Willingness to Pay for Sensory Attributes in Beer

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As microbrew beers have become more popular, the intrinsic characteristics of beer have become more important in consumer purchasing decisions. We identify sensory properties that influence consumers' willingness to pay for beer using a contingent valuation model that includes subjective sensory evaluations and socio-demographic characteristics of consumers. We find that overall taste and hoppiness of a beer have a significant and positive impact on willingness to pay.

***Key Words*:** beer, contingent valuation analysis, willingness to pay

Beer is made of four main ingredients: malt, yeast, water, and hops. These ingredients allow brewers to create horizontally differentiated varieties of beer that range from lighter lagers to hoppier ales. The particular variety of hops used and the intensity of those hops in the flavor are essential in differentiating beers in terms of quality. Consumers select beers based on extrinsic characteristics (e.g., brand, price, and alcohol content), their demographic characteristics (e.g., age, income, and education level), and intrinsic characteristics that include aroma, flavor, bitterness, and hop content. Cultural attributes also can influence consumer's choices (McCluskey and Shreay 2011).

We apply sensory analysis and the contingent valuation (CV) method to evaluate consumers' willingness to pay (WTP) for beers that have different intrinsic characteristics related to taste, hop intensity, aroma, and appearance. We examine the relationship between sensory characteristics and consumers' WTP for beer and evaluate whether specific sensory attributes play a role in determining WTP. The results will allow us to better understand how consumers value taste, hoppiness, aroma, and appearance and thus to characterize potential buyers and prices for beers with premium quality and taste.

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Background

In the United States, American-made lagers have long been the most popular type of beer. Those lagers are produced by a small number of large brewers ("macrobrewers"). Products of the top twenty firms operating in the U.S. beer industry accounted for more than 80 percent of total beer consumption in the United States in 2009 (Tremblay and Tremblay 2011). As the name suggests, macrobrewers produce beer in huge quantities, driving down both the per-unit production cost and the price to consumers. Relatively low prices and the beers' light taste have contributed to its popularity.

In recent years, however, the number of microbrewers[1] in the United States has increased dramatically, rising from just two in 1977 to more than 1,700 in 2009 (Tremblay and Tremblay 2011). Microbrewed beers often have a stronger flavor and/or a more intensive use of hops. This shift suggests that consumers' tastes and preferences have been changing. Microbrewers do not have the advantage of economies of scale, which makes their beer more expensive to produce and purchase, and their products are differentiated from macrobrewed American lagers by taste and other attributes. As demand for beer from microbreweries has increased, we expect that consumers' WTP for beer has also been increasing. Furthermore, we hypothesize that the increase in WTP can be attributed to intrinsic qualities of beer.

A number of studies have examined consumers' WTP for beer. Thaler (1985) estimated WTP for beer using a survey. The results showed that WTP depended on where the beer was purchased (from a resort hotel at the beach versus a rundown grocery store),[2] and the author thus concluded that transaction utility can affect WTP. Ranyard, Charlton, and Williamson (2001) extended work by Thaler (1985) with a choice experiment analyzing WTP for beer. Arguing that one must take variances within samples into account as suggested by Cohen (1988, 1992), they conducted two studies. The first was similar to Thaler's original experiment and used a process-tracing approach. The second used a regression model and a larger sample with seven additional scenarios. In the first study, the authors concluded that their price data did not support Thaler's (1985) conclusion. They found that the relative difference in median price between two specific markets was only 4 percent of the average and that the distributions of WTP in the two versions of the scenario were not significantly different. In the second study, the authors concluded that the effect of seller context in the beer scenario was present and was statistically significant but was relatively small overall.

Beer can be categorized as an experience good because consumers discover the quality of a product only after purchasing and consuming it. Intrinsic characteristics and/or sensory attributes are considered to be a major factor in the process of forming quality expectations (Grunert 2002), and those expectations underlie decisions about whether to purchase the product again. There are similarities in the markets for beer and wine. The wine market is highly differentiated based on factors such as origin of production or appellation, brand, winemaker, scores by experts, and grape varieties. While

[1] Microbreweries are defined as breweries that produce less than 15,000 barrels of beer per year and sell 75 percent or more of their beer offsite (Brewers Association 2013).

