# Nested Logit Demand Estimation in Japanese Beer-like Beverage Markets*

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Abstract

In Japanese beer-like beverage market there are three kinds of products: beer, happoshu (low-malt beer), and "the third beer" (also called "new genre" or sonota no zasshu). Each brand of beer-like beverages in Japan must be classified into one of the three groups, and they are taxable at different rates depending on the groups they are classified under. Historically, the liquor tax in Japan on the beer-like beverages has been based on malt content in the products. The Japanese major breweries tried to avoid high tax rate on beer by inventing happoshu with low malt content and, then, the third beer with no malt content. Japanese authority reacted against it by carrying out the liquor tax revision effective from May 2006, when the tax rate on the third beer was raised and that on beer was reduced.

This paper estimates the price elasticities of demand in Japanese beer-like beverage markets, comparing them between product groups by using data collected in 2005 and 2006. In the econometric analysis, we formulate a nested logit model for the differentiated products assuming that consumers choose one of the three groups of beer-like beverages in the first stage and, in the second stage, choose one brand from the product group chosen in the first stage so as to avoid independence from irrelevant alternatives (IIA). Furthermore, we choose a set of appropriate instrumental variables in the regression analysis because price and "within group" market share must be regarded as endogenous variables and OLS cannot be used.

As the result, we show that the elasticities of the third beer with respect to a change in the price of beer or happoshu decreased after the tax revision. This finding suggests that the third beer became less attractive in terms of price by the tax revision in May 2006.

Keywords: demand estimation, product differentiation, discrete choice

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## 1 Introduction

When estimating the demand function in the standard logit model, we face independence from irrelevant alternatives (IIA), that is, the proportional substitution property across brands. This property may be too restrictive for real market analyses and its application may lead to unrealistic conclusions, especially when product brands are not regarded equally by consumers, but instead are divided into several groups or nests in terms of their characteristics.

A good example of this type of market is that for the Japanese beer-like beverage. In this market, there are three kinds of products: beer, happoshu (low-malt beer), and "the third beer" (also called "new genre" or sonota no zasshu). Each brand of beer-like beverages in Japan must be classified into one of these three groups, and are taxed at different rates accordingly. Clearly, there is a wider product differentiation between two brands in different groups than between two brands within the same group. Therefore, applying the standard logit model to estimate demand in this market will be problematic. In fact, the cross-price elasticities of a brand with respect to a change in the price of any brand regardless of group must become equal. This would not be realistic because it means that the demand for a beer brand responds in the same manner to changes in the prices of the third beer and to those of another beer.

In this case, the nested logit model is a more appropriate method for estimating demand, as it will avoid this inappropriate IIA property. In this model, we assume a two-stage discrete choice: in the first stage, consumers choose one of the three groups of beer-like beverages, and in the second stage, choose one brand from this chosen product group. The IIA holds only for the brands within a group and does not affect brands in the other groups, as demonstrated by Train (2009).

This paper estimates the price elasticities of demand in the Japanese beer-like beverage markets using the nested logit model. In the nested logit framework, the estimated price elasticities are expected to reflect how far brands are from each other in terms of product differentiation. We then compare the elasticities between product groups using data collected in 2005 and 2006 to examine the impact of the tax revision which went into effect on May 2006. In the estimation, we choose a set of appropriate instrumental variables in the regression analysis because price and "within group" market share must be regarded as endogenous variables, and we cannot use ordinary least squares (OLS).

Our results show that the elasticities of the third beer with respect to a change in the price of beer or happoshu decreased after the tax revision, and vice versa. This finding suggests that the third beer, the cheapest group, became less attractive in terms of price because of the tax revision that went into effect on May 2006, which effectively reduced the sensitivity to the price of beer-like beverage.

Demand estimation analysis using the discrete choice model has been used for various markets in recent years (Revelt & Train 1997; Petrin 2002; Goolsbee & Petrin 2004). This study's approach, however, follows Nevo (2001) and Berry (1994). Nevo (2001) applied a

random coefficient model based on Berry, Levinsohn and Pakes (1995). In this study, we extend Nevo's approach to the nested logit model but do not apply random coefficient model owing to a difficulty which is described in a later section. We also follow the nested logit framework by Berry (1994), which expresses the regression model with "within group" market share as an explanatory variable.

The next section describes the Japanese beer-like beverage market. Nest, we provide the empirical model and outline the data, estimation method, and instrumental variables. Then, we present the results. Finally, we discuss the results and present the conclusion.

## 2 The Japanese Beer-like Beverage Market

In Japan, there are four major beer breweries (Asahi, Kirin, Sapporo, and Suntory). In addition, there are many small breweries producing local beer. The four major breweries have been under severe competition for long time, which resulted in the invention of new beer-like beverages. For instance, during the "Dry War" in the late 1980s, Asahi produced a new type of beer, Asahi Super Dry, which was then adopted by other breweries.

In the 1990s, each brewery began producing happoshu, or low-malt beer, to avoid the high liquor tax on beer in Japan. The success of this product increased the producing companies' shares in the beer-like beverage market, which greatly impacted the industry. For years, the four major breweries competed in introducing new brands to attract consumers.

During that time, Japanese tax law defined beer as a beverage with more than 67% malt content. Because happoshu contains low malt, they were taxed lower than beer. In 1996, however, the authorities raised the tax rate on happoshu with more than 50% malt content. The breweries, then, reduced the malt content in happoshu and developed a new beer-like beverage: the third beer.[1] Because this product tastes like beer but uses soy protein or peptide instead of malt, it can be sold at lower prices. After Sapporo's introduction of the third beer in 2004, other breweries followed, and the third beer began to prevail in the beer-like beverage market.

The Japanese authorities, however, responded to this new product by changing the classification of beer-like beverage and revising the liquor tax which went into effect on May 2006. In this revision, the tax rate on the third beer was raised by 3.8 yen per 350 milliliters while that on beer was reduced by 0.7 yen per milliliter. The Brewery Association of Japan reports that, today, the tax ratios (including the consumption tax) in the retail price of beer-like beverage in Japan are 45.1% for beer; 34.3% for happoshu; and 24.9% for the third beer.[2]

The impact of the 2006 tax revision must be of great interest to economists. Because of this tax revision, it is logical to expect that the attractiveness of the third beer compared to beer

1 The name comes from the fact that this new beverage follows (real) beer and happoshu. The third beer is also called "new genre" or sonota no zasshu in Japanese. This category includes various liquor beverage types with no malt content.

2 Brewers Association of Japan, "Current status of beer tax in Japan," http://www.brewers.or.jp/english/11-zeil.html (accessed July 31, 2011).

will decrease. Thus, this study aims to examine how consumer preference for the beer-like beverages has changed owing to the tax revision by comparing the price elasticities of beer products in 2005 and 2006.

## 3 The Empirical Model

### 3.1 The Nested Logit Model

In this analysis below, we adopt a discrete-choice model following Berry (1994) and Nevo (2000, 2001). As noted previously, the beer-like beverages are classified into beer, happoshu, and the third beer, where the nested logit model is an appropriate method for estimation. In this model, we assume that consumers choose one of the three groups of beer-like beverages in the first stage, and choose one brand from this chosen product group in the second stage.

