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A hedonic analysis of the effect of expert wine ratings on price and retailer profits

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A HEDONIC ANALYSIS OF THE EFFECT OF EXPERT WINE RATINGS ON PRICE AND RETAILER PROFITS

by

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ABSTRACT

During the last few decades, economists have become interested in the wine industry and several of them have focused on the determinants of price. One characteristic that has been identified as an important determinant is expert wine ratings. Much of the previous research on this topic has focused on relating expert grades to the *retail price* of wine. Using proprietary data, this paper will test whether these grades influence *retail prices* as well as *retailer profits* and *wholesale pricing*. By analyzing an individual wholesale firm in South Florida and their distribution network, this paper determines the effect expert ratings have on these dependent variables.

Empirical evidence confirms that expert ratings have a positive effect on wholesale and retail wine prices and that they exhibit a parallel influence on retailer profits. This thesis aims to contribute new information to aid both the end consumers purchasing decisions as well as business pricing strategies.

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INTRODUCTION

Wine has been in existence for millennia, originating in Eastern Europe,[1] and appearing in America in the 1500's (Stevenson, 1997). Over the years, wine production has been transformed into a sophisticated art form. And like any fine piece of art, there are critics and experts that judge and rate its quality. One expert in particular has rocked the foundation of modern wine making and exerted great influence on wine consumption. American wine critic Robert Parker arrived on the wine scene in the 1970's and has since become a leading influence on wine markets in several countries. Even in more established wine regions, such as France, his opinion has become *de rigueur*. Today, he is arguably the most influential wine critic in the world. His tasting notes and ratings are published in *Wine Advocate*, a magazine founded on unbiased reporting. Given that his reputation, pallet, and nose have apparently become so influential within the wine community, a natural question arises regarding whether his ratings affect wine prices. More specifically, and of particular interest to this paper, is whether or not his ratings affect retailer profits and wholesale prices.

Although former research shows Parker has exhibited influence on the market in past years, this may not be the case today. His influence may be dampened by the evolution of *Wine Advocate*. Robert Parker was a one-man show until 1996 when Pierre Rovani became the second critic to join *Wine Advocate*. Since that time, nine wine critics have joined and eight are currently reviewing wines for the magazine in addition to Parker (Parker, 2001). This brings about a question: is the "Parker Effect," as determined by Ali et al. (2007), still the "Parker effect," or is it

[1] The exact location of the origin of wine is a debated topic. "In his book *Ancient Wine: The Search for the Origins of Viniculture* (Princeton: Princeton University Press, 2003), McGovern proposes modern-day Georgia and Armenia as the likely sites of the domestication of the Eurasian wine grape some 8,000 years ago." (Harrington 2004)

now the “Parker, Galloni, MacNeil, Martin, Miller, Perrotti-Brown, Schildknecht, Squires, Zraly Effect”? Either consumers accept the new members on Parker’s team to be representative of Parker himself, or the effect Parker has on the market is no longer as substantial as it once was. Because this may be the case, it is of merit to include expert ratings from another source to see *Wine Advocates* influence in comparison with its peers.

Wine Spectator is another periodical that publishes expert wine ratings and may have an even greater influence on how wine prices are set than *Wine Advocate*. *Wine Spectator* was founded in 1976 and has since generated a large following. The magazine consists of six senior tasters and four additional tasting members, each having expertise in a specific wine region. According to senior and managing editor of *Wine Spectator*, Dana Nigro, “[the] magazine now reaches more than 2.58 million readers” and is the most widely read wine magazine in the world. As of 2010 *Wine Spectator* has 401,000 paid subscribers, dwarfing *Wine Advocates* nearly 50,000. This being the case, it would be reasonable to assume that *Wine Spectator* may have a more substantial influence on the setting of wine prices than *Wine Advocate*.

Florida beverage law states that there cannot be a direct relationship between producers and retailers, instead wine must be sold through an intermediary. This three-tier system adds another degree of pricing, wholesale pricing, that will be addressed in this paper. The goal of this research is to measure the marginal impact each wine characteristic has on the setting of wholesale prices, retail prices and retailer profits. To do so, data on the wholesale costs and retail prices of bottles of wine that differ in a large number of observable characteristics was collected. The information on these wines was used to obtain a comprehensive analysis of the influence, if any, of expert ratings on wine prices, and which publication, if any, has a greater influence. It will also report any interesting or unexpected results regarding attributes and their effects on the three dependent variables being tested. This paper will focus only on wines sold in Florida.

