CONSUMER WILLINGNESS-TO-PAY FOR SUSTAINABILITY ATTRIBUTES IN BEER: A CHOICE EXPERIMENT USING ECO-LABELS

by

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ABSTRACT

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Commercial and regional brewers are increasingly investing in sustainability equipment that reduces input use, operating costs, and environmental impact. These technologies often require significant upfront costs that can limit market access to microbreweries. One potential solution for these brewers is to market their product as sustainable and charge a premium for their product to offset some of the costs. A stated preference choice experiment of a nationally-representative sample is undertaken to elicit consumer willingness-to-pay (WTP) for sustainability attributes in beer, thus determining whether a market for sustainably-made beer exists. The facets of sustainability, including water reduction, energy reduction, and landfill diversion, are portrayed through eco-labels affixed the front of the primary packaging (aluminum can or glass bottle). Multiple specifications are employed to handle model shortcomings and incorporate discrete heterogeneity. Across all model specifications, consumers show positive and statistically significant marginal WTP for landfill diversion practices and carbon reduction practices, ranging from \$0.40 to \$1.37 per six-pack and \$0.67 to \$1.21 per six-pack, respectively. These results indicate consumers do in fact place value on beer produced using sustainable practices, and the demographics of consumers with the greatest WTP are similar to that of craft beer consumer.

INTRODUCTION

Brewing beer is a water- and energy-intensive process that generates a great deal of waste, especially for craft brewers as their products require more inputs to extract the flavor of the hops (Brewers Association, 2016a). Craft brewers are defined as breweries that produce less than six million barrels annually, are independently owned and operated, and use traditional ingredients (Brewers Association, 2019b). On average, each barrel of craft beer produced requires the use of seven barrels of water (Brewers Association, 2017c); uses nearly 80.5 kilowatt-hours of energy (Sloane, 2012); and generates 280 pounds of solid waste (Brewers Association, 2017b). Water and energy consumption is smaller for macro-brews, or commercial beer produced by large breweries like Anheuser-Busch (AB) InBev.

Macro-brewers are increasingly investing in technologies and practices to enhance the sustainability of their production. For example, AB InBev agreed to a partnership with a wind energy farm in 2017 to purchase enough renewable energy to brew 20 billion 12-ounce beers annually (AB InBev, 2019). Beginning in January 2018, the company placed a label on each can and bottle of Budweiser stating that the beer has been brewed with "100% renewable electricity" (AB InBev, 2018b). The brewer also recently purchased 2.2 million bushels of sustainable rice at a price premium from Indigo Agriculture, serving as an early investor to the company devoted to sequestering carbon dioxide from the atmosphere by incentivizing farmers to engage in regenerative agriculture (Burwood-Taylor, 2019). Regional craft breweries, the largest segment of craft brewers, have also begun adopting sustainable technology to lower input use (Hoalst-Pullen, Patterson, Mattord, & Vest, 2014), just not at the same scale as AB InBev.

These technologies encompass different aspects of environmental sustainability including: (i) water use and wastewater reduction; (ii) energy reduction and decreased carbon emissions; and (iii) increased landfill diversion or solid waste reduction. The Brewers Association, the primary craft beer organization with more than 50,000 members in the United States, has released sustainability manuals highlighting best practices and breweries leading the charge in sustainability. Examples of sustainability investment include clean-in-place (CIP) systems, solar panels, carbon dioxide recovery systems, and cardboard/plastic balers. These technologies are often adopted by commercial and regional breweries.

In contrast, microbreweries, the smallest craft brewers, face numerous challenges to sustainable production. These include (i) restricted financial access to technologies that promote sustainability, which often require significant up-front capital expenditures (Hoalst-Pullen et al., 2014), and (ii) tight profit margins presenting extreme risk on investment.

The primary goal of this study is to estimate willingness to pay (WTP) for beer produced with sustainable technologies that reduce water use, energy use, or increase landfill diversion. If consumers are willing to bear some of the cost for the brewery to invest in the technology, or if the brewery could simply attract more consumers by marketing their product as sustainable, then microbreweries can continue to compete in the market while simultaneously reducing their environmental impact.

While existing work examines WTP for organic and locally-sourced craft beer (Ha, 2017; Hart, 2018; Waldrop & McCluskey, 2018), little prior work estimates WTP for sustainability attributes in beer (Carley & Yahng, 2018). My study uses choice data from a nationally-representative survey of U.S. adults aged 21 and over to estimate consumers' WTP for sustainability attributes in beer. Specifically, I design a stated preference discrete choice experiment following Van Loo, Caputo, Nayga, Jr., & Seo (2015) and Janßen & Langen (2017). Each survey respondent is asked to envision the style of beer he or she most commonly purchases and is presented with a series of choice exercises. The beers vary in price and five additional attributes, including: (i) primary packaging; (ii) the amount of water consumed in production; (iii) the amount of energy consumed in production; (iv) the amount of solid waste generated in production; and (v) localness. Each sustainability attribute is indicated by eco-labels affixed the front of each hypothetical beer. Separating the eco-labels into different attributes allows for the estimation of marginal willingness to pay (MWTP) for each sustainability attribute, providing valuable insight into which sustainability factors consumers prefer most. Localness, which has no universal definition, is modeled by presenting a beer as "Locally Brewed" on the label. I use observations of respondents' choices to estimate MWTP for each attribute using multiple model specifications. The first is a standard multinomial logit (MNL) model with the full data set. A large portion of my sample comprises serial nonparticipants, or those who never choose a beer during the choice experiment (say, because they object to the study premise or do not typically purchase beer at prices represented in my experiment). I therefore account for serial nonparticipation by estimating several additional models, including a standard MNL dropping serial nonparticipants, a single-hurdle (SH) model following von Haefen, Massey, & Adamowicz (2005), and a latent class model (LCM).

Under the MNL with the full data set and MNL dropping serial nonparticipants, I find a large and statistically significant preference for beer packaged in glass bottles and for the landfill diversion and carbon reduction attributes. Under the SH, I find older, lower-income females are most likely to be serial nonparticipants. The results from this specification show positive and statistically significant premiums for packaging in glass bottles and all three sustainability attributes. The final specification, the LCM, groups respondents into three classes, which features a clear distinction between beer buyers, Classes 1 and 2, and non-beer buyers, Class 3.

Both beer buying groups show a positive WTP for glass bottles and landfill diversion, but Class 1 is also willing to pay a premium for carbon reduction practices. Class 2 has lower MWTP estimates than Class 1 across all attributes, suggesting a preference for non-sustainable, less expensive beer.

This study has two important empirical contributions to the brewing industry. Primarily, it is the first to elicit a dollar value for the extrinsic attributes associated with lower water use, decreased energy use, and increased landfill diversion in beer production and hence considers a broader perspective of sustainability than prior work (Carley & Yahng, 2018; Schmit, Rickard, & Taber, 2013). This is an important contribution as it attaches a monetary value to sustainability attributes, a necessary measure for microbreweries if they are to invest in sustainability technology. The results across all model specifications show consumers place a positive and statistically significant price premium on landfill diversion practices (ranging from \$0.40 to \$1.37 per six-pack) and energy reduction practices (ranging from \$0.67 to \$1.21 per six-pack), while water reduction practices remains statistically insignificant.

Second, the LCM specification allows me to group "like-respondents" into classes, which provides insight as to which demographics are important predictors of class membership. Classes 1 and 2 are comprised primarily of male beer buyers, but Class 1 is comprised of younger, median- to upper-income males that recycle and have higher preferences for sustainability attributes in beer. This is favorable to craft brewers, as these demographics appear to match their consumer demographics (Malone & Lusk, 2018b; Nielsen, 2018; Zondag & Watson, 2017). If true, brewers could differentiate their product from the competition using eco-labels or graphics on their packaging. This could attract new consumers that: (i) have a positive preference for sustainability attributes; and/or (ii) enjoy trying new beers—as 80% of craft beer buyers do, according to my sample—making investment in sustainable technology more feasible for microbreweries.

LITERATURE REVIEW

Sustainability in the Beer Market

Once a consolidated market of few commercial brands exhibiting complete market control, the United States is now home to more than 7,300 breweries with more in planning stages (Brewers Association, 2019). The beer industry is divided into three distinct categories: (i) commercial; (ii) import; and (iii) craft. Commercial beer, which will be interchangeably referred to as big beer and macro-beer, is mass produced. Big beer includes AB InBev, maker of beers such as Bud Light and Budweiser, and Miller-Coors, makers of Miller Lite and Coors Light. Imports are beers brewed in other countries and imported by the United States. Examples of imports include Heineken and Guinness. Breweries qualify as craft beer if annual production does not exceed six million barrels, have less than 25% ownership by a non-craft beer organization, and use traditional brewing ingredients (water, yeast, hops, and malt) (Brewers Association, 2019b).

Craft beer is divided into three categories: (i) regional brewers; (ii) brewpubs; and (iii) microbreweries. Brewers Association (2019a) defines a regional brewery as brewers producing between 15,000 and 6,000,000 barrels of beer annually. Brewpubs are restaurant-breweries with more than 25% of beer being sold on-premise. Microbreweries produce less than 15,000 barrels annually and 75% or more of sales for consumption off-premise. Craft beer now accounts for nearly 13.2% of beer market volume and sales now account for 24% of U.S. annual sales (Brewers Association, 2019c). The craft segment has grown because of its appeal to a wider range of consumers due to the broad range of styles and flavors. However, these beers require a more intensive brewing process with more inputs per barrel than commercial beers (Brewers Association, 2016a).

Xie et al. (2018) suggest climate change will lead to global beer shortages as extreme weather events reduce the global supply of barley, a key input to beer as it is used as malt. Watson & Swersey (2018) respond, stating brewers have been preparing for future shortages and have voluntarily reduced their environmental impact by creating sustainability goals and investing in efficient technology. Indeed, both commercial and craft breweries are adopting sustainability measures involving water, energy, and waste reduction. For example, AB InBev, responsible for 45.8% of U.S. beer production and 28% globally (Statista, 2019a; Statista, 2019b), recently partnered with an Oklahoma wind farm, purchasing $435 million worth of renewable energy—enough to brew 20 billion 12-ounce beers annually (AB InBev, 2019; Enel Green Power, 2017). The brewery markets this investment by placing a label on each can and bottle stating the beer is brewed with “100% renewable electricity” (AB InBev, 2018b). Craft brewers have also engaged in sustainability practices, but not at the same scale as the largest brewer in the world.

New Belgium Brewing Company, with breweries in both Fort Collins, Colorado and Asheville, North Carolina, is one of the most successful craft breweries in the United States in terms of production and sustainability. Their company webpage includes a “Sustainability” tab with sub-headers on water use, carbon emissions, and hops and barley (New Belgium Brewing Company, 2019b). Their sustainability initiative includes an internal energy tax to reduce fossil fuel use and save for carbon reducing technologies. Now, 18% of New Belgium Brewing Company’s electricity is produced through on-site solar and biogas (New Belgium Brewing Company, 2019d). Other regional brewers, such as Sierra Nevada Brewing Company and Bell’s Brewing Company, have invested in technology to promote different sustainability measures, including recycling and composting to achieve a 99.8% landfill diversion rate (Sierra Nevada

Brewing Company, 2019c) and a bio-energy building that converts more than 100,000 gallons of wastewater into renewable energy each day (Bell's Brewing Company, 2019).

Although these technologies require high upfront costs to the regional breweries, the hope is that the investment will pay for itself in the long run. These technologies may be infeasible for microbreweries due to the high upfront cost, lower production, and tighter profit margins, but the Brewers Association has created manuals of best brewing practices that all breweries, regardless of size or location, can apply (Brewers Association, 2019d).

Water Reduction and Wastewater Treatment

Beer is 90-95% water and is therefore a vital input in craft beer production (Olajire, 2012). However, water use goes beyond what is seen in the bottle or can. Water is used, and wastewater is generated, in nearly all components of the brewing process. Calculating total water use is essential to knowing the true environmental impact that comes from beer brewing. According to Brewers Association (2017c), the average brewery has a 7:1 barrel of water to beer ratio. Simply put, every six-pack of 12 oz. beers (72 oz.) requires nearly 4 gallons of water to produce. The water that does not end up in the final product (e.g., water used to clean tanks) is left behind as wastewater (Olajire, 2012). Breweries have therefore developed goals to reduce water use, or invest in technology and best practices to lower input costs and decrease their environmental impact.

Arguably the most important piece of technology is water meters and sub-meters, which record exactly how much water brewers use in the different steps of the brewing process. This allows breweries to track the full cost of water and wastewater, which Brewers Association (2017c) defines as the sum of: (i) the price of incoming water; (ii) sewer service charge; (iii) costs of energy and chemicals needed to process water; and (iv) labor and other costs associated with water processing and treatment.

Another more advanced technology that has significantly reduced water use for one brewery is a cellar clean-in-place (CIP) system. Bell's Brewing Company, near Kalamazoo, Michigan, has invested in a CIP system and claim it has reduced water use in the cleaning process by 65% compared to the traditional manual washing system (Bell's Brewing Company, 2019).

Smaller brewers can also follow best practices by engaging in water reuse (Brewers Association, 2017c). Much of the water consumed in the brewing process is used for cleaning and rinsing bottles, kegs, tanks, and other equipment. Rinse water "can be re-used for the external rinse or for the pre-rinse of the cask. If that is not possible, the final rinse water may be used for cooling applications or for conveyor belt washing" (Brewers Association, 2017c). Recycling and reusing this water can generate an instant reduction in water consumption at minimal cost.

Energy and Carbon Footprint

Reducing thermal and electrical energy use—and thus reducing carbon emissions—impacts brewers' environmental and financial sustainability by reducing both contributions to global climate change and energy expenditures, which can account for as much as 8% of a brewery's overhead costs (Olajire, 2012; Sloane, 2012). Some low-cost, energy efficient strategies that nearly any brewery can adopt are installing efficient lighting fixtures and motion sensors (Brewers Association, 2017a). These technologies do not require the significant upfront capital costs that some of the other technologies require (e.g., onsite renewable energy sources) and can pay for themselves in a matter of a few weeks (Olajire, 2012). One example is Rising Tide

Brewing, a brewery based in Portland, Maine; this brewery invested in motion sensor LED lighting, decreasing energy use by 70% in the taproom (Rising Tide Brewing, 2019).

Regional breweries driving the sustainability movement are investing in onsite solar panels and reducing transportation emissions. For example, Sierra Nevada Brewing Company's Asheville, North Carolina location has 10,751 total panels producing 20% of the brewery's energy, and was the first brewery to be awarded platinum LEED certification in 2016 (Sierra Nevada Brewing Company, 2019b).

Sierra Nevada Brewing Company, along with many other breweries across the country, have looked to reduce their transportation emissions by sourcing ingredients locally. Although the Pacific Northwest accounts for nearly 95% of hop production in the United States, smaller hop markets are opening up in states such as Colorado, Michigan, and Indiana (Ha, 2017). This has allowed breweries to reduce their transportation costs and emissions. Some brewers have even begun growing hops on-site. Once again, Sierra Nevada Brewing Company leads this charge, as their Chico, California location holds a ten-acre hop field and dedicates one hundred acres to barley production (Sierra Nevada Brewing Company, 2019a).

Though some of these technologies require significant capital expenditures, Olajire (2012) states training staff members can have a significant impact in reducing energy use. Whether it be through the formation of an energy management team or energy audits to generate awareness of energy use in day-to-day operations, brewers can reduce energy consumption without investment in sustainable technology (Olajire, 2012).

Landfill Diversion

Though water and energy come to mind first when thinking of natural resources and sustainability, it is also crucial for brewers to consider how to handle and reduce waste as each barrel of beer produces approximately 0.14 U.S. tons of solid waste (Brewers Association, 2017b). Landfill diversion practices include reusing byproducts of the brewing process, switching to more environmentally-friendly packaging alternatives, and improving recycling rates.

Byproducts of brewing can be sold or donated to farmers for cattle feed, as the spent grain is rich in protein, fiber, and other nutrients (Brewers Association, 2017b). Though it does not contain the same nutritional content as the typical dried barley, each barrel of beer produces, on average, 36 pounds of spent grain (Olajire, 2012). Victory Brewing Company, for example, has three locations in Pennsylvania and sends 65 tons of spent grain per week to help feed animals in Chester County, Pennsylvania (Victory Brewing Company, 2019). In a survey to regional brewers, Hoalst-Pullen et al. (2014) find 100% of respondents collect their spent grain for other purposes. Feeding cattle is not the only alternative for spent grain, as other opportunities include making dog treats, cookies, and pizza dough (Brewers Association, 2017b).

Another way to reduce waste is through switching packaging materials. Saltwater Brewery in Florida has developed a 100% biodegradable six-pack carrier from spent grain (Galanty, 2016). The "eco six-pack ring" (E6PR) is now being tested among a select group of brewers. The brewery claims that

> "When disposed of properly, the E6PR finds its way to a compostable facility, where it will degrade in days, and when, unfortunately, left out in open land or a water system, it will degrade in a matter of weeks. Another encouraging fact of our product is that it's made from compostable organic materials that do not cause harm to wildlife in case of ingestion" (E6PR, 2019).

Corona, owned by AB InBev, has joined the microbrewery in this movement, stating in

November 2018 that it would shift away from plastic and use a plastic-free six-pack ring, becoming the first global beer to package this way (Pomranz, 2018).

Improved recycling rates are also important in reducing waste from both primary and secondary packaging. Aluminum cans, when recycled, are considered to have lower global warming potential and cumulative energy demand than glass bottles (Pasqualino, Meneses, & Castells, 2011). This is one reason why some breweries are converting their packaging to cans. Rising Tide Brewing (2019b) states that cans are readily recyclable, require less cardboard, and generate less plastic waste. However, some brewers that are recognized for glass bottle packaging have taken it upon themselves to improve recycling rates of glass bottles. New Belgium Brewing Company co-found the Glass Recycling Coalition to improve recycling infrastructure (New Belgium Brewing Company, 2019a) and believes in “Extended Producer Responsibility” (New Belgium Brewing Company, 2019c). This belief states that the producer’s role extends past the point of distribution and that the entire burden of recycling cannot be placed on the consumer.

