Willingness to Pay for Sensory Attributes in Beer

Gnel Gabrielyan, Jill J. McCluskey, Thomas L. Marsh, and Carolyn F. Ross

Abstract

As microbrewed beers, which are differentiated by product characteristics including the level of hoppiness, have become increasingly popular, the intrinsic characteristics of beer are more important in consumers' purchasing decisions. The objective of this article is to identify the sensory properties that influence consumers' willingness to pay (WTP) for beer. A contingent valuation (CV) model of WTP that includes subjective consumer sensory evaluations and consumer socio-demographic characteristics is estimated. We find that that overall taste and hoppiness have a significant and a positive impact on WTP.

Key words: willingness to pay, beer, and contingent valuation analysis

JEL: L11, L13, L66.

Gnel Gabrielyan is a Doctoral Candidate, Jill J. McCluskey and Thomas L. Marsh are Professors, School of Economic Sciences, Carolyn Ross is Associate Professor, School of Food Science, Washington State University, Pullman, WA 99164. This article has also benefited from consultation, input, and discussions with Ron Mittelhammer. All remaining errors are the responsibility of the authors. Thomas Marsh gratefully acknowledges funding from USDA-NIFA.

Beer is made of four main ingredients: malt, yeast, water, and hops. These ingredients make it possible to brew horizontally differentiated varieties of beer that range from lighter lagers to hoppier ales. Using different hop varieties and different levels of hoppiness intensity is a key for quality differentiation. Consumers choose a beer based on extrinsic characteristics (e.g. brand, price, and alcohol content), demographic characteristics (e.g. age, income, and education level) and intrinsic characteristics (e.g. aroma, flavor, bitterness, and hop content). Cultural attributes can also influence the consumer's choice of beer (McCluskey and Shreay 2011).

The current article utilizes sensory analysis and the contingent valuation (CV) method to evaluate consumers' willingness to pay (WTP) for beer with different intrinsic characteristics such as taste, hoppiness, aroma, and appearance. The objective of this study is to examine the relationship between sensory characteristics and consumers' WTP for beer and evaluate whether the specific sensory attributes play a role in determining consumers' WTP. The findings will help us to understand consumers' valuation of taste, hoppiness, aroma, and appearance. Implications can be drawn about potential buyers and how much to charge for the premium quality and taste.

Background

American lagers have long been the most popular types of beer among U.S. consumers and are produced by limited number of large brewers or "macrobrewers." The top twenty firms operating in the U.S. beer industry accounted for over 80% of total beer consumption in the U.S. in 2009 (Tremblay and Tremblay 2011). Macrobrewers, as the name suggests, produce beer in

huge quantities, which drives down the unit costs, as well as, the prices of their products. Lower prices and lighter taste have contributed to the popularity of this type of beer.

In contrast, the number of microbrewers[1] in the U.S. increased over the years from two to over 1700 from 1977 to 2009, respectively (Tremblay and Tremblay 2011). This shift suggests that consumers' tastes and preferences are changing over time. Unlike macrobrewers, microbrewers do not have the advantage of economies of scale, which makes their beer more expensive to produce. Beer produced by microbrewers is differentiated from American lagers by its taste and other attributes. As the demand for beer from microbreweries has increased, one would assume that consumers' WTP for beer has also increased over time. Furthermore, we hypothesize that the increase of WTP is attributed to intrinsic cues of beer.

Previous studies examine consumers' WTP for beer. Thaler (1985) estimates WTP for beer using survey results. He concludes that transaction utility can affect consumers' WTP. He finds that WTP depends on where the beer is purchased.[2] WTP is higher if the purchasing point is a fancy resort hotel assuming the consumer is on the beach on a hot day compared to the small, run-down grocery store. In a follow-up choice experiment, Ranyard, Charlton, and Williamson (2001) argue that it is necessary to take into account variances within samples, as suggested by Cohen (1988, 1992). They conducted two studies: the first one being similar to Thaler's original experiment using a process-tracing approach and the second one used a regression model with larger sample size including seven more scenarios. In the first study, the authors conclude that the seller context has an influence on the WTP decisions for beer was not supported by their

[1] Breweries that produce less than 15,000 barrels of beer per year with 75% or more of their beer sold off-site (Brewers Association, 2013a).

[2] The survey participants were asked a hypothetical question about either being on the beach on a hot day buying a beer from a nearby fancy resort hotel or buying a beer from the small, run-down grocery store.

price data. They found that relative difference between median prices of two specific markets was only 4% of the average and the distributions of WTP prices in the two versions of the scenario were not significantly different. In the second study, they conclude that although the effect of seller context in beer scenario was relatively small, overall, it was statistically significant.

