Prices of Domestic and Imported Riesling Wine in the U.S. Market: A Hedonic Price Approach

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Abstract

The price of wine reflects the various features that differentiate each bottle. This study is aimed at analyzing the determinants of Riesling wine prices, one of the most popular varieties in the white wine category. A hedonic price model is estimated using data collected between 2000 and 2015 from the *Wine Spectator*, with a total of 3078 individual wines, focusing on age, vintage, production, critical points, and variables related to the country of origin. The impact of geographic production of origin from Canada, Germany, France, Italy, New Zealand and South Africa is analyzed. An important aspect of this analysis is to investigate whether the country of origin of production is important, and if any price premium from a key import region like Germany is changing, holding quality and quantity constant. The main findings suggest Riesling prices are determined by time related variables such as age and vintage. The levels of production and expert points given by the Wine Spectator also have a significant impact on prices.

Keywords: Hedonic price model, Riesling, Wine prices, U.S. wine market

Introduction

The wine market is a worldwide market. Regardless of growing rivalry, very limited trademarks have prospered in establishing themselves at a global level. Growth forecasts in the 'premium' segment, the advanced quality classification of wine above every day drinking table wines, are impressive (The revolution of the global wine market, 2015). Furthermore, growing attention for top wines are exposed by shoppers. Also, the higher level of income has an impact on beverage

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and food expenditures and results in a shift towards top wines with higher quality and prices (Corsi and Ashenfelter, 2001).

McMillan (2015) suggests that consumer demand for higher-priced wine will increase in 2015. In the 2015 market, many wines that cost between $10 and $20 per bottle will be available. Wines under $7 in the 2014 market performed poorly and are expected to continue this trend in 2015. On the other hand, bulk imports in the lowest price range in 2014 have been held back by the huge harvest in U.S., and the drought has produced changes in production and planting decisions, especially within the California Central Valley, the most vulnerable position geographically.

<<Figure 1 here>>

As wine becomes more of a drinker's choice in America, it is fast becoming an item that must be seen on a restaurant menu, and this trend is now seen in non-traditional upscale restaurants. This trend is an indicator that adults of all ages are looking to drink wine. Tasting different types of wine is an increasing trend among millennials, and wine marketers hope to capture them while they are still young so that marketers can create permanent consumers out of them (Wine in the US, 2014).

<<Figure 2 here>>

Lyons (2015) asserts that, according to the latest figures from International Wines and Spirits Record (IWSR), in 2013 Italy led wine consumption per capita, followed by France, Switzerland, Portugal, and Austria. However, by considering just volume, there is no doubt that the U.S. is the largest market, consuming a total of 339 million cases of wine just in 2013. They exceeded France's 296 million cases, Italy's 288 million cases, and Germany's 274 million cases. This represents volume growth for 22 consecutive years. The U.S. has been the main wine consuming nation in the world since 2010. According to figures 1 and 2, U.S. wine production and sales are growing, but still, per capita, the wine consumption of the U.S. (Table 1) is far behind that of Europe (Wine Institute Statistics, 2015).

<<Table 1 here>>

Riesling and Chardonnay are frequently credited as the 'kings' of white wine grapes. Riesling is a decent grape variety used to produce excellent white wine styles. Although the sweet German style is well known, Washington State also produces high-quality Riesling; almost all of these wines are developed into a sweeter style and are a great substitute to White Zinfandel (Guide to Sweet Riesling Wines, 2015).

In 2006, with 20.8% and 21,197 hectares dedicated to its growth out of all grape production, Riesling was the most cultivated variety of grape in Germany. In the French region of Alsace, Riesling was grown on 3,350 hectares, which accounts for 21.9% of the harvested area. In the U.S., producing around 2,000,000 cases yearly, makes Chateau Ste. Michelle the global leader in the production of Riesling wines by volume (Wines of Germany, 2015). Considering the variations in Chardonnay and Riesling production and their prices, understanding the relationship between wine prices and their features is crucial (Lecocq and Visser, 2006). Figure 3 shows that vineyards in California are more interested in the Riesling variety than before (California Riesling, 2015).

<<Figure 3 here>>

Literature Review

There is a lot of literature on wine prices. Combris, Lecocq and Visser (1997) applied the hedonic technique by including both the observable features, which can be found on the bottle's label like vintage year, vineyard region and grape variety, and the sensory features of the wine such as level of acidity, tanning, and alcohol. In the same way, Jones and Storchmann (2001) and Haeger and Storchmann (2006) studied factors that determine prices by regressing wine prices on a set of features to examine which features affect the hedonic functions significantly.

Oczkowski (2001) asserted that quality and reputation are hidden paradigms and consequently engaged factor analysis and 2SLS techniques for hedonic price estimation while characteristics are determined with error.