Miscellaneous Practices

Although water, energy, and landfill diversion are the facets of sustainability included in this study, breweries are also engaging in miscellaneous strategies that help reduce their environmental impact and improve community relationships. Examples of miscellaneous practices include forming “green” committees, partnering with environmental organizations, and supporting educational programs.

Founders Brewing Company created “Strike Force Green” to help build community relations (Founders Brewing Company, 2019). This team is made up of members of the Founders’ organization and help with “events like Tribute on the Grand, the WMEAC Mayors’

Grand River Cleanup, Friends of Grand Rapids Parks tree plantings and park beautification projects" (Founders Brewing Company, 2019).

Breweries have also begun partnerships with nonprofit organizations dedicated to conserving the environment. Maine Beer Company is a member of "1% for the Planet," a nonprofit organization dedicated to protecting the environment from its most pressing issues (Maine Beer Company, 2018). Members donate 1% of annual revenues to environmental nonprofits, such as Maine Coast Heritage Trust, an organization committed to conserving Maine's coastline (1% for the Planet, 2019). Appalachian Mountain Brewery's Long Leaf IPA features a "Drink a Pint, Plant a Pine" fundraiser to help restore the longleaf ecosystem in the Southeast United States. The partnership between Appalachian Mountain Brewing Company and The Longleaf Alliance has led to the planting of 80,000 trees in the region (The Longleaf Alliance, 2018).

Supporting educational programs, such as the Western Michigan University Sustainable Brewing Program, is a final way to build community relations and a greener future. This program has an advisory board of industry leaders, which includes Bell's Brewery, New Holland Brewing Company, and Arcadia Brewing, among others (Western Michigan University, 2019) and trains undergraduate students in sustainable brewing techniques for careers in the craft beer industry.

Consumer Preference Research in Beer

Despite the growing interest surrounding sustainability among brewers, little research has been conducted to uncover how consumers value these attributes in beer. Instead, much of the consumer preference research in beer has focused on demand and consumer knowledge (Malone & Lusk, 2018b; Toro-González, McCluskey, & Mittelhammer, 2014), intrinsic attributes

(Gabrielyan, Marsh, McCluskey, & Ross, 2018; Gabrielyan, McCluskey, Marsh, & Ross, 2014), and localness (Ha, 2017; Hart, 2018). Recent studies focus on brand familiarity and consumer knowledge due to the explosion of craft beer offerings, which has been followed by acquisitions of successful craft brewers by big beer (Howard, 2018; Malone & Lusk, 2017, 2018b).

The main characteristics that set big beer apart from craft are taste, aroma, and color, also known as the intrinsic attributes. Gabrielyan et al. (2014) use a double-bounded question sequence and blind taste test to uncover which intrinsic properties drive preferences. They find that microbreweries can demand a premium for their product, and that taste was the most important factor for WTP, followed by price and brand. Gabrielyan et al. (2018) study how different hop fertilizer treatments (under-fertilization or standard fertilization) impact perceived hoppiness and consumer WTP. The study finds that standard fertilizer treatment does play a role in consumer WTP as it produces a higher quality hop and enhances perceived hoppiness. Prior research also examines WTP for organic beer inputs (e.g., Poelmans & Rousseau, 2009; Waldrop & McCluskey, 2018). Both studies find consumers have minimal WTP for organic beer, and in fact, Waldrop & McCluskey (2018) find a negative marginal effect on WTP when information about organic properties is presented to the consumer.

Although there does not appear to be a large market for organic beer, research suggests there is a premium attached to localness. Ha (2017) studies consumer preferences for local hops. The Pacific Northwest has a comparative advantage in hop production, but Ha (2017) is unsure if the region will be able to meet the growing demand. Hop production outside the Pacific Northwest will be more expensive, and thus farmers must be assured that: (i) a market for local hops exists to incentivize production; and (ii) consumers are willing to pay a premium for these hops. The study finds that 45% of consumers consider localness when purchasing craft beer.

Experienced consumers attach a premium to this attribute, but inexperienced consumers are indifferent. Hart (2018) studies consumer WTP for local beer without defining localness. Instead, each participant is asked to provide his or her own definition of "local." The experiment separates the participants into three groups, with different amounts of information regarding the origins of the craft beer. Across all models, a positive WTP for the localness attribute is seen, ranging from \$0.19-\$0.54. However, this WTP diminishes when the consumer has more knowledge of the craft beer industry (Hart, 2018). The preference for localness in beer is consistent with that of other food products (e.g., Feldmann & Hamm, 2015; Gracia, 2014; Hasselback & Roosen, 2015; and Yue & Tong, 2009).

Despite the growing literature relating to consumer preferences for craft beer, only one study has examined sustainability attributes. Carley & Yahng (2018) conduct an online survey to elicit consumer WTP for both craft and mass produced beer that is made sustainably by "saving energy and reducing carbon emissions" (Carley & Yahng, 2018, p. 7). The respondents are first asked to state their WTP for their favorite beer, then are told that sustainably-made beer may increase beer prices. Immediately following this statement, the respondent is asked to state their WTP for the sustainably-made version of their favorite beer by means of an open-ended question format. Their results indicate that the majority of consumers are willing to pay a premium of \$1.30 per six-pack of 12-oz. cans or bottles for sustainable beer, on average. This study is similar to the present one, but features three limitations that my research addresses.

The first limitation is that this study uses a narrow definition of sustainability: carbon emissions. Of course, sustainability in beer production is broader than carbon emissions alone and encompasses other dimensions such as water consumption and solid waste generation. By only studying how consumers value carbon emissions, the authors ignore these other dimensions and do not measure consumer preferences for sustainability more broadly.

Second, the authors do not control for censoring in their response data. This is important as 41% of respondents report a MWTP of $0 for sustainable beer. Failing to account for censoring may lead to inconsistent WTP estimates.

Finally, open-ended questions—like those Carley & Yahng (2018) use to elicit WTP for sustainable beer—are well-known to not be incentive compatible (Champ, Boyle, & Brown, 2017). Consumers typically state a desire for sustainability and sustainable consumption, but deviate in realistic settings (Grunert, Hieke, & Wills, 2014). Without an incentive to respond realistically, the respondent might: (i) feel morally obligated to state a higher WTP; or (ii) not know how to value the sustainable technology.

Eliciting WTP for Sustainability Attributes in Food and Drink using Choice Experiments

The issue of incentive compatibility in contingent valuation methods has led to the use of choice experiments to estimate consumer WTP for specific attributes. The design of these experiments resembles the traditional Lancasterian framework, which states that rather than deriving utility from a good, consumers derive utility from a collection of attributes that the good possesses (Lancaster, 1966). A respondent is asked to choose between products that vary in price and other attributes. Then, through different regression techniques, the researcher can estimate the WTP for each attribute. These experiments have become increasingly popular for use in determining consumer WTP for environmental and sustainability attributes in the food and drink literature (e.g., Breustedt, 2014; Ortega, Wang, Wu, & Olynk Widmar, 2011; Wang, Ge, & Ma, 2018).

Van Loo et al. (2015) use a choice experiment, eye tracking technology, and a generalized attitudinal survey to determine how consumers react to sustainability labels on coffee. Participants are asked to envision roasted ground coffee, the most common style consumed in the United States (Van Loo et al., 2015), in order to keep the intrinsic properties of the coffee the same across all alternatives. The attributes varying in this experiment are price and four different extrinsic properties indicated by labels on the coffee: (i) whether or not the coffee is "fair trade," or traded between developed and developing countries to combat poverty; (ii) whether the roaster is part of the Rainforest Alliance, which assures the product is "grown and harvested using environmentally and socially responsible practices and focuses on biodiversity conservation" (Van Loo et al. p. 216, 2015); (iii) whether the coffee is produced using organic cultivation methods; and (iv) whether the producer is committed to reducing carbon emissions. The authors find that consumers are willing to pay $1.16 per 12-oz. package for organic coffee and $0.84 per 12-oz. package if the roaster is part of the Rainforest Alliance.

Janßen & Langen (2017) examine consumer WTP for sustainability attributes in milk using five sustainability labels in a hypothetical choice experiment. These labels indicate whether the milk is: (i) produced organically; (ii) GMO-free; (iii) produced locally; (iv) produced from cows raised with higher animal welfare standards; and (v) produced using carbon reduction practices. The respondents in their sample are divided into three classes. The researchers find that the largest class (47.5%) is willing to pay a premium on all five sustainability labels. Other studies also find a positive WTP for different environmental or sustainability attributes in other types of food and drink. Schmit et al. (2013) find consumers are willing to pay a premium for environmentally-friendly attributes in champagne, as long as the consumer attaches positive sensory factors to the product (e.g., taste). Namkung & Jang (2014) conclude 68.3% of consumers are willing to pay more for green restaurant practices (e.g., waste reduction and recycling). Lastly, Van Loo, Caputo, Nayga, Jr., & Verbeke (2014) find that consumers had positive preferences for certified food labels in meat (e.g., organic and "green food") and appreciate being informed about production practices.

Cheap Talk Scripts

Choice experiments can take one of two forms: (i) stated preference or (ii) revealed preference. The difference between the two procedures is the setting in which the experiment takes place. Stated preference is typically done through online or mail surveys, but can also be conducted in person. These experiments are purely hypothetical in nature, meaning that even though the participants are asked to choose between different alternatives, no transaction takes place. In a revealed preference choice experiment, the researcher will randomly draw one round as binding (Alfnes, Guttormsen, & Kolstad, 2006; Lusk & Schroeder, 2004). This means that a real transaction takes place, where the participant receives the product he or she selected in that round for the transaction price.

One drawback to using stated preference research is concern over hypothetical bias, or the lack of consequences that come from sub-optimal decision making (Campbell-Arvai, Arvai, & Kalof, 2014). Economists have found ways to mitigate hypothetical bias by using cheap talk scripts. These remind the participant that although the experiment is hypothetical in nature and no transaction will take place, they are to treat each round as a real market transaction that would have monetary consequences. Cheap talk scripts are common in choice experiments (e.g., Ha, 2017; Janßen & Langen, 2017; Van Loo et al., 2014), but have received criticism for having the potential to actually increase hypothetical bias (Gabrielyan et al., 2018; Vossler, 2016). Other potential downfalls to cheap talk scripts include that they: (i) assume that participants overvalue a good in a hypothetical setting; (ii) are a behavioral que to the respondent which will diminish the incentive to respond to a hypothetical survey (Vossler, 2016); and (iii) begin losing effectiveness if respondents are asked to complete more than three choice sets (Ladenburg, 2013). By avoiding hypothetical bias, revealed preference choice experiments are preferred to stated preference, but are not always feasible. However, Lusk & Schroeder (2004) suggest that although hypothetical bias is present in stated preference settings, the marginal WTP for the attributes are similar in both revealed and stated preference choice experiments.

MODELING CONSUMER CHOICE FOR SUSTAINABLE BEER

I use a stated preference choice experiment modeled after Van Loo et al. (2015) and Janßen & Langen (2017) to estimate consumers' WTP for several sustainability attributes in beer. In a nationally-representative survey of U.S. adults over 21 years of age, respondents are asked to choose which hypothetical beer they would purchase from a list of alternatives that vary in sustainability attributes. I then use response data to estimate a random utility maximization (RUM) model (McFadden, 1974) and use the model to calculate respondents' WTP for these attributes.

The RUM model assumes individual i gains utility U_{ijt} from choosing alternative j in choice set $\{1, \ldots, J\}$ on choice occasion t. Note that the choice set includes the option of choosing no alternative. I specify indirect utility as $U_{ijt} = V_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta}_i) + \varepsilon_{ijt}$, where $V_{ijt}(\cdot)$ is the observable component of indirect utility respondent i receives from consuming beer j; $\mathbf{X}_{jt}$ is a $(1 \times N)$ vector of attributes associated with beer j, including price; $\mathbf{Z}_i$ is a vector of individual sociodemographic and attitudinal characteristics; $\boldsymbol{\theta}_i$ is a vector of marginal utility parameters; and ε_{ijt} is an independent and identically-distributed type-1 extreme value (Gumbel) unobservable error term, assumed independent of $\mathbf{X}_{jt}$. Individual i will choose alternative j if and only if $U_{ijt} > U_{ikt} \forall j \neq k$. Since indirect utility is random, I can estimate only the probability that individual i chooses alternative j:

$$\begin{aligned} P_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta}_i) &= \Pr\big(V_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta}_i) + \varepsilon_{ijt} > V_{ikt}(\mathbf{X}_{kt}, \mathbf{Z}_i; \boldsymbol{\theta}_i) + \varepsilon_{ikt};\ \forall\, j \neq k\big) \\ &= \Pr\big(V_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta}_i) - V_{ikt}(\mathbf{X}_{kt}, \mathbf{Z}_i; \boldsymbol{\theta}_i) > \varepsilon_{ikt} - \varepsilon_{ijt};\ \forall j \neq k\big). \end{aligned} \tag{1}$$

I assume the utility from consuming a given beer depends on the attributes shown in Table 1, including primary packaging, several sustainability attributes, whether the beer is locally produced, and its price. These attributes are extrinsic, meaning they do not affect the taste of the beer. They are instead external attributes considered to add value to a product.

Table 1: Full list of beer attributes and levels taken in the choice experiment.

Beer Attribute	Attribute Levels
Primary Packaging (six-pack of 12-oz. containers)	Can, Bottle
Sustainability attributes	
Beer produced using water-conserving practices	Yes, No
Beer produced using energy-conserving practices	Yes, No
Beer produced using waste reduction practices	Yes, No
Beer is locally produced	Yes, No
Price	\$6.99, \$8.49, \$9.99, \$11.49

Primary packaging options in the beer industry are aluminum cans or glass bottles. For simplicity, and because six-packs are the predominant form of packaging in the market (Toro-González et al., 2014), the two levels primary packaging can take are (i) a six-pack of 12-oz. cans (72 oz. total) or (ii) a six-pack of 12-oz. bottles (72 oz. total). The three sustainability attributes and the localness attribute take two levels each—either the attribute is present on the beer or not. The presence of these attributes are indicated by distinct eco-labels affixed the front of each hypothetical beer (Figure 1). Respondents cannot distinguish between sustainably- and non-sustainably produced products without time and effort to acquire this knowledge (Grunert et al., 2014). Eco-labels on beer packaging could reduce the information asymmetry that currently exists between producer and consumer regarding sustainability practices. A water sustainability label, featuring a water droplet, indicates that a brewery engages in water sustainability practices (e.g., investing in a CIP system or reusing rinse water). An energy conservation label, featuring a footprint, indicates the brewer engages in practices that reduces their carbon footprint (e.g., installing solar panels or investing in a high-efficiency wort boiler). Finally, a landfill diversion label, featuring a growing plant, indicates the brewer has taken steps to increase landfill diversion (e.g., investing in warehouse balers or starting recycling programs). A final label (not shown in Fig. 1) indicates whether the beer is produced locally, where the respondent is to infer his or her own definition of localness following Hart (2018). Finally, price per six-pack ranges from $6.99-$11.49 with $1.50 increments, which encompasses common six-pack prices at liquor retail outlets.

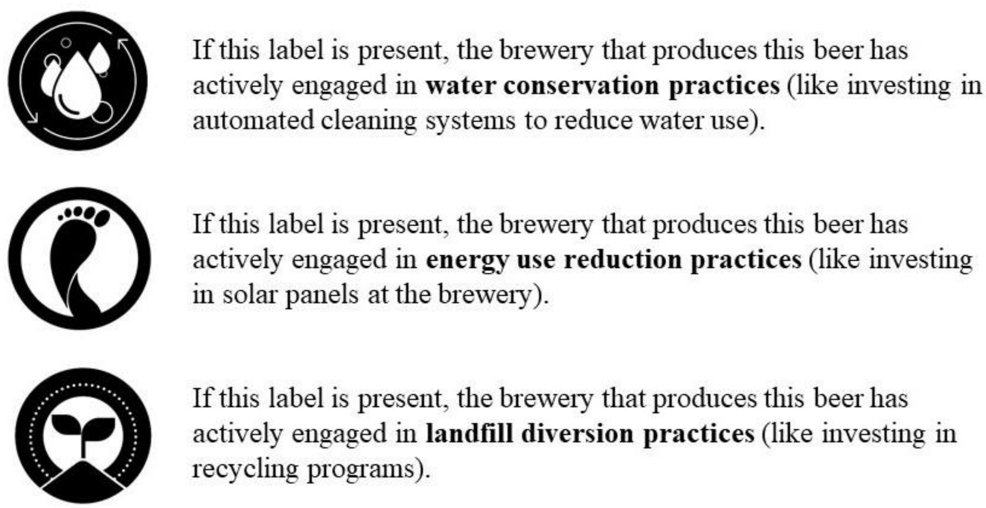

Figure 1: Eco-labels used and their meaning.

I expect that utility increases in the presence of the sustainability attributes, as well as with localness. Also, I expect that respondents have greater preference for beer in glass bottles due to the perception that lower-quality beer is typically packaged in aluminum cans (Watson, 2017). Lastly, an increase in price will decrease consumers' utility, consistent with economic theory.

SURVEY INSTRUMENT

I estimate (1) using a choice experiment embedded in a survey of U.S. adults over 21 years of age on their beer buying and consumption habits. The survey is constructed in Qualtrics and administered online. The survey instrument is divided into five parts following Janßen and Langen (2017), which I describe in turn. A copy of the complete survey instrument is available in Appendix A.

Part 1. Demographics

The first part of the survey collects information on respondents' demographic characteristics, including gender, age, educational attainment, income, and region of residence (including state and county).

Demographic information is used to (i) determine whether respondents' utility depends on their personal characteristics and (ii) confirm that our sample (described in the Data section) matches the demographic profile of the U.S. population according to recent Census estimates (United States Census Bureau, 2017). For this reason, responses to demographic questions are divided into categories that match those used by the U.S. Census Bureau. Respondents are asked to enter their demographic information by selecting, for each characteristic, the category that best describes them from a drop-down menu in the survey. The demographic characteristics and their possible levels are shown in Table 2.

