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Consumers' Valuation of Soft Drinks Labeled with Calorie and Sweetener Information: The Impact of Taste

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Abstract

In the U.S., soft drink consumption has been considered one culprit for the obesity epidemic. Improved product labeling is considered a policy tool that can help consumers choose healthier products. This research uses an auction to determine consumers' willingness to pay (WTP) for soft drinks labeled with sweetener and calorie information after consumers tasted the soft drinks. Soft drink taste is the primary driver of consumers' WTP for soft drinks, while sweetener labeling also influences WTP. Calorie labeling has little impact on WTP. Consumers' least preferred soft drink label was "sweetened with HFCS"; sugar was consumers' most preferred sweetener ingredient.

Key words: calorie labeling, sweetener, soft drinks, taste, auction

1. Introduction

From 1995 to 2012, the percentage of obese people in the U.S. increased from 15.9% to 27.6% which is an increase of nearly 12% (Center for Disease Control, 2013). Although overall costs of poor nutritional habits of individuals are difficult to quantify, Finkelstein et al. (2009) estimated that the 2008 annual healthcare cost of obesity in the U.S. was $147 billion. Recent research has focused on identifying factors which contribute to the obesity epidemic in response to increased obesity rates and the corresponding increase in the cost of obesity in the U.S.

The consumption of soft drinks is one factor that is often blamed for increased obesity rates in the U.S. Similar to the pattern of increased obesity in the U.S., the percentage of calories individuals in the U.S. received from beverages increased from 11.8% in 1965 to 21.0% in 2002 (Duffey and Popkin, 2007). Specifically, Nielsen and Popkin (2004) discovered that energy intake from sweetened beverages increased 135% from 1977 to 2001. Ogden et al. (2011) also found that consumption of sugar drinks in the U.S. has increased over the past thirty years and approximately half of the U.S. population consumes sugar drinks every day[1].

Accordingly, Malik, Schulze and Hu (2006) and Vartanian, Schwartz and Brownell (2007) examined the association between obesity and soft drink consumption. Malik et al. (2006) conducted a meta-analysis examining the link between obesity and sugar-sweetened beverages and found that a positive association exists between increased consumption of sugar-sweetened beverages, weight gain and obesity in children and adults. A meta-analysis by Vartanian et al. (2007) also found support for strong correlations between soft drink consumption and increased body weight.

In general, the two most commonly discussed policy measures to improve obesity problems are (1) taxes on foods which are considered to lead to increased obesity and (2) improved labeling of food products (e.g. see Unnevehr (2013) for a review of research related to these policy measures). In relation to improving the labeling of food products, the American Beverage Association proactively pledged a "Clear on Calories" commitment which involves clear calorie labeling on the front of soft drink packages (American Beverage Association,

[1] Sugar drinks is defined by Ogden et al. (2011) as fruit drinks, sodas, energy drinks, sports drinks, sweetened bottled waters and excludes diet drinks.

2013). The impact of improved labeling of food products with regards to calorie labeling has also been investigated (e.g. Krieger and Saelens, 2013 and Swartz, Braxton, and Viera, 2011). This paper will build upon existing calorie labeling literature by investigating the impact of calorie labeling on consumers' soft drink preferences. Also investigated is how sweetener ingredient information impacts consumers' preferences for soft drinks. In addition to calorie information, sweetener ingredients in soft drinks are important information consumers may utilize to form preferences about soft drinks. Given the negative assertion made by some researchers that sweetener usage also contributes to the obesity epidemic (e.g. Lustig, Schmidt, and Brandis, 2012), it is critical to also consider how consumers utilize sweetener ingredient information on soft drinks and how this information impacts consumers' preferences of soft drinks. Ultimately, consumers' valuation of soft drinks is likely influenced by the existence of both calorie and sweetener information. Therefore, this analysis will determine the impact calorie information and sweetener information has on consumers' willingness to pay (WTP) for soft drinks.

