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ESTIMATING THE DEMAND FOR WINE USING INSTRUMENTAL VARIABLE TECHNIQUES

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Estimating the Demand for Wine Using Instrumental Variable Techniques

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Abstract

The demand for wine is generally estimated on an aggregate level as a single commodity. However, as recent history shows us, the demand for wine not only varies considerably by varietal, but also by price point within each varietal. As a result, although estimates of the demand for wine may be beneficial to the wine industry as a whole, they provide little benefit to individual wine producers. This paper seeks to overcome the limitations of prior research on the demand for wine by providing estimates for the demand for wine by varietal and price point. We also provide estimates of own price effects, income effects as well as cross price effects by color, varietal and price point. Problems of endogeneity inherent in demand estimation are corrected by utilizing a novel instrumental variable technique using grape prices as the instrument.

Key words: Pooled Cross Section Time Series Data; Instrumental Variable Regression; Wine Demand.

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INTRODUCTION

The purpose of this paper is to investigate the demand for wine and provide insight into the behavior of U.S. wine consumers. We use a unique data set consisting of pooled cross sectional data on the price paid and number of cases sold of wine at the sku level. The data set allows us to disaggregate the demand for wine by color, varietal and price segment. We use a fixed effects model and correct for endogeneity by using an obvious yet novel instrument, grape prices, to identify the demand for wine. In addition to providing own price and income elasticities by color, varietal and price segment, the paper also provides empirical estimates of cross price elasticities by color, varietal and price segment.

REVIEW OF LITERATURE

Most of the earlier research on the alcohol consumption aggregate wine with beer and spirits into a single category of alcohol, Baltagi and Griffin (1995 and 2002), and Grossman, Chaloupka and Sirtalan (1998), or disaggregate alcohol consumption into the three categories of wine, beer and spirits Nelson (2003). These studies generally examine time series data or pooled state level time series data and use past consumption as an instrument for current consumption. Two studies, Folwell and Baritell (1978) and Pompelli and Heien ((1991), use household survey data to examine consumption specific to wine. Finally, Buccola and VanderZanden (1997) use in store scanner data similar to ours, however, only obtain data from retail chains in Portland Oregon. Nevertheless, Buccola and Vandrezanden (1997) do disaggregate their data into four categories: Red

wine from Oregon, white wine from Oregon, red wine from California and white wine from California.

DATA

The wine data used for this research is Nielsen Scantrack data consisting of a cross section of sku (stock keeping unit) level monthly sales of wine scanned in U.S. retail outlets over the years 2002-2005. We concentrate on cases of traditional glass, 750 ML bottles. The benefit of scan data is that it represents actual purchases of wine by consumers and is reflective of the demand for wine. The drawback of scan data is that it only reflects purchases in major U.S. retail chains and does not represent wine sold on premise at wineries, purchases through wine clubs or purchases at restaurants. Income is measured using monthly per capita disposable income. The grape price data comes from the Grape Crush reports published by the California Department of Food and Agriculture and contains the price per ton and number of tons sold of wine grapes by varietal in each district in California for the years 1999-2005.

THE MODEL

To estimate the demand for wine, we begin with a basic fixed effects model where the demand for wine is of the form:

$$\text{Cases}_{ijt} = \beta_0 + \beta_1 \text{Price}_{ijt} + \beta_2 Income_{jt} + \sum_t \delta T_t + u_{ijt} \qquad (1)$$

Where: Cases_{ijt} represents the number of cases of wine of type i(color or varietal) sold in month j and year t.

$Price_{ijt}$ represents the price of wine type i, sold in month j and year t.

$Income_{jt}$ represents per capita disposable income in month j and year t.

T_t represents the fixed effect for year t.

ENDOGENEITY

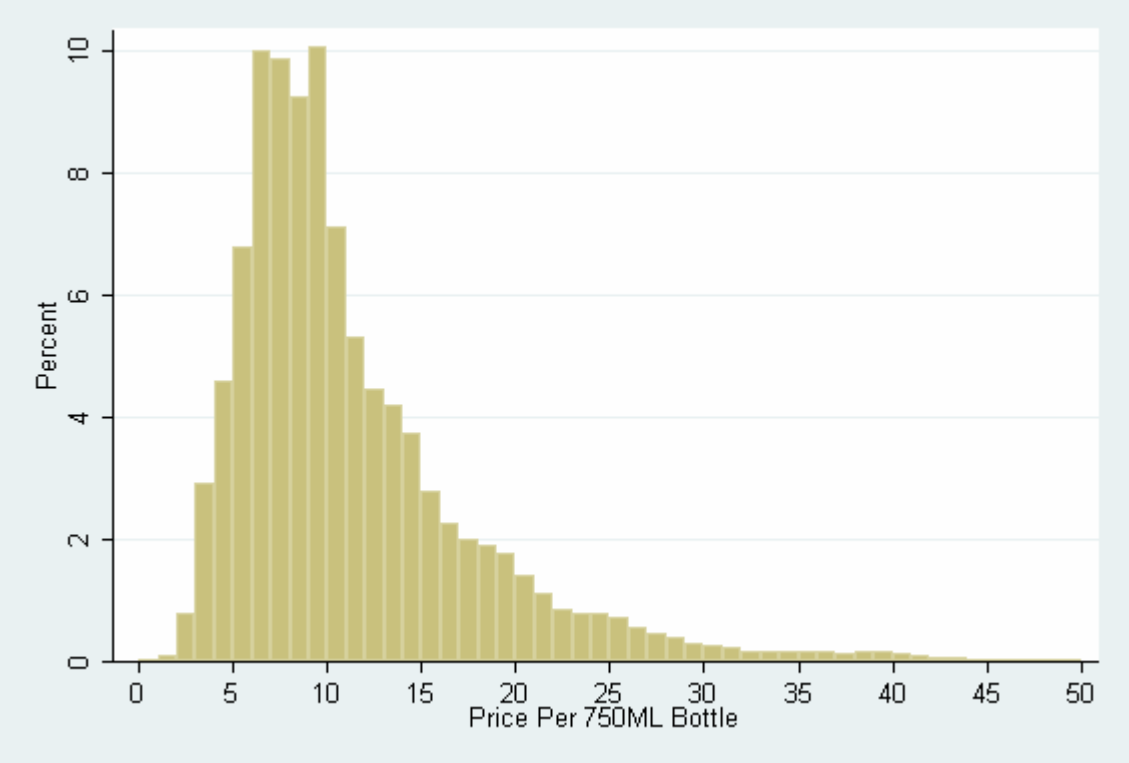
Estimating demand inevitably raises questions about endogeneity and identification. Following Hausman (1978), we find the presence of simultaneity between the price per bottle of wine and the number of cases sold. To correct for endogeneity we instrument the price of wine using grape prices. The price of grapes seems to be the most obvious choice of instruments for the price of wine. Intuitively, grape prices appear uncorrelated with the error term in the demand for wine and as the primary ingredient in a bottle of wine, should be highly correlated with wine prices. Unfortunately, correlations between the price of wine and the price of grapes show little relationship. This is not too surprising given the variation in the price of wine across varietals as well as the variation in price within varietals. In addition, while grapes are the primary ingredient in a bottle of wine, grapes do not constitute the primary cost in producing a bottle of wine, accounting for only about 10% of the price of the average bottle of wine.[1] Nevertheless, of the costs associated with the production of wine, grapes seem a logical choice and appear to be the most tractable.

[1] This is according to a wine industry report published by Gomberg-Frederickson which breaks down the cost of a $13 bottle of wine as follows: Grapes 11%, bottling and packaging 5%, wine making 10%, winery profit, marketing and overhead 19%, distribution 23% and retail markup 32%.

To illustrate the problems associated with correlating wine and grape prices, we summarize the data used in this study below. Summary statistics for both the price of wine and grapes are shown in Table 1.

The price of wine in our sample varies from 80 cents for a single 750 ML bottle to just under $220. However, most wines defined as those falling between 10th and 90th percentiles range from $5-$20 per bottle. The distribution of wine prices is shown in Figure 1.

Figure 1



The prices of grapes in California, on the other hand, vary from $1 per ton to over $26,000 per ton depending on varietal and the district grown. Most grapes, defined again as those falling between the 10th and 90th percentiles, sold for between $350 and $3,000 per ton. The distribution of grape prices is shown in Figure 2. Because of the wide

variation in grape prices in California depending on the district grown, we are fairly sanguine about using California grape prices as a instrument for all grape prices.