Table 2: Demographic characteristics and levels.

Demographic characteristic	Levels
Gender	Male
	Female
Age (years)	21-24
	25-34
	35-44
	45-54
	55-64
	65+
Income ($US 2017)	0-24,999
	25,000-49,999
	50,000-74,999
	75,000-99,999
	100,000+
Education	Less than High School
	High school graduate
	Some college, no degree
	Associate's degree or Bachelor's degree
	Graduate or professional degree
Region	Northeast
	Midwest
	South
	West

Part 2. Beer Buying Habits

The next part of the survey pertains to beer buying habits. The first question asks if the respondent is the primary shopper in the household, followed by how often he or she buys beer from a retail outlet. Responses to the latter range from “never” to “more than once a week.” If “never” is selected, the respondent is taken to the end of this part. Any other response allows the respondent to answer all remaining questions in this part. These questions include the price one typically pays per six-pack of beer (<$6.00, $6.00-6.99, … , $11.00-$11.99, or ≥$12.00),[1] who drinks the beer that the respondent buys (yourself, someone else, or both yourself and someone else), and the type of beer the respondent buys (commercial, craft, both commercial and craft, or unsure). The final question in the part asks which factors affect the respondent's beer buying decision. Potential factors include taste, price, style, brand, localness, organic, can or bottle design, environmental impact, organic, and packaging. Respondents are asked to choose all factors that apply to their decision. The list of factors is randomized to prevent order bias and includes a write-in option if a factor he or she considers is not listed.

Part 3. Beer Consumption Habits

Respondents are next asked to answer questions about their beer consumption habits. These questions are similar to those in the "beer buying" part of the survey. However, I expect that those who purchase beer for a household may, in some cases, be different from those who consume it. Intuitively, one household member may be the primary shopper and buys beer for others in the household (e.g., a spouse), but may opt to drink wine or another beverage for themselves. If there is a significant difference between the population of beer buyers and the population of beer drinkers, then marketing eco-labels only to beer drinkers is not sufficient enough to attract shoppers buying the product for the household, but not consuming the product.

Respondents are initially asked how frequently they consume beer (never, less than once a month, once a month, two or three times a month, once a week, more than once a week, or every day). Respondents who choose any alternative besides "never" are asked to answer follow-up questions about the setting in which they typically consume beer (home, bar, taproom,

[1] If the respondent typically buys beer packaged in quantities greater than a six-pack, they are asked to scale into six-pack terms. For example, if a 12 pack costs $18.00, the cost per six pack would be $9.00.

sporting events, parties, and other) and preferred packaging for consumption (can, bottle, or no preference). Those who select “never” for the initial question skip to the next part of the survey.

Part 4. Choice Experiment

The main part of the survey is the choice experiment. Here, respondents are asked to choose a hypothetical beer from several alternatives, where each beer varies in the attributes described in Table 1. Information about respondents’ choices can be used to estimate the choice model (1), as I describe later.

At the beginning of this part, each participant is shown a page with a brief summary of sustainability in brewing. The page provides multiple examples of real breweries engaging in sustainability practices. The description concludes by stating that significant upfront costs exist for these technologies and that small breweries are unable to invest in sustainability equipment without extreme financial risk; however, they could offset some of these costs by increasing the price of their product.

Next, the respondents are presented with instructions for the choice experiment. There are two versions of the instructions, as the effectiveness of cheap talk scripts are still in question. Respondents are randomly assigned into two different groups. Half of the sample receives the first set of instructions, while the other half receives the second set. The first set of instructions states:

> “The purpose of this experiment is to learn about the importance of various attributes of beer. This experiment will consist of eight rounds. In each round, you will be presented with two hypothetical six-packs of beer that will differ in several ways. You will be asked to choose the beer that you most prefer to buy, "Beer A" or "Beer B." You will also be given an option to not buy either of the beers. With over 400 different styles of beer,

ranging from India Pale Ale (IPA) to Lager, I ask you to treat both beers as if they are your favorite style. Please also imagine that the beers are identical except for differences in characteristics listed for each choice, and that the differences in characteristics do not affect the beer's taste. Once completed, you will be asked to answer a few final questions."

The other set of instructions includes a cheap talk script to remind the respondent that even though the experiment is hypothetical, he or she should treat it like a real transaction. The instructions to the experiment are the same as above, but have the additional cheap talk script placed at the end:

"Although this is purely hypothetical and no beer will be purchased at the end of the experiment, I ask you to please treat each round as if it were a real transaction. Meaning, the price that is posted on the beer that you select would be the price that you pay at your favorite retail outlet. If you would not purchase either beer, then you should choose the option to not buy either product."

After the instructions are read, respondents are shown a figure explaining the meaning of the eco-labels (Figure 1). This figure is also provided throughout the duration of the experiment for convenience. Next, each respondent is shown an example choice alternative with a text description on how it should be interpreted (Figure 2).

Figure 2: Example choice alternative with text description.

At this point, the respondents begin the choice experiment. The experiment comprises sixteen choice sets blocked into two groups of eight choice tasks (so that each respondent sees eight choice tasks). I use Ngene (ChoiceMetrics, 2018) to generate a D-efficient experimental design.[2] Respondents are randomly assigned to one of two blocks. Note that block assignment is independent of the set of instructions the respondent receives (either with or without the cheap talk script). Each choice set presents a respondent with two hypothetical beers, labeled "Beer A" and "Beer B," that vary in the attributes shown in Table 1. A third alternative comprises an opt-out alternative, labeled "No Purchase." The eight choice sets are randomly presented to prevent ordering effects. An example choice set is shown in Figure 3. The respondent is asked to select

[2] One drawback to D-efficient modeling is the reliance on priors, or "guesses," about the population values of $\boldsymbol{\theta}_i$. No reliable prior estimates of $\boldsymbol{\theta}_i$ exist, and so I establish priors in three steps: (i) I set priors to zero and use Ngene to generate a D-efficient design; (ii) I conduct a pilot choice experiment and estimate $\boldsymbol{\theta}_i$; then (iii) use the estimated $\boldsymbol{\theta}_i$ from the pilot survey as priors to update the D-efficient design. The pilot choice experiment was conducted on February 25 and 26, 2019 with 14 Purdue graduate students anonymously responding to the experiment. Once I finalized the experimental design, I implemented the full-scale choice experiment in spring 2019.

which alternative they would choose if given this selection. Prices are posted below each alternative. By using stated prices, the experiment better resembles market transactions, even in a hypothetical setting.

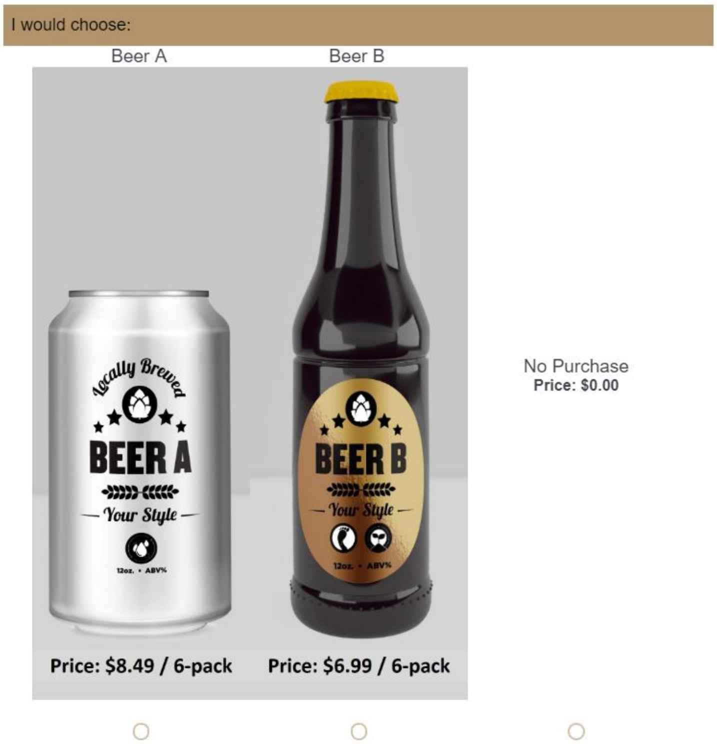

Figure 3: Example choice set

Part 5. Sustainability Preferences

The final part of the survey elicits respondents' preferences for sustainability. This information, much like sociodemographic characteristics, is collected to determine whether individual-specific variables affect WTP. The sustainability questions are asked after the choice experiment concludes to avoid any priming effects (Poelmans & Rousseau, 2009). Avoiding priming effects is particularly important for behaviors that are subject to social desirability tendencies in which the respondent answers questions to appear better or to impress the surveyor (Poelmans & Rousseau, 2009).

This part of the survey begins with a definition of sustainability according to the UCLA Sustainability Committee, stating:

> “Sustainability is ‘the physical development and institutional operating practices that meet the needs of present users without compromising the ability of future generations to meet their own needs, particularly with regard to use and waste of natural resources. Sustainable practices support ecological, human, and economic health and vitality. Sustainability presumes that resources are finite, and should be used conservatively and wisely with a view to long-term priorities and consequences of the ways in which resources are used’ (UCLA Sustainability Committee, 2019).”

The respondent then indicates how much he or she agrees or disagrees with the following four statements on a seven-point Likert scale:

- “Sustainability is a major concern in today's world.”
- “Industries need to have practices and regulations in place to reduce water consumption.”
- “Industries need to have practices and regulations in place to reduce energy consumption.”
- “Industries need to have practices and regulations in place to increase landfill diversion.”

Next, the respondent is asked to select their definition of local from a list of possible responses based on the Feldmann & Hamm (2015) literature review of localness. Options include: (i) sourced within a given radius from your household; (ii) sourced within a political boundary (state, country, etc.); (iii) having emotional and social relations to the origin of the product; and (iv) having specialty criteria or brand names associated with a certain area.

Respondents can also write in a response if he or she has a definition of local that is not listed. Also, conditional on selecting the response of "sourced within a given radius from your household," the respondent is asked the maximum distance he or she considers to be "local" (10 miles, 30 miles, 100 miles, or 400 miles).

This part of the survey continues with questions about whether the respondent's household recycles (yes, no, do not know, or prefer not to answer), avoids certain ingredients in their food (corn syrup, saturated fat, GMOs, artificial sweeteners, or none), and makes contributions to environmental groups (yes, no, do not know, or prefer not to answer). At this point, the respondent is thanked for their time and informed that their results have been recorded.

DATA

Census Demographics versus Sample Demographics

The survey is administered online by Kantar, a survey distributor, over the period March 26 to April 14, 2019. The goal is to attain a nationally-representative sample of US adults over age 21. A power analysis conducted as part of the experimental design indicated statistically significant results require a sample size of at least 520 respondents. Of course, not all respondents in a nationally-representative survey will buy or drink beer. Assuming at least 40% of individuals will buy beer (Auter, 2016), I target a sample of 1,300 individuals to attain statistically significant results. In total, 1,291 respondents completed the survey.

I calculate respondent quotas for gender, age, income, educational attainment, and region to match population estimates from 2017 U.S. Census data (United States Census Bureau, 2017). Table 3 compares the final sample demographic characteristics against U.S. population estimates. I use a test of proportions to determine whether the sample demographic characteristics are statistically different from those of the U.S population. The demographics of the sample closely matches the U.S. population with respect to gender and age, where only individuals in the age range 21-24 are under-represented and statistically different from that of the population (4.03% in the sample versus 7.62% in the population). The sample over-represents individuals in the $0-24,999 and $25,000-$49,999 income brackets (23.36% and 24.50% in the sample, respectively, versus 21.40% and 22.50% in the population). Individuals in the highest income bracket, $100,000 or greater, are under-represented (19.53% in the sample versus 26.4% in the population). The sample is also overeducated as a whole. Specifically, only 3.80% of respondents state they did not graduate from high school, when the nationally representative proportion is 12.68%. Likewise, my sample has a larger proportion of respondents with some college but no degree (23.08% in the sample versus 20.78% in the population); an associate's or bachelor's degree (31.68% in the sample versus 27.42% in the population); and a graduate or professional degree (13.71% in the sample versus 11.8% in the population). It is common for samples recruited online to oversample relatively well-educated individuals, as people with lower educational attainment may have less internet access (Bir, Olynk Widmar, & Croney, 2018; Cummins, Olynk Widmar, Croney, & Fulton, 2015). Finally, respondents from the South are over-represented in the sample (40.20% against 37.96 in the population), while the West is under-represented (19.36% versus 23.77 in the population).

Table 3: Demographics of the U.S. population versus the demographics of the sample.

Demographic characteristic	% U.S. population	% Sample
Gender		
Male	48.52%	48.41%
Female	51.48%	51.59%
Age		
21-24	7.62% †	4.03% †
25-34	18.81%	19.13%
35-44	17.37%	17.51%
45-54	18.41%	19.44%
55-64	17.40%	18.36%
65+	20.39%	21.53%
Income ($)		
0-24,999	21.40% †	23.36% †
25,000-49,999	22.50% †	24.50% †
50,000-74,999	17.70%	19.30%
75,000-99,999	12.30%	13.41%
100,000+	26.20% †	19.53% †
Education		
Less than high school	12.68% †	3.80% †
High school graduate	27.32%	27.73%
Some college, no degree	20.78% †	23.08% †
Associate's or bachelor's degree	27.42% †	31.68% †
Graduate or professional degree	11.80% †	13.71% †
Region		
Northeast	17.34%	18.28%
Midwest	20.93%	22.15%
South	37.96% †	40.20% †
West	23.77% †	19.36% †

† The sample proportion is statistically different from U.S. Census estimates at the 5% level.

Beer Purchasing and Consumption Habits

I choose to separate beer buying and beer consumption as two different behaviors and determine whether there is a statistically significant difference between the two groups. The goal is to determine whether the demographics of these two groups are different, as suggested in Zondag & Watson (2017).[3]

By asking respondents about the frequency of beer purchase and consumption, I allow them to self-identify as beer buyers and/or beer consumers. Specifically, if a respondent selects “never” to either question, then he or she is not a beer buyer or consumer. Table 4 shows the sample responses to questions about how frequently respondents buy and consume beer.[4]

Table 4: Responses to frequency of buying beer and consuming beer

	Responses	
Response Option	Buying Beer	Consuming Beer
Never	466	469
Less than once a month	295	228
Once a month	158	99
Two or three times a month	148	153
Weekly	157	110
More than weekly	67	232

As expected, the number of individuals that consume beer more than weekly is significantly greater than those that buy beer more than weekly. This makes intuitive sense as individuals may buy in bulk, or simply not drink the entirety of their purchase in one sitting.

Table 5 illustrates the demographics of the participants that self-identify as beer buyers and drinkers. Now, future work can rely on the data presented in Table 5 to sample beer buyers

[3] The demographics of beer buyers and beer drinkers are not well-documented in prior literature. My nationally-representative sample allows me to statistically identify the characteristics of these groups, and hence, an additional contribution to the literature. Future research can use these demographic results for more efficient testing.
[4] The question regarding frequency of beer consumption had an additional choice selection of “every day.” Responses to this level are grouped into category “more than weekly” to maintain level balance in responses for comparison across the two questions. Of the 1291 respondents, 65 (5.03%) stated they consume beer daily.

or beer drinkers more efficiently. Also, a test of proportions reveals no statistical difference between the two groups, rejecting the idea that the two groups would be statistically different, as suggested by Zondag & Watson (2017).

Table 5: Demographics of beer buyers and beer drinkers

Demographic characteristic	Beer buyer *n* = 825	Beer drinker *n* = 822
Gender		
Male	55.15%	57.30%
Female	44.85%	42.70%
Age		
21-24	4.73%	4.87%
25-34	24.00%	23.36%
35-44	17.21%	17.52%
45-54	18.42%	18.37%
55-64	16.61%	16.18%
65+	19.03%	19.71%
Income ($)		
0-24,999	18.69%	19.24%
25,000-49,999	25.12%	25.33%
50,000-74,999	20.15%	19.00%
75,000-99,999	14.93%	15.10%
100,000+	21.12%	21.32%
Education		
Less than high school	3.64%	3.65%
High school graduate	25.82%	26.28%
Some college, no degree	23.15%	23.11%
Associate's degree or bachelor's degree	32.73%	32.73%
Graduate or professional degree	14.67%	14.23%
Region		
Northeast	17.70%	18.37%
Midwest	21.09%	20.56%
South	41.33%	41.73%
West	19.88%	19.34%

Another area of interest is whether there is heterogeneity amongst beer buyers according to the type of beer the individuals buy: commercial only, craft only, or both commercial and craft. Table 6 displays the demographics, and some attitudinal variables, of strictly commercial beer buyers versus strictly craft beer buyers. These results are obtained during Part 2 of the survey, after participants are asked to indicate how often he or she buys beer. Respondents that select “never” are dropped, resulting in a data set of 825 individuals. Of these respondents, 339 state they only buy commercial beer; 311 state they buy both commercial and craft beer; 147 state they only buy craft beer; and 28 state they are unsure. Respondents who state they are unsure which type of beer they buy are dropped, as these provide no valuable information and represent only 3.4% of total responses.

Table 6: Demographics of commercial only buyers versus craft only buyers

	Beer bought	
Demographic characteristic	Commercial only (*n* = 339)	Craft only (*n* = 147)
Gender		
Male	55.46%	55.78%
Female	44.54%	44.22%
Age		
21-24	4.42%	4.76%
25-34	22.71%	20.41%
35-44	12.09% †	21.09% †
45-54	19.47%	22.45%
55-64	17.40%	15.65%
65+	23.89% †	15.65% †
Income		
0-24,999	22.71% †	12.24% †
25,000-49,999	33.04% †	16.33% †
50,000-74,999	18.29%	23.13%
75,000-99,999	11.80% †	16.33% †
100,000+	14.16% †	31.97% †
Education		
Less than high school	4.13%	2.04%
High school graduate	33.33% †	12.93% †
Some college, no degree	25.96%	25.17%
Associate's degree or bachelor's degree	23.89% †	42.86% †
Graduate or professional degree	12.68%	17.01%
Region		
Northeast	17.40%	14.97%
Midwest	25.66% †	14.97% †
South	43.95%	40.14%
West	12.98% †	29.93% †
Recycle		
Yes	76.70% †	88.44% †
No	21.24% †	10.20% †
Unsure	1.47%	0.68%
Prefer no answer	0.59%	0.68%

Table 6 continued

Enjoy buying new beer		
Yes	41.00% †	78.91% †
No	59.00% †	21.09% †

† The craft-only sample proportion is statistically different from that of the commercial only sample at the 5% level.