Using a non-hypothetical second-price Vickrey auction, the objective of this research is to determine consumers' WTP for soft drinks labeled with different sweetener and calorie information. In addition, a determination is made on how soft drink taste impacts consumers' WTP for soft drinks. Research has shown that food product taste, in addition to ingredient information, is a leading driver of consumption behavior (Elbel, Gyamfi, and Kersh, 2011; Bollinger, Leslie, and Sorensen, 2011). Understanding how calorie and sweetener labeling on soft drinks impacts consumers' WTP for soft drinks is important for policy makers given improved labeling of food products is considered an important policy tool available for influencing consumers to eat and drink healthier foods. This research is also important for policy makers because it will help determine whether calorie and sweetener information is used by consumers, or instead ignored by consumers, if they are already familiar with the taste of the soft drinks they are purchasing. The results of this analysis will also assist the sweetener industry and food manufacturers in understanding which sweeteners consumers perceive most positively while also giving them estimates for what consumers are willing to pay for soft drinks labeled with different sweetener and calorie information.

The remainder of the paper is organized as follows. First a review of the literature is presented. Next an overview of the methods is presented followed by the empirical results. The final section concludes.

2. Literature on Calorie and Sweetener Ingredient Labeling

Krieger and Saelens (2013) provide an overview of studies from 2008 through 2012 which examine the impact of restaurant and cafeteria menu labeling on consumer behavior. The authors conclude by stating, "Current evidence suggests that menu labeling produces modest 10 to 20 calorie-per-meal reductions in purchases when assessed among all customers" (Krieger and Saelens 2013, pg. 7). Swartz et al. (2011) also provides a review of several research articles examining the impact of consumer purchase decisions regarding the presence of calories on menus. They conclude by stating, "It appears that calorie menu labeling does not have the intended effect of decreasing calorie ordering and consumption from quick-service restaurants" (Swartz et al., 2011, pg. 7). Elbel et al. (2011) found, as well, that calorie labeling did not result in any statistically significant difference in calories purchased. According to Elbel et al. (2011), seventy-two percent of adolescents stated that taste was the most important factor in their meal selection. In terms of beverage specific impacts on calorie labeling, Bollinger et al. (2011) examined consumers' purchase decisions in Starbucks after mandatory calorie posting became effective. They found that average calories per transaction fell by six percent for consumers' food choices. They also discovered that there was no impact of calorie

labeling on consumers' purchase decisions regarding beverages. Bollinger et al. (2011) had survey respondents rate the importance of taste, price and calories in their purchase decisions. Survey participants in both Seattle and San Francisco specified that taste was the most important factor in their purchase decision followed by price and calories. Ultimately, previous research has determined that calorie labeling on food products does not have a strong impact on consumers' purchasing decisions; however, previous research has discovered that consumers consider taste the most important factor influencing food choice.

Therefore, this study will help improve existing literature by determining how important product taste is in determining consumers' WTP for soft drinks labeled with varying amounts of calories and sweetener information. This research also contributes to previous research by examining how consumers' WTP for soft drinks is impacted when presented with different sweetener information. While a stream of literature exists examining the impact of calorie labeling on consumers' food choices, to the authors' knowledge no known research has previously investigated how sweetener information impacts consumers' food choices. While consumers may disregard calorie information when making decisions, they may have strong preferences for which types of sweeteners are in soft drinks especially because of recent negative attention in the U.S. given to sweeteners like high-fructose corn syrup (HFCS) (e.g. Sweet Surprise, 2013).

3. Non- Hypothetical Experimental Auction

To determine how consumers' WTP for soft drinks labeled with different calorie and sweetener information is impacted by taste, a non-hypothetical second price Vickrey auction was conducted. Non-hypothetical Vickrey auctions have been used extensively in literature to determine consumers' WTP for several food products and their methods are well established (e.g. Lusk and Shogren, 2007; Grebitus et al., 2013; Corrigan and Rousu, 2006; Lusk et al., 2004; Melton et al., 1996; Lusk et al., 2001; Umberger et al., 2002; Umberger and Feuz, 2004; Feuz et al., 2004). Experimental auctions are a preferred way of determining consumers' WTP for products because they avoid the problem of hypothetical bias (i.e. participants overstating WTP) by being incentive compatible (e.g. List and Gallet, 2001; Little and Berrens, 2004; Murphy et al., 2005). Furthermore, when informing participants of the demand revealing strategy of an experimental auction, which was done in this study, it has been shown that experimental auctions are in fact demand revealing (e.g. Table 2.3 in Lusk and Shogren, 2007). To accommodate a non-hypothetical laboratory experiment, examining different sweetener and calorie labeling scenarios for soft drinks is feasible because the soft drink industry produces soft drinks containing various amounts of calories and sweeteners.