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

some studies have found that most sensory attributes do not have a significant impact on wine prices (Combris, Lecocq, and Visser 1997, Lecocq and Visser 2006), a number of others have found that intrinsic cues play a significant role in consumer WTP (Cardebat and Fique 2004, Yang, McCluskey, and Ross 2009, Holmquist, McCluskey, and Ross 2012).

We analyze results from a sensory experiment and a consumer survey involving valuation questions to estimate WTP for beer based on its sensory attributes. A double-bounded, dichotomous-choice CV model is used to estimate consumers' WTP for beers brewed from different hops. We evaluate the impact of taste and hoppiness in terms of consumers' preferences and WTP. The resulting information on product characteristics that consumers prefer and how much they are willing to pay for those characteristics is useful to the hop and beer industries.

Methodology

While hedonic price analyses study the effect of extrinsic and demographic characteristics on equilibrium prices in a market, WTP analyses study the value consumers place on characteristics expressed as the maximum amount they are willing to pay. When analyzing sensory characteristics, the objective is to examine WTP for the product in question and how its sensory properties influence that amount. The CV methodology is commonly used to estimate WTP (Hanemann, Loomis, and Kanninen 1991). In our survey, we included a double-bounded question sequence. In a double-bounded model, each participant is presented with two bids. The amount of the second bid is contingent on the participant's response to the first bid. If the individual is willing to pay the amount of the initial bid (B_I), the second bid presented is a "premium" (higher) bid (B_P). If the individual is not willing to pay the amount of the initial bid, the second amount presented is a discounted (lower) bid (B_D).

Since WTP is a latent variable, the sequential questions serve to place upper and lower bounds on the participant's true WTP. The WTP variable can then be partitioned into four intervals based on the answers to the double-bounded bidding questions: (1) $(-\infty, B_D)$—the respondent's WTP is less than the offered discounted price, B_D, when both bids are rejected; (2) $[B_D, B_I)$—the respondent's WTP is between the low bid, B_D, and the initial bid, B_I, when the initial bid is rejected and the lower bid is accepted; (3) $[B_I, B_P)$—the respondent's WTP exceeds the initial bid but is less than the high bid, B_P, when the initial bid is accepted and the higher bid is rejected; and (4) $[B_P, +\infty)$—the respondent's WTP exceeds the premium price when both bids are accepted.

Let WTP_i denote individual i's true WTP. The discrete outcomes of the bidding process are

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

The bid function for individual i is specified as

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

where B_i is the initial bid presented to individual i and $\mathbf{z}_i$ is a vector of explanatory variables that includes socio-demographics, beer purchases, beer consumption, drinking behavior, and intensity of hops. The coefficients α, ρ, and λ are parameters to be estimated. The error term, ε_i, captures potential unobservable factors and characteristics that could affect the decision. The distribution of the error term is assumed to follow a cumulative logistic distribution with a mean of zero and variance of σ^2; in other words, $\varepsilon \sim G(0, \sigma^2)$. In implementing the model empirically, we define $G(\cdot)$ as having a standard logistic distribution having a mean of zero and standard deviation of $\sigma = \pi / \sqrt{3}$.

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

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

The log-likelihood function is

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

where $I_{Y_i=j}$ is an indicator function for individual *i* choosing the *j*th alternative. We use a maximum likelihood method to estimate the model.

Data

We recruited 127 untrained consumer panelists and provided a small nonmonetary item as compensation for participation in the study. Each participant signed an informed consent form and the project was approved for human subject participation by a university institutional review board. Using a survey, we collected information about the panelists' socio-demographic characteristics, beer purchases, beer consumption, and drinking behavior. All participants were 21 years of age or older. Table 1 presents summary statistics

for the demographic variables. In our sample, 57.5 percent of the participants were male. The mode age group was 26 to 30 years and the mode annual income was between $20,000 and $29,000. Almost 78 percent of the respondents were white/Caucasian. Since our sample came from a university community, 51 percent of the panelists held an advanced degree. As with all surveys, we were concerned about sample representativeness. We acknowledge that there are limitations regarding the extent to which our findings can be fully generalized to broader populations.