Beer can be categorized as an experience good because consumers discover the quality of a product only after the purchase of a good. Consumers form quality expectations after the actual consumption. Intrinsic characteristics or sensory attributes are considered one of the major factors for forming quality expectations (Grunert 2002), which are important factors for the repeat purchase decisions. Comparisons can be drawn with the wine market which is highly differentiated based on factors such as origin of production or appellation, brand or winemaker, expert score, and grape varieties. While some studies find that the majority sensory attributes do not have a significant impact on wine prices (Combris, Lecocq, and Visser 1997; Lecocq and Visser 2006), others find that intrinsic cues have more significant impact on the WTP (Cardebat and Fique, 2004; Yang, McCluskey, and Ross 2009; Holmquist, McCluskey, and Ross 2012).

In this article, we analyze results from a sensory experiment and a consumer survey with valuation questions. A double-bounded, dichotomous-choice CV model is utilized to estimate consumers' WTP for beers brewed from different hops. This study provides information for the hop and beer industries about the impact of taste and hoppiness in terms of consumers' preferences and willingness to pay. The objective of the current article is to estimate the WTP for beer based on its sensory attributes. The results will shed light on product characteristics that consumers prefer and how much they are willing to pay for these attributes.

Methodology

While hedonic price analyses study the effect of extrinsic and demographic characteristics on the equilibrium prices in the market, WTP analyses study consumers' maximum willingness to pay. In a WTP analysis of sensory characteristics, the objective is to examine the maximum a consumer would pay for the product in question and how the sensory properties influence this amount. The CV methodology is a technique that is commonly used to estimate WTP. A double-bounded question sequence was included in the survey. In the double-bounded model, each participant is presented with two bids. The level of the second bid is contingent upon the response to the first bid. If the individual responds "yes," meaning that he or she is willing-to-pay the amount of the initial bid (B_I), then the individual is presented with a second premium bid (B_P). Alternatively, if the individual responds "no," meaning that he or she is not willing to pay the amount of the initial bid, then he/she is presented with a second discounted bid (B_D).

Since WTP is a latent variable, the sequential questions serve to place upper and lower bounds on the true WTP in a way that it can be partitioned into four intervals based on the answers to the double-bounded bidding questions: (1) $(-\infty, B_D)$, the respondent's WTP is lower than the offered discounted price B_D when both bids are rejected ("no, no"); (2) $[B_D, B_I)$, the respondent's WTP is between the lower bid B_D and the initial bid B_I when the initial bid is rejected but the lower bid is accepted ("no, yes"); (3) $[B_I, B_P)$, the respondent's WTP is above the initial bid but lower than the higher bid B_P when the initial bid is accepted but the higher bid is rejected ("yes, no"); (4) $[B_P, +\infty)$, the respondent's WTP is higher than the premium price when both bids are accepted ("yes, yes").

Let WTP_i denote individual *i*'s true WTP. The discrete outcomes of the bidding process can be presented as the following:

$$(1) \qquad Y = \begin{cases} 1 & if \quad WTP_i < B_D \\ 2 & if \quad B_D \le WTP_i < B_I \\ 3 & if \quad B_I \le WTP_i < B_P \\ 4 & if \quad WTP_i \ge B_P \end{cases}$$

The bid function for individual *i* is specified as:

$$(2) \qquad Y_i = \alpha - \rho B_i + \lambda' z_i + \varepsilon_i, \qquad \text{for } i = 1, \ldots, n$$

where B_i is the ultimate bid that individual *i* faces, z_i is a vector of explanatory variables including socio-demographics, consumption and beer drinking habits, hop treatment, and other attributes. The coefficients α, ρ, and λ are parameters to be estimated. The error term ε_i captures possibly unobservable factors and characteristics affecting the decision. The distribution of the error term is assumed to follow a cumulative logistic distribution with mean zero and variance σ^2, i.e., $\varepsilon \sim G(0, \sigma^2)$. In the empirical implementation of the model, we define G(·) to have a standard logistic distribution having zero mean and standard deviation $\sigma = \pi / \sqrt{3}$.

The dependent variable in (1) can be expressed as the choice probability for individual *i*:

$$(3) \quad Pr(Y_i = j) = \begin{cases} = Pr(WTP < B_D) = G(\alpha - \rho B_D + \lambda' z_i) = \dfrac{e^{\alpha - \rho B_D + \lambda' z_i}}{1 + e^{\alpha - \rho B_D + \lambda' z_i}} \\ = Pr(B_D \le WTP < B_I) = G(\alpha - \rho B_I + \lambda' z_i) - G(\alpha - \rho B_D + \lambda' z_i) = \dfrac{e^{\alpha - \rho B_I + \lambda' z_i}}{1 + e^{\alpha - \rho B_I + \lambda' z_i}} - \dfrac{e^{\alpha - \rho B_D + \lambda' z_i}}{1 + e^{\alpha - \rho B_D + \lambda' z_i}} \\ = Pr(B_I \le WTP < B_P) = G(\alpha - \rho B_P + \lambda' z_i) - G(\alpha - \rho B_I + \lambda' z_i) = \dfrac{e^{\alpha - \rho B_P + \lambda' z_i}}{1 + e^{\alpha - \rho B_P + \lambda' z_i}} - \dfrac{e^{\alpha - \rho B_I + \lambda' z_i}}{1 + e^{\alpha - \rho B_I + \lambda' z_i}} \\ = Pr(WTP \ge B_P) = 1 - G(\alpha - \rho B_P + \lambda' z_i) = 1 - \dfrac{e^{\alpha - \rho B_P + \lambda' z_i}}{1 + e^{\alpha - \rho B_P + \lambda' z_i}} \end{cases} \quad for\ j = \begin{cases} 1 \\ 2 \\ 3 \\ 4 \end{cases}$$

The log-likelihood function is:

$$L = \sum_i \begin{cases} I_{Y_i=1} \ln G(\alpha - \rho B_D + \lambda' z_i) \\ + I_{Y_i=2} \ln[G(\alpha - \rho B_I + \lambda' z_i) - G(\alpha - \rho B_D + \lambda' z_i)] \\ + I_{Y_i=3} \ln[G(\alpha - \rho B_P + \lambda' z_i) - G(\alpha - \rho B_I + \lambda' z_i)] \\ + I_{Y_i=4} \ln[1 - G(\alpha - \rho B_P + \lambda' z_i)] \end{cases} \tag{4}$$

where $I_{Y_i=j}$ is an indicator function for the event that individual *i* chooses the j^{th} alternative. Maximum likelihood method is the approach that is used to estimate the model.

Data

We recruited 127 untrained consumer panelists with a small non-monetary compensation to participate in this study. All participants signed an informed consent form and the project was approved for human subject participation by a university Institutional Review Board. Information was collected about panelists' socio-demographics, consumption and beer drinking habits. Only participants of age 21 and older were recruited. Summary statistics for the demographic variables are presented in the Table 1. 57.5% of the survey participants are male. The mode age group is 26 to 30 years and the mode annual income between $20,000 and $29,000. Almost 78% of respondents are white/Caucasian. Since our sample comes from a university community, 51% of the panelists of our panelists held an advanced degree. As in all surveys, sample representativeness is of concern to the researcher. We acknowledge that there are limitations regarding the extent to which the findings can be fully generalized to broader populations.

Beers with different attributes, including different hops and bitterness were brewed for the purpose of this study. Data on consumer preferences and perceptions of the sensory attributes of the beers were collected. We obtained blind tastings from at the University's

sensory evaluation facilities in 2013. The beer was kept in the cooling area before the experiment. The beer samples were presented in a random serving order, one sample at a time. Each sample consisted of 25 milliliters of beer and served in an international Standards Organization/*Institut National des Appellations d'Origine* (ISO/INAO) tulip-shaped wine tasting glasses (25 mL) covered with petri dish at refrigerated temperatures (approximately 5ºC). Each sample was coded with three digits. The consumer panelists were instructed to rinse with a bite of cracker and deionized filtered water as palate cleansers and wait at least 30 seconds between samples.

Four types of beers were brewed from four different types of hops (Columbus, Chinook, Mt. Hood and Willamette) grown at a university-operated facility located five miles northeast of Prosser, Washington. A summary of four samples with hop types, beer styles, and alcohol content is provided in Table 2. After tasting each of four samples of beer the panelists were asked questions on how much they liked the sample based on the following sensory attributes appearance, aroma, taste/flavor, hoppiness, and overall liking of a sample. These are categorical variables taking values from '1' if the panelist strongly dislikes the sample to '9' if the panelist likes it extremely. Beer 3 was the panelists' favorite in the majority of categories, with beer 2 taking over in appearance category. The summary statistics of sensory attributes are presented in Table 3.

Panelists were asked contingent valuation questions after assessing sensory attributes of different types of beer. The panelists were given an initial offer and were asked if they are willing to pay $6.99, which was average market price for a 6-pack of beer at the time of the study, for the specific beer. If the panelist answered "yes" to the initial offer, then a higher, follow-up bid was proposed. If the panelist answered "no" to the first offer, then a lower follow-

up bid was proposed. To cover the distribution of consumers' WTP, one of four different follow-up premium bids were randomly assigned to each participant who responded positively: $7.49, $7.99, $8.49, and $8.99 and one of four follow-up discounted bids were assigned to each consumer who responded negatively: $6.49, $5.99, $5.49, and $4.99. That is, each panelist, depending on the first response, randomly received only one premium or discounted price offer. The range of bids was determined by pre-testing of the questionnaire.