Benfratello, Piacenza and Sacchetto (2009) offered new proof on the elements influencing wine prices, not only on methodological but also factual grounds. Methodologically, their study applied a general Box–Cox transformation related to hedonic models. On the factual

ground, for the first time, they worked on two wines with high quality, Barolo and Barbaresco, including the 1995–1998 vintages. Their results indicate that sensorial characters, the wines and producers' legitimacy, and objective features are altogether main elements that impact the consumers' willingness to pay.

However, more research can be conducted with an emphasis on New World[1] wine, and specifically on markets for wines that are producing in low temperature areas (Schroeter, Ritchie and Rickard, 2011). All reviewed articles focus on climate, expert quality ratings, vintage, aging, regions, grape variety and so forth. Nevertheless, the impact of country of origin labeled on imported wine is not addressed.

The objective of this paper is to determine which variables significantly affect the price of Riesling in the U.S. market using a hedonic approach. As mentioned above, there are many factors that affect quality and also prices of wine in past studies. This paper explores the impact of region, production level, aging, vintage, critic scores and country of origin.

The paper proceeds as follows: After presenting the model and data in the next section, section 4 provides the main empirical results. The paper ends in section 5 with a conclusion and implication of results.

Empirical Model and Data Description

In recent years, hedonic methods have been employed to measure how a group of quality determinants affects the price of a commodity. Different models of hedonic price give an explanation of the commodity price with regard to the qualities of a commodity by applying a certain degree of the quality as explanatory variables (Nerlove, 1995). Furthermore, this method of analysis has backgrounds in agricultural economics. Waugh (1928), the pioneer of hedonic analysis, investigated the connection between factors of quality that impact vegetable prices in pursuance of determining relative assessments of these features by customers.

The analysis draws on a pooled data set of 3078 wines reported and reviewed in the *Wine Spectator,* one of the most comprehensive sources of wine information on the web. It includes

[1] New World wine includes countries such as Argentina, Australia, Chile, New Zealand, and the USA versus the traditional wine countries such as France, Italy, and Spain (Lecoc and Visser, 2006).

more than 250,000 wine ratings, tasting reports, news and features, editors' blogs and more (Wine Spectator, 2015). Vintages are between 2000 and 2014 and were grown in 5 different U.S. viticulture regions and 6 countries that are major exporters to the U.S. wine market. In the model, *P* stands for wine price, all prices are nominal, assumed to increase over time, and vary from $6 to $1398. The inflationary effect is captured by using alcoholic beverage CPI (consumer price index) to adjust prices for inflation to current dollars (Bureau of Labor Statistics, 2015).

Each region has special climatic characteristics which affect the quality of grape. Assuming that decrease in supply leads to increase in prices (Haeger and Storchmann, 2006), production is considered in this model because of supply impact on prices. We introduced *PROD* variable which is quantity produced in the U.S. and quantity imported to the U.S. from other countries. The unit of production in this study is "case" which contains 12 bottles of wine. All prices belong to standard 750ml bottle; otherwise the prices have converted to an equivalent amount.

Aging and vintage time-related variables are included in the model because the value of most wines suitable for aging increases as they become older, but it does not happen to most table wines. Hence the overall effect regarding these variables is uncertain and needs to be investigated (Haeger and Storchmann, 2006). In the model, *AGE* represents age of wine which is the difference between vintage year and the year that the wine was reviewed. The reviewed year is one year after the vintage in most cases and means that the wine was available in the market. The model takes the year of production into account by introducing a vintage year variable *(VINT).*

The impact of experts' ratings is controversial. While some studies found significant impact (Jones and Storchmann, 2001), others proposed that the effects of fundamentals such as weather or knowledge of the winemaker on the wine prices, are more important (Ashenfelter and Corsi, 2001). Scoring systems for ranking or rating wines normally use a 0 to 20 or a 100-point scale. Scores are considered as ordinal instead of cardinal. Many factors affect the scoring of wine quality: aesthetics, pleasure, complexity, color, appearance, odor, aroma, bouquet, tartness, and the interactions with the senses of these features (Olkin et al., 2015). To examine the possible effects of critical scores, the rating system of a well-known wine journal, *Wine*

Spectator, is used. The journal employs a parker point system with a 100-point scale. Ratings given to the wines by the *Wine Spectator* in this sample vary between 55 and 99.

Additionally, with favor to the production region, buyers might value wines from certain U.S. states. We considered California, New York, Oregon, Washington and Other U.S. using the data provided by *Wine Spectator*. One objective of this paper is to examine the possible effect of imported Riesling wines from France, Italy, Germany, Canada, New Zealand and South Africa. Therefore, we added dummy variables for each of the 5 U.S. major regions, as well as the six countries exporting Riesling wine to the U.S. market. Dummy variables for U.S states and importing countries represent the skill and experience of the winemaker in the model.

<<Table 2 here>>

As Germany is the major importer in our sample (figure 4), we considered the impact of vintage on imported Riesling wine from Germany by introducing the *GR*VINT* variable. In this case, the hypothesis of whether the price of wines imported from Germany changing over time, other factors held constant, is tested.

