University Avenue Undergraduate Journal of Economics

Volume 5 | Issue 1 Article 3

2001

Relationships Among Wine Prices, Ratings, Advertising, and Production: Examining a Giffen Good

Carol Miu
Massachusetts Institute of Technology

University Avenue
UNDERGRADUATE JOURNAL OF ECONOMICS

Relationships Among Wine Prices, Ratings, Advertising, and Production: Examining a Giffen Good

Carol Miu

Massachusetts Institute of Technology

http://digitalcommons.iwu.edu/uauje

Abstract

It has become increasingly popular for statistics to be used in the prediction of wine prices. In fact, the prices of mature wines produced in the Bordeaux region of France have been accurately predicted by vintage growing-season characteristics. This paper analyzes the relationships among wine prices, ratings, advertising, and production, using data obtained from a wine ratings magazine, *Wine Spectator*. It presents a model of wine price based on information about production quantity, vintage, country of origin, and wine type. This paper then examines the scoring method of *Wine Spectator* by evaluating the effects of wine price on wine rating. Finally, the effects of awards and advertising on wine ratings are studied. It is found that, *ceteris paribus*, doubling the number of cases produced decreases the price of wine by $2.36 and each additional dollar in price increases rating by .0942 points. In addition, wineries that advertised in *Wine Spectator* during the years 1999 or 2000 received reviews that were .402 points higher than wineries that did not advertise during the same time period, holding all other variables constant.

This paper has greatly benefited from the guidance of Jonathan Reuter, who generously provided valuable suggestions as well as the data on wine advertising and awards. Additionally, Professor Peter Davis of the Economics Department at the Massachusetts Institute of Technology has acted as the advisor of this Undergraduate Research Opportunities Program (UROP) project. I gratefully acknowledge their help while remaining culpable for any errors.

I. Introduction

Wine is an experience good whose quality can only be assessed after a bottle is opened and its contents are tasted (Reuter (2000)). When looking for a good wine, the uninformed consumer, who has limited knowledge of wine types and quality, will often set a price floor on the amount that he is willing to pay. For example, the consumer may opt for a $100 bottle of champagne rather than a $10 bottle because he believes that price is positively correlated with quality. Therefore, wine is a good for which demand increases with price on a certain interval. Wine is a Giffen good; it defies the Law of Demand. When deciding on price settings and types of wine production, wineries attempt to maximize either profit or utility. Given that demand increases with price, some poorer-quality wines may be sold at high prices in order to mislead uninformed consumers about quality level and generate larger profits. Reuter (2000) claims that wine manufacturers are willing to accept smaller profits in return for the pride of producing the best wines; he refers to this phenomenon as "valuing the winery owner experience."

Studies performed by Ashenfelter, Ashmore, and Lalonde (1995) indicate that the auction prices of mature wines are measures of true quality. There are currently two schools of thought concerning prediction methods for the future quality of wines that have not yet matured. Ashenfelter, Ashmore, and Lalonde belong to the school that bases predictions of wine quality on the growing conditions of its constituent grapes; vintage growing-season characteristics such as region and weather determine the price of mature wines. Through statistical analysis, Ashenfelter, Ashmore, and Lalonde show that the quality of red wines from the Bordeaux region of France, as judged by the prices of mature wines, can be accurately predicted by the weather during the growing season that produced the wines. Tasting note and rating manufacturers belong to the other school, which uses tasting impressions at a single point in time to form predictions on future wine quality. Ashenfelter (1995) and Reuter (2000) make the point that tasting impressions of young wines can be quite misleading. *Wine Spectator*, whose online search engine provided the data for my study, is among the most well-known tasting note and rating manufacturers.