Figure 2

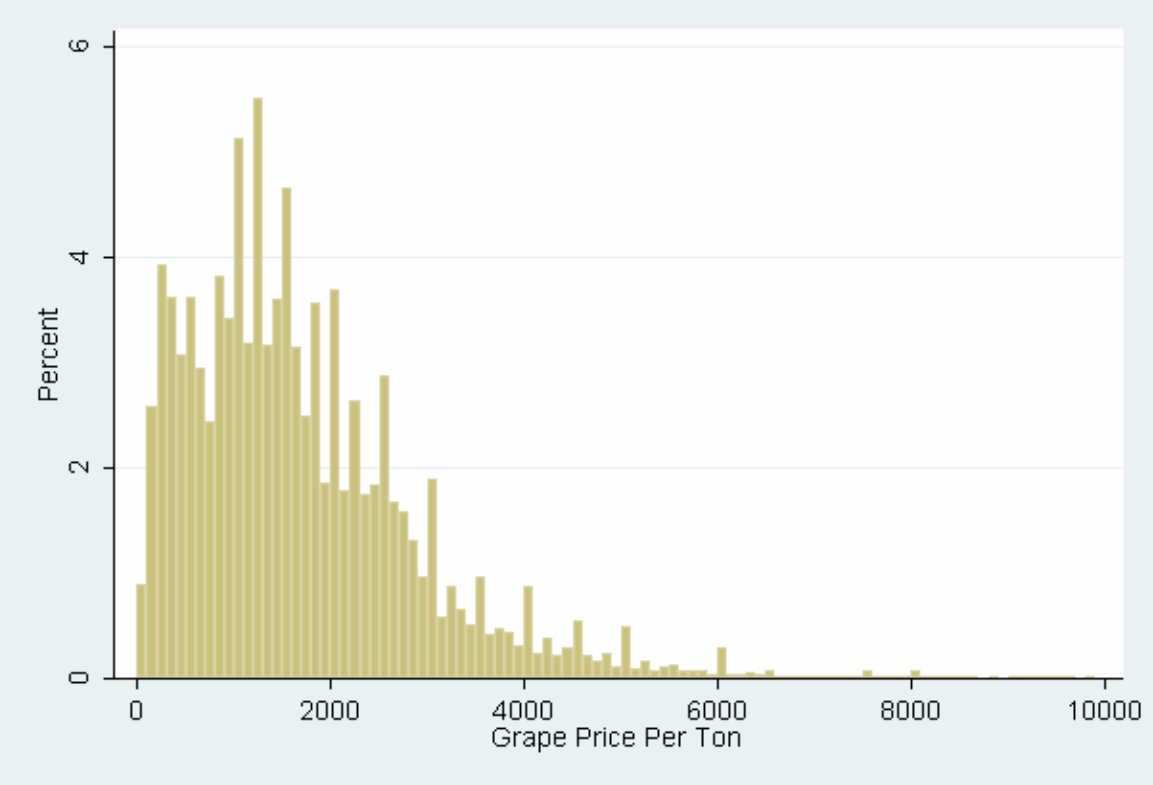


Table 1

	Price Per Bottle of Wine	Price Per Ton of Grapes
Mean	11.70	1,708.91
Minimum	.80	1.00
Maximum	218.46	26,500.00
10^{th} Percentile	5.25	350
90^{th} Percentile	20.15	3,263
Standard Deviation	8.18	1,327.12
Observations	128,552	44,817

To correlate grape prices with wine prices we use the "bottle price rule" which states that the price of grapes in a bottle of wine is roughly one hundred times the bottle

price of the wine.[2] We then broke the wine data into six common industry price points shown in Table 2.[3] Finally, we found the mean price of grapes in each price point, by color, varietal and year and correlated them with wine of the same categories. Because of the number of varietal contained in the data, we concentrate only on the six biggest selling red varietals and six biggest selling white varietals. The list of varietals is shown in Table 3.

Table 2

Price Per 750ML Bottle	Prices Per Ton of Grapes
Under $3	Under $300
$3 - Under $7	$300 - Under $700
$7 - Under $10	$700 - Under $1,000
$10 - Under $15	$1,000 - Under $1,500
$15 – Under $25	$1,500 – Under $2,500
$25 & Above	$2,500 & Above

Table 3

Red Wines		White Wines	
Varietal	Observations	Varietal	Observations
Cabernet Sauvignon	30,274	Chardonnay	37,191
Merlot	30,090	Sauvignon Blanc	9,734
Syrah	12,490	Pinot Grigio	7,399
Pinot Noir	9,882	White Zinfandel	4,094
Zinfandel	7,815	Riesling	3,959
Malbec	1,405	Chenin Blanc	1,420

Figure 3 shows the correlation between wine and grape prices for all varietals and price points along with the regression line. Figure 4 shows the correlation between wine and grape prices by varietal while Tables 4-6 show the simple regressions between wine and grape prices for all wines and by varietal. As the tables show, the correlation between the

[2] The "bottle price rule" is a wine industry standard and is generally attributed to grape grower Andy Beckstoffer of Beckstoffer Vineyards.

[3] These price points are used by the Nielsen Company, among others, to categorize wines.

price of wine and grapes is significant for all varietals and relatively strong with a coefficient of determination ranging from .51 to .91.

Figure 3

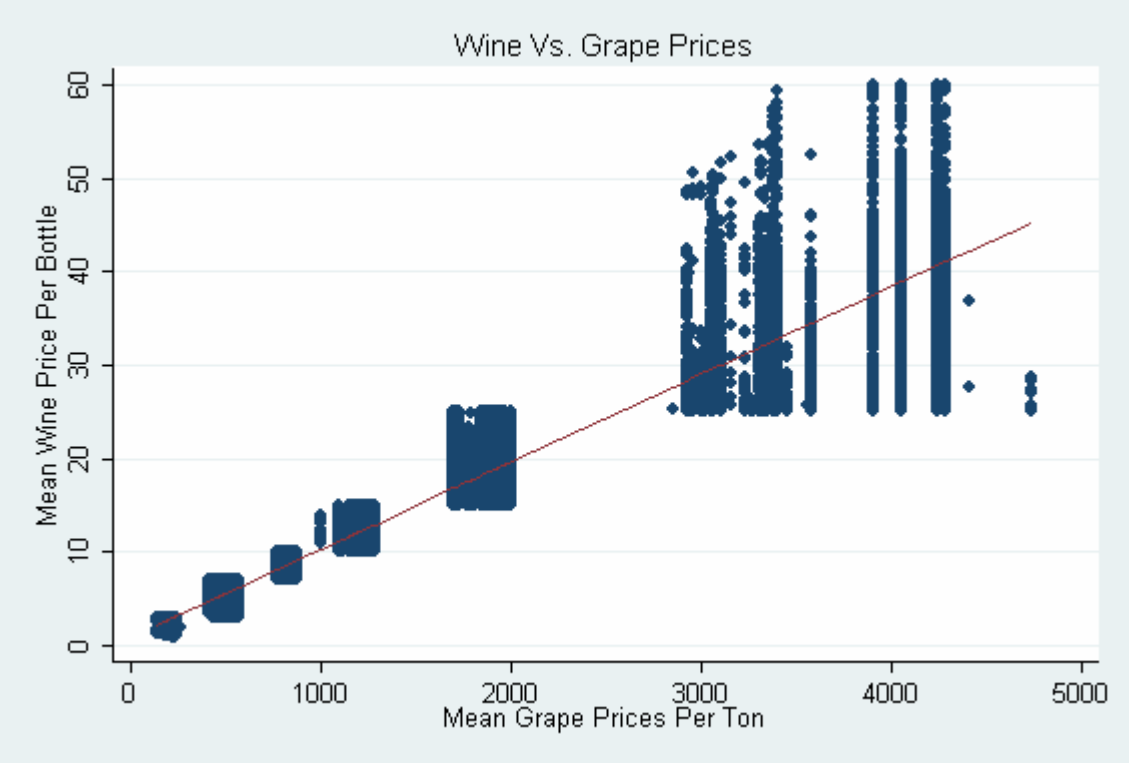


Figure 4

Table 4

	Price of Wine
Price of Grapes	0.009
	(772.93)**
Constant	0.865
	(53.70)**
Observations	155591
R-squared	0.79

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 5

Red Wine

	Cabernet Sauvignon	Merlot	Syrah	Pinot Noir	Zinfandel	Malbec
	Price of Wine	Price of Wine	Price of Wine	Price of Wine	Price of Wine	Price of Wine
Price of Grapes	0.01	0.009	0.011	0.009	0.009	0.009
	(296.12)**	(514.68)**	(113.50)**	(287.39)**	(258.21)**	(84.87)**
Constant	0.796	1.065	-0.157	1.8	1.477	0.989
	(14.60)**	(46.91)**	(1.47)	(36.46)**	(30.06)**	(9.81)**
Observations	30262	30078	12478	9870	7803	1388
R-squared	0.74	0.9	0.51	0.89	0.9	0.84

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

Table 6

	White Wine					
	Chardonnay	Sauvignon Blanc	Pinot Grigio	White Zinfandel	Riesling	Chenin Blanc
	Price of Wine	Price of Wine	Price of Wine	Price of Wine	Price of Wine	Price of Wine
Price of Grapes	0.009	0.009	0.009	0.009	0.009	0.01
	(596.08)**	(224.94)**	(222.68)**	(164.10)**	(165.14)**	(87.70)**
Constant	0.78	1.459	0.94	1.19	1.372	0.76
	(41.29)**	(35.25)**	(23.55)**	(27.61)**	(27.05)**	(9.72)**
Observations	37179	9722	7387	4094	3926	1404
R-squared	0.91	0.84	0.87	0.87	0.87	0.85

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

Given the results shown in Tables 4-6, we are confident in using grape prices as our instrument and that grape prices satisfy the requirements for an efficient instrument. The functional form of the instrument used in the demand estimation is:

$$\text{Price}_{it} = \alpha_0 + \alpha_n \sum_{n=1}^{3} \text{Price}_{i,t-n} + \nu_{it} \qquad (2)$$

Where: Price_{it} represents the price of a bottle of wine of type i in period t.