A test of proportions reveals significant heterogeneity between the two groups. On average, the craft-only consumers appear to be younger, wealthier, more highly-educated individuals concentrated in the West. These same individuals also recycle at a higher rate and nearly 80% state they enjoy buying new beers. Commercial-only beer buyers, on average, are older, lower-income, and less-educated. These consumers are concentrated predominantly in the Midwest and South, have lower recycling rates, and the majority do not enjoy buying beers they have never bought before. Both groups have similar proportions of males and females.

The craft industry has become popular with millennials, which has been one of the biggest drivers of the craft beer boom due to their preference for variety in style (Aquilani, Laureti, Poponi, & Secondi, 2015; Malone & Lusk, 2018b; Nielsen, 2018; Zondag & Watson, 2017). In contrast, over 40% of commercial-only consumers are over the age of 55, a finding that matches Malone & Lusk (2018b), which states this age range is less likely to drink craft beer. Income discrepancies are even more apparent between the two groups, with craft consumers being, on average, wealthier than commercial only consumers. This reflects on the price premium that exists between the two styles and displays that craft consumers must be able to afford the expensive hobby. Education, often correlated with income, has two statistically significant differences between the two groups. The craft-only buyers are often more highly educated, with just under 60% of the sample holding an advanced degree (associate, bachelors, or graduate/professional). In comparison, only 37% of the commercial-only consumers hold advanced degrees. One-third of commercial-only consumers have only a high school diploma versus 13% of craft-only consumers.

The proportion of craft-only drinkers in the West is significantly larger than the proportion of commercial-only drinkers. Conversely, the proportion of commercial-only drinkers in the Midwest is significantly larger than the proportion of craft-only drinkers. The Western United States is where the craft beer revolution began, and is the birthplace to some of the most well-established craft breweries, such as New Belgium Brewing Company, Sierra Nevada Brewing Company, and Stone Brewing Company (Brewers Association, 2019e). The Midwest is a newer craft beer market and could potentially see an emergence in years to come as Kalamazoo, Royal Oak, and Grand Rapids, Michigan are now among the Top 25 in the United States in breweries per capita (Champion, 2019).

Two attitudinal variables are included in Table 6 to further display the heterogeneity that exists between the two groups. Recycling habits could serve as a positive indicator of sustainability preferences, suggesting craft consumers have higher sustainability preferences. Also, the fact that 78.91% of craft-only buyers enjoy buying new beers that they have not tried before does not come as a surprise in such a saturated market. According to Brewers Association (2016b), there are now 152 styles of beer coming from over 7,300 breweries, creating endless options for the consumer. Meanwhile, commercial beer tends to have brand loyalty from their consumers (Allison & Uhl, 1964; Malone & Lusk, 2018a; Miller, Sirrine, McFarland, Howard, & Malone, 2019; Toro-González et al., 2014), offering an explanation for the statistic that only 41% of commercial-only buyers enjoy buying new beers.

A nearly identical trend is seen when comparing commercial-only beer buyers versus respondents that buy both commercial and craft beer, shown in Table 7. These results not only portray heterogeneity within the beer market, but will also be used to support later findings.

Table 7: Demographics of commercial only buyers versus commercial and craft buyers

	Beer bought	
Demographic characteristic	Commercial only (n = 339)	Commercial and craft (n = 311)
Gender		
Male	55.46%	54.98%
Female	44.54%	45.02%
Age		
21-24	4.42%	5.14%
25-34	22.71%	26.37%
35-44	12.09% †	21.22% †
45-54	19.47%	16.08%
55-64	17.40%	15.76%
65+	23.89% †	15.43% †
Income		
0-24,999	22.71% †	16.45% †
25,000-49,999	33.04% †	21.29% †
50,000-74,999	18.29%	20.65%
75,000-99,999	11.80% †	18.06% †
100,000+	14.16% †	23.55% †
Education		
Less than high school	4.13%	3.22%
High school graduate	33.33% †	24.12% †
Some college, no degree	25.96% †	19.94% †
Associate's degree or bachelor's degree	23.89% †	37.30% †
Graduate or professional degree	12.68%	15.43%
Region		
Northeast	17.40%	19.29%
Midwest	25.66% †	18.97% †
South	43.95% †	38.91% †
West	12.98% †	22.83% †
Recycle		
Yes	76.70% †	87.46% †
No	21.24% †	10.29% †
Unsure	1.47%	1.93%
Prefer no answer	0.59%	0.32%
Enjoy buying new beer		
Yes	41.00% †	84.57% †
No	59.00% †	15.43% †

† The craft only sample proportion is statistically different from that of the commercial only sample at the 5% level.

Choice Experiment Serial Nonparticipation

Of the 1,291 respondents who completed the survey, 245 (18.98% of the sample) chose the opt-out alternative on all eight choice occasions. This is unusual as most surveys in the consumer choice literature are used to estimate demand for goods that all respondents typically buy (Lusk, 2003; Lusk & Schroeder, 2004; Ortega et al., 2011; Van Loo et al., 2014; Vecchio & Annunziata, 2015). However, not all adult consumers drink beer, therefore it is not surprising that a large portion of respondents never choose a beer in my experiment. Respondents who choose the opt-out alternative in each choice occasion are "serial nonparticipants" (von Haefen et al., 2005) and their decision not to participate in the choice experiment implies their utility function may differ fundamentally from respondents who did participate. I must therefore account for serial nonparticipation in estimating choice model (1) as failing to do so may result in biased WTP estimates (von Haefen et al., 2005). The second column in Table 8 portrays the demographics of serial nonparticipants. The overwhelming majority of these nonparticipants are older, lower income females.

Table 8: Demographics of serial nonparticipants against self-identified non beer buyers

Demographic characteristic	% of serial nonparticipants (*n* = 245)	% of non-beer buyers (*n* = 466)
Gender		
Male	31.43%†	36.48% †
Female	68.57%†	63.52% †
Age		
21-24	2.86%	2.79%
25-34	9.80%	10.52%
35-44	13.88%	18.03%
45-54	19.59%	21.24%
55-64	28.16%	21.46%
65+	25.71%	25.97%
Income ($)		
0-24,999	34.69%	31.33%
25,000-49,999	22.45%	23.39%
50,000-74,999	16.73%	17.81%
75,000-99,999	9.39%	10.73%
100,000+	16.73%	16.74%

Table 8 continued

Education		
Less than high school	3.67%	4.08%
High school graduate	28.57%	31.12%
Some college, no degree	27.35%	22.96%
Associate's degree or bachelor's degree	30.20%	29.83%
Graduate or professional degree	10.20%	12.02%
Region		
Northeast	17.96%	19.31%
Midwest	24.90%	24.03%
South	37.96%	38.20%
West	19.18%	18.45%

† The demographic characteristic of serial nonparticipants is statistically different at the 5% level than that of self-identifying non-beer buyers.

The third column indicates the demographics of self-identifying non-beer buyers—or those respondents who answered “never” when asked how frequently they buy beer. Through a test of proportions, I conclude the only demographic that is statistically different between serial nonparticipants and non-beer buyers at the five percent level is gender, where females are more likely to be a serial nonparticipant. Considering these discrepancies, Table 9 shows how serial nonparticipants respond to the frequency of beer buying question. Of the 245 serial nonparticipants, 207 (84.49%) select “never” and 22 (8.98%) state “less than once a month.” These responses show that the vast majority of serial nonparticipants are the same individuals who state they never buy beer in Part 2 of the survey.

Table 9: Frequency of beer buying by serial nonparticipants

Response option	Number of responses (n=245)	%
Never	207	84.49%
Less than once a month	22	8.98%
Once a month	6	2.45%
Two or three times a month	2	0.82%
Weekly	6	2.45%
More than weekly	2	0.82%

Sustainability Preferences

Figure 3 summarizes responses to the Likert scale statements regarding sustainability and industry regulation on water use, energy use, and landfill diversion from Part 5 of the survey.

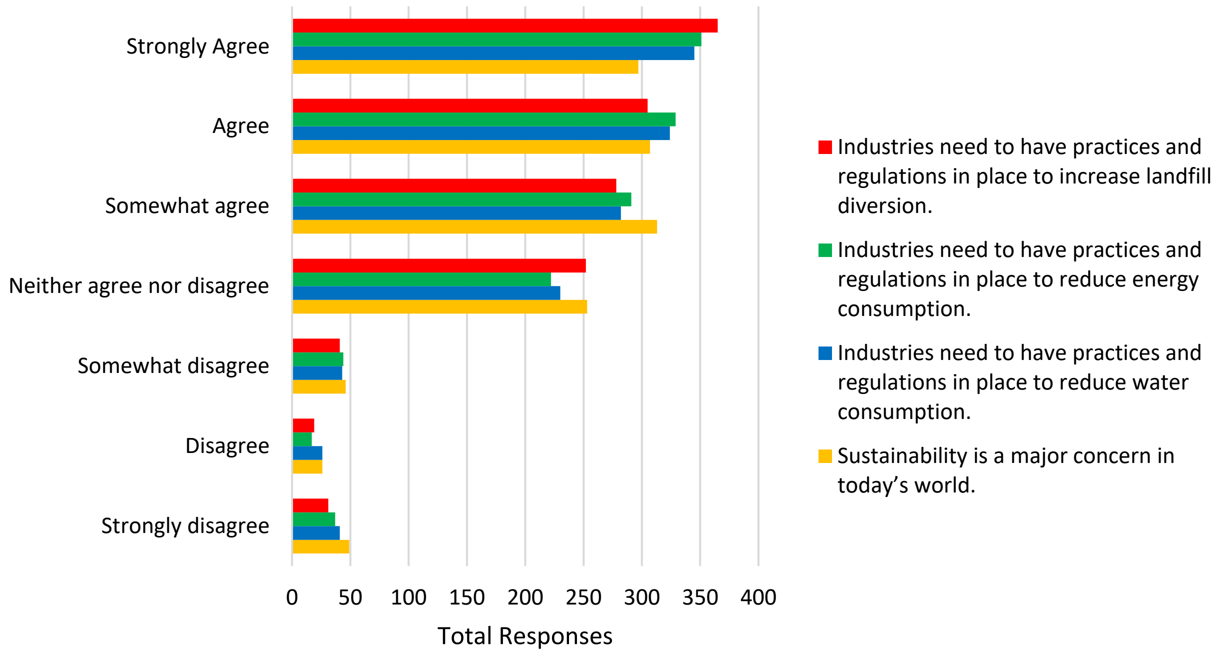

Figure 4: Sustainability Likert scale question responses

After providing a definition of sustainability according to UCLA Sustainability Committee (2019) (see Part 5. Sustainability Preferences under Survey Instrument), the first Likert scale statement is, "Sustainability is a major concern in today's world." Of the 1,291 respondents, the majority (917 respondents, or 71% of the sample) state they either somewhat agree, agree, or strongly agree. The following three statements are specific to each of the eco-labels used in the choice experiment: water use, energy use, and landfill diversion. The second statement is, "Industries need to have practices and regulations in place to reduce water consumption." Of the 1,291 respondents, 951 (74% of the sample) state they either somewhat agree, agree, or strongly agree. The next statement is, "Industries need to have practices and regulations in place to reduce energy consumption." Of the 1,291 respondents, 971 (75% of the sample) state they either somewhat agree, agree, or strongly agree. Finally, respondents are then asked to respond to the statement, "Industries need to have practices and regulations in place to increase landfill diversion." Of the 1,291 respondents, 948 (73.43% of the sample) state they either somewhat agree, agree, or strongly agree.

The first key finding seen here is that landfill diversion practices and regulations elicit the strongest preferences from respondents. More respondents strongly agreed with the need for landfill diversion practices than with the need for reduced energy consumption. The fewest respondents strongly disagreed with the need for landfill diversion regulations. Overall, the largest number of respondents agreed with the need for reduced energy consumption; this statement has the greatest number of total agreement responses (i.e., the sum of "somewhat agree," "agree," or "strongly agree" responses). Water and landfill are similar in this respect with nearly identical total agreement responses.

In general, respondents show a positive preference for the sustainability attributes used in this study. The summary data presented in Figure 4 therefore serves as a robustness check for the regression results of my choice experiment, described later.

MODEL ESTIMATION AND WILLINGNESS-TO-PAY CALCULATIONS

I estimate the choice model (1) using four different econometric approaches. The first, denoted "Model 1," is a standard MNL with the full data set. The MNL model is computationally convenient as the choice probability (1) can be expressed in closed form. However, the MNL model also assumes marginal utility parameters are homogeneous across respondents. Furthermore, while the traditional MNL places a positive probability on every series of choices, it does a poor job predicting the serial nonparticipation (von Haefen et al., 2005). These traits become an issue when there is a large portion of respondents selecting the opt-out alternative repeatedly; this is the case in my choice experiment, as 18.98% of the sample are serial nonparticipants. Selecting the opt-out alternative on all eight choice occasions implies these individuals have preferences for beer that are distinct from the rest of the sample.

Burton & Rigby (2009) and von Haefen et al. (2005) suggest several alternative approaches for dealing with serial nonparticipation that I adopt. One approach, denoted "Model 2," involves purging the dataset of serial nonparticipants.[5] This approach has the drawback of continuing to assume homogenous preferences across remaining respondents. It also introduces bias to our estimates due to sample truncation. I therefore estimate a single-hurdle (SH) MNL model, denoted "Model 3," following von Haefen et al. (2005). Briefly, the SH model is a generalization of the standard MNL that models respondents' participation decision explicitly, then estimates their marginal utility parameters conditional on participation.

A major disadvantage of the MNL model is that it is subject to "independence of

[5] Alternatives to purging serial non-participants would be to purge the dataset of all participants that state they never buy beer (resulting in a dataset with n = 825) or those who do not purchase beer at least once a month (resulting in a dataset with n = 530). I estimate a MNL using these restricted datasets and find that mean MWTP estimates are not statistically different from those estimated for Model 2, described below.

irrelevant alternatives" (IIA), under which the odds ratio of choosing between two alternatives depends only on the attributes of those alternatives. IIA implies unrealistic cross-elasticities of substitution across alternatives (Holmes & Adamowicz, 2003). An alternative approach for estimating (1) that is not subject to this limitation is the latent class model (LCM). The LCM, denoted "Model 4," is also flexible in that it allows for a discrete form of preference heterogeneity. Briefly, respondents are probabilistically assigned to different classes, or market segments, with estimated utility functions that are distinct across classes (but homogenous within a class).[6]

For all models, I assume the deterministic portion of a class-*s* consumer *i*'s indirect utility from choosing alternative $j \in$ {Beer A, Beer B, Opt-out} during choice occasion *t* takes the form

$$V_{isjt}\left(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta}_s\right) = \alpha_s 1(o_{it} = 1) + \beta_{s1} Packaging_{jt} + \beta_{s2} Water_{jt} + \beta_{s3} Carbon_{jt} + \beta_{s4} Landfill_{jt} + \beta_{s5} Local_{jt} + \mu_s\left(y_i - p_{jt}\right). \tag{2}$$

The parameter α_s is an alternative-specific constant (ASC) for the opt-out alternative; if the respondent chooses the opt-out alternative, then the binary variable $o_{it} = 1$ and the indicator function $1(\cdot)$ evaluates to 1. Otherwise, the binary variable $o_{it} = 0$ and the indicator function evaluates to zero. The attributes $Packaging_{jt}$, $Water_{jt}$, $Carbon_{jt}$, $Landfill_{jt}$, and $Local_{jt}$ are effects-coded variables. The variable $Packaging_{jt}$ takes a value of 1 if the alternative is packaged in glass bottles and –1 if packaged in aluminum cans. The variables $Water_{jt}$, $Carbon_{jt}$, $Landfill_{jt}$, and $Local_{jt}$ take values of 1 if a label for the corresponding sustainability attribute is present on the alternative and –1 otherwise. The attribute price is p_{jt}, which takes the levels mentioned in Table

[6] I also considered modeling continuous preference heterogeneity by estimating a random parameter logit (RPL), which models each respondent's marginal utility parameters as a random variable drawn from a distribution that is constant across individuals (Train, 2003). However, the results from the RPL model showed that this model was not a good fit to the data.

1. The respondent's income is y_i.[7] The vector $\boldsymbol{\theta}_s = [\alpha_s \; \boldsymbol{\beta}_s \; \mu_s]$ contains the respondent's marginal utility parameters, where $\boldsymbol{\beta}_s = [\beta_{s1} \cdots \beta_{s5}]$. Note that I allow for respondents' preference parameters, $\boldsymbol{\theta}_s$, to be heterogeneous across classes in general.

The MNL model assumes homogeneity in preferences across classes such that $\boldsymbol{\theta}_s = \boldsymbol{\theta} \; \forall s$. I therefore drop the s subscript from (2). The distributional assumption on ε_{ijt} implies the choice probability (1) can be written

(3) $$P_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta}) = \frac{e^{V_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta})}}{\sum_{j'} e^{V_{ij't}(\mathbf{X}_{j't}, \mathbf{Z}_i; \boldsymbol{\theta})}}.$$

Let $d_{ijt} = 1$ if respondent i chooses alternative j in choice occasion t and zero otherwise. Then the respondent's likelihood contribution is $\ell_i^{MNL} = \prod_t \prod_j P_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta})^{1(d_{ijt}=1)}$. The MNL likelihood function is then $\mathcal{L} = \sum_i \ln(\ell_i^{MNL})$. This is Model 1. Model 2 uses the same MNL approach, but drops serial nonparticipants from the sample.