<< Figures 4 and 5 here>>

An Ordinary Least Squares (OLS) regression is used to estimate the following models:

$$\log(P_i) = \alpha_0 + \alpha_1 AGE_i + \alpha_2 VINT_i \quad (1)$$

$$\log(P_i) = \alpha_0 + \alpha_1 AGE_i + \alpha_2 VINT_i + \alpha_3 \log(PROD)_i + \alpha_4 PTS_i \quad (2)$$

$$\log(P_i) = \alpha_0 + \alpha_1 AGE_i + \alpha_2 VINT_i + \alpha_3 \log(PROD)_i + \alpha_4 PTS_i + \alpha_5 GR * VINT + \sum_{k=1}^{5} \gamma_k \, REG_i + \sum_{j=1}^{6} \delta_j \, IMPT_i + \varepsilon_i \quad (3)$$

In which, P represents adjusted price of wine; *AGE* indicates age of wine; *VINT* denotes vintage; *PROD* shows quantity produced or imported; *PTS* represents critical scores; *REG* denotes regional dummies and *IMPT* is a dummy variable for importing countries. In this equation i=1,2, …, 3078 represents an individual wine, k=1, 2, …, 5 represents each region, j=1, 2, …, 6 represents each importing country. In order to adjust the scales of production unit, logarithmic form is used for *PROD* variable.

Estimation Results

Table 3 presents the results of ordinary least squares (OLS) estimates of the models. It can be inferred from the results, that wines get more expensive over time as age increases, indicated by the significant positive coefficient for the age variable. The marginal effect and elasticity are 3.59 and 0.14, respectively. It means for each year increase in age, ceteris paribus, the price rate of wine will increase by $3.59/bottle and also for each 10% increase of age; the price rate will increase by 1.4%. Also the significant negative coefficient for vintage variable denotes that newer wines are cheaper. As predicted, with an R^2 of only 8% Equation 1 does not give an enough explanation of wine price dissimilarity.

Column 2 of table 3 shows the results of estimating Equation 2 which refers to production and the *Wine spectator* points and their ability to describe the price variations. Wine prices have a negative correlation with the volume of production; consequently, higher quantities bring lower prices per case which is according to the law of demand. The elasticity of about -0.18 means, holding everything else constant, an increase in quantity by 10% leads to a decrease in price by 1.8%.

The variable *PTS* has a significantly positive influence on Riesling wine price. By adding the expert knowledge, which is considered in the form of rating given to the wines by the *Wine Spectator,* and also level of production, which is supply side variable, the results of Equation 2 display a significant increase in the goodness to fit measured by R^2 =0.60.

<< Table 3 here >>

By considering Equation 3 and leaving out "Other U.S." dummy variable, the estimated coefficients for regional dummies were compared to that variable. Half of the regional (State/Country) dummy variables are significant. Wines from California are more expensive than other U.S. regions. Also countries such as Canada, France, New Zealand and specifically Germany show a premium comparing to the left out region which is "other U.S.". On the one hand, positive parameters can be interpreted as an indication of better and more expensive wines from these regions. This can be due to geological factors or skill, knowledge and experience of winemakers. The other factor could be the reputation of winemaker. The regions with lower prices are required to leave their wines in more reasonable prices because they have not gained

enough reputation that satisfies their customers. Thus, wines originating from other states in the U.S., same as Italy and South Africa seem to show a discount and lower price in the U.S. market.

Riesling variety is originated from Germany so it is not surprising to see the high premium comparing to other regions. However, the Riesling prices have declined over time to compete within U.S. highly competitive wine market. According to figure 6, German Riesling wine prices which are imported to U.S. between 2000 and 2013, had a decreasing rate after a jump in prices in 2002. The significantly positive estimated coefficient for the variable *GR*VINT* is to be interpreted as the premium price for German wine that erodes with later ("larger") vintages (Figure 7).

<<Figures 6 and 7 here>>

By including all variables in the model, R^2 of Equation 3 increases to 0.62 which may imply an improvement in the model by considering the country of origin variable.

White test results show some evidence of heteroskedasticity in the model; therefore robust standard errors are considered and the proper t-statistics are reported in parentheses. Furthermore, the Ramsey RESET test shows the possible presence of a specification error in Equation 3. It could be due to the functional form or missing variable bias. Different functional forms, linear, quadratic and logarithmic, have been tested and the problem still remains. Next step would be to test whether including climate variables can address the issue. Hence, the results should be interpreted with caution before resolving this issue.

Another potential problem could be multicollinearity. The variance inflation factors (VIF) for all variables in Equation 3 are reported in Table 4. Any number above 10 is representing multicollinearity problem. It seems that, multicollinearity is only caused by the two Germany related variables. To the extent that we introduced GR*VINT by using GERMANY dummy variable, they are closely correlated by design.