We let G denote the set of product groups and $g \in G=\{B,H,T,O\}$, where B is beer, H is happoshu, and T is the third beer. Group $g=0$ is a special group that includes only one member, "outside good," denoted by $j=0$ .

Consumer i's utility for product $j \in g$ can be expressed in a linear form as:

$$u_{ij} = \alpha p_j + x_j \beta + \xi_j + \sum_{g \in G} d_{jg} \zeta_{jg} + (1-\sigma)\, \varepsilon_{ij} \tag{1}$$

where $p_j$ is the price of product j, $x_j$ is the observable product characteristics vector, $\zeta_j$ is the unobservable product characteristics, $\alpha$ and $\beta$ are parameters, and $\varepsilon_{ij}$ is the error term assumed to have the extreme value distribution. $\zeta_{jg}$ is a "random coefficient" on group-specific dummy variable, $d_{jg}$, which is equal to one if $j \in g$, and zero otherwise. Parameter $\sigma$, which is $0 \leq \sigma < 1$, determines the "within group" correlation. If $\sigma$ approaches one, the correlation among brands within a group becomes one, which means that the choice of group only concerns the consumers. If $\sigma$ approaches zero, the "within group" correlation becomes zero, which is equivalent to a simple logit model. In other words, the larger $\sigma$ becomes, the higher the degree of product differentiation across groups is.

We assume that consumer i purchases brand j if $u_{ij} > u_{ik}$, where $\forall k \neq j$. If $\varepsilon_{ij}$ follows a generalized extreme value distribution, the market share of product $j \in g$ within group g is derived as follows:

$$s_{j/g} = \frac{\exp\left\{\dfrac{\delta_j}{1-\sigma}\right\}}{\Sigma_{j' \in g} \exp\left\{\dfrac{\delta_{j'}}{1-\sigma}\right\}} \tag{2}$$

where $\delta_j \equiv \alpha p_j + x_j \beta + \xi_j$, that is, the mean utility level of brand j. Similarly, the market share of group g within G is:

$$s_g = \frac{\left(\Sigma_{j \in g} \exp\left\{\dfrac{\delta_j}{1-\sigma}\right\}\right)^{1-\sigma}}{\Sigma_{g' \in G}\left(\Sigma_{j \in g'} \exp\left\{\dfrac{\delta_j}{1-\sigma}\right\}\right)^{1-\sigma}} \tag{3}$$

Accordingly, the market share of product $j \in g$ can be derived from the following

relationship:

$$s_j = s_{j/g} \cdot s_g \tag{4}$$

Meanwhile, the market share of "outside good" is:

$$s_0 = \frac{1}{\Sigma_{g' \in G} \left( \Sigma_{j \in g'} \exp\left\{ \frac{\delta_j}{1-\sigma} \right\} \right)^{1-\sigma}} \tag{5}$$

In this nested logit framework, IIA holds for brands within each group and does not affect brands from the other groups.[3] This property restricts the characteristics of the cross-price elasticities of a brand with respect to a change in the price of any brand within a group; it must be identical. For example, a brand of beer will have the same cross-price elasticity with respect to a price change of any brand of happoshu. In the following, we show the calculations of the price elasticities.

By dividing Eq. (4) by Eq. (5) and taking the natural logarithm, we derive the following regressed equation:

$$\ln(s_{jt}) - \ln(s_{0t}) = \alpha p_{jt} + x_j \beta + \sigma \ln(s_{j/g,t}) + \xi_{jt} \tag{6}$$

where t is the market index. We then estimate the parameters, $\alpha$, $\beta$, and $\sigma$. Here, the price, $p_{jt}$, must be correlated with the unobserved product characteristics, $\xi_{jt}$. Similarly, the log of the "within group" market share, $\ln(s_{j/g,t})$, must be correlated with $\ln(s_{jt})$ and $\xi_{jt}$. Thus, we cannot estimate this regression without the instrumental variables for endogeneity. We discuss the instrumental variables later.

### 3.2 Price Elasticities

To evaluate the change in consumers' taste in 2005 and 2006, we examine the price elasticities of brands within a group and across groups. Here, the price elasticity of brand i with respect to a change in the price of brand j is defined as $\partial \log s_i / \partial \log s_j$. We can calculate these elasticities using from Eqs. (2) to (4).

The own-price elasticity of demand of brand i is:

$$\eta_{ii} = \frac{\alpha}{1-\sigma} p_i - \frac{\alpha}{1-\sigma} s_{i/g} p_i + \alpha (1 - s_g) s_{i/g} p_i \tag{7}$$

where i belongs to group g. The first term in the left-hand side of Eq. (7) refers to the "own-price effect" which affects "own demand" by price change, expected to be negative. The second term is the "within group" cross effect, that is, the effect of changes in the demand for other brands within the group. Meanwhile, the third term represents the "between group" cross effect which is caused by the change in the demand for the "own group" compared the other groups. Although the second term must be positive, the total effect must be negative because $\alpha < 0$ and $0 \leq \sigma < 1$.

3 See Train (2009).

The cross-price elasticities are:

$$\eta_{ij} = -\frac{\alpha}{1-\sigma} s_{j/g} p_j + \alpha (1-s_g) s_{j/g} p_j \quad (8)$$

where both brands i and j belong to group g ($i \neq j$), and

$$\eta_{ij} = -\alpha s_g s_{j/g} p_j \quad (9)$$

where j belongs to group g but brand i does not. These elasticities are positive as long as $\alpha < 0$ and $0 \leq \sigma < 1$. The second term in the left-side of Eq. (8), the "between group cross effect" must also be positive. Note again that in the logit framework, the cross-price elasticities of brand i with respect to a change in the price of another brand, j, are identical when brands i and j belong to a same group.

## 4 Data and Estimation

### 4.1 Data

Our analysis uses three sets of data. One of these data sets comes from the point-of-sale (POS) survey collected by Nikkei NEEDS. This data set includes weekly information on prices, sales in quantity and volume, and area and period sold for 171 beer-like beverages. We used data collected during the period May 30, 2005 to November 6, 2005 (23 weeks) and May 29, 2006 to November 5, 2006 (23 weeks) for ten areas in Japan including Hokkaido, Tohoku, Hokuriku, Kanto, Tokyo, Chubu, Kinki, Chugoku, Shikoku, and Kyushu.[4] We treat the data as cross sectional, and the number of "markets" in our analysis totals 230 each for 2005 and 2006. Although there are 465 beer-like beverages sold in 2005 and 2006 according to the survey, they include many minor brands sold in limited areas or periods only. Then, for the purposes of this study, we only chose 171 items under major brands sold in every area in Japan.[5] These items correspond to 36 brands in different sizes (250ML, 350ML, 500ML, or 633ML), cases (can or bottle), and boxed quantities (1, 4, 6, 12, 20, or 24). We then combined the different sizes, cases, and boxed quantities of each brand into one "brand," and aggregated the sold volume. Table 1 shows the 36 brands with their sold volume and quantities in boxes.[6] Except for "Asahi Super Dry, Bottled," the top 22 brands are canned products. In the logit model, then, we chose 21 of these brands and treated the other brands as "outside goods".[7] Table 2 shows these 21 brands' prices and market shares. Price is expressed as the average per 500 milliliters and market share is based on volume sold in each market. In each market,

4 Kanto consists of six prefectures: Ibaraki, Tochigi, Gunma, Yamanashi, Nagano, and Shizuoka. Similarly, Tokyo consists of the Tokyo Metropolis and two prefectures, Kanagawa and Chiba.

