ABSTRACT

HEO, JEONGHOI. Three Essays on the Demand for Wine and Winery Tourism. (Under the direction of Michael Wohlgenant.)

The wine industry has grown continuously over the past few decades in the United States and wine consumption has also increased during the same period. A survey study was conducted in order to identify the consumer base of wine market and winery tourism. A total of 701 consumers in North Carolina, New York, and Virginia were surveyed on their wine consumption patterns, visits to wineries, as well as demographics. The survey was conducted through telephone interviews from February through March in 2013. The first essay describes the results of the survey.

In the second essay, an empirical study is conducted to estimate the demand for wine. Using the survey data described in the first essay, two different empirical frameworks are applied. One is a continuous data model represented by the Tobit model, and the other is a count data model represented by the Poisson and the negative binomial models. The random effects specification is applied to each model in order to control for unobserved individual heterogeneity. As price data are necessary for every observation to estimate the demand models, unit price is imputed for the missing prices of zero purchase observations. Heckman's sample selection model and the ordinary least squares model are considered to estimate the unit price. Heckman's model is considered because the observations used to estimate the unit price is solely of those who did purchase wine and there could be sample selection bias. Since the results of Heckman's model indicate there is no sample selection problem, it is justified to use OLS.

Overall, the continuous and count data models show similar results. Along with wine price, factors that have a significant impact on wine demand are found to be household income and preference for wine taste. Although the estimates are somewhat different across models, individual characteristics such as level of education, race, and preference for certain color of wine have less impact on wine consumption. The price elasticity estimates vary between the continuous data model and the count data models. The price elasticity of wine

demand is -1.4 in the random effects Tobit model, while it is -0.27 in the random effects Poisson model and -0.24 in the random effects negative binomial model.

In the third essay, a probit model is adopted to examine what affects an individual's decision whether or not to visit a winery in their state. The economic value wineries provide their visitors is derived from the winery trip demand that is estimated by the truncated negative binomial model. The results of the probit model show that what affect an individual's decision to visit a winery are household income, race, number of years lived in the state, and wine consumption. And the results of the truncated negative binomial model show that travel cost, household income, and age are the factors that significantly affect the number of visits to wineries. The consumer surplus estimates of visiting wineries are $28.9 per visit when the opportunity cost of time is not included, and $149.6 per visit when one-third of the wage rate is assumed as the opportunity cost of time.

Three Essays on the Demand for Wine and Winery Tourism

by
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DEDICATION

To my parents.

BIOGRAPHY

Jeonghoi is from South Korea. He studied agricultural economics at Seoul National University and received his bachelor's and master's degrees. Thereafter, he worked at the Korea Rural Economic Institute. He decided to further his education and joined the Ph.D. program at North Carolina State University in 2010.

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CHAPTER 1

Wine Consumer Survey in North Carolina, Virginia, and New York

1.1 Introduction

The wine industry has grown continuously over the past few decades in the United States. The number of wineries significantly increased from 445 in 1963 to 8,991 in 2013, and wine consumption per person has also increased from 0.93 gallons to 2.73 gallons during the same period. The wine industry has grown throughout all 50 states with considerable growth in the South. In North Carolina, for instance, the number of wineries has more than quadrupled since 2001 to more than 100. It ranked number 9 in wine production among all states in 2011 and the retail value of wine production was $79 million in 2009 (Frank, Rimmerman & Co., 2011).

There have been survey studies to examine the customer profile in the wine market. Recently in North Carolina, for example, Stoddard and Evans (2011) and Byrd et al. (2013) surveyed visitors to North Carolina wineries. Stoddard and Evans (2011) surveyed 903 visitors at 11 wineries in 2010, and Byrd et al. (2013) surveyed 832 visitors at 23 wineries in 2012. Through an on-site survey, they tried to examine the visits patterns to North Carolina wineries. These studies, however, focus only on winery visits and do not investigate consumers' detailed wine consumption patterns.

In this study, a total of 701 consumers in North Carolina, New York, and Virginia are surveyed through telephone interviews to identify the consumer base in each wine market and analyze consumer wine purchases and winery visits patterns to better understand the wine market in the region. In section 1.2, I explain how the survey was conducted, and the results of the survey are described in section 1.3. The survey results include customer profile,

general wine consumption patterns, wine purchase patterns by outlet, consumption of state wines, and visits to state wineries.

1.2 Methodology

The survey was conducted through telephone (land-line only) in North Carolina, Virginia, and New York from February 4th through March 14th 2013 under the auspices of the North Carolina Department of Agriculture and the National Agricultural Statistics Service.

A list of 7,000 names of those who identified themselves as 'wine enthusiasts' was purchased from *infoUSA*, a data and marketing services company. Out of 2,728 randomly selected consumers from the list, 688 refused to answer the survey and 26 were inaccessible. Of the remaining 2,014 respondents, the survey was completed for 701 consumers who purchased or drank wine at least once in 2012. The survey questionnaire includes consumers' wine purchase patterns, preference for wine types, visits to wineries in the state, and demographic information.

1.3 Survey results

1.3.1 Customer profile

More than half, 61.8%, of those who participated in the survey were women while 38.2% were men. A similar pattern was shown in each state with Virginia having the largest percentage of women and New York the largest percentage of men participating. (Table 1.1)

The average age of the respondents was 56.4. Respondents in New York were relatively younger with an average age of 55.8; the percentage of those under 44 was the highest and the percentage of 65 or older was the lowest among the three states. Respondents were quite evenly distributed throughout the age groups. The highest percentage of respondents belonged to the oldest group of 65 or older (29.2%), and as the age group became younger, the percentage slightly decreased.

As for the income distribution, aside from the highest income group of $100,000 or more, the middle group of $50,000 to $74,999 was of the highest percentage; as income either decreases or increases the percentage decreased. An income of $100,000 or more indicated the highest percentage, presumably because the range was very broad. Respondents in North Carolina reportedly had the lowest income. The percentage of lower income group was higher and that of higher income group was lower in North Carolina than the other two states.

As for the education level, 21.2% of respondents indicated high school or less, while 9.1% had associates or two-year junior college degree, 20.0% went to college but no degree, 26.0% had bachelor's degree, and 19.4% achieved post graduate degrees. The percentage of those with at least a bachelor's degree was higher in New York and Virginia than in North Carolina.

Three-fourths of the respondents reported that they had lived in their state over ten years. More than half (66.5%) said they had lived at their current residence over 20 years and 9.4 % had lived 11 to 20 years, while those who had lived less than 5 years were 12.3% and 5 to 10 years were 7.9%. In New York, a significantly higher percentage of people lived in their state over 20 years than those in the other states. 86.7% of respondents in New York said they had lived at their current residence over 20 years and only 2.8% had lived there less than 5 years. This means population influx had been more significant in North Carolina and Virginia than in New York in the recent years.

As for the ethnic group, white (72.8%) and African American (19.8%) comprised an overwhelming majority. The percentage of white was relatively higher in New York than in the other two states.

To compare the demographics of the survey respondents with the total population in the region, the census statistics are provided in Table 1.2. The total population in North Carolina, Virginia, and New York was about 37 million in 2010. Overall, the demographics of both groups show similar patterns but there is some difference. The percentage of younger group is higher and older group is lower in the total population compared to the survey

respondents. Those who are under 44 were 46.4% and over 45 were 53.7% in the total population[1] whereas the percentage of those under 44 was 22.1% and over 45 was 73.5% in the respondents group. Because the household income distribution data were not available by state, the country level data are provided. The income distribution was similar between the total population and the survey respondents except for the lowest income group of under $25,000. The percentage of the population with less than $25,000 annual household income was 24.7% whereas it was 6.7% in the respondents group. As for the education level, the survey respondents show higher education level compared to the total population. The percentage of those who do not have a bachelor's degree was 68.8% and those who have a bachelor's or post graduate degree were 31.2% in the total population, whereas the corresponding percentages were 50.3% and 45.4% in the respondents group. The distributions of ethnic group are similar between the two groups with 67.1-69.8% of white and 18.1-19.5% of African American consisting of the majority. Overall, the survey respondents were older, richer, and achieved higher education compared to the total population in the region.

1.3.2 Wine consumption patterns

The primary places where consumers purchased wine were grocery stores in North Carolina and Virginia, and liquor stores in New York. When asked where they had bought wine in the last month, over half (50.7%) of the respondents in North Carolina and Virginia reported that they purchased at grocery stores, followed by box stores (16.1%), specialty wine stores (12.7%), and restaurants (8.6%). The percentage of those who purchased at wineries was 7.7%, while on-line and mail order were 1.8% and 0.5%, respectively, in North Carolina and Virginia. Meanwhile in New York, where grocery stores are not allowed to sell wines, liquor stores (35.0%) were the primary place to purchase wines followed by wine specialty stores (23.2%), restaurants (18.1%), wineries (9.8%), grocery stores (4.7%), on-line (3.9%), and mail order (1.2%). The percentage of those who had purchased wine at wineries

[1] In order to compare with the survey respondents, 20 years old or over are only counted.

in the last month was 8.3% with New York being the highest (9.8%), followed by Virginia (8.8%) and North Carolina (6.7%). (Table 1.4)

Over half (54.4%) of the respondents indicated that they consumed wine at least once a week; 15.0% drinking daily, 22.3% several times a week, and 17.1% once a week. On a weekly basis, consumers in New York tended to drink wine more often than those in Virginia, and Virginia more often than in North Carolina. The percentage of those who consumed wine at least once a week was 61.7% in New York while it was 55.9% in Virginia and 47.9% in North Carolina. Those who consumed wine less than once a month was 26.6% in North Carolina, 20.9% in Virginia, and 12.2% in New York. This means that North Carolina and Virginia have a greater opportunity to boost wine consumption. (Table 1.6)

54.3% of respondents chose red wine as their favorite type of wine, followed by white wine (31.0%), and rosé / blush wine (10.0%); the remaining 4.7% were not sure about their preference. Slightly more people preferred red wine in New York, while white wine was more preferred in Virginia. (Table 1.7)

Of those who preferred red wine, 30.4% reported Merlot as their favorite wine, followed by Cabernet Sauvignon (19.7%), Pinot Noir (9.2%), and Shiraz/Syrah (4.7%); 29.0% of those who preferred white wine chose Chardonnay as their favorite wine, followed by Moscato (18.0%), Riesling (11.5%), and Pinot Grigio (5.5%). The majority (58.6%) of those who preferred rosé / blush wine reported that White Zinfandel was their favorite. It is notable that 22-27% did not know what respective type of wines they liked the best. It is also notable that in North Carolina, 4.9% of those who preferred red wine, 3.7% of those who preferred white wine, and 12.0% of those who preferred rosé / blush wine reported that Muscadine, a wine grape variety native to their state, was their favorite type of wine.

Of the red wines, Merlot was preferred in New York than in North Carolina and Virginia, while Cabernet Sauvignon was preferred in Virginia. Pinot Noir was more popular in NC, and Shiraz/Syrah was preferred in VA than in the other states. As for white wine, Chardonnay was preferred in North Carolina, while Moscato was preferred in Virginia;

Riesling and Pinot Grigio were preferred in New York than the other two states. (Table 1.8, Table 1.9, Table 1.10)

Consumers were also asked about their preference for dry versus sweet wines. Overall, slightly more respondents liked dry wines (45.2%) better than sweet wines (42.5%), while 7.4% had no clear preference; 4.9% did not know what they liked. While consumers in New York and Virginia preferred dry wines, slightly more in North Carolina reported that they preferred sweet wines. (Table 1.11)

The main purpose of purchasing wine was for Celebration (38.4%), such as birthday and anniversary, followed by Drink with meals at home (30.1%), Gift (14.3%), and Meals at a restaurant (10.2%). It was more likely that consumers purchased wine for celebration in Virginia, while it was more likely that they drank with meal at home in North Carolina. Also, more people purchased wine for gift in North Carolina and New York than in Virginia, and more people consumed wine with meal at restaurants in New York. (Table 1.12)

The primary factor that made consumers choose the wines they purchased in 2012 was found to be Loyalty (Brand I always get) (27.1%), followed by Price (17.6%), Recommendation of friends or family (13.4%), New brand I wanted to try (10.6%). Other factors that influenced consumers' choice were On sale (6.0%), Produced locally (5.7%), Taste (5.6%), Label design (3.2%), Read about and wanted to try (2.8%), Organic wine (0.6%), and Only brand available (0.6%). Consumers in North Carolina and Virginia were found to be more brand loyal than those in New York, and consumers in North Carolina were more price conscious than those in the other states. Consumers in New York relied more on the recommendation of others than did those in North Carolina and Virginia. The percentage of those who reported that being produced locally influenced their selection was higher in New York. It is notable that consumers did not consider it very important whether wine was produced locally or organic as only 5.7% and 0.6% of respondents indicated that those were the factors that influenced their wine purchase in 2012. (Table 1.13)

1.3.3 Wine purchase patterns by outlet

8.6% (NC 7.0%, NY 10.1%, VA 9.1%) of respondents reported that someone in their household purchased wine over the internet or by mail order in 2012, indicating that internet or mail order is the least frequent way of purchasing wine. However, when it comes to the number of bottles purchased, it was the one that the highest percentage of consumers purchased more than twelve bottles per year, or one bottle per month on average. As high as 72.3% of those who have purchased wine over the internet or by mail order indicated that they bought more than twelve bottles in 2012: 12-17 bottles (38.9%), 18-23 bottles (1.9%), and 24 or more bottles (31.5%), respectively. As for money spent per bottle, a plurality of 38.9% reported that they spent $10-$14.99 per bottle, followed by $20 or more (25.9%), $9.99 or less (20.4%), and $15-$19.99 (14.8%). (Figure 1.1, Table 1.14)

Grocery stores were found to be the place where the most consumers purchased wines. The survey results show that equally in North Carolina and Virginia, 87.5% of respondents indicated that they or anyone in their household purchased wine at the grocery store in 2012. Of those who purchased wine at grocery store, about one third (32.2%) reported that the number of bottles they purchased was 5 or fewer, while 19.0% purchased 6-11 bottles, 12.7% purchased 12-17 bottles, 5.5% purchased 18-23 bottles, and 30.6% purchased 24 or more bottles of wine at grocery stores. In terms of money spent per bottle, a plurality of 42.6% spent $10-$14.99, followed by $9.99 or less (39.6%), $15-$19.99 (13.0%), and $20 or more (4.8%). The results indicate that consumers in Virginia purchased relatively more wines at grocery stores as well as they spent more money per bottle than those in North Carolina. This question was excluded in New York where it is prohibited to sell wine at grocery stores. (Figure 1.2, Table 1.15)

The percentage of respondents who have purchased wine at wine specialty stores in 2012 was 35.5% (NC 28.7%, NY 44.1%, VA 36.3%). Of those, 32.5% indicated that they purchased 1-5 bottles in 2012, while 23.3% purchased 24 or more bottles, 20.6% purchased 6-11 bottles, 17.5% purchased 12-17 bottles, and 6.1% purchased 18-23 bottles. As for the amount spent per bottle, over half (55.7%) reported that they spent between $10 and $14.99,

while the others reported that they spent $9.99 or less (14.5%), $15-$19.99 (14.9%), and $20 or more (14.9%) for a bottle of wine they purchased. (Figure 1.3, Table 1.16)

When asked if they had purchased wine from a winery in 2012, 29.1% (NC 26.3%, NY 28.5%, VA 32.4%) indicated that they had done so. Half of those who have bought wine at a winery reported that they purchased 1-5 bottles, followed by 12-17 bottles (16.0%), 24 or more bottles (14.9%), 6-11 bottles (14.3%), and 18-23 bottles (3.9%). As for the amount they spent, 53.0% of those who have purchased wine at a winery reported that they spent $10-$14.99 per bottle, followed by $15-$19.99 (17.7%), $9.99 or less (16.6%), $20 or more (12.7%). The pattern of amount spent by those who purchased from winery was found to be quite similar to that of those who purchased at wine specialty stores. (Figure 1.4, Table 1.17)

As the last question asking where consumers have purchased wines, it was asked if they had purchased wine in restaurants or bars in 2012. 63.7% (NC 63.2%, NY 60.2%, VA 66.5%) of respondents indicated that they had. Of those who had purchased wine in restaurants or bars, 29.1% reported that they purchased 1-5 glasses in 2012, while 28.1% purchased 24 or more glasses, 20.6% purchased 6-11 glasses, 13.6% purchased 12-17 glasses, and 8.6% purchased 18-23 glasses. Most frequently purchased price range was $5-$9.99 per glass. 36.4% and 35.0% of respondents, respectively, indicated that they spent $5-$6.99, $7-$9.99 per glass, while 14.4% spent $10 or more and 14.2% spent less than $5. (Figure 1.5, Table 1.18)

1.3.4 Consumption of in-state wines

When asked if they had ever tasted wines produced in their states, 70.5% of respondents reported that they had. Of those who said yes, 30.2% tasted it within a month, 20.0% 2-3 months before, 14.4% 4-6 months before, and 2.0% 7-12 months before the survey was conducted. A relatively large percentage of consumers had not tasted a wine produced in their state in over a year with 31.3%, 26.2%, 33.0% reported in North Carolina, New York, and Virginia, respectively. (Table 1.19, Table 1.20)

Consumers who had tasted wines produced in their states were then asked to indicate the level of their overall satisfaction. The results show that the overall satisfaction was quite high, especially in VA. The percentage of those who indicated either somewhat satisfied or very satisfied was 76.5% (NC 69.8%, NY 70.8%, VA 87.4%), while 9.5% were neutral (NC 13.7%, NY 11.5%, VA 3.8%), and 8.9% were either somewhat unsatisfied or very unsatisfied (NC 13.7 %, NY 6.9%, VA 5.5%). (Figure 1.6)

About half of respondents indicated that they purchased wine produced in their state in 2012, regardless of the place where they bought. The percentage of those who did was lower in North Carolina (45.3%) than in New York (51.1%) and Virginia (51.9%). (Table 1.21)

Survey results show that consumers' preference for the wines produced in their states over the ones produced elsewhere in the United State is not very high. Only 18.2% of the respondents indicated that they preferred wines produced in their state (NC 22.1%, NY 12.8%, VA 18.2%). Meanwhile, those who were not sure about their preference were as high as 32.7%. (Table 1.32)

Additional question was asked to those who preferred wines produced in their states to see what affected their preference. Over half (51.1%) of them indicated that it is the Taste, followed by Health / Locally grown products are healthier (23.0%), the Price (8.4%), State loyalty / Support local economy (7.9%), and Environmental concerns / Reduce carbon footprint (1.7%). A higher percentage of consumers in North Carolina indicated that they liked locally produced wines because of the taste than did consumers in other states (NC 61.3%, NY 38.9%, VA 46.3%), while a higher percentage of consumers in New York and Virginia considered health concerns (Locally grown products are healthier) more important than did consumers in North Carolina (NC 13.3%, NY 27.8%, VA 31.3%). (Table 1.33)

Consumers who did not prefer wines produced in their states were also asked why. Taste and price emerged as primary factors that affected their preference. 65.3% indicated that taste was the reason why they preferred wines produced elsewhere, while 16.7% indicated that price was the reason. (Table 1.34)

1.3.5 Visits to in-state wineries

About half of the respondents indicated that they had ever visited a winery in their state. However, there is some difference between states. While 56.1% of respondents in New York had visited a winery in their state, 51.9% in Virginia and 42.2% in North Carolina indicated that they had done so. Those who had ever visited were asked whether it was in 2012, and 55.2% (NC 51.4%, NY 53.5%, VA 59.7%) of them reported it was. This implies that 27.2% of the total respondents visited a winery in their states in 2012 (NC 21.7%, NY 30.0%, VA 31.0%). (Table 1.22, Table 1.23)