<<Table 4 here>>

Conclusion/Implication

The objective of this paper is to determine significant variables affecting the price of Riesling in the U.S. market using a hedonic approach. The analysis draws on a pooled data set of 3078 wines reported and reviewed by the *Wine Spectator*. Vintages are between 2000 and 2014 and were grown in 5 different regions in most of the U.S. viticulture regions and also 6 countries that are major importer to the U.S. wine market. Price data, considering suggested retail prices, were associated with age and vintage of wines, ratings given to each wine by the *Wine Spectator* magazine, quantity produced and imported to the U.S. market, regional dummy variables of geographic production of origin and also interacting variable between price and vintage of German Riesling wine.

The age variable is significant and has a positive impact on price. Also the significant negative parameter for vintage variable denotes that newer wines are cheaper. The production variable is statistically significant and wine prices are negatively correlated with quantity produced. The critical scores given by experts to each wine has a significantly positive influence on Riesling wine price. By adding production and points variables into the model the overall goodness to fit of the model greatly improved. Among all states considered in this study California significantly positive effect on the other states prices. Canada, Germany, France and New Zealand significantly affect the price of Riesling in the U.S. market. The premium price for German wine erodes with later vintages.

The empirical results point out that the objective features which are accessible on the bottle's description, such as vintage, age and origin of production could explain the price of Riesling wine in the market. As the expert points has a significantly positive influence on Riesling wine price, providing information about ratings and also awards received by the winemaker for that specific wine on the label is recommended. Tasting and having subscription of wine magazines, in order to reading guides and obtaining information, are only ways of learning about sensory features. This can be costly enough to force consumers to make their decision about wine choices based on the objective characteristics. Additionally, the premium prices for imported wines indicate that U.S. Riesling winemakers should work towards creating an uncompromising reputation to gain more market share to compete with imported wines.

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Table 1. Per Capita Wine Consumption by Country

Country	2009	2010	2011	2012
France	46.5	44.06	45.61	44.19
Italy	39.34	40.2	37.66	37.54
Germany	24.87	24.23	24.23	23.98
New Zealand	15.2	15.99	16.5	17.01
Canada	11.12	11.78	11.7	12.5
U.S.	9.08	9.59	10.48	10.42
South Africa	6.93	7.09	7.23	7.37

Source: Wine Institute Statistics, 2015

Table 2. Descriptive Statistics of Variables

Variable	Definition	Unit	Mean	Std. Dev.	Min	Max
P	Adjusted retail price	$ per bottle	45.00	102.28	6	1514
AGE	Age of wine	year	1.76	0.61	1	9
VINT	Date of production	year	2007.4	3.38	2000	2014
PROD	Quantity produced or imported	cases	5982.01	42915.38	1	900000
PTS	Critics' scores	points	87.74	3.98	55	99
GR*VINT	Interaction of country of origin and vintage for Germany	$ per bottle	807.78	984.28	0	2013
CA	Regional dummy variable for California	-	0.04	0.20	0	1
NY	Regional dummy variable for New York	-	0.29	0.45	0	1
OR	Regional dummy variable for Oregon	-	0.04	0.20	0	1
OTHER	Regional dummy variable for Other U.S.	-	0.03	0.17	0	1
WA	Regional dummy variable for Washington	-	0.13	0.34	0	1
CAN	Regional dummy variable for Canada	-	0.003	0.04	0	1
FR	Regional dummy variable	-	0.002	0.49	0	1

	for France					
GR	Regional dummy variable for Germany	-	0.40	0.49	0	1
ITA	Regional dummy variable for Italy	-	0.005	0.07	0	1
NZ	Regional dummy variable for New Zealand	-	0.02	0.16	0	1
SA	Regional dummy variable for South Africa	-	0.006	0.08	0	1

Table 3. OLS Estimation Results

Variables	Equation (1) n= 3078	Equation (2) n= 3078	Equation (3) n= 3078
Constant	75.87***	81.57***	55.23***
	(8.284)	(5.410)	(6.528)
Age	0.30***	0.10***	0.07***
	(0.031)	(0.018)	(0.017)
Vintage	-0.03***	-0.04***	-0.02***
	(0.004)	(0.002)	(0.003)
Log(Production)		-0.17***	-0.18***
		(0.005)	(0.006)
Points		0.08***	0.08***
		(0.003)	(0.004)
California			0.15***
			(0.059)
New York			-0.09*
			(0.050)
Oregon			-0.11**
			(0.059)
Washington			-0.02
			(0.057)

Canada			1.27***
			(0.057)
France			0.94***
			(0.258)
Germany			70.97***
			(13.066)
Italy			-0.13
			(0.095)
New Zealand			0.02
			(0.065)
South Africa			-0.31***
			(0.111)
Germany*Vintage			-0.03***
			(0.006)
R^2	0.08	0.60	0.62
F-statistic	151.01	1164.46	338.64

Note: heteroskedasticity consistent standard errors in parentheses.