For this study, we used four beers specifically brewed to have different levels of hops and bitterness. Each beer was brewed with a different type of hops (Columbus, Chinook, Mt. Hood, and Willamette, all grown at a facility operated by Washington State University and located outside of Prosser, Washington). Table 2 presents a summary of the style, hop content, and alcohol content of each beer.

We collected data on consumer preferences and perceptions of the sensory attributes of the beers through blind tastings conducted at Washington State University's sensory evaluation facility in 2013. The beers were kept in a cooling area prior to the experiment. In each tasting, the beer samples were presented one at a time in random order. Each sample consisted of 25 milliliters (ml) of beer served in an International Standards Organization / *Institut National des Appellations d'Origine* (ISO/INAO) tulip-shaped wine tasting glass covered with a petri dish at refrigerated temperatures (approximately 5 degrees Celsius) and was coded with three digits. Consumer panelists were instructed to rinse their palates with a bite of cracker and deionized filtered water and wait at least 30 seconds between tastings.

After the panelists tasted each sample of beer, they were asked questions about how much they liked the sample based on five sensory attributes: appearance, aroma, taste/flavor, hoppiness, and overall liking. Each attribute was a categorical variable that took a value between 1 (the panelist strongly disliked the sample) and 9 (the panelist strongly liked the sample). Table 3 presents summary statistics for the results of the tastings. Beer 3 was the panelists' favorite in the majority of categories while beer 2 was most popular in terms of appearance.

Panelists were next asked CV questions. They were offered the opportunity to buy a specific beer and were asked if they were willing to pay $6.99 for a six-pack of it. That was the average market price for a six-pack of beer at the time of the study. If the panelist was willing to pay the initial amount, a second offer was made of the same beer for a higher, "premium" price. If the panelist rejected the initial price, a second offer was made of the same beer for a lower, discounted price. To cover the distribution of consumers' WTP, the premium offer was one of four amounts randomly assigned to the participant: $7.49, $7.99, $8.49, or $8.99. Similarly, each participant who rejected the initial price was offered a randomly chosen discount price of $6.49, $5.99, $5.49, or $4.99. Thus, each panelist received a second offer of either a discounted or a premium price based on their initial response. The range of prices offered was determined by pre-testing of the questionnaire.

Panelists were also asked about their beer buying and consumption habits (see Table 4). About 41 percent of the respondents drank beer a few times per week; 24 percent drank beer once a week. On average, participants drank just short of two servings (12 ounces per serving) of beer at a time. This is comparable to average U.S. consumption, which is about four pints per week

Table 1. Definitions and Summary Statistics of the Demographic Variables

Variable Description	Frequency (percent)	Mean	Standard Deviation
Gender		0.574	0.495
1 if male	57.48		
0 if female	42.52		
Age		2.535	1.414
1 if 21–25	31.50		
2 if 26–30	22.05		
3 if 31–40	23.62		
4 if 41–50	8.66		
5 if 51–60	12.60		
6 if 61–70	1.57		
Student		0.512	0.500
1 if student	51.18		
0 otherwise	48.82		
Income		2.807	2.436
1 if less than $19,999	47.06		
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 $150,000 or greater	47.06		
Prefer not to answer	6.30		
Race		0.780	0.416
1 if white/Caucasian	77.95		
0 otherwise	22.05		
Married		0.349	0.477
1 if married	34.92		
0 otherwise	65.08		
Education		4.346	0.758
1 if some high school	—		
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 India pale ale	Chinook	6.0 percent
Beer 2	American India pale ale	Columbus	6.0 percent
Beer 3	Honey ale	Mt. Hood	7.1 percent
Beer 4	Honey ale	Willamette	7.1 percent

(Beer Institute 2013). Beer was most often consumed at home. Overall, the most popular style of beer was amber. Pale ales were the second most popular style and dark/stout beers were third most popular. Panelists reported paying $7 to $8 on average for a six-pack, and taste was more important than price (second) or brand (third) in selecting a beer to buy. Other factors mentioned by the