The experimental design in this research had two treatments. In Treatment 1 there were seven sessions, with seven to twelve participants in each session, for a total of sixty-one participants. In Treatment 2, there were a total of seven sessions, with seven to twelve participants in each session, for a total of seventy-one participants. In both treatments, prior to participating in the soft drink auction, subjects first participated in a second-price Vickrey auction with chocolate bars to familiarize themselves with the auction procedure. Participants were given examples of how the auction worked and information regarding why the best strategy was to bid truthfully. Both treatments had two bidding rounds.

Prior to each round of bidding, subjects also participated in a blind taste test where they tasted each soft drink on which they were bidding. Participants used the Schutz and Cardello (2001) labeled affective magnitude scale (LAM scale) to rank the taste of each soft drink on a scale from one to eleven, with one being greatest imaginable dislike and eleven being greatest imaginable like.

In Treatment 1, Round 1, participants tasted five soft drink samples in cups labeled one through five and rated them according to the LAM scale. The participants then bid on those five soft drinks. The soft drinks were labeled with sweetener information only. In Round 2, participants tasted five soft drink samples in cups labeled six through ten and rated them according to the LAM scale. The participants then bid on those soft drinks. In Round 2 the soft drinks were labeled with sweetener and calorie information. This concluded the auction.

In Treatment 2, the procedure was the same, except in Round 1 labels only contained calorie information instead of sweetener information. The taste tests and bidding rounds proceeded the similar to Treatment 1. Table 1 illustrates the labeling of the soft drinks in the bidding rounds in Treatment 1 and Treatment 2.

Table 1. Soft Drink Labeling by Round

	Treatment 1	**Treatment 2**
Round 1	Sweetener	Calories
Round 2	Sweetener and Calories	Sweetener and Calories
Number of Observations	61	71

Table 2 illustrates the specific information regarding the twenty-ounce soft drinks used in the experiment. The soft drinks were all Pepsi products but the labels were removed as illustrated in Figure 1. In addition to the labeled soft drinks, one soft drink contained no label or information and this was referred to as the "control." The control soft drink was Pepsi and contained 250 calories and was sweetened with HFCS but remained unlabeled so a direct comparison could be made between a completely unlabeled soft drink and the labeled soft drinks. The order in which the bottles were presented to the participants was randomized between bidding rounds and sessions following an NGENE design. Figure 1 exemplarily illustrates the appearance of a soft drink from Round 2.

Table 2. Specific Labeling Information

Soft Drink #Number	Product	Calories	Sweetener**
1	Pepsi (No label/Control)	Unlabeled	Unlabeled
2	Pepsi	250	HFCS
3	Diet Pepsi	0	Aspartame
4	Pepsi Throwback	260	Sugar
5	Pepsi Next	100	HFCS and Aspartame

* The order of the soft drinks was randomized between rounds and sessions following a design generated with the software NGENE.

**This is the primary sweetener used in the soft drink. HFCS=High Fructose Corn Syrup.

Ultimately, the experimental auction procedures were as follows:

Step 1 The rules of the auction were described and subjects were told why their best strategy in the auction was to bid according to what their maximum WTP was for the soft drinks.

Step 2 Subjects bid on the five soft drinks in Round 1. In Round 1, depending on the treatment, participants either bid on four soft drinks labeled with only sweetener information or four soft drinks with only calorie information. The fifth soft drink had no label and served as the "control." Participants' bid sheets were then collected by the monitor.

Step 3 Subjects bid on the five soft drinks in Round 2. Four soft drinks were labeled with

both calorie and sweetener information. The fifth soft drink had no label and served as the "control." Participants' bid sheets were then collected by the monitor.