This paper examines the effect of quantity of production and vintage growing-season characteristics on current prices of wine that has yet to mature, the correlation between wine price and rating, and whether tasters for *Wine Spectator* are biased toward giving better ratings to wineries that advertise. The prices of immature wines are used to study the effect of growing conditions since I wish to see if the correlation between vintage-growing characteristics and price is as strong for immature wines as it is for mature wines; in addition, auction prices of mature wines are not easily accessible. Shewbridge (1998) investigates the relationship between prices and ratings, using data from *Wine Spectator* magazines published in 1994. In his study, Shewbridge discovered that price and rating are positively correlated, but there are many inexpensive wines that receive high ratings and a few expensive wines that receive low ratings. This paper expands on Shewbridge's work by using several years of data from *Wine Spectator* and evaluating data on advertising in order to examine possible biases toward better ratings.

The remainder of this paper is organized as follows: Section II provides a description of *Wine Spectator* and the data I use. In Section III, I present the empirical framework and discuss models of wine price and rating. Section IV is devoted to estimation results of wine price and rating based on vintage growing-season characteristics and advertising. Section V concludes.

II. Data

The *Wine Spectator* online database consists of approximately 87,000 entries containing information on wine price, rating, type, country, region, vintage year, varietal, date of review, and tasting notes. The *Wine Spectator* data were combined with advertising data provided by Jonathan Reuter. Observations from vintage years prior to 1995 or for which there was no available advertising data were dropped from the sample in order to minimize misspecification errors. Summary statistics for the data sample used in this paper are presented in Figure 1.

Figure 1.

Descriptive Statistics

Variable	# of Observations	Mean	Standard Deviation
price	5870	23.37	30.46
cases produced	5376	8844.88	34695.71
type	5908	.64	.50
rating	5908	85.91	3.83
ln(cases produced)	5376	7.54	1.63
advertising 1999-2000	5908	.20	.40
advertising prior to 1999	5908	.14	.35

Sources: The *Wine Spectator* Online, Jonathan Reuter
Notes: The variable "type" refers to wine type; in the data, type is set equal to 0 for white wines, 1 for red wines, and 2 for dessert wines. The wine rating scale is from 0 to 100. The dummy variables "advertising 1999-2000" and "advertising prior to 1999" are set equal to 1 if the winery advertised in the specified time period and 0 otherwise. Dummy variables for 74 wine varietals, 38 regions, 5 countries, 4 vintage years, and the interaction between country and vintage year are present in text format.

The data contain 5908 wines, for which there are 5870 observations on price, 5376 observations on cases produced, and 5908 observations on type, rating, advertising during January 1999-December 2000, and advertising prior to 1999. The variable ln(cases produced) was generated using data on number of cases produced. The data also contain variables indicating wine varietal, country, region, vintage year, and interaction between country and vintage year; these variables appear in text form and therefore are not included in the calculation of summary statistics.

The mean price of the wines in the data is $23.37, with a relatively large standard deviation of $30.46. The mean number of cases produced is 8844.88, also with a relatively large standard deviation, 34695.71. These data indicate that the pricing and production of wine do not follow a normal distribution. There are many wines whose prices are clustered between $0 and $23.37; the price observations of wines above $23.37 are more spread out. Data on production quantities show that many wines are produced in quantities between 0 and 8844.88 cases and the remainder, which are produced in quantities greater than 8844.88 cases, are distributed more sparsely. The laws of supply and demand lead to the intuition that price and number of cases produced are negatively correlated. In Section IV, I estimate the relationship between price and ln(cases produced), examining the effects on price of doubling the number of cases produced.

The "type" variable is set to 0 for white wines, 1 for red wines, and 2 for dessert wines. Most of the wines in the sample are either white wines or red wines. The "rating" variable indicates the numerical score from 0 to 100 given to a wine by *Wine Spectator*. The wine ratings categories are listed in Figure 2. The mean rating is 85.91, which falls in the "Very Good" range; a standard deviation of 3.83 indicates that most wines fall in either the "Good" or "Very Good" categories.

Figure 2.

