Beer Snobs do Exist: Estimation of Beer Demand by Type

Daniel Toro-González, Jill J. McCluskey and Ron C. Mittelhammer*

Abstract

Although mass-produced beers still represent the vast majority of U.S. beer sales, there has been a significant growth trend in the craft beer segment. This study analyzes the demand for beer as a differentiated product and estimates own-price, cross-price and income elasticities for beer by type: craft beer, mass-produced beer, and imported beer. We verify that beer is a normal good with a considerably inelastic demand and also find that the cross price elasticity across types of beer is close to zero. The results suggest that there are effectively separate markets for beer by type.

Key Words: craft beer, demand analysis, differentiated products

JEL: L11, L13, L66.

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*Authors are Assistant Professor, School of Economics and Business, Universidad Tecnologica de Bolivar, and Professor and Regents Professor, School of Economic Sciences, Washington State University, respectively. The authors wish to thank Rebecca Hellerstein for information provided on variables related to beer characteristics, Luis Castro and Bret Noble for consultations on the brewing production process and effects of beer characteristics, and Jia Yan, Karina Gallardo, Vic Tremblay, Julian Alston, and Jo Swinnen for helpful comments.

1. Introduction

The craft brew revolution has transformed the industry. Thirty years ago, there were only a handful of specialty craft breweries. In 2011, there were 1,970 microbreweries in the United States offering a wide variety of differentiated products (Bradford, 2012) in almost every form and flavor that one could imagine.[1] With this increasing focus on variety, taste, and quality, a new term entered our vocabulary: the "beer snob." This is term given to those consumers who enjoy craft beers. Beer snobs are often accused of looking down on those who drink mass-produced beers (see Urbandictionary.com). A typical beer snob would rather drink nothing than drink a mass-produced beer.

Beer as a product can be placed in one of three broad categories in the U.S. market: mass-produced beer (macrobrews), craft beer (microbrews), and imports.[2] Mass-produced beers are traditional American lagers, which are produced on a mass production scale. In particular, macro beers have similar characteristics of lightness, use bottom-fermenting yeast, and sometime use adjuncts, such as corn or rice. Imported beers are those produced abroad. The Brewers Association defines the craft beer segment as beer made by brewers with annual production of six million barrels or less, who are independently owned, and use traditional ingredients without adjuncts to lighten the taste. The product differentiation across beer categories is horizontal rather than vertical, meaning that different consumers prefer each category.

Although macro brews still account for the vast majority of beer sales, sales of craft beers have also grown steadily for many years. According to the Brewer's Association, craft brewers'

[1] For example, "Beard Beer" by Rogue is brewed with yeast created from their brew master's beard.

[2] The macrobrew category has been further partitioned by marketers into "premium," "popular," and "light" subcategories (as discussed in Hausman, Leonard, and Zona, 1994). The premium beers have a premium brand image based on persuasive advertising and constitute a high percentage of the market; while the popular beers charge discounted prices; and light beers are low calorie beers.

share of sales grew by 20% to an estimated $14.3 billion in retail sales. This constitutes an estimated 14.3% sales in the U.S. beer market. This growth occurred while overall U.S. beer sales were down an estimated -1.9%. Imported beer sales have been flat; down an estimated -0.6% in 2013, while up 1.3% in 2012 (Brewers Association, 2014). Consumers may choose imported beers based on Veblen effects and identification with their ancestral heritage (e.g. consumers with an Irish ancestry may choose Guinness). According to Tremblay et al. (2005), factors such as the homogenization of macro brewed beer, changes in local demand conditions, and a more favorable regulatory environment created profitable niches in many local markets for microbrewery beer. Younger consumers are driving the increase in consumption of craft beer (Voight, 2013). Hence, as more millennials reach legal drinking age, one might expect for the craft segment to grow as a percent of the market.

Advertising has played a key role in the development of the industry, especially in the macro and import sectors. Beer advertising has generally been persuasive rather than informative about product characteristics. As a result, leading brewers acquired "brand personalities" that target the market they want to be associated with (Choi and Stack, 2005). One could argue that advertising in the macrobrew category has been predatory at the brand level with mega brewers gaining market share,[3] but the effect at the category level is flat. In contrast, the craft brewers market primarily with festivals, social media and other websites, at brew pubs, with t-shirts, and through word of mouth. With exceptional growth in craft beers, one could argue that these grass roots marketing strategies are not predatory within the craft category. In fact, strategies such as festivals encourage consumers to taste many different brands and leverage marketing efforts across brands.

[3] Beer advertising is a major topic of inquiry, an incomplete list includes Lee and Tremblay, 1992; Iwasaki, Seldon, and Tremblay, 2008; Nelson, 2005; Rojas and Peterson, 2008.

