. Carew, and S. He. (August 26-28, 2008). "British Columbia Consumers' Preferences for Italian Wines: Reputation and Vintage Effects on Wine Quality and Prices." Paper presented at the 12th EAAE Congress 'People, Food and Environments: Global Trends and European Strategies,' Belgium.

Gorman, W. (October 1980). "A Possible Procedure for Analyzing Quality Differentials in the Egg Market." Review of Economic Studies 47(5), 843-856.

Griliches, Z. (1961). "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change." In: *The Price Statistics of the Federal Government* (pp. 137-196). General series No. 73. New York: Columbia University Press.

Guillermo, S., B. Brummer, and J. Troncoso. (April 2008). "Determinants of Argentinean Wine Prices in the U.S. Market." *American Association of Wine Economists (AAWE)* Working Paper No. 15, 1-19.

Heslop, L.A., D. Cray, D., and A. Armenakyan. (December 2010). "Cue Incongruity in Wine Personality Formation and Purchasing." *International Journal of Wine Business Research* 22(3). December, 288-307.

Mora, P. and J. Moscarola. (November 2010). "Representations of the Emotions Associated with a Wine Purchasing or Consumption Experience." *International Journal of Consumer Studies* 34(6), 674-683.

Neeley, C.R., K.S. Min, and P.A. Kennett-Hensel. (June 2010). "Contingent Consumer Decision Making in the Wine Industry: The Role of Hedonic Orientation." Journal of Consumer Marketing 27(4), 324-335.

Nerlove, M. (1995, January). "Hedonic Price Functions and the Measurement of Preferences: The case of Swedish Wine Consumers." European Economic Review 39, 1697-1716.

Oczkowski, E. (1994) "A Hedonic Price Function for Australian Premium Table Wine." *Australian Journal of Agricultural Economics* 38, 93-110.

Rosen, S. (1974). "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." Journal of Political Economy 82(1), 34-55.

Rosen, S. (2002). "Markets and Diversity." American Economic Review 92(1), 1-15.

Schamel, G. (July 28-31, 2002). "California Wine Winners: A Hedonic Analysis of Regional and Winery Reputation Indicators." Paper presented at the Annual Meeting of the American Agricultural Economics Association-Western Agricultural Economics Association, Long Beach, Calif.

Schamel, G. (August 16-22, 2009). "Can German Wine Cooperatives Compete on Quality?" Paper presented at the International Association of Agricultural Economists Conference, Beijing, China.

Schamel, G. and K. Anderson. (2003). "Wine Quality and Varietal, Regional and Winery Reputations: Hedonic Prices for Australia and New Zealand." *The Economic Record* 79(246), 357-369.

Schnabel, H., and K. Storchmann. (January 2010). "Prices as Quality Signals: Evidence from the Wine Market." *Journal of Agricultural and Food Industrial Organization* 8(1), Article 2.

Steiner, B. (July 28-31, 2002). "The Valuation of Labeling Attributes in a Wine Market." Paper presented at the Annual Meeting of the American Agricultural Economics Association-Western Agricultural Economics Association, Long Beach, Calif.

U.S. Department of Treasury. Alcohol and Tobacco Tax and Trade Bureau (TTB). 2010. "The 2010 TTB Compliance Seminar for Bonded Wine Premises." Department of Treasury, Alcohol and Tobacco Tax and Trade Bureau, Trade Investigations Division, 1-172.

Troncoso, J. and M. Aguirre. (2006). "Price Determinants of Chilean Wines in the U.S. Market: A Hedonic Approach." The Spanish Journal of Agricultural Research 4(2), 124-129.

Waugh, F.V. (1928). "Quality Factors Influencing Vegetable Prices." *Journal of Farm Economics* 10, 185-196.

Wine Institute. (2009). "New California Wine Varietals Quench America's Thirst for Diversity."Press Room. March. (San Francisco). Online. Available at: http://www.wineinstitute.org/resources/pressroom/03312009. [Retrieved December 9, 2010].

Wine Spectator. (2010). "Wine Ratings." *Wine Spectator Online*. Online. Available at: http://www.winespectator.com/display/show/id/scoring-scale. [Retrieved February 7, 2011].