The paper proceeds as follows: first, a detailed explanation is provided on the expert ratings analyzed in this paper. Then, the hedonic price method is described and followed up by previous related literature. Data collection and organization is discussed before the econometric models are presented. The hedonic regression equations are calculated and finally, the results and conclusions of the regressions are presented, and their implications are discussed.

BACKGROUND INFORMATION

Wine Advocate Grades

In order to fully comprehend this research, it is important to understand the data to be investigated, the first being *Wine Advocate* scores. *Wine Advocate* uses a 50 to 100 point system to score wines. The tastings are conducted under peer-group blind conditions, meaning the same varietals of wines are tasted without knowing the identity of the producer. There are a few exceptions to this rule with regard to barrel tastings, specific appellation tastings (in which producers do not submit samples for group tastings), and for all wines priced below $25.00. The score given to the wine is representative of what *Wine Advocate* thinks of the wine “vis-à-vis its peer group” (Parker, n.d.). Many wines may be reviewed more than once, in which case the score given to the individual bottle of wine signifies the average of the wines performance to date. *Wine Advocate* ratings focus on color, aroma and bouquet, flavor and finish, and overall quality or aging potential. Table 1 provides *Wine Advocates* explanation for each grade range.

Table 1 – Taxonomy of *Wine Advocate* Scores

Score	Explanation
90 – 100	Is equivalent to an **A** and is given only for an outstanding or special effort. Wines in this category are the very best produced of their type. There is a big difference between a 90 and 99, but both are top marks.
80 – 89	Is equivalent to a **B** in school and such a wine, particularly in the 85-89 range, is very, very good; many of the wines that fall into this range often are great values as well.
70 – 79	Represents a **C**, or average mark, but obviously 79 is a much more desirable score than 70. Wines that receive scores between 75 and 79 are generally pleasant, straightforward wines that lack complexity, character, or depth. If inexpensive, they may be ideal for uncritical quaffing.
Below 70	Is a **D** or **F**, depending on where you went to school. For wine, it is a sign of an imbalanced, flawed, or terribly dull or diluted product that will be of little interest to the discriminating consumer.

Source: Parker, R. (n.d.). *The wine advocate rating system*. Retrieved from http://www.erobertparker.com /info/legend.asp

Wine Spectator Grades

Wine Spectator also uses a 50 to 100 point scale. Its critics taste in excess of 15,000 wines per year and seem to be more systematic in their approach than those in *Wine Advocate*. They conduct blind tastings and have similar exceptions as *Wine Advocate*, including barrel and unofficial tastings,[2] but all tastings are held in private rooms and the reviewers follow a strict process for each one. Tastings are conducted on similar wines grouped by varietal, appellation, or region, each of which are known by the taster, but the identity of the producer, wine, and prices are concealed. They begin with a non-blind tasting of a previously rated wine for a reference point. During tastings, other previously rated wines are presented with the new wines in order to ensure consistency. All wines are covered with a bag and numbered. Critics enter their review notes and their ratings before the bag is removed. Once the bag is removed, additional information may be entered into the tasting notes, but the rating is never altered. Critics taste corked, flawed, and

[2] Unofficial tastings are those in which the editors taste wines in non-blind, unofficial settings from their cellars or in restaurants. These tastings are denoted as such.

high scoring wines again to confirm their evaluations. *Wine Spectators* ratings are based on potential quality, which they define as "how good the wines will be when they are at their peak." Table 2 presents *Wine Spectators* explanation for each grade range.

Table 2 – Taxonomy of *Wine Spectator* Scores

Score	**Explanation**
95 – 100	Classic: a great wine
90 – 94	Outstanding: a wine of superior character and style
85 – 89	Very good: a wine with special qualities
80 - 84	Good: a solid, well-made wine
75 - 79	Mediocre: a drinkable wine that may have minor flaws
50 - 74	Not recommended

Source: *Wine spectator's 100-point scale*. (n.d.). Retrieved from http://www.winespectator.com/wso_dev.php/display/show/id/scoring-scale.

Although *Wine Advocate* and *Wine Spectator* do not comprise the entire critic pool (others exist, including *Decanter Magazine* and *International Wine Cellar*), they will be the focus of this paper. Both quality ratings will be present in the hedonic regression equation, in addition to other wine characteristics.

THE HEDONIC METHOD

Before presenting the literature review, let me provide a brief exposition of the hedonic method for informational purposes.