Panelists were also asked questions about their beer buying and consumption habits (see Table 4). About 41% of our respondents drink beer a few times per week, and 24% drink beer once a week. On average, they drink almost two servings of beer each time. This is comparable to the average U.S. consumption, which is about four pints per week (Beer Institute 2013b). The most common response to the question of where they drink beer is at home. Overall, the most favorite style of beer is amber followed by pale ale and dark/stout. On average, panelists reported that they usually pay $7 to $8 for a six pack, and taste is the most important factor for buying the beer, followed by the price, and the brand. The other factors that affect their consumption choice mentioned by the panelists are label/packaging, recommendations, and brewery specifications.

Panelists were also asked about whether they agree with several statements that are related to their beer consumption. These are 9-point Likert scale categorical variables which take values from '1' if the panelist strongly disagrees with the statement to '9' if the panelist strongly agrees. The data shows that the majority of panelists are eager to try local beers when they are in a new place and they are eager to try new beer as it becomes available in the market. Descriptive statistics from the data are presented in Tables 2 to 4.

Results and Discussion

The parameter estimates of double-bounded contingent valuation analysis and marginal effects of variables with confidence intervals are presented in Table 5. As expected, the bid coefficient is significant at the 1% level and has a negative effect. This means that as the bid amount increases, the probability of choosing to buy the product decreases. Figure 1 shows distribution of the probability saying "yes" to the offer to purchase the beer given different bids.

From the sensory questions, the taste variable has a positive and significant effect at the 1% level of significance. If panelists like the taste of a specific beer and rate it one unit higher on the nine-point Likert scale, they are willing to pay 41 cents more for a 6-pack of that beer. Taste is one of the major factors for consumers for making repeat purchase decisions. Hence, if consumers like a specific beer because of the taste, they are more likely to buy the beer again and are willing to pay a higher price for that beer relative to other beers. Thus, the results show that microbrewers can demand higher prices for the premium taste of their beer.

Panelists reported how much they liked the hoppiness of each beer. It is likely the case that consumers have heterogeneous preferences for level of hoppiness, which implies that hoppiness is a "horizontal quality attribute." A horizontal quality attribute means there is a distribution over consumer preferences and that an individual consumer prefers the level of that attribute that is closest to his or her ideal. Therefore, if a panelist increases his or her ranking of liking of the sample based on its hoppiness by one more unit on the nine-point Likert scale, then the estimated WTP for the beer increases by eleven cents. However, our result does not imply that the hoppier the beer, the more consumers are willing to pay.

Quality differentiation through the taste is also one of the major tools for microbreweries to differentiate their products in a market highly dominated by macro beers. The numerous

varieties of hops make it easier to create new beers with different sensory attributes. Thus, microbrewers can charge higher price margins by brewing a beer with a taste/hoppiness that is liked and perceived by consumers. The appearance and beer aroma, on the other hand, do not have significant impacts on the estimated WTP. It may be the case that the untrained consumer panelists could not discern differences across the beer samples. In fact, the mean scores for appearance and aroma are not statistically different across the four samples. If we had offered a more extreme light lager or dark stout beer, there would have been greater variation. However, beers that are more similar in appearance and aroma allow us to focus on hoppiness.

Consumers with higher incomes are willing to pay more for the beer, and it is significant at the 10% significance level. The result shows that beer is a normal good. The marginal effect of income coefficient shows that if consumers' income increases by one category ($10,000) than their WTP for a 6-pack beer increases by 5 cents. However, age has a negative and significant impact at the 1% significance level on the WTP for beer. Older consumers are willing to pay less for beer; if the age goes up by one year than the willingness to pay decreases by 17 cents. One possible explanation for the negative relationship between age and WTP may be that older consumers may already have developed taste preferences for specific beers and they are less likely to be willing to pay higher priced for microbrew-style beers. Another possible explanation for this phenomenon is that older consumers might prefer wine or other spirits to beer. Married consumers are also willing to pay less for the beer as the variable is significant at the 10% significance level and has a negative sign. White/Caucasian consumers are willing to pay more for the sampled beers.

Consumption frequency has a significant (at the 10% level of significance) and a positive impact on consumers' WTP for beer. It is possible that panelists with high frequency of

consumption are beer connoisseurs, so they are more informed and appreciative of different beers. Therefore, they are willing to pay higher premiums for the sampled beers compared to less frequent buyers. However, if consumers drink beer at home the most, then they are willing to pay less (significant at the 5% significance level).

Not surprisingly, consumers who prefer microbrew beers the most are willing to pay higher prices for the microbrew beers in our experiment (significant at the 5% significance level) compared to consumers who usually consume macro or imported beers. This may represent an exposure effect[3] and/or a preference for microbrew beers. The variable that represents how much consumers usually pay for beer is also significant at the 1% significance level and has a positive impact on the WTP. The result implies that those consumers who already pay higher prices for a 6-pack beer at grocery stores in general are also willing to pay higher prices for the sampled beers.