*** 1% significance level, **5% significance level and *10% significance level.

Table 4. Variance Inflation Factors for Equation 3

Variable	VIF
AGE	1.14
VINT	1.71
LnPROD	1.83
PTS	1.82
CA	2.42
NY	7.73
OR	2.4
WA	5.35
CAN	1.11
FR	1.07
GR	42
ITA	1.19
NZ	1.88
SA	1.22
GR*VINT	42

Note: Multicollinearity is assumed to be present when *VIF*>5

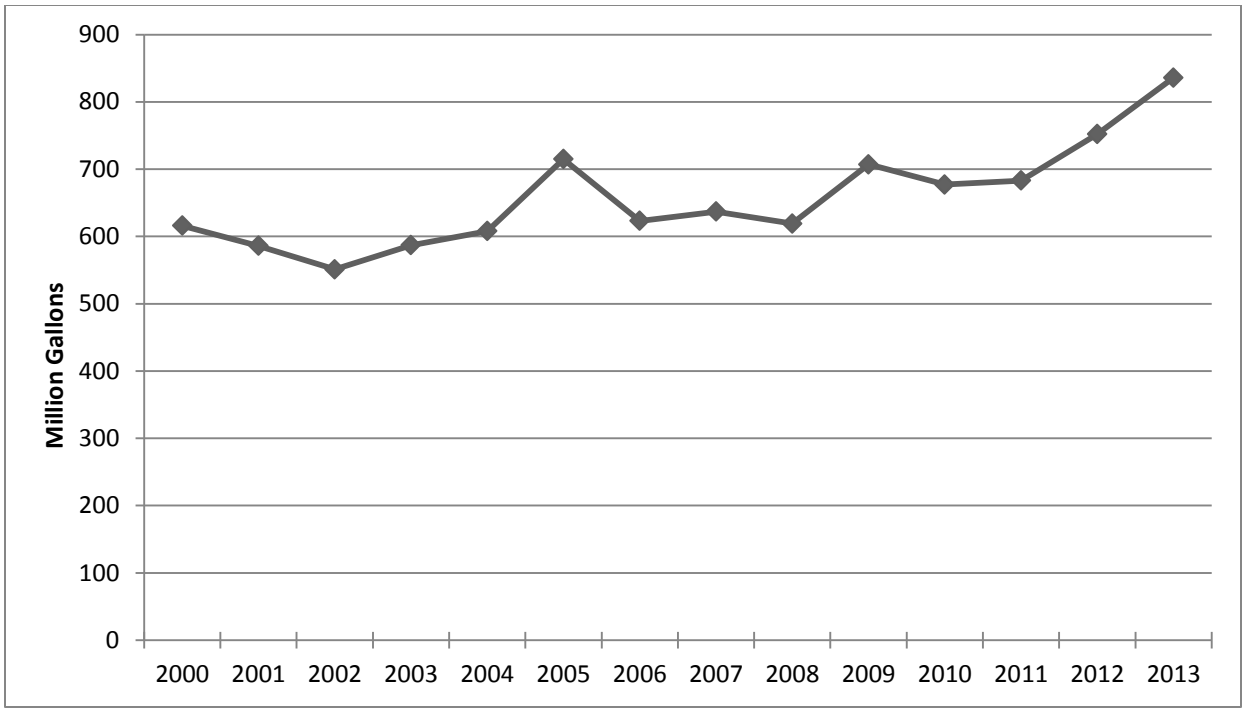

Figure 1. U.S. wine production

Source: Wine Institute Statistics, 2015

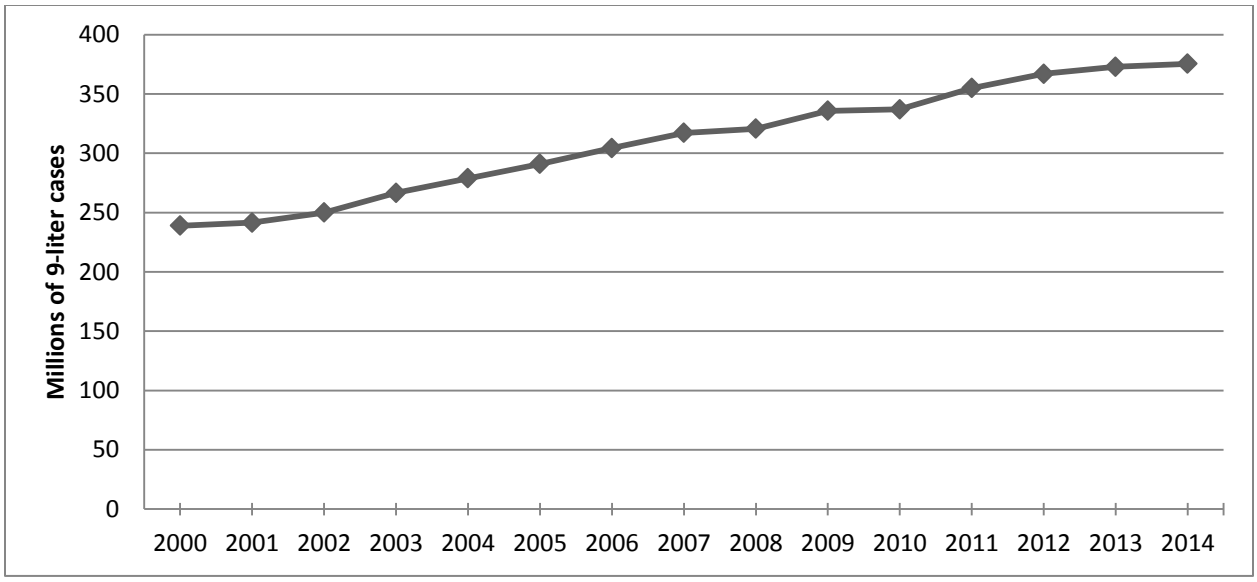