Many goods are heterogeneous in nature. While they may be similar in that they are sold in the same market, they may also be distinct because of their differing characteristics. The different characteristics in products are often reflected in the different prices assigned to those products in their markets. However, the explicit price of each characteristic is typically not observable. If there existed only one differing characteristic, it would be fairly easy to assign an implicit price to it. Taylor (2003) used an example of two houses situated on two different lakes, *ceteris paribus*, to explain the underlying theory of the hedonic method and how one arrives at the implicit prices. Both homes have an initial equilibrium price of $200,000. Now, imagine that Lake A has higher water clarity than Lake B. At $200,000, assuming people prefer higher water clarity, there would be an excess demand for homes on Lake A, putting upward pressure on the price in order to return to equilibrium. The home on Lake A sells at, for example, $210,000 in the new equilibrium. In this case, the implicit price of higher water clarity is $10,000.

However, most markets are not this simple, and reasonable consumers take into consideration an array of factors when deciding to purchase a home, such as location, school zones, and crime rates. Fortunately, the hedonic method can be applied to both simple and more complex situations.

By observing consumer purchasing decisions on heterogeneous products within the same market, one can estimate the implicit prices, or hedonic prices, associated with each characteristic. In principle, this information makes it possible to determine underlying consumer preferences for individual characteristics and the willingness to pay for a marginal unit of the characteristic (Taylor 2003). In short, the hedonic method is a statistical approach used to explain the marginal effects of individual characteristics on the dependent variable. The hedonic method has been used by several other economists and the following papers show that the approach is ubiquitous in research.

REVIEW OF LITERATURE

Rosen (1974) laid the foundation for the hedonic price method in his pure competition model for product differentiation. Rosen's (1974) model established a competitive equilibrium by assigning prices and values to characteristics of the good, determining consumption and production decisions, and then equating those decisions. When the buyers' and sellers' decisions "intersect," the price buyers are willing to pay for a set of characteristics equals the amount sellers are willing to accept. In Rosen's (1974) model, substitution is assumed to be absent, producers are assumed to be profit maximizers, consumers are assumed to be budget-constrained utility maximizers, and factor prices are assumed to differ among firms. In its basic form, Rosen's (1974) hedonic method is essentially "a regression model that links a good's price, the dependent variable, with its various attributes, the independent variables" (Nordman & Wagner, 2009). This paper will employ this hedonic price regression.

Oczkowski (1994) estimated marginal values for individual characteristics of Australian premier table wine with the hedonic price method. He employed the linear and log-linear regressions on his dependent variable, recommended retail prices. He excludes technical attributes, such as sugar and acid levels, from his regression under the supposition that these characteristics are unimportant to the end consumer and cannot significantly affect wine prices on the demand side of the market. He concluded that six characteristics, namely, quality, cellaring potential, grape variety/style, grape region, grape vintage, and producer size were statistically significant determinants of retail wine prices. Oczkowski (1994) used interaction terms in his analysis, however, this paper will not, mainly because the number of observations is low and the number of independent variables is high. This paper employs the linear and log-linear models, but does not use the exact same set of independent variables.

Parker and Zilberman (1993) employed the hedonic method in their analysis of the California fresh peach industry by taking into consideration peach quality at the producer and retail levels. They controlled for factors such as spoilage and seasonal limitations, and focused on marketing costs and the marketing margin, defined by producer costs and retailer margins, respectively. They concluded that margins decline as the season progresses and increase with quality characteristics. The time component present in Parker and Zilberman's (1993) regression is an important variable considering fruit show signs of spoilage throughout the season which in turn affect its quality and price. This paper can be compared to Parker and Zilberman's (1993) regression in that wine prices are a function of quality ratings and other characteristics.

Hadj Ali et al. (2007) examined the impact of Parker's oenological grades on Bordeaux *en primeur* wine prices. The authors focused on "price when wine is graded minus price in the absence of grading." One year, Parker was late in his tastings, and producers were forced to price their wines before his rating was assigned. A small but negative effect was exhibited on the wines that did not have the rating, in comparison to the wines that were rated before the prices were released in other years. They estimated a "Parker Effect" and found a statistically significant relationship between Parker grades and prices. The authors determined that the impact of Parker is important for high quality wines but vanish for low quality wines, without turning negative. Because a positive relationship exists between Parker's ratings and price, it may also be true that one exists with retailer profits and wholesale price as well, but information on costs need to be analyzed. This paper also considers the ratings of *Wine Spectator*, which are thought to have a positive relationship with price as well.

Lecocq and Visser's (2006) primary objective was to determine whether sensory or objective characteristics influence the price of Bordeaux and Burgundy wines. They concluded through hedonic price estimates that the prices of Bordeaux and Burgundy wines are largely determined by objective characteristics that people can easily observe, such as vintage. They concluded that their jury grades,[3] which are considered sensory in nature, have a positive and significant effect on prices as well, but are less important than objective attributes in determining price. This paper will also examine the effect that sensory and objective characteristics have on price as well as profit margins.