RESULTS

We begin with an analysis of the demand for all wines defined by the 12 varietals of red and white wines used in the sample. Double log regressions are used for all estimates with the initial OLS and IV estimates shown in Table 7. The results in Table 7 show that the OLS and IV regressions produce similar results. The coefficient on price for both models is negative and statistically significant at the 10% level representing a confirmation of the law of demand. Note also that regression results using both OLS and IV regression indicate a price elasticity of demand greater than one. The coefficients on

income for both OLS and IV estimates are again similarly positive and significant indicating the normality of wine as defined by economic theory. Furthermore, both estimates indicate an income elasticity of approximately 1.5.

Table 7

	OLS Cases	IV Cases
Price	-1.158	-1.232
	(106.82)**	(108.34)**
Income	1.544	1.515
	(3.70)**	(3.63)**
Year 1	-0.087	-0.089
	(3.71)**	(3.81)**
Year 2	-0.123	-0.125
	(3.27)**	(3.32)**
Year 3	-0.042	-0.043
	(0.89)	(0.91)
Constant	-9.93	-9.449
	(2.27)*	(2.16)*
Observations	128552	128541
R-squared	0.08	0.08

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Next we disaggregate the data to examine the difference in demand between red and white wines. Table 8 shows the OLS and IV regressions for all the wines in the sample by color. Note that for the white and red wines examined, the estimate price coefficients are similar between the OLS and IV regressions in that both methods produce negative and significant price elasticities. While the OLS and IV results are similar within each color category, the estimated price elasticities for red and white wines are different. The estimated price elasticity for red wine shows greater price responsiveness than that for white wines and are significantly different from each other at the 1% level. However, as Figure 5 indicates, while the results are statistically different,

they do not appear economically significant in that the demand curves look very similar to each other.

With respect to income, the coefficients for white wines are similar between OLS and IV regressions, producing both positive and statistically significant income elasticities. While the estimated income elasticities for red wine are positive and similar between the OLS and IV regression, neither are statistically significant at the 1% or 5% level but are significant at the 10% level. Furthermore, estimated income elasticities for white wine are significantly larger than the income elasticities for red wine, with an estimated income of approximately 2.3 compared to an estimated income elasticity of red wine of just under one. Thus, as we disaggregate the data we begin to see a difference between the demands for red and white wines: For the wines examined, red wines are more price elastic than white wines but less income elastic.

Figure 5

Table 8

	White		Red	
	OLS	IV	OLS	OV
	Cases	Cases	Cases	Cases
Price	-1.111	-1.016	-1.203	-1.277
	(54.31)**	(48.66)**	(93.75)**	(95.15)**
Income	2.415	2.354	0.927	0.888
	(3.55)**	(3.55)**	(1.76)	(1.68)
Year 1	-0.049	-0.036	-0.117	-0.121
	(1.3)	(0.98)	(3.94)**	(4.06)**
Year 2	-0.1	-0.095	-0.145	-0.148
	(1.64)	(1.6)	(3.04)**	(3.11)**
Year 3	-0.075	-0.079	-0.028	-0.03
	(0.97)	(1.05)	(0.47)	(0.51)
Constant	-19.304	-18.654	-3.248	-2.651
	(2.70)**	(2.68)**	(0.59)	(0.48)
Observations	51761	63712	76791	76784
R-squared	0.05	0.04	0.1	0.1

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level

To provide further insight into the demand for wine, we further disaggregate the data and break down both red and white wines into two price segments: Wines below $10 and wines $10 and above. We chose $10 as our break point for two main reasons: First, $10 is still considered by many to be a psychological threshold for wine purchases. Second, breaking wine into segments below $10 and $10 and above results in relatively even sample sizes of the two groups. Table 9 shows the regression results for red and white wines in both price categories.

Consider first the estimate price elasticities. For white wines, the estimated price elasticities are negative and statistically significant for both the OLS and IV estimates in both price categories. Furthermore, for white wine, the price elasticities decrease as you move from the lower to upper price categories. For the red wines, the estimated price elasticities are all negative and statistically significant for both the OLS and IV estimates in both price categories. However, in contrast to white wine, the estimated price elasticities for red wine increase as you move up to the higher price category.

The estimated income elasticities are positive for both red and white wines in both price categories. However, while the estimated income elasticities are statistically significant for all white wines, the estimated income elasticities for the red wines are insignificant for the low priced segment but significant at the 10% level for the high priced segment. For both red and white wines, the income elasticities increase as you move up the price categories. However, the income elasticities for the white wines consistently show significantly larger coefficients.

As Figure 6 shows, we continue to observe different consumptive behavior between red and white wines. To begin with, white wine consumers are more price

responsive at the lower price point than the upper price point. On the other hand, red wine consumers are more price responsive at the upper price point than the lower price point, although the difference is slight. Additionally, red and white wine consumers are more income sensitive at the upper price point than the lower price point, but white wine consumers are nearly twice as income responsive as red wine consumers at either price points.

Figure 6

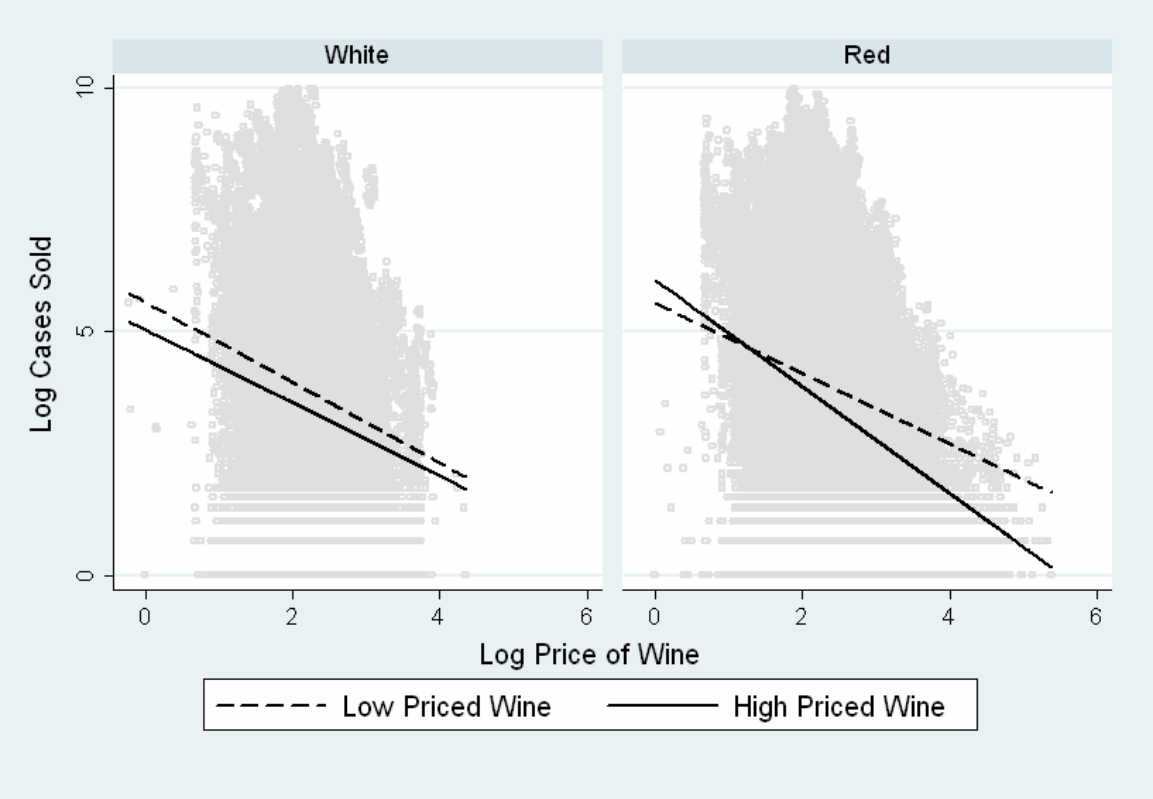


Table 9

	White				Red			
	$10 & Under		Over $10		$10 & Under		Over $10	
	OLS Cases	IV Cases	OLS Cases	IV Cases	OLS Cases	IV Cases	OLS Cases	IV Cases
Price	-0.823	-1.096	-0.751	-0.688	-0.723	-1.053	-1.093	-1.154
	(19.07)**	(21.28)**	(16.05)**	(13.18)**	(19.55)**	(24.05)**	(46.39)**	(44.43)**
Income	2.347	2.299	2.576	2.58	0.712	0.609	1.27	1.244
	(2.57)*	(2.51)*	(2.58)*	(2.58)**	(0.87)	(0.75)	(1.90)	(1.86)
Year 1	0.018	0.015	-0.147	-0.148	-0.071	-0.081	-0.155	-0.155
	(0.36)	(0.29)	(2.70)**	(2.72)**	(1.52)	(1.72)	(4.16)**	(4.18)**
Year 2	-0.003	-0.007	-0.239	-0.24	-0.105	-0.113	-0.179	-0.179
	(0.04)	(0.08)	(2.68)**	(2.69)**	(1.43)	(1.53)	(2.97)**	(2.97)**
Year 3	0.022	0.023	-0.22	-0.221	-0.018	-0.022	-0.036	-0.036
	(0.21)	(0.22)	(1.94)	(1.95)	(0.19)	(0.24)	(0.47)	(0.47)
Constant	-19.164	-18.128	-21.945	-22.162	-1.854	-0.137	-7.22	-6.77
	(2.00)*	(1.89)	(2.09)*	(2.11)*	-0.22	-0.02	-1.03	-0.96
Observations	31420	31420	20341	20337	38248	38241	38543	38543
R-squared	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