Although all three categories of beer are considered to be the same product, one could argue that they are not close substitutes to each other. In general, beer is a product that one develops a taste for, suggesting an "exposure" effect. If a loyal Budweiser drinker tries a Dogfish Head 90 Minute India Pale Ale (IPA) for the first time, he or she will likely be unappreciative of the taste. Similarly, a craft beer snob would likely prefer to drink nothing over a light American lager. We explore whether different categories of beer are substitutes by estimating demand for beer by category. A testable hypothesis is that cross price elasticities are close to zero.[4]

Many studies have analyzed the demand for beer (Hogarty and Elzinga, 1972; Tegene, 1990; Lee and Trembley, 1992; Nelson, 1999; and Freeman, 2001), and some authors have estimated brand-level elasticities (Hausman, Leonard and Zona, 1994, hereinafter HLZ; Rojas and Peterson, 2008; and Bray et al., 2009). However, to our knowledge, cross-price elasticities differentiated by category (i.e. craft, macro, and import) have not been presented in the literature[5]. The availability of data and computational power allowed us to evaluate these particular set of parameters with the confidence that they will help marketers and producers to be more aware about the characteristics of the market and to help them to design better and more effective selling techniques. In addition, the microbrew movement is consistent with a more general shift in food preferences. There is an increasing desire for variety, taste, and local products. Thus, the main idea from this study, that highly differentiated products are not substitutes for each other, is applicable to other categories of horizontally differentiated products.

The objective of this article is to identify the price, income and cross price elasticities of

[4]Some caveats include that the preference for consumption of beer may be affected by the context in which it is consumed. For example, on a hot day at the beach, a Corona might be preferable to a Guinness for a consumer who in other circumstances likes Guinness.

[5] HLZ (1994) estimate segment elasticities for light, popular and premium beers as intermediate step to obtain their brand level elasticities.

craft, imported, and mass-produced beers, accounting for consumer valuation of product specific unobserved (by the econometrician) quality and other attributes such as freshness, bitterness, and sweetness. The theoretical framework follows Berry (1994) in estimating aggregate demand functions with unobservable product characteristics. We use a detailed scanner database from Dominick's supermarkets in Chicago to perform the analysis. This database contains approximately nine years of store-level data for more than 700 beer products distributed in a 100-store chain[6] and includes information on product and consumer characteristics.

The remainder of this article is organized as follows. Section two reviews related literature on consumers' preferences for alcoholic beverages. Descriptive statistics are presented in section three, followed by a presentation of the empirical analysis framework in section four. The fifth section is devoted to a discussion of the estimation results, and conclusions are presented in the final section.

2. Literature Related to Analyses of Beer Demand

Several approaches have been followed to study demand for beer with many studies including the effect of advertising. The Almost Ideal Demand System (AIDS) model (Deaton and Muellbauer 1980) has been applied frequently to estimate demand for beer (Clements and Johnson, 1983; Heien et al. 1989; and Blake et al. 1997). Clements and Johnson (1983) show that when the consumer's utility function is appropriately separable in alcoholic beverages and all other goods, it is possible to confine attention to the three main categories of alcoholic beverages (wine, beer, and spirits) and ignore all other goods. Heien and Pompelli (1989) estimate a demand system that considers all beverages simultaneously while incorporating the effect of demographics. Blake and Nied (1997) use an AIDS model to estimate demand for beer

[6] The data set contains weekly information on beer sales beginning on 06/06/1991 and ending on 05/07/1997.

in the United Kingdom.

Other empirical approaches evaluate factors that are expected to influence beverage consumption. Levy and Shelfin (1985) utilize a Cobb-Douglass consumption function in which per capita consumption of alcoholic beverages depends on real per capita disposable personal income and the relative price of alcoholic beverages to personal income to analyze demand in the period between 1940 and 1980. They find that total demand for alcoholic beverages is inelastic and discover weak evidence of a higher propensity to consume alcoholic beverages by those under 21. Fenn et al. (2001) build on Becker and Murphy's (1988) theory of rational addiction to analyze an inter-temporal utility maximization problem leading to a demand equation where consumption depends on prices and past and expected future consumption linearly.

We follow Berry (1994), Berry et al (1995), and Nevo (2001), in implementing a differentiated product-market identification strategy for analyzing beer demand, where it is assumed that consumers' preferences are described by an indirect utility function that is a function of observed and unobserved (by the econometrician) product and individual characteristics. Berry's approach addresses the model dimensionality problem induced by the existence of a large number of underlying differentiated beer products by projecting the products onto a product characteristics space. The method also accommodates the possibility that prices are correlated with unobserved demand factors within a cross section of markets while allowing estimation to proceed via a traditional instrumental variables approach.