5 In this study, an "item" must be classified by brands, cases, sizes, and boxed quantities. For example, it might be labeled as "Kirin Super Dry, Canned, 350ML 6" in the data.

6 In Japan, Budweiser is domestically distributed by the Kirin Brewery Company.

7 A rationale for eliminating bottled products from the analysis is that in Japan, bottled beer is rarely served at home compared to restaurants or formal parties. Japanese bottled beer today is said to be reserved for "business use." Indeed, most convenience stores in Japan do not sell them.

the 21 brands or "inside goods" account for approximately 98 percent of market share.

The second data set consists of the product characteristics of the 21 brands, collected from the websites of the breweries websites. These product characteristics are described in the next subsection. Meanwhile, the third data set includes weather information collected from weather reports for each prefecture from the Japan Meteorological Agency website. In the analysis, we calculated the average weekly temperature and humidity of the areas for the period included in this study. In the regression, we use the temperature and humidity as explanatory variables to control market characteristics, instead of using dummy variables for area and period.

### 4.2 Product Characteristics and Multicollinearity

In the analysis of the beer market, the choice of product characteristics is important. Some of these characteristics may be highly correlated with each other; if these characteristics are included as explanatory variables in the regression, severe multicollinearity may occur, the symptoms of which include a positive coefficient for the price variable or a negative coefficient for the "within group" market share variable. To avoid this problem, we chose the product characteristics carefully. We collected data for the product characteristics of the included brands, from which we formulated eight variables: Color, Non-draught, Alcohol, Calorie, Protein, Sugar, Fiber, and Purine (Table 3). Table 4 shows the correlation coefficients between the characteristics. It shows, for instance, that Alcohol and Calorie are highly and significantly correlated (0.787864), while Calorie and Sugar are extremely correlated (0.9142666). Therefore, some of the characteristics variables must be omitted from the analysis because of their correlation with each other. In the end, we used the following five characteristics variables: Color, Non-draught, Sugar, Fiber, and Purine.

### 4.3 Instrumental variables

From Eq. (6), it is clear that the price, $p_j$, and log of the "within group" market share, $\ln(s_{j/g,t})$, must be regarded as endogenous variables. According to Nevo (2001), price is a function of marginal costs and a markup that reflects a deviation by the market. Thus, price must be correlated with the error term in the regression, which means that OLS would not be appropriate for estimation. Similarly, the "within group" market shares may be affected by the brand's market share, $s_j$, and must not be treated as an exogenous variable.

To eliminate these endogenous biases, we need to use a set of valid instrumental variables for the regression. Some of these variables have been used in previous studies for prices. It is possible that one of these variables is a set of prices of the brands in other areas. In some situations, we can assume that area-specific valuations are independent across areas but not within an area and that the prices of the brands in other areas are not correlated with the area-specific valuations. The average price for other areas would then be useful because they are correlated with the prices of the brand in each area but uncorrelated with the error terms. Another variable that can be used as an instrumental variable are the product characteristics. If the product characteristics of a brand are predetermined, then they are correlated with the price of the brand but uncorrelated with the demand shock. According to Nevo

(2001), the matrix of instrumental variables must be singular when the brand dummy variables are included in the regression, because product characteristics do not vary over markets. In our case, a set of values for the product characteristics determines a "brand" and the same symptoms may arise even if the brand dummy is included in the regression. We only adopt the average price over the other areas in all periods as the instrumental variable for price.[8]

Other instrumental variables are expected to be correlated with "within group" market share but uncorrelated with the market-specific error. Berry (1994) suggests that a potential instrumental variable is the characteristics of the other firms in the group. Another possible instrumental variable is the share of price within the group. In this study, we use these two instrumental variables in the analysis then compare the results using the Sargan test for evaluating the validity of the instrumental variables.

## 5 Results

The estimation results for 2005 and 2006 are reported in Tables 5 and 6, respectively. The estimation methods we used are OLS and the three types of IV method. The OLS column displays the results from OLS regressing the difference of the log of the market share of brands on price, log of "within group" market share, product characteristics, company dummies, and temperature and humidity, without using any instrumental variable.[9] It is clear that the OLS results are problematic. For 2005, three estimates are not statistically significant: Color, Fiber, and Purine. For 2006, the results are even worse, as they show that the five estimates, including price, are not significant, and that the sign of the coefficient for price is positive, which is inconsistent with theory. The wrong sign for price may be caused by the price variable's endogeneity. For both years, the coefficients for the "within group" market share are almost one, significant at the 0.1% level. However, we cannot be sure that these high estimates are due to the nested logit model, as it is also possible that they may have been caused by the endogeneity for the "within group" market share. Based on these results, we conclude that OLS is inadequate as the estimation method for this analysis.

Columns IV(1) to IV(3) show the results for the IV methods. The regressions in IV(1) and IV(2) include the same set of explanatory variables used in the OLS estimation. Meanwhile, the explanatory variables in IV(3) are price, log of the "within group" market share, brand dummies, and temperature and humidity. We do not report the results for the brand dummies in the tables. IV(1) and IV(3) apply two instrumental variables: average price over other areas and share of price within the group. IV(2), on the other hand, applies average price over other areas and product characteristics of other firms in the group. Of

8 Nevo (2001) used 20 average regional prices in all periods (excluding the city being instrumented) based on cereal data in 65 U.S. cities. Meanwhile, our data covers only 10 areas, and consists only of one instrument, the average price of the other 9 areas.

9 In the regression analysis, we included dummies for all four companies (Asahi, Kirin, Sapporo, and Suntory) and do not use the constant term.

these three cases, IV(1) appears to be the most adequate for both 2005 and 2006 — the signs for the prices are right; the estimates for "within group" market share are not too high; and the significance of the coefficients are almost high (except for that of Color in 2006). The Sargan statistic for IV(1) is approximately zero, which implies that the null hypothesis that the instrumental variables are not correlated with the error term cannot be rejected. Thus, the instrumental variables are both deemed valid. On the other hand, IV(2) is problematic as evidenced by the weak significance; the wrong sign of the coefficient for price in 2006; and the invalidity of the instrumental variables. These problems in IV(2) are caused by the fact that the product characteristics are not adequate instrumental variables because they are correlated with error term. IV(3) is also inadequate because the coefficient for "within group" market share in 2005 is negative which is inconsistent with the constraint, $0 \leq \sigma < 1$. The cause for the problems in IV(3) is not clear, although it may be a result of the multicollinearity of the brand dummies. Based on the results of this analysis, we decide to use the results from IV(1) to evaluate the effect of the tax revision.