Costanigro et al. (2007) proposed that different hedonic functions should be used for each classification or market segment of wine (they used the example of red and white classifications, but notice that other segmentations exist). The authors argued that different functions should be used in order to prevent model specification issues and reduce sample heterogeneity. They note that by estimating separate hedonic functions, the sum of the squared errors is significantly reduced and the resulting estimates are more defensible and informative. This paper will not estimate separate hedonic functions for each market segment primarily because the number of observations is too small.

[3] The jury grades used by Lecocq and Visser are not those of well known wine critics (such as *Wine Advocate* or *Wine Spectator*). They performed their own tasting in which the wines were bought anonymously from the producers. The samples were randomly selected and were tasted by 4 or 5 independent wine experts (unspecified). Each jury member would write comments concerning olfactory and gustatory findings and general comments on alcohol content, aging, etc. The members assigned a grade between 0 and 20, in which the average score would indicate the "jury grade."

Additionally, it is not exactly clear which segmentation is best to use, resulting in several possible regression equations. An example of one classification that could segment the variables in this data set includes on- and off-premise wines, the distinction being those institutions in which you can consume alcoholic beverages in the facility versus those in which you cannot, respectively. This data set also includes red and white wines, still and sparkling wines, and other variables that could be divided into market segments. Although Costanigro (2007) would most likely deem the resulting coefficients as less defensible and informative, the use of dummy variables in this paper should ameliorate these effects.

One novel aspect of the proposed research is the use of profit margins and wholesale price, in addition to the retail price of the wine, as the dependent variables in the hedonic regression equations. A reason that other researchers may have not considered retailer profits or wholesale price is that inside information from profit earning companies that is neither publicly available nor easily accessible is required. Another unique aspect of this paper is the comparison of *Wine Advocate* ratings to those of *Wine Spectator* and which has a greater influence, if any, on price and/or retailer profits.

DATA

Variable Selection

There are numerous characteristics of wine that can be included in the hedonic regression. As Oczkowski (1994) points out, “any variable that influences consumer benefit or producer cost is a candidate for inclusion in the hedonic price function.” This paper used my own knowledge of the wine market as well as previous research to determine which characteristics of wine were included or excluded. For example, technical attributes, as Oczkowski (1994) mentions, are not expected to be of major concern to consumers because this information is neither widely accessible nor significant in determining price. Other potentially important variables, such as label appeal, production size, and reputation were omitted from these regressions due to either time constraints or because quantifying the information was too subjective.

Issues with Data Collection and Organization

It is best to begin by defining the pricing terminology used throughout the remainder of the paper. Wholesale price is defined as the price the distributor charged the retailer for a case of wine. The retail price is the price the retailer charges the end consumer per bottle. The per-bottle retailer profit is determined by subtracting the quotient of wholesale price and pack (bottle per case) from the retail price.

For the wines included in the data set, the scores of each individual bottle of wine were collected from *Wine Advocate* and *Wine Spectator*. During this process, several issues emerged. For example, most 2011 vintage ratings had not yet been released when the data was being collected, thus reducing the number of observations drastically. 2010 vintages could not be substituted for the 2011 vintages because the wholesaler was no longer selling the 2010 vintages and therefore prices weren't available. In addition, ratings were obviously different between vintages, and in most cases, restaurants no longer sold the 2010 vintage.

In addition to newer vintages not being rated, non-vintage wines often times have different ratings from year to year. Non-vintage wines are a combination of the most successful vintages, and because one bottle of wine may consist of multiple vintages, they are designated non-vintage. The same non-vintage wine (i.e. a wine with the same label but different combination of vintages) is often released multiple times over several years, but each is rated in the year it is released. This results in multiple ratings for the same wine. In this case, the bottle with the most recent issue date by the expert notes was used. The issue date is the date in which the expert notes were posted to the website and show the most recently released non-vintage wine. This procedure is accurate because the non-vintage wines included in the data are made for "drink youngest available" (J. Mayfield, personal communication, October 23, 2011).

Of the ratings gathered, certain ratings by *Wine Advocate* were given in ranges. In order to create a single quality measure, the average of the range was used. For example, if a bottle of wine was rated (87-88+) the average quality indicator would be 87.5. In the cases where a plus sign was used, as in the 88+ mentioned previously, the score of 88 was used.

While gathering scores, it became apparent that *Wine Spectator* and *Wine Advocate* do not always rate the same wines. This being so, many observations do not have both ratings available. As shown later in this paper, this rating effect will be accounted for and the consequences of this feature will be addressed in the hedonic regression.