Of those who visited winery in their state in 2012, 36.6% visited only one winery, while 57.6% visited two or more: 18.3% visited two, 13.1% visited three, and 26.2% visited four or more. The number of wineries visited was fewer in North Carolina than in the other two states. While respondents in North Carolina indicated that 45.6% of them visited one winery and 45.7% visited two or more in 2012, 33.3% in New York and 32.5% in Virginia visited one, while 61.1% in New York and 63.8% in Virginia visited two or more, respectively. (Table 1.24)

When asked whether they had purchased a wine during their visit to a winery in 2012, a majority (87.4%) of visitors indicated that they had. The results also show that a lower percentage of visitors in North Carolina (80.7%) purchased wine than did in New York (88.9%) and Virginia (91.3%). (Table 1.25)

As far as the number of bottles of wine they purchased, on average 33.0% of winery visitors purchased three or fewer bottles. In North Carolina, 43.5% of winery visitors purchased three or fewer bottles of wines, while 29% of those in New York and Virginia purchased the same number of bottles. Thus higher percentages in New York and Virginia purchased more bottles of wines than did in North Carolina. (Table 1.26)

The amount of money visitors spent at wineries in 2012 was also higher in New York and Virginia than in North Carolina. The percentage of those who spent less than $30 was 32.6% in North Carolina, 12.5% in New York and 20.6% in Virginia. In contrast, the

percentage of whose who spent over $120 was 17.4% in North Carolina, while it was almost double in New York (35.4%) and Virginia (39.7%). (Table 1.27)

Similar results were found with respect to money spent per bottle. While 40.0% of the visitors to North Carolina wineries spent less than $10 per bottle, about half that percentage in New York (19.1%) and Virginia (21.5%) spent the same amount. In contrast, those who spent $15 or more per bottle was 12.5% in North Carolina, 26.2% in New York and 43.1% in Virginia. (Table 1.28)

The percentage of respondents who remembered the name of the winery they visited in 2012 was highest in North Carolina (76.1%), followed by Virginia (67.1%) and New York (52.1%). The most visited wineries in each state were as follows: Duplin Winery, Biltmore Winery in North Carolina, Dr. Konstantin Frank Vinifera Wine Cellars, Martha Clara Vineyards in New York, and Chateau Morrisette Winery, King Family Vineyards, Mountain Rose Vineyard in Virginia. (Table 1.29)

Consumers were asked whether the reason they purchased wine produced in their state was because it was produced there. Over half (55.0%) replied yes to this question, indicating that being locally produced is a factor in attracting customers. (Table 1.30)

Consumers were also asked to indicate their overall satisfaction with the quality of wine they bought at wineries in their state. The results show that the overall satisfaction was quite high. 77.7% indicated that they were somewhat satisfied or very satisfied (NC 72.4%, NY 72.3%, VA 86.1%), those neutral was 7.2% (NC 11.5%, NY 7.2%, VA 3.7%), and somewhat unsatisfied or very unsatisfied was 6.5% (NC 11.5%, NY 2.4%, VA 5.6%). (Figure 1.7)

When it comes to the distance that visitors drove to wineries, the survey results show that people tend to visit the ones close to their home. The highest percentage (30.6%) of respondents visited wineries that are within 24 miles from their residence, followed by 25 to 49 miles (21.1%), 50 to 74 miles (16.7%), and 75 to 99 miles (6.4%). Those who drove farther than 100 miles were 16.5%. This result was found to be similar across the states. (Table 1.31)

The primary sources of information about wineries are winery billboards (19.3%), books or magazines (18.3), followed by family, friends or neighbors (11.9%), newspaper (11.5%), Department of Transportation (DOT) signs (5.2%), and wine and grape industry association flyer / brochure (4.1%). The percentage of those who obtained information on wineries though internet-based media was 11.5%, including winery website, Living Social, NCwine.org, Facebook, Groupon, and Twitter. (Table 1.35)

The primary purpose of visiting wineries was Something to do (32.9%), followed by Wanted to learn about the winery (25.7%), Wineries sponsored events such as concert and festival (10.4%), and Farm/Winery experience (8.0%). Minor percentages of visitors indicated their purpose of visit was Wine trail (2.6%), Wedding (2.2%), Anniversary (1.6%), and Winery coupon (1.6%). (Table 1.36)

1.4 Summary

In this study, the results of a telephone survey on 701 wine consumers in North Carolina, New York, and Virginia are described. The purpose of the survey is to identify the consumer demographic characteristics, wine consumption patterns, wine purchase patterns by outlet, and visits to in-state wineries. This study may be useful for local wineries to make better marketing decisions for their products and services.

1.5 Tables and figures

Table 1.1: Demographics

%	Total	NC	NY	VA
Usable Survey:	701	263	180	258
Gender:				
Male	38.2	38.9	39.3	36.7
Female	61.8	61.1	60.7	63.2
Age: (Mean)	(56.4)	(56.3)	(55.8)	(56.8)
Less than 21	0.0	0.0	0.0	0.0
21-24	1.0	1.1	0.6	1.2
25-44	21.1	21.7	23.9	18.6
45-54	21.5	17.1	22.8	25.2
55-64	22.8	25.1	21.1	21.7
65 or older	29.2	30.8	26.7	29.5
Missing Observations	4.3	4.2	5.0	3.9
Household Income:				
Less than $25,000	6.7	9.9	3.3	5.8
$25,000-$34,999	10.3	11.8	7.2	10.9
$35,000-$49,999	16.0	19.4	15.6	12.8
$50,000-$74,999	18.3	17.1	21.1	17.4
$75,000-$99,999	13.4	11.8	12.8	15.5
$100,000 or more	20.0	15.6	21.7	23.3
Missing Observations	15.4	14.5	18.3	14.3
Education Level:				
High School or less	21.2	20.5	22.8	20.9
Associates	9.1	9.9	8.9	8.5
College but no degree	20.0	23.2	14.4	20.5
Bachelor’s Degree	26.0	26.2	28.3	24.0
Post Graduate	19.4	15.6	18.9	23.6
Missing Observations	4.3	4.6	6.7	2.3

Table 1.1: Continued

	Total	NC	NY	VA
Years at Current Residence:				
Less than 5	12.3	17.9	2.8	13.2
5-10	7.9	9.1	1.7	10.9
11-20	9.4	11.8	3.9	10.9
More than 20	66.5	57.0	86.7	62.0
Missing Observations	4.0	4.2	5.0	3.1
Race / Ethnic Group:				
White	69.8	70.7	68.2	70.6
Black or African American	19.5	20.5	22.1	14.4
Hispanic	4.0	1.9	4.3	6.7
Native American / Hawaiian	1.3	2.3	0.8	0.6
Asian / Asian Indian	0.6	0.0	0.0	2.2
Missing Observations	4.8	4.6	4.7	5.6

Table 1.2: Demographics (Census 2010)

%	Total	NC	NY	VA
Total Population:	36,914,609	9,535,483	19,378,102	8,001,024
Gender:				
Male	48.6	48.7	48.4	49.1
Female	51.4	51.3	51.6	50.9
Age: (over 20 only)				
20-24	9.7	9.5	9.7	9.7
25-44	36.7	36.9	36.4	37.2
45-54	20.0	19.6	19.9	20.5
55-64	16.1	16.3	15.9	16.1
65 or older	17.6	17.7	18.1	16.5
Household Income:				
Less than $25,000	24.7			
$25,000-$34,999	10.7			
$35,000-$49,999	13.6	N/A	N/A	N/A
$50,000-$74,999	17.5			
$75,000-$99,999	11.7			
$100,000 or more	21.9			
Education Level:				
Less than high school	15.0	15.7	15.3	13.4
High school, Associates	53.8	57.8	52.3	52.6
Bachelor's Degree	18.5	17.7	18.4	19.9
Post Graduate	12.7	8.8	14.0	14.1
Race / Ethnic Group:				
White	67.1	68.5	65.7	68.6
Black or African American	18.1	21.5	15.9	19.4
Asian	5.6	2.2	7.3	5.5
Native American/Hawaiian	0.8	1.3	0.6	0.4
Other	5.7	4.3	7.4	3.2
Identified by two or more	2.8	2.2	3.0	2.9

Note: Household income data are from 2012 and education level data are from 2009.

Table 1.3: Q1. Have you or anyone in your household bought a bottle of wine in 2012?

%	Total	NC	NY	VA
Yes	98.2	96.6	99.4	98.8
No	1.8	3.4	0.6	1.2

Table 1.4: Q3. Where have you bought wine in the last month?

%	Total	NC	NY	VA
Grocery Store	39.3	51.1	4.7	50.5
Wine Specialty Store	15.4	12.8	23.2	12.6
Box Store	12.9	16.6	3.2	15.7
Restaurant	11.0	9.4	18.1	8.0
Liquor Store	8.8	-	35.0	-
Winery	8.3	6.7	9.8	8.8
On-line	2.4	1.9	3.9	1.8
Mail Order	1.4	0.3	1.2	0.8
Don't know	0.7	1.3	0.8	1.8

Table 1.5: Q4. Have you or anyone in your household consumed any wine in 2012?

%	Total	NC	NY	VA
Yes	100.0	100.0	100.0	100.0
No	0.0	0.0	0.0	0.0

Table 1.6: Q4A. How often do you consume wine?

%	Total	NC	NY	VA
Daily	15.0	13.3	15.0	16.7
Several times a week	22.3	19.4	25.0	23.3
Once a week	17.1	15.2	21.7	15.9
About once a month	18.7	16.4	17.8	21.7
Less than once a month	20.8	26.6	12.2	20.9
Don't know	6.1	9.1	8.3	1.5

Table 1.7: Q4B. What kind of wine is your favorite?

%	Total	NC	NY	VA
Red	54.3	54.4	57.2	52.3
White	31.0	30.8	26.1	34.5
Rosé / Blush	10.0	9.5	10.6	10.1
Don't know	4.7	5.3	6.1	3.1

Table 1.8: Q4B. What is your favorite type of red wine?

%	Total	NC	NY	VA
Merlot	30.4	27.3	35.0	30.4
Cabernet Sauvignon	19.7	15.4	19.4	24.4
Pinot Noir	9.2	11.2	9.7	6.7
Shiraz / Syrah	4.7	2.8	3.9	7.4
Other	8.7	11.9	2.9	9.6
Don't know	27.3	31.5	29.1	21.5

Table 1.9: Q4B. What is your favorite type of white wine?

%	Total	NC	NY	VA
Chardonnay	29.0	32.1	29.8	25.8
Moscato	18.0	14.8	19.1	20.2
Riesling	11.5	8.6	14.9	12.4
Pinot Grigio	5.5	4.9	8.5	4.5
Other	10.6	11.1	12.8	9.0
Don't know	25.3	28.4	14.9	28.1

Table 1.10: Q4B. What is your favorite type of rosé / blush wine?

%	Total	NC	NY	VA
White Zinfandel	58.6	60.0	47.4	65.4
Other	18.6	24.0	10.5	19.2
Don't know	22.9	16.0	42.1	15.4

Table 1.11: Q4C. Do you prefer wine that is dry or sweet?

%	Total	NC	NY	VA
Dry	45.2	43.0	48.3	45.4
Sweet	42.5	43.7	42.8	41.1
No Preference	7.4	6.1	3.3	11.6
Don't know	4.9	7.2	5.6	1.9

Table 1.12: Q5. Why did you buy wine in 2012?

%	Total	NC	NY	VA
Celebration (Birthday, Anniversary etc.)	38.4	35.1	35.9	43.2
Drink with meals at home	30.1	34.5	25.7	29.7
Gift	14.3	15.5	15.9	12.1
Meal at a restaurant	10.2	9.9	12.5	8.8
Other	6.9	5.0	10.0	6.3

Table 1.13: Q6. What reasons made you choose the wines you purchased in 2012?

%	Total	NC	NY	VA
Loyalty (Brand I always get)	27.1	29.3	20.2	30.6
Price	17.6	18.9	17.8	16.4
Recommendation of friends or family	13.4	12.0	17.5	11.3
New brand I wanted to try	10.6	10.5	8.2	12.8
On sale	6.0	5.0	7.3	6.0
Produced locally	5.7	4.7	7.0	5.5
Taste	5.6	3.7	7.9	5.5
Label design	3.2	4.2	3.0	2.4
Read about and wanted to try	2.8	1.8	3.6	2.9
Organic wine	0.6	0.0	1.2	0.7
Only brand available	0.6	1.1	0.6	0.2
Other	6.7	8.9	5.7	5.5

Figure 1.1: Q7. Have you or anyone in your household purchased wine over the internet or by mail order in 2012?

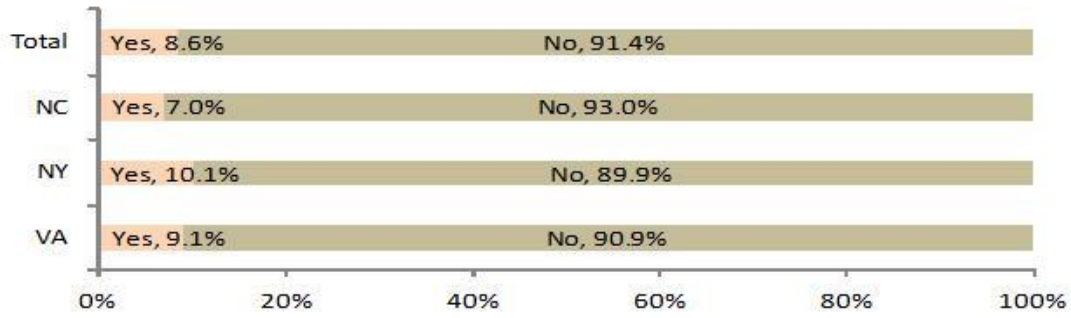


Table 1.14: Q7. How many bottles did you buy over the internet or by mail order in 2012? On average, how much did you pay for a bottle of wine over the internet or by mail order in 2012 including shipping costs?

Bottles Purchased	Total	NC	NY	VA	Price per bottle	Total	NC	NY	VA
1-5	11.1	18.8	11.8	4.8	$9.99 or less	20.4	37.5	17.7	9.5
6-11	16.7	12.5	5.9	28.6	$10.00-$14.99	38.9	31.3	29.4	52.4
12-17	38.9	50.0	41.2	28.6	$15.00-$19.99	14.8	12.5	11.8	19.1
18-23	1.9	0.0	5.9	0.0	$20.00 or more	25.9	18.8	41.2	19.1
24 or more	31.5	18.8	35.3	38.1					

Figure 1.2: Q8. Have you or anyone in your household purchased wine at the grocery store in 2012?

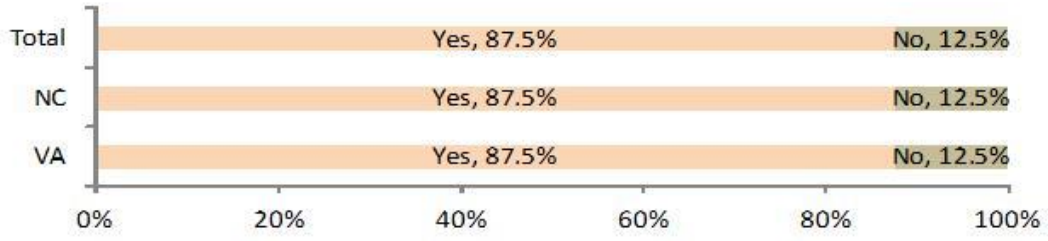


Table 1.15: Q8. How many bottles did you buy at the grocery store in 2012? On average, how much did you pay for a bottle of wine at the grocery store in 2012?

Bottles purchased	Total	NC	NY	VA	Price per bottle	Total	NC	NY	VA
1-5	32.2	34.1	n/a	30.3	$9.99 or less	39.6	39.3	n/a	39.9
6-11	19.0	21.5	n/a	16.5	$10.00-$14.99	42.6	45.3	n/a	39.9
12-17	12.7	11.7	n/a	13.8	$15.00-$19.99	13.0	12.6	n/a	13.3
18-23	5.5	6.1	n/a	5.1	$20.00 or more	4.8	2.8	n/a	6.9
24 or more	30.6	26.6	n/a	34.4					

Figure 1.3: Q9. Have you or anyone in your household purchased wine in wine specialty stores in 2012?

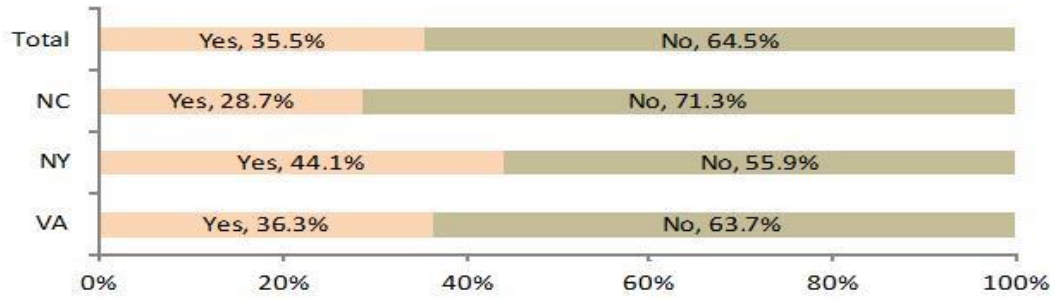


Table 1.16: Q9. How many bottles did you buy in Wine Specialty stores in 2012? On average, how much did you pay for a bottle of wine in Wine Specialty stores?

Bottles purchased	Total	NC	NY	VA	Price per bottle	Total	NC	NY	VA
1-5	32.5	35.3	26.0	35.6	$9.99 or less	14.5	13.2	11.0	18.4
6-11	20.6	22.1	12.3	26.4	$10.00-$14.99	55.7	55.9	63.0	49.4
12-17	17.5	22.1	19.2	12.6	$15.00-$19.99	14.9	17.7	8.2	18.4
18-23	6.1	8.8	9.6	1.2	$20.00 or more	14.9	13.2	17.8	13.8
24 or more	23.3	11.8	32.9	24.1					

Figure 1.4: Q10. Have you or anyone in your household purchased wine from a winery in 2012?

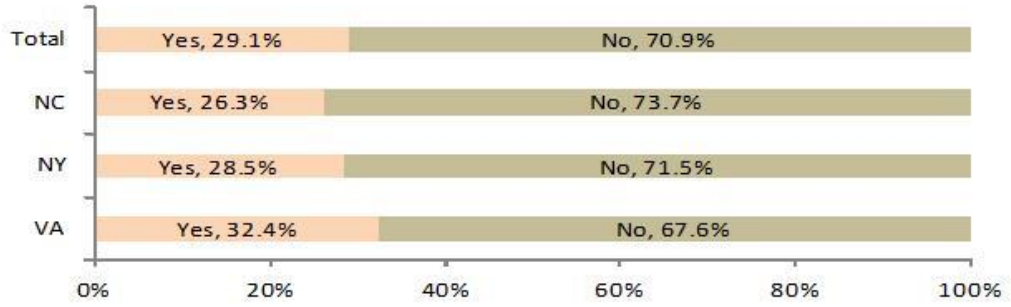


Table 1.17: Q10. How many bottles did you buy from a winery in 2012? On average, how much did you pay for a bottle of wine from a winery in 2012?

Bottles purchased	Total	NC	NY	VA	Price per bottle	Total	NC	NY	VA
1-5	50.8	56.1	38.3	54.5	$9.99 or less	16.6	21.1	17.0	13.0
6-11	14.3	12.3	17.0	14.3	$10.00-$14.99	53.0	52.6	59.6	49.4
12-17	16.0	14.0	27.7	10.4	$15.00-$19.99	17.7	15.8	14.9	20.8
18-23	3.9	1.8	4.3	5.2	$20.00 or more	12.7	10.5	8.5	16.9
24 or more	14.9	15.8	12.8	15.6					

Figure 1.5: Q11. Have you or anyone in your household purchased wine in restaurants or bars in 2012?