Figure 2. U.S. wine sales

Source: Wine Institute Statistics, 2015

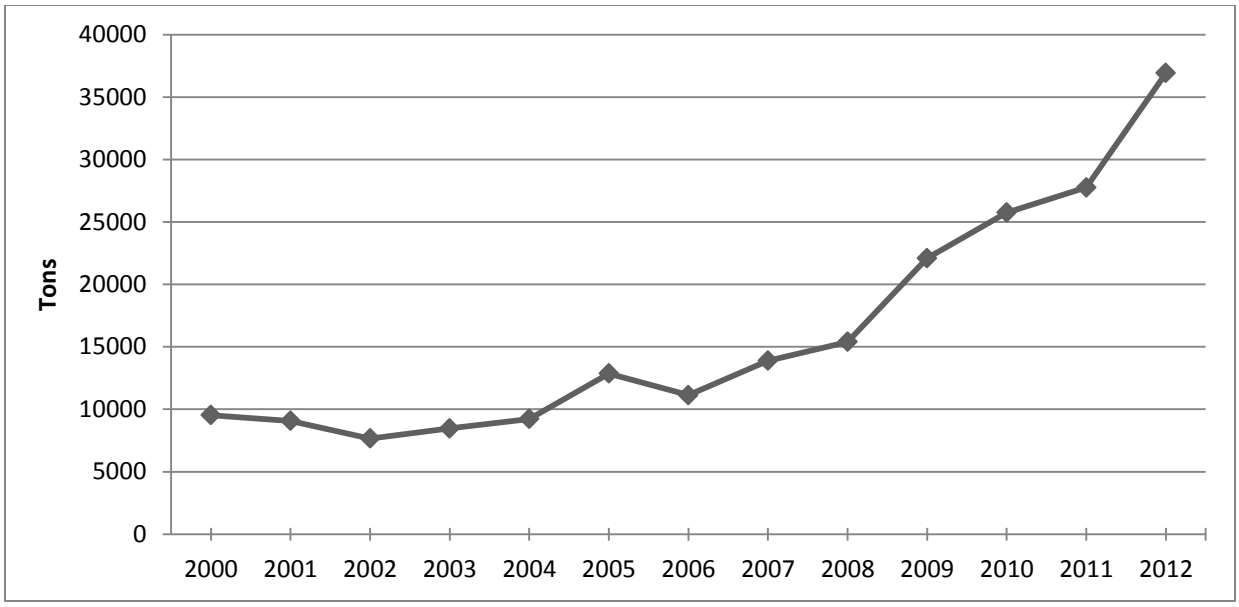

Figure 3. California Riesling grape crush tonnage

Source: California Riesling, 2015

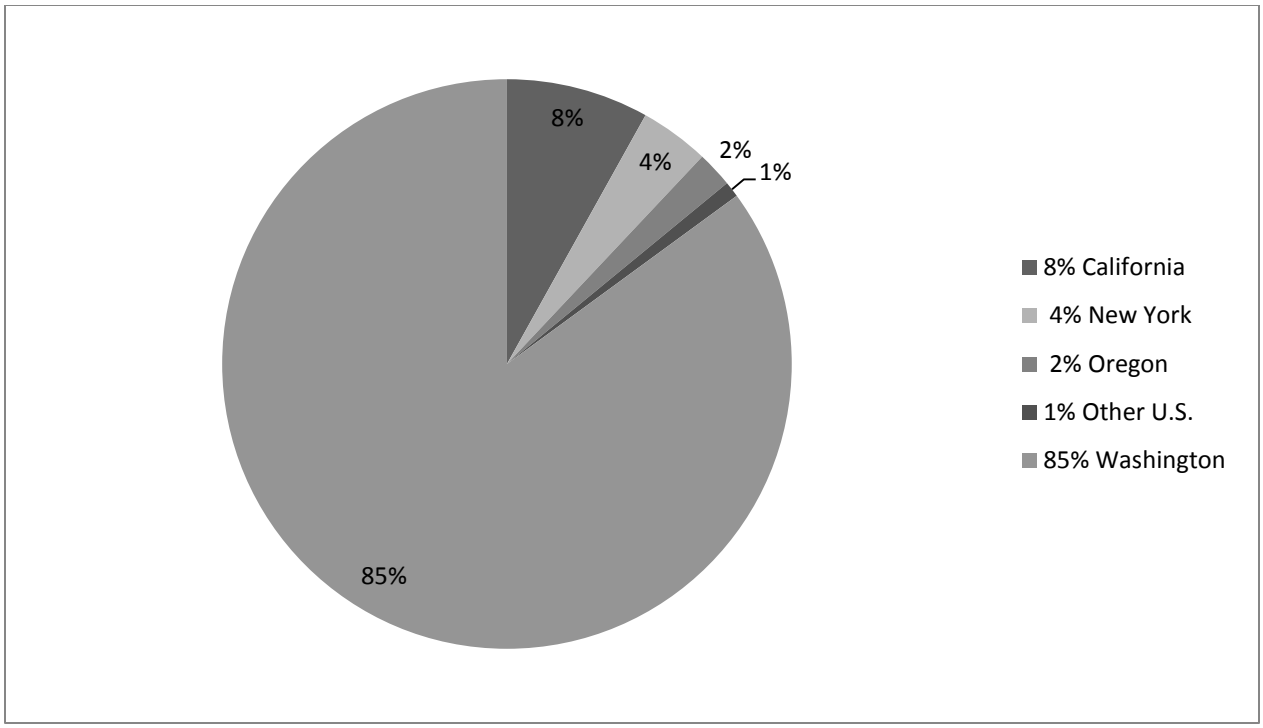

Figure 4. U.S. Riesling production by states