3. Data

The Dominick's scanner dataset used in this study was obtained from the Kilts Center for Marketing at the University of Chicago, Booth School of Business. The data base consists of approximately 1.4 million observations providing information on weekly sales of 484 universal product codes (UPCs) for 343 different beer products sold in 60 stores over seven years (from 1991 to 1997), a period of steep increase in the number of craft beer manufacturers. The data set contains product information as well as information about the distribution of the socio-demographic variables for the areas where each store is located. In particular, the total quantities sold of each beer product in each store are known, as well as the price of the item, the brand and particular product within brand, the type (mass or American Lager, craft, or import), the number of units in the bundle, and the alcohol content. Other product characteristics (see Table 1) were constructed by cross-referencing the brand/product with information available from ratebeer.com and beeradvocate.com.

The vast majority of sales correspond to mass-produced beer, comprising 86.4% of the market share. Imported beer accounts for 8.2% of sales, and the remaining 5.3% is the market share for craft beers (see Table 1). Prices are notably different across types of beers. The least expensive category is mass-produced beer at an average price of 54 cents per unit. The lower price is partially explained by the economies of scale generated through mass production and distribution and the use of lower-cost grains such as corn and rice[7]. In contrast, craft beers command a price premium of 26 cents per unit, on average, over the price of mass-produced beers, reflecting in part the higher cost of more specialized ingredients and the smaller scale of production. In the case of imported beers, the price premium is, on average, 41 cents, reflecting additional costs such as greater transportation costs and import taxes.

We examine demand for the most common unit of production, 12-ounce units (either can or bottle), bundled in different numbers, from four unit bundles up to 30 unit bundles. By far,

[7] However, because the cost of ingredients is a small share of total cost (only about 4%), the scale economy argument is the dominant explanation on the supply side.

the most popular choice of package is a six-unit bundle with 54% of the market share. Mass-produced beer can be differentiated from craft and import beers on the basis of packaging strategy. While most of the craft and import segments are sold in six packs, where market shares are 93% and 86% respectively, more than half of the total mass-produced beer (57%) is sold in bundles having more than 12 units. In terms of the style of beer[8], most of the beers sold are pale lagers or lager beers (90%) produced by large breweries. Ales represent about 6%, stouts represent 0.8%, and the remaining share of the market is distributed across a wide array of beer types. Mass-produced beers have lower alcohol by volume (ABV)[9] with an average level of 4.5%, followed by import beers with 4.6% ABV, with craft beers being the highest at 4.9% ABV.

In terms of socio-demographic variables, the average income and home values for the neighborhood surrounding each store, as well as the percentage of black and Hispanic residents, the percentage of college graduates, and the average size of the household are available. The socio-economic variables represent average values for the neighborhoods surrounding each store. The average household across all stores has 2.6 members, income of almost $43,000, and a home value of approximately $150,000. The percentage of the neighborhood populations who graduated from college is 22%, and the average proportion of blacks and Hispanics living in the community is 15% (see Table 2).

There are notable differences in the levels of some consumer characteristics relating to beer sales. For example, average income level is higher by an average of $900 in those neighborhoods in which more craft beers are sold compared to neighborhoods where more mass-produced beer is sold. The increase in average income for neighborhoods in which more

[8] Classification according to Michael Jackson's criteria (see http://michaeljacksonthebeerhunter.blogspot.com/).
[9] ABV represents the portion of the total volume of liquid that is alcohol. Information on this variable was constructed from different sources including ratebeer.com, beeradvocate.com, and Rebecca Hellerstein.

imported beers are sold is $1,200 compared to neighborhoods that sell more mass-produced beer. These socio-demographic differences suggest that demographics may be useful explanatory factors regarding the demands for the different types of beer. We underscore that consumers' demographics in the Dominick's dataset are based on U.S. Census data, so they vary across store locations but do not vary over time. However, there is substantial heterogeneity across the different neighborhoods surrounding the stores, both in terms of demographics and beer consumption. For example, the share of mass-produced beer sold by stores ranges from a low of 7.7% to a high of 88%. In the case of craft beers, sales range from 4% to 40%, for imported beers, the market share varies between 7% and 51%.

4. Modeling Framework

We adapt Berry's (1994) approach to model the market for beer as one with differentiated products, where each store operates in a market composed of the neighborhood surrounding the store and each brand of beer is considered as a product within a discrete choice framework. Following Berry (1994), we assume consumer i's utility for product j depends on the price per unit (bottle or can), product characteristics, and the consumer's tastes, $U(x_j, \xi_j, p_j, \epsilon_{ij}, \theta_i)$, where x_j and ξ_j refer to the observed and unobserved product characteristics, respectively. The price of each product is represented by p_j. The unobservable consumer-specific terms affecting utility are represented by ϵ_{ij} and parameters of the utility function, which ultimately appear in the demand functions as coefficients on observables, are given by θ_i. Among the observed product characteristics we explicitly account for the size of the bundle (number of units), the ABV, whether the beer type is mass-produced, craft, or imported; the style (ale, fruit, low alcohol, Oktoberfest, seasonal, smoked, steam, stout, wheat), and the price per bottle/can (p_j).