The SH model, Model 3, is a generalization of the traditional MNL that accounts for serial nonparticipation and avoids the issues inherent in truncating the sample, as in Model 2. Formally, the SH model explicitly models the probability that individual i will be a serial nonparticipant, then estimates respondents' utility from beer conditional on them choosing a beer at least once. The probability of nonparticipation, denoted $\pi_i(\mathbf{Z}_i; \boldsymbol{\gamma})$ and observed in the data, is allowed to depend on demographic characteristics and attitudinal variables $\mathbf{Z}_i$ (e.g., age, education, or frequency of beer buying) with accompanying parameter vector $\boldsymbol{\gamma}$. Without loss, denote the opt-out alternative as $j = 3$. The probability of serial nonparticipation is then defined

[7] Note that the probability an individual chooses a particular alternative in equation (1) depends only on the difference in utility across alternatives. This implies that any attribute that is fixed across alternatives (like income) will not affect the choice probability and hence will drop out of model (1). I therefore include income here only for theoretical consistency as indirect utility depends on income.

from (3) as $g_i(\mathbf{X}_{3t}, \mathbf{Z}_i; \boldsymbol{\theta}) = \prod_t P_{i3t}(\mathbf{X}_{3t}, \mathbf{Z}_i; \boldsymbol{\theta})^{1(d_{i3t}=1)}$. From Bayes' Rule, I can write the probability an individual chooses option *j* conditional on choosing a beer at least once as $\tilde{P}_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta}) = P_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta})[1 - g_i(\mathbf{X}_{3t}, \mathbf{Z}_i; \boldsymbol{\theta})]^{-1}$. Individual i's likelihood contribution is then

$$\ell_i^{SH} = \pi_i(\mathbf{Z}_i; \boldsymbol{\gamma})^{1(n_i=1)} \left([1 - \pi_i(\mathbf{Z}_i; \boldsymbol{\gamma})]\tilde{P}_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta})\right)^{1-1(n_i=1)},$$

where $n_i = 1$ if individual *i* is a serial nonparticipant and zero otherwise. Note that $\pi_i(\cdot)$ can either be assumed constant or modeled as a function of individual demographic characteristics; I use the latter approach below. Specifically, I assume the probability individual *i* is a serial nonparticipant follows the standard logit model,

(4) $$\pi_i(\mathbf{Z}_i; \boldsymbol{\gamma}) = \frac{e^{\boldsymbol{\gamma}^T\mathbf{Z}_i}}{1+e^{\boldsymbol{\gamma}^T\mathbf{Z}_i}},$$

where the superscript "T" denotes the matrix transpose.

One drawback to the hurdle model is that it assumes preference homogeneity among beer buyers and provides no information about nonparticipants' preferences. A more flexible approach that overcomes this drawback is the LCM, denoted Model 4. The LCM incorporates discrete heterogeneity in preferences by sorting respondents into different classes distinguished by their estimated utility functions, where each class is composed of homogenous respondents (Boxall & Adamowicz, 2002). The probability that individual *i* chooses alternative *j* is

$$\hat{P}_{ijt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \hat{\boldsymbol{\theta}}, \hat{\boldsymbol{\gamma}}) = \sum_{s=1}^{S} P_{isjt}(\mathbf{X}_{jt}, \mathbf{Z}_i; \boldsymbol{\theta}_s)\psi_{is}(\mathbf{Z}_i; \boldsymbol{\gamma}_s)$$

where $\hat{\boldsymbol{\theta}} = [\boldsymbol{\theta}_1 \cdots \boldsymbol{\theta}_s \cdots \boldsymbol{\theta}_S]$ is a vector of marginal utility parameters for individuals in each class *s* and $\hat{\boldsymbol{\gamma}}$ is defined similarly; $P_{isjt}(\cdot)$ is the probability that individual *i* chooses alternative *j* in choice set t conditional upon being in class s, defined as in (3); and $\psi_{is}(\cdot)$ is the probability individual i is in class s, modeled as

(5) $$\psi_{is} = \frac{e^{\boldsymbol{\gamma}_s^{\mathrm{T}}\mathbf{z}_i}}{\sum_{s'=1}^{S} e^{\boldsymbol{\gamma}_{s'}^{\mathrm{T}}\mathbf{z}_i}}.$$

WTP Calculations

Each model specification allows for the estimation of MWTP for attributes included in the choice experiment. I calculate WTP as compensating variation for each attribute. Compensating variation is the amount of money, WTP_i, that makes an individual indifferent between receiving a good at cost WTP_i and not receiving the good. Applying this to the context of choice modeling yields compensating variation for each of a good's attributes.

Formally, suppose for simplicity that a good has a single attribute, X, that takes on two levels, as the attributes in this study do. The observable component of indirect utility for a class-s individual i is $V_{isj}(X, y_i; \boldsymbol{\theta}_s) = \alpha_s + \beta_s X + \mu y_i$, where α_s is a constant; β_s is the estimated marginal utility parameter for attribute X; μ is the marginal utility of income; and y_i is income. Recall that with effects coding, an attribute takes a value of 1 if the good has the attribute and –1 otherwise. Compensating variation then satisfies the indifference condition

$$V_{isj}(1, y_i - WTP_s; \boldsymbol{\theta}_s) = V(-1, y_i; \boldsymbol{\theta}_s) \Rightarrow \alpha_s + \beta_s + \mu(y_i - WTP_s) = \alpha_s - \beta_s + \mu y_i.$$

I solve for WTP_s as

$$WTP_s = 2\frac{\beta_s}{\mu}.$$

I can generalize this expression for a good with K attributes by writing MWTP for attribute k as

(6) $$WTP_{sk} = 2\frac{\beta_{sk}}{\mu}.$$

Expression (6) is the class-specific MWTP estimated in the LCM (Model 4). For the MNL (Models 1 and 2), $\beta_{sk} = \beta_k \; \forall s$ so that

$$WTP_k = 2\frac{\beta_k}{\mu}. \tag{7}$$

For the SH model (Model 3), calculating MWTP for attributes may require adjusting for serial nonparticipation. von Haefen et al. (2005) suggest ignoring the participation decision in calculating WTP if nonparticipants' decisions are due to incomprehension of the survey instrument. The expression for MWTP would be the same as (7) in this case. However, the choice setting (i.e., whether or not to buy a food product) is likely to be very familiar to respondents, and the survey instrument was thoroughly pre-tested. I therefore dismiss the notion that respondents do not understand the survey and instead assume serial nonparticipation is driven by consumers' own preferences against buying beer. von Haefen et al. (2005) suggest treating WTP for sustainability attributes as $0.00 among serial nonparticipants in this case, such that mean WTP becomes

$$WTP_{ik} = 2\frac{\beta_k}{\mu}[1 - \pi_i(\mathbf{Z}_i;\, \boldsymbol{\gamma})], \tag{8}$$

or WTP weighted by the probability an individual chooses a beer in at least one choice occasion.

The expressions for MWTP are nonlinear functions of random parameters. I therefore calculate confidence intervals (CI) of MWTP measures from each of the models following Krinsky & Robb (1986). Briefly, this approach involves sampling the marginal utility parameters $\boldsymbol{\theta}_s$ from their estimated asymptotic distributions over several thousand draws, calculating the desired MWTP measure, then identifying the 95% CI from the distribution of simulated MWTP measures.

RESULTS

Model 1: Multinomial Logit with Full Data Set

I first use a traditional MNL to estimate the marginal utility parameters α, β_k, and μ in (2) using the "clogit" routine in Stata (StataCorp, 2017). The complete data set is composed of 30,984 observations (1,291 participants × 8 choice sets × 3 alternatives per choice set). Table 10 presents estimation results, including mean coefficient estimates and robust standard errors.

Table 10: Model 1 marginal utility parameter estimation results

Variable	Estimate (Std. error)[a]
Packaging (glass bottles)	0.358*** (0.020)
Water sustainability practices	0.024 (0.015)
Carbon sustainability practices	0.110*** (0.015)
Landfill sustainability practices	0.148*** (0.013)
Localness (locally brewed)	-0.035** (0.016)
Price	-0.241*** (0.012)
ASC	-2.186*** (0.126)

[a]Superscript *** and ** denotes statistical significance at the 1 and 5 percent level, respectively.

The estimated coefficients on packaging (in glass bottles), the carbon eco-label, and the landfill eco-label are all positive and significant at the 1% level, implying that the presence of these attributes increases a consumer's utility. Price and the ASC are negative and significant at the 1% level, indicating a higher price decreases a consumer's utility, and the consumer is worse off when choosing the opt-out alternative. Localness is negative and significant at the 5% level, suggesting locally brewed beer decreases a consumer's utility. The water sustainability attribute is insignificant in this specification, suggesting consumers do not place value on this attribute.

Using the estimated parameters from Table 10, I calculate MWTP for each attribute using condition (7). Table 11 shows the mean MWTP estimate for each attribute, along with 95% CIs, calculated via the Krinsky-Robb procedure.

Table 11: Model 1 distribution of marginal willingness-to-pay estimates

Variable[a]	Mean	95% confidence interval
Packaging (glass bottles)	\$2.97	[\$2.75, \$3.20]
Water sustainability practices	\$0.20	[-\$0.81, \$1.21]
Carbon sustainability practices	\$0.92	[\$0.47, \$1.37]
Landfill sustainability practices	\$1.23	[\$1.02, \$1.44]
Localness (locally brewed)	-\$0.29	[-\$0.57, -\$0.02]

[a]Grey shading indicates mean marginal WTP estimate is not significantly different from zero.

Consumers' mean MWTP for glass bottles (relative to cans) is \$2.97 per six pack. Carbon reduction and landfill diversion earn a mean premium of \$0.92 and \$1.23, respectively. These results indicate that consumers strictly prefer bottles to cans and have a higher mean MWTP for the landfill diversion eco-label than the carbon reduction eco-label. The water sustainability attribute is not statistically different from zero, as the 95% CI includes zero. Localness has a mean MWTP of -\$0.29, suggesting that on average, consumers value locally-brewed beer less than non-locally brewed beer.

This specification has two drawbacks that severely impact the validity of the results. The first is that it includes serial nonparticipants, which account for 5,880 observations (245 respondents × 8 choice sets × 3 alternatives per choice set). This issue has been dealt with in the past by introducing an ASC, as I have done here. von Haefen et al. (2005) suggests that "this approach has the potential of increasing the probability mass associated with serial nonparticipation, but it restrictively assumes that serial nonparticipants' marginal rates of substitution are the same as participants'." This is the second drawback to Model 1's specification. Another way to address issues of serial participation is to drop serial nonparticipants from the analysis, which is done in Model 2.

Model 2: Multinomial Logit without Serial Nonparticipants

Dropping serial nonparticipants results in a dataset comprised of 1,046 individuals (25,104 observations) who bought the hypothetical beer on at least one choice occasion. An ASC is also included in this data set, as there are still 259 self-identifying non-beer buyers remaining in this data set. These individuals state they never buy beer, but chose either Beer A or Beer B on at least one occasion in the choice experiment. Furthermore, only 45% of the sample chose a beer on all eight choice occasions. Therefore, an ASC is included to account for the high opt-out rate that still exists in the dropped data set. Table 12 presents the estimates of (2) after dropping serial nonparticipants from the dataset.

Table 12: Model 2 marginal utility parameter estimation results

Variable	Estimate (Std. error)[a]
Packaging (glass bottles)	0.365***
	(0.021)
Water sustainability practices	0.125***
	(0.017)
Carbon sustainability practices	0.144***
	(0.016)
Landfill sustainability practices	0.175***
	(0.013)
Localness (locally brewed)	-0.011
	(0.017)
Price	-0.347***
	(0.012)
ASC	-4.110***
	(0.155)

[a]Superscript *** denotes statistical significance at the 1 percent level.

Much like the MNL with the full data set, the marginal utility parameters for packaging, landfill diversion, carbon reduction, price, and the ASC remain significant at the 1% level and maintain the same signs. The marginal utility from localness becomes insignificant, even at the 10% level. Marginal utility from water reduction practices becomes significant at the 1% level. These results suggest an increase in utility, on average, for beer packaged in glass bottles and beer that displays any of the three sustainability attributes. I calculate MWTP for each attribute using (7), found in Table 13.

Table 13: Model 2 distribution of marginal willingness-to-pay estimates

Variable[a]	Mean	95% confidence interval
Packaging (glass bottles)	$2.10	[$1.94, $2.25]
Water sustainability practices	$0.71	[–$0.27, $1.72]
Carbon sustainability practices	$0.83	[$0.45, $1.21]
Landfill sustainability practices	$1.01	[$0.86, $1.16]
Localness (locally brewed)	-$0.06	[–$0.26, $0.14]

[a]Grey shading indicates mean marginal WTP estimate is not significantly different from zero.

Consumers in the dropped data set have the strongest preference for packaging in glass bottles; consumers attach a $2.10 per six-pack premium to this attribute. This is smaller than the mean MWTP of $2.97 for this attribute in Model 1. The sustainability attributes for reduced carbon emissions and increased landfill diversion have mean premiums of $0.83 and $1.01, respectively. Mean MWTP for water sustainability practices is not significantly different from zero. The ranking of mean MWTP for the sustainability attributes follows Model 1, where landfill diversion is greatest, followed by carbon reduction practices, although, again, the overlapping confidence intervals for these attributes indicate MWTP for these attributes are the same. Both the landfill diversion practices and carbon reduction practices have lower mean premiums in Model 2 than in Model 1 by $0.22 and $0.08, respectively.

Dropping serial nonparticipants results in several potential biases. The first source of bias is an uneven distribution of cheap talk scripts and uneven blocking. As mentioned in the methodology section, half of the respondents receive instructions with a cheap talk script while the other half does not. Likewise, the sample is assigned evenly to either block one or block two, unconditional on which set of instructions the individual sees. Screening out serial nonparticipants leads to a statistical imbalance, resulting in potentially biased results. Of the 1,046 respondents used in these results, 533 (50.95%) receive the cheap talk script, while 513 (49.04%) did not. For the choice experiment blocking, 534 (51.05%) are in block one and 512 (48.95%) are in block two. The second source of bias is sample truncation. This bias is the result of selecting a sample conditional upon meeting a given criteria, which in turn introduces a potential for WTP estimates to deviate from the true mean. Finally, this model continues to assume preference homogeneity across respondents. Considering these drawbacks, I use two alternative approaches to estimate choice model (2).

Model 3: Single-Hurdle Multinomial Logit Model

The SH MNL explicitly models the probability that individual *i* is a serial nonparticipant to overcome serial nonparticipation. As such, the analysis uses the entire data set to calculate (2) and incorporates demographic and attitudinal variables that may drive serial nonparticipation. In the ‘Beer Purchasing and Consumption Habits’ subsection of the ‘Data’ section, I show that demographics and attitudinal variables are drivers of both beer buying and serial nonparticipation. Therefore, I assume respondents’ participation decisions depend on five demographic characteristics (gender, age, education, income, and region), their frequency of beer buying, and their recycling habits.

The SH model is estimated in MATLAB (see Appendix B for code). Table 14 provides estimates from the logit model predicting serial nonparticipation (equation (4)). Results indicate that gender, age, income, beer buying habits, and recycling tendencies drive serial nonparticipation. Lower income, older females that do not by beer are more likely to be serial nonparticipants. This matches the summary results on serial nonparticipation shown in the "Data" section referred to previously. Also, individuals who state that their household does not recycle are more likely to be serial nonparticipants. This makes intuitive sense as recycling habits can serve as an indicator for an individual's sustainability preferences. If an individual does not recycle, then a choice experiment focusing on sustainability preferences gives little incentive for these individuals to respond.

Table 14: Model 3 logit estimates for serial nonparticipation model

Variable	Level	Estimate (std. error)[a]
Gender	Male	-0.473*** (0.068)
Age (yrs)	21-24	-0.425** (0.213)
	25-34	-0.475*** (0.111)
	35-44	-0.540*** (0.010)
	45-54	-0.247*** (0.094)
	55-64	0.425*** (0.085)
Education	High school diploma	-0.006 (0.177)
	Some college, no degree	0.446** (0.180)
	Associate's or bachelor's degree	0.216 (0.178)
	Graduate or professional degree	0.226 (0.193)
Income ($)	25,000-49,999	-0.445*** (0.085)
	50,000-74,999	-0.657*** (0.093)
	75,000-99,999	-0.726*** (0.116)
	100,000 +	-0.460*** (0.096)
Region	Northeast	0.045 (0.088)
	Midwest	0.131* (0.081)
	West	0.164** (0.088)
Beer buying	Never	2.821*** (0.267)

Table 14 continued

	<1 time per month	0.508** (0.276)
	1 per month	-0.082 (0.314)
	2-3 per month	-1.057*** (0.391)
	Weekly	0.211 (0.314)
Recycle	Yes	-0.575*** (0.077)
	Not sure	-0.167 (0.239)
	Prefer no answer	-0.037 (0.261)
Constant		-2.213*** (0.339)

[a]Superscript ***, **, and * denotes statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 15 presents the mean marginal utility parameter estimates and standard errors, while Table 16 presents MWTP estimates for the SH model. Table 16 includes both unweighted and weighted MWTP means and distributions (conditions (7) and (8), respectively). The unweighted estimates ignore serial nonparticipation, and the weighted estimates set the serial nonparticipant's MWTP equal to zero such that the MWTP estimates are weighted by the probability of participating (81%).

Table 15: Model 3 marginal utility parameter estimation results

Variable	Estimate (std. error)[a]
Packaging (glass bottles)	0.364*** (0.013)
Water sustainability practices	0.126*** (0.019)
Carbon sustainability practices	0.145*** (0.014)
Landfill sustainability practices	0.175*** (0.013)
Localness (locally brewed)	-0.011 (0.014)
Price	-0.347*** (0.136)
ASC	-4.110*** (0.014)

[a]Superscript *** denotes statistical significance at the 1 percent level.