Respondents who agree more strongly with the statement, "I am willing to drink whatever beer my friends are drinking," are WTP more for beer, and this effect is significant at the 1% level. The interpretation of this result is not obvious. Beer is a product that is often consumed in social settings. Psychological research conjectures that the qualities that affect consumer preferences not only exist in a product but also in the social setting in which the product is being used (Hayakawa and Vinieris 1997). A possible explanation for this result these respondents are WTP more based on their enjoyment of the product with their friends.

The mean WTP is calculated as $\text{WTP} = \frac{1}{\hat{\rho}}\left(\hat{\alpha} + \hat{Z}'\bar{X}\right)$ (Hanemann 1984). A confidence interval is calculated using the delta method. The mean WTP is \$7.04 for a six pack with a 95% confidence interval of \$6.70 to \$7.38. Though the point estimate is slightly higher (five cents)

[3] Zajonc (1968) demonstrated that the mere exposure to a stimulus increases consumer's enjoyment of these stimuli.

than the initial price (based on the current market price) offered to consumers ($6.99), it is not statistically different. This suggests that consumers, on average, are willing to pay the same price that they face in stores across the four sampled beers. Thus, we cannot say that consumers, overall, are willing to pay higher prices for the new beers offered in this study. Nevertheless, the same consumers are willing to pay higher premiums for the samples if they like the taste and hoppiness of the beers. As we discussed earlier, the effect of taste is statistically significant. Consumers are WTP a 44 cents premium for superior taste alone.

McCluskey and Shreay (2011) found that for their sample of international subjects living in the United States and who reported that taste is the most important factor in their choice of beer are less likely to prefer U.S. beers. Thus, it may be the case that panelists who have strong preferences for specific taste attributes may underreport the WTP for the new varieties of beer that were presented to them during the experiment. Therefore, the WTP might be understated by those consumers.

Conclusions

Considering the market size and importance of the beer market, surprisingly, this study is the first attempt in estimating the consumers' WTP for beer based on the sensory attributes and consumer demographics. The objective of this article is to study the effects of intrinsic characteristics on consumers' WTP for beer. The findings indicate that taste and hoppiness positively impact consumers' WTP for beer with taste having the largest impact. In our sample with limited variation of appearance and aroma, these factors do not have a significant impact. Intrinsic cues have long been a major deciding factor for forming quality expectations with

positive effects on the repeat business. Taste attributes represent the major differentiating factor for craft beers. The taste and hoppiness have positive and significant impacts on the WTP.

The results show that consumers with higher incomes are willing to pay higher price for the beer in the market. In contrast, age has a negative impact on the WTP. Consumers who drink beer more frequently are willing to pay more. On the contrary, if consumers drink beer mostly at home they are willing to pay less for a 6-pack beer. Consumers who are willing to drink the beer their friends drink are WTP more for beer. As all four beer samples in our analysis are new to panelists, one would expect that overall WTP for beer based on sensory and demographic characteristics might be underestimated. Therefore, the impact that the taste attributes have on real WTP may be higher if consumers already formed taste preferences.

Our findings may be useful in new product introductions into the market. Given beer and food trends in general, we expect for new beers to be increasingly differentiated. Using different hop varieties and different levels of hoppiness intensity is a key for quality differentiation. As consumers find beers that fit their ideal tastes, they will be willing to pay a premium for them. However, the social aspect of beer makes it different from other products that fall into a "monopolistic competition" category, such as breakfast cereals or candy bars. Since beer is often consumed socially and there is an exposure effect, we recommend for the industry to target more frequent beer drinkers who consume socially. Then, these consumers will both impact their peers' consumption habits and WTP for beer.

References

Brewers Association, 2013a. "Market Segments." available at http://www.brewersassociation.org/pages/business-tools/craft-brewing-statistics/market-segments.

Beer Institute, 2013b. "Shipments of Malt Beverages and Per Capita Consumption by State 2012," available at http://www.beerinstitute.org/assets/uploads/2012_Beer_Consumption_By_State.pdf.

Cardebat, J.-M. and J.-M. Figuet. 2004. "What Explains Bordeaux Wine Prices?" *Applied Economics Letters* 11(5): 293-96.

Cohen, J. 1992. "A Power Primer." *Psychological bulletin* 112(1): 155.

———. 1988. *Statistical Power Analysis for the Behavioral Sciences*. Lawrence Erlbaum.

Combris, P., S. Lecocq, and M. Visser. 1997. "Estimation of a Hedonic Price Equation for Bordeaux Wine: Does Quality Matter?" *The Economic Journal* 107(441): 390-402.

Grunert, K.G. 2002. "Current Issues in the Understanding of Consumer Food Choice." *Trends in Food Science & Technology* 13(8): 275-85.