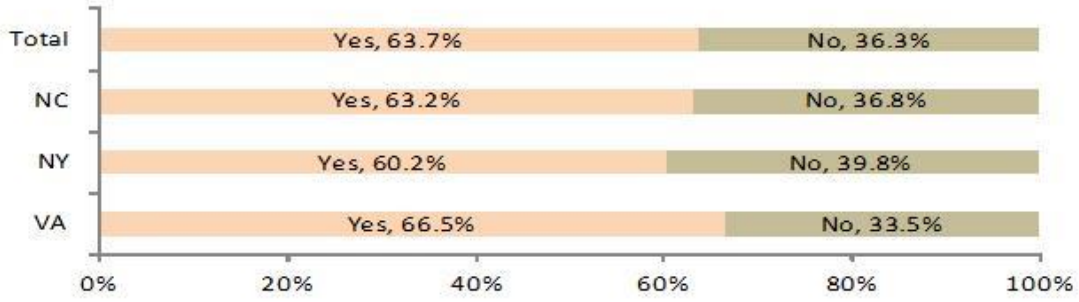


Table 1.18: Q11. How many glasses of wine did you buy in restaurants or bars in 2012? On average, how much did you pay for a glass of wine in restaurants or bars in 2012?

Glasses purchased	Total	NC	NY	VA	Price per glass	Total	NC	NY	VA
1-5	29.1	25.9	37.2	27.0	$4.99 or less	14.2	16.6	7.5	16.3
6-11	20.6	23.7	11.7	23.4	$5.00-$6.99	36.4	33.1	38.3	38.3
12-17	13.6	20.1	12.8	7.8	$7.00-$9.99	35.0	35.2	35.1	34.8
18-23	8.6	6.5	10.6	9.2	$10.00 or more	14.4	15.1	19.2	10.6
24 or more	28.1	23.7	27.7	32.6					

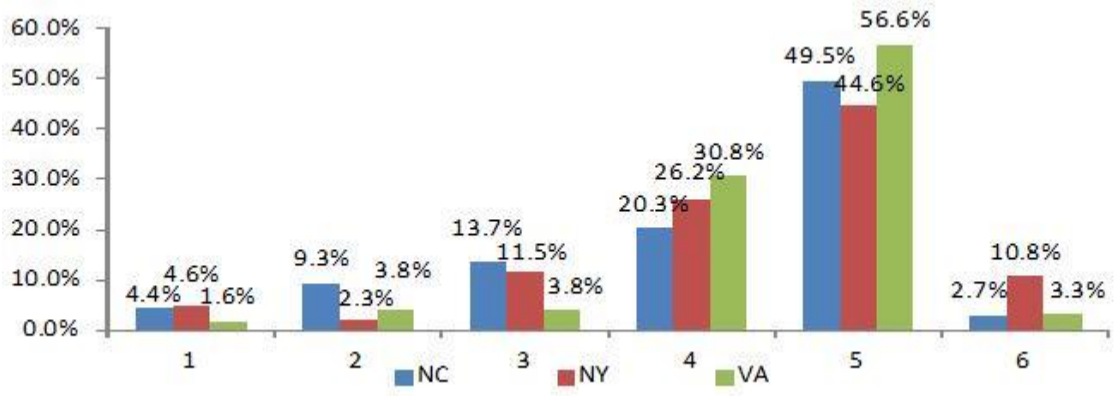
Table 1.19: Q12. Have you ever tasted wines produced in your state?

%	Total	NC	NY	VA
Yes	70.5	69.2	72.2	70.5
No	21.8	24.0	19.4	21.3
Don't know	7.7	6.8	8.3	8.1

Table 1.20: Q13. How recently did you taste wine produced in your state?

%	Total	NC	NY	VA
1 month or less	30.2	30.8	31.5	28.6
2-3 months	20.0	20.3	19.2	20.3
4-6 months	14.4	13.7	18.5	12.1
7-12 months	2.0	1.6	3.9	1.1
over 1 year	30.6	31.3	26.2	33.0
Don't know	2.8	2.2	0.8	5.0

Figure 1.6: Q14. Overall how satisfied are you with the taste of wines produced in your state?



1.Very Unsatisfied 2.Somewhat Unsatisfied 3.Neutral 4.Somewhat Satisfied 5.Very Satisfied 6.Don't know

Table 1.21: Q15. In 2012, did you purchase wine produced in your state?

	Total		NC		NY		VA	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes	345	49.2	119	45.3	92	51.1	134	51.9
No	312	44.5	125	47.5	78	43.3	109	42.3
Don't know	44	6.3	19	7.2	10	5.6	15	5.8
Total	701	100.0	263	100.0	180	100.0	258	100.0

Table 1.22: Q16. Have you ever visited a winery in your state?

	Total		NC		NY		VA	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes	346	49.4	111	42.2	101	56.1	134	51.9
No	302	43.1	115	43.7	77	42.8	110	42.6
Don't know	53	7.5	37	14.1	2	1.1	14	5.4
Total	701	100.0	263	100.0	180	100.0	258	100.0

Table 1.23: Q16A. If answered Yes, was it in 2012?

	Total		NC		NY		VA	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes	191	55.2	57	51.4	54	53.5	80	59.7
No	154	44.5	54	48.6	46	45.5	54	40.3
Don't know	1	0.3	0	0.0	1	1.0	0	0.0
Total	346	100.0	111	100.0	101	100.0	134	100.0

Table 1.24: Q16B. If answered Yes, how many wineries did you visit in 2012?

	Total		NC		NY		VA	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
1	70	36.6	26	45.6	18	33.3	26	32.5
2	35	18.3	14	24.6	8	14.8	13	16.3
3	25	13.1	7	12.3	7	13.0	11	13.8
4 or more	50	26.2	5	8.8	18	33.3	27	33.7
Don't know	11	5.8	5	8.8	3	5.6	3	3.8
Total	191	100.0	57	100.0	54	100.0	80	100.0

Table 1.25: Q17. During 2012, have your or anyone in your household purchased wine at a winery in your state?

	Total		NC		NY		VA	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes	167	87.4	46	80.7	48	88.9	73	91.3
No	23	12.0	10	17.5	6	11.1	7	8.7
Don't know	1	0.5	1	1.8	0	0.0	0	0.0
Total	191	100.0	57	100.0	54	100.0	80	100.0

Table 1.26: Q17A. If answered Yes, how many bottles did you buy from a winery in your state in 2012?

	Total		NC		NY		VA	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
1	10	6.0	3	6.5	3	6.3	4	5.5
2-3	45	27.0	17	37.0	11	22.9	17	23.3
4-6	44	26.4	14	30.4	13	27.1	17	23.3
7-9	9	5.4	1	2.2	3	6.3	5	6.9
10 or more	52	31.1	10	21.7	17	35.4	25	34.3
Don't know	7	4.2	1	2.2	1	2.1	5	6.9
Total	167	100.0	46	100.0	48	100.0	73	100.0

Table 1.27: Q17B. How much did you pay for all the wine purchased at a winery in your state in 2012?

	Total		NC		NY		VA	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
$29.99 or less	36	21.6	15	32.6	6	12.5	15	20.6
$30.00-$59.99	26	15.6	7	15.2	10	20.8	9	12.3
$60.00-$89.99	23	13.8	7	15.2	7	14.6	9	12.3
$90.00-$119.99	10	6.0	3	6.5	2	4.2	5	6.9
$120.00 or more	54	32.3	8	17.4	17	35.4	29	39.7
Don't know	18	10.8	6	13.0	6	12.5	6	8.2
Total	167	100.0	46	100.0	48	100.0	73	100.0

Table 1.28: Q17A/B. On average, how much did you pay for a bottle of wine purchased at a winery in your state in 2012?

	Total		NC		NY		VA	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
$9.99 or less	38	25.9	16	40.0	8	19.1	14	21.5
$10.00-$14.99	65	44.2	19	47.5	23	54.8	23	35.4
$15.00-$19.99	25	17.0	3	7.5	6	14.3	16	24.6
$20.00 or more	19	12.9	2	5.0	5	11.9	12	18.5
Total	147	100.0	40	100.0	42	100.0	65	100.0

Table 1.29: Q17C. What was the name of the winery in your state where you purchased the most wine in 2012?

	Total	NC	NY	VA
Percent	65.3	76.1	52.1	67.1
Wineries		Duplin Biltmore	Dr. Konstantin Frank Martha Clara	Chateau Morrisette King Family Mountain Rose

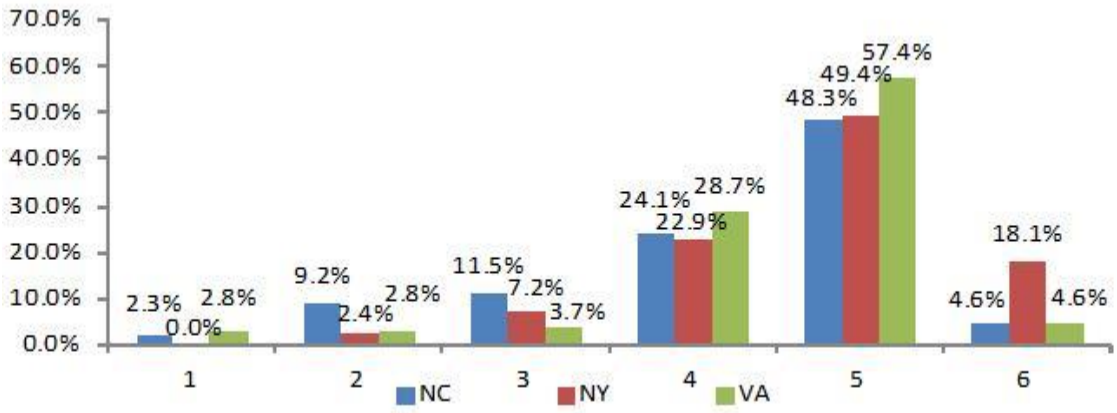
* Percent: Percentage of people who could recall the winery names they had visited.

* Wineries: Names of mostly visited wineries.

Table 1.30: Q18. Did you purchase wine from a winery in your state because it was produced in your state?

%	Total	NC	NY	VA
Yes	55.0	52.0	54.6	57.8
No	40.1	41.2	41.2	38.3
Don't know	4.9	6.9	4.1	3.9

Figure 1.7: Q19. How satisfied are you with the overall quality of wine bought at winery in your state?



1.Very Unsatisfied 2.Somewhat Unsatisfied 3.Neutral 4.Somewhat Satisfied 5.Very Satisfied 6.Don't know

Table 1.31: Q20. Considering your last visit to a winery in your state, how far did you have to drive?

%	Total	NC	NY	VA
1 to 24 miles	30.6	31.6	23.8	35.1
25 to 49 miles	21.1	16.2	20.8	25.4
50 to 74 miles	16.7	16.2	15.8	17.9
75 to 99 miles	6.4	6.3	8.9	4.5
100 to 124 miles	8.4	8.1	14.9	3.7
125 to 150 miles	2.0	2.7	3.0	0.7
over 150 miles	6.1	8.1	4.9	5.2
Don't know	8.7	10.8	7.9	7.5

Table 1.32: Q21. Do you prefer wines produced in your state to wines produced elsewhere in the U.S.?

	Total		NC		NY		VA	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes	128	18.2	58	22.1	23	12.8	47	18.2
No	344	49.1	110	41.8	84	46.7	150	58.1
Don't know	229	32.7	95	36.1	73	40.6	61	23.6
Total	701	100.0	263	100.0	180	100.0	258	100.0

Table 1.33: Q21A. If answered Yes, why did you prefer wines produced in your state?

	Total		NC		NY		VA	
	Freq.	Pct.	Freq.	Pct.	Freq.	Pct.	Freq.	Pct.
The Taste	91	51.1	46	61.3	14	38.9	31	46.3
Locally Grown Products are Healthier	41	23.0	10	13.3	10	27.8	21	31.3
The Price	15	8.4	6	8.0	4	11.1	5	7.5
State Loyalty / Support Local Economy	14	7.9	5	6.7	3	8.3	6	9.0
Environmental Concerns	3	1.7	3	4.0	0	0.0	0	0.0
Other	14	7.9	5	6.7	5	13.9	4	6.0
Total	178	100	75	100	36	100	67	100

Table 1.34: Q21B. If answered No, why did you prefer other wines to wines produced in your state?

	Total		NC		NY		VA	
	Freq.	Pct.	Freq.	Pct.	Freq.	Pct.	Freq.	Pct.
The Taste	239	65.3	77	70.0	51	66.2	111	62.0
The Price	61	16.7	11	10.0	15	19.8	35	19.6
Don't want to drink locally produced wine	6	1.6	2	1.8	2	2.6	2	1.1
Health*	2	0.6	1	0.9	0	0.0	1	0.6
Other	58	15.9	19	17.3	9	11.7	30	16.8
Total	366	100	110	100	77	100	179	100

* Wines produced in other areas of the US are healthier.

Table 1.35: Q22. Where have you seen information about wineries in your state?

%	Total	NC	NY	VA
Winery Billboard	19.3	24.0	17.8	15.7
Books/Magazines	18.3	20.4	16.6	17.5
Family, Friends or Neighbors	11.9	13.7	10.9	11.0
Newspaper	11.5	8.7	12.9	13.3
I do not get information from any source	6.4	4.7	10.6	5.0
Department of Transportation (DOT) Sign	5.2	5.9	1.9	7.1
Wine and Grape Industry Association Flyer/Brochure	4.1	2.4	4.9	5.3
Winery Website	4.1	3.3	2.5	6.0
Living Social	3.4	3.1	3.2	3.7
Regional Wine Festival	3.2	3.1	3.9	2.7
Radio	3.0	1.4	5.5	2.7
NCwine.org Website	1.5	1.7	0.5	2.1
Facebook	1.3	1.2	1.2	1.4
TV	1.2	0.9	0.5	2.1
Wine of the Month Club	1.1	1.4	1.6	0.4
Groupon	1.0	0.5	1.9	0.9
Twitter	0.2	0.4	0.2	0.0
Other	3.4	3.3	3.5	3.4

Table 1.36: Q23. Why did you visit wineries in your state?

%	Total	NC	NY	VA
Something to do	32.9	32.9	33.7	32.3
Wanted to learn about the Winery (wine tasting)	25.7	26.0	22.9	28.0
Winery Sponsored Event (Concert, Festival Etc.)	10.4	8.9	7.2	14.5
Farm/Winery Experience	8.0	8.9	10.8	4.8
Wine Trail	2.6	0.7	5.4	1.6
Wedding	2.2	2.7	3.0	1.1
Anniversary	1.6	1.4	3.6	0.0
Winery Coupon	1.6	2.1	0.6	2.2
Other	14.9	16.4	12.7	15.6

CHAPTER 2

Estimating the Demand for Wine : Comparison Between Continuous and Count Data Models

2.1 Introduction

The wine industry has grown continuously over the past few decades in the United States. As wine has become an increasing part of U.S. agriculture, there have been a number of studies that have attempted to estimate the demand for wine. In an effort to summarize these studies, Gallet (2007) conducts a meta-analysis of the demand for alcohol using the results of 132 studies that provide 1,172 estimated price elasticities and 1,014 estimated income elasticities. The median price elasticity and income elasticity estimates of wine are found to be -0.7 and 1.1, respectively. Elasticity estimates also show that wine and spirits are relatively more responsive to price and income than is beer. Another meta-analysis by Nelson (2013) summaries the results of 182 studies on alcohol demand and finds the average price and income elasticity of wine is -0.45 and 1.00, respectively. Fogarty (2010) summarizes price elasticity estimates obtained from 141 studies on 20 different countries finding the average price elasticity of wine demand to be -0.65.

Most of the earlier research analyze wine demand along with other alcoholic beverages. This group of studies often adopt the Almost Ideal Demand System (AIDS) introduced by Deaton and Muellbauer (1980) or the Rotterdam model developed by Theil (1965) and Barten (1964, 1968, 1977). For instance, Heien and Pompelli (1989) and Gao et al. (1995) examine the impact of economic and demographic variables on the demand for wine, beer, and spirits using household food consumption survey data by USDA. Similar studies have been also conducted using data from other countries. Clements and Johnson (1983) analyzed Australian wine consumption using annual time-series data, while Jones (1989) and Moosa and Baxter (2002) use quarterly data from the United Kingdom. More recently, Faroque (2008) studied the demand for alcoholic beverages in Canada, and Muhammad et al. (2013)

analyzed the demand for wine in China. Selvanathan (1991) compares the consumption pattern of alcoholic beverages in nine countries.

A recent trend in wine demand analysis is to use scanner data in estimation. Buccola and Vander Zanden (1997) estimate the demand for wine using scanner data from retail chain stores in Portland, Oregon. They adopt the Rotterdam model to estimate the demand for wine divided into four categories: Oregon reds, Oregon whites, California and Washington reds, and California and Washington whites. Cuellar et al. (2010) estimate the demand for wine in the U.S. disaggregated by color, varietal, and price segment using the store keeping unit level of pooled cross sectional data and the fixed effect model.

The shortcoming of scanner data, however, is that it only reflects sales in major retail stores and only contains information on what consumers purchased and does not reflect what they did not purchase. One way to get around this problem is to use survey data. When using micro level survey data, however, censoring in the dependent variable is an issue because it could result in biased parameter estimates if not properly accounted for. In that respect, Blaylock and Blisard (1993) apply the double hurdle model to the USDA Nationwide Food Consumption Survey to investigate wine consumption by men, and Yen (1995) uses the same model on the Continuing Survey of Food Intakes by Individuals by USDA to study overall alcohol consumption. Yen (2005) adopts a multivariate sample selection model to investigate the demand for wine, beer, and cigarette by gender using the Continuing Survey of Food Intakes by Individuals.

While most studies that estimate the demand for alcoholic beverages assume a continuous dependent variable for model specification, other approaches could be applied when micro level consumer survey data are used. When one uses the number of bottles purchased in a year as the dependent variable of wine demand, it usually takes nonnegative integer values within a certain range. In this regard, count data model could be another way to estimate wine demand. While applications of count data model have been made in various fields of studies, only a few studies have used this approach in food demand analysis. Cameron and Trivedi (1986) apply the Poisson model and the negative binomial model to

examine hospital visits. Portney and Mullahy (1986) adopt count data model to study incidents of pollution induced illness, and Grogger (1990) used the model to analyze daily homicide counts. Mullahy (1986) is one of few studies that apply count data model to estimate food demand. Mullahy analyzes individual's daily consumption of beverages including coffee, tea, and milk using national survey data. In an effort to compare the performance between continuous and count data models, von Haefen and Phaneuf (2003) compare the conceptual framework as well as the empirical performance of the two models in estimating recreation demand. They find that although there is substantial difference in conceptual frameworks between the two models, both models generate qualitatively similar implications.

In this study, I apply both continuous and count data framework to estimate the demand for wine in North Carolina and Virginia and compare the results. Unique household level survey data obtained through a telephone survey are used. The survey was conducted in 2013 to collect consumer wine purchase data by major outlets. An advantage of the data is that they can overcome some of the shortcomings of scanner data by including purchases made not only at retail chains but also online order, on-site purchase at winery, and on-premise consumption. Also, consumer preference for wine taste and color is obtained from survey so quality characteristics can be used.

As a continuous data framework, the Tobit model developed by Tobin (1958) and Amemiya (1973) is used to account for the nontrivial fraction of zero purchases, and the Poisson and negative binomial models are adopted as count data framework. Furthermore, as the data feature panel-like structure in the sense that several observations are obtained from each respondent, the random effects specification is applied to each model to control for the unobserved individual heterogeneity. And, because price data are necessary for every observation to estimate the Tobit and Poisson models, virtual price, or often called unit price, is imputed for the missing prices of zero purchase observations. I consider Heckman (1979)'s sample selection model and the ordinary least squares (OLS) model to estimate the unit price.

In section 2.2, I explain how the survey was conducted and present the summary statistics including demographics of respondents and their wine purchase patterns by outlet. Model specification for demand estimation is explained in section 2.3, and the results are discussed in section 2.4.