In addition to issues with ratings, issues of price arose. The firm has several different pricing strategies divided into four levels of pricing. Instead of choosing a suggested retail price, like many previous researchers have done, each wine's *actual* wholesale price per case was used. Although this was a more labor intensive process and decreased the number of observations, this allowed the profit to be *exactly* that earned by the retailer. During this process, some prices charged by the wholesaler to the *same* retailer were different. In this case, the lower price was given as a promotion and thus the higher, more consistently charged price was used. Furthermore, many retailers purchase the same case of wine for different prices; in this case, the information from the retailer with the most common selling price was used.

Because researching each characteristic was labor intensive, the resulting number of observations is small but accurately reflects the price at which the wine was sold and the profit earned by the retailer.

Data

The final data set consisted of 147 observations of wines from 13 different countries, 60 different regions, and 108 different varietal categories. In the sample, wholesale prices range from $5.00 to $179.00 per case, retail prices range from $7.99 to $370.00 per bottle, and profits range from $7.51 to $345.33 per bottle. *Wine Advocate* scores range from 84-94, while *Wine Spectator* scores range from 77-97. The majority of the wines in this study were from France, Italy, Spain, and the United States.

Based on the type of data that was gathered it was determined that many dummy variables were required, namely, one dummy for each wine characteristic: country, region, varietal, color, type, closure, premise, vintage, quality, *Wine Advocate*, *Wine Spectator*, or both. In order to decrease the number of dummies, which was imperative due to the small data set, certain varietals were combined and regions that were most prevalent in the data set were used. There were a total number of 58 dummy variables employed. The ensuing table is an overview of the final characteristics used and their definitions.

Table 3 – Overview of Characteristics and Dummy Variables

Pack	6 or 12 bottles per case
Size	375, 750 or 1500mL
Wholesale Price	The exact price the retailer paid the distributor for the case of wine
Retail Price	The exact price for a bottle of wine based on the retailers menu. In one instance, there was only a per glass price, in which case, the bottle price was calculated by multiplying the glass price by 5 to get the bottle price. This procedure was used because a 750mL bottle of wine will usually pour about 5 glasses of wine.
Profit	Calculated by subtracting the quotient of wholesale price and pack (bottle per case) from the retail price. This is a per bottle profit.
Quality	*Wine Advocate* score if only scored by *Wine Advocate*, *Wine spectator* score if only scored by *Wine Spectator* and an average of the *Wine Advocate* and *Wine Spectator* scores if scored by both.
Wine Advocate	1 if rated by *Wine Advocate* only, 0 if not
Wine Spectator	1 if rated by *Wine Spectator* only, 0 if not
Both	1 if rated by *Wine Advocate* **and** *Wine spectator*, 0 if not
Country	Argentina, Australia, Austria, Chile, France, Germany, Greece, Italy, New Zealand, South Africa, Spain, USA
Varietal	Cabernet Franc, Cabernet Sauvignon, Meritage, Rhone Blend, Chardonnay, Dolcetto, Garnacha, Gewurztraminer, Malbec, Merlot, Nebbiolo, Pinot Noir, Riesling, Sangiovese, Sauvignon Blanc, Shiraz, Tempranillo, Zinfandel
Region	Alsace, Beaujolais, Bordeaux, Burgundy, Chablis, Champagne, La Rioja, Languedoc, Loire, Napa Valley, Piedmont, Rhone, Sonoma Valley, South Australia, Tuscany
Color	Red, Rose, White
Type	Still, Sparkling, Dessert
Closure	Screw, Cork
Premise	On, Off
Vintage	2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, NV

ECONOMETRIC MODELS

Functional Form

The choice of functional form for this data set is limited, given the use of dummy explanatory variables. One method to be employed by this paper naturally consists of the linear model in order to get a general understanding of the variable effects. But because the relationship between dependent variables and independent variables might not be linear, in that the effect on price or profit margins due to a marginal change in a particular characteristic is not constant for all levels of that characteristic, other models will also be used. To illustrate, an additional point added to an expert wine score is not expected to have the same effect for a wine with a grade of 70 as for a wine with a grade of 90. The dependent variables will be wholesale price, retail price, and profits, whereas the independent variables will be various wine characteristics that are hypothesized to affect price, including expert wine ratings.

Hedonic Regressions

Before running the regressions, a decision of base characteristics had to be made for the dummy categories. The base characteristics of a classic bottle of wine were chosen; France, Cabernet Sauvignon, Bordeaux, red, still, cork, on-premise, and 2010. These variables were excluded from all regressions.