Wine Spectator Rating Categories

95-100	Classic
90-94	Outstanding
85-89	Very Good
80-84	Good
70-79	Average
Below 70	Below Average to Poor

Source: *Wine Spectator*

The dummy variables "advertising 1999-2000" and "advertising prior to 1999" are set to 1 if the winery advertised and 0 if the winery did not advertise in the specified time period. 20% of the wines in the sample were produced by wineries that placed advertisements in *Wine Spectator* between January 1999 and December 2000. 14% of the wines were produced by wineries that advertised prior to January 1999. I assume that advertisements that appeared in *Wine Spectator* between January 1999 and December 2000 were placed *after* the wines were reviewed, whereas advertisements that appeared prior to January 1999 were placed *before* the wine were reviewed. Therefore, possible biases in ratings due to advertising can only be attributed to advertising prior to 1999, since wineries may have advertised in the 1999-2000 time period *because* they received high ratings.

III. Empirical Framework

Estimation

An exponential specification of the price function is estimated as:

$$Y_1 = \alpha_0 + \alpha_3 \ln(X_3) + \alpha_{4i}X_{4i} + \alpha_{5i}X_{5i} + \alpha_{6i}X_{6i} + \alpha_{7i}X_{7i} + \alpha_{8i}X_{8i} + \alpha_{9i}X_{7i}{*}X_{8i} + \varepsilon_i \quad (1)$$

where Y_1 is wine price, X_3 is number of cases produced, X_{4i} represents wine type, X_{5i} is wine varietal, X_{6i} corresponds to region, X_{7i} is country, and X_{8i} represents vintage year. X_{4i}, X_{5i}, X_{6i},

X_{7i}, X_{8i}, and $X_{7i}*X_{8i}$ are dummy variables for vintage growing-season characteristics. $X_{7i}*X_{8i}$ represents the interaction between country and vintage year dummy variables, and ε_i is an exogenous random error term.

I estimate the model for rating given by *Wine Spectator* as:

$$Y_2 = \beta_0 + \beta_2 X_2 + \beta_3 \ln(X_3) + \beta_{4i}X_{4i} + \beta_{5i}X_{5i} + \beta_{6i}X_{6i} + \beta_{7i}X_{7i} + \beta_{8i}X_{8i} + \beta_{9i}X_{7i}*X_{8i} + u_i \quad (2)$$

where Y_2 is the rating the wine receives and X_2 represents the price of the wine. X_{3i}, X_{4i}, X_{5i}, X_{6i}, X_{7i}, and X_{8i} are defined exactly as they are for equation (1). u_i is an exogenous random error term.

It may be the case that, *ceteris paribus*, *Wine Spectator* gives higher ratings to wineries that advertise, since *Wine Spectator* relies on advertising revenues. The effect of advertising on rating can be estimated using a model for rating that includes advertising dummy variables. Since advertising prior to 1999 may have caused a wine to receive a higher rating than it deserved, whereas advertising in the 1999-2000 time period may have been the result of a wine having received a high rating, I run two separate regressions.

To examine the relationship between advertising in 1999-2000 and rating, I formulate the model:

$$Y_3 = \delta_0 + \delta_{1i}X_{1i} + \delta_2 X_2 + \delta_3 \ln(X_3) + \delta_{4i}X_{4i} + \delta_{5i}X_{5i} + \delta_{6i}X_{6i} + \delta_{7i}X_{7i} + \delta_{8i}X_{8i} + \delta_{9i}X_{7i}*X_{8i} + v_i \quad (3)$$

where Y_3 is the rating the wine receives and X_1 is the dummy variable for whether the winery advertised in 1999-2000. X_2, X_{3i}, X_{4i}, X_{5i}, X_{6i}, X_{7i}, and X_{8i} are defined exactly as they are for equation (2). v_i is an exogenous random error term.

The effect of advertising on rating is estimated using the specification:

$$Y_4 = \gamma_0 + \gamma_{1i}X_{1i} + \gamma_2X_2 + \gamma_3\ln(X_3) + \gamma_{4i}X_{4i} + \gamma_{5i}X_{5i} + \gamma_{6i}X_{6i} + \gamma_{7i}X_{7i} + \gamma_{8i}X_{8i} + \gamma_{9i}X_{7i}*X_{8i} + w_i \quad (4)$$

where Y_4 is the rating the wine receives and *X_1 is altered* to represent the dummy variable for whether the winery advertised prior to 1999. X_2, X_{3i}, X_{4i}, X_{5i}, X_{6i}, X_{7i}, and X_{8i} are defined exactly as they are for equations (2) and (3), and w_i is an exogenous random error term.