Our main concern is the difference in the results for price and "within group" market share for 2005 and 2006. The results using IV(1) show that the magnitude of the coefficients for price decreased (from 0.009230 to 0.002178) but that of "within group" market share increased (from 0.663184 to 0.799207). We discuss this observation in the next section.

The results also yield other valuable findings. First, the two characteristics, Sugar and Fiber, are both negative factors for demand. This seems reasonable because both Sugar and Fiber are highly correlated with product calories, and consumers tend to avoid high-calorie products. Second, the company dummies correctly reflect the companies' market shares in 2005 and 2006. Third, humidity is a negative factor for the demand of the beer-like beverages but temperature, interestingly, is not. This unexpected effect may have been caused by tsuyu, the rainy season in Japan during late spring. The fact that this season exhibits smaller demand for beer-like beverage than the summer season from late July to early September might explain the negative sign of the coefficient for humidity.

## 6 Discussion

In this study, we examine how the liquor tax revision in May 2006 affect the demand and taste of the Japanese consumers for the beer-like beverages. We used the coefficients of estimation by IV(1) described above — 0.009230 versus 0.002178 for price ($|\alpha|$) and 0.663184 versus 0.799207 for "within group" market share ($\sigma$). We found that because of the tax revision, the consumers became less sensitive to prices of the beer-like beverages over one year, but more sensitive to the difference of the products across groups.

The breweries, meanwhile, may have responded to the tax revision by changing their prices; consequently, their market shares have changed. Recall that the tax revision reduced the tax rate of the beer products but increased that of the third beer products, suggesting that beer may have become cheaper and the third beer may have become slightly more expensive. Table 7 shows the mean values of prices, market shares, and "within group" market shares for each brand in 2005 and 2006. The differences are shown in Abs(2006) to Abs(2007).

We found that prices for all beer products and almost all of the happoshu products decreased but those for all but one of the third beer products increased after the tax revision. As a result, almost all beer products gained more market share but almost all of happoshu and the third beer products lost ground.[10]

Based on these results, we can infer how the consumers reacted to the change in the prices of beer-like beverages. First, reducing the difference in the prices between beer and the third beer could have made the third beer less attractive to consumers who prefer cheaper products. Then, they may have switched from the third beer to beer and may have become another type of consumer who is less sensitive to prices. This change in consumer preference is evident in the change in the coefficient for price, $\alpha$, in the estimation. Second, the reduction in "vertical" differentiation may have led consumers to regard the third beer as the same class of beverage as beer. Meanwhile, the tax revision also affected the "horizontal" difference between two products in that the choice between beer and the third beer became more significant than the choice between brands within a group. This may have caused the increase in the coefficient for "within group" market share, $\sigma$.

The total effect of the prices on demand can be determined by calculating the price elasticities. Recall that the cross-price elasticity across groups is $\eta_{ij} = -\alpha s_j p_j$. Thus, the change in the demand of brand $i \in g$ with respect to the change in the price of brand $j \in g'$, $g' \neq g$, is derived using three factors: price sensitivity, market share, and price of brand j, where $\partial \eta_{ij} / \partial \alpha < 0$, $\partial \eta_{ij} / \partial s_j > 0$, and $\partial \eta_{ij} / \partial p_j > 0$. Hence, even if the magnitude of $\alpha$ decreased (i.e., $\alpha$ increased) and the price of brand j decreased, price elasticity $\eta_{ij}$ could increase when the market share of brand j increased. We know that $\alpha$ increased after the tax revision, and the other two factors determine the change in the price elasticities. For instance, the cross-price elasticity of Kirin Nodogoshi with respect to the change in the price of Asahi Super Dry would have increased (decreased) when the market share and price of Kirin Nodogoshi increased (decreased).

Tables 8 to 11 shows the own- and cross-price elasticities of beer-like beverages in 2005 and 2006 based on the estimated values of $\alpha$ and $\sigma$. In this study, we follow Nevo (2001) in the construction of the tables, calculating the elasticity for each market in the data then taking the medians of these values each for 2005 and 2006. As noted above, the cross-price elasticities with respect to the price change of brands in the same group must be identical in the logit model.[11] The result is clear: the magnitudes of price elasticities decreased for all brands after the tax revision. This is because the price sensitivities, $\alpha$, decreased in magnitude to offset the change in prices and market shares. In conclusion, after the tax revision, consumers would not easily switch from beer to the third beer even if beer prices increased, and vice versa.

10 The means of prices of the brands in groups B, H and T are: ¥270.03, ¥175.96, and ¥147.18 in 2005, and ¥268.64, ¥175.89, and ¥147.56 in 2006, respectively. Meanwhile, their market shares are: 31.4%, 40.5%, and 25.7% in 2005, and 33.9%, 38.8%, and 25.1% in 2006, respectively.

11 There appear some exceptions such as brand 9 in 2005 and brands 8, 11, 17, and 20 in 2006. These exceptions are caused by the lack of samples.

## 7 Conclusion

In this paper, we examined the impact of the Japanese liquor tax revision that went into effect in May 2006 on consumer preferences by determining the price elasticities of the beer-like beverages, using data for 2005 and 2006. We found that all cross-price elasticities decreased after the tax revision. A highlight of these results concerns the price elasticities of the third beer with respect to beer price changes. Our results showed that the elasticities decreased, which suggests that the third beer became less attractive in terms of price because of the tax revision.

This paper adopted the nested logit model and assumed that the coefficients for price and product characteristics are identical over consumers, which may not necessarily hold true in reality. We could adopt the random coefficient model where we use $\alpha_i$ and $\beta_i$ in Eq. (1) rather than $\alpha$ and $\beta$, respectively. This alternative method may produce better results for the price elasticities because the cross-price elasticities with respect to price change in the same group brands are no more identical. Unfortunately, our data contains only 10 demographic areas and each area is too broad, and the variation of demographic characteristics (such as income and age) across the areas would be small. Using alternative models for beer-like beverage market analysis would be an important topic for future research.

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Table 1: Ranking of Brands of Beer-like Beverages