Step 4 In each session, one round was randomly selected as the "binding" round. The individual who bid the highest price for the soft drinks then paid the second highest price and received the product. All other bidders paid nothing and received nothing other than their participation payment. Participants were informed that under any circumstances they would take home more than one soft drink if they were the winner of the auction.

Figure 1. Sample Round 2 Soft Drink

4. Empirical Results

4.1 Sample Characteristics

Data for this analysis was collected by researchers at a large university in the U.S. A total of 132 participants were recruited via email lists, flyers and online recruitment. Participants were recruited based on the fact that they were Pepsi drinkers because all of the soft drinks in the auction were Pepsi products. Interviewees received $30.00 as compensation for their time. Table 3 illustrates the socio-demographics of the sample. The sample is characterized by an almost even share of male and female respondents. The sample is slightly younger than the U.S. population. The sample's education level is higher than that of the average U.S. American. The income level is comparable to that of the U.S. population. A lower share of the sample is white compared to the U.S. population. The average household size is 2.3, with 22% of the households having children in the household.

Table 3. Sample Socio-Demographics

Characteristics	Mean	S.D.	U.S. Population
Gender (female %)	48.50%	0.50	50.80%[1]
Age (years)	33.33	14.23	37.22[2]
Household Size	2.33	1.51	2.61
Education (% bachelor's degree and above)	45.5%	0.50	28.20%[1]
Annual Household Income	$47,654.00	$36,901.00	$52,762.00
Households with children under 12	21.97%	0.42	
Race (% white)	65.90%	0.48	78.1%[1]

[1]U.S. Census Bureau, 2011 [2]CIA Factsheet

4.2 Descriptive Results for Taste Test

Table 4 illustrates the results from the taste tests conducted prior to the bidding rounds. Participants were not given any labeling information regarding the soft drinks prior to the taste tests. The control soft drink was a HFCS sweetened soft drink, containing 250 calories, which was directly comparable to the HFCS, 250 calorie labeled soft drink. The control was chosen to be the HFCS sweetened soft drink because among the sweeteners, HFCS is the most controversial. In terms of the taste test, the soft drink sweetened with HFCS and containing 250 calories was ranked as the best tasting soft drink consistently throughout the treatments. The soft drink sweetened with Aspartame and HFCS and containing 100 calories was ranked the second best tasting soft drink followed by the soft drink sweetened with sugar and containing 260 calories. The least preferred tasting soft drink was sweetened with aspartame and contained zero calories.

Table 4. Results for Taste Test

	Treatment 1 Round 1		**Treatment 1 Round 1**		**Treatment 1 and 2 Round 2**	
Label on product / **Product tasted**	**Sweetener**		**Calorie**		**Calorie and Sweetener**	
	Mean	SD	Mean	SD	Mean	SD
No label (Control)	7.08	2.15	6.39	2.18	6.27	2.03
HFCS/250 calories	6.31	2.34	6.79	1.96	6.54	2.14
Aspartame/0 calories	5.43	2.45	4.85	2.10	4.67	2.43
Sugar/260 calories	5.51	2.85	5.76	2.36	5.11	2.50
HFCS and Aspartame/ 100 calories	6.21	2.36	5.96	2.10	5.82	2.33

4.3 Descriptive Results for Willingness to Pay for Calorie and Sweetener Labeling

Table 5 displays the mean bids in Round 1 for Treatment 1 (sweetener labels) and Treatment 2 (calorie labels). From visual inspection of Table 5 it is apparent that calorie labeling had little impact on consumers' WTP for soft drinks while sweetener labeling produced large impacts on consumers' WTP for soft drinks. In terms of sweetener labeling there is great variability between consumers' mean bids for soft drinks labeled with different sweetener information. For example, once a soft drink contains a HFCS label, consumers bid nearly twenty cents less for the soft drink. However, in terms of calorie labeling there is little

variability between mean bids. If a soft drink contains a label of 250 calories, participants actually bid nearly two cents more for the soft drink than if it contained no label.