Table 3. Summary Statistics of Sensory Attributes by Beer Sample

Sensory Attribute Variable	Mean	Standard Deviation
Scale: 1=Extremely Dislike Attribute – 9=Extremely Like Attribute		
Overall		
Appearance	6.553	1.446
Aroma	6.159	1.560
Taste/Flavor	5.569	2.034
Hoppiness	5.482	1.764
Sample 1		
Appearance	6.488	1.397
Aroma	6.110	1.503
Taste/Flavor	6.110	1.503
Hoppiness	5.591	1.724
Sample 2		
Appearance	6.638	1.467
Aroma	6.173	1.633
Taste/Flavor	5.449	1.995
Hoppiness	5.173	1.890
Sample 3		
Appearance	6.496	1.490
Aroma	6.268	1.635
Taste/Flavor	5.819	1.958
Hoppiness	5.803	1.700
Sample 4		
Appearance	6.591	1.438
Aroma	6.087	1.475
Taste/Flavor	5.488	2.232
Hoppiness	5.362	1.689

Table 4. Beer Consumption and Preferences

Variable Description	Scaled Values and Frequencies (percent)	Mean	Standard Deviation
Frequency of Beer Consumption		3.055	1.160
1 if occasionally	15.75		
2 if once or twice a month	13.39		
3 if once a week	24.41		
4 if a few times a week	42.52		
5 if every day	3.94		
Home: Frequency of beer consumption at home		3.220	1.109
1 if least often	14.17		
2 if less often	10.24		
3 if more often	14.96		
4 if most often	60.63		
Type of Beer		0.646	0.480
1 if microbrew	64.57		
0 otherwise	35.43		
Ranking of 1=least favorite – 9=most favorite			
Lite		3.646	2.345
Lager/Pilsner		4.882	1.711
Amber		6.055	1.488
Pale Ale		5.394	1.728
Dark/stout		5.008	2.415
Indian pale ale		4.480	2.153
Weather: Deciding factor for beer consumption		0.150	0.357
1 if weather is deciding factor	14.96		
0 otherwise	85.04		
Factor Importance for Beer Consumption: 1=least important – 4=most important			
Price importance		2.591	0.681
Taste importance		3.850	0.378
Brand importance		2.433	0.648
Pay: Actual amount paid for beer per six-pack		3.055	0.836
1 if less than or about $5	0.79		
2 if $6.00 – $6.99	24.41		
3 if $7.00 – $7.99	48.82		
4 if $8.00 – $8.99	20.47		
5 if $9.00 – $9.99	5.51		
6 if $10.00 or more	—		
Friends		4.102	2.416
1=strongly disagree – 9=strongly agree: *I am willing to drink whatever beer my friends are drinking*			
New place		8.055	1.570
1=strongly disagree – 9=strongly agree: *When in a new place, I am willing to try local beers*			
New beer		7.386	1.846
1=strongly disagree – 9=strongly agree: *I enjoy trying new beers as they become available*			

panelists as affecting their choices were labeling/packaging, recommendations by others, and brewery specifications.

Panelists were then asked whether they agreed with several statements related to their consumption of beer. Their degree of agreement or disagreement with each statement was measured using a Likert scale, generating categorical variables that took a value between 1 (strongly disagrees with the statement) and 9 (strongly agrees). The data show that the majority of the panelists were eager to try local beers when in a new place and to try new brands and types of beer as they became available in the market. Descriptive statistics from the data are presented in Tables 2 through 4.

Results and Discussion

We present parameter estimates from the double-bounded CV analysis and marginal effects of the variables with confidence intervals in Table 5. As expected, the coefficient on the bid is significant at the 1 percent level and has a negative effect. That is, as the bid amount increases, the probability of a participant choosing to buy the product decreases. Figure 1 shows the distribution of the probability of accepting the offer to purchase the beer for each bid amount.

In terms of sensory attributes, the taste variable has a positive and significant effect at the 1 percent level. Panelists who liked the taste of a specific beer and rated it one unit higher on the nine-point Likert scale were willing to pay 41 cents more for a six-pack of that beer. Taste is one of the major factors on which consumers base decisions about repeat purchases. They are more likely to buy a beer that tastes good to them again and are willing to pay more for it than for other beers. Thus, the results show that microbrewers can demand higher prices for the premium taste of their beers.