We now disaggregate the data into varietals. Regressions results for the six red wines examined are shown in Table 10 and the estimated demand functions are shown in Figure 7. Note first that the estimated price elasticities are all negative and statistically different than zero. Note also that the estimated price elasticities from the OLS and IV estimates are similar across varietals. The two most popular red wines, Cabernet Sauvignon and Merlot, produce price elasticities close to one at 1 and 1.2 respectively. Syrah and Zinfandel produce result in greatest price elasticities at approximately 1.7 for both. Malbec produces the most inelastic price estimates with the OLS and IV results both producing price elasticities less than one. While the estimated income elasticities are all positive, only Pinot Noir produces results statistically different than zero.

Figure 7

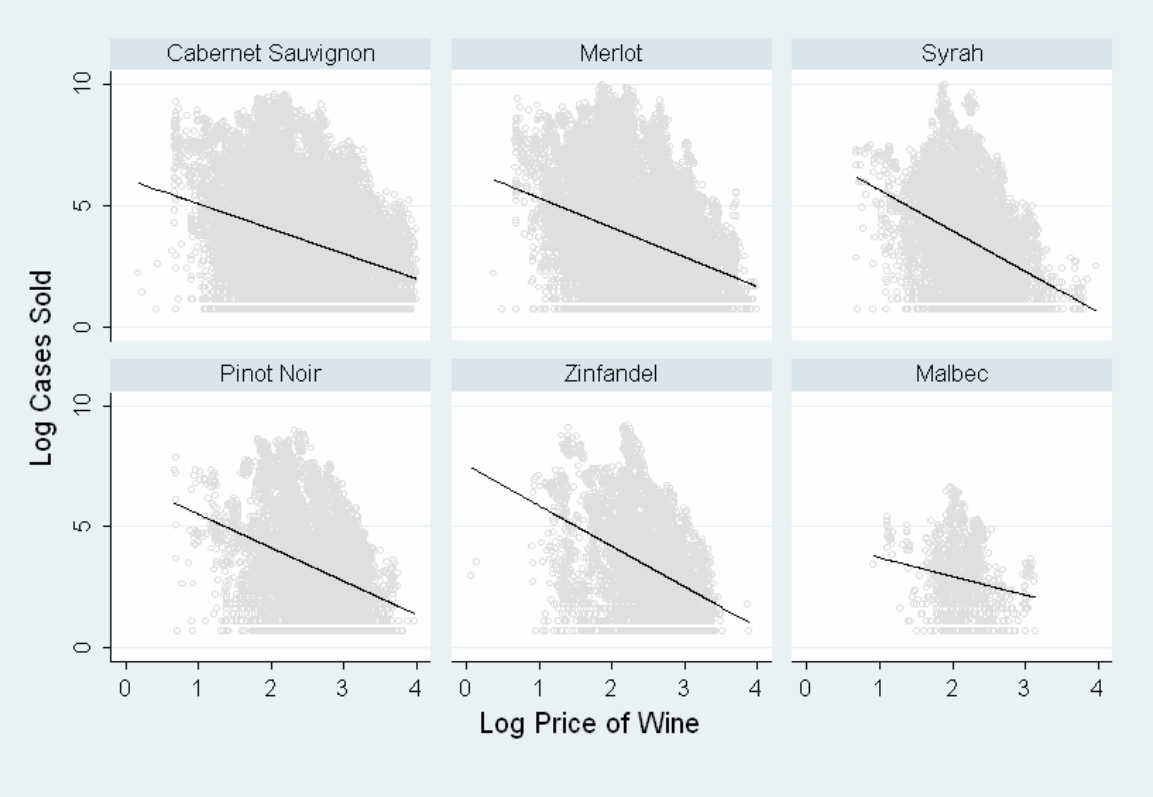


Table 10

Red Wines

Varietal	Cabernet Sauvignon		Merlot		Syrah		Pinot Noir		Zinfandel		Malbec	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases
Price	-1.031	-1.097	-1.223	-1.297	-1.676	-1.898	-1.379	-1.403	-1.673	-1.716	-0.827	-0.485
	(51.67)**	(52.54)**	(48.60)**	(49.38)**	(41.18)**	(43.62)**	(35.02)**	(34.16)**	(35.66)**	(34.98)**	(6.46)**	(3.40)**
Income	0.762	0.722	-0.395	-0.432	1.313	1.122	5.001	4.991	0.642	0.647	0.329	0.025
	(0.80)	(0.76)	(0.40)	(0.44)	(0.98)	(0.84)	(3.56)**	(3.55)**	(0.40)	(0.40)	(0.11)	(0.01)
Year 1	-0.094	-0.099	-0.094	-0.096	-0.196	-0.2	-0.224	-0.225	-0.034	-0.035	-0.122	-0.118
	(1.76)	(1.85)	(1.69)	(1.73)	(2.41)*	(2.46)*	(2.85)**	(2.86)**	(0.38)	(0.39)	(0.68)	(0.65)
Year 2	-0.121	-0.125	-0.1	-0.102	-0.257	-0.261	-0.315	-0.317	-0.023	-0.024	0.072	0.081
	(1.41)	(1.46)	(1.12)	(1.14)	(2.07)*	(2.10)*	(2.49)*	(2.50)*	(0.16)	(0.16)	(0.26)	(0.29)
Year 3	0.013	0.009	-0.057	-0.058	-0.166	-0.168	-0.088	-0.088	0.127	0.126	0.38	0.376
	(0.12)	(0.09)	(0.51)	(0.52)	(1.08)	(1.09)	(0.55)	(0.55)	(0.69)	(0.69)	(1.10)	(1.09)
Constant	-1.86	-1.276	10.79	11.347	-6.342	-3.836	-45.643	-45.478	0.771	0.829	1.082	3.549
	(0.19)	(0.13)	(1.04)	(1.10)	(0.45)	(0.27)	(3.10)**	(3.09)**	(0.05)	(0.05)	(0.03)	(0.11)
Observations	24723	24716	23808	23808	10588	10588	9263	9263	7075	7075	1334	1334
R-squared	0.1	0.1	0.09	0.09	0.14	0.14	0.13	0.13	0.15	0.15	0.04	0.04

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

Estimates for white wines are shown in Table 11. For the white wines examined, all the estimated price elasticities are negative and statistically different from zero at the 1% level. Furthermore, all price elasticities are greater than one except White Zinfandel. The estimated income elasticities are all positive with only Pinot Grigio and Riesling statistically significant at the 54% level and Chardonnay and Sauvignon Blanc significant at the 10%.