Hanemann, M.W., J. Loomis, and B.J. Kanninen. 1991. "Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation." *American Journal of Agricultural Economics* 73: 1255-63.

Hanemann, W. M. 1984. "Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses." *American Journal of Agricultural Economics* 66(3): 332-41.

Hayakawa, H. and Y.P. Vinieris. 1997. "Consumer Interdependence via Reference Groups." *Journal of Political Economy* 85: 599-615.

Holmquist, C., J.J. McCluskey, and C.F. Ross. 2012. "Consumer Preferences and Willingness to Pay for Oak Attributes in Washington Chardonnays." *American Journal of Agricultural Economics* 94(2): 556-61.

Lecocq, S. and M. Visser. 2006. "What Determines Wine Prices: Objective vs. Sensory Characteristics." *Journal of Wine Economics* 1(1): 42-56.

McCluskey, J.J., and S. Shreay. 2011. "Culture and Beer Preferences." in *The Economics of Beer.* edited by J. F. M. Swinnen: Oxford University Press.

Ranyard, R., J.P. Charlton, and J. Williamson. 2001. "The Role of Internal Reference Prices in Consumers' Willingness to Pay Judgments: Thaler's Beer Pricing Task Revisited." *Acta Psychologica* 106(3): 265-83.

Thaler, R. 1985. "Mental Accounting and Consumer Choice." *Marketing Science* 4(3): 199-214.

Tremblay, C.H., and V.J. Tremblay. 2011. "Recent Economic Developments in the Import and Craft Segments of the U.S. Brewing Industry." *The Economics of Beer.* edited by J. F. M. Swinnen: Oxford University Press.

Yang, N., J.J McCluskey, and C.F. Ross. 2009. "Willingness to Pay for Sensory Properties in Washington State Red Wines." *Journal of Wine Economics* 4(1): 81-93.

Zajonic, R. B. 1968. "The Attitudinal Effects of Mere Exposure." *Journal of Personality and Social Psychology* 9 (2): 1-27.

Table 1 – Definitions and Summary Statistics of the Demographic Variables

Variable	Description	Frequency (%)	Mean	St. Dev.
Gender	1 if male	57.48	0.574	0.495
	0 if female	42.52		
Age	1 if 21-25	31.5	2.535	1.414
	2 if 26-30	22.05		
	3 if 31-40	23.62		
	4 if 41-50	8.66		
	5 if 51-60	12.6		
	6 if 61-70	1.57		
Student	1 if student	51.18	0.512	0.500
	0 otherwise	48.82		
Income	1 if < $19,999	47.06	2.807	2.436
	2 if $20,000-$29,999	15.97		
	3 if $30,000-$39,999	7.56		
	4 if $40,000-$49,999	8.40		
	5 if $50,000-$59,999	5.88		
	6 if $60,000-$69,999	4.20		
	7 if $70,000-$79,999	3.36		
	8 if $80,000-$89,999	3.36		
	9 if $90,000-$99,999	1.68		
	10 if $100,000-$149,999	2.52		
	11 if > $150,999	47.06		
	Prefer not to answer	6.30		
Race	1 if white	77.95	0.780	0.416
	0 otherwise	22.05		
Married	1 if married	34.92	0.349	0.477
	0 otherwise	65.08		
Education	1 if some high school	-	4.346	0.758
	2 if high school graduate	0.79		
	3 if some college	14.96		
	4 if bachelor's degree	33.07		
	5 if advanced degree	51.18		

Table 2: Beer Sample Information

Sample	Style	Hops Used	Alcohol Content
Beer 1	American IPA	Chinook	6.0%
Beer 2	American IPA	Columbus	6.0%
Beer 3	Honey Ale	Mt Hood	7.1%
Beer 4	Honey Ale	Willamette	7.1%