According to Feenstra and Shapiro (2003), one should consider that a seller may maintain prices zones[10] with different pricing strategies depending on the presence of other stores in the area. We control for this by including indicator variables to identify the zone in which each store is located, where the fifteen zones used were predefined by Dominick's in the data base[11]. The unobserved product characteristics (ξ_j) represent all of the product attributes that the econometrician cannot measure or observe, but that the consumer takes into the account when making their choice. Examples include the quality of the ingredients used in brewing, the freshness of the product, bitterness, sweetness, and all the possible flavors and aromas that can be generated in the brewing process, as well as such things as labels and bottle shapes.

Proceeding to the empirical implementation of the model, consider a specification for utility that depends on, among other factors, unobserved consumer-specific taste effects represented by the error terms ϵ_{ij}:

$$u_{ij} = x_j\beta - \alpha p_j + \xi_j + \epsilon_{ij} \quad (1)$$

In distinguishing what can be interpreted as two error terms in this model, ξ_j is interpreted as the (unobserved) mean of the consumers' valuations of the unobserved product characteristics for product j, and the error term ϵ_{ij} is reflective of the distribution of the consumers' preferences around the mean value ξ_j.

[10] Stores from a single supermarket chain in a city are partitioned into zones, with retail prices varying across zones (Besanko, et. al, 2005).

[11] As documented by Pophal, Capps, and Love (2006), as well as additional references contained therein, the fact that Dominick's pursues a zone pricing strategy is well documented, as well as the contention that consumer demographics have more to do with the choice of Dominick's pricing zones than horizontal competition. Because of these findings, Pophal, Capps, and Love assumed that stores within each price zone were local monopolists, and that any price discrimination that may have been pursued was the result of responding to varying consumer price sensitivities.

Given the linear index nature of the model, it is assumed that the marginal effects of changes in product attributes adjust mean levels of consumer preferences (as set by the specific socio-demographic of a given consumer type and other observed explanatory variables) in like manner and the error term is *iid* from an extreme value distribution. Berry (1994) demonstrates that market share for product *j* can then be represented by the multinomial logit (MNL) model as:

(2) $$s_j = \frac{e^{\delta_j}}{\sum_{k=0}^{J} e^{\delta_k}},$$

where $\delta_j = x_j\beta - \alpha p_j + \xi_j$ represents the mean utility for product j, and $k = 0$ refers to an "outside good" that represents the consumer's expenditure on all other goods besides beer. A difficulty in the estimation of this logit specification is that the unobserved product characteristics enter the relation non-linearly, and moreover, prices and the unobserved characteristics are correlated. Berry (1994) provides a solution to these issues by transforming the model so that the unobserved characteristics enter linearly, and the endogeneity issues can be addressed in a relatively standard way.

By normalizing the mean utility of the outside good to zero and assuming the relationship between observed- and predicted-market shares is invertible; Berry represents the share relation in the following linear-in-log-difference form:

(3) $$\ln(s_j) - \ln(s_0) = \delta_j = x_j\beta - \alpha p_j + \xi_j$$

Prices will be correlated with unobservable product characteristics, and the explanatory variables are not all exogenous to the model, resulting in an identification problem due to endogeneity that needs to be addressed. For example, on an average per-unit basis, small breweries use greater quantities and varieties of hops and fewer adjuncts such as corn or rice, but more malted grains such as barley. The use of these ingredients increases production costs, and thus the prices are positively correlated with factors that are unobservable in our dataset.

An advantage of Berry's representation of market shares is that instrumental variables (IV) can be used to account for endogeneity of prices. As instruments in this case, we utilize the prices of the same products in other markets[12] (Hausman, 1996) under the assumption that product valuations are independent across markets (recall the substantial heterogeneity of demand across markets), so that prices of product *j* outside of a given market will be correlated with the price of product *j* within the market due to the product's common marginal costs, but the outside prices will be uncorrelated with internal market-specific valuations of the product. We assess the appropriateness of this choice of instruments via a statistical test of instrument validity.

As an alternative specification, we follow Berry in modifying the MNL model to account for potential correlation between consumer and product characteristics within types of beer, which is expected *a priori* to be the principal types of interactions between these characteristics. In particular, we adopt a nested logit (NL) type of specification, which enables the preservation of the assumption that consumer tastes follow an extreme value distribution while allowing those tastes to be correlated across products of a particular type. The NL model allows for more flexible substitution patterns in comparison to the MNL model. We motivate the plausibility for nesting with a simple choice example: if a consumer wishes to purchase an American lager, he or

[12] In our case, other market refers to a different store in a different price zone.

she will consider alternatives such as Coors, Budweiser, or Millers lager, but he or she will not consider an IPA or other beer choices outside the American lager type. Consequently, removing IPA and other beers, outside of American lagers, from the choice set would not change the consumer's probabilities of choosing amongst the mass-produced beers, and a nested view of the decision process makes sense.