Table 16: Model 3 unweighted and weighted distribution of marginal willingness-to-pay

	Unweighted		Weighted	
Variable[a]	Mean	95% confidence interval	Mean	95% confidence interval
Packaging (glass bottles)	$2.10	[$1.85, $2.36]	$1.70	[$1.50, $1.91]
Water sustainability practices	$0.72	[-$0.27, $1.70]	$0.58	[-$0.22, $1.38]
Carbon sustainability practices	$0.84	[$0.44, $1.23]	$0.67	[$0.36, $0.99]
Landfill sustainability practices	$1.01	[$0.84, $1.18]	$0.82	[$0.68, $0.96]
Localness (locally brewed)	-$0.06	[-$0.27, $0.14]	-$0.05	[-$0.22, $0.12]

[a] Grey shading indicates mean marginal WTP estimate is not significantly different from zero.

The results suggest that the marginal utility parameter estimates for packaging, all sustainability attributes, price, and the ASC are all statistically significant at the 1% level, with expected signs. Packaging in glass bottles again yields the highest mean price premium at $2.10 per six-pack using the unweighted estimate and $1.70 using the weighted estimate. Of the sustainability practices, mean MWTP for landfill diversion practices is greatest; on average, consumers attach a premium of $0.82–$1.01 on this practice. This is followed by carbon sustainability practices (mean MWTP is $0.68–$0.83 on average). Consumers' MWTP for water sustainability practices is again not significantly different from zero. MWTP for localness is also insignificant, consistent with Model 2.

The one drawback to this model is that it assumes homogeneity across participants. Therefore, no inference can be made as to the differences between consumer classes. Put differently, there is no way of knowing which consumers value sustainability more than another.

Model 4, described below, introduces discrete heterogeneity across utility parameters by segmenting like respondents into classes distinguished by their preferences for beer attributes.

Model 4: Latent Class Model with Full Data Set

The LCM is the most flexible approach used here, as it does not require *a priori* knowledge of serial nonparticipation and incorporates discrete preference heterogeneity by grouping like respondents into distinct classes, or market segments. Similar to the SH MNL, the LCM uses the full dataset and includes demographic and attitudinal variables as determinants of class membership, modeled as the probability of being included in each class *s* as in condition (5). I assume each respondent can be categorized into one of three classes. Typically one estimates a LCM by increasing the number of classes until the Akaike and/or Bayesian Information Criteria start to decline. As shown in Figure 5, the Bayesian Information Criterion remains relatively unchanged after the second class is added, and although the Akaike Information Criteria continues to decline as the number of classes increases, the improvement of fit seems trivial. Given these results, I choose to model three classes for computational tractability and parsimony.

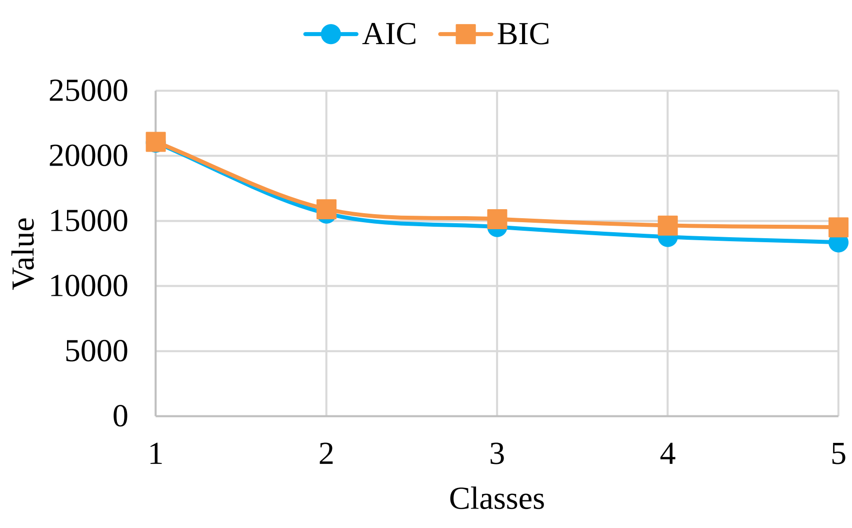

Figure 5: Akaike and Bayesian Information Criterion under alternate class specifications

I estimate the LCM using Pacifico & Yoo (2013) "lclogit2" routine in Stata (StataCorp, 2017). The class membership model estimates are presented in Table 17, where Class 3 is the reference class.

Table 17: Estimated class membership coefficients and standard errors for Model 4

		Estimate (std. error)[a]	
Variable	Level	Class 1	Class 2
Gender	Male	0.411**	0.668**
		(0.187)	(0.215)
Age (yrs)	21-24	0.974*	0.329
		(0.548)	(0.621)
	25-34	0.900**	0.117
		(0.309)	(0.360)
	35-44	0.865**	0.504
		(0.281)	(0.330)
	45-54	0.514*	0.539*
		(0.264)	(0.305)
	55-64	-0.123	-0.113
		(0.254)	(0.296)
Education	High school diploma	0.111	0.634
		(0.575)	(0.577)
	Some college, no degree	-0.232	0.269
		(0.473)	(0.586)
	Associate's or bachelor's degree	-0.050	0.323
		(0.471)	(0.585)
	Graduate or professional degree	0.127	0.133
		(0.520)	(0.645)
Income ($)	25,000-49,999	0.570**	0.341
		(0.244)	(0.284)
	50,000-74,999	0.761***	0.742**
		(0.275)	(0.312)
	75,000-99,999	0.777**	1.009***
		(0.326)	(0.361)
	100,000 +	0.599**	-0.191
		(0.277)	(0.339)
Region	Northeast	0.005	-0.080
		(0.251)	(0.292)
	Midwest	-0.302	-0.178
		(0.228)	(0.258)
	West	-0.133	-0.405
		(0.243)	(0.289)
Beer buying	Never	-2.615***	-2.26***
		(0.624)	(0.699)
	<1 time per month	-0.624	0.368
		(0.654)	(0.722)
	1 per month	0.117	0.558
		(0.728)	(0.797)
	2-3 per month	0.971	1.58*
		(0.897)	(0.954)
	Weekly	-0.057	0.031
		(0.725)	(0.803)

Table 17 continued

Recycle	Yes	0.825***	0.279
		(0.228)	(0.254)
	Not sure	0.329	0.540
		(0.675)	(0.745)
	Prefer no answer	-0.495	-0.746
		(0.814)	(1.039)
Constant		0.870	-0.135
		(0.808)	(0.939)
Class Share		54.90%	24.00%

[a]Superscript ***, **, and * denotes statistical significance at the 1, 5, and 10 percent levels, respectively.

Class membership shares are 54.9%, 24%, and 21.1% of my sample for Classes 1–3, respectively. Class 3 is clearly composed of the serial nonparticipants. The portion of respondents in this class (21.1%) is slightly higher than the serial nonparticipation rate of 18.98%, meaning there are also respondents in this category that chose a beer on at least one choice occasion, but are still placed in this group. The primary indicator that these are the serial nonparticipants is the sign and significance on the beer buying habit level “never.” The negative parameter on beer buying level “never” in Classes 1 and 2 is significant at the 1% level, suggesting respondents that answer the beer buying question this way are less likely to be placed in these classes relative to Class 3. A second indicator that this group is comprised of serial nonparticipants is gender and income, where lower-income females are more likely to be placed in Class 3. Based on these results, I will refer to Class 3 as “Non-Beer Buyers.”

Classes 1 and 2 are more likely to comprise males relative to Class 3. Differences between Classes 1 and 2 include age, income, and recycling habits. Class 1 members tend to be younger, have higher-income, and are more likely to recycle. The positive and statistically significant parameter value on household recycling, along with estimation results presented in Table 18 and Table 19, give reason to call Class 1 the “Eco-Conscious Beer Buyers.” In contrast, Class 2 members tend to be medium-income, older males that are less likely than Class 1 members to recycle and pay a premium for sustainability attributes. I therefore refer to these individuals as "Price-Driven Beer Buyers."

Table 18: Model 4 marginal utility parameter estimation results

	Class 1 (54.9%)	Class 2 (24.0%)	Class 3 (21.1%)
Variable	Estimate (std. error)[a]	Estimate (std. error)	Estimate (std. error)
Packaging (glass bottles)	0.349*** (0.156)	0.506*** (0.046)	-0.074 (0.206)
Water sustainability practices	0.171*** (0.029)	.100** (0.046)	0.055 (0.206)
Carbon sustainability practices	0.171*** (0.017)	0.062 (0.046)	-0.022 (0.211)
Landfill sustainability practices	0.192*** (0.016)	0.129*** (0.037)	0.162 (0.211)
Localness (locally brewed)	-0.018 (0.017)	0.030 (0.042)	-0.025 (0.200)
Price	-0.281*** (0.024)	-0.736*** (0.036)	-0.128 (0.136)
ASC	-5.343*** (.257)	-6.142*** (0.311)	3.723*** (1.235)

[a]Superscript ***, **, and * denotes statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 19: Model 4 distribution of marginal willingness-to-pay estimates

Variable[a]	Class 1 (54.9%) Mean	Class 1 (54.9%) 95% confidence interval	Class 2 (24.0%) Mean	Class 2 (24.0%) 95% confidence interval	Class 3 (21.1%) Mean	Class 3 (21.1%) 95% confidence interval
Packaging (glass bottles)	$3.80	[$1.13, $13.50]	$1.61	[$0.85, $3.73]	-$1.68	[$-5.36, $4.97]
Water sustainability practices	$0.25	[$-5.96, $2.31]	$0.08	[$-1.63, $0.74]	-$1.47	[$-4.50, $5.67]
Carbon sustainability practices	$1.63	[$0.59, $3.7]	$0.12	[$-0.48, $0.46]	$1.77	[$-5.24, $4.82]
Landfill sustainability practices	$2.11	[$0.59, $7.17]	$0.40	[$0.05, $0.96]	$0.79	[$-5.82, $6.39]
Localness (locally brewed)	-$0.35	[$-1.76, $0.30]	$0.07	[$-0.34, $0.43]	$1.06	[$-4.42, $5.72]

[a] Grey shading indicates mean marginal WTP estimate is not significantly different from zero.

Eco-Conscious Beer Buyers (Class 1) show statistically significant marginal utility parameters for the water, carbon, and landfill sustainability practices at the 1% level, although only the mean MWTP estimates for carbon and landfill practices are significantly different from zero (mean MWTP is \$1.63 for carbon reduction practices and \$2.11 for landfill diversion practices). Parameter estimates for glass bottle packaging, price, and the ASC are also significant at the 1% level, while localness, once again, remains insignificant.

Price-Driven Beer Buyers (Class 2) have statistically significant marginal utility parameter values for packaging and landfill diversion at the 1% level, along with price and the ASC. The marginal utility parameter for water sustainability is statistically significant at the 5% level, while the marginal utility parameters for carbon reduction practices and localness are insignificant. The mean MWTP estimates for glass bottle packaging and landfill diversion are \$1.61 and \$0.40 per six-pack, respectively. No other MWTP estimates are significantly different from zero for Price-Driven Beer Buyers. Comparing these estimates to those of Eco-Conscious Beer Buyers shows Class 2 has uniformly smaller mean MWTP estimates, driving the class name “Price-Driven Beer Buyers.” The signs and relative magnitude of the estimated parameters match those from Models 1–3, indicating my results are robust to model specification.

Lastly, the Non-Beer Buyers, Class 3, have only one statistically significant variable: the positive ASC. This indicates that these consumers obtain relatively more utility from choosing the opt-out alternative, holding all else equal. This finding matches Burton & Rigby (2009) suggesting that a class comprised of serial nonparticipants is characterized by a positive ASC with insignificant parameters on the other included attributes.

DISCUSSION & CONCLUSIONS

The first interesting finding coming from this choice experiment that does not match the literature is the insignificance of, and even sometimes negative, premium on localness. One potential explanation for this result is the experimental design asking respondents to envision the style they most often buy. Not all participants that engage in the choice experiment state they buy beer. Also, if the respondent strictly buys commercial beer (e.g., Bud Light), or has a favorite beer that they are envisioning instead, then the individual may know it is not a locally brewed beer. In this case, their attention would drift away from this label and towards packaging, sustainability attributes, and price. Given this potential shortcoming in design, and the literature backing a positive WTP for localness, I am not ready to dismiss that consumers do not value localness in their beer. Despite the insignificance of the localness label, I do not see this as an issue for microbrewery investment in sustainability equipment. Microbreweries tend to distribute within a given radius, thus most of their sales are coming from a local community. These consumers may buy the product because they either: (i) value the localness; or (ii) just enjoy their product more than competitors' beers. However, none of this should impact a brewer's investment in sustainability equipment.

Regarding the sustainability labels included in the choice experiment, consumers are willing to pay positive and statistically significant price premiums for beers produced with landfill diversion and carbon reduction practices, across all specifications. The price premium for landfill diversion practices ranges from \$0.40 (Class 2, Model 4) to \$2.11 (Class 1, Model 4) per six-pack. Carbon reduction practices yield a price premium that ranges from \$0.67 (Model 3) to \$1.63 (Class 1, Model 4) per six-pack. The results from the Likert scale sustainability preferences responses—where respondents indicate how much they agree or disagree with statements regarding a broad definition of sustainability and industry water use, energy use, and landfill diversion—serve as a robustness check on these estimates. Of the three statements mirroring the eco-labels, the statement, “Industries need to have practices and regulations in place to increase landfill diversion” had the most respondents stating “strongly agree,” at 365 (28.27% of the sample). This is followed by the statement, “Industries need to have practices and regulations in place to reduce energy consumption,” with which 351 respondents (27.19% of the sample) strongly agreed. Lastly, although the marginal utility parameter on water sustainability practices is statistically significant in Models 2, 3, and 4, the estimated WTP for this attribute is not significantly different from zero for any specification.

Note also that my estimates of MWTP for carbon reduction are mostly smaller than the $1.30 per six-pack Carley & Yahng (2018) find in their study. Indeed, estimated MWTP for this attribute is found to be less than $1 using all models except the LCM (Model 4), which estimates MWTP for carbon reduction to be $1.63 for Eco-Conscious Beer Buyers and $0.00 for everyone else. Potential explanations for greater WTP estimates in Carley & Yahng (2018) include: (i) incentive compatibility issues with open-ended surveys; (ii) unfamiliarity with valuing extrinsic attributes; and (iii) assuming a linear WTP function, when economic theory suggests diminishing WTP. Open-ended surveys lack consequence for over-stating WTP, which generates exaggerated responses. High WTP estimates can also be the product of not knowing how to value the attribute in question, as could be the case with sustainability in beer. Lastly, the authors measure WTP per ounce and multiply this by 72 to get WTP per six-pack. This assumes MWTP is linear, when diminishing MWTP is more likely.

These positive and statistically significant price premiums show that brewers could charge an additional premium on beer produced using sustainable practices. Positive price premiums suggest a market exists for these attributes, such that including them will increase consumer demand for sustainable beer. I do not believe that the aggregate demand for beer would shift outwards if brewers adopt sustainability practices; there is little reason to think that people that do not currently buy beer will begin buying beer that is marketed as sustainably-made. Instead, there is likely another reason they choose to not buy beer (e.g., do not like the taste). What may shift is demand for an individual brewery that markets beer as sustainable. At the most basic level, an outward shift in demand will increase quantity demanded and increase price. The producer surplus gains to craft and commercial brewers may differ; although beer is a normal good with an inelastic demand, demand for craft beer is more elastic than commercial beer due in large part to the abundance of options, the desire for variety, and enjoyment from trying new beers (Toro-González et al., 2014). Still, this research demonstrates that there are potential welfare gains to brewers from sustainable production.

A secondary finding from this study comes from the LCM analysis, which finds beer consumers are composed of “Eco-Conscious Beer Buyers” and “Price-Driven Beer Buyers.” The Eco-Conscious Beer Buyers class is more likely to be comprised of younger, higher-income males that recycle and are willing to pay significantly higher premiums for sustainability attributes than that of other classes. These results are promising, as the data suggests that these demographics are similar to that of the craft beer buyer, presented in Tables 6 and 7. When distinguishing between the craft-only buyer versus commercial only buyer, a test of proportions reveals statistically significant differences in age, income, education, and recycling habits. The craft buyer is younger, higher-income, better educated, and recycles, suggesting many of the craft-only buyers are categorized into Class 1. The same is true when testing craft and commercial buyers against those that only buy commercial beer. This analysis suggests microbreweries could offset some investment costs if they market their beer as sustainable, as near 80% of craft beer drinkers state a preference to try new beers. Differentiating their product could attract competitors' consumers, while simultaneously demonstrating a commitment to sustainable brewing.

Finally, despite finding that consumers value sustainability attributes, the highest premium found here is for glass bottle packaging. Mean MWTP for glass packaging ranges from $1.61 (Class 2, Model 4) to $3.80 (Class 1, Model 4). This reveals that consumers are willing to pay more for glass bottle packaging, potentially associating it with higher elegance and perceived taste (Barnett, Velasco, & Spence, 2016; Buck, 2016; Rhodes, 2014). The finding also matches Watson (2017; 2018) stating that glass bottles still dominate the craft beer sector, which are more expensive than commercial beers and are associated with a higher perceived elegance to certain consumer bases (Malone & Lusk, 2018b). Yang & Raghubir (2005) suggest that this preference could also be due to an elongation bias, where longer containers (bottles) are perceived as having more volume, even when the actual volume per container is posted on the packaging (as is done in this study). I reject the idea that participants in this choice experiment believe that bottles have a greater volume. During the "Beer Buying Habits" section of the survey, self-identifying beer buyers are asked "When given the option, what packaging would you rather buy?" with options: cans, bottles, or no preference. Of the 825 self-identifying beer buyers, over half (55.15%) state a preference for glass bottle packaging, while 22.55% state cans and 22.30% state no preference. The results are even more skewed towards glass bottle packaging when asking about consumption, with over 60% of self-identifying beer drinkers state a preference for glass bottles. Similar results are seen in Barnett et al. (2016) where over 60% of their sample states that beer tastes better from the bottle. With these questions serving as a robustness check for the premiums, and market data supporting the preference consumers have for glass bottles, I reject the idea that an elongation effect is present in this study. Rather, consumers have a higher perceived taste from bottles.