2.2 Data

2.2.1 Survey design and demographics of respondents

The data were collected by telephone survey (land-line only) from February 4th through March 14th, 2013 under the auspices of the North Carolina Department of Agriculture and the National Agricultural Statistics Service. Although this study focuses on the data obtained in North Carolina and Virginia, the survey was also conducted in New York. A list of 7,000 names of those who identified themselves as 'wine enthusiasts' was purchased from *infoUSA*, a data and marketing services company. Out of 2,728 randomly selected consumers from the list, 688 refused to answer the survey and 26 were inaccessible. Of the remaining 2,014 respondents, the survey was completed for 701 consumers who purchased or drank wine at least once in 2012.

The survey questionnaire includes consumers' wine purchase patterns such as how many bottles they purchased and how much they spent per bottle at each of five major outlets: grocery stores, wine specialty stores, internet / mail order, wineries, and restaurants / bars. An advantage of the data is that they include not only major retail chains but also online orders, on-site purchases at wineries, and on-premise consumption. The survey questionnaire also includes respondents' demographic information such as age, gender, race, annual household income, and level of education.

Table 2.1 shows the demographics of respondents. 701 respondents who completed the survey are composed of 263 consumers in North Carolina, 180 in New York, and 258 in Virginia. As for the gender, 61.8% of those who participated in the survey were women

while 38.2% were men. A similar pattern was shown in each state with Virginia having the largest percentage of women and New York the largest percentage of men participating.

The average age of the respondents was 56.4. Respondents in New York were relatively younger with an average age of 55.8; the percentage of those under 44 was the highest and the percentage of 65 or older was the lowest among the three states. Respondents were quite evenly distributed across the age groups. The highest percentage of respondents belonged to the oldest group of 65 or older (29.2%), and as the age group became younger, the percentage slightly decreased.

As for the income distribution, aside from the highest income group of $100,000 or more, the middle group of $50,000 to $74,999 was of the highest percentage; as income either decreases or increases the percentage decreased. An income of $100,000 or more indicated the highest percentage, presumably because the range was very broad. Respondents in North Carolina reportedly had the lowest income. The percentage of lower income group was higher and that of higher income group was lower in North Carolina than the other two states.

As for the education level, 21.2% of respondents indicated high school or less, while 9.1% had associates or two-year junior college degree, 20.0% went to college but no degree, 26.0% had bachelor's degree, and 19.4% achieved post graduate degrees. The percentage of those with at least a bachelor's degree was higher in New York and Virginia than in North Carolina.

As for the ethnic group, white (69.8%) and African American (19.5%) comprised an overwhelming majority. The percentage of white was lower in New York than in the other two states.

2.2.2 Wine purchase patterns and preference for wine

Grocery stores were found to be the outlet where the most consumers purchased wine in North Carolina and Virginia. The survey results show that equally in both states 87.5% of respondents indicated that they or anyone in their household purchased wine at grocery stores

in 2012 (Table 2.2). Of those who purchased wine at grocery store, 32.2% reported that the number of bottles they purchased was 5 or fewer, while 19.0% purchased 6-11 bottles, 12.7% purchased 12-17 bottles, 5.5% purchased 18-23 bottles, and 30.6% purchased 24 or more bottles of wine at grocery stores. In terms of money spent per bottle, a plurality of 42.6% spent $10-$14.99, followed by $9.99 or less (39.6%), $15-$19.99 (13.0%), and $20 or more (4.8%). The results indicate that consumers in Virginia purchased relatively more wines at grocery stores as well as they spent more money per bottle than those in North Carolina. This data is not available for the respondents in New York because it is prohibited to sell wine at grocery stores in the state (Table 2.3).

The percentage of respondents who have purchased wine at wine specialty stores in 2012 was 35.5% (NC 28.7%, NY 44.1%, VA 36.3%). Of those, 32.5% indicated that they purchased 1-5 bottles, while 23.3% purchased 24 or more bottles, 20.6% purchased 6-11 bottles, 17.5% purchased 12-17 bottles, and 6.1% purchased 18-23 bottles. As for the amount spent per bottle, over half (55.7%) reported that they spent between $10 and $14.99, while the others reported that they spent $9.99 or less (14.5%), $15-19.99 (14.9%), and $20 or more (14.9%) for a bottle of wine they purchased (Table 2.4).

8.6% (NC 7.0%, NY 10.1%, VA 9.1%) of respondents reported that someone in their household purchased wine over the internet or by mail order in 2012, indicating that internet or mail order was the least frequent way of purchasing wine. However, when it comes to the number of bottles purchased, it was the one that the highest percentage of consumers purchased more than twelve bottles per year. As high as 72.3% of those who had purchased wine over the internet or by mail order indicated that they bought more than twelve bottles in 2012: 12-17 bottles (38.9%), 18-23 bottles (1.9%), and 24 or more bottles (31.5%), respectively. As for money spent per bottle, a plurality of 38.9% reported that they spent $10-$14.99 per bottle, followed by $20 or more (25.9%), $9.99 or less (20.4%), and $15-$19.99 (14.8%) (Table 2.5).

When asked if they had purchased wine from a winery in 2012, 29.1% (NC 26.3%, NY 28.5%, VA 32.4%) indicated that they had done so. Half of those who had bought wine at a

winery reported that they purchased 1-5 bottles, followed by 12-17 bottles (16.0%), 24 or more bottles (14.9%), 6-11 bottles (14.3%), and 18-23 bottles (3.9%). As for the amount they spent, 53.0% of those who have purchased wine at a winery reported that they spent $10-$14.99 per bottle, followed by $15-$19.99 (17.7%), $9.99 or less (16.6%), $20 or more (12.7%). The pattern of amount spent by those who purchased from a winery was found to be quite similar to that of those who purchased at wine specialty stores (Table 2.6).

Lastly, it was asked if they had consumed wine in restaurants or bars in 2012. 63.7% (NC 63.2%, NY 60.2%, VA 66.5%) of respondents indicated that they had. Of those who had consumed wine in restaurants or bars, 29.1% reported that they consumed 1-5 glasses in 2012, while 28.1% consumed 24 or more glasses, 20.6% consumed 6-11 glasses, 13.6% consumed 12-17 glasses, and 8.6% consumed 18-23 glasses. Most frequently paid price range was $5-$9.99 per glass. 36.4% and 35.0% of the respondents, respectively, indicated that they spent $5-$6.99, $7-$9.99 per glass, while 14.4% spent $10 or more and 14.2% spent less than $5 (Table 2.7).

When asked about the preference for wine, 54.3% of the respondents chose red wine as their favorite type of wine, followed by white wine (31.0%), and rosé / blush wine (10.0%); the remaining 4.7% were not sure about their preference. Slightly higher percentage of consumers preferred red wine in New York, while white wine was more preferred in Virginia. Consumers were also asked about their preference for dry versus sweet wines. Overall, slightly more respondents liked dry wines (45.2%) better than sweet wines (42.5%), while 12.3% had no clear preference. Compared to North Carolina, a higher percentage of respondents in New York and Virginia preferred dry wines to sweet ones (Table 2.8).

2.2.3 Data used for empirical analysis

Although the survey was conducted in North Carolina, Virginia, and New York, the data obtained from New York are excluded in the demand analysis because of different wine purchase patterns and limitation of data acquisition. In New York, it is prohibited to sell wine at grocery stores, and liquor stores are the primary outlet where consumers purchase wine.

However, liquor stores are not included in the survey design. Therefore, the data obtained from 521 respondents (North Carolina 263, Virginia 258) are used to estimate the wine demand.

Because wine purchase quantity and price data are obtained for five different outlets for each respondent, one respondent creates five observations, which are stacked to create a data set of 2,605 observations. The number of observations used in the demand estimation reduces to 2,220 after deleting observations with missing values. The structure of the data is just like panel data in the sense that several observations are obtained for each individual respondent. An advantage of this formulation of the data is that the panel model specification can be applied so that one can control for unobserved individual heterogeneity.

Table 2.9 shows the summary statistics on wine consumption in North Carolina and Virginia. Because the data include purchase as well as non-purchase, they include significant proportion of zeros. Internet / mail order, for example, includes highest percentage (92.5%) of zeros as it is least frequently used chain for consumers to purchase wine, whereas grocery store contains least percentage (15.9%) of zeros. The average number of bottles purchased was the highest at grocery stores (23.9%) followed by wine specialty stores (6.1%), while internet / mail order was the lowest (2.4%). However, because these include zero purchases, the number of bottles purchased by the actual purchaser group shows a different pattern. Those who purchased through internet or mail order bought on average 31.6 bottles, followed by grocery stores (28.5%), and restaurants / bars[2] (4.9%). Consumers paid the highest price at restaurants or bars ($33.5) followed by wineries ($20.2), wine specialty stores ($15.7), internet / mail order ($13.8), and grocery stores ($10.6).

[2] As wine consumptions at restaurants / bars are measured in glass units, they are converted from glasses to bottles on a basis of five glasses equal to one bottle.

2.3 Model Specification

2.3.1 OLS

First, the ordinary least squares (OLS) regression is run to provide a baseline to compare with the results of the other models. Table 2.10 describes the variables used in the estimation. To estimate the demand for wine, the number of bottles of wine purchased in 2012 is regressed on price per bottle, annual household income and a set of individual characteristics as well as outlet dummies indicating where wine was purchased. Individual characteristics include race, level of education, and preference for wine. The semi-logarithmic functional form of the demand equation is adopted following LaFrance (1990).[3]

As wine consumption cannot be a negative value, its distribution is censored at zero. In such cases, OLS results in inconsistent estimates and does not guarantee nonnegative predicted values. Therefore OLS would not be an appropriate model for demand estimation given the data but it could still be useful in the sense that it could be used as a basis for comparison with other models.

2.3.2 Tobit model

In order to account for the nontrivial fraction (58.2%) of zero wine purchases, the Tobit model developed by Tobin (1958) and Amemiya (1973) is adopted. This kind of censored dependent variable is often called the corner solution response. What we observe is the following q

$$q = max(0,\ q^*)\ , \tag{2.1}$$

where q is quantity of wine a consumer purchases and q^* is the latent variable defined as

$$q^* = x\beta + \epsilon, \qquad \epsilon|x \sim Normal(0,\ \sigma^2). \tag{2.2}$$

[3] For a semi-logarithmic demand function to be integrable into a utility function that incorporates income effect, it should be in the form of $q_i = x\beta + \delta \log p_i + \gamma y$, where p_i is price of good i and y is consumer's income.

The vector x contains variables that determine wine demand, β is a vector of corresponding parameters, and ϵ is a random error that is assumed to have a normal distribution. So, we have the following log-likelihood function for the Tobit model

$$f(q|x) = 1(q = 1)\, log\left[1 - \Phi\left(\frac{x\beta}{\sigma}\right)\right] + 1(q > 0)\, log\left[\frac{1}{\sigma} \cdot \phi\left(\frac{q - x\beta}{\sigma}\right)\right], \qquad (2.3)$$

where ϕ is the standard normal probability density function, Φ is the standard normal cumulative distribution function, and $1(\cdot)$ is an indicator function that equals one if what is in the parenthesis is true, and zero otherwise.

In order to see the partial effect of a variable x_j on q, $E(q|x)$ and $E(q|q > 0, x)$ need to be defined first. $E(q|x)$, the unconditional expectation, can be stated as

$$E(q|x) = P(q > 0|x) \cdot E(q|q > 0, x) = \Phi(x\beta/\sigma) \cdot E(q|q > 0, x), \qquad (2.4)$$

where $E(q|q > 0, x)$ is the conditional expectation of q that can be expressed as follows:

$$E(q|q > 0, x) = x\beta + \sigma\lambda(x\beta/\sigma), \qquad (2.5)$$

where $\lambda(\cdot) \equiv \phi(\cdot)/\Phi(\cdot)$ is the inverse Mills ratio (Wooldridge, 2010). Now, we have the expression for the unconditional expectation as follows:

$$E(q|x) = \Phi(x\beta/\sigma)[x\beta + \sigma\lambda(x\beta/\sigma)] = \Phi(x\beta/\sigma)x\beta + \sigma\phi(x\beta/\sigma). \qquad (2.6)$$

So the partial effect of variable x_j on wine consumption (q) is

$$\partial E(q|x)/\partial x_j = \beta_j\, \Phi(x\beta/\sigma). \qquad (2.7)$$

Furthermore, as the data are structured like panel data, I extend the empirical framework by applying the random effects specification to the Tobit model so that I can both exploit the corner solution nature of wine consumption and control for the unobserved individual heterogeneity. The random effects Tobit model can be written as

$$q_{io} = max(0, q_{io}^{*}), \qquad o = outlet\ type \qquad (2.8)$$

$$q_{io}^{*} = x_{io}\beta + \alpha_i + \epsilon_{io}$$

$$\epsilon_{io}|x_i, \alpha_i \sim Normal(0, \sigma_\epsilon^2)$$

$$\alpha_i|x_i \sim Normal(0, \sigma_\alpha^2)$$

where q^* is the latent variable and α_i is the unobserved heterogeneity of individual i that is constant across outlet types and assumed to have a normal distribution. Now, the partial effect of variable x_j on wine consumption (q) can be stated as

$$\partial E(q|x)/\partial x_j = \beta_j \, \Phi(x\beta/\sigma_v) \tag{2.9}$$

where $\sigma_v^2 = \sigma_\epsilon^2 + \sigma_\alpha^2$.

2.3.3 Poisson model

For a dependent variable that is continuous and takes on a large range of values, the normality assumption would be reasonable. But as the individual household's wine consumption (q) measured in bottles is in nonnegative integer values, it also could be considered as a count variable that takes on a relatively shorter range of values. So, one can consider a count data model to estimate wine demand rather than a model assuming the normal distribution.

Poisson regression is one of the count data models that is entirely determined by its conditional mean. The conditional mean is often assumed as an exponential function to ensure positivity of the dependent variable:

$$E(q|x) = exp(x\beta), \tag{2.10}$$

where x denotes a vector of explanatory variables and β is a vector of corresponding parameters. And the probability density function of q given x is

$$f(q|x) = exp[-exp(x\beta)][exp(x\beta)]^q/q! \tag{2.11}$$

A restriction of the Poisson distribution is that it assumes the conditional variance equals the conditional mean. However, in the presence of overdispersion where the conditional variance increases as the conditional mean increases, Poisson regression results in an underestimated standard error. One way to deal with overdispersion is to use Poisson QMLE (quasi-maximum likelihood estimation), which refers to maximum likelihood estimation with a misspecified density. It is known that, so long as the conditional mean is correctly specified, Poisson QMLE is consistent[4] (Gourieroux et al., 1984). While no assumption on variance is required for consistent estimation, the conditional variance is usually assumed to be proportional to the conditional mean: $Var(q|x) = \sigma^2 E(q|x)$, under which the Poisson QMLE is known to be efficient in the class of all QMLEs in the linear exponential family of distributions (Gourieroux et al., 1984).

Just as in the Tobit model, the random effects specification can be applied to the Poisson model to control for unobserved individual heterogeneity. In the random effects Poisson model, the conditional mean of the dependent variable is defined as

$$E(q_{io}|c_i, x_{io}) = c_i exp(x'_{io}\beta), \qquad o = outlet\ type \tag{2.12}$$

where c_i is the unobserved individual effect that is constant across outlet types. c_i follows a gamma distribution with mean 1, variance α. The density function for the *i*th consumer is derived as follows (Cameron and Trivedi, 1998).

$$f(q_i|x_i, \beta, \eta) = \left[\prod_o \frac{\lambda_{io}^{q_{io}}}{q_{io}!}\right]\left(\frac{\alpha^{-1}}{\sum_0 \lambda_{io} + \alpha^{-1}}\right)^{\alpha^{-1}} \left(\sum_o \lambda_{io} + \alpha^{-1}\right)^{-\sum_o q_{os}} \frac{\Gamma(\sum_o q_{io} + \alpha^{-1})}{\Gamma(\alpha^{-1})}, \tag{2.13}$$

where $\lambda_{io} = \exp(x'_{io}\beta)$.[5]

[4] This property generally holds when the specified density is linear exponential family.

[5] $\Gamma(\eta)$ is the gamma function defined by $\Gamma(\eta) = \int_0^\infty e^{-t}\, t^{\eta-1} d\eta, \ \ \eta > 0$.

2.3.4 Negative binomial model

The negative binomial distribution is a generalization of the Poisson distribution that accounts for overdispersion of data (Johnson and Kotz, 1969; Cameron and Trivedi, 1986). It can be modeled as a gamma mixture of the Poisson distribution, where q_i is distributed as $Poisson(\lambda v)$ and ν follows the gamma distribution with mean 1 and variance α. The probability distribution of the negative binomial[6] is

$$Pr(q) = \frac{\Gamma(q+\alpha^{-1})}{\Gamma(q+1)\Gamma(\alpha^{-1})}\,(\alpha\lambda)^{q}[1+\alpha\lambda]^{-(q+\alpha^{-1})}\,, \tag{2.14}$$

where $\alpha \geq 0$ is the dispersion parameter. The Poisson distribution is a special case of the negative binomial distribution where α is zero. The first two moments of the negative binomial distribution imply overdispersion since $\alpha \geq 0$ and $\lambda > 0$.

$$E(q|x) = \lambda = ex\,p(x\beta), \tag{2.15}$$

$$Var(q|x) = \lambda(1+\alpha\lambda)\,. \tag{2.16}$$

The random effects specification of the negative binomial model was introduced by Hausman et al. (1984). In this model, it is assumed that the dispersion (α) varies randomly from group to group and follows $1/(1+\alpha^{-1}) \sim Beta(r,s)$. The probability function for consumer i is written as

$$f(q_i) = \frac{\Gamma(r+s)\Gamma(r+\sum_o \lambda_{io})\Gamma(s+\sum_o q_{io})}{\Gamma(r)\Gamma(s)\Gamma(r+s+\sum_o \lambda_{io}+\sum_o q_{io})} \times \prod_o \frac{\Gamma(\lambda_{io}+q_{io})}{\Gamma(\lambda_{io})!\,\Gamma(q_{io}+1)}\,, \tag{2.17}$$

where $\lambda_{io} = \exp(x'_{io}\beta)$.

[6] The derivation of the negative binomial model is similar to that of the random effects Poisson model. But the difference is that unobserved heterogeneity in the negative binomial is u_i whereas it is u_{io} in the random effects Poisson model.

2.3.5 Unit price imputation

A problem that arises when estimating the Tobit, Poisson, or negative binomial model with the survey data is that price is unobservable whenever quantity purchased is zero. In order to estimate the models, however, price data are necessary for every observation. So I run an auxiliary regression to estimate the virtual price, or unit price, using price information of those who did purchase. However, estimating price of those who did not purchase using the data of those who did purchase can only be justified if the sample is random.

I first apply Heckman's (1976, 1979) sample selection model to estimate the unit price. Heckman's sample selection model is used when the regression equation of interest is correlated with the decision whether or not to be selected in the sample so the selected data are not random. That is, one can apply Heckman's model when the price equation is correlated with the consumer's decision of whether or not to purchase wine. Because price is one of the primary factors that affect consumer's purchase decision, the Heckman model could be a proper method to estimate the price equation.