Pursuing the nested logit formulation, Berry (1994) groups products into mutually exclusive and exhaustive subsets $g = 0,1,2,...,G$, where the outside good $j = 0$ is assumed to be the only member of group $g = 0$. Denoting the set of products in group g as $\mathcal{g}_g$, for product $j \in \mathcal{g}_g$, the utility of consumer i is represented by:

$$u_{ij} = \delta_j + \zeta_{ig} + (1 - \sigma)\epsilon_{ij}, \tag{4}$$

where again $\delta_j = x_j\beta - \alpha p_j + \xi_j$, and ϵ_{ij} is *iid* extreme value. For a given consumer i, the variable ζ is constant and common to all products in group g and its distribution function depends on σ, with $0 \leq \sigma < 1$. As $\sigma \rightarrow 0 \; or \; 1$, the within-group correlation of utility levels approaches 0 or 1, respectively. One can interpret Equation 4 as a random coefficients model involving random coefficients ζ_{ig} only on group-specific indicator variables. That is, if d_{jg} is an indicator variable equaling one for $j \in \mathcal{g}_g$ and zero otherwise, then Equation 4 can be written as:

$$u_{ij} = \delta_j + \sum_g d_{jg}\zeta_{ig} + (1 - \sigma)\epsilon_{ij} \tag{5}$$

An analytic expression involving mean utility levels that represents an expanded version of

Equation 3 is then given by[13]:

$$\ln(s_j) - \ln(s_0) = \delta_j \equiv x_j\beta - \alpha p_j + \sigma \ln(\bar{s}_{j/g}) + \xi_j, \quad (6)$$

where $\ln(\bar{s}_{j/g})$ is the natural log of product j's within-group share ($\bar{s}_{j/g}$). However, as in the case of prices, the within-group share is expected to be related to the unobserved characteristics because unobserved product characteristics influence the market share within each category. Thus, $\bar{s}_{j/g}$ is endogenous, suggesting the need for additional instrumental variables for the within-group share.

We use product variety, indicated by the number of products available in each market, as an instrumental variable, which is correlated with the within-group product share but not with the unobservable product attributes. Economic theory provides support for the use of the number of products within the market as an instrument by framing the situation as a sequential-decision game.[14] The decision made by each firm about the number of products is made before the realization of consumer preferences. At this stage, firms do not know consumer preferences. Hence, the number of products is not related to the consumers' valuations of the unobservable product attributes. Alternatively, the number of products may be considered exogenous because in Illinois, as in most of the United States, brewers are not allowed to sell directly to retailers, configuring the "three-tier system."[15] Hence, the variety of products available in the market at a given point in time is not an outcome of the market, but a result of distributors' decisions.

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[13] For details refer to Berry (1994), p. 253.

[14] We acknowledge that alternatively supermarkets and consumers might be playing a repeated game (not a simple dynamic game), making the number of products predetermined rather than exogenous.

[15] The three-tier system (producers, distributors, and retailers) was introduced after Prohibition to avoid contact between producers and retailers.

5. Estimation Results

The empirical model is based on yearly aggregated observations, per store, on variables contained in equations (3) and (6), resulting in 12,066 annual observations on beer products sold over seven years across the 60 stores. The results of estimating the ordinary least squares (OLS), MNL and NL models are presented in Table 4. The coefficients for the MNL and NL models were obtained by an application of two-stage least squares (2SLS). The definitions of all of the variables used in estimating the model are provided in Table 3.

The explanatory power of the estimated model increased substantially when the within-group product shares were accounted for via the NL model. In the case of the MNL model, the R^2 statistic is 0.45, whereas for the NL model, the R^2 statistic increases to 0.73. The estimated parameters of the MNL model and the NL model have the same signs and high levels of statistical significance (all at the 0.01 level), but the magnitudes of the parameter estimates in many cases differ notably between the models.

For both the MNL and NL models, the product characteristics of package size and alcohol content have a positive effect on demand. A market location in a neighborhood with greater proportions of black and Hispanic population has a negative effect, while a location in a neighborhood with a greater percentage of college graduates also affects beer consumption negatively. A negative effect was also observed for the case of larger families. The income effect on demand is positive. A host of other statistically significant effects relating to beer characteristics and price zones can be deduced from the results presented in Table 4. The agreement in signs across all of the explanatory factors associated with statistically significant effects in both the MNL and NL models promote confidence in the directions of those effects.

However, given the substantially higher goodness of fit, as well as the additional substitution flexibility provided by the NL model, we henceforth focus on the NL results for presenting and interpreting elasticity results[16].

Mean level estimated own-price and cross-price elasticities as well as income elasticities are presented in Table 5. Confidence intervals for the elasticities are presented in Table 6. The overall estimated demand for beer is highly inelastic with a mean level elasticity of -0.1771 when considered across all beer types. With respect to other studies, estimation results consistently find beer demand to be inelastic, but the variation across estimates is considerable, ranging from -0.142 to -0.889 (see Table 7). Our estimates are in the lower part of the range.