Interpretation of Coefficients

α_0, β_0, δ_0, and γ_0 are the intercepts (constant terms) for equations (1), (2), (3), and (4), respectively.

α_4, α_5, α_6, α_7, α_8, α_9, β_2, β_4, β_5, β_6, β_7, β_8, β_9, δ_1, δ_2, δ_4, δ_5, δ_6, δ_7, δ_8, δ_9, γ_1, γ_2, γ_4, γ_5, γ_6, γ_7, γ_8, and γ_9 are linear coefficients. An increase of one unit of a continuous variable, or a value of 1 for a dummy variable, corresponding to a particular coefficient increases the dependent variable by an amount equal to the coefficient.

α_3, β_3, δ_3, and γ_3 are coefficients for $\ln(X_3)$ in the respective equations (1), (2), (3), and (4). When all other variables are held constant, the following equation results from equation (1):

$$Y_1 = \alpha_3*\ln(bX_3) + c \quad (5)$$

where b and c are some constants. Equation (5) can be manipulated to produce:

$$Y_1 = \alpha_3*\ln(b) + \alpha_3*\ln(X_3) + c \quad (6)$$

so doubling X would result in an increase in Y_1 of $\alpha_3*\ln(2)$.

Issues

Heteroskedasticity has been taken into consideration by generating and examining robust standard errors for each of the four regressions specified in equations (1) through (4). It was found that robust standard errors were extremely similar if not identical to regular standard errors generated by ordinary least-squares. There may exist some autocorrelation of advertising variables; unfortunately, I cannot determine whether serial correlation is present because data is incomplete.

IV. Results

Estimates of the wine price function specified in equation (1) are reported in Figure 3. Wines for which only one case was produced and all dummy variables are jointly equal to zero were priced at $32.99 on average. Doubling the number of cases produced decreased price by 3.41*ln(2) dollars, or $2.36. All of the results for country, vintage year, and type were insignificant. Most of the coefficients for region and varietal dummy variables were insignificant; however, *ceteris paribus*, wines from the region of Australia were priced $35.27 higher than wines from Argentina (the omitted dummy variable). Wines from California were priced $7.39 higher and wines from Washington State were priced $2.63 lower than wines from Argentina, holding all other variables constant. Wines of the Petit Verdot varietal cost $45.03 more than wines of the missing varietal (the omitted dummy variable), all else being constant. F-test 1 indicated that there is a chance that all dummy variables for country are jointly equal to zero. F-test 2 showed that there is a reasonable probability that all dummy variables for vintage year are jointly insignificant. The p-lim for Test 1 was found to be 0.2999 and the p-lim for Test

2 was calculated as 0.4736. Since the R^2 is 0.3604, the regression model fails to fully explain the existing variance of wine price.

Figure 3.

Determinants of Wine Price

Independent Variable	Dependent Variable: Price
intercept	32.99
	(2.03)
ln(cases produced)	- 3.41
	(-27.32)
dummy for region 2	35.27
(Australia)	(2.61)
dummy for region 4	7.39
(California)	(9.03)
dummy for region 38	- 2.63
(Washington State)	(2.33)
dummy for varietal 43	45.03
(Petit Verdot)	(2.78)

F-tests:	Test 1:	0.2999
	Test 2:	0.4736

Notes: The numbers in parentheses are *t* statistics. The table shows the ordinary least-squares estimate of wine price. The number of observations is 5356. The R^2 is 0.3604. In addition to the variables listed, the regression included dummy variables for 38 regions, 2 types, 74 varietals, 5 countries, 4 vintage years, and the interaction between country and vintage year. Coefficients for country and vintage year had insignificant t statistics; however, coefficients for some regions and one varietal were significant. F-tests - Test 1: Dummy variables for country jointly insignificant; Test 2: Dummy variables for vintage jointly insignificant.