| | Brand | Volume (milliliter) | Quantity (box) |
|---|---|---|---|
| 1 | Asahi Super Dry, Canned | 5258470 | 3446920 |
| 2 | Kirin Nodogoshi, Canned | 5223928 | 3889165 |
| 3 | Kirin Tanrei, Canned | 4114938 | 2629062 |
| 4 | Kirin Tanrei Green Label, Canned | 2450699 | 1874082 |
| 5 | Sapporo Draft One, Canned | 2019844 | 1451680 |
| 6 | Kirin Ichibanshibori, Canned | 1851092 | 1411600 |
| 7 | Asahi Honnama, Canned | 1671826 | 1196969 |
| 8 | Asahi Honnama Aqua Blue, Canned | 1386922 | 1066588 |
| 9 | Suntory Diet, Canned | 1086427 | 1001527 |
| 10 | Kirin Lager, Canned | 1029475 | 759516 |
| 11 | Suntory Super Blue, Canned | 955075 | 754234 |
| 12 | Asahi Honnama Gold, Canned | 627229 | 501824 |
| 13 | Sapporo Yebisu, Canned | 619864 | 673376 |
| 14 | Kirin Classic Lager, Canned | 424459 | 440117 |
| 15 | Kirin Tanrei Alpha, Canned | 410428 | 433178 |
| 16 | Sapporo Kuro Label, Canned | 172939 | 59451 |
| 17 | Asahi Super Dry, Bottled | 162433 | 214851 |
| 18 | Sapporo Yebisu Kuro, Canned | 134864 | 237825 |
| 19 | Sapporo Namashibori, Canned | 134480 | 18502 |
| 20 | Kirin Gokunama, Canned | 98315 | 219143 |
| 21 | Suntory The Premium Malt's, Canned | 78285 | 223670 |
| 22 | Kirin Budweiser, Canned | 77376 | 160991 |
| 23 | Kirin Ichibanshibori Toretate Hop, Canned | 70696 | 61882 |
| 24 | Suntory Malt's, Canned | 60587 | 15091 |
| 25 | Kirin Lager, Bottled | 58828 | 68253 |
| 26 | Kirin Classic Lager, Bottled | 51655 | 71884 |
| 27 | Kirin Ichibanshibori, Bottled | 43553 | 65838 |
| 28 | Sapporo Yebisu, Bottled | 15111 | 22846 |
| 29 | Sapporo Kuro Label, Bottled | 12970 | 20489 |
| 30 | Asahi Kuronama, Canned | 11342 | 28568 |
| 31 | Suntory Magnum Dry, Canned | 10271 | 4171 |
| 32 | Sapporo Classic, Canned | 6752 | 749 |
| 33 | Kirin Ichibanshibori Kuronama, Canned | 2999 | 8569 |
| 34 | Kirin Tanrei, Bottled | 1132 | 1788 |
| 35 | Sapporo Lager, Bottled | 561 | 886 |
| 36 | Suntory Malt's, Bottled | 203 | 16 |
| | Total | 30336027 | 23035301 |

Note: Data were calculated from the POS survey by Nikkei NEEDS for the summers of 2005 and 2006.

Table 2: Descriptive Statistics of Price, Market Share and "Within Group" Market Share

| | Brand | Group | Sample | Price (in yen) | | | | | Market Share (within total) | | | | | Market Share (within group) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Mean | Median | Std | Min | Max | Mean | Median | Std | Min | Max | Mean | Median | Std | Min | Max |
| 1 | Asahi Super Dry | B | 460 | 247.65 | 247.69 | 4.48 | 232.42 | 257.82 | 0.190 | 0.183 | 0.048 | 0.110 | 0.456 | 0.577 | 0.588 | 0.077 | 0.396 | 0.745 |
| 2 | Kirin Classic Lager | B | 460 | 255.30 | 254.91 | 6.47 | 243.10 | 275.15 | 0.012 | 0.011 | 0.004 | 0.004 | 0.026 | 0.038 | 0.034 | 0.014 | 0.007 | 0.077 |
| 3 | Kirin Budweiser | B | 460 | 268.64 | 268.96 | 14.93 | 214.62 | 348.47 | 0.003 | 0.002 | 0.002 | 0.000 | 0.010 | 0.008 | 0.006 | 0.007 | 0.001 | 0.028 |
| 4 | Kirin Lager | B | 460 | 252.13 | 251.70 | 4.52 | 243.37 | 268.01 | 0.034 | 0.034 | 0.014 | 0.006 | 0.078 | 0.106 | 0.109 | 0.042 | 0.019 | 0.198 |
| 5 | Kirin Ichiban shibori | B | 460 | 250.61 | 250.16 | 5.20 | 237.30 | 262.36 | 0.055 | 0.053 | 0.017 | 0.027 | 0.102 | 0.170 | 0.164 | 0.048 | 0.083 | 0.298 |
| 6 | Sapporo Yebisu Kuro | B | 460 | 290.22 | 288.44 | 8.49 | 253.26 | 320.31 | 0.004 | 0.004 | 0.002 | 0.001 | 0.010 | 0.013 | 0.012 | 0.006 | 0.002 | 0.033 |
| 7 | Sapporo Yebisu | B | 460 | 281.21 | 280.79 | 7.66 | 250.68 | 296.39 | 0.019 | 0.017 | 0.006 | 0.007 | 0.043 | 0.058 | 0.054 | 0.018 | 0.023 | 0.126 |
| 8 | Sapporo Kuro Label | B | 307 | 250.59 | 250.06 | 10.45 | 222.20 | 281.64 | 0.010 | 0.004 | 0.015 | 0.000 | 0.098 | 0.034 | 0.014 | 0.052 | 0.000 | 0.288 |
| 9 | Suntory The Premium Malt's | B | 435 | 324.50 | 325.03 | 11.36 | 284.29 | 364.66 | 0.002 | 0.002 | 0.002 | 0.000 | 0.008 | 0.007 | 0.007 | 0.005 | 0.000 | 0.024 |
| 10 | Asahi Honnama Aqua Blue | H | 460 | 173.04 | 172.75 | 3.55 | 166.18 | 182.99 | 0.048 | 0.046 | 0.011 | 0.023 | 0.093 | 0.121 | 0.120 | 0.024 | 0.078 | 0.205 |
| 11 | Asahi Honnama Gold | H | 453 | 174.49 | 172.90 | 7.70 | 109.40 | 234.55 | 0.019 | 0.016 | 0.015 | 0.000 | 0.074 | 0.048 | 0.042 | 0.037 | 0.000 | 0.149 |
| 12 | Asahi Honnama | H | 460 | 172.15 | 172.21 | 3.56 | 164.44 | 183.90 | 0.057 | 0.058 | 0.014 | 0.021 | 0.103 | 0.145 | 0.145 | 0.035 | 0.054 | 0.248 |
| 13 | Kirin Gokunama | H | 460 | 180.63 | 181.70 | 6.06 | 152.68 | 192.51 | 0.003 | 0.002 | 0.002 | 0.000 | 0.007 | 0.007 | 0.007 | 0.004 | 0.000 | 0.017 |
| 14 | Kirin Tanrei Alpha | H | 460 | 195.60 | 195.69 | 5.53 | 150.28 | 212.84 | 0.013 | 0.013 | 0.005 | 0.001 | 0.030 | 0.033 | 0.034 | 0.011 | 0.003 | 0.067 |
| 15 | Kirin Tanrei Green Label | H | 460 | 173.30 | 172.59 | 3.40 | 167.18 | 181.93 | 0.085 | 0.083 | 0.021 | 0.027 | 0.137 | 0.214 | 0.206 | 0.048 | 0.107 | 0.352 |
| 16 | Kirin Tanrei | H | 460 | 170.08 | 169.65 | 3.07 | 164.25 | 180.66 | 0.138 | 0.133 | 0.029 | 0.055 | 0.228 | 0.346 | 0.342 | 0.049 | 0.165 | 0.473 |
| 17 | Sapporo Hokkaido Namashibori | H | 301 | 163.79 | 162.48 | 4.75 | 144.00 | 174.61 | 0.008 | 0.006 | 0.009 | 0.000 | 0.039 | 0.022 | 0.014 | 0.025 | 0.000 | 0.108 |
| 18 | Suntory Diet | H | 460 | 175.82 | 174.50 | 5.16 | 167.91 | 191.08 | 0.029 | 0.028 | 0.010 | 0.005 | 0.054 | 0.072 | 0.070 | 0.025 | 0.015 | 0.148 |
| 19 | Kirin Nodogoshi | T | 460 | 149.28 | 149.48 | 2.83 | 137.02 | 155.52 | 0.167 | 0.168 | 0.039 | 0.065 | 0.287 | 0.667 | 0.640 | 0.150 | 0.271 | 0.998 |
| 20 | Sapporo Draft One | T | 455 | 148.59 | 147.97 | 6.32 | 99.47 | 182.86 | 0.063 | 0.060 | 0.039 | 0.000 | 0.190 | 0.236 | 0.235 | 0.124 | 0.000 | 0.591 |
| 21 | Suntory Super Blue | T | 460 | 144.23 | 142.64 | 6.03 | 132.86 | 160.71 | 0.025 | 0.025 | 0.014 | 0.000 | 0.060 | 0.099 | 0.099 | 0.054 | 0.002 | 0.300 |