Table 3 – Summary Statistics of Sensory Attributes by Beer Sample

Variable	Description	Values	Mean	St. Dev.
Appearance	Panelists' level of likings of the sample based on the appearance	Equals to '1' if the panelists extremely dislike to '9' if extremely like the sample based on the sensory attribute	6.553	1.446
Aroma	Panelists' level of likings of the sample based on the aroma		6.159	1.560
Taste/Flavor	Panelists' level of likings of the sample based on the taste/flavor		5.569	2.034
Hoppiness	Panelists' level of likings of the sample based on the hoppiness		5.482	1.764
Appearance	Panelists' level of likings of the sample 1 based on the appearance	Equals to '1' if the panelists extremely dislike to '9' if extremely like the sample 1 based on the sensory attribute	6.488	1.397
Aroma	Panelists' level of likings of the sample 1 based on the aroma		6.110	1.503
Taste/Flavor	Panelists' level of likings of the sample 1 based on the taste/flavor		6.110	1.503
Hoppiness	Panelists' level of likings of the sample 1 based on the hoppiness		5.591	1.724
Appearance	Panelists' level of likings of the sample 2 based on the appearance	Equals to '1' if the panelists extremely dislike to '9' if extremely like the sample 2 based on the sensory attribute	6.638	1.467
Aroma	Panelists' level of likings of the sample 2 based on the aroma		6.173	1.633
Taste/Flavor	Panelists' level of likings of the sample 2 based on the taste/flavor		5.449	1.995
Hoppiness	Panelists' level of likings of the sample 2 based on the hoppiness		5.173	1.890
Appearance	Panelists' level of likings of the sample 3 based on the appearance	Equals to '1' if the panelists extremely dislike to '9' if extremely like the sample 3 based on the sensory attribute	6.496	1.490
Aroma	Panelists' level of likings of the sample 3 based on the aroma		6.268	1.635
Taste/Flavor	Panelists' level of likings of the sample 3 based on the taste/flavor		5.819	1.958
Hoppiness	Panelists' level of likings of the sample 3 based on the hoppiness		5.803	1.700
Appearance	Panelists' level of likings of the sample 4 based on the appearance	Equals to '1' if the panelists extremely dislike to '9' if extremely like the sample 4 based on the sensory attribute	6.591	1.438
Aroma	Panelists' level of likings of the sample 4 based on the aroma		6.087	1.475
Taste/Flavor	Panelists' level of likings of the sample 4 based on the taste/flavor		5.488	2.232
Hoppiness	Panelists' level of likings of the sample 4 based on the hoppiness		5.362	1.689

Table 4 – Beer Consumption and Preferences

Variable	Description	Scaled values/ Frequencies (%)	Mean	St. Dev.
Frequency	*The frequency of beer consumption*			
	1 if occasionally	15.75		
	2 if once or twice a month	13.39		
	3 if once a week	24.41	3.055	1.160
	4 if a few times a week	42.52		
	5 if every day	3.94		
Home	*The frequency of beer consumption at home*			
	1 if least often	14.17		
	2 if less often	10.24	3.220	1.109
	3 if more often	14.96		
	4 is most often	60.63		
Type	1 if micro beer	64.57	0.646	0.480
	0 otherwise	35.43		
Lite	*The rankings of the Lite style*		3.646	2.345
Lager/Pilsner	*The rankings of the lager/pilsner style*		4.882	1.711
Amber	*The rankings of the amber style*	Equals to 1 if it is the least favorite to 9 if the most favorite style for panelists	6.055	1.488
Pale Ale	*The rankings of the pale ale style*		5.394	1.728
Dark/stout	*The rankings of the dark/stout style*		5.008	2.415
IPA	*The rankings of the IPA style*		4.480	2.153
Weather	1 if weather is the deciding factor for beer consumption	14.96	0.150	0.357
	0 otherwise	85.04		
Price importance	*The importance of the price factor for beer consumption*	Equals to 1 if it is the least important to 4 if the most important factor for panelists	2.591	0.681
Taste importance	*The importance of the taste factor for beer consumption*		3.850	0.378
Brand importance	*The importance of the brand factor for beer consumption*		2.433	0.648
Pay (per 6-pack)	*Actual amount paid for beer*			
	1 if less than or about $5	0.79		
	2 if $6 – $7	24.41		
	3 if $7 – $8	48.82	3.055	0.836
	4 if $8 – $9	20.47		
	5 if $9 – $10	5.51		
	6 if above $10	-		
Friends	*"I am willing to drink whatever beer my friends are drinking"*	Equals to 1 if panelists strongly disagree to 9 if strongly agree with the statement	4.102	2.416
New place	*"When in a new place, I am willing to try local beers"*		8.055	1.570
New beer	*"I enjoy trying new beers as they become available"*		7.386	1.846