Within each beer type, demands for particular types are own-price inelastic, but there are differences between types. Mass-produced beer has the lowest own-price elasticity at -0.1260. A possible explanation for this insensitivity to price is high brand loyalty among consumers to their particular brand of mass-produced beers. Advertising rivalries in the mass-produced segment have traditionally been intense (Nelson, 2003). In addition, contributing to the inelastic nature of demand for beer could be factors such as the social, habit-forming, and addictive qualities that beer evokes in some consumers. Both craft and import beers are also substantially own-price inelastic at -0.2124 and -0.2247, respectively, although demand for these beer types is notably more price responsive than is mass-produced beer. A similar explanation for the price insensitivity may be that consumers are traditionally loyal to the craft category and specific import brands. Moreover, stores that sell larger quantities of craft and imported beers in our data

[16] We follow Nevo (2000) in defining the own and cross-price elasticities as follows:

$$\eta_{jk} = \frac{\partial s_j p_k}{\partial p_k s_j} = \begin{cases} -\alpha p_j(1-s_j) & if\ j=k \\ \alpha p_k s_k & otherwise \end{cases} .$$

set are surrounded by neighborhoods with higher average incomes, and thus craft and import beer consumers may be less sensitive to changes in price.

Our major result in Table 6 is that the cross-price elasticity estimates across the three types of beer are near zero, as is evident from the ranges of values encompassed by the 95% confidence intervals for these elasticities. This suggests that there is little substitution across types of beer and implies, for example, that if a consumer desires to buy a six pack of Budweiser, the fact that IPA craft beer is on sale will have little-to-no effect on his choice, on average. As another example, regarding the relatively more price responsive craft and import beer types, if there is a notable increase in price, craft or import beer drinkers will reduce their consumption of craft or import beer somewhat, but will substitute little or no alternative types of beer in its place, perhaps substituting wine, spirits, or other beverages. While all of the cross price effects are significant statistically, they are essentially insignificant in magnitude and effect, suggesting that the markets for the different types of beer are nearly independent of one another.

The independence of each market suggests intense differences among beer consumers in each category. With respect to the craft beer market, as we point out previously, the phenomena of increasing demand with higher average prices might be explained by differences in quality but also as described by Kastanakis and Balabanis (2011) as evidence of the existence of "snob" consumers, for which the acquisition of scarce goods generate "signaling effects" on consumption, increasing their utility when the good consumed is uncommon and generates status (Veblen goods).

In terms of income elasticities, beer is a normal good regardless of the type (see Tables 5 and 6). Across all beer types, beer is income inelastic at 0.5801. Regarding specific types of beer, income elasticities are all very similar, ranging from a low of 0.5701 for mass-produced beer, to 0.5818 for import beer, and a high of 0.5923 for craft beer. The demand for all types of beer increases as income increases. However, with the information available we were unable to verify the hypothesis that sub-premium mass-produced beer is an inferior good, as suggested by Tremblay and Tremblay (2011).

We conducted tests to analyze the appropriateness of the model specification and estimation approach, and assess the validity of the preceding results. To verify that the prices and within-market product shares are endogenous regressors in the model, we calculate the difference-in-Sargan test statistic for exogeneity. Under the null hypothesis that the variables are exogenous, if the test statistic is significant, the variables being tested (prices and the within-market shares) must be treated as endogenous. According to the results of the test, the null hypothesis is rejected with 99% of confidence, suggesting the variables are in fact endogenous.

The variables used as instruments include prices of the same product in different markets and product variety, which are represented by the number of products available in each market. Since the number of instruments exceeds the parameters to be estimated, the model is over-identified. We calculated Hansen's (1982) J-statistic to test the hypothesis that the instruments were uncorrelated with the error term of the share models (ξ_j). Based on the test, we cannot reject the hypothesis that the variables are uncorrelated at any conventional level of type I error, which when coupled with the fact that the variables are correlated with the endogenous explanatory variables in the model, support the validity of the instruments.

6. Conclusions

Although a number of researchers have estimated demand for beer and other alcoholic beverages, this study estimates demand for particular types of beer and identifies the price, cross-price, and income elasticities among craft, imported, and mass-produced beers based on supermarket scanner data. The results indicate that beer is a normal good with a demand that is inelastic to changes in prices and with almost no substitution between types of beer. Although the own-price elasticity is quite inelastic across all types, the category that is the least price-responsive is mass-produced (American lager) beer, which supports the hypothesis that consumers who purchase American lagers consumers are highly loyal to this type of beer. In contrast, consumers are relatively more responsive to price for the craft and import beer categories, indicating more of a willingness to change consumption levels as prices change. The increased demand responsiveness may be due, in part, to the significantly higher prices of craft and import beers, in addition to the fact that wide availability of craft beers is a relatively new phenomenon, with consumer tastes likely still in formative stages.