Table 3: Definition of Product Characteristics Variables

| Variable | Definition |
|---|---|
| Color | 1 if the beer's color is black; 0 otherwise |
| Non-draught | 1 if the beer is non-draught beer; 0 otherwise |
| Alcohol | Alcohol content by volume (percent) |
| Calorie | Calories in 100 milliliters of beer (kcal) |
| Protein | Protein content in 100 milliliters of beer (g) |
| Sugar | Sugar content in 100 milliliters of beer (g) |
| Fiber | Fiber content in 100 milliliters of beer (g) |
| Purine | Purine content in 100 milliliters of beer (mg) |

Table 4: Correlation Coefficients between Product Characteristics

| | Color | Non-draught | Alcohol | Calorie | Protein | Sugar | Fiber | Purine |
|---|---|---|---|---|---|---|---|---|
| Color | 1.0000 | | | | | | | |
| Non-draught | -0.1325 | 1.000 | | | | | | |
| Alcohol | -0.0493 | -0.2067 | 1.000 | | | | | |
| Calorie | 0.1167 | 0.0380 | 0.7879 | 1.0000 | | | | |
| Protein | 0.4167 | 0.1446 | 0.1794 | 0.4679 | 1.0000 | | | |
| Sugar | 0.1720 | 0.2401 | 0.5269 | 0.9143 | 0.4961 | 1.0000 | | |
| Fiber | 0.5399 | -0.2453 | 0.0562 | 0.2147 | 0.4994 | 0.1953 | 1.0000 | |
| Purine | 0.1473 | 0.3403 | 0.1023 | 0.3883 | 0.8484 | 0.4853 | 0.41515 | 1.0000 |

Note: We have omitted information on the significant levels in this table.

Table 5: Estimation Results for 2005

| | OLS | | IV(1) | | IV(2) | | IV(3) | |
|---|---|---|---|---|---|---|---|---|
| Price | -0.001124 | * | -0.009230 | *** | -0.001408 | * | -0.082731 | *** |
| | (0.0005) | | (0.0011) | | (0.0006) | | (0.0017) | |
| "Within group" market share | 0.946589 | *** | 0.663184 | *** | 0.881453 | *** | -1.082086 | |
| | (0.0077) | | (0.0268) | | (0.0121) | | (0.5530) | |
| Color | -0.035938 | | 0.270784 | *** | -0.079902 | | | |
| | (0.0481) | | (0.0689) | | (0.0519) | | | |
| Non-draught | -0.065644 | * | -0.391922 | *** | -0.150108 | *** | | |
| | (0.0334) | | (0.0472) | | (0.0352) | | | |
| Sugar | -0.080329 | *** | -0.149363 | *** | -0.083169 | *** | | |
| | (0.0126) | | (0.0163) | | (0.0131) | | | |
| Fiber | 0.374016 | | -4.378910 | *** | -0.094798 | | | |
| | (0.3219) | | (0.6195) | | (0.3778) | | | |
| Purine | 0.005343 | | 0.123423 | *** | 0.007078 | | | |
| | (0.0082) | | (0.0166) | | (0.0100) | | | |
| Asahi | 3.418299 | *** | 4.578943 | *** | 3.390617 | *** | | |
| | (0.1519) | | (0.2225) | | (0.1639) | | | |
| Kirin | 3.293008 | *** | 4.365548 | *** | 3.238853 | *** | | |
| | (0.1509) | | (0.2173) | | (0.1623) | | | |
| Sapporo | 3.209192 | *** | 4.304541 | *** | 3.141631 | *** | | |
| | (0.1564) | | (0.2249) | | (0.1682) | | | |
| Suntory | 3.129668 | *** | 3.891098 | *** | 2.996117 | *** | | |
| | (0.1506) | | (0.2021) | | (0.1594) | | | |
| Temperature | 0.032715 | *** | 0.031380 | *** | 0.032029 | *** | 0.028827 | *** |
| | (0.0019) | | (0.0022) | | (0.0019) | | (0.0047) | |
| Humidity | -0.013324 | *** | -0.014893 | *** | -0.013267 | *** | -0.030786 | *** |
| | (0.0017) | | (0.0019) | | (0.0017) | | (0.0049) | |
| Adjusted $R^2$ | 0.8793 | | | | | | | |
| Sargan statistic | | | 2.54E-19 | | 103.2595 | | 1.53E-10 | |
| Instrumental variables | | | average price, price share | | average price, characteristics | | average price, price share | |

Note: The sample total is 4805. The standard errors are reported in parentheses.Average price denotes average price over other areas; price share denotes share of price within the group; characteristics denotes product characteristics of other firms in the group. *** denotes significance at the 0.001 level ** denotes significance at the 0.01 level; and * denotes significance at the 0.05 level.