The initial linear regressions tested *Wine Advocate* and *Wine Spectator* scores separately, which resulted in a collinearity issue. To determine which variables were collinear, a correlation analysis on all of the characteristics, including the dependent and independent variables was done. The analysis did not indicate any pair-wise perfect collinearity. Because of the limited number of observations with *Wine Spectator* and *Wine Advocate* Scores, the full data set was employed by creating a quality variable, as defined in Table 3. This decision was made because dividing the data set between *Wine Advocate* and *Wine Spectator* decreased the number of observations per regression drastically and considering the data set is already small, using an even smaller data set with the number of dummy variables wasn't returning a good analysis. With a single "quality" variable, each observation was assigned a rating and a single regression was calculated with the full set of observations from the data set. Dummies were also created for "*Wine Advocate*," "*Wine Spectator*," and "both" to designate which was being used as described in Table 3. *Wine Advocate* was chosen as the base characteristic from this set of variables, and was therefore removed from all regressions. This allowed for two regressions as opposed to four. The new regressions were:

(i) profit as the dependent variable regressed on all characteristics and quality

(ii) and retail price as the dependent variable regressed on all characteristics and quality

It turned out that dolcetto was an exact linear combination of two or more other variables within the data set, and so was eliminated from all the regressions.

Only retail price was used as a dependent variable because retail price and profit had a correlation of .9985 with a probability of 1. A multi-variable F-test was conducted on all the retail price coefficients with p-values greater than 0.6 for a total of 24 variables. The computed F-statistic was 0.19 with a p-value of 1.0. Hence, the regression was re-estimated excluding these variables.

In addition to running a linear regression model, a log-linear regression was also estimated, where the logarithm of the dependent variable was taken and regressed on all the linear independent variables. A multi-variable F-test on the coefficients with a p-value above 0.6 resulted in an F-statistic of 0.10 with a p-value of 1.0. As above, the model was re-estimated excluding the 19 variables. A linear-quadratic, linear-log, and log-log model were also estimated in the same fashion. In the linear-quadratic model, all dependent and independent variables remained linear, but an additional variable, namely quality squared, was added to the regression. The linear-log model regressed a linear dependent variable on the logarithm of quality in addition to all other variables, which remained linear. In the log-log model, the logarithm of the dependent variable was regressed on the logarithm of quality in addition to the dummy variables. It is important to note that the dummies are always represented as linear in all regressions and remained unchanged throughout and only the dependent variables and/or quality were transformed.

Table 4 shows the regression statistics for all five regressions, before the variables whose coefficients were insignificant were eliminated, and after.

Table 4 – Hedonic Regression Analysis on Retail Price

	Linear Before	*Linear After*	*Linear-Log Before*	*Linear-Log After*
Number of Observations	147	147	147	147
Variables	58	34	58	34
F-Statistic	3.12	6.28	3.10	6.30
P-value	0.000	0.000	0.000	0.000
R^2	0.6730	0.6559	0.6712	0.6567
$\bar{R}^2$	0.4575	0.5514	0.4544	0.5525
Root MSE	40.749	37.055	40.866	37.012

	Linear-Quadratic Before	*Linear-Quadratic After*
Number of Observations	147	147
Variables	59	36
F-Statistic	3.35	6.54
P-value	0.000	0.000
R^2	0.6945	0.6815
$\bar{R}^2$	0.4873	0.5773
Root MSE	39.617	35.972

	Log-Linear Before	*Log-Linear After*	*Log-Log Before*	*Log-Log After*
Number of Observations	147	147	147	147
Variables	58	39	58	39
F-Statistic	5.85	10.30	5.80	10.21
P-value	0.000	0.000	0.000	0.000
R^2	0.7940	0.7896	0.7926	0.7882
$\bar{R}^2$	0.6582	0.7129	0.6558	0.7110
Root MSE	0.48433	0.4439	0.48601	0.44536

After observing the quality effect on retail price, a curiosity developed regarding the effect quality may have on the wholesale price the retailers paid. A linear regression was estimated using this as a dependent variable as well. As before, a multi-variable F-test was conducted on all of the variables with a p-value larger than 0.6. The computed F-statistic was 0.29 with a p-value of 0.9994. The model was re-estimated excluding these 23 variables. The same procedure was followed for the log-linear, linear-quadratic, linear-log, and log-log regressions as well. Table 5 shows the regression statistics for all regressions, before the variables whose coefficients were insignificant were eliminated, and after.