However, glass bottle packaging is inconsistent with sustainability, as glass bottles have a greater carbon footprint and a lower landfill diversion rate than aluminum cans (New Belgium Brewing Company, 2019a; Pasqualino et al., 2011; Wilcox, Cruz, & Neal Jr., 2013). New Belgium Brewing Company, which primarily packages in glass bottles and is thought of as an industry leader in sustainability, states that 38% of their carbon footprint is attributed to glass (New Belgium Brewing Company, 2019a). Glass bottles are heavier than aluminum cans, thus requiring higher transportation costs and higher carbon emissions. Glass is also tougher to recycle than aluminum and requires more packaging per unit (Pasqualino et al., 2011). A pessimistic stance suggests that when faced with the tradeoff between glass bottles and varying sustainability attribute, the consumer is going to choose the glass bottles. However, a more optimistic approach suggests that the difference in recycling rates has decreased in recent years due to contributions from brewers such as AB InBev, New Belgium Brewing Company, and Boulevard Brewing Company (AB InBev, 2018a; Brewers Association, 2017b; New Belgium Brewing Company, 2019c), lessening the environmental harm from this form of packaging. The contributions to recycling programs and lightweight bottles seeks to mitigate the tradeoff, offering consumers both their preferred packaging and sustainability attributes.

There are two additional limitations I have identified as part of this study: (i) potential bias stemming from the hypothetical nature of my stated preference choice experiment and (ii) the inability to incorporate all aspects of sustainability. The first limitation is the largest shortcoming of stated preference choice experiments. Though choice experiments typically generate WTP estimates that are incentive compatible relative to open-ended surveys (Lusk & Schroeder, 2004), the results are purely hypothetical as there is no consequence for suboptimal decision making amongst participants (Campbell-Arvai et al., 2014). Therefore, I suggest that these results could serve as an upper bound on the price premium consumers are willing to pay for these attributes. However, a positive and statistically distinct price premium for landfill diversion and carbon emissions across specifications is nonetheless a preliminary indicator of consumer preference for sustainability attributes in beer. A revealed preference choice experiment could provide a more accurate MWTP measure, and this is left for future work. The last limitation to the study is that although multiple facets of sustainability are included, modeling every aspect of sustainability as an attribute is infeasible. I sought to capture the three broadest facets possible in water, energy, and waste, but could not capture all the miscellaneous actions (e.g., contributions to environmental agencies or educational program commitments). Despite these limitations, the positive and statistically significant premiums seen for multiple sustainability attributes across all specifications is encouraging to microbreweries seeking investment in sustainability technology.

Determining that a price premium exists for sustainability attributes is only a preliminary goal of my broader research program, as this only depicts how consumers value these attributes. A microbrewery eager to join the sustainability movement should consider different investments in relation to their current production function. Future research includes conducting a techno-economic analysis to determine the feasibility of investment in sustainability equipment using a benchmark brewery. Once modeled, breakeven analysis on a price premium charged to consumers could be found that sets the net present value of investing in the equipment equal to zero. This breakeven premium will then be compared to the price premium found in this choice experiment. With this knowledge, a brewery will be better equipped to handle sustainability investment decisions while simultaneously differentiating their product in a saturated market and reducing their environmental footprint.

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APPENDIX A. SURVEY

Survey Flow

EmbeddedData
idValue will be set from Panel or URL.
tableValue will be set from Panel or URL.

Standard: Survey Intro (1 Question)
Block: Demographics (12 Questions)

Branch: New Branch
If
If I am ____ years old. Under 21 Is Selected

EndSurvey: Advanced

Standard: Beer Buying Behavior (9 Questions)
Standard: Beer Consumption Habits (7 Questions)
Standard: Brewers and Sustainability (2 Questions)

BlockRandomizer: 1 - Evenly Present Elements

Block: Instructions without Cheap Talk Script (2 Questions)
Block: Instructions with Cheap Talk Script (2 Questions)

Standard: Labels and their meaning (2 Questions)

BlockRandomizer: 1 - Evenly Present Elements

Block: Choice Experiment Block 1 (17 Questions)
Block: Choice Experiment Block 2 (17 Questions)

Standard: Sustainability Preferences (7 Questions)

EndSurvey: Advanced

Page Break

Survey Blocks & Questions

Start of Block: Survey Intro

Q1.1 This survey will take approximately 10-12 minutes. Your participation is completely voluntary and you may choose not to participate at any time during the experiment. If you choose not to participate, you may exit the survey at any point.

End of Block: Survey Intro

Start of Block: Demographics

Q2.1 Browser Meta Info
Browser
Version
Operating System
Screen Resolution
Flash Version
Java Support
User Agent

Q2.2 Timing
First Click
Last Click
Page Submit
Click Count

Q2.3 For federal government-related forms, I identify as:

- ○ Male
- ○ Female

Q2.4 I am ____ years old.

- ○ Under 21
- ○ 21 - 24
- ○ 25 - 34
- ○ 35 - 44
- ○ 45 - 54
- ○ 55 - 64
- ○ 65 +

Q2.5 The best description of my educational background is:

- ◯ Did not graduate from high school
- ◯ Graduated from high school, did not attend college
- ◯ Attended college, no degree earned
- ◯ Attended college, associate's or bachelor's degree earned
- ◯ Attended college, graduate or professional degree earned

Q2.6 My annual pre-tax, household income is:

- ◯ $0-$24,999
- ◯ $25,000-$49,999
- ◯ $50,000-$74,999
- ◯ $75,000-$99,999
- ◯ $100,000 or higher

Q2.7 My region of residence is: ___________. Select one option from the drop down menu.

▼ Northeast (CT, ME, MA, NH, NJ, NY, PA, RI, VT) ... West (AK, AZ, CA, CO, HI, ID, MT, NV, NM, OR, UT, WA, WY)

Display This Question:
If My region of residence is: ___________. Select one option from the drop down menu. = Northeast (CT, ME, MA, NH, NJ, NY, PA, RI, VT)

Q2.8 My state and county of residence in the Northeast is:
State
County

▼ Connecticut ... Vermont ~ Windsor County

Display This Question:
If My region of residence is: ___________. Select one option from the drop down menu. = South (AL, AR, DE, DC, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV)

Q2.9 My state of residence in the South is:
State
County

▼ Alabama ... West Virginia ~ Wyoming County

Display This Question:
If My region of residence is: ___________. Select one option from the drop down menu. = Midwest (IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SD, WI)

Q2.10 My state of residence in the Midwest is:
State
County

▼ Illinois... Wisconsin ~ Wood County

Display This Question:
If My region of residence is: ___________. Select one option from the drop down menu. = West (AK, AZ, CA, CO, HI, ID, MT, NV, NM, OR, UT, WA, WY)

Q2.11 My state of residence in the West is:
State
County

▼ Alaska ... Wyoming ~ Weston County

Q2.12 Which of the following industries most closely matches the one in which you or other adult members in your household are employed? (Select all that apply)

☐ Agriculture

☐ Forestry or natural resource management

☐ Real estate or rental and leasing

☐ Mining, oil, or natural gas industries

☐ Educational services

☐ Health care or social assistance

☐ Retail

☐ Food services or restaurants

☐ Other - Not listed

End of Block: Demographics

Start of Block: Beer Buying Behavior

Q3.1 Timing
First Click
Last Click
Page Submit
Click Count

Q3.2 Are you the primary shopper in your household?

- ○ Yes
- ○ No

Q3.3 How often do you buy beer from a retail outlet for you or your household?

- ○ Never
- ○ Less than once a month
- ○ Once a month
- ○ Two or three times a month
- ○ Weekly
- ○ More than weekly

Skip To: End of Block If How often do you buy beer from a retail outlet for you or your household? = Never

Q3.4 How much do you typically pay for a six-pack (1 can or bottle = 12 oz.) of beer from a retail outlet? If you purchase quantities greater than six-packs, please scale to the cost of a six pack. For example, if you buy a 12 pack for $18.00, the cost per six pack would be $9.00.

- Less than $6.00
- $6.00-$6.99
- $7.00-$7.99
- $8.00-$8.99
- $9.00-$9.99
- $10.00-$10.99
- $11.00-$11.99
- $12.00 or greater

Q3.5 Who typically drinks the beer you buy?

- Yourself
- Someone else (like a family member, friend, or partner)
- Both yourself and someone else

Q3.6 What type of beer do you buy?

- Only commercial beer (Bud Light, Miller Lite, etc.)
- Only craft beer (Samuel Adams Boston Lager, New Belgium Fat Tire, etc.)
- Both commercial and craft beer
- Unsure

Q3.7 Do you enjoy buying new beers that you have never tried before?

- ○ Yes
- ○ No

Q3.8 When given the option, what packaging would you rather buy?

- ○ Cans
- ○ Bottles
- ○ No preference

Q3.9 What factors do you consider when buying beer?

- ☐ Price
- ☐ Style
- ☐ Brand
- ☐ Taste
- ☐ Localness
- ☐ Organic
- ☐ Can or Bottle Design
- ☐ Environmental Impact
- ☐ Packaging
- ☐ Other (please explain) ____

End of Block: Beer Buying Behavior

Start of Block: Beer Consumption Habits

Q4.1 Timing
First Click
Last Click
Page Submit
Click Count

Q4.2 How often do you consume beer?

- Never
- Less than once a month
- Once a month
- Two or three times a month
- Once a week
- More than once a week
- Every day

Skip To: End of Block If How often do you consume beer? = Never

Q4.3 Where do you consume beer? (select all that apply)

- Home
- Bar
- Taproom
- Sporting event
- Parties (birthday, holiday, etc.)
- Other (please explain) ____

Q4.4 What type of beer do you consume?

- ◯ Commercial beer only (Bud Light, Miller Lite, etc.)
- ◯ Craft beer only (Sam Adams Boston Lager, New Belgium Fat Tire, etc.)
- ◯ Both commercial and craft beer
- ◯ Unsure

Display This Question:
If What type of beer do you consume? = Commercial beer only (Bud Light, Miller Lite, etc.)

Q4.5 Is your favorite beer Bud Light?

- ◯ Yes
- ◯ No

Q4.6 Do you enjoy drinking new beers that you have never tried before?

- ◯ Yes
- ◯ No

Q4.7 When given the option, which option would you rather drink from?

- ◯ Can
- ◯ Bottle
- ◯ No preference

End of Block: Beer Consumption Habits

Start of Block: Brewers and Sustainability

Q5.1 Timing
First Click
Last Click
Page Submit
Click Count

Q5.2 Breweries across the country have begun investing in sustainable technology to reduce their water and energy use and increase their landfill diversion. For example, Anheuser-Busch, the world's largest brewer, agreed to buy

enough energy from a wind farm to make 20 billion 12 oz. cans of Budweiser annually. This allows the company to state that their product is made with “100% Renewable Energy.” Larger craft breweries have also invested in sustainable technology, including:
Bell’s Brewing Company, which has adopted an automated cleaning system to reduce water use;
Sierra Nevada, which installed onsite solar panels to reduce greenhouse gas emissions; and
New Belgium, which co-founded the Glass Recycling Coalition to reduce solid waste generation.
Investing in sustainable technologies requires significant upfront costs. This can limit smaller craft breweries’ access to these technologies and prevent them from reducing their environmental impact. If these smaller breweries invest in this equipment, they may be able to offset these costs by charging higher prices on their beer.
End of Block: Brewers and Sustainability

Start of Block: Instructions without Cheap Talk Script

Q6.1 Timing
First Click
Last Click
Page Submit
Click Count

Q6.2 The purpose of this experiment is to learn about the importance of various attributes of beer. This experiment will consist of eight rounds. In each round, you will be presented with two hypothetical six-packs of beer that will differ in several ways. You will be asked to choose the beer that you most prefer to buy, "Beer A" or "Beer B." You will also be given an option to not buy either of the beers. With over 400 different styles of beer, ranging from India Pale Ale (IPA) to Lager, I ask you to envision both beers as the style you buy most often. Please also imagine that the beers are identical except for differences in characteristics listed for each choice, and that the differences in characteristics do not affect the beer’s taste. Once completed, you will be asked to answer a few final questions.
End of Block: Instructions without Cheap Talk Script

Start of Block: Instructions with Cheap Talk Script

Q7.1 Timing
First Click
Last Click
Page Submit
Click Count

Q7.2 The purpose of this experiment is to learn about the importance of various attributes of beer. This experiment will consist of eight rounds. In each round, you will be presented with two hypothetical six-packs of beer that will differ in several ways. You will be asked to choose the beer that you most prefer to buy, "Beer A" or "Beer B." You will also be given an option to not buy either of the beers. With over 400 different styles of beer, ranging from India Pale Ale (IPA) to Lager, I ask you to envision both beers as the style you buy most often. Please also imagine that the beers are identical except for differences in characteristics listed for each choice, and that the differences in characteristics do not affect the beer’s taste. Once completed, you will be asked to answer a few final questions.

Although this is purely hypothetical and no beer will be purchased at the end of the experiment, I ask you to please treat each round as if it were a real transaction. You can interpret this to mean that the price that is posted on the beer you select would be the price that you would pay at your favorite retail outlet. If you would not purchase either beer, then you should choose the option to not buy either product.
End of Block: Instructions with Cheap Talk Script

Start of Block: Labels and their meaning

Q8.1

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Page Break

Q8.2

Example: This 6-pack is priced at $9.99. It is *locally brewed* and the brewery that produces this beer engages in **energy reduction** practices and **landfill diversion** practices.

End of Block: Labels and their meaning

Start of Block: Choice Experiment Block 1

Q9.1

I would choose:

Beer A	Beer B	

No Purchase
Price: $0.00

Q9.2

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q9.3

I would choose:

Beer A | Beer B

No Purchase
Price: $0.00

Q9.4

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q9.5 I would choose:

I would choose:

Beer A	Beer B	

No Purchase
Price: $0.00

Q9.6

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q9.7 I would choose:

I would choose:

Beer A | Beer B

No Purchase
Price: $0.00

○ ○ ○

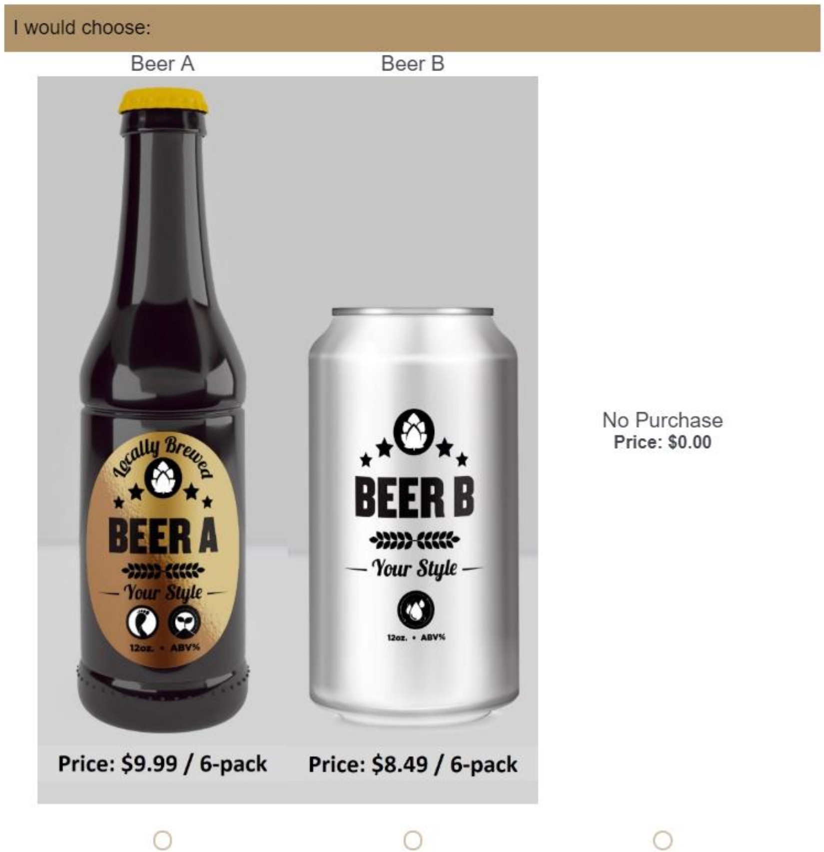
Q9.8

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q9.9 I would choose:



Q9.10

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q9.11 I would choose:

Q9.12

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q9.13 I would choose:

I would choose:

Beer A | Beer B

No Purchase
Price: $0.00

○ ○ ○

Q9.14

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q9.15 I would choose

I would choose:

Beer A | Beer B

No Purchase
Price: $0.00

Q9.16

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q9.17 Timing
First Click
Last Click
Page Submit
Click Count

End of Block: Choice Experiment Block 1

Start of Block: Choice Experiment Block 2

Q10.1

I would choose:

Beer A Beer B

No Purchase
Price: $0.00

○ ○ ○

Q10.2

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q10.3

I would choose:

Beer A	Beer B	

No Purchase
Price: $0.00

○ ○ ○

Q10.4

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q10.5

I would choose:

Beer A	Beer B	

No Purchase
Price: $0.00

○ ○ ○

Q10.6

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q10.7

Q10.8

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q10.9

I would choose:

Beer A | Beer B

No Purchase
Price: $0.00

○ ○ ○

Q10.10

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q10.11

I would choose:

Beer A	Beer B	

No Purchase
Price: $0.00

○ ○ ○

Q10.12

If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q10.13

I would choose:

Beer A	Beer B	

No Purchase
Price: $0.00

○ ○ ○

Q10.14

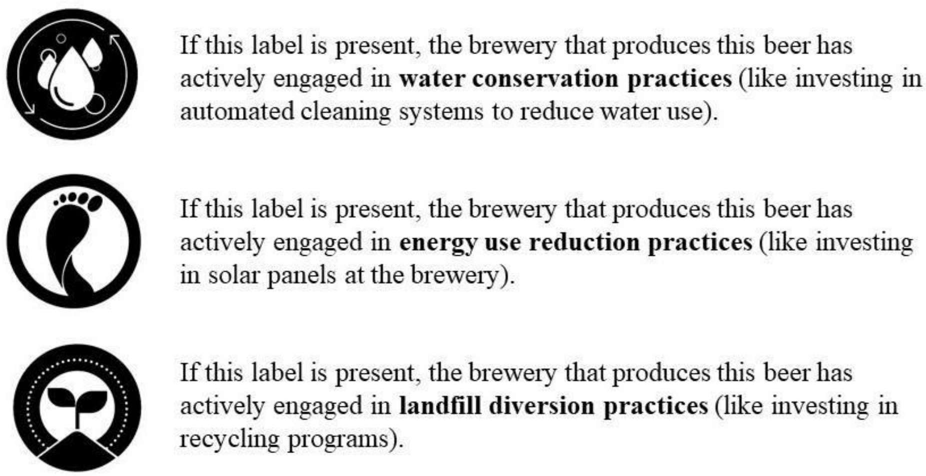
If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q10.15

Q10.16



If this label is present, the brewery that produces this beer has actively engaged in **water conservation practices** (like investing in automated cleaning systems to reduce water use).