Table 6: Estimation Results for 2006

| | OLS | | IV(1) | | IV(2) | | IV(3) | |
|---|---|---|---|---|---|---|---|---|
| Price | 0.000618 | | -0.002178 | ** | 0.000995 | | -0.041925 | ** |
| | (0.0005) | | (0.0007) | | (0.0006) | | (0.0180) | |
| "Within group" market share | 0.984056 | *** | 0.799207 | *** | 0.924568 | *** | 0.590899 | |
| | (0.0065) | | (0.0201) | | (0.0122) | | (0.3452) | |
| Color | 0.008173 | | -0.058906 | | -0.098098 | | | |
| | (0.0626) | | (0.0692) | | (0.0643) | | | |
| Non- draught | -0.023459 | | -0.308616 | *** | -0.123329 | ** | | |
| | (0.0375) | | (0.0494) | | (0.0409) | | | |
| Sugar | -0.078313 | *** | -0.144655 | *** | -0.089620 | *** | | |
| | (0.0143) | | (0.0176) | | (0.0151) | | | |
| Fiber | 0.664164 | | -1.570002 | ** | 0.412941 | | | |
| | (0.3661) | | (0.4971) | | (0.4072) | | | |
| Purine | 0.001839 | | 0.062394 | *** | 0.001187 | | | |
| | (0.0090) | | (0.0135) | | (0.0106) | | | |
| Asahi | 2.953460 | *** | 3.028430 | *** | 2.754023 | *** | | |
| | (0.1534) | | (0.1738) | | (0.1590) | | | |
| Kirin | 2.854353 | *** | 2.946584 | *** | 2.655811 | *** | | |
| | (0.1528) | | (0.1739) | | (0.1588) | | | |
| Sapporo | 2.708621 | *** | 2.684184 | *** | 2.459279 | *** | | |
| | (0.1598) | | (0.1795) | | (0.1653) | | | |
| Suntory | 2.726463 | *** | 2.576418 | *** | 2.444530 | *** | | |
| | (0.1539) | | (0.1712) | | (0.1587) | | | |
| Temperature | 0.062073 | *** | 0.062069 | *** | 0.061956 | *** | 0.067478 | *** |
| | (0.0023) | | (0.0025) | | (0.0023) | | (0.0040) | |
| Humidity | -0.017977 | *** | -0.016598 | *** | -0.017416 | *** | -0.018564 | *** |
| | (0.0016) | | (0.0018) | | (0.0017) | | (0.0022) | |
| Adjusted $R^2$ | 0.8873 | | | | | | | |
| Sargan statistic | | | 2.06E-20 | | 57.4966 | | 9.93E-11 | |
| Instrumental variables | | | average price, price share | | average price, characteristics | | average price, price share | |

Note: The sample total is 4805. The standard errors are reported in parentheses.Average price denotes average price over other areas; price share denotes share of price within the group; characteristics denotes product characteristics of other firms in the group. *** denotes significance at the 0.001 level ** denotes significance at the 0.01 level; and * denotes significance at the 0.05 level.

Table 7: Means of Prices and Shares for 2005 and 2006

| | | 2005 | | | | 2006 | | | | Abs(2006) to Abs(2007) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brand | Group | Sample | Price | Share | Share(wg) | Sample | Price | Share | Share(wg) | Sample | Price | Share | Share (wg) |
| Asahi Super Dry | B | 230 | 248.759 | 0.17825 | 0.56227 | 230 | 246.538 | 0.20162 | 0.59250 | 0 | -2.222 | 0.02337 | 0.03023 |
| Kirin Classic Lager | B | 230 | 256.444 | 0.01180 | 0.03837 | 230 | 254.165 | 0.01228 | 0.03695 | 0 | -2.280 | 0.00049 | -0.00142 |
| Kirin Budweiser | B | 230 | 270.496 | 0.00232 | 0.00759 | 230 | 266.775 | 0.00304 | 0.00911 | 0 | -3.721 | 0.00073 | 0.00152 |
| Kirin Lager | B | 230 | 252.793 | 0.03321 | 0.10640 | 230 | 251.469 | 0.03579 | 0.10657 | 0 | -1.324 | 0.00258 | 0.00018 |
| Kirin Ichibanshibori | B | 230 | 251.591 | 0.05293 | 0.16998 | 230 | 249.629 | 0.05747 | 0.16989 | 0 | -1.962 | 0.00454 | -0.00009 |
| Sapporo Yebisu Kuro | B | 230 | 292.031 | 0.00364 | 0.01208 | 230 | 288.402 | 0.00448 | 0.01357 | 0 | -3.630 | 0.00084 | 0.00149 |
| Sapporo Yebisu | B | 230 | 282.799 | 0.01691 | 0.05418 | 230 | 279.628 | 0.02068 | 0.06152 | 0 | -3.171 | 0.00378 | 0.00735 |
| Sapporo Kuro Label | B | 230 | 252.842 | 0.01388 | 0.04509 | 77 | 243.857 | 0.00036 | 0.00106 | -153 | -8.985 | -0.01351 | -0.04403 |
| Suntory The Premium Malt's | B | 205 | 329.560 | 0.00135 | 0.00454 | 230 | 319.988 | 0.00315 | 0.00953 | 25 | -9.571 | 0.00180 | 0.00498 |
| Asahi Honnama Aqua Blue | H | 230 | 173.651 | 0.04755 | 0.11822 | 230 | 172.437 | 0.04829 | 0.12444 | 0 | -1.214 | 0.00074 | 0.00622 |
| Asahi Honnama Gold | H | 230 | 173.981 | 0.03219 | 0.07964 | 223 | 175.007 | 0.00548 | 0.01438 | -7 | 1.026 | -0.02671 | -0.06527 |
| Asahi Honnama | H | 230 | 173.249 | 0.05787 | 0.14329 | 230 | 171.054 | 0.05632 | 0.14628 | 0 | -2.195 | -0.00154 | 0.00299 |
| Kirin Gokunama | H | 230 | 182.249 | 0.00351 | 0.00865 | 230 | 179.010 | 0.00190 | 0.00499 | 0 | -3.239 | -0.00161 | -0.00366 |
| Kirin Tanrei Alpha | H | 230 | 196.757 | 0.01238 | 0.03056 | 230 | 194.442 | 0.01400 | 0.03584 | 0 | -2.315 | 0.00162 | 0.00528 |
| Kirin Tanrei Green Label | H | 230 | 173.692 | 0.07457 | 0.18351 | 230 | 172.899 | 0.09454 | 0.24352 | 0 | -0.793 | 0.01997 | 0.06001 |
| Kirin Tanrei | H | 230 | 170.415 | 0.13787 | 0.33727 | 230 | 169.750 | 0.13817 | 0.35571 | 0 | -0.665 | 0.00031 | 0.01844 |
| Sapporo Hokkaido Namashibori | H | 230 | 163.232 | 0.01093 | 0.02882 | 71 | 165.585 | 0.00044 | 0.00118 | -159 | 2.352 | -0.01049 | -0.02764 |
| Suntory Diet | H | 230 | 176.414 | 0.02825 | 0.07003 | 230 | 175.232 | 0.02898 | 0.07492 | 0 | -1.181 | 0.00073 | 0.00489 |
| Kirin Nodogoshi | T | 230 | 148.339 | 0.14417 | 0.56850 | 230 | 150.216 | 0.18957 | 0.76600 | 0 | 1.877 | 0.04539 | 0.19749 |
| Sapporo Draft One | T | 230 | 148.017 | 0.07956 | 0.30144 | 225 | 149.177 | 0.04552 | 0.16923 | -5 | 1.161 | -0.03404 | -0.13222 |
| Suntory Super Blue | T | 230 | 145.182 | 0.03287 | 0.13006 | 230 | 143.277 | 0.01729 | 0.06846 | 0 | -1.904 | -0.01557 | -0.06160 |

Note: The columns Price, Share, and Share(wg) show means of prices (in yen), market shares, and "within group" market shares over markets, respectively.The column Abs(2006) to Abs(2007) shows the differences of the absolute values for the values in 2005 and 2006.