Table 5 – Hedonic Regression Analysis on Wholesale Price

	Linear Before	*Linear After*	*Log-Liner Before*	*Log-Linear After*
Number of Observations	147	147	147	147
Variables	58	35	58	37
F-Statistic	3.35	6.29	5.55	10.31
P-value	0.000	0.000	0.000	0.000
R^2	0.6883	0.6649	0.7853	0.7777
$\bar{R}^2$	0.4829	0.5592	0.6439	0.7022
Root MSE	20.112	18.571	0.4773	0.43644

	Linear-Quadratic Before	*Linear-Quadratic After*
Number of Observations	147	147
Variables	59	35
F-Statistic	3.50	6.89
P-value	0.000	0.000
R^2	0.7036	0.6848
$\bar{R}^2$	0.5026	0.5854
Root MSE	19.727	18.011

	Linear-Log Before	*Linear-Log After*	*Log-Log Before*	*Log-Log After*
Number of Observations	147	147	147	147
Variables	58	36	58	37
F-Statistic	3.32	6.12	5.51	10.23
P-value	0.000	0.0000	0.000	0.000
R^2	0.6866	0.6670	0.7840	0.7764
$\bar{R}^2$	0.4801	0.5580	0.6416	0.7005
Root MSE	20.168	18.596	0.47884	0.43769

It is important to remember that the linear model is making an implicit assumption, namely, that quality affects the retail or wholesale price in a linear manner. Results from the linear-quadratic regression provide evidence to the contrary as the coefficient on the quality squared variable is significant with a p-value of 0.000. Due to this finding and the superior measures of fit, the linear-quadratic model dominates the linear regression. For the same reasons, the linear-quadratic model dominates the linear-log model, and the linear model marginally dominates the linear-log model.

RESULTS

Hedonic Regression on Retail Price

The correlation between the dependent variables profit and retail price was .9985, and therefore are affected by each wine characteristic in a very similar manner. Results for the linear regression model with retail price as the dependent variable are interpreted in comparison to the base characteristics (France, Cabernet Sauvignon, Bordeaux, red, still, cork, on-premise, 2010 and with a *Wine Advocate* score). Only the effects of the variables whose coefficients had a p-value of 0.05 or less are discussed in what follows.

The *Wine Spectator* and *both* dummy coefficients were not significantly different from zero at the 0.05 level of confidence, indicating that a score given by *Wine Advocate* or *Wine Spectator*, or the average score when rated by both, do not have significantly different effects on the retail price. The quality variable indicated that for every quality point increase, retail price is estimated to rise by $7.14, on average. Off-premise wines are predicted to be priced $15.22 lower than an identical wine consumed on-premise. A wine from Spain is estimated to be priced $36.24, on average, lower than an otherwise identical wine from France. Relative to varietal, a nebbiolo wine will be priced, on average, $82.12 higher than a Cabernet Sauvignon. A wine from Burgundy will, on average, receive a price $88.01 higher than a wine from Bordeaux. Finally, a wine from the 2006 vintage will on average sell for $13.64 more than a 2010 vintage. These results are parallel with those when profit was used as the dependent variable and are only applicable to the observations in the data set.

The estimated marginal effect of quality in the linear-quadratic model was evaluated using quality scores of 85, 90, and 95, and is given by the following formula:

$$\frac{\partial E(Y)}{\partial Q} = \hat{\beta}_Q + 2\hat{\beta}_{Q^2} Q \tag{1}$$

Where Q is the quality rating, $\hat{\beta}_Q$ is the estimated coefficient on Q, and $\hat{\beta}_{Q^2}$ is the estimated coefficient on Q^2. The expected change in retail price given a quality score of 85 is negative $0.80; for a quality score of 90, price is predicted to increase by $8.79; while for a quality score of 95 price is predicted to increase by $18.38.

When evaluating the log-linear model, the coefficients show the expected change in the logarithm of the dependent variable given a change in the independent characteristics, but this paper is not interested in the logarithm of the dependent variable. Instead this paper wants to predict the expected change in the non-logarithmic dependent variable. The following formula must be used when interpreting the log-linear coefficients of this regression:

$$\frac{\partial E(Y)}{\partial Q} = \hat{\beta}_Q e^{[\ln y]} e^{\frac{1}{2}\hat{\sigma}^2} \tag{2}$$

For more information on this formula and its derivation, please refer to Hill et al. (2011) or Cameron et al. (2009) which provide great explanations.

This equation was also evaluated using quality scores of 85, 90, and 95. The expected increase in retail price given a marginal change in quality from 85 is $3.24. For a marginal change from a quality score of 90, price is predicted to increase by $5.49, which from 95 price is predicted to increase by $9.30. Thus for the log-linear model, the predicted marginal effect of quality on price is positive and increases with an increase in quality, i.e. predicted price is an increasing function of quality at an increasing rate. The qualitative nature of quality on price is thus the same as that in the linear-quadratic regression model. The remaining models are summarized in the Appendix.