Table 5: Marginal Effects of the Explanatory Variables on Mean WTP for Beer

Variable	Coefficient	St. Error	Z-stats.	Marginal Effect	St. Error	Z-stats.	90 % Confidence interval	
							Lower bound	Upper bound
Constant	11.081***	3.233	3.427					
Bid	-2.667***	0.170	-15.700					
Gender	0.346	0.279	1.243	0.130	0.104	1.243	-0.041	0.301
Age	-0.463***	0.152	-3.039	-0.174***	0.057	-3.052	-0.267	-0.080
Student	-0.300	0.306	-0.979	-0.112	0.115	-0.979	-0.301	0.076
Income	0.136***	0.041	3.297	0.051***	0.015	3.332	0.026	0.076
White/Caucasian	0.680**	0.350	1.941	0.255**	0.131	1.951	0.041	0.469
Married	-0.563*	0.318	-1.773	-0.211*	0.119	-1.777	-0.406	-0.016
Education	0.030	0.183	0.163	0.011	0.069	0.163	-0.101	0.124
Appearance	0.097	0.096	1.011	0.036	0.036	1.013	-0.023	0.095
Aroma	0.044	0.100	0.440	0.016	0.037	0.440	-0.045	0.078
Taste/Flavor	1.108***	0.113	9.845	0.415***	0.039	10.757	0.352	0.479
Hoppiness	0.283***	0.105	2.703	0.106***	0.039	2.741	0.043	0.170
Frequency	0.260*	0.137	1.898	0.097*	0.051	1.907	0.014	0.181
Home	-0.255**	0.129	-1.975	-0.096**	0.048	-1.976	-0.175	-0.016
Micro beer	0.709**	0.325	2.183	0.266**	0.121	2.196	0.067	0.464
Lite	0.135	0.083	1.627	0.051	0.031	1.635	0.000	0.101
Lager/Pilsner	0.136	0.088	1.540	0.051	0.033	1.541	-0.003	0.105
Amber	0.033	0.091	0.360	0.012	0.034	0.360	-0.044	0.068
Pale ale	-0.020	0.087	-0.233	-0.008	0.033	-0.233	-0.061	0.046
Dark/stout	-0.022	0.075	-0.292	-0.008	0.028	-0.292	-0.054	0.038
IPA	0.055	0.080	0.693	0.021	0.030	0.693	-0.028	0.070
Weather	-0.595	0.369	-1.612	-0.223	0.138	-1.613	-0.450	0.004
Price importance	-0.360	0.292	-1.233	-0.135	0.109	-1.238	-0.314	0.044
Taste importance	-0.546	0.352	-1.551	-0.205	0.131	-1.558	-0.420	0.011
Brand importance	0.235	0.288	0.817	0.088	0.108	0.817	-0.089	0.265
Pay	0.550***	0.162	3.402	0.206***	0.060	3.433	0.108	0.305
Friends	0.168***	0.055	3.077	0.063***	0.020	3.099	0.030	0.096
New place	-0.168	0.120	-1.398	-0.063	0.045	-1.399	-0.136	0.011
New beer	-0.176	0.108	-1.631	-0.066	0.040	-1.640	-0.132	0.000

* significant at 10% level, ** significant at 5% level, *** significant at 1% level.

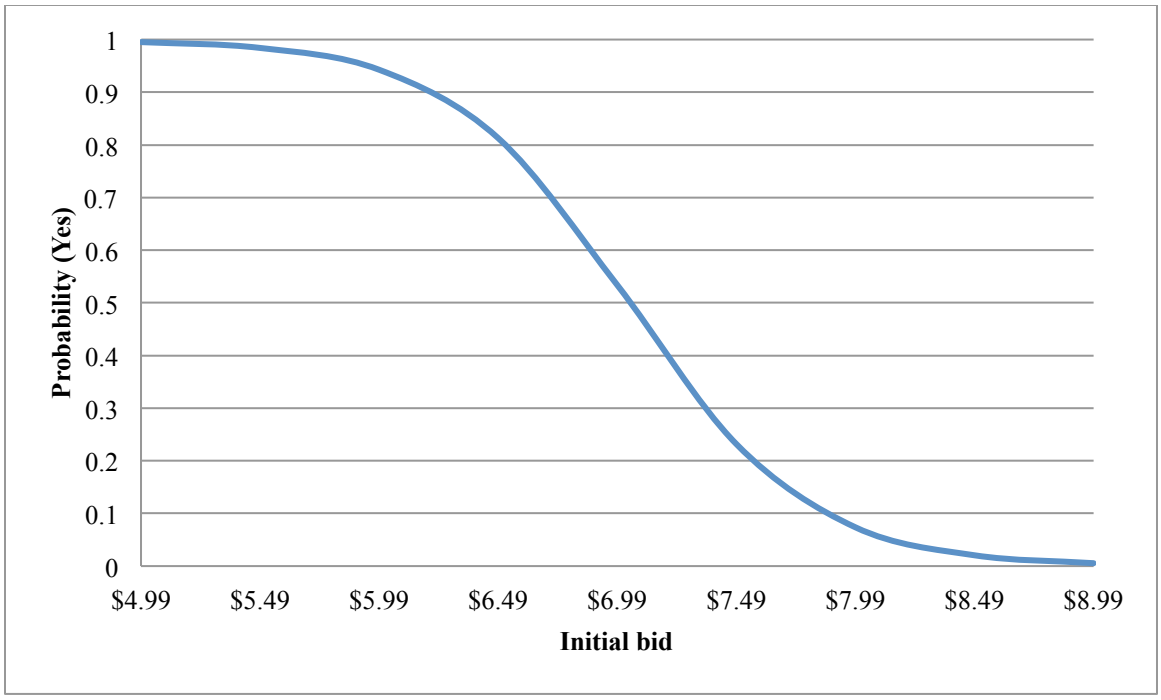

Figure 1: Probability of WTP as bid varies