The primary equation of interest is the wine price equation

$$ln\, p = \omega\delta + u, \qquad E(u|x) = 0, \tag{2.18}$$

where $\ln p$ is the log of wine price, ω is a vector of variables that determine wine price, δ is a vector of parameters, and u is the random error. A consumer decides whether or not to purchase wine based on the following selection equation:

$$b = 1[z\gamma + v \geq 0], \tag{2.19}$$

where b is a binary variable that equals one if the consumer purchases wine (in other words, if we observe price), and zero otherwise; z is a vector of variables that affect consumer's choice whether or not to purchase; and v is random error with a standard normal distribution. It is assumed that z is independent of u and v, and ω is a strict subset of z. Now, taking the expectation of the price equation conditional on z and v gives

$$E(ln\,p\,|z,v) = \omega\delta + E(u|z,v) = \omega\delta + E(u|v) = \omega\delta + \rho v, \qquad (2.20)$$

where the last equality holds when u and v are correlated. If $\rho = 0$, u and v are uncorrelated and there is no sample selection problem. If $\rho \neq 0$, then one can show that

$$E(ln\,p\,|z,b) = \omega\delta + \rho E(v|z,b). \qquad (2.21)$$

And for the selected sample, it can be rewritten as

$$E(ln\,p\,|z,b=1) = \omega\delta + \rho\lambda(z\gamma), \qquad (2.22)$$

where $\lambda(\cdot)$ is the inverse Mills ratio, and this equation can be estimated by the two stage procedure that is often called the Heckit method (Heckman, 1976) [7].

Another way of estimating the unit price would be using OLS. δ can be consistently estimated by OLS using the selected sample if the results of the Heckman's model show the sample is random, or $\rho = 0$.

2.4 Results

The demand for wine in North Carolina and Virginia is estimated and the results from each model are compared. The same set of explanatory variables is used across the models. With the number of bottles of wine purchased in 2012 as the dependent variable, wine price per bottle, annual household income, individual characteristics, and outlet dummies are included as explanatory variables. Individual characteristics include consumer's race, level of education, and preference for wine taste and color.

First, the results of OLS estimation are provided in Table 2.11. Although OLS is not a proper model for censored data, the results still maintain some expected properties of wine demand. Wine price has a negative impact on wine demand whereas income has a positive impact. The price elasticity calculated from OLS is -2.1 (Table 2.16), which is quite elastic

[7] As γ is unknown, first estimate it by a probit model $P(b=1|z) = \Phi(z\gamma)$ using the entire sample. Secondly, estimate δ and ρ using the selected sample.

compared to the elasticities estimated in many previous studies. As stated previously, meta analyses by Gallet (2007) and Nelson (2013) respectively found the median price elasticity of wine to be -0.7 and the mean price elasticity to be -0.45. While consumers who prefer dry wine consume significantly more wine than those who prefer sweet wine or those who do not have a preference for wine taste, consumer preference for certain wine color did not have a significant impact on wine consumption. Demographics such as college education and race do not have significant impact on wine demand. The results of OLS are compared with those of the other models.

In order to run the Tobit, Poisson, and negative binomial models, unit price is first imputed to fill in the missing prices of those who did not purchase. The results of Heckman's sample selection model are given in Table 2.12. The selection equation shows what affects the consumer's decision to purchase or not purchase wine. Consumers who are white with higher household income, college education, and prefer dry wine are more likely to be wine purchasers. The estimates of the price equation show that consumers with higher household income, younger age, and preference for dry wine tend to pay a higher price for the wine they purchase. More importantly, however, the estimate of correlation parameter rho(ρ) in equation (2.20) is not significantly different from zero, indicating there is no sample selection problem. Therefore one can simply use OLS results instead of using Heckman's model to impute unit price. Because the estimate of rho is close to zero, the OLS regression results of unit price show very similar results to those of Heckman's model.

Using unit price imputed by the OLS, the Tobit and random effects Tobit models are estimated. Parameter estimates as well as their marginal effects on the dependent variable are shown in Tables 2.13. As the results of the two models are very similar in terms of direction and magnitude, interpretation of estimates is focused on the random effects Tobit model. As expected, wine price has a significantly negative impact on wine demand whereas income has a positive influence. The price elasticity is calculated to be -1.4, and on average, the highest income group ($100,000 or more) consumes about ten more bottles per year than the lowest income group (less than $25,000). Individuals with college education consume about two more bottles than those who had no college education. Consumer preference on wine

taste also has significant impact on wine consumption. Those who prefer dry wines purchase about five more bottles than those who prefer sweet wines or those who do not have preference for wine taste. Individual characteristics such as race or preference for certain colors of wine do not have a significant impact on wine consumption.

Comparing the marginal effects of the explanatory variables, the estimates of the Poisson model show similar results with the Tobit models (Table 2.14). And the gap even narrows once the random effects specification is applied to the Poisson model. The income effects especially show similar results between the two models. Preference for the taste of wine is a factor that has a significant impact on wine consumption in every model. The estimates of the random effects Poisson model show that consumers who prefer dry wines consume about nine more bottles per year than those who prefer sweet wines or those who do not have a preference for wine taste. Individual characteristics such as race or preference for wine color do not have a significant impact on wine consumption. College education, which has a significantly positive impact (at 10% level) on wine demand in the random effects Tobit model, is not statistically significant in the random effects Poisson model. The price elasticity estimate of the random effects Poisson model is -0.27 and smaller in absolute value compared to the random effects Tobit model.

Although the results of the negative binomial model show some difference in terms of the magnitude of marginal effects compared with the results of other models, they become quite similar once the random effects specification is applied (Table 2.15). The results of the random effects negative binomial model show, for example, that the highest income group consumes about nine more bottles of wine per year than the lowest income group. Consumers with college education purchase about three more bottles of wine than those with no college education, and consumers who prefer dry wines consume about four more bottles per year than those who prefer sweet wines or those who do not have a preference for wine taste. Just as in the other models, consumer preference for wine color did not have a significant impact on wine consumption. Unlike the other models, however, the random effects negative binomial model shows that race significantly affects wine consumption. White consumers

purchase about three more bottles per year than the other ethnic groups. The price elasticity estimate is -0.24 in the random effects negative binomial model.

The same estimation methods are applied on the data that exclude wine consumption at restaurants and bars in order to have integer values only for the dependent variable. Table 2.18, Table 2.19, and Table 2.20 respectively shows the results of the Tobit, Poisson, and negative binomial model. They show similar results compared to the results of the models that include on-premise consumption. Along with wine price and household income, consumer preference for taste of wine turned out to be the factor that has a significant impact on wine consumption throughout the various models. Although consumer's race and college education are shown to have a significant impact on wine consumption in the random effects negative binomial model, especially in the random effects Tobit and the random effects Poisson models, they are not significant. These results are similar to the models using the data which include on-premise consumption.

Another set of estimations are conducted with price variable disaggregated by outlet and a Chow test (F-test) is computed to see if there are structural differences in price effect across outlets (Table 2.22 through Table 2.24). Here, variable '*ln* p' is interpreted as the log of wine price purchased at a grocery store and '*ln* p*spclty,' is the interaction term between '*ln* p' and 'spclty.' Its coefficient is interpreted as the difference in the log of price between wines purchased at a grocery store and wines purchased at a wine specialty store. Except for the price coefficients, the results of these models are very similar to those in Table 2.13 through Table 2.15 where price is aggregated across outlets. Despite the significance in Chow test, these models are not reliable because of positive signs of price coefficients on some price coefficients. Presumably, it is due to a high proportion of zero purchase observations at some outlets.

Another set of estimations are also conducted with separate price variables for each outlet, where '*ln* p*grcry' is the log of wine price purchased at a grocery store and '*ln* p*spclty' is the log of wine price purchased at a wine specialty store, and so forth. The results of t-tests show that the null hypotheses, non-positive demand slope, cannot be rejected

for the random effects Tobit model and the random effects negative binomial model, except for the wines purchased through internet or mail order which accounts for only little portion of the total wine purchase. With the random effects Poisson model, the null hypotheses are rejected for the wines purchased at a winery as well as through internet or mail order.

As a way to compare the performance of the models, I compare the price elasticity estimates of each model with the estimates in other studies. Because most of previous studies used off-premise data to estimate the demand for wine, I compare the price elasticities estimated in the models using off-premise data (Table 2.21). The price elasticity of the demand for wine was -0.87 in the random effects Tobit model, -0.24 in the random effects Poisson model, and -0.30 in the random effects negative binomial model. The difference in the price elasticity estimates are noticeable especially between the Tobit model and the count data models. According to the meta analyses that summarize the price elasticities of the demand for wine, the mean or median price elasticities were around -0.7: -0.65 in Forgarty (2010), -0.7 in Gallet (2007), -0.69 in Wagenaar et al. (2009), and -0.45 in Nelson (2013). The price elasticity of the random effects Tobit model is closer to the average estimates. However, the price elasticities of the count data model also fall within the standard deviation of 0.51 (Forgaty, 2010).

2.5 Conclusion

This is one of a few studies to estimate the demand for wine using both continuous and count data model and compare the results. The study uses unique household level survey data obtained through a telephone survey in North Carolina and Virginia. The survey of 521 consumers includes wine purchase data by major outlets. An advantage of the data is that they encompass virtually all wine purchase channels including grocery stores, wine specialty stores, internet / mail order, wineries, and restaurants / bars. Also, consumer preference for wine color and taste were included in the survey to see how they affect wine purchases.

In order to account for the nontrivial fraction of zero purchases, the Tobit model and the Poisson and negative binomial models were adopted as continuous and count data

modeling approaches, respectively. Furthermore, as the data feature panel-like structure, in the sense that several observations are obtained from each respondent, the random effects specification is applied to each model to control for unobserved individual heterogeneity.

As price data are necessary for every observation to estimate the demand models, unit price is imputed for the missing prices of zero purchase observations. Heckman's sample selection model and ordinary least squares model are considered to estimate the unit price. Heckman's model is considered because the observations used to estimate the unit price is solely of those who did purchase wine and there could be sample selection bias. Since the results of Heckman's model indicate there is no sample selection problem, it is justified to use OLS.

Compared through the marginal effects of the explanatory variables, the results of the Tobit, Poisson, and negative binomial models are similar. And the gap even narrows once the random effects specification is applied. Along with wine price, factors that have a significant impact on wine demand are found to be household income and preference for wine taste. Consumers of the highest income group ($100,000 or more) consume about nine to ten more bottles per year than those of the lowest income group (less than $25,000), and those who prefer dry wines purchase about four to nine more bottles than those who prefer sweet wines or those who do not have a preference for wine taste. The price elasticity of wine is estimated to be -1.4 in the random effects Tobit model, -0.27 in the random effects Poisson model and -0.24 in the random effects negative binomial model. Although the estimates are somewhat different across models, individual characteristics such college education, race, and preference for certain color of wine turn out to have less impact on wine consumption.

Overall, despite some differences in the scale of marginal effects, the continuous and count data models show similar results. It is hard to say which model is superior to the others because the each model differs in the basic assumption of the data distribution. But it follows the findings of previous studies in the sense that continuous and count data models generate qualitatively similar results.

2.6 Tables and figures

Table 2.1: Demographics

%	Total	NC	NY	VA
Usable Survey:	701	263	180	258
Gender:				
Male	38.2	38.9	39.3	36.7
Female	61.8	61.1	60.7	63.2
Age: (Mean)	(56.4)	(56.3)	(55.8)	(56.8)
Less than 21	0.0	0.0	0.0	0.0
21-24	1.0	1.1	0.6	1.2
25-44	21.1	21.7	23.9	18.6
45-54	21.5	17.1	22.8	25.2
55-64	22.8	25.1	21.1	21.7
65 or older	29.2	30.8	26.7	29.5
Missing Observations	4.3	4.2	5.0	3.9
Household Income:				
Less than $25,000	6.7	9.9	3.3	5.8
$25,000-$34,999	10.3	11.8	7.2	10.9
$35,000-$49,999	16.0	19.4	15.6	12.8
$50,000-$74,999	18.3	17.1	21.1	17.4
$75,000-$99,999	13.4	11.8	12.8	15.5
$100,000 or more	20.0	15.6	21.7	23.3
Missing Observations	15.4	14.5	18.3	14.3
Education Level:				
High School or less	21.2	20.5	22.8	20.9
Associates	9.1	9.9	8.9	8.5
College but no degree	20.0	23.2	14.4	20.5
Bachelor’s Degree	26.0	26.2	28.3	24.0
Post Graduate	19.4	15.6	18.9	23.6
Missing Observations	4.3	4.6	6.7	2.3

Table 2.1: Continued

	Total	NC	NY	VA
Race / Ethnic Group:				
White	69.8	70.7	68.2	70.6
Black or African American	19.5	20.5	22.1	14.4
Hispanic	4.0	1.9	4.3	6.7
Native American / Hawaiian	1.3	2.3	0.8	0.6
Asian / Asian Indian	0.6	0.0	0.0	2.2
Missing Observations	4.8	4.6	4.7	5.6

Table 2.2: Wine Purchase Experience by Outlet (%)

	Total		NC		NY		VA	
	Yes	No	Yes	No	Yes	No	Yes	No
Grocery store	87.5	12.5	87.5	12.5	n/a	n/a	87.5	12.5
Wine specialty store	35.5	64.5	28.7	71.3	44.1	55.9	36.3	63.7
Internet / Mail order	8.6	91.4	7.0	93.0	10.1	89.9	9.1	90.9
Winery	29.1	70.9	26.3	73.7	28.5	71.5	32.4	67.6
Restaurant / Bar	63.7	36.3	63.2	36.8	60.2	39.8	66.5	33.5

Table 2.3: Wine Purchase Patterns: Grocery Store (%)

Bottles Purchased	Total	NC	NY	VA	Price per bottle	Total	NC	NY	VA
1-5	32.2	34.1	n/a	30.3	$9.99 or less	39.6	39.3	n/a	39.9
6-11	19.0	21.5	n/a	16.5	$10.00-$14.99	42.6	45.3	n/a	39.9
12-17	12.7	11.7	n/a	13.8	$15.00-$19.99	13.0	12.6	n/a	13.3
18-23	5.5	6.1	n/a	5.1	$20.00 or more	4.8	2.8	n/a	6.9
24 or more	30.6	26.6	n/a	34.4					

Table 2.4: Wine Purchase Patterns: Wine Specialty Store (%)

Bottles purchased	Total	NC	NY	VA	Price per bottle	Total	NC	NY	VA
1-5	32.5	35.3	26.0	35.6	$9.99 or less	14.5	13.2	11.0	18.4
6-11	20.6	22.1	12.3	26.4	$10.00-$14.99	55.7	55.9	63.0	49.4
12-17	17.5	22.1	19.2	12.6	$15.00-$19.99	14.9	17.7	8.2	18.4
18-23	6.1	8.8	9.6	1.2	$20.00 or more	14.9	13.2	17.8	13.8
24 or more	23.3	11.8	32.9	24.1					

Table 2.5: Wine Purchase Patterns: Internet / Mail Order (%)

Bottles purchased	Total	NC	NY	VA	Price per bottle	Total	NC	NY	VA
1-5	11.1	18.8	11.8	4.8	$9.99 or less	20.4	37.5	17.7	9.5
6-11	16.7	12.5	5.9	28.6	$10.00-$14.99	38.9	31.3	29.4	52.4
12-17	38.9	50.0	41.2	28.6	$15.00-$19.99	14.8	12.5	11.8	19.1
18-23	1.9	0.0	5.9	0.0	$20.00 or more	25.9	18.8	41.2	19.1
24 or more	31.5	18.8	35.3	38.1					

Table 2.6: Wine Purchase Patterns: Winery (%)

Bottles purchased	Total	NC	NY	VA	Price per bottle	Total	NC	NY	VA
1-5	50.8	56.1	38.3	54.5	$9.99 or less	16.6	21.1	17.0	13.0
6-11	14.3	12.3	17.0	14.3	$10.00-$14.99	53.0	52.6	59.6	49.4
12-17	16.0	14.0	27.7	10.4	$15.00-$19.99	17.7	15.8	14.9	20.8
18-23	3.9	1.8	4.3	5.2	$20.00 or more	12.7	10.5	8.5	16.9
24 or more	14.9	15.8	12.8	15.6					

Table 2.7: Wine Purchase Patterns: Restaurant / Bar (%)

Glass purchased	Total	NC	NY	VA	Price per glass	Total	NC	NY	VA
1-5	29.1	25.9	37.2	27.0	$4.99 or less	14.2	16.6	7.5	16.3
6-11	20.6	23.7	11.7	23.4	$5.00-$6.99	36.4	33.1	38.3	38.3
12-17	13.6	20.1	12.8	7.8	$7.00-$9.99	35.0	35.2	35.1	34.8
18-23	8.6	6.5	10.6	9.2	$10.00 or more	14.4	15.1	19.2	10.6
24 or more	28.1	23.7	27.7	32.6					

Table 2.8: Preference for Wine (%)

	Total	NC	NY	VA
Color				
Red	54.3	54.4	57.2	52.3
White	31.0	30.8	26.1	34.5
Rosé	10.0	9.5	10.6	10.1
No preference	4.7	5.3	6.1	3.1
Total	100.0	100.0	100.0	100.0
Taste				
Dry	45.2	43.0	48.3	45.4
Sweet	42.5	43.7	42.8	41.1
No preference	12.3	13.3	8.9	13.5
Total	100.0	100.0	100.0	100.0

Table 2.9: Summary Statistics on Wine Purchase

	Total	Grocery Sto.	Wine Spec. Sto.	Internet / Mail	Winery	Restaurant / Bar
No. of obs.	2,220	444	444	444	444	444
% of zero purchases	58.2	15.9	69.1	92.5	72.2	41.1
q	7.9 (29.1)	23.9 (46.6)	6.1 (24.7)	2.4 (20.8)	4.1 (25.3)	2.9 (6.9)
q w/o zeros	18.8 (42.6)	28.5 (49.5)	19.7 (41.4)	31.6 (70.7)	14.6 (46.5)	4.9 (8.5)
Price per bottle	19.0 (22.2)	10.6 (4.0)	15.7 (9.9)	13.8 (7.3)	20.2 (51.7)	33.5 (13.3)

Note: Wines consumed at restaurants / bars are converted from glasses to bottles on a scale of five glasses equal to one bottle.
Standard deviations are given in parentheses.