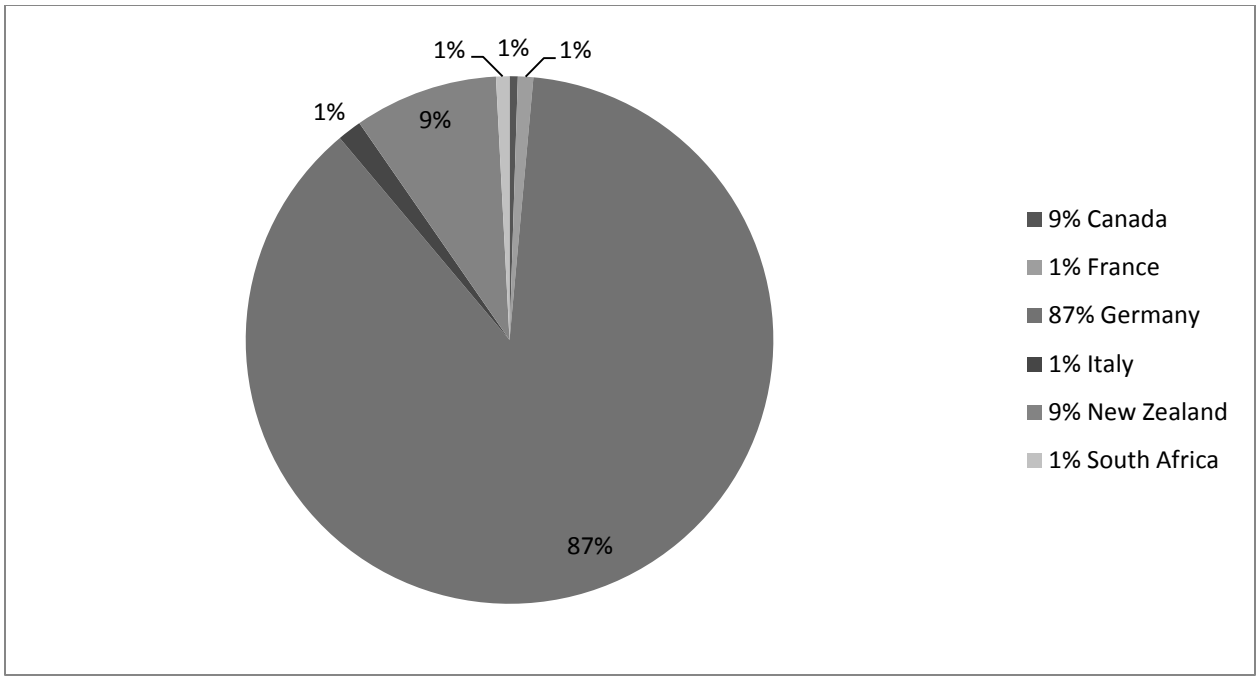

Figure 5. Imported Riesling by country

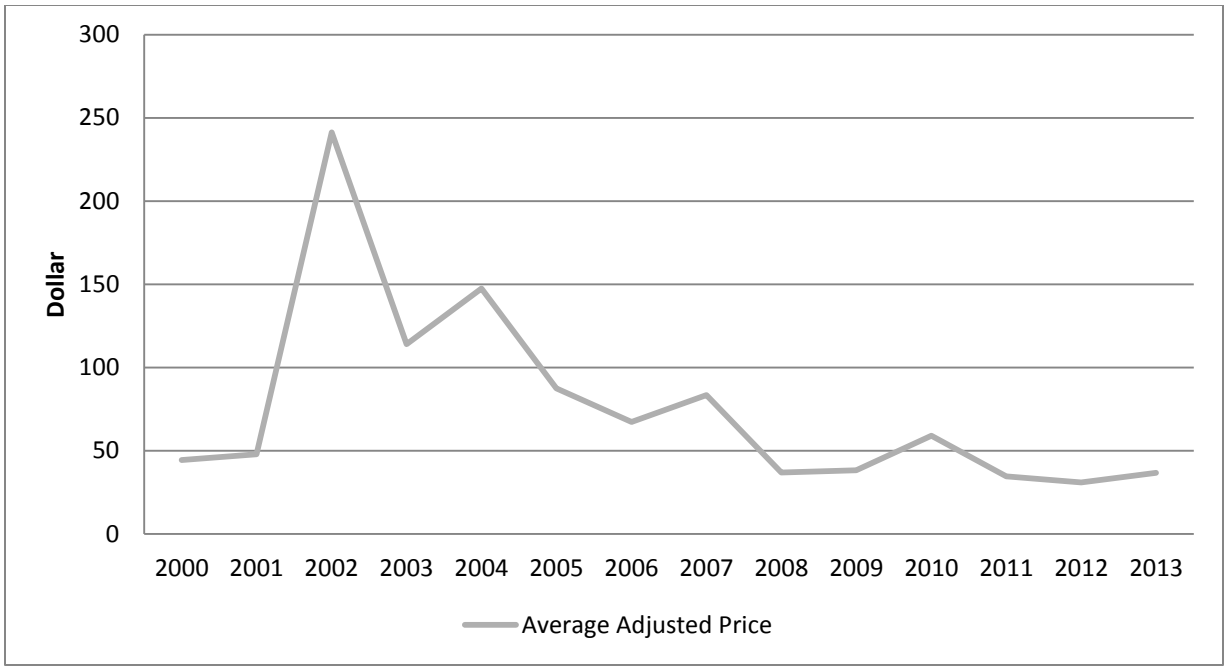

Figure 6. German Riesling price

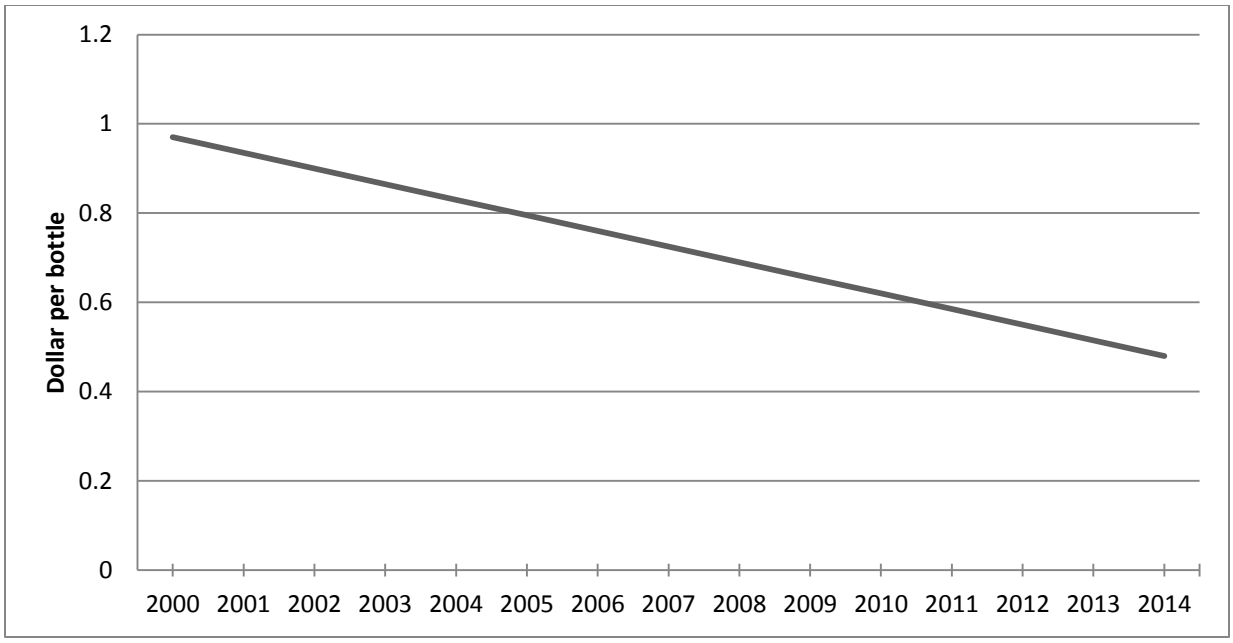

Figure 7. Marginal effect from Germany