Figure 8

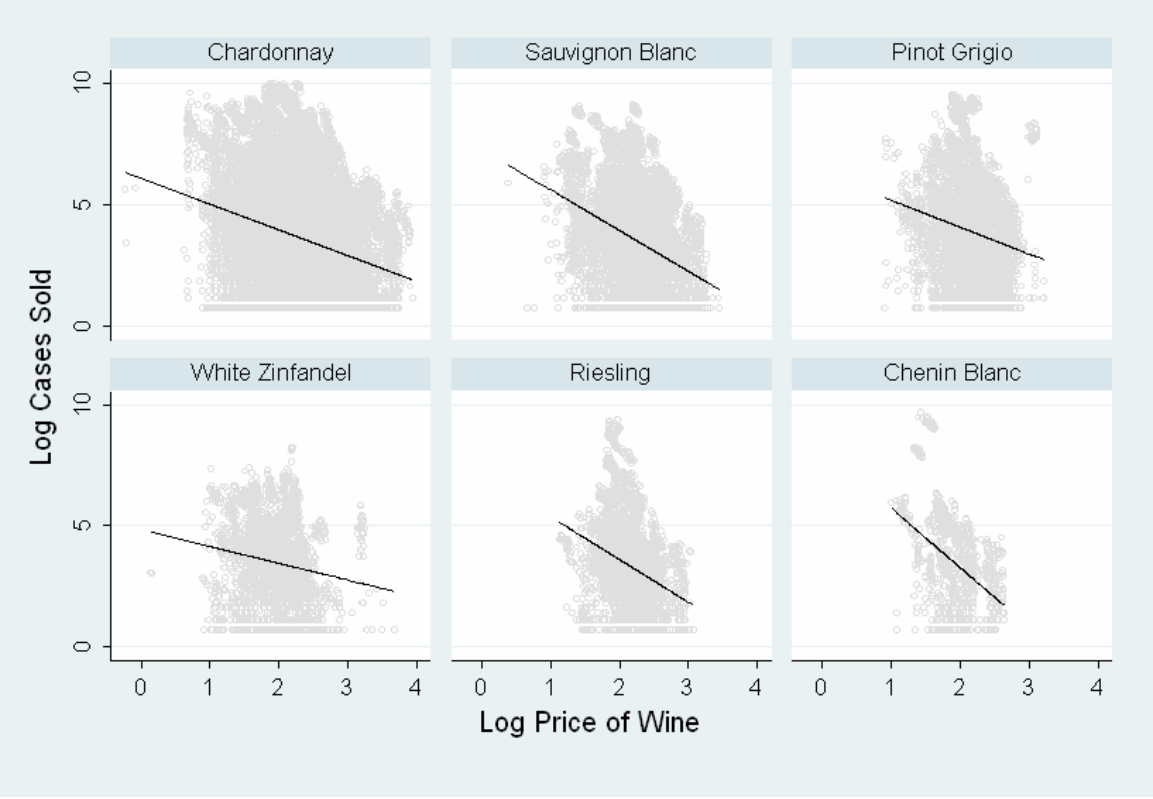


Table 11

White Wines

Varietal	Chardonnay		Sauvignon Blanc		Pinot Grigio		White Zinfandel		Riesling		Chenin Blanc	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases
Price	-1.062	-1.14	-1.688	-1.811	-1.122	-1.363	-0.697	-0.96	-1.807	-2.091	-2.449	-2.561
	(41.27)**	(42.15)**	(30.94)**	(30.86)**	(13.22)**	(14.76)**	(8.96)**	(11.20)**	(19.38)**	(20.60)**	(15.18)**	(13.03)**
Income	1.711	1.677	3.036	3.02	4.484	4.539	1.094	1.19	4.609	4.686	4.34	4.357
	(1.86)	(1.82)	(1.87)	(1.86)	(2.06)*	(2.08)*	(0.49)	(0.54)	(2.11)*	(2.15)*	(1.03)	(1.04)
Year 1	-0.062	-0.064	-0.018	-0.019	-0.08	-0.081	0.067	0.069	-0.121	-0.122	-0.104	0.006
	(1.23)	(1.27)	(0.20)	(0.21)	(0.64)	(0.65)	(0.55)	(0.57)	(0.99)	(1.00)	(0.48)	(0.03)
Year 2	-0.107	-0.109	-0.184	-0.185	-0.179	-0.179	0.119	0.125	-0.053	-0.051	0.087	0.199
	(1.30)	(1.33)	(1.27)	(1.27)	(0.91)	(0.91)	(0.60)	(0.63)	(0.27)	(0.26)	(0.23)	(0.53)
Year 3	-0.078	-0.079	-0.122	-0.12	-0.133	-0.13	0.008	0.021	0.03	0.04	-0.027	0.083
	(0.75)	(0.75)	(0.66)	(0.65)	(0.53)	(0.52)	(0.03)	(0.08)	(0.12)	(0.16)	(0.06)	(0.18)
Constant	-11.894	-11.353	-24.621	-24.17	-40.864	-40.928	-6.761	-7.274	-41.329	-41.526	-37.57	-37.647
	(1.23)	(1.17)	(1.45)	(1.42)	(1.79)	(1.79)	(0.29)	(0.31)	(1.81)	(1.81)	(0.85)	(0.85)
Observations	30332	30332	8338	8338	5345	5345	3189	3189	3430	3430	1127	1123
R-squared	0.05	0.05	0.1	0.1	0.03	0.03	0.03	0.02	0.11	0.1	0.18	0.19

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

Next we examine wines by varietal and price category. Consider first the six red wine varietals chosen: Cabernet Sauvignon, Merlot, Syrah, Pinot Noir, Zinfandel and Malbec. The instrumental variable regression results for the red wine varietals by price point are shown in Table 12. From Table 12 you can see that the estimated price elasticities are generally negative and statistically significant with the exception of low priced Zinfandel and Malbec varietals. The estimated price elasticities low price Zinfandel and Malbec are positive but not statistically different from zero. Furthermore, the regression results indicate that these models result in the lowest explanatory power of the models estimated. We attribute these results to the relatively small sample size of both models as well as the model specification and view these results as an avenue for future research.

The estimated income elasticities range from negative for low priced Merlot and high priced Malbec, although neither is statistically significant, to relatively large,

positive and significant values for Pinot Noir. Interestingly, Pinot Noir is the only wine that exhibits statistically significant income elasticities.

Figure 9

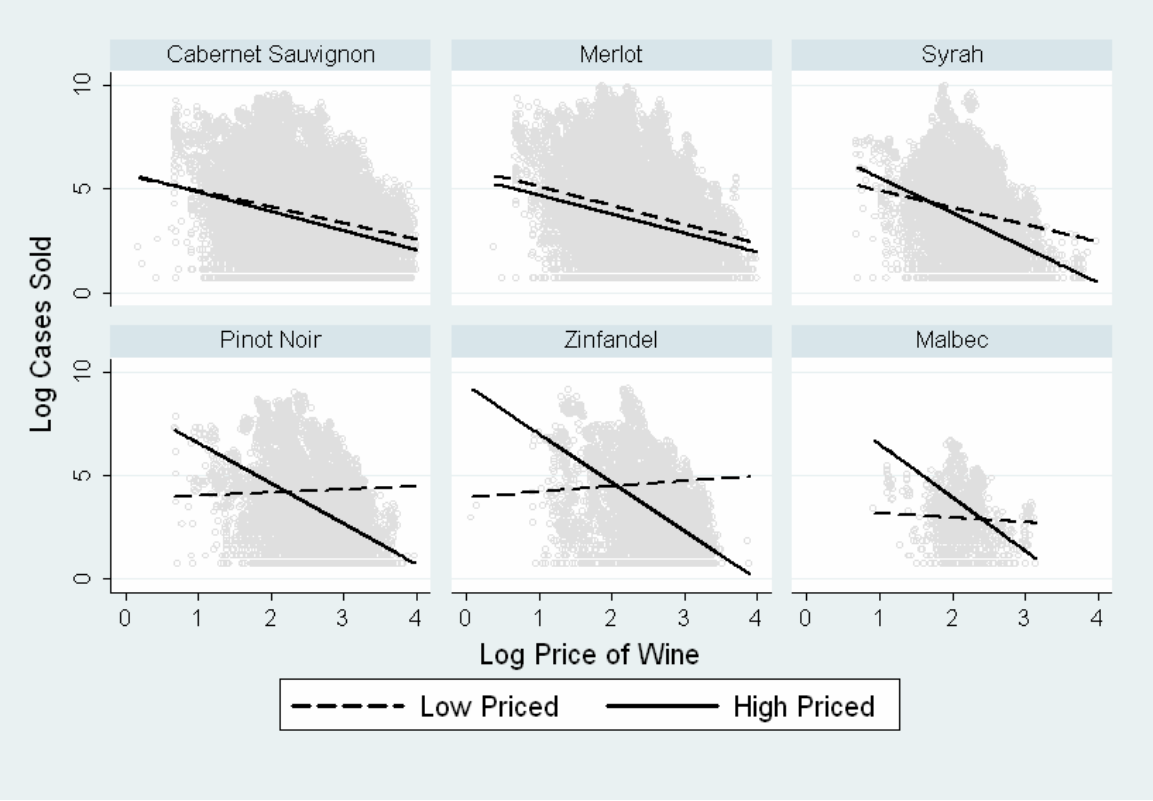


Table 12

Red Wines

Varietal	Cabernet Sauvignon		Merlot		Syrah		Pinot Noir		Zinfandel		Malbec	
	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10
	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases
Price	-1.137	-1.003	-1.145	-1.017	-1.434	-2.164	-0.169	-1.868	0.139	-2.247	0.509	-2.087
	(15.13)**	(26.10)**	(15.48)**	(17.36)**	(12.14)**	(23.54)**	(1.04)	(26.07)**	(0.86)	(22.52)**	(1.76)	(5.40)**
Income	1.063	0.43	-1.196	0.725	0.568	2.248	7.045	3.88	0.197	0.633	0.772	-2.356
	(0.73)	(0.35)	(0.85)	(0.54)	(0.30)	(1.23)	(2.39)*	(2.54)*	(0.06)	(0.37)	(0.21)	(0.46)
Year 1	-0.037	-0.159	-0.038	-0.163	-0.197	-0.212	-0.252	-0.208	-0.024	-0.015	-0.176	0.058
	(0.46)	(2.31)*	(0.47)	(2.22)*	(1.69)	(2.00)*	(1.45)	(2.49)*	(0.13)	(0.16)	(0.83)	(0.17)
Year 2	-0.113	-0.137	-0.036	-0.185	-0.252	-0.277	-0.407	-0.275	0.109	-0.063	-0.017	0.356
	(0.87)	(1.23)	(0.28)	(1.54)	(1.44)	(1.67)	(1.51)	(2.00)*	(0.37)	(0.41)	(0.05)	(0.72)
Year 3	-0.014	0.033	0.009	-0.143	-0.162	-0.189	-0.297	0.01	0.31	0.067	0.307	0.614
	(0.09)	(0.23)	(0.06)	(0.94)	(0.75)	(0.91)	(0.88)	(0.06)	(0.82)	(0.34)	(0.73)	(1.03)
Constant	-4.805	1.542	19.095	-1.614	1.13	-15.01	-69.526	-32.486	2.008	2.403	-6.197	32.406
	(0.32)	(0.12)	(1.29)	(0.12)	(0.06)	(0.79)	(2.25)*	(2.02)*	(0.06)	(0.13)	(0.16)	(0.60)
Observations	12398	12318	13482	10326	6339	4249	2797	6466	2286	4789	939	395
R-squared	0.01	0.06	0.02	0.03	0.01	0.09	0.01	0.13	0	0.13	0	0.14

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

Table 13 contains the instrumental variable regression results by price segment for the white wines contained in the sample: Chardonnay, Sauvignon Blanc, Pinot Grigio, White Zinfandel, Riesling and Chenin Blanc. The estimated price elasticities are again mostly negative and significant. The exceptions being high priced Pinot Grigio, high priced White Zinfandel, and high priced Chenin Blanc which produce positive but statistically insignificant price elasticities. Once again we attribute these anomalous results to sample size and model specification issues.