Table 2.10: Variable Descriptions

Variable	Description
q	number of bottles of wine purchased in 2012
ln p	log of wine price per bottle
ln p*grcry	*ln* p*grcry
ln p*spclty	*ln* p*spclty
ln p*intrnt	*ln* p*intrnt
ln p*wnry	*ln* p*wnry
ln p*rstrnt	*ln* p*rstrnt
income0	dummy=1 if annual household income is less than $25,000
income1	dummy=1 if annual household income is $25,000-$34,999
income2	dummy=1 if annual household income is $35,000-$49,999
income3	dummy=1 if annual household income is $50,000-$74,999
income4	dummy=1 if annual household income is $75,000-$99,999
income5	dummy=1 if annual household income is $100,000 or more
college	dummy=1 if achieved at least some college education
race white	dummy=1 if race is white
ln age	log of age
red wine	dummy=1 if one prefers red wine to white wine or rosé wine
dry wine	dummy=1 if one prefers dry wine to sweet wine
grcry	dummy=1 if wine is purchased at grocery store
spclty	dummy=1 if wine is purchased at wine specialty store
intrnt	dummy=1 if wine is purchased through internet or mail order
wnry	dummy=1 if wine is purchased at winery
rstrnt	dummy=1 if wine is purchased at restaurant or bar

Table 2.11: Results of the OLS for Wine Demand

Variable	Coefficient	Std. error
Intercept	24.798 ***	5.207
ln p	-4.317 **	2.104
income1	1.562	2.544
income2	2.050	2.435
income3	4.399 *	2.450
income4	5.756 **	2.589
income5	9.152 ***	2.549
college	0.127	1.596
race white	0.708	1.361
red wine	1.802	1.218
dry wine	7.932 ***	1.309
spclty	-16.810 ***	1.960
intrnt	-21.607 ***	1.877
wnry	-18.373 ***	2.014
rstrnt	-16.472 ***	3.024
Adjusted R^2	0.1129	
N	2,220	

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2.12: Results of Unit Price Estimation

		Sample Selection Model		OLS	
Equation	Variable	Coefficient	Std. error	Coefficient	Std. error
Price Equation	intercept	3.034 ***	0.209	3.016 ***	0.207
	income1	-0.037	0.075	-0.033	0.075
	income2	0.010	0.072	0.015	0.072
	income3	0.068	0.071	0.076	0.070
	income4	0.133 **	0.074	0.143 **	0.071
	income5	0.179 **	0.073	0.191 ***	0.069
	ln age	-0.208 ***	0.049	-0.208 ***	0.049
	red wine	0.005	0.029	0.005	0.029
	dry wine	0.052 *	0.031	0.056 *	0.031
	spclty	0.310 ***	0.058	0.291 ***	0.043
	intrnt	0.135	0.109	0.099	0.079
	wnry	0.383 ***	0.062	0.362 ***	0.044
	rstrnt	1.132 ***	0.039	1.123 ***	0.034
Selection Equation	intercept	0.166	0.472		
	income1	0.324 **	0.149		
	income2	0.314 **	0.141		
	income3	0.526 ***	0.140		
	income4	0.702 ***	0.146		
	income5	0.922 ***	0.144		
	ln age	-0.018	0.112		
	college	0.297 ***	0.089		
	race white	0.242 ***	0.076		
	red wine	0.045	0.066		
	dry wine	0.245 ***	0.071		
	spclty	-1.703 ***	0.102		
	intrnt	-2.768 ***	0.125		
	wnry	-1.812 ***	0.102		
	rstrnt	-0.952 ***	0.099		
	rho	-0.053	0.112		
Log L		-1,539		-	
Adjusted R^2		-		0.568	
N		2,220		929	

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2.13: Results of the Tobit Models for Wine Demand

	Tobit Model			RE Tobit Model		
Variable	Coefficient	Std. error	Marg. effect	Coefficient	Std. error	Marg. effect
Intercept	0.164	8.955	-	5.022	9.308	-
ln p	-6.693 **	3.376	-2.227	-8.488 **	3.405	-2.769
income1	10.100 *	5.642	3.360	9.808	6.282	3.200
income2	9.169 *	5.403	3.050	8.832	6.019	2.881
income3	17.809 ***	5.333	5.925	17.558 ***	5.956	5.729
income4	23.853 ***	5.510	7.935	23.407 ***	6.186	7.637
income5	31.442 ***	5.399	10.460	30.898 ***	6.054	10.081
college	6.742 **	3.358	2.243	6.437 *	3.799	2.100
race white	4.730 *	2.770	1.574	4.617	3.170	1.506
red wine	3.871	2.402	1.288	3.782	2.774	1.234
dry wine	16.302 ***	2.553	5.423	16.379 ***	2.954	5.344
spclty	-46.302 ***	3.613	-9.260	-45.521 ***	3.418	-14.852
intrnt	-85.273 ***	4.740	-17.055	-84.239 ***	4.540	-27.484
wnry	-49.756 ***	3.737	-16.553	-48.909 ***	3.553	-15.957
rstrnt	-27.471 ***	4.950	-9.139	-25.515 ***	4.836	-8.325
Log L	-5,501.328			-5,482.453		
N	2,220			2,220		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2.14: Results of the Poisson Models for Wine Demand

	Poisson Model			RE Poisson Model		
Variable	Coefficient	Std. error	Marg. effect	Coefficient	Std. error	Marg. effect
Intercept	2.326 ***	0.882	-	2.129 ***	0.226	-
ln p	-0.473	0.364	-3.900	-0.270 ***	0.028	-2.217
income1	0.673 *	0.394	5.551	0.329	0.253	2.698
income2	0.762 ***	0.273	6.284	0.466 *	0.248	3.820
income3	1.117 ***	0.313	9.214	0.891 ***	0.243	7.308
income4	1.243 ***	0.293	10.260	0.902 ***	0.261	7.398
income5	1.496 ***	0.269	12.341	1.201 ***	0.257	9.849
college	0.025	0.256	0.203	0.116	0.160	0.955
race white	0.062	0.179	0.514	0.106	0.132	0.873
red wine	0.236 *	0.136	1.944	0.061	0.125	0.500
dry wine	1.065 ***	0.148	8.789	1.066 ***	0.132	8.743
spclty	-1.216 ***	0.212	-10.032	-1.262 ***	0.022	-10.353
intrnt	-2.251 ***	0.399	-18.574	-2.252 ***	0.032	-18.467
wnry	-1.502 ***	0.293	-12.390	-1.559 ***	0.027	-12.785
rstrnt	-1.508 ***	0.417	-12.445	-1.715 ***	0.044	-14.063
Log L	-24,318.174			-13,140.216		
N	2,220			2,220		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2.15: Results of the Negative Binomial Models for Wine Demand

	NB Model			RE NB Model		
Variable	Coefficient	Std. error	Marg. effect	Coefficient	Std. error	Marg. effect
Intercept	1.400 ***	0.274	-	-0.656 **	0.307	-
ln p	-0.040	0.088	-0.452	-0.238 **	0.120	-2.474
income1	-0.061	0.224	-0.691	0.203	0.178	2.106
income2	0.119	0.218	1.349	0.307 *	0.171	3.180
income3	0.734 ***	0.215	8.291	0.402 **	0.169	4.167
income4	0.985 ***	0.230	11.123	0.618 ***	0.173	6.412
income5	1.559 ***	0.232	17.610	0.822 ***	0.170	8.531
college	0.514 ***	0.144	5.803	0.287 ***	0.106	2.973
race white	0.294 *	0.115	3.323	0.291 ***	0.086	3.014
red wine	0.338 **	0.113	3.817	0.006	0.075	0.064
dry wine	0.914 ***	0.121	10.326	0.363 ***	0.080	3.768
spclty	-1.954 ***	0.157	-22.065	-1.648 ***	0.100	-17.094
intrnt	-3.359 ***	0.172	-37.928	-3.446 ***	0.181	-35.754
wnry	-2.022 ***	0.159	-22.831	-1.841 ***	0.107	-19.102
rstrnt	-2.385 ***	0.188	-26.928	-0.959 ***	0.154	-9.954
Log L	-4,663.704			-4,417.387		
N	2,220			2,220		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2.16: Price Elasticities of Demand for Wine

Model	Elasticity	Model	Elasticity
OLS	-2.050		
Tobit	-1.120	RE Tobit	-1.398
Poisson	-0.473	RE Poisson	-0.270
Neg. Bin.	-0.040	RE Neg. Bin.	-0.238

Table 2.17: Results of Unit Price Estimation (Off-Premise)

		Sample Selection Model		OLS	
Equation	Variable	Coefficient	Std. error	Coefficient	Std. error
Price Equation	intercept	3.142 ***	0.263	3.140 ***	0.262
	income1	0.008	0.087	0.017	0.088
	income2	0.076	0.083	0.087	0.082
	income3	0.135 *	0.081	0.148 *	0.081
	income4	0.223 ***	0.084	0.246 ***	0.082
	income5	0.232 ***	0.084	0.261 ***	0.078
	ln age	-0.246 ***	0.061	-0.238 ***	0.061
	red wine	-0.007	0.035	-0.041	0.059
	dry wine	0.026	0.038	-0.053	0.062
	spclty	0.305 ***	0.063	0.294 ***	0.045
	intrnt	0.130	0.118	0.103	0.083
	wnry	0.376 ***	0.068	0.359 ***	0.047
Selection Equation	intercept	-0.163	0.545		
	income1	0.190	0.173		
	income2	0.216	0.164		
	income3	0.368 **	0.162		
	income4	0.621 ***	0.168		
	income5	0.874 ***	0.166		
	ln age	0.115	0.130		
	college	0.222 **	0.103		
	race white	0.225 **	0.089		
	red wine	0.076	0.076		
	dry wine	0.096	0.082		
	spclty	-1.679 ***	0.101		
	intrnt	-2.733 ***	0.125		
	wnry	-1.791 ***	0.102		
	rho	-0.039	0.120		
Log L		-1,168		-	
Adjusted R^2		-		0.175	
N		1,764		674	

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2.18: Results of the Tobit Models for Wine Demand (Off-Premise)

	Tobit Model			RE Tobit Model		
Variable	Coefficient	Std. error	Marg. effect	Coefficient	Std. error	Marg. effect
Intercept	0.594	17.777	-	27.191 ***	6.488	-
ln p	-8.335	7.152	-2.561	-6.075 **	2.604	-3.758
income1	6.781	6.111	2.083	2.329	3.598	1.441
income2	9.429 *	5.151	2.897	2.966	3.449	1.835
income3	17.995 ***	6.153	5.529	5.777 *	3.475	3.574
income4	27.846 ***	6.442	8.556	7.514 **	3.689	4.649
income5	37.176 ***	6.555	11.423	10.927 ***	3.610	6.760
college	5.606	4.245	1.723	-0.206	2.256	-0.128
race white	5.281	3.549	1.623	0.595	1.925	0.368
red wine	6.077 **	3.072	1.867	2.083	1.722	1.289
dry wine	16.681 ***	3.518	5.125	9.268 ***	1.852	5.734
spclty	-51.678 ***	6.556	-15.879	-16.303 ***	2.089	-10.086
intrnt	-97.400 ***	10.257	-29.928	-21.421 ***	1.968	-13.252
wnry	-55.291 ***	6.458	-16.989	-17.735 ***	2.164	-10.972
Log L	-4,098.270			-8,582.079		
N	1,776			1,776		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2.19: Results of the Poisson Models for Wine Demand (Off-Premise)

	Poisson Model			RE Poisson Model		
Variable	Coefficient	Std. error	Marg. effect	Coefficient	Std. error	Marg. Effect
Intercept	2.447 ***	0.905	-	2.100 ***	0.235	-
ln p	-0.516	0.378	-4.918	-0.237 ***	0.030	-2.236
income1	0.720 *	0.412	6.856	0.345	0.262	3.261
income2	0.801 ***	0.295	7.629	0.492 *	0.256	4.652
income3	1.154 ***	0.335	10.988	0.898 ***	0.251	8.482
income4	1.289 ***	0.320	12.272	0.893 ***	0.270	8.437
income5	1.515 ***	0.289	14.429	1.190 ***	0.266	11.240
college	-0.030	0.262	-0.288	0.056	0.165	0.533
race white	0.037	0.188	0.353	0.098	0.136	0.930
red wine	0.245 *	0.146	2.334	0.072	0.129	0.681
dry wine	1.077 ***	0.155	10.258	1.070 ***	0.137	10.110
spclty	-1.206 ***	0.213	-11.486	-1.271 ***	0.022	-12.011
intrnt	-2.248 ***	0.398	-21.412	-2.257 ***	0.032	-21.323
wnry	-1.489 ***	0.292	-14.185	-1.572 ***	0.027	-14.856
Log L	-22,446.123			-11,484.834		
N	1,776			1,776		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2.20: Results of the Negative Binomial Models for Wine Demand (Off-Premise)

	NB Model			RE NB Model		
Variable	Coefficient	Std. error	Marg. Effect	Coefficient	Std. error	Marg. Effect
Intercept	1.523 ***	0.566	-	-0.684 **	0.341	-
ln p	-0.081	0.180	-1.140	-0.299 **	0.141	-3.111
income1	-0.096	0.427	-1.342	0.104	0.195	1.084
income2	0.092	0.403	1.288	0.305 *	0.184	3.173
income3	0.725 *	0.406	10.158	0.335 *	0.184	3.494
income4	1.016 **	0.417	14.223	0.628 ***	0.190	6.544
income5	1.680 ***	0.415	23.532	0.854 ***	0.184	8.896
college	0.381 *	0.207	5.333	0.198 *	0.116	2.066
race white	0.309 *	0.170	4.328	0.250 ***	0.095	2.599
red wine	0.451 ***	0.156	6.313	0.045	0.082	0.464
dry wine	0.913 ***	0.162	12.783	0.290 ***	0.087	3.019
spclty	-1.967 ***	0.191	-27.554	-1.531 ***	0.104	-15.945
intrnt	-3.416 ***	0.244	-47.846	-3.298 ***	0.182	-34.347
wnry	-2.022 ***	0.217	-28.316	-1.701 ***	0.112	-17.713
Log L	-3,747.388			-3,515.543		
N	1,776			1,776		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2.21: Price Elasticities of Demand for Wine (Off-Premise)

Model	Elasticity	Model	Elasticity
Tobit	-0.757	RE Tobit	-0.873
Poisson	-0.516	RE Poisson	-0.237
Neg. bin.	-0.081	RE Neg. Bin.	-0.299

Table 2.22: Results of the Tobit Models for Wine Demand (Price Disaggregated)

	Tobit Model			RE Tobit Model		
Variable	Coefficient	Std. error	Marg. effect	Coefficient	Std. error	Marg. Effect
Intercept	42.178 ***	13.836	-	46.326 ***	13.802	-
ln p	-25.255 ***	5.836	-8.440	-26.856 ***	5.741	-8.798
ln p*spclty	19.590 **	9.120	6.547	19.986 **	8.769	6.547
ln p*intrnt	80.527 ***	15.207	26.912	77.537 ***	14.785	25.400
ln p*wnry	28.083 ***	8.850	9.385	28.845 ***	8.591	9.449
ln p*rstrnt	19.745 **	9.262	6.599	17.228 *	8.935	5.644
income1	10.746 *	5.636	3.591	10.538 *	6.276	3.452
income2	9.342 *	5.390	3.122	9.046	6.006	2.963
income3	17.827 ***	5.317	5.958	17.687 ***	5.941	5.794
income4	23.447 ***	5.493	7.836	23.213 ***	6.169	7.604
income5	30.592 ***	5.381	10.224	30.341 ***	6.036	9.939
college	7.742 **	3.349	2.587	7.528 **	3.791	2.466
race white	4.566 *	2.741	1.526	4.503	3.146	1.475
red wine	3.879	2.377	1.296	3.782	2.753	1.239
dry wine	16.444 ***	2.529	5.496	16.556 ***	2.933	5.424
spclty	-91.109 ***	22.957	-18.222	-91.493 ***	22.080	-29.972
intrnt	-278.344 ***	37.263	-55.669	-270.147 ***	36.229	-88.495
wnry	-117.338 ***	22.575	-39.214	-118.651 ***	21.910	-38.868
rstrnt	-73.939 ***	28.411	-24.710	-63.603 **	27.451	-20.835
Log L	-5485.500			-5,466.547		
F(outlet)	7.79			7.79		
N	2,220			2,220		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.
ln p*spclty refers to the interaction term between *ln* p and spclty, etc.
F(outlet) refers to F-test of the joint significance of the four coefficients of the interactions between *ln* p and the outlet dummies: *ln* p*spclty, *ln* p*intrnt, *ln* p*wnry, and *ln* p*rstrnt.

Table 2.23: Results of the Poisson Models for Wine Demand (Price Disaggregated)

	Poisson Model			RE Poisson Model		
Variable	Coefficient	Std. error	Marg. effect	Coefficient	Std. error	Marg. Effect
Intercept	3.472 ***	0.578	-	4.139 ***	0.238	-
ln p	-0.997 ***	0.227	-8.224	-1.177 ***	0.046	-9.680
ln p*spclty	0.194	0.454	1.601	0.646 ***	0.054	5.315
ln p*intrnt	4.484 ***	0.627	36.998	3.475 ***	0.077	28.581
ln p*wnry	1.733 ***	0.436	14.296	1.959 ***	0.075	16.116
ln p*rstrnt	1.670 ***	0.431	13.782	1.240 ***	0.091	10.196
income1	0.728 *	0.395	6.007	0.323	0.253	2.653
income2	0.818 ***	0.274	6.751	0.392	0.249	3.221
income3	1.135 ***	0.312	9.365	0.815 ***	0.243	6.703
income4	1.290 ***	0.296	10.641	0.912 ***	0.262	7.505
income5	1.464 ***	0.272	12.079	1.133 ***	0.258	9.318
college	0.062	0.251	0.509	0.278 *	0.159	2.284
race white	0.076	0.176	0.629	0.133	0.132	1.095
red wine	0.214	0.135	1.765	0.075	0.124	0.614
dry wine	1.065 ***	0.153	8.789	1.008 ***	0.132	8.290
spclty	-1.571	1.061	-12.964	-2.691 ***	0.131	-22.133
intrnt	-13.645 ***	1.743	-112.582	-11.071 ***	0.206	-91.067
wnry	-5.995 ***	1.102	-49.463	-6.564 ***	0.202	-53.993
rstrnt	-6.706 ***	1.401	-55.332	-4.987 ***	0.305	-41.020
Log L	-22,412.956			-12,062.712		
F(outlet)	16.70			559.50		
N	2,220			2,220		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.
ln p*spclty refers to the interaction term between *ln* p and spclty, etc.
F(outlet) refers to F-test of the joint significance of the four coefficients of the interactions between *ln* p and the outlet dummies: *ln* p*spclty, *ln* p*intrnt, *ln* p*wnry, and *ln* p*rstrnt.

Table 2.24: Results of the Negative Binomial Models for Wine Demand (Price Disaggregated)

	NB Model			RE NB Model		
Variable	Coefficient	Std. error	Marg. effect	Coefficient	Std. error	Marg. Effect
Intercept	3.420 ***	0.637	-	-0.274	0.359	-
ln p	-0.944 ***	0.268	-9.911	-0.402 ***	0.148	-4.221
ln p*spclty	0.522	0.329	5.483	0.554	0.388	5.811
ln p*intrnt	1.642 ***	0.324	17.235	3.523 ***	0.634	36.979
ln p*wnry	0.862 ***	0.309	9.049	0.340	0.467	3.574
ln p*rstrnt	1.144 ***	0.403	12.003	0.341	0.240	3.582
income1	-0.121	0.225	-1.268	0.218	0.178	2.285
income2	0.047	0.221	0.489	0.322 **	0.171	3.381
income3	0.653 ***	0.219	6.856	0.401 ***	0.169	4.206
income4	0.949 ***	0.231	9.964	0.605 ***	0.174	6.347
income5	1.454 ***	0.231	15.256	0.805 ***	0.171	8.453
college	0.631 ***	0.146	6.623	0.287 ***	0.106	3.012
race white	0.314 ***	0.115	3.298	0.296 ***	0.086	3.112
red wine	0.343 ***	0.111	3.602	0.006	0.075	0.060
dry wine	0.836 ***	0.120	8.770	0.366 ***	0.079	3.842
spclty	-3.017 ***	0.807	-31.670	-3.049 ***	1.012	-32.006
intrnt	-7.276 ***	0.782	-76.363	-12.065 ***	1.611	-126.641
wnry	-3.940 ***	0.757	-41.347	-2.698 ***	1.244	-28.315
rstrnt	-5.247 ***	1.219	-55.066	-1.950 ***	0.752	-20.469
Log L	-4,647.012			-4,411.308		
F(outlet)	8.13			7.91		
N	2,220			2,220		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.
ln p*spclty refers to the interaction term between *ln* p and spclty, etc.
F(outlet) refers to F-test of the joint significance of the four coefficients of the interactions between *ln* p and the outlet dummies: *ln* p*spclty, *ln* p*intrnt, *ln* p*wnry, and *ln* p*rstrnt.

CHAPTER 3

The Demand for Winery Tourism

3.1 Introduction

As the wine industry has become a growing part of agriculture, the number of wineries has reached almost 9,000 in 2013 in the United States. Although about 43% of them are located in California, the number has been increasing in many other parts of the country as well. The number of wineries in North Carolina, Virginia, and New York was respectively 160, 275, and 405 in 2013 (New York Times, 2013), which accounts for 9.3% of the total number of wineries in the U.S. (Table 3.1)

Wineries not only produce wines but also provide amenities such as wine tasting and scenery of the vineyard, and thus they have become a popular tourist destination in recent years. Despite the benefits wineries provide their visitors, the economic value in terms of tourism is not explicit. While research has focused on the marketing side of wine tourism (Beverland, 1998; Bruwer, 2003; Carlsen and Dowling, 2001) or examined the characteristics of winery visitors (Dodd and Bigotte, 1997; Williams and Dossa, 2003; Getz and Brown, 2006), only a few studies have tried to measure the economic welfare that wineries provide in terms of tourism (Taylor et al., 2004).