There are some limitations to this study that should be underscored. The geographical region analyzed was limited to the Chicago area, so we clearly cannot claim that our conclusions generalize geographically, and almost certainly do not apply nationally. For example, it is expected that stronger preferences for craft beer would be identified in a region such as the U.S. Pacific Northwest, given the more developed and longer craft brew culture, and thus the inelastic nature of demand, reflective of craft beer loyalty, would likely be more pronounced. On the other hand, there are other major U.S. cities with similar demographic compositions for which the results may be relevant. A second limitation is the period of study. Following the time period covered by the data, the craft beer industry continued to expand apace throughout the United States, as well as worldwide. A comparison across time periods would be useful for understanding how preferences continued to develop over time. The craft beer movement is consistent with a broader trend in food marketing that products are becoming increasingly differentiated and customized. An understanding of the evolving consumption patterns for the craft beer segment could have implications for other newly developing differentiated food product categories.

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Table 1. Product Descriptive Statistics

Variable	Description	Mean	Std. Dev.
Price per unit	$ per single unit		
craft		$0.80	
mass		$0.54	
import		$0.95	
Mass	market share	0.053	
Craft	market share	0.864	
Import	market share	0.082	
Bundle size	bottles	9.286	6.343
Alcohol Content	% Alcohol	4.777	0.798
Ale	1 if ale, 0 otherwise	0.164	0.370
Fruit	1 if fruit, 0 otherwise	0.023	0.151
Low Alcohol	1 if low alcohol, 0 otherwise	0.013	0.115
Oktoberfest	1 if Oktoberfest, 0 otherwise	0.025	0.155
Seasonal	1 if seasonal, 0 otherwise	0.018	0.135
Smoked	1 if smoked, 0 otherwise	0.026	0.160
Steam	1 if steam, 0 otherwise	0.001	0.039
Stout	1 if stout, 0 otherwise	0.020	0.142
Wheat	1 if wheat beer, 0 otherwise	0.016	0.126

Table 2. Descriptive Statistics of Consumer's Characteristics

Variable	Mean	Std. Dev.	Min	Max
Income	42,612	12,652	19,285	75,826
House Value	146.694	46.986	64.348	267.390
HH Size	2.680	0.281	1.554	3.309
Education	0.220	0.112	0.050	0.518
Ethnic	0.150	0.179	0.024	0.996

Note: Income is the average for the sample of the median income; House Value is average house value in thousands of dollars; HH Size is the average number of members in each household for the area; Education is the average percentage College Graduates; and Ethnic is the average percentage of Blacks and Hispanics.
Source: Dominick's dataset, calculations by the authors.

Table 3. Variable Descriptions

Market Share Ratio: $[\ln(s_j) - \ln(s_0)]$ Is the dependent variable and represents the market share ratio between each market and the outside good market share.

Price: Unit price (12 ounce bottle or can).

Size: Number of units in the bundle.

Alcohol: Percentage alcohol content.

Beer Type Indicators: Mass, Craft, Import representing each beer category.

Ethnic: Percentage of Hispanic and black populations in the neighborhood.

Education: Percentage of college graduates in the neighborhood.

HH Size: Average household size in the neighborhood.

Income: Mean household income.

Beer Characteristic Indicators: Ale, Fruit, Low alcohol, Oktoberfest, Seasonal, Smoked, Steam, Stout, Wheat.

Zone_1 to 15: Indicators of pricing zones defined by Dominicks.

Price Tier: Indicator for stores designated as a "CUB-Fighter" by Dominicks, where CUB Foods is a supermarket chain in direct competition with Dominicks stores.

Table 4. Results for Multinomial Logit (MNL) and Nested Logit (NL)