The estimated income elasticities are all positive with only upper priced Riesling being statistically different from zero at the 5% level.

Figure 10

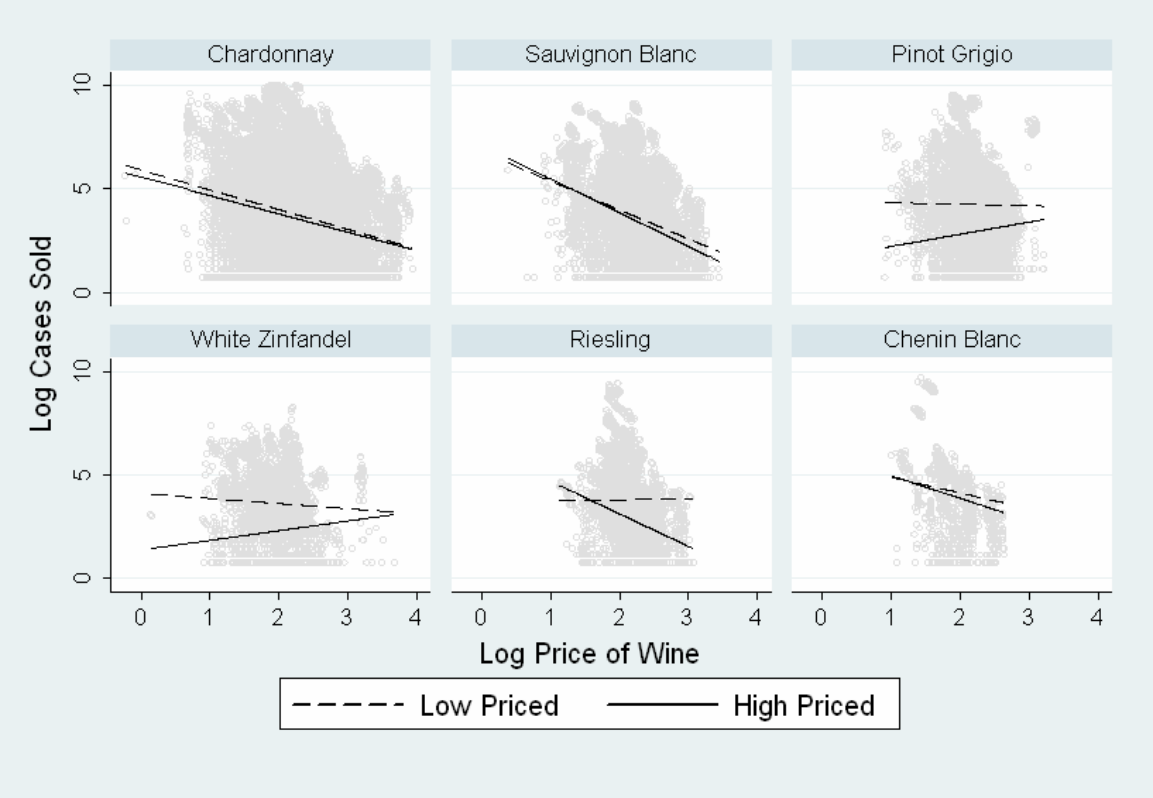


Table 13

White Wines

Varietal	Chardonnay		Sauvignon Blanc		Pinot Grigio		White Zinfandel		Riesling		Chenin Blanc	
	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10
	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases
Price	-1.255	-0.902	-1.812	-1.716	-0.042	1.072	-0.578	0.285	-0.727	-1.085	-3.368	0
	(18.24)**	(15.01)**	(12.98)**	(10.35)**	(0.22)	(3.02)**	(4.60)**	(0.91)	(3.38)**	(4.10)**	(10.82)**	(.)
Income	1.546	1.777	2.531	3.622	4.605	4.632	0.663	4.72	3.842	6.714	3.375	7.241
	(1.19)	(1.38)	(1.07)	(1.68)	(1.66)	(1.42)	(0.28)	(0.86)	(1.40)	(2.20)*	(0.72)	(1.08)
Year 1	0.005	-0.149	0.019	-0.061	-0.009	-0.337	0.065	0.215	-0.094	-0.187	-0.018	0.121
	(0.07)	(2.16)*	(0.15)	(0.52)	(0.06)	(1.77)	(0.51)	(0.62)	(0.63)	(1.03)	(0.08)	(0.32)
Year 2	-0.028	-0.21	-0.076	-0.314	-0.114	-0.303	0.174	-0.007	-0.017	-0.08	0.22	-0.005
	(0.24)	(1.84)	(0.36)	(1.63)	(0.46)	(1.02)	(0.82)	(0.01)	(0.07)	(0.28)	(0.53)	(0.01)
Year 3	0.027	-0.209	0.013	-0.278	-0.153	-0.162	0.093	-0.264	0.073	-0.009	0.041	0.393
	(0.19)	(1.44)	(0.05)	(1.14)	(0.48)	(0.43)	(0.34)	(0.41)	(0.23)	(0.03)	(0.08)	(0.51)
Constant	-9.822	-12.97	-19.085	-30.687	-44.154	-48.208	-2.389	-47.986	-35.245	-65.73	-25.868	-74.059
	(0.72)	(0.96)	(0.77)	(1.35)	(1.52)	(1.41)	(0.10)	(0.83)	(1.22)	(2.05)*	(0.52)	(1.05)
Observations	17103	13229	4569	3769	3625	1720	2751	438	2404	1026	968	155
R-squared	0.01	0.02	0.03	0.04	0	0.01	0	0.01	0	0.08	0.18	0.07

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

CROSS PRICE EFFECTS

To estimate the cross price effects we estimate the following demand function for wine:

$$\text{Cases}_{ijt} = \beta_0 + \beta_1 \text{Price}_{ijt} + \beta_2 Income_{jt} + \sum_t \delta T_t + \sum_k \gamma \chi_k + u_{ijt} \quad (2)$$

Where: Cases_{ijt} represents the number of cases of wine of type i(color or varietal) sold in month j and year t.

Price_{ijt} represents the price of wine type i, sold in month j and year t.

Income_{jt} represents per capita disposable income in month j and year t.

X is a vector of bottle price prices of wine for color or varietals $j \neq i$

T_t represents the fixed effect for year t.

Once again, all variables are in natural logarithms. Table 14 contains OLS and IV estimates of cross price elasticities between red and white wines. The estimated demand function for white wine shows a cross price elasticity of white wine for red wine that is positive but less than one. For red wine, however, the estimated cross price elasticity of red for white wine are positive and greater than two indicating a high degree of substitutability of white wine among red wine drinkers. While only the red wine cross price effects are statistically significant, the inference here is that red wine drinkers are more likely to switch to white wine than white wine drinkers are to switch to reds. Once again, the income elasticities are twice as large for white wines as for red wines.

Table 14

	White Wine		Red Wine	
	OLS Cases	IV Cases	OLS Cases	IV Cases
Own Price	-1.112	-1.195	-1.203	-1.278
	(54.32)**	(55.07)**	(93.78)**	(95.18)**
Price of Red	0.957	0.998		
	(1.22)	(1.27)		
Price of White			2.065	2.132
			(2.31)*	(2.39)*
Income	2.996	3.003	1.312	1.285
	(3.60)**	(3.61)**	(2.37)*	(2.32)*
Year 1	-0.027	-0.027	-0.077	-0.079
	(0.65)	(0.66)	(2.22)*	(2.28)*
Year 1	-0.08	-0.08	-0.116	-0.118
	(1.26)	(1.26)	(2.36)*	(2.41)*
Year 2	-0.069	-0.069	-0.028	-0.03
	(0.90)	(0.89)	(0.47)	(0.51)
Constant	-27.886	-27.882	-12.125	-11.815
	(2.78)**	(2.78)**	(1.80)	(1.75)
Observations	51761	51757	76791	76784
R-squared	0.05	0.05	0.1	0.1

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 15 examines white and red wine cross price effects by price. As with the estimates shown in Table 14, all coefficients are positive indicating substitutability between red and white wines. However, Table 15 indicates that the demand for white wines over $10 is much more sensitive to changes in the price of red wine than the demand for white wines $10 and under. Similarly, for red wines, the cross price elasticity for white wines is greater for red wines over $10 than for red wines $10 and under. Interestingly, consumers of both white and red wines over $10 are more willing to switch colors than consumers at the lower price point.