If this label is present, the brewery that produces this beer has actively engaged in **energy use reduction practices** (like investing in solar panels at the brewery).

If this label is present, the brewery that produces this beer has actively engaged in **landfill diversion practices** (like investing in recycling programs).

Q10.17 Timing
First Click
Last Click
Page Submit
Click Count

End of Block: Choice Experiment Block 2

Start of Block: Sustainability Preferences

Q11.1 Timing
First Click
Last Click
Page Submit
Click Count

Q11.2 Sustainability is defined by the UCLA Sustainability Committee as: "The physical development and institutional operating practices that meet the needs of present users without compromising the ability of future generations to meet their own needs, particularly with regard to use and waste of natural resources. Sustainable

practices support ecological, human, and economic health and vitality."
Given this definition, how much do you agree or disagree with the following statements?

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly Agree (7)
Sustainability is a major concern in today's world. (1)	○	○	○	○	○	○	○
Industries need to have practices and regulations in place to reduce water consumption. (2)	○	○	○	○	○	○	○
Industries need to have practices and regulations in place to reduce energy consumption. (3)	○	○	○	○	○	○	○
Industries need to have practices and regulations in place to increase landfill diversion. (4)	○	○	○	○	○	○	○

Q11.3 What does "localness" mean to you? (check all that apply)

- ▢ Sourced within a given radius from your houshold
- ▢ Sourced within a political boundary (state,country, etc.)
- ▢ Emotional and social relations to the origin of the product
- ▢ Specialty criteria or brand names associated with a certain area
- ▢ Other (please explain) ____

Display This Question:
If What does "localness" mean to you? (check all that apply) = Sourced within a given radius from your houshold

Q11.4 What is the maximum radius that you would consider local?

- ○ 10 miles
- ○ 30 miles
- ○ 100 miles
- ○ 400 miles

Q11.5 Does your household recycle?

- ○ Yes
- ○ No
- ○ I do not know
- ○ Prefer not to answer

Q11.6 Which of the following ingredients do you look to avoid in your food or drink purchases? Check all that apply. If you do not look to avoid any of these ingredients, select none.

- ▢ Corn syrup
- ▢ Saturated fat
- ▢ Genetically modified organisms (GMOs)
- ▢ Artificial sweeteners
- ▢ None

Q11.7 In the last two years, has your household contributed time or money to any environmental groups (like Sierra Club or Nature Conservancy)?

- ○ Yes
- ○ No
- ○ I do not know
- ○ Prefer not to answer

End of Block: Sustainability Preferences

APPENDIX B. SINGLE HURDLE ESTIMATION SCRIPT

Main Estimation Script

```
close all
clear

% SET PARAMETERS----------------------------------------------------------
simIter = 1e4;   % Iterations for WTP distribution calculation
rng(1196);    % Starting seed for random number generator

% LOAD DATA---------------------------------------------------------------
[data,name,raw] = xlsread('Copy of Complete1291_5.3.19.xlsx');

% Concatenate data matrix
choice = data(:,87);
water = data(:,88);
package = data(:,89);
carbon = data(:,90);
landfill = data(:,91);
local = data(:,92);
asc = data(:,93);
price = data(:,72);
X = [water package carbon landfill local asc price];


% CONDITIONAL LOGIT-------------------------------------------------------
b0 = [1 1 1 1 1 -1 -1];       % Initial parameter vector
obj = @(b)MNL(b,choice,X,1);     % Define objective function
ub = [Inf Inf Inf Inf Inf 0 0];     % Set parameter bounds
options = optimoptions('fmincon',...
 'FiniteDifferenceType','central','Display',...
 'iter','StepTolerance',1e-12,...
 'SpecifyObjectiveGradient',true);   % Optimization options
[bstarCL,llCL,exitflagCL] = fmincon(obj,b0,[],...
 [],[],[],[],ub,[],options);     % Run model

% Calculate VCV matrix
[ll,gradCL] = MNL(bstarCL,choice,X,0);
VCVCL = inv(gradCL'*gradCL);

% Calculate standard errors
seCL = sqrt(diag(VCVCL));

% Simulate distribution of WTP
C_CL = chol(VCVCL,'lower');
x = randn(size(bstarCL',1),simIter);
bD = repmat(bstarCL',[1,simIter]) + C_CL'*x;
mu_CL = bD(end,:);
asc_CL = bD(end-1,:);
beta_CL = bD(1:end-2,:);
WTP_CL = sort([(-2*beta_CL./repmat(mu_CL,[size(beta_CL,1),1]))' ((asc_CL +
sum(beta_CL,1))./mu_CL)'],'descend');
EWTP_CL = mean(WTP_CL);      % Mean WTP
lCIWTP_CL = quantile(WTP_CL,0.025,1);  % Lower confidence interval
uCIWTP_CL = quantile(WTP_CL,0.975,1);  % Upper confidence interval
```

```
% SIMPLE HURDLE CONDITIONAL LOGIT-------------------------------------------

% Identify serial nonparticipants
choiceAlt = choice.*data(:,85);
s = [];
for idx1 = 1:size(data,1)/24
 ctr = (idx1 - 1)*24 + 1;
 if sum(choiceAlt(ctr:ctr+23)) < 24
  s = [s; zeros(24,1)];
 else
  s = [s; ones(24,1)];
 end
end

b0 = bstarCL;
p0 = .2;
theta0 = [b0 p0];         % Initial parameter vector
obj = @(theta)MNL_Hurdle(theta,choice,s,X);  % Define objective function
ub = [Inf Inf Inf Inf 0 0 0 .21];     % Set parameter upper bounds
lb = [0 0 0 0 -Inf -Inf -Inf .1];     % Set parameter lower bounds
options = optimoptions('fmincon','Algorithm',...
 'interior-point','Display','iter',...
 'SpecifyObjectiveGradient',false);   % Set optimization options
[thetastarCLH,llCLH,exitflagCLH] = fmincon(obj,...
 theta0,[],[],[],[],lb,ub,[],options);  % Run model

% Calculate gradient
llCLHperturbed = zeros(size(data,1),size(thetastarCLH,2),2);
epsilon = 1e-6;
for idx1 = 1:2
 for idx2 = 1:size(thetastarCLH,2)
  deviation = zeros(1,size(thetastarCLH,2));
  deviation(1,idx2) = (-1)^idx1*epsilon;
  thetagrad = thetastarCLH + deviation;
  llCLHperturbed(:,idx2,idx1) = MNL_HurdleGrad(thetagrad,choice,s,X);
 end
end
gradCLH = (llCLHperturbed(:,:,2) - llCLHperturbed(:,:,1))/(2*epsilon);

% Calculate VCV matrix
VCVCLH = inv(gradCLH'*gradCLH);

% Calculate standard errors
seCLH = sqrt(diag(VCVCLH));


% HURDLE CONDITIONAL LOGIT W/ DEMOGRAPHICS---------------------------------

% Identify serial nonparticipants
choiceAlt = choice.*data(:,85);
s = [];
for idx1 = 1:size(data,1)/24
 ctr = (idx1 - 1)*24 + 1;
 if sum(choiceAlt(ctr:ctr+23)) < 24
  s = [s; zeros(24,1)];
 else
  s = [s; ones(24,1)];
 end
end
```

```
% Initialize demographic variables
gender = data(:,1);
age21_24 = data(:,3);
age25_34 = data(:,4);
age35_44 = data(:,5);
age45_54 = data(:,6);
age55_64 = data(:,7);
educHS = data(:,10);
educSC = data(:,11);
educUG = data(:,12);
educGrad = data(:,13);
income25_49 = data(:,15);
income50_75 = data(:,16);
income75_99 = data(:,17);
income100 = data(:,18);
regionNE = data(:,19);
regionMW = data(:,21);
regionW = data(:,22);
freq_never = data(:,33);
freq_lt_monthly = data(:,34);
freq_monthly = data(:,35);
freq_23_monthly = data(:,36);
freq_weekly = data(:,37);
recycle_yes = data(:,79);
recycle_dk = data(:,80);
recycle_na = data(:,81);

Z = [ones(size(data,1),1) gender age21_24 age25_34 age35_44 age45_54 age55_64...
 educHS educSC educUG educGrad income25_49 income50_75 income75_99...
 income100 regionNE regionMW regionW freq_never freq_lt_monthly ...
 freq_monthly freq_23_monthly freq_weekly recycle_yes recycle_dk recycle_na];

b0 = thetastarCLH(1:7);
c0 = 0.1*ones(1,size(Z,2));
theta0 = [b0 c0];         % Initial parameter vector
obj = @(theta)MNL_HurdleLogit(theta,choice,s,X,Z); % Define objective function
ub = [Inf Inf Inf Inf 0 0 0 Inf.*ones(1,size(Z,2))]; % Set parameter upper bounds
lb = [0 0 0 0 -Inf -Inf -Inf -Inf.*ones(1,size(Z,2))]; % Set parameter lower bounds
options = optimoptions('fmincon','Algorithm',...
 'interior-point','Display','iter',...
 'SpecifyObjectiveGradient',false,...
 'MaxFunctionEvaluations',Inf,'UseParallel',true); % Set optimization options
[thetastarCLHL,llCLHL,exitflagCLHL] = fmincon(obj,...
 theta0,[],[],[],[],lb,ub,[],options);   % Run model

% Approximate gradient
epsilon = 1e-6;
for idx1 = 1:2
 parfor idx2 = 1:size(thetastarCLHL,2)
  deviation = zeros(1,size(thetastarCLHL,2));
  deviation(1,idx2) = (-1)^idx1*epsilon;
  thetagrad = thetastarCLHL + deviation;
  llCLHLperturbed(:,idx2,idx1) = MNL_HurdleLogitGrad(thetagrad,choice,s,X,Z);
 end
end
gradCLHL = (llCLHLperturbed(:,:,2) - llCLHLperturbed(:,:,1))/(2*epsilon);

% Calculate VCV matrix
VCVCLHL = inv(gradCLHL'*gradCLHL);

% Calculate standard errors
```

```
seCLHL = sqrt(diag(VCVCLHL));

% Simulate distribution of WTP
C_CLHL = chol(VCVCLHL,'lower');
x = randn(size(thetastarCLHL',1),simIter);
bD = repmat(thetastarCLHL',[1,simIter]) + C_CLHL'*x;
mu_CLHL = bD(7,:);
asc_CLHL = bD(6,:);
beta_CLHL = bD(1:5,:);

WTP_CLHL = sort([(-2*beta_CLHL./repmat(mu_CLHL,[size(beta_CLHL,1),1]))' ...
 ((asc_CLHL + sum(beta_CLHL,1))./mu_CLHL)'],'descend');  % Normal WTP
EWTP_CLHL = mean(WTP_CLHL);           % Mean WTP
lCIWTP_CLHL = quantile(WTP_CLHL,0.025,1);     % Lower confidence interval
uCIWTP_CLHL = quantile(WTP_CLHL,0.975,1);     % Upper confidence interval

p = sum(s)/size(s,1);
WTP_CLHL_w = sort([(1-p)*(-2*beta_CLHL./repmat(mu_CLHL,[size(beta_CLHL,1),1]))' ...
 (1-p)*((asc_CLHL + sum(beta_CLHL,1))./mu_CLHL)'],'descend'); % WTP weighted by prob
of participation

EWTP_CLHL_w = mean(WTP_CLHL_w);       % Mean WTP
lCIWTP_CLHL_w = quantile(WTP_CLHL_w,0.025,1);    % Lower confidence interval
uCIWTP_CLHL_w = quantile(WTP_CLHL_w,0.975,1);    % Upper confidence interval
```

Likelihood Function MNL.m

```
function [ll,grad] = MNL(b0,choice,X,gradFull)

[m,k] = size(X);
n = m/3;
P = zeros(m,1);
g = zeros(m,k);
for idx1 = 1:n
 ctr = (idx1 - 1)*3 + 1;
 V = X(ctr:ctr+2,:)*b0';
 P(ctr:ctr+2) = exp(V)./repmat(sum(exp(V)),[3,1]);
 g(ctr:ctr+2,:) = X(ctr:ctr+2,:) -
repmat(sum(P(ctr:ctr+2).*X(ctr:ctr+2,:)),[3,1]);
end

ll = -sum(log(P).*choice);

if gradFull == 1
 grad = -sum(g.*choice);
else
 grad = -g.*choice;
end
```

Likelihood Function MNL Hurdle.m

```
function ll = MNL_Hurdle(theta,choice,s,X)


[m,~] = size(X);
n = m/3;
P = zeros(m,1);
P3 = zeros(m,1);
L3 = zeros(m,1);
b = theta(1:end-1);
p = theta(end);
for idx1 = 1:n
 ctr = (idx1 - 1)*3 + 1;
 V = X(ctr:ctr+2,:)*b';

 choiceProb = exp(V)./repmat(sum(exp(V)),[3,1]);

 P(ctr:ctr+2) = choiceProb;
 P3(ctr:ctr+2) = repmat(choiceProb(end)^(1/3),[3,1]);
end

for idx1 = 1:m/24
 ctr = (idx1 - 1)*24 + 1;
 L3(ctr:ctr+23) = repmat(prod(P3(ctr:ctr+23)),[24,1]);
end

LSH = p.^s.*(1 - p).^(1-s).*(P./(1 - L3)).^(1-s);
ll = -sum(log(LSH).*choice)./1e5;
```

Gradient Function MNL_HurdleGrad.m

```
function ll = MNL_HurdleGrad(theta,choice,s,X)


[m,~] = size(X);
n = m/3;
P = zeros(m,1);
P3 = zeros(m,1);
L3 = zeros(m,1);
b = theta(1:end-1);
p = theta(end);
for idx1 = 1:n
 ctr = (idx1 - 1)*3 + 1;
 V = X(ctr:ctr+2,:)*b';

 choiceProb = exp(V)./repmat(sum(exp(V)),[3,1]);
```

```
 P(ctr:ctr+2) = choiceProb;
 P3(ctr:ctr+2) = repmat(choiceProb(end)^(1/3),[3,1]);
end

for idx1 = 1:m/24
 ctr = (idx1 - 1)*24 + 1;
 L3(ctr:ctr+23) = repmat(prod(P3(ctr:ctr+23)),[24,1]);
end

LSH = p.^s.*(1 - p).^(1-s).*(P./(1 - L3)).^(1-s);
ll = -(log(LSH).*choice);
```

Likelihood Function MNL_HurdleLogit.m

```
function ll = MNL_HurdleLogit(theta0,choice,s,X,Z)

[m,~] = size(X);
n = m/3;
P = zeros(m,1);
P3 = zeros(m,1);
L3 = zeros(m,1);
b = theta0(1:7);
c = theta0(8:end);
PLogit = zeros(m,1);
for idx1 = 1:n
 ctr = (idx1 - 1)*3 + 1;
 V = X(ctr:ctr+2,:)*b';

 choiceProb = exp(V)./repmat(sum(exp(V)),[3,1]);

 P(ctr:ctr+2) = choiceProb;
 P3(ctr:ctr+2) = repmat(choiceProb(end)^(1/3),[3,1]);


 VLogit = Z(ctr:ctr+2,:)*c';
 PLogit(ctr:ctr+2) = exp(VLogit)./(1 + exp(VLogit));
end

for idx1 = 1:m/24
 ctr = (idx1 - 1)*24 + 1;
 L3(ctr:ctr+23) = repmat(prod(P3(ctr:ctr+23)),[24,1]);
end

LSH = PLogit.^s.*(1 - PLogit).^(1-s).*(P./(1 - L3)).^(1-s);
choice(isnan(LSH)) = [];
LSH(isnan(LSH)) = []; % Drop those with missing data
ll = -sum(log(LSH).*choice)./1e5;
```

Gradient Function MNL_HurdleLogitGrad.m

```
function ll = MNL_HurdleLogitGrad(theta0,choice,s,X,Z)

[m,~] = size(X);
n = m/3;
P = zeros(m,1);
P3 = zeros(m,1);
L3 = zeros(m,1);
b = theta0(1:7);
c = theta0(8:end);
PLogit = zeros(m,1);
for idx1 = 1:n
 ctr = (idx1 - 1)*3 + 1;
 V = X(ctr:ctr+2,:)*b';

 choiceProb = exp(V)./repmat(sum(exp(V)),[3,1]);

 P(ctr:ctr+2) = choiceProb;
 P3(ctr:ctr+2) = repmat(choiceProb(end)^(1/3),[3,1]);


 VLogit = Z(ctr:ctr+2,:)*c';
 PLogit(ctr:ctr+2) = exp(VLogit)./(1 + exp(VLogit));
end

for idx1 = 1:m/24
 ctr = (idx1 - 1)*24 + 1;
 L3(ctr:ctr+23) = repmat(prod(P3(ctr:ctr+23)),[24,1]);
end

LSH = PLogit.^s.*(1 - PLogit).^(1-s).*(P./(1 - L3)).^(1-s);
choice(isnan(LSH)) = [];
LSH(isnan(LSH)) = []; % Drop those with missing data
ll = -(log(LSH).*choice);
```