Variable	BASE (OLS)		MNL-IV		NL-IV	
Price	-9.98E-06	***	-0.2915	***	-0.2372	***
	0.000		0.0000		0.0000	
Size	9.04E-06	***	0.0537	***	0.0046	***
	0.000		0.0000		0.0000	
Alcohol	-2.84E-06	***	0.0265	***	0.0570	***
	0.004		0.0058		0.0000	
Craft	-1.78E-05	***	-0.3210	***	-5.3313	***
	0.000		0.0000		0.0000	
Import	-1.75E-05	***	-0.2035	***	-5.2005	***
	0.000		0.0000		0.0000	
Ethnic	-8.75E-07		-0.0016		-0.0209	
	0.918		0.9771		0.5970	
Education	-1.04E-04	***	-0.4022	**	-1.0543	***
	0.001		0.0331		0.0000	
Household Size	-1.14E-05	*	-0.2193	***	-0.1724	***
	0.051		0.0000		0.0000	
Incomes	2.32E-07	***	0.0028	***	0.0040	***
	0.004		0.0000		0.0000	
Ale	-8.17E-07		-0.0794	***	-0.0586	***
	0.525		0.0003		0.0066	
Fruit	1.47E-07		-0.0474		-0.0935	**
	0.936		0.2003		0.0113	
LowA	-2.99E-05	***	0.0560		0.1645	***
	0.000		0.4087		0.0000	
Oktfst	9.35E-07		0.1732	***	0.2032	***
	0.649		0.0000		0.0000	
Season	-5.69E-06	**	0.1203	***	0.1620	***
	0.012		0.0049		0.0004	
Smoked	-3.70E-06	**	-0.2046	***	-0.2426	***
	0.013		0.0000		0.0000	
Steam	2.12E-06		0.0465		-0.0296	
	0.610		0.7035		0.8128	
Stout	3.41E-06	**	0.0003		-0.0456	
	0.042		0.9935		0.2147	
Wheat	-2.20E-06		-0.2915	***	-0.3558	***
	0.278		0.0000		0.0000	
zone_2	4.86E-05	*	0.5990	***	0.7877	***
	0.056		0.0000		0.0000	
zone_3	3.46E-05		0.3899	***	0.5355	***
	0.186		0.0042		0.0000	

zone_4	2.05E-05		0.1798	**	0.2806	***
	0.179		0.0369		0.0000	
zone_5	2.46E-05		0.2709	***	0.3951	***
	0.107		0.0004		0.0000	
zone_6	-3.20E-05	***	-0.3586	***	-0.4266	***
	0.006		0.0000		0.0000	
zone_7	1.26E-06		0.0130		-0.0390	
	0.804		0.7036		0.1415	
zone_8	-1.63E-05	**	-0.1733	***	-0.1284	***
	0.035		0.0011		0.0001	
zone_10	3.21E-05		0.4043	***	0.5950	***
	0.249		0.0042		0.0000	
zone_11	2.68E-05	***	3.78E-01	***	4.81E-01	***
	0.004		0.0000		0.0000	
zone_12	6.70E-05	***	0.7283	***	0.9880	***
	0.009		0.0000		0.0000	
zone_13	6.21E-05	**	0.7013	***	0.9508	***
	0.019		0.0000		0.0000	
zone_14	3.89E-05	**	0.3751	***	0.5271	***
	0.011		0.0000		0.0000	
zone_15	5.36E-05	***	0.5404	***	0.7514	***
	0.001		0.0000		0.0000	
Price Tier	-2.69E-05	**	-0.3087	***	-0.4009	***
	0.025		0.0000		0.0000	
σ					0.9050	***
					0.0000	
Observations	12,066		12,066		12,066	
R^2	0.2061		0.4500		0.7345	

NOTE: * p<.1; ** p<.05; *** p<.01, P-values.

Table 5. Estimated Elasticities

	Price Elasticity			Income
	Mass	Craft	Import	Elasticity
Mass	-0.1260	0.0004	0.0003	0.5701
S.E.	5.90E-03	1.16E-05	1.35E-05	5.28E-02
Craft	0.0019	-0.2124	0.0005	0.5923
S.E.	8.73E-05	9.94E-03	2.26E-05	5.48E-02
Import	0.0020	0.0004	-0.2247	0.5818
S.E.	9.24E-05	2.05E-05	1.05E-02	5.39E-02
Over All		-0.1771		0.5801
S.E.		8.29E-03		5.37E-02

Table 6. 95% Confidence Intervals for Elasticities

	Price Elasticity Matrix									Income		
	Mass			Craft			Import			Elasticity		
	LB	Coef	UB	LB	Coef	UB	LB	Coef	UB	LB	Coef	UB
Mass	-0.1378	-0.1260	-0.1142	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003	0.4645	0.5701	0.6756
Craft	0.0017	0.0019	0.0020	-0.2323	-0.2124	-0.1925	0.0004	0.0005	0.0005	0.4826	0.5923	0.7020
Import	0.0018	0.0020	0.0022	0.0004	0.0004	0.0005	-0.2458	-0.2247	-0.2037	0.4740	0.5818	0.6896
				LB	Coef.	UB				LB	Coef	UB
Over All				-0.1936	-0.1771	-0.1605				0.4727	0.5801	0.6875

Note: LB = Lower Bound and UB = Upper Bound.

Table 7. Comparisons with Elasticity Results from other Studies

Source	Price Elasticity	Income Elasticity
Hogarty and Elzinga 1972	-0.889	0.430
Orstein and Hanssens 1985	-0.142	0.011
Tegene 1990	-0.768	0.731
Lee and Tremblay 1992	-0.583	0.135
Gallet and List 1998	-0.730	-0.545
Nelson 1999	-0.200	0.760
Nelson 2003	-0.174	-0.032
This study	-0.173	0.163

Source: Table 2.2. Tremblay and Tremblay (2005).