Figure 4 presents the results of the regression specified in equation (2). Assuming that one case of a wine was produced and all dummy variables were jointly equal to zero, the minimum rating the wine could have received was 79.76. An increase in price of $1 corresponded to a 0.0942 increase in rating. Figure 4 indicates a positive correlation between wine price and rating given by *Wine Spectator*. This positive correlation seems relatively small because wine price has a larger range than wine rating. An R^2 of 0.3484 indicates that this particular specification only explains a portion of the variance of wine rating.

Figure 4.

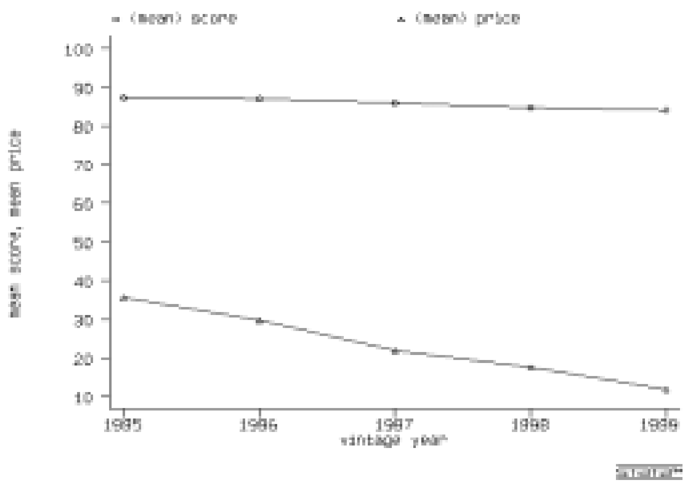
Effect of Wine Price on *Wine Spectator* Rating

Independent Variable	Dependent Variable: *Wine Spectator* Rating
intercept	79.76
	(20.86)
price	0.0942
	(28.91)
ln(cases produced)	-0.0241
	(-0.767)

Notes: The numbers in parentheses are *t* statistics. The table shows the ordinary least-squares estimate of wine rating. The number of observations is 5356. The R^2 is 0.3484. In addition to the variables listed, the regression included dummy variables for 38 regions, 2 types, 74 varietals, 5 countries, 4 vintage years, and the interaction between country and vintage year.

Figure 5 compares variations in mean score and mean price, based on vintage year. The most recent wines, as they are furthest from reaching maturation, have lower average scores and prices than older wines. Mean price seems to have a greater rate of decrease than mean score, as indicated by the slope of the two lines on the graph. However, the range of prices is greater than the range of scores, so a seemingly large decrease in price can correspond to the same percentage decrease as a seemingly small decrease in rating.

Figure 5. Variation in Mean Score Compared to Variation in Mean Price, Based on Vintage Year



Estimates of the correlation between advertising and rating are shown in Figure 6. The coefficient on advertising prior to 1999 corresponds to γ_1 in equation (4), whereas the coefficient on advertising in 1999-2000 relates to δ_1 in equation (3). Advertising prior to 1999 was thought to have possibly biased *Wine Spectator* ratings; however, the positive coefficient of 0.192 is insignificant at the 5% level. Therefore, although the coefficient indicates a positive correlation between advertising prior to 1999 and wine rating, the placement of advertisements prior to review may not have affected ratings. The dummy variable on advertising between January 1999 and December 2000 has an estimated coefficient of 0.402 with a significant *t* statistic of 3.33, indicating a positive correlation between rating and advertising in 1999-2000. The regression model which includes advertising prior to 1999 produced an R^2 of 0.3487 and the specification which includes advertising in 1999-2000 resulted in an R^2 of 0.3498. Both of these R^2 values are slightly larger than the R^2 of 0.3484 produced by the rating estimation that excluded advertising data. Therefore, the specifications that include advertising variables explain variance in rating to a greater extent than the model that excludes advertising data.