Early studies on winery tourism (Dodd, 1995; Fuller, 1997; King and Morris, 1997) focused on the possible benefits that winery tourism could provide. Dodd (1995), for example, argues that wine tourism can build brand loyalty and provide an alternative distribution outlet especially for small wineries and also provide an opportunity for customers to try new products at little cost.

Another group of studies on winery tourism focus on analyzing the visitor profiles. Dodd and Bigotte (1997) examine the characteristics of visitors to wineries in Texas. They divide the visitors into two different age groups and analyze their difference in perception of winery attributes. Williams and Dossa (2003) describe traits of non-resident visitors to

wineries in British Columbia, Canada, and Getz and Brown (2006) examine the wine tourism among wine consumers located far from wine regions using factor analysis and a sample of wine consumers in Calgary, Canada. Recently in North Carolina, Stoddard and Evans (2011) surveyed visitors to 11 wineries in North Carolina, and Byrd et al. (2013) surveyed visitors at 23 wineries in North Carolina. Both studies focus on consumer visits patterns to North Carolina wineries using on-site surveys.

Taylor et al. (2004) is one of a few studies that estimate the demand for winery tourism and derive the economic value for the winery visitors. They use a truncated Poisson model and on-site survey data collected at the four largest wineries in Canyon county, Idaho. Attempts have been made to estimate benefits of visiting other agricultural areas as well. Rosenberger and Loomis (1999) estimate the value of ranchland to tourists visiting a resort town in the Rocky Mountains. They use a random effects Poisson model combining observed behavior data from actual trips with contingent behavior data on intended visitation if the resource was converted to urban and resort uses. Fleischer and Tsur (2000) measure the recreational value of agricultural landscape by applying truncated count data model to data of visitors in two rural areas in Israel. Carpio et al. (2008a) study determinants of visits to farms and estimate the economic value of the rural landscape for the farm visitors in the U.S. using data from the 2000 National Survey on Recreation and the Environment.

Count data models are frequently adopted to estimate trip demand because the number of trips taken is usually in nonnegative integer values. Shaw (1988) was the first study to apply count data model to recreational sites. Shaw developed a Poisson model that deals with truncation and endogenous stratification problem of on-site survey data. Grogger and Carson (1991) introduce estimators for the truncated Poisson and truncated negative binomial count data. They apply the truncated count data models to recreational fishing trips taken by Alaskan fishermen. Englin and Shonkwiler (1995) develop a negative binomial model that corrects for endogenous stratification and truncation, and apply the model to a sample of hikers in the Cascade Mountains of Washington state. Haab and McConnell (1996) develop a count data model for demand with a large number of zero observations for the dependent

variable and derive the consumer surplus measures. They illustrate the model using a recreational survey of the residents of New Bedford, Massachusetts.

In this study, I examine the determinants of wine consumers' visits to wineries in the state they reside, and estimate the economic value that winery visits provide in terms of tourism. Unique survey data obtained through a telephone survey on wine consumers in North Carolina, New York, and Virginia are used. First, probit model is adopted to examine the factors that affect individual wine consumer's decision whether or not to visit a winery in their state. Second, the economic value that wineries provide their visitors is derived from the winery trip demand that is estimated by truncated negative binomial model.

In section 3.2, I explain how the survey was conducted and present the summary statistics of data including demographics of respondents and their winery visits patterns. Model specification for demand estimation is explained in section 3.3 and the results are discussed in section 3.4.

3.2 Data

3.2.1 Survey and demographics

The data were collected through a telephone survey in North Carolina, Virginia, and New York from February 4th through March 14th, 2013 under the auspices of the North Carolina Department of Agriculture and the National Agricultural Statistics Service. A list of 7,000 names of those who identified themselves as 'wine enthusiasts' was purchased from *infoUSA*, a data and marketing services company. Out of 2,728 randomly selected consumers from the list, the survey was completed for 701 consumers who purchased or drank wine at least once in 2012. The survey questionnaire includes information on respondents' winery visits as well as their demographic information such as age, gender, race, annual household income, and level of education.

Table 3.2 shows the demographics of respondents. 701 respondents who completed the survey are composed of 263 consumers in North Carolina, 180 in New York, and 258 in

Virginia. As for the gender, 61.8% of those who participated in the survey were women while 38.2% were men. A similar pattern was shown in each state with Virginia having the largest percentage of women and New York the largest percentage of men participating.

The average age of the respondents was 56.4. Respondents in New York were relatively younger with an average age of 55.8; the percentage of those under 44 was the highest and the percentage of 65 or older was the lowest among the three states. Respondents were quite evenly distributed across the age groups. The highest percentage of respondents belonged to the oldest group of 65 or older (29.2%), and as the age group became younger, the percentage slightly decreased.

As for the income distribution, aside from the highest income group of $100,000 or more, the middle group of $50,000 to $74,999 was of the highest percentage; as income either decreases or increases the percentage decreased. An income of $100,000 or more indicated the highest percentage, presumably because the range was very broad. Respondents in North Carolina reportedly had the lowest income. The percentage of lower income group was higher and that of higher income group was lower in North Carolina than the other two states.

As for the education level, 21.2% of respondents indicated high school or less, while 9.1% had associates or two-year junior college degree, 20.0% went to college but no degree, 26.0% had bachelor's degree, and 19.4% achieved post graduate degrees. The percentage of those with at least a bachelor's degree was higher in New York and Virginia than in North Carolina.

Three-fourths of the respondents reported that they had lived in their state over ten years. More than half (66.5%) said they had lived at their current residence over 20 years and 9.4% had lived 11 to 20 years, while those who had lived less than 5 years were 12.3% and 5 to 10 years were 7.9%. In New York, a significantly higher percentage of people lived in their state over 20 years than those in the other states. 86.7% of respondents in New York said they had lived at their current residence over 20 years and only 2.8% had lived there less

than 5 years. This means population influx had been more significant in North Carolina and Virginia than in New York in the recent years.

As for the ethnic group, white (69.8%) and African American (19.5%) comprised an overwhelming majority. The percentage of white was relatively lower in New York than in the other two states.

A special treatment is applied to the income data. Because the respondents were asked to select from given income ranges in the survey, the annual household income was reported in intervals rather than a continuous value. The intervals, however, are converted to continuous values for estimation. One possible way to do so could be simply assigning the midpoint of each interval but as this does not generally result in consistent estimates, a procedure developed by Stewart (1983) is adopted. For each income, its conditional expectation q_k is assigned as follows.

$$q_k = \mu + \sigma \cdot \frac{\phi(b_{k-1}) - \phi(b_k)}{\Phi(b_k) - \Phi(b_{k-1})} \tag{3.1}$$

where q_k has to satisfy $A_{k-1} < q_k < A_k$, and A_k is the boundary value for an interval. Also, $b_k = (A_k - \mu)/\sigma$, and ϕ and Φ are the density function and cumulative distribution of the standard normal distribution. Consistent estimates of μ and σ are obtained by fitting a normal distribution to the sample distribution of the observed variable. One convenient way of doing this is a least square variant of Aitchson and Brown (1957). Let C_k be the sample cumulative frequency, then regress $\Phi^{-1}(C_k)$ on A_k. The cumulative frequency C_k with a normal distribution can be expressed as

$$C_k = \Phi\left(\frac{A_k - \mu}{\sigma}\right) = \int_{-\infty}^{(A_k-\mu)/\sigma} \phi(t)\, dt \tag{3.2}$$

The inverse of the cumulative frequency is

$$\Phi^{-1}(C_k) = \frac{A_k}{\sigma} - \frac{\mu}{\sigma} = Z_k \tag{3.3}$$

where Z_k is the distance from the mean of a normal distribution expressed in units of standard deviation. Regressing $\Phi^{-1}(C_k)$ on $A_k$will provide consistent estimates of μ and σ. Then q_k is obtained by substituting the estimates of μ and σ back into the equation of q_k. Table 3.6 shows the results of the transformation.

3.2.2 Winery visits

Out of 701 total respondents, about half (49.4%) of the respondents reported that they have visited a winery in their state. By state, North Carolina shows relatively lower percentage of visitor group compared to New York and Virginia. 42.2% of respondents in North Carolina, 56.1% in New York, and 51.9% in Virginia, respectively, indicated that they have visited a winery in their state (Table 3.3). Also, 55.2% of those who have visited winery in their state indicated that they visited in 2012. Of the total respondents, 21.7% in North Carolina, 30.0% in New York, and 31.0% in Virginia visited a winery in their state in 2012 (Table 3.4).

Of those who visited a winery in their state in 2012, 36.6% visited a winery only once, while 18.3% visited twice, 13.1% visited three times, and 26.2% visited four times or more. The number of wineries visited was fewer in North Carolina than in the other two states. While respondents in North Carolina indicated that 45.6% of them visited just once and 45.7% visited twice or more in 2012, 33.3% in New York and 32.5% in Virginia visited once, and 61.1% in New York and 63.8% in Virginia visited twice or more, respectively (Table 3.5).

When it comes to the distance that visitors drove to wineries, the survey results show that people tend to visit the ones close to their home. The highest percentage (36.7%) of respondents visited wineries that are within 24 miles from their residence, followed by 25 to 49 miles (22.0%), 50 to 74 miles (17.8%), and 75 to 99 miles (8.4%). Those who drove farther than 100 miles were 12.6%. The same treatment that is applied to the income data is applied to the distance data to convert them into continuous values. Table 3.7 shows the results of the transformation.

Travel cost of visiting a winery is derived under two different scenarios. While travel cost often include the opportunity cost of time to account for the forgone income, the disutility of driving time, and the opportunity cost of giving up other activities, it suffers the problem that welfare estimates vary depending on what proportion of income is considered as the opportunity cost of income (Bockstael et al., 1987; Casey et al. 1995). In a study to estimate the consumer surplus of goose hunting permit in Wisconsin, Bihop and Heberlein (1979) found that the consumer surplus can be nearly four times as large when time costs are added at one-half the wage rate as when time costs were not included. In this study, one scenario assumes opportunity cost of time as one-third of hourly income as often used in the travel demand literature (Phaneuf and Smith, 2005), and travel cost of visiting a winery is derived as the sum of transportation cost and the opportunity cost of time. Transportation cost is calculated by multiplying miles driven by cost per mile, and dividing it by the party size. The average party size is assumed to be 2.5. Cost per mile includes gas cost [8] as well as tire abrasion (1.00cent), maintenance cost (4.47cents), and car value depreciation (4.68cents) for driving one more mile (AAA, 2012). The average gas cost per mile is calculated to be 14.63cents by dividing the gas price by MPG[9]. And the hourly income is calculated by dividing annual household income by 1,789 hours, the average working time in the U.S. in 2012 (OECD). The travel time is calculated by dividing the miles driven by an average speed of 55MPH. The other scenario assumes there is no opportunity cost of time visiting winery. The travel cost under this scenario could be considered as the lower bound of the actual travel cost and thus the consumer surplus derived under this scenario would also serve as the lower bound.

[8] For gas price in North Carolina and Virginia $3.618 per gallon is used, and $3.763 per gallon for New York (Energy Information Administration, 2012).

[9] 25 miles per gallon (MPG) is assumed.

3.3 Model specification

Winery visits are analyzed using a two-stage decision making framework. The first stage is the decision whether or not to visit a winery, and the second stage is to decide how many times to visit for those who decided to visit. Therefore, a binary choice model such as logit or probit model can be adopted to model individual's decision whether or not to visit a winery. Once an individual has decided to visit a winery, the number of visits is formulated using the travel cost method for the visitor group. The demand for visits to a winery is a function of travel cost and individual characteristics. The welfare of winery tourism is then derived from the estimated winery trip demand model.

3.3.1 Probit model

The first stage of empirical analysis is conducted by a binary choice model to examine respondents' decision on whether or not to visit a winery that is located in their state. The probit model is adopted to examine the factors that affect an individual's decision. The probit model is derived from a random utility model where individuals select the alternative that provides a higher utility. The probability that an individual decides to visit a winery is

$$P(y = 1|x) = \Phi(x\beta) \tag{3.4}$$

where y is a binary variable that is equal to one if one decides to visit winery, or zero otherwise. x is a vector of variables that include individual characteristics such as annual household income, age, college education, race, number of years lived in the state, and wine consumption, and β is a vector of parameters to be estimated. Because the parameters cannot be directly interpreted as to how much each variable affects the probability of visiting winery, the marginal effects are derived as follows, which represents the change in the probability of visiting winery for one unit change in variable x_j.

$$\frac{\partial P(x)}{\partial x_j} = \phi(x\beta) \cdot x_j \tag{3.5}$$

3.3.2 Truncated negative binomial model

For the winery visitor group, how many times to visit is estimated using the travel cost method. I adopt the truncated negative binomial regression because the number of visits to wineries is positive integer values that are truncated at zero. Truncated data models are often used for recreational demand because data are often obtained from on-site surveys that exclude zero visits from the sample. Although the data used in this study are not obtained from an on-site survey, zero visit observations cannot be used estimating the trip demand because of the lack of travel cost when trips are not taken.

The bias that would result from not taking into account data truncation have been illustrated by Smith et al. (1986), Smith (1988), and Creel and Loomis (1990) in the recreational demand literature. An estimator based on the truncated negative binomial distribution was developed by Grogger and Carson (1987, 1988, 1991). The probability density function of the negative binomial distribution is defined as

$$Pr(N = n) = \frac{\Gamma(n + \alpha^{-1})}{\Gamma(n+1)\Gamma(\alpha^{-1})} (\alpha\lambda)^n (1 + \alpha\lambda)^{-(n+\alpha^{-1})}, \tag{3.6}$$

where $\Gamma(\cdot)$ is the gamma function, and $\alpha > 0$, $\lambda > 0$. The mean and variance of the random variable N, is λ and $\lambda(1 + \alpha\lambda)$, respectively. So the mean-variance ratio is $1 + \alpha\lambda$ implying that this model accounts for the overdispersion of data[10]. A commonly used form of λ is an exponential function to ensure positivity of the dependent variable:

$$\lambda = E(n|x) = exp(x\beta), \tag{3.7}$$

where n is the number of visits to winery, x is a vector of variables that include individual characteristics as well as the attributes of winery such as travel cost, and β is a vector of parameters to be estimated.

Applying Bayes' theorem and the following property of the negative binomial distribution,

[10] The Poisson distribution is a special case of the negative binomial distribution where $\alpha = 0$.

$$F(Z=0) = f(N=0) = (1+\alpha\lambda)^{-(\alpha^{-1})}, \quad (3.8)$$

where $F(\cdot)$ is the cumulative density function and $f(\cdot)$ indicates the probability density function, the density function of the negative binomial distribution truncated at zero can be written as

$$Pr(N=n|N>0) = \frac{\Gamma(n+\alpha^{-1})}{\Gamma(n+1)\Gamma(\alpha^{-1})}\,(\alpha\lambda)^n(1+\alpha\lambda)^{-(n+\alpha^{-1})}\left[\frac{1}{1-(1+\alpha\lambda)^{-(\alpha^{-1})}}\right] \quad (3.9)$$

Welfare for visiting winery is measured by consumer surplus given by Haab and McConnell (2002)

$$WTP = \int_{TC_0}^{\infty} exp(\beta_0+\beta_1 TC)\,dTC = \left[\frac{exp(\beta_0+\beta_1 TC)}{\beta_1}\right]_{TC=TC_0}^{TC\to\infty} = -\frac{n}{\beta_1}, \quad (3.10)$$

where β_1 denotes the parameter of travel cost and TC_0 is the current travel cost. Since this measures the consumer surplus of a visitor who visits wineries *n* times in a year, per trip consumer surplus can be estimated as $-1/\beta_1$.

3.4 Results

The results of the probit model are provided in Table 3.10. The intercept represents the respondents with characteristics of the dummy variables that are not included in the model (i.e., no college education, race other than white, residents of North Carolina). The estimation results show that factors that have significant impact on individual's decision whether or not to visit a winery in their state are household income, race, number of years lived in the state, and wine consumption. The impact of each variable on the winery visits decision can be interpreted through the marginal effects. Individuals with $10,000 higher annual household income are 1.3% more likely to visit winery, and the white are 12.8% more likely to visit winery than other ethnic groups. Those who lived one more year in their state are 0.2% more likely to visit, and drinking one more bottle of wine per year increases 0.1% of chance to

visit one. Meanwhile, age and college education did not have a significant impact on the decision whether or not to visit a winery.

Table 3.11 shows the results of the truncated negative binomial models with two different settings of the opportunity cost of time. Model 1 assumes one-third of wage rate as opportunity cost of time, and Model 2 assumes zero time cost. Both models show similar results as to what are the factors that affect how many times to wineries. While race, number of years lived in the state, and wine consumption had significant impact on the decision whether or not to visit winery, once one decided to visit, these factors did not have a significant impact on the number of visits. Travel cost, household income, and age are the factors that significantly affect how many times to visit wineries. For winery visitors, an increase in annual household income of $100,000 tends to visit wineries about 1.7 times more than those with $100,000 less household income. Visitors who are ten years older tend to visit about 0.4 times less than those who are ten years younger.

As shown in Table 3.9, the average travel cost of winery visitors is nearly four times larger when the opportunity cost of time is included than when time cost is not included. As this results in difference in the parameter estimates of travel cost from the two models, consumer surplus derived from each model also show noticeable difference. The consumer surplus of visiting winery is $28.9 per visit when time cost is not included, whereas it was $149.6 per visit when time cost is included. Although the difference in consumer surplus between two scenarios is considerable, it seems quite reasonable given the difference in the travel cost between the two models.

3.5 Conclusion

The purpose of this study is to investigate the determinants that affect individual's decision on whether or not to visit a winery in their state, and estimate the economic value that winery provide in terms of tourism. Unique survey data obtained through a telephone survey on wine consumers in North Carolina, New York, and Virginia in 2013 are used. First, a probit model is adopted to examine the factors that affect an individual wine consumer's

decision whether or not to visit a winery in their state. Second, the economic value that wineries provide their visitors is derived from the winery trip demand that is estimated by the truncated negative binomial model.

The results of the probit model show that what affect individual's decision to visit a winery are household income, race, number of years lived in the state, and wine consumption. Characteristics such as age and college education do not have a significant impact on the decision. The truncated negative binomial model is estimated with two different settings of opportunity cost of time, one assuming one-third of wage rate as opportunity cost of time and the other assuming zero time cost. The results commonly show that travel cost, household income, and age are the factors that significantly affect how many times to visit wineries. While race, number of years lived in the state, and wine consumption have a significant impact on the decision whether or not to visit a winery, once it was decided to visit one, these factors did not have significant impact on how many times to visit. The consumer surplus estimate of visiting a winery is $28.9 per visit when time cost is not included, whereas it is $149.6 per visit when time cost is assumed as one-third of the wage rate. Carpio et al. (2008b) found that in activities where time not only is a resource constraint but also provides utility, the opportunity cost of time is around 4% of the wage rate, which is lower than the values of between 10% and 30% commonly reported in the literature (Phaneuf and Smith, 2005). Therefore, the consumer surplus of visiting a winery would be close to the estimate of $28.9.

There are potential issues with respect to the data used in this study. There could be unobserved quality effects of wineries. Assuming that visitors are willing to drive farther to visit wineries with better quality, having this effect omitted in the model would result in a higher value of parameter estimate for travel cost and thus result in higher consumer surplus estimates. There also may be an attenuation bias resulting from measurement error in travel cost that would result in a smaller absolute value of the parameter estimate for travel cost. This would also mean that consumer surplus could be expected to be smaller than estimated.

3.6 Tables and figures

Table 3.1: Number of Wineries by State in the U.S.