Table 15

	White		Red	
	$10 & Under Cases	Over $10 Cases	$10 & Under Cases	Over $10 Cases
Own Price	-1.156	-0.711	-1.113	-1.17
	(22.59)**	(13.56)**	(25.49)**	(44.94)**
Price of Red	0.246	2.11		
	(0.23)	(1.82)		
Price of White			1.676	2.556
			(1.22)	(2.25)*
Income	2.438	3.845	0.845	1.782
	(2.18)*	(3.15)**	(0.99)	(2.53)*
Year 1	0.022	-0.103	-0.048	-0.106
	(0.39)	(1.69)	(0.89)	(2.46)*
Year 1	-0.003	-0.194	-0.087	-0.148
	(0.04)	(2.08)*	(1.13)	(2.38)*
Year 2	0.022	-0.204	-0.018	-0.04
	(0.21)	(1.79)	(0.20)	(0.53)
Constant	-20.112	-40.833	-6.423	-18.352
	(1.49)	(2.77)**	(0.62)	(2.14)*
Observations	31597	20160	38409	38375
R-squared	0.01	0.01	0.01	0.06

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 16 examines the cross price effects for the six white wines included in the study. The signs of the coefficients are mixed indicating substitutability and complementarity among the varietals, although none of the coefficients are statistically different from zero. Estimates for the red wine varietals, shown in Table 17, are mostly positive indicating substitutability among varietals. One notable exception is the price of Malbec which is negative across three of the six varietals. Again, however, none are statistically different from zero.

Table 16

	Chardonnay Cases	Sauvignon Blanc Cases	Pinot Grigio Cases	White Zinfandel Cases	Riesling Cases	Chenin Blanc Cases
Own Price	-1.14	-1.811	-1.363	-0.96	-2.086	-2.562
	(42.17)**	(30.85)**	(14.76)**	(11.18)**	(20.53)**	(13.02)**
Price of Chardonnay		-0.053	-0.118	0.135	-0.067	0.25
		(0.26)	(0.43)	(0.57)	(0.24)	(0.47)
Price of Sauvignon Blanc	-0.008		-0.102	-0.112	0.036	-0.266
	(0.06)		(0.34)	(0.37)	(0.12)	(0.49)
Price of Pinot Grigio	0.041	-0.023		-0.105	-0.639	-0.824
	(0.19)	(0.06)		(0.20)	(1.33)	(0.85)
Price of White Zinfandel	-0.081	-0.134	-0.182		-0.105	0.177
	(0.91)	(0.71)	(0.75)		(0.43)	(0.37)
Price Riesling	0.08	0.084	-0.037	0.019		-0.111
	(0.97)	(0.59)	(0.21)	(0.10)		(0.30)
Price of Chenin Blanc	0.121	-0.004	0.076	0.025	-0.142	
	(0.92)	(0.02)	(0.26)	(0.08)	(0.46)	
Income	1.594	3.22	4.634	1.594	6.784	6.2
	(1.33)	(1.56)	(1.88)	(0.57)	(2.39)*	(1.14)
Year 1	0.139	-0.05	0.003	0.134	-0.414	0.04
	(0.58)	(0.12)	(0.01)	(0.24)	(0.74)	(0.15)
Year 2	0.066	-0.21	-0.089	0.185	-0.296	0.255
	(0.30)	(0.56)	(0.18)	(0.36)	(0.58)	(0.65)
Year 3	0.097	-0.134	0.05	0.105	-0.111	0.29
	(0.43)	(0.34)	(0.10)	(0.19)	(0.21)	(0.56)
Constant	-11.964	-25.204	-38.555	-11.309	-55.383	-49.933
	(1.01)	(1.25)	(1.43)	(0.39)	(1.95)	(0.90)
Observations	30332	8338	5345	3189	3430	1123
R-squared	0.05	0.1	0.03	0.02	0.1	0.19

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

Table 17

	Cabernet Sauvignon Cases	Merlot Cases	Syrah Cases	Pinot Noir Cases	Zinfandel Cases	Malbec Cases
Own Price	-1.097	-1.298	-1.898	-1.404	-1.717	-0.485
	(52.57)**	(49.42)**	(43.64)**	(34.18)**	(35.00)**	(3.39)**
Price of Cabernet Sauvignon		0.078	0.174	0.092	0.127	0.179
		(1.13)	(1.81)	(0.95)	(1.12)	(0.83)
Price of Merlot	-0.023		-0.073	0.035	0.03	-0.544
	(0.16)		(0.36)	(0.20)	(0.12)	(1.24)
Price of Syrah	0.073	0.05		0.039	0.09	0.147
	(1.49)	(1.01)		(0.55)	(1.08)	(0.95)
Price of Pinot Noir	0.099	0.089	0.144		0.044	0.169
	(1.27)	(1.38)	(1.31)		(0.32)	(0.68)
Price of Zinfandel	0.191	0.097	0.15	0.197		0.235
	(1.90)	(0.94)	(1.03)	(1.32)		(0.72)
Price of Malbec	-0.007	-0.073	-0.015	0.007	0.072	
	(0.09)	(0.90)	(0.12)	(0.06)	(0.51)	
Income	1.913	1.984	3.269	6.206	2.888	1.409
	(1.28)	(1.30)	(1.61)	(2.78)**	(1.13)	(0.37)
Year 1	0.008	0.001	-0.07	-0.156	0.065	-0.034
	(0.12)	(0.01)	(0.72)	(1.76)	(0.60)	(0.15)
Year 2	-0.044	-0.023	-0.118	-0.266	0.062	0.16
	(0.47)	(0.24)	(0.86)	(2.05)*	(0.40)	(0.52)
Year 3	0.042	-0.019	-0.127	-0.076	0.117	0.329
	(0.37)	(0.16)	(0.77)	(0.45)	(0.61)	(0.93)
Constant	-18.339	-17.784	-32.187	-63.151	-27.265	-14.587
	(1.16)	(1.09)	(1.49)	(2.65)**	(0.99)	(0.36)
Observations	24716	23808	10588	9263	7075	1334
R-squared	0.1	0.09	0.14	0.13	0.15	0.04

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 18 provides cross price effects for the six white wine varietals by price segment. Once again the signs of the coefficients vary and none are statistically significant. In addition to the cross price effects by varietal, Table 18 also provides cross over price elasticities for each varietal. The cross over price indicates whether consumers view wines of the same varietal in adjacent price points as complements or substitutes while the magnitude indicates the willingness of consumer to trade up or down a price point within each varietal. For example, the cross over price elasticity for Chardonnay $10 and under indicates the willingness of consumers to move up to Chardonnay priced

over $10. Based on the regression results shown in Table 18, which indicate a negative coefficient for the cross over price effect for Chardonnay $10 and under, consumers of Chardonnay priced $10 and under view Chardonnay over $10 as a complement. However, for Chardonnay price over $10, the results in Table 18 indicate a positive cross over price coefficient. That is, consumer of Chardonnay over $10 view Chardonnay priced $10 and below as a substitute. However, none of cross over price coefficients are statistically different from zero.

Table 19 shows the cross price effects for the six red wine varietals. While the cross price effects are mostly positive, indicating substitutability among the varietals, once again none of the coefficients are statistically significant. For the cross over price coefficients, no clear pattern of behavior emerges. For example, for Cabernet Sauvignon, both coefficients are negative indicating complementarity between low priced and high priced Cabernet Sauvignon. For Pinot Noir, on the other hand, both coefficients are positive indicating substitutability between low priced and high priced Pinot Noirs. The remaining red varietals produce mixed coefficients, although for none of the cross over price effects are statistically significant.