Figure 6.

Effects of Advertising on *Wine Spectator* Rating

	Dependent Variable: *Wine Spectator* Rating	
Independent Variable	1	2
advertising in 1999-2000	0.402 (3.33)	
advertising prior to 1999		0.192 (1.42)

Notes: The numbers in parentheses are *t* statistics. The table shows the ordinary least-squares estimates of the coefficients of advertising on wine rating. The coefficients of advertising in 1999-2000 and advertising prior to 1999 were found using two separate regressions. The number of observations is 5356. The R^2 is 0.3498 for the regression run on advertising in 1999-2000 and 0.3487 for the regression run on advertising prior to 1999. In addition to the variables listed, the regression included price, ln(cases produced), and dummy variables for 38 regions, 2 types, 74 varietals, 5 countries, 4 vintage years, and the interaction between country and vintage year.

V. Conclusion

Regression results based on the estimation of price in this paper show that prices of immature wines are not as strongly correlated to vintage growing-season characteristics than auction prices of mature wines. In fact, the models I specified yielded insignificant coefficients for many of the dummy variables for growing conditions such as country, region, type, and vintage year. F-tests indicated reasonable probabilities that coefficients for dummy variables for vintage year were jointly insignificant and that coefficients for country dummy variables were also jointly equal to zero. Therefore, this paper indicates that prices of immature wines do not follow the same specification as the model for mature wines devised by Ashenfelter, Ashmore, and Lalonde (1995). The specification for wine pricing used in this paper produced a negative coefficient of ln(cases produced) on wine price. Holding all other variables constant, doubling the number of cases produced decreases wine price by $2.36, on average; this is consistent with the laws of supply and demand. A few regions and one varietal had significant effects on wine price, indicating some correlation between price, regional weather, and growing conditions.

Wine ratings given by *Wine Spectator* are positively correlated with wine price. This result was reached by Shewbridge (1998) in his study of wines reviewed in issues of *Wine Spectator* in 1994 and has been replicated in this paper, using data from 1995 to the present. I have found that a $1 increase in wine price corresponds to a 0.0942 increase in wine rating. Assuming that there are no regional or weather fixed effects and that one case of wine was produced, the lowest rating is 79 points. Wine prices range from a few dollars to many thousands of dollars. Since wine prices have a larger range than wine ratings, the coefficient of wine price on wine rating is less than one. It is found that the number of cases produced has no effect on wine rating; this may be a result of the production quantity of wine depending more on crop (grape) yields than wine quality. Graphs generated by Shewbridge show that the vast majority of expensive wines are of high quality; therefore, very few wineries are setting prices misrepresentative of wine quality.

Advertising prior to the review of a wine does not affect rating, as evidenced by regression results in Figure 6. Estimates indicate no correlation between advertising prior to 1999 and ratings given by *Wine Spectator*. However, receiving slightly better reviews may cause wineries to advertise, as shown by the small positive correlation between advertising during 1999-2000 and *Wine Spectator* ratings.

According to Reuter (2000), the consumer wishes to find the highest quality of wine for consumption or the most undervalued wine for investment purposes. Experts disagree on whether to base predictions of quality on tasting impressions or statistics. Although this paper sheds some light on the relationships among wine prices, ratings, advertising, and production, questions remain as to the proper method of determining which wines to buy.

References

1. Ashenfelter, Orley, David Ashmore, and Robert Lalonde. "Bordeaux Wine Vintage Quality and the Weather." *Chance*. Volume 8 Number 4 (1995): 7-14.
2. Rachman, Gideon. "The Globe in a Glass." *The Economist*. 18 December 1999: 91-105.
3. Reuter, Jonathan. *Wine and Economics*. Speech. 26 January 2000.
4. Shewbridge, Scott. *Probability of Exceeding a Wine Spectator Score: An Evaluation of the Difficulties Wine Consumers Face and Some Coming Changes Wineries Should Prepare For*. Online. 1998.
5. "Wine Ratings." *Wine Spectator*. Online. 2000.