Panelists reported their evaluations of the hoppiness intensity in each beer. Since consumers likely have heterogeneous preferences for the intensity of hop flavor, hoppiness is a "horizontal quality attribute"—there is a distribution of consumer preferences and an individual consumer prefers the level of that

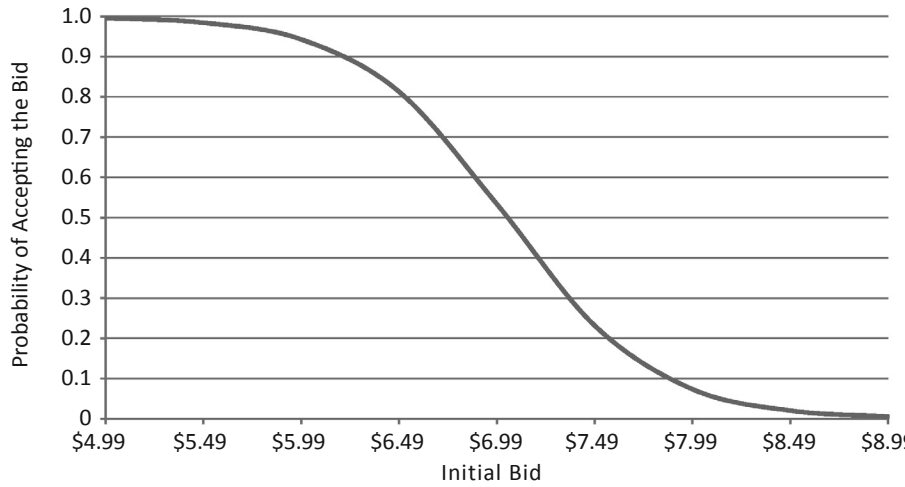

Figure 1. Probability of Willingness to Pay as Bid Varies

Table 5. Coefficient Estimates and Marginal Effects of the Explanatory Variables on Mean WTP for Beer

Variable	Coefficient Estimate	Standard Error	Z-statistic	Marginal Effects Estimate	Standard Error	Z-statistic	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
Microbeer	0.709**	0.325	2.183	0.266**	0.121	2.196	0.067	0.464

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Table 5. (continued)

Variable	Coefficient Estimate	Standard Error	Z-statistic	Marginal Effects Estimate	Standard Error	Z-statistic	90% Confidence Interval Lower Bound	90% Confidence Interval Upper Bound
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
India pale ale	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 a 10 percent level. ** Significant at a 5 percent level. *** Significant at a 1 percent level.

attribute that is closest to his or her ideal level. Our results show that a panelist who increased the ranking of a sample based on its perceived hoppiness by one unit on the nine-point scale was willing to pay 11 cents more for a six-pack of that beer. Note, however, that our results do not imply a direct relationship between actual hoppiness and WTP.

Quality differentiation through taste is a major tool for microbreweries in a market dominated by macrobrewers. The many varieties of hops available make it relatively easy to create new beers with unique sensory attributes. Thus, microbrewers can charge a higher price by brewing a beer with a taste/hoppiness that is especially appealing to consumers. We find that the appearance and aroma of beer, on the other hand, do not have significant impacts on estimated WTP. Perhaps the untrained consumer panelists could not differentiate the samples by those characteristics. The mean scores for appearance and aroma for the samples are not statistically different. If we had offered a more extreme difference in those characteristics, such as a light lager or dark stout beer, there might have been greater variation. However, our use of beers that were relatively similar in appearance and aroma allowed us to focus on the influence of hops.

Consumers with relatively high incomes are willing to pay more for a beer, a difference that is significant at the 10 percent level. This result shows that beer is a normal good. According to the marginal effect of the income coefficient, a one-category increase ($10,000) in consumer income would increase WTP for a six-pack of beer by 5 cents. Age, on the other hand, has a negative and significant impact on WTP for beer at the 1 percent level. When age goes up by one category, WTP decreases by 17 cents. One potential explanation for this negative relationship between age and WTP is that older consumers may have already developed taste-based preferences for specific beers and thus are less likely to pay more for more recently developed microbrew-style beers. Another possible explanation is that older consumers may prefer wine or other spirits to beer. Married consumers are also less willing to pay for beer; the variable is significant at the 10 percent level and has a negative sign. White/Caucasian consumers are willing to pay more for the sampled beers than other racial/ethnic groups.

Consumption frequency has a significant (at the 10 percent level) and positive impact on consumers' WTP for beer. Panelists who drank beer more often may have been connoisseurs and so were more informed about and appreciative of various beers and so were willing to pay higher premiums. Consumers who drink beer mostly at home are less willing to pay for beer (significant at the 5 percent level).