Table 18

	Chardonnay		Sauvignon Blac		Pinot Grigio		White Zinfandel		Riesling		Chenin Blanc	
	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10
	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases
Own Price	-1.3	-0.92	-1.935	-1.772	-0.194	1.06	-0.617	0.298	-0.798	-1.099	-3.363	0
	(19.01)**	(15.22)**	(13.91)**	(10.65)**	(1.03)	(2.95)**	(4.94)**	(0.93)	(3.72)**	(4.14)**	(10.78)**	(.)
Price of Chardonnay			-1.192	0.302	-3.57	4.047	0.853	4.067	1	-5.507	3.823	4.643
			(0.37)	(0.10)	(0.94)	(0.87)	(0.26)	(0.52)	(0.26)	(1.25)	(0.56)	(0.46)
Price of Sauvignon Blanc	0.5	0.485			-0.918	-0.094	-1.146	-2.708	1.467	-2.546	-4.28	-0.404
	(0.26)	(0.27)			(0.23)	(0.02)	(0.34)	(0.31)	(0.39)	(0.57)	(0.63)	(0.04)
Price of Pinot Grigio	0.425	-0.253	-0.949	0.298			-3.498	15.045	-4.784	-9.106	-10.702	7.033
	(0.15)	(0.09)	(0.18)	(0.06)			(0.66)	(1.15)	(0.87)	(1.40)	(1.05)	(0.50)
Price of White Zinfandel	-1.684	0.255	-0.562	-1.306	-2.046	0.298			0.468	-3.976	0.869	3.681
	(1.70)	(0.25)	(0.27)	(0.68)	(0.86)	(0.11)			(0.20)	(1.45)	(0.22)	(0.62)
Price of Riesling	-0.496	0.701	0.217	1.113	-1.183	1.364	0.149	0.946			-0.399	-1.206
	(0.36)	(0.62)	(0.11)	(0.64)	(0.52)	(0.54)	(0.08)	(0.19)			(0.10)	(0.20)
Price of Chenin Blanc	1.091	0.088	0.46	-0.435	-1.178	5.619	-0.304	1.951	0.276	-4.232		
	(0.78)	(0.06)	(0.18)	(0.20)	(0.36)	(1.71)	(0.12)	(0.30)	(0.10)	(1.26)		
Cross-Over Price	-4.042	0.388	1.069	3.363	-0.191	-8.124	-0.222	-5.928	-0.098	0.316	0.634	1.426
	(1.48)	(0.15)	(0.39)	(0.87)	(0.06)	(1.40)	(0.26)	(0.70)	(0.06)	(0.09)	(0.30)	(0.22)
Income	2.56	1.896	3.489	3.246	4.697	4.701	1.582	2.065	5.583	9.885	5.853	5.094
	(1.38)	(1.08)	(1.15)	(1.17)	(1.48)	(1.27)	(0.53)	(0.29)	(1.55)	(2.50)*	(0.96)	(0.58)
Year 1	0.233	-0.119	0.083	-0.158	-0.357	1.019	-0.015	0.721	-0.013	-1.337	0.47	0.295
	(0.72)	(0.35)	(0.14)	(0.31)	(0.50)	(1.32)	(0.02)	(0.48)	(0.02)	(1.70)	(0.30)	(0.63)
Year 2	0.178	-0.195	-0.049	-0.36	-0.391	0.785	0.1	0.464	0.044	-1.04	0.725	0.099
	(0.61)	(0.63)	(0.09)	(0.76)	(0.58)	(1.13)	(0.18)	(0.34)	(0.07)	(1.46)	(0.48)	(0.15)
Year 3	0.265	-0.234	0.044	-0.402	-0.301	1.041	0.099	0.016	0.145	-0.672	0.752	0.288
	(0.89)	(0.74)	(0.08)	(0.81)	(0.43)	(1.40)	(0.17)	(0.01)	(0.23)	(0.93)	(0.47)	(0.33)
Constant	-9.266	-17.746	-27.135	-33.516	-24.343	-58.082	-2.723	-51.961	-49.992	-43.203	-30.474	-84.6
	(0.55)	(0.92)	(0.82)	(1.19)	(0.63)	(1.30)	(0.08)	(0.64)	(1.30)	(1.05)	(0.47)	(0.90)
Observations	17205	13127	4600	3738	3646	1699	2764	425	2414	1016	968	155
R-squared	0.02	0.02	0.03	0.04	0	0.01	0	0.02	0	0.09	0.18	0.08

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

Table 19

	Cabernet Sauvignon		Merlot		Syrah		Pinot Noir		Zinfandel		Malbec	
	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10	$10 & Under	Over $10
	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases	Cases
Own Price	-1.191	-1.017	-1.196	-1.04	-1.512	-2.188	-0.313	-1.895	0.08	-2.26	0.512	-2.085
	(15.91)**	(26.40)**	(16.21)**	(17.68)**	(12.85)**	(23.75)**	(1.93)	(26.40)**	(0.49)	(22.63)**	(1.77)	(5.34)**
Price of Cabernet Sauvignon			0.247	2.257	1.451	3.616	0.768	2.102	1.056	2.224	1.233	5.581
			(0.16)	(1.70)	(0.75)	(1.97)*	(0.25)	(1.28)	(0.31)	(1.29)	(0.33)	(1.05)
Price of Merlot	0.501	-0.819			0.269	-2.592	-1.971	0.925	-0.3	-0.39	-6.416	-5.173
	(0.20)	(0.37)			(0.08)	(0.82)	(0.46)	(0.42)	(0.05)	(0.12)	(1.06)	(0.53)
Price of Syrah	0.546	1.127	0.666	0.322			0.214	0.485	1.281	1.029	2.216	0.786
	(0.68)	(1.57)	(0.88)	(0.44)			(0.13)	(0.59)	(0.70)	(1.07)	(1.10)	(0.25)
Price of Pinot Noir	0.298	2.816	1.147	1.28	3.491	0.964			1.877	0.134	8.529	-6.178
	(0.17)	(1.68)	(0.80)	(0.84)	(1.54)	(0.40)			(0.46)	(0.06)	(1.87)	(0.76)
Price Zinfandel	2.112	2.882	1.39	1.223	1.492	2.579	5.822	0.983			2.842	7.595
	(1.05)	(1.62)	(0.68)	(0.65)	(0.54)	(0.99)	(1.40)	(0.45)			(0.55)	(0.93)
Price of Malbec	-0.305	0.037	-0.253	-1.105	-0.666	0.188	0.679	0.003	0.222	0.784		
	(0.27)	(0.04)	(0.24)	(1.12)	(0.45)	(0.13)	(0.29)	0.00	(0.08)	(0.58)		
Cross over Price	-0.41	-0.836	-0.636	1.887	0.612	-0.935	0.761	0.946	-0.321	1.204	5.101	-3.014
	(0.30)	(0.28)	(0.29)	(0.50)	(0.91)	(0.30)	(0.16)	(0.56)	(0.07)	(0.49)	(1.05)	(0.42)
Income	1.495	2.096	-0.077	4.657	3.659	3.152	5.955	6.188	3.273	2.003	-1.67	-1.106
	(0.63)	(1.09)	(0.03)	(2.24)*	(1.29)	(1.10)	(1.15)	(2.56)*	(0.63)	(0.71)	(0.99)	(0.23)
Year 1	0.021	-0.013	0.042	-0.031	0.019	-0.156	-0.194	-0.135	0.111	0.074	0.157	-0.173
	(0.21)	(0.16)	(0.43)	(0.31)	(0.13)	(1.18)	(0.99)	(1.44)	(0.48)	(0.64)	(0.58)	(0.42)
Year 2	-0.074	-0.015	0.041	-0.082	-0.041	-0.204	-0.361	-0.219	0.204	0.03	0.278	0.09
	(0.53)	(0.12)	(0.28)	(0.63)	(0.21)	(1.12)	(1.30)	(1.56)	(0.63)	(0.18)	(0.76)	(0.16)
Year 3	0.036	0.063	0.041	-0.104	-0.053	-0.194	-0.299	0.014	0.309	0.078	0.335	0.399
	(0.20)	(0.42)	(0.25)	(0.67)	(0.23)	(0.86)	(0.83)	(0.08)	(0.78)	(0.36)	(0.78)	(0.64)
Constant	-16.157	-30.238	0.79	-57.68	-49.447	-35.618	-74.301	-70.225	-40.138	-23.919	-70.968	34.651
	(0.58)	(1.42)	(0.03)	(2.41)*	(1.55)	(1.09)	(1.21)	(2.60)**	(0.68)	(0.76)	(1.24)	(0.46)
Observations	12449	12267	13533	10275	6366	4222	2826	6437	2294	4781	941	393
R-squared	0.01	0.06	0.02	0.03	0.01	0.1	0.01	0.14	0	0.13	0.01	0.15

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

CONCLUSION

We use individual sku level price and quantity data on wine to estimate the demand for wine. Further more we disaggregate the demand for wine by color, major varietal and price segment. We believe this paper provides a significant improvement in the estimation of wine demand and provides a foundation for future research investigating the demand for wine. Prior studies use aggregate data which fails to capture the differences between red and white wines and differences among varietals and price segments. We overcome endogeneity issues by using grape prices as an instrument for wine prices to identify demand. Our results are generally consistent with economic theory and confirm the law of demand. In the few instances where we get estimates contradicting the law of demand, the results are not statistically significant. We believe these anomalies can be overcome by specifying a more general model of wine consumption and plan on pursuing this research in the future. We also find that wine is a normal good as defined by economic theory. These results hold across color, varietal and price segment.

With respect to cross price effects, we examined the price responsiveness of each of the six white and six red varietals with each other within each color group and by price segment. While we did not find any statistically significant effects by varietal we did find a greater willingness of red wine drinkers to switch to white wines than white wine drinkers to switch to red wines. To some extent, white wine drinkers appear more loyal to white wine than red wine drinkers are to reds. However, when examine by price segment we find consumers of both white and red wines over $10 are more willing to switch colors than consumers of wine at the lower price segment.

We are interested in seeing if future research shows some of the lower priced wines to be inferior goods. Future research also plans to examine the relationship between red and white wines and among the various varietals.

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