Table 5. Bids (in cents) for Round 1

	Treatment 1 Sweetener Label only		**Treatment 2 Calorie Label only**
Soft Drink Label	Mean (n=61)	**Soft Drink Label**	Mean (n=71)
No label	51.10	No label	50.00
HFCS	30.43	250 Calories	51.68
Aspartame	34.41	0 Calories	45.99
Sugar	45.51	260 Calories	52.87
HFCS and Aspartame	32.69	100 Calories	51.77

Table 6 displays the mean bids for Round 2, which involved soft drinks being labeled with both sweetener and calorie information. Results are presented jointly for Treatments 1 and 2. One of the most interesting results from Round 2 is that if a soft drink was labeled with only its sweetener information compared to both its sweetener and calorie information, consumers on average bid 13.02 cents less for the soft drink labeled HFCS compared to the soft drink labeled HFCS and 250 calories. Thus, once consumers found out the calorie information associated with HFCS, they were actually willing to bid 13.02 cents more for the soft drink. Once again, this confirms that consumers do not utilize calorie information labels. This suggests that most sweeteners, especially HFCS, causes consumers to lower their WTP estimates.

Table 6. Bids (in cents) for Round 2

Soft Drink Label (n=132)	Mean	Sweetener only Mean Difference*	Calorie only Mean Difference*
No label	47.61	-3.49	-2.39
HFCS/250 Calories	43.45	+13.02	-8.23
Aspartame/0 Calories	41.56	+7.15	-4.43
Sugar/260 Calories	40.60	-4.91	-12.27
HFCS and Aspartame /100 Calories	42.27	+9.58	-9.50

*This is the difference between participants' mean bids in treatment 1 (calorie label only) in Round 1 and the bids in Round 2 and the difference between participants' mean bids in treatment 2 (sweetener label only) in Round 1 and the bids in Round 2, respectively.

4.5 Econometric Results

The results presented above do not account for the fact that many participants bid zero for some of the soft drinks. Therefore, the means that are reported above are censored means. To address this issue, Tobit models with the lower bound set to zero are applied to account for participants' zero bids (Greene, 2003). In each round, participants bid on five different soft drinks which creates a panel. Thus, a random-effects Tobit panel model is utilized to determine consumers' WTP for soft drinks labeled with different calorie and sweetener information. In addition to this, separate Tobit models are estimated to determine which consumer socio demographics are predictive of bidding behavior for each specifically labeled soft drink.

Results Round 1: Sweetener versus Calorie Labeling

In Round 1 participants either saw only sweetener information (Treatment 1) or only calorie information (Treatment 2). Table 8 displays the results for both Treatment 1 and Treatment 2.

The dependent variable in all models was consumers' bids, in cents, for the soft drinks. Independent variables in the model included dummy variables indicating the labeling information. For example, in the Treatment 1 model, the dummy variable "aspartame" is equal to one if the participants bid on a soft drink labeled "sweetened with aspartame." The other dummy variables were also constructed following this procedure. For example, in the Treatment 2 model, the dummy variable "260 calories" is equal to one if participants bid on a soft drink labeled "260 calories." The other dummy variables were constructed following this procedure.

The "HFCS" and "250 calorie" label variables were dropped from the models, respectively due to multicollinearity. Thus, all variables are compared to the condition of "HFCS" or "250 calories", respectively. The HFCS labeled soft drink was chosen to be compared to because, in terms of sweeteners, in the U.S. the sweetener HFCS has received a great deal of negative attention in recent years for being bad for peoples' health, thus, making HFCS the most interesting sweetener to analyze (Sweet Surprise 2013). To provide a consistent analysis, the associated calorie attribute for HFCS is also dropped in the calorie model (e.g., 250 calories). When comparing the calorie options, great variability exists between all of the calorie options; therefore, comparing "0 calories," "260 calories" and "100 calories" to the "250 calorie" option still creates important and interesting results.