As expected, respondents who preferred microbrewed beers were willing to pay higher prices for microbrewed beers in our experiment (significant at the 5 percent level) than respondents who usually drank macrobrewed or imported beers. This may represent an exposure effect[3] and/or a preference for microbrewed beer. The variable that represents how much respondents usually paid for beer has a positive effect on WTP and is significant at the 1 percent level. This result suggests that participants who generally were willing to pay higher prices for a six-pack of beer at a grocery store were willing to pay higher prices for the sampled beers.

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

Respondents who agreed strongly with the statement "I am willing to drink whatever beer my friends are drinking" were willing to pay more for beer, and this effect is significant at the 1 percent level. There is no obvious interpretation of this result. Beer is a product that is often consumed in social settings. Psychological studies have indicated that qualities that affect consumer preferences exist not only in a product but also in the social setting in which the product is consumed (Hayakawa and Vinieris 1997). A possible explanation for our result is that these respondents' greater WTP is based mostly on their enjoyment of the product with friends.

We calculated overall mean WTP as

$$\frac{1}{\hat{\rho}}\left(\hat{\alpha}+\hat{\lambda}'\overline{\mathbf{z}}_i\right)$$

(Hanemann 1984) and a confidence interval using the delta method. The mean WTP for a six-pack of beer is $7.04 with a 95 percent confidence interval of $6.70 to $7.38. Though the point estimate is slightly higher (5 cents) than the initial price offered to consumers of $6.99 (based on the market price at the time), it is not statistically different. This result suggests that consumers, on average, are willing to pay the same price for the four sampled beers as they would pay in stores. Thus, we cannot say that consumers overall are willing to pay higher prices for the newer beers offered in the study. Nevertheless, the same consumers are willing to pay higher premiums for the sampled beers when they like the taste and hoppiness of the beers. As discussed earlier, the effect of taste is statistically significant. Consumers are willing to pay a 44 cent premium for superior taste alone.

McCluskey and Shreay (2011) found that international individuals in their sample who were living in the United States and who reported that taste was the most important factor in their choices of beers were unlikely to prefer U.S.-made beers. Thus, panelists who have strong preferences for specific taste attributes may underreport their WTP for the new varieties of beer presented to them in the experiment, and our results may understate WTP for the sampled products.

Conclusions

Considering the size and importance of the beer market in the United States, it is surprising that this study is the first to estimate consumers' WTP for beer based on sensory attributes and consumer demographics. We study the effects of intrinsic characteristics on consumers' WTP for beer and find that taste and hoppiness have a positive impact with taste having the largest impact. In our sample of beers, appearance and aroma did not vary much and we found no significant impact from those characteristics. Intrinsic cues such as taste are a primary basis for consumers' expectations of quality and decisions about whether to make repeat purchases of a product. Taste attributes represent the most important differentiating factor for craft beers, and both taste and hoppiness have positive and significant impacts on WTP.

The results of this study demonstrate that consumers who have relatively high incomes are willing to pay more for beer. In contrast, age has a negative impact on WTP. Consumers who drink beer relatively frequently and those who are willing to drink whatever beer their friends are drinking are willing to pay more for beer. People who drink beer mostly at home are willing to pay

less. Since all of the beer samples in our analysis were new to the panelists (we had them brewed and they were not commercially available), we expect that our model may underestimate overall WTP for beer based on sensory and demographic characteristics. Therefore, the impact of taste attributes on real WTP may be greater if consumers have already formed taste preferences.

Our findings can be useful to brewers making new product introductions into the market. Given beer and food trends in general, we expect that newly introduced beers will be increasingly differentiated and that different hop varieties and levels of hop intensity will be keys to quality differentiation. As consumers find beers that match their ideal concept of taste, they will be willing to pay a premium for them. However, the social aspect of beer consumption sets it apart from consumption of other products such as breakfast cereals and candy bars that also fall into the monopolistic competition category. Since beer is often consumed socially and is subject to an exposure effect, we recommend that brewers target consumers who drink beer relatively frequently and socially. Those consumers will influence their peers' consumption habits and WTP for beer.

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