Rank	State	Wineries	%	Rank	State	Wineries	%
1	California	3,839	42.7	26	Massachusetts	58	0.6
2	Washington	872	9.7	27	Tennessee	53	0.6
3	Oregon	492	5.5	28	Connecticut	50	0.6
4	New York	405	4.5	29	Georgia	44	0.5
5	Texas	341	3.8	30	New Hampshire	41	0.5
6	Virginia	275	3.1	31	Vermont	37	0.4
7	Michigan	230	2.6	32	Kansas	36	0.4
8	Pennsylvania	217	2.4	33	Nebraska	34	0.4
9	Ohio	202	2.2	34	Maine	31	0.3
10	Missouri	174	1.9	35	West Virginia	29	0.3
11	North Carolina	160	1.8	36	South Dakota	25	0.3
12	Illinois	135	1.5	37	South Carolina	22	0.2
13	Colorado	128	1.4	38	Arkansas	20	0.2
14	Iowa	108	1.2	39	Montana	20	0.2
15	Wisconsin	107	1.2	40	Alabama	19	0.2
16	Kentucky	83	0.9	41	Louisiana	12	0.1
17	Indiana	81	0.9	42	North Dakota	12	0.1
18	Maryland	76	0.8	43	Rhode Island	12	0.1
19	Florida	74	0.8	44	Utah	12	0.1
20	Oklahoma	74	0.8	45	Nevada	7	0.1
21	New Jersey	71	0.8	46	Mississippi	5	0.1
22	Minnesota	68	0.8	47	Wyoming	5	0.1
23	New Mexico	68	0.8	48	Delaware	3	0.0
24	Arizona	62	0.7	49	Alaska	0	0.0
25	Idaho	62	0.7	50	Hawaii	0	0.0
					Total	8,991	100.0

Source: New York Times (2013).

Table 3.2: Demographics

%	Total	NC	NY	VA
Usable Survey:	701	263	180	258
Gender:				
Male	38.2	38.9	39.3	36.7
Female	61.8	61.1	60.7	63.2
Age: (Mean)	(56.4)	(56.3)	(55.8)	(56.8)
Less than 21	0.0	0.0	0.0	0.0
21-24	1.0	1.1	0.6	1.2
25-44	21.1	21.7	23.9	18.6
45-54	21.5	17.1	22.8	25.2
55-64	22.8	25.1	21.1	21.7
65 or older	29.2	30.8	26.7	29.5
Missing Observations	4.3	4.2	5.0	3.9
Household Income:				
Less than $25,000	6.7	9.9	3.3	5.8
$25,000-$34,999	10.3	11.8	7.2	10.9
$35,000-$49,999	16.0	19.4	15.6	12.8
$50,000-$74,999	18.2	17.1	21.1	17.4
$75,000-$99,999	13.4	11.8	12.8	15.5
$100,000 or more	20.0	15.6	21.7	23.3
Missing Observations	15.4	14.5	18.3	14.3
Education Level:				
High School or less	21.2	20.5	22.8	20.9
Associates	9.1	9.9	8.9	8.5
College but no degree	20.0	23.2	14.4	20.5
Bachelor's Degree	26.0	26.2	28.3	24.0
Post Graduate	19.4	15.6	18.9	23.6
Missing Observations	4.3	4.6	6.7	2.3

Table 3.2: Continued

Years at Current Residence:				
Less than 5	12.3	17.9	2.8	13.2
5-10	7.9	9.1	1.7	10.9
11-20	9.4	11.8	3.9	10.9
More than 20	66.5	57.0	86.7	62.0
Missing Observations	4.0	4.2	5.0	3.1
Race / Ethnic Group:				
White	69.8	70.7	68.2	70.6
Black or African American	19.5	20.5	22.1	14.4
Hispanic	4.0	1.9	4.3	6.7
Native American / Hawaiian	1.3	2.3	0.8	0.6
Asian / Asian Indian	0.6	0.0	0.0	2.2
Missing Observations	4.8	4.6	4.7	5.6

Table 3.3: Visits to In-State Wineries

	Total		NC		NY		VA	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	346	49.4	111	42.2	101	56.1	134	51.9
No	302	43.1	115	43.7	77	42.8	110	42.6
Don't know	53	7.5	37	14.1	2	1.1	14	5.4
Total	701	100.0	263	100.0	180	100.0	258	100.0

Table 3.4: Visits to In-State Wineries in 2012

	Total		NC		NY		VA	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	191	27.2	57	21.7	54	30.0	80	31.0
No	456	65.0	169	64.3	123	68.3	164	63.6
Don't know	54	7.7	37	14.1	3	1.7	14	5.4
Total	701	100.0	263	100.0	180	100.0	258	100.0

Table 3.5: Number of Visits to In-State Wineries in 2012

	Total		NC		NY		VA	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
1	70	36.6	26	45.6	18	33.3	26	32.5
2	35	18.3	14	24.6	8	14.8	13	16.3
3	25	13.1	7	12.3	7	13.0	11	13.8
4	11	5.8	0	0.0	3	5.6	8	10.0
5	8	4.2	1	1.8	4	7.4	3	3.8
6	10	5.2	4	7.0	3	5.6	8	3.8
7	1	0.5	0	0.0	0	0.0	1	1.3
8	5	2.6	0	0.0	4	7.4	1	1.3
9	3	1.6	0	0.0	2	3.7	1	1.3
10 or more	12	6.3	0	0.0	2	3.7	10	12.5
Don't know	11	5.8	5	8.8	3	5.6	3	3.8
Total	191	100.0	57	100.0	54	100.0	80	100.0

Table 3.6: Household Income Converted from Discrete Interval to Continuous Value

Distance traveled	Frequency	Percent	Continuous value
Less than $25,000	47	6.7	14,579
$25,000-$34,999	72	10.3	30,235
$35,000-$49,999	112	16.0	42,855
$50,000-$74,999	128	18.2	62,721
$75,000-$99,999	94	13.4	86,776
$100,000 or more	140	20.0	120,396
Missing observation	108	15.4	-
Total	701	100.0	-

Table 3.7: Distance Traveled Converted from Discrete Interval to Continuous Value

Distance traveled	Frequency	Percent	Continuous value
1 – 24 miles	70	36.7	12.816
25 – 49 miles	42	22.0	37.471
50 – 74 miles	34	17.8	62.127
75 – 99 miles	16	8.4	86.783
100 – 124 miles	12	6.3	111.442
125 – 150 miles	4	2.1	136.103
Over 150 miles	8	4.2	173.816
Don’t know	5	2.6	-
Total	191	100.0	-

Table 3.8: Variable Descriptions

Variable	Description
No. of trips	number of times visited in-state wineries in 2012
travel cost	travel cost to visit a winery (round-trip)
income	annual household income ($10,000)
college	dummy=1 if achieved at least some college education
race white	dummy=1 if race is white
age	age
residence	number of years lived in the state
wine	total wine consumption in 2012 (in bottle)
NC	dummy=1 if one lives in North Carolina
NY	dummy=1 if one lives in New York
VA	dummy=1 if one lives in Virginia

Table 3.9: Summary Statistics

Variable	Visitors (N= 152)	Nonvisitors (N= 380)
No. of trips	3.3 (3.3)	-
travel cost (with time cost)	36.7 (32.0)	-
travel cost (without time cost)	9.9 (8.4)	-
distance traveled (round-trip, miles)	99.5 (84.5)	-
income ($10,000)	7.9 (3.4)	6.4 (3.5)
college	0.8 (0.4)	0.7 (0.4)
race white	0.8 (0.4)	0.7 (0.5)
age	56.4 (15.2)	56.7 (16.2)
residence	36.9 (23.9)	35.4 (22.9)
wine	63.2 (107.7)	25.8 (51.2)

Note: Standard deviations are given in parentheses.

Table 3.10: Results of the Probit Model

Variable	Coefficient	Std. error	Marg. Effect
intercept	-1.436 ***	0.321	-
income	0.040 **	0.019	0.013
age	-0.003	0.004	-0.001
college	0.021	0.153	0.007
race white	0.393 ***	0.144	0.128
residence	0.006 *	0.003	0.002
wine	0.004 ***	0.001	0.001
NY	0.297 *	0.164	0.097
VA	0.301 **	0.140	0.098
Log L	-306.01		
N	532		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 3.11: Results of the Truncated Negative Binomial Models

	Model 1			Model 2		
Variable	Coefficient	Std. error	Marg. effect	Coefficient	Std. error	Marg. effect
intercept	-0.145	0.752	-	0.119	0.734	-
travel cost	-0.007 *	0.004	-0.013	-0.035 **	0.015	-0.070
income	0.084 **	0.041	0.167	0.065 *	0.036	0.132
age	-0.019 **	0.008	-0.038	-0.019 **	0.008	-0.039
college	-0.034	0.348	-0.068	-0.054	0.346	-0.109
race white	0.227	0.350	0.450	0.214	0.344	0.435
residence	0.009	0.006	0.017	0.009	0.006	0.017
wine	0.0001	0.001	0.0002	0.0002	0.001	0.0003
NY	0.822 ***	0.307	1.628	0.876 ***	0.315	1.783
VA	1.220 ***	0.320	2.417	1.217 ***	0.322	2.477
Log L	-299.60			-298.62		
N	152			152		

Note: *, **and *** denote significance at the 10%, 5% and 1% levels, respectively.
Model 1 assumes one-third of wage rate as opportunity cost of time, and Model 2 assumes zero time cost.

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APPENDICES

Appendix A

Consumer Wine Survey

North Carolina

Hello, this is _____ calling on behalf of researchers at North Carolina State University. I am conducting a Consumer Wine Survey. All individual data will remain confidential and will only be used to arrive at survey totals. The results from this survey will be used to better understand how people's preferences and opinions about wine and their wine buying habits. *This survey is voluntary.*

SCREENING

1. **Have you or anyone in your household bought a bottle of wine in 2012?**

☐$_1$ **YES** – [*Continue*.] ☐$_3$ **NO – Go to item 4** ☐$_5$ **Don't know** – **Go to Item 4**

2. **May I please speak with the person who bought the majority of wine in 2012?**

01 ☐ Yes
02 ☐ Spouse will give information
03 ☐ Someone else in the household will give information Specify

3. Where have you bought wine in the last month? Check all that apply

01 ☐ Grocery Store
02 ☐ Box Store (for example Walmart Target, Costco, Sam's)
03 ☐ On-line, over the internet
04 ☐ Mail Order
05 ☐ Winery
06 ☐ Specialty Wine Store (for example Total Wine)
07 ☐ Restaurant
08 ☐ Don't Know
09 ☐ Refused

4. **Have you or anyone in your household consumed any wine in 2012?**

☐$_1$ **YES** – [*Continue*.] ☐$_3$ **NO –** [***Go to Question 5***] ☐$_5$ **Don't know** – **[*Go to Question* 5]**

A. **How often do you consume wine?**

01 ☐ Daily
02 ☐ Several times a week
03 ☐ Once a week
04 ☐ About once a month
05 ☐ Less than once a month
08 ☐ Don't Know
09 ☐ Refused

B. **What kind of wine is your favorite? [Check only one]**

01☐ Red Wines **If checked Ask:** What is your favorite type[301]_____
02 ☐ White Wines **If checked Ask:** What is your favorite type[302]_____
03 ☐ Rose/Blush Wines **If checked Ask:** What is your favorite type [303]_____
04 ☐ Don't Know
05 ☐ Refused

C. **Do you prefer wine that is dry or sweet?**

01 ☐ Dry
02 ☐ Sweet
03 ☐ No preference
04 ☐ Don't Know
05 ☐ Refused

5. **Why did you buy wine in 2012?** [*Check ALL that apply*.]

☐ Drink with meals at home
☐ Gift
☐ Birthday Celebration
☐ Wedding Celebration
☐ Anniversary Celebration
☐ Other Celebration
☐ Meal at a restaurant
☐ Other Reason [304]_____

6. **What reasons made you choose the wine(s) you purchased in 2012?** [*Check ALL that apply.*]

- ☐ Loyalty (brand I always get)
- ☐ On Sale
- ☐ Price
- ☐ Label Design
- ☐ Organic Wine
- ☐ New brand I wanted to try
- ☐ Produced Locally
- ☐ Read about and wanted to try
- ☐ Recommendation of friends or family
- ☐ Only brand available
- ☐ Other reason [310]_____

7. **Have you or anyone in your household purchased wine over the internet or by mail order in 2012?**

☐$_1$ **YES–** [*Continue*.] ☐$_3$ **NO** [***Go to Question 8***] ☐$_5$ **Don't know** – [***Go to Question 8***]

A. **How many bottles did you buy over the internet or by mail order in 2012?**

B. **On average, how much did you pay for a bottle of wine over the internet or by mail order in 2012 including shipping costs?**

8. **Have you or anyone in your household purchased wine at the grocery store in 2012?**

☐$_1$ **YES–** [*Continue*.] ☐$_3$ **NO [*Go to Question 9*]** ☐$_5$ **Don't know** – [***Go to Question 9***]

A. **How many bottles did you buy at the grocery store in 2012?**

B. **On average, how much did you pay for a bottle of wine at the grocery store in 2012?**

9. **Have you or anyone in your household purchased wine in Wine Specialty stores such as Total Wine in 2012?**

☐$_1$ **YES–** [*Continue*.] ☐$_3$ **NO** [***Go to Question 10***] ☐$_5$ **Don't know** – [***Go to Question 10]***

A. **How many bottles did you buy in Wine Specialty stores such as Total Wine in 2012?**

B. **On average, how much did you pay for a bottle of wine in Wine Specialty stores such as Total Wine in 2012?**

10. **Have you or anyone in your household purchased wine from a winery in 2012?**

☐$_1$ **YES–** [*Continue*.] ☐$_3$ **NO** [***Go to Question 11***] ☐$_5$ **Don't know** – [***Go to Question 11]***

A. **How many bottles did you buy from a winery in 2012?**

B. **On average, how much did you pay for a bottle of wine from a winery in 2012?**

11. **Have you or anyone in your household purchased wine in restaurants or bars in 2012?**

☐$_1$ **YES–** [*Continue*.] ☐$_3$ **NO** [***Go to Question 12***] ☐$_5$ **Don't know** – [***Go to Question 12]***

A. **How many glasses of wine did you buy in restaurants or bars in 2012?**

B. **On average, how much did you pay for a glass of wine in restaurants or bars in 2012?**

12. **Have you ever tasted North Carolina wines?**

☐$_1$ **YES–** [*Continue*.] ☐$_3$ **NO** [***Go to Question 15***] ☐$_5$ **Don't know** – [***Go to Question 15]***

13. **How recently did you taste North Carolina wine?**

YEARS _____ OR **MONTHS** _____ ☐$_5$ **Don't know**

14. **Overall how satisfied are you with the taste of North Carolina Wines?**

1=Very Unsatisfied 2=Somewhat Unsatisfied 3=Neutral 4=Somewhat Satisfied
5=Very Satisfied 6=Don't Know

15. **Did you purchase North Carolina wine in 2012?**

☐$_1$ **YES–** [*Continue*.] ☐$_3$ **NO** ☐$_5$ **Don't know**

16. **Have you ever visited a North Carolina winery?**

☐$_1$ **YES–** [*Continue*.] ☐$_3$ **NO** [***Go to Question 21***] ☐$_5$ **Don't know** [***Go to Question 21***]

A. Was it in 2012?

☐$_1$ **YES–** [*Continue*.] ☐$_3$ **NO** [***Go to Question 18***] ☐$_5$ **Don't know** [***Go to Question 18***]

B. How many North Carolina wineries did you visit in 2012?

17. **During 2012, Have you or anyone in your household purchased wine at a North Carolina winery?**

☐$_1$ **YES–** [*Continue*.] ☐$_3$ **NO** [***Go to Question 18***] ☐$_5$ **Don't know** – [***Go to Question 18]***

A. **How many bottles did you buy from a North Carolina winery in 2012?**

B. **How much did you pay for all the wine purchased at a North Carolina winery in 2012?**

C. **What was the name of the North Carolina winery where you purchased the most wine in 2012?** [305] _____

18. **Did you purchase wine from a North Carolina winery because it was produced in North Carolina?**

☐$_1$ **YES** ☐$_3$ **NO** ☐$_5$ **Don't know**

19. **Overall how satisfied are you with the overall quality of Wine bought at the North Carolina Winery?**

1=Very Unsatisfied 2=Somewhat Unsatisfied 3=Neutral

4=Somewhat Satisfied 5=Very Satisfied 6=Don't Know

20. **Considering your last visit to a North Carolina winery, how far did you have to drive***?*

01☐ 1 to 24 miles

02☐ 25 to 49 miles.

03☐ 50 to 74 miles

04☐ 75 to 99 miles

05☐ 100 to 124 miles

06☐ 125 to 150 miles

07☐ over 150 miles.

77☐ Don't know

99☐ Refused

21. **Do you prefer wines produced in North Carolina to wines produced elsewhere in the U.S.?**

☐$_1$ **YES–**[*Continue to **A***.] ☐$_3$ **NO-**[***Go to Question 21B***] ☐$_5$ **Don't know**-[**Go to Question 22**]

A. W**hy did you prefer wines produced in North Carolina?** [*Check ALL that apply*.]

☐ The taste
☐ The price
☐ Environmental Concerns/Reduce Carbon Footprint
☐ Health/Locally Grown Products are Healthier
☐ Other Reason [306]_____

B. [If answered **No** to Q 21] **Why did you prefer other wines to wines produced in North Carolina?** [*Check ALL that apply*.]

☐ The taste
☐ The price
☐ Don't want to drink locally produced wine.
☐ Health/Wines produced in other areas of the US are Healthier
☐ Other Reason [307]_____

22. W**here have you seen information about North Carolina wineries?** [*Check ALL that apply*.]

☐ Department of Transportation (DOT) Sign
☐ Winery Billboard
☐ Privately Owned Winery Sign
☐ Winery Website
☐ NCwine.org Website
☐ North Carolina Wine and Grape Industry Association Flyer/Brochure
☐ Newspaper
☐ Books/Magazines
☐ Facebook
☐ Twitter
☐ Groupon
☐ Social Living
☐ Radio
☐ Family, Friends or Neighbors
☐ Wine of the Month Club
☐ Regional Wine Festival
☐ I do not get information from any source
☐ Other Sources [308]_____

23. W**hy did you visit North Carolina Wineries?** [*Check ALL that apply*.]

- ☐ Wanted to learn about the Winery (wine tasting)
- ☐ Farm/Winery Experience
- ☐ Winery Sponsored Event (Concert, Festival Etc.)
- ☐ Wedding
- ☐ Anniversary
- ☐ Something to do
- ☐ Winery Coupon
- ☐ Wine Trail
- ☐ Other Reason [309]_____

Demographics

24. **[ENUM: If not known ask the Respondent's Gender**?]

01 ☐ Male 02 ☐ Female

25. **What year were you born?**

26. **How long have you lived in North Carolina?**

Years_____ **0 if less than 1 year** 99 ☐ Refused

27 **Are you of Spanish, Hispanic, or Latino origin or background, such as Mexican, Cuban, or Puerto Rican, regardless of race?**

01 ☐ Yes 03 ☐ No

28. **What is the highest education level you have achieved?** (Check ONLY ONE)

- 01☐ Less than high school
- 02☐ High School Diploma/GED
- 03☐ Associates, two-year Junior College degree
- 04☐ Some College, but no degree
- 05☐ Bachelor's Degree
- 06☐ Post Graduate
- 77☐ Don't know
- 99☐ Refused

29. **What is your race?** (Please check √ ONE OR MORE)

01 ☐ White
02 ☐ Black or African American
03 ☐ American Indian or Alaska Native
04 ☐ Native Hawaiian or other Pacific Islander
05 ☐ Asian
06 ☐ Asian Indian
77 ☐ Don't Know
99 ☐ Refused

30. **What code represents your household income for the past year? (***Check ONLY ONE***)**

01☐ Under $25,000
02☐ $25,000 to $34,999
03☐ $35,000 to $49,999
04☐ $50,000 to $74,999
07☐ $75,000 to $99,999
08☐ $100,000 and over
77☐ Don't know
99☐ Refused

This completes the survey. Thank you for your help.