Hedonic Regression on Wholesale Price

Although retail price and profit are highly correlated, the same effect was not true for wholesale price. Table 6 shows the correlation analysis of the three variables.

Table 6 – Correlation of Dependent Variables

	Wholesale Price	*Retail Price*	*Profit*
Wholesale Price	1.0000		
Retail Price	0.9078	1.0000	
Profit	0.8889	0.9985	1.0000

Results for the linear regression model with wholesale price as the dependent variable are interpreted in comparison to the base characteristics. Only the effects of the variables whose co-efficients had a p-value of 0.05 or less are discussed in what follows.

The quality variable indicated that for every point increase, wholesale price is estimated to rise by $4.29, on average. A wine from Spain is estimated to be priced lower than an other-wise identical wine from France. The nebbiolo varietal and region of burgundy are predicted to be sold at a premium price, which is similar to the findings in the previous regression. Additional results for wholesale price indicate that white wines and Rhone blends on average have a lower price than red and Cabernet Sauvignon wines respectively. Relative to the type of establishment, a wine sold to an off-premise location will be priced, on average, $8.56 higher than an on-premise location. Finally, 2004 and 2005 vintages will, on average, sell at a premium compared to the 2010 vintage

The linear-quadratic model was evaluated following the same procedure as before. The expected change in wholesale price given an incremental increase in quality from 85 was $0.42. Similarly, a marginal increase in quality from 90 yielded a predicted price increase of $4.99, and given a quality score of 95, price was predicted to increase by $9.56.

The log-linear model was also evaluated following the same procedure. The expected change in retail price given a marginal change in quality from 85 resulted in a $3.24 increase in price; a marginal increase in quality from 90 resulted in a $5.49 increase in price and an incremental increase in quality from 95 resulted in a $9.30 increase in predicted price. The remaining models are summarized in the Appendix.

CONCLUSIONS

The linear-quadratic model is a better representation of the data and allows for a more accurate interpretation of the quality variable coefficients. *Wine Advocate* and *Wine Spectator* were found not to differ significantly in their influence on price, proving the mere existence of a rating is more important than which periodical issued it, when considering those two ranking systems.

The effect expert ratings have on wholesale price, retail price, and retailer profits are positive. The dollar values resulting from an incremental quality increase have more influence on the predicted price/profit of the wine the higher the rating becomes. This implies that if expert ratings increase, the distributor is expected to charge higher prices to retailers and the retailer is expected to charge higher prices to consumers. These resulting dollar values are higher for the predicted retail price than for the predicted wholesale price in all models.

Consumers can use this information for their purchasing decisions. Many blind taste tests reveal that highly rated wines may not actually taste better to consumers than their lowly rated counterparts. In a sample of roughly 6,000 blind tastings, Goldstein et al. (2008) revealed that "individuals on average enjoy more expensive wines slightly less." Therefore, for South Florida residents, it may be in their best interest to purchase lower rated wines from on-premise locations. If those prices are still too steep for consumers, their best interest lies, as one would assume, with the better value of purchasing wine at off-premise locations.

Implications for the retailer mainly evolve around obtaining highly rated wines to increase their profits per bottle. Although the prudent customer may not submit to this pricing strategy, research shows there are consumers who will. As Lecocq and Visser (2006) point out, for some consumers, “higher wine prices act as a stimulant rather than as a deterrent,” and that “part of the pleasure is apparently to know that a wine is famous and very expensive.”

The information retrieved from the wholesaler is not as clear. Although the data suggests that the wholesaler increases their price when quality increases, this may not be true. The wholesaler may be reacting to higher prices from the producer causing them to adjust their prices accordingly, without taking into consideration expert ratings. In order to fully understand the strategy behind the wholesaler, information from the producer is needed. This would make an interesting future study.

Moreover, these are not universal implications, but rather findings associated with a single company and their distribution of retailers. Although the research is limited to South Florida and the distribution of stores in this study, it does reveal important information about pricing determinants at different distribution levels. It would be interesting to know whether the findings of this paper concur with other states and countries.

APPENDIX: LINEAR-LOG AND LOG-LOG RESULTS

Linear-Log Regression

Dependent Variable	Quality	Marginal Effects*
Wholesale Price	85	4.16224941
	90	3.93101333
	95	3.72411790
Retail Price	85	7.65337412
	90	7. 22818667
	95	6.84775579

*Determined by dividing coefficients by quality rating

Log-Log Regression

Dependent Variable	Coefficients*
Wholesale Price	9.98331
Retail Price	9.303774

*Represent the elasticity of expected price with respect to quality.

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