As illustrated by Table 8, when controlling for taste, it is apparent that sugar is the most preferred sweetener, meanwhile HFCS is very negatively perceived. If the soft drink was labeled "sweetened with sugar" as opposed to "sweetened with HFCS" the average participant bid twenty-seven cents more. If the soft drink contained no label compared to "sweetened with HFCS," the average participant bid nearly eighteen cents more for the soft drink. Taste was significant in both the model. As participants enjoyed the taste of the soft drink more, this increased their bids for the soft drinks by approximately eleven cents. In terms of calorie labeling, participants were willing to pay nearly nineteen cents more for a zero calorie option. Once again, taste was strongly significant.

Table 8. Results for Round 1

	Treatment 1 (Sweetener labeling)		**Treatment 2 (Calorie labeling)**
Variable	Coefficient	Variable	Coefficient
No label	17.591**	No label	5.136
Sugar	27.269***	260 Calories	12.957
Aspartame	16.936*	0 Calories	18.533**
HFCS and Aspartame	7.406	100 Calories	13.256*
Income	-0.130	Income	-0.287
Age	-0.411	Age	0.804
Gender	-16.632	Gender	-12.664
BMI	1.116	BMI	0.774
White	-19.867	White	-17.940
Taste Test	11.326***	Taste Test	12.991***
Constant	-43.542	Constant	-60.289**

Note: Participants tasted the same soft drink in both the "no label" and HFCS, 250 calorie conditions to further improve analysis on the impact of taste. *** p<0.01, **p<0.05, *p<0.10

Results Round 2: Sweetener and Calorie Labeling

Table 9 examines consumers' WTP for soft drinks when they are labeled with both sweetener and calorie information. The model was analyzed similar to the Round 1 models. Again, taste was strongly significant. If a soft drink was labeled as "sweetened with sugar/ 260 calories" on average participants bid twelve cents more than if a soft drink was labeled "sweetened with HFCS/250 calories." Once again this suggests consumers prefer sugar compared to HFCS. If a soft drink was labeled, "sweetened with aspartame/0 calories," on average participants bid eighteen cents more for the soft drink than if it was labeled, "sweetened with HFCS/250 calories." Interestingly, if a participant was white, they on average bid nearly twenty-seven cents less for all soft drinks.

Table 9. Results for Round 2

Variable	Coefficient
Control	8.762*
Sugar/260 Calories	12.090**
Aspartame/0 Calories	18.047***
HFCS and Aspartame/100 Calories	7.358
Income	-0.125
Age	-0.231
Gender	-6.906
BMI	1.155
White	-26.872***
Taste Test	11.530***
Constant	-37.699*

Note: Dummy variable "HFCS and 250 calories" was dropped, so results are compared to that condition. *** p<0.01, **p<0.05, *p<0.10

5. Conclusions

When consumers decide to purchase food products they utilize ingredient information to determine what they would be willing to pay for the food product. If they are familiar with the product, the food product taste likely also plays an important role in consumers' purchasing decisions. In terms of soft drink purchases, taste of the soft drink, calorie information and sweetener ingredient information are assumed to be the primary sources of information used to determine consumers' WTP for the soft drink. This research confirmed previous literature (e.g. Bollinger et al. 2011; Elbel et al. 2011) that, ultimately, the most important driver of soft drink consumption is the taste of the soft drink. Results also confirm previous studies (e.g. Krieger and Saelens, 2013; Swartz, Braxton, and Viera, 2011) which indicate calorie labeling does not have a strong influence on consumers purchasing decisions.

Most interestingly, as evidenced particularly in Round 1, sweetener labeling has a greater impact on subjects' WTP for soft drinks than calorie labeling. Given many policy initiatives have focused on increased front of packaging calorie labeling, as well as menu calorie labeling, this research suggests that particular ingredient labeling may be more effective at nudging consumers towards healthier food choices. For example, if soft drinks were labeled as "sweetened with HFCS," consumers' WTP for the soft drink immediately decreased by nearly forty percent.

Results indicate that if consumers are already familiar with the taste of food products, they may not be willing to change their food preferences if calorie labels are suddenly present. However, results do suggest that if consumers are already familiar with the taste of the food product, one possible avenue to reduce consumers' WTP for food products is to emphasize that the food product is made with an ingredient they perceive as unhealthy (e.g. HFCS). This information is important for policy makers to consider as they move forward with different legislation aimed at influencing consumers to make healthier food choices.

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