Table 8: Own- and Cross-Price Elasticities for 2005

| | Group | Brand 1 | Brand 2 | Brand 3 | Brand 4 | Brand 5 | Brand 6 | Brand 7 | Brand 8 | Brand 9 | Brand 10 | Brand 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brand 1 | B | -3.87094 | 0.19516 | 0.03140 | 0.57203 | 0.85650 | 0.06871 | 0.30583 | 0.15419 | 0.02707 | 0.07373 | 0.04901 |
| Brand 2 | B | 2.98208 | -6.82242 | 0.03140 | 0.57203 | 0.85650 | 0.06871 | 0.30583 | 0.15419 | 0.02707 | 0.07373 | 0.04901 |
| Brand 3 | B | 2.98208 | 0.19516 | -7.33237 | 0.57203 | 0.85650 | 0.06871 | 0.30583 | 0.15419 | 0.02707 | 0.07373 | 0.04901 |
| Brand 4 | B | 2.98208 | 0.19516 | 0.03140 | -6.31544 | 0.85650 | 0.06871 | 0.30583 | 0.15419 | 0.02707 | 0.07373 | 0.04901 |
| Brand 5 | B | 2.98208 | 0.19516 | 0.03140 | 0.57203 | -6.00594 | 0.06871 | 0.30583 | 0.15419 | 0.02707 | 0.07373 | 0.04901 |
| Brand 6 | B | 2.98208 | 0.19516 | 0.03140 | 0.57203 | 0.85650 | -7.85763 | 0.30583 | 0.15419 | 0.02707 | 0.07373 | 0.04901 |
| Brand 7 | B | 2.98208 | 0.19516 | 0.03140 | 0.57203 | 0.85650 | 0.06871 | -7.40556 | 0.15419 | 0.02707 | 0.07373 | 0.04901 |
| Brand 8 | B | 2.98208 | 0.19516 | 0.03140 | 0.57203 | 0.85650 | 0.06871 | 0.30583 | -6.74768 | 0.02707 | 0.07373 | 0.04901 |
| Brand 9 | B | 2.92727 | 0.19513 | 0.03323 | 0.58208 | 0.87556 | 0.07105 | 0.30533 | 0.15635 | -9.02506 | 0.07340 | 0.04739 |
| Brand 10 | H | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | -4.30070 | 0.29171 |
| Brand 11 | H | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.44358 | -4.45267 |
| Brand 12 | H | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.44358 | 0.29171 |
| Brand 13 | H | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.44358 | 0.29171 |
| Brand 14 | H | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.44358 | 0.29171 |
| Brand 15 | H | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.44358 | 0.29171 |
| Brand 16 | H | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.44358 | 0.29171 |
| Brand 17 | H | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.44358 | 0.29171 |
| Brand 18 | H | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.44358 | 0.29171 |
| Brand 19 | T | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.07373 | 0.04901 |
| Brand 20 | T | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.07373 | 0.04901 |
| Brand 21 | T | 0.37430 | 0.02564 | 0.00438 | 0.07439 | 0.11402 | 0.00895 | 0.04158 | 0.02036 | 0.00376 | 0.07373 | 0.04901 |

Note: Each entry in row i and column j shows the percentage change in the market share of brand i with respect to a change in the price of brand j.

Table 9: Own- and Cross-Price Elasticities for 2005 (continued)

| | Group | Brand 12 | Brand 13 | Brand 14 | Brand 15 | Brand 16 | Brand 17 | Brand 18 | Brand 19 | Brand 20 | Brand 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Brand 1 | B | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | 0.19837 | 0.10690 | 0.04344 |
| Brand 2 | B | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | 0.19837 | 0.10690 | 0.04344 |
| Brand 3 | B | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | 0.19837 | 0.10690 | 0.04344 |
| Brand 4 | B | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | 0.19837 | 0.10690 | 0.04344 |
| Brand 5 | B | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | 0.19837 | 0.10690 | 0.04344 |
| Brand 6 | B | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | 0.19837 | 0.10690 | 0.04344 |
| Brand 7 | B | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | 0.19837 | 0.10690 | 0.04344 |
| Brand 8 | B | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | 0.19837 | 0.10690 | 0.04344 |
| Brand 9 | B | 0.09378 | 0.00526 | 0.02198 | 0.11294 | 0.20847 | 0.01072 | 0.04586 | 0.20315 | 0.10730 | 0.04311 |
| Brand 10 | H | 0.53864 | 0.03288 | 0.13178 | 0.67920 | 1.24468 | 0.06234 | 0.26427 | 0.19837 | 0.10690 | 0.04344 |
| Brand 11 | H | 0.53864 | 0.03288 | 0.13178 | 0.67920 | 1.24468 | 0.06234 | 0.26427 | 0.19837 | 0.10690 | 0.04344 |
| Brand 12 | H | -4.21741 | 0.03288 | 0.13178 | 0.67920 | 1.24468 | 0.06234 | 0.26427 | 0.19837 | 0.10690 | 0.04344 |
| Brand 13 | H | 0.53864 | -4.96129 | 0.13178 | 0.67920 | 1.24468 | 0.06234 | 0.26427 | 0.19837 | 0.10690 | 0.04344 |
| Brand 14 | H | 0.53864 | 0.03288 | -5.26388 | 0.67920 | 1.24468 | 0.06234 | 0.26427 | 0.19837 | 0.10690 | 0.04344 |
| Brand 15 | H | 0.53864 | 0.03288 | 0.13178 | -4.04296 | 1.24468 | 0.06234 | 0.26427 | 0.19837 | 0.10690 | 0.04344 |
| Brand 16 | H | 0.53864 | 0.03288 | 0.13178 | 0.67920 | -3.41495 | 0.06234 | 0.26427 | 0.19837 | 0.10690 | 0.04344 |
| Brand 17 | H | 0.53864 | 0.03288 | 0.13178 | 0.67920 | 1.24468 | -4.36105 | 0.26427 | 0.19837 | 0.10690 | 0.04344 |
| Brand 18 | H | 0.53864 | 0.03288 | 0.13178 | 0.67920 | 1.24468 | 0.06234 | -4.51066 | 0.19837 | 0.10690 | 0.04344 |
| Brand 19 | T | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | -2.35632 | 0.90828 | 0.37241 |
| Brand 20 | T | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | 1.69936 | -3.08153 | 0.37241 |
| Brand 21 | T | 0.09387 | 0.00536 | 0.02207 | 0.11487 | 0.20859 | 0.01065 | 0.04617 | 1.69936 | 0.90828 | -3.54310 |

Note: Each entry in row i and column j shows the percentage change in the market share of brand i with respect to a change in the price of brand j.

Table 10: Own- and Cross-Price Elasticities for 2006

| | Group | Brand 1 | Brand 2 | Brand 3 | Brand 4 | Brand 5 | Brand 6 | Brand 7 | Brand 8 | Brand 9 | Brand 10 | Brand 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brand 1 | B | -1.29447 | 0.07694 | 0.01466 | 0.25905 | 0.38380 | 0.03222 | 0.14920 | 0.00221 | 0.02644 | 0.01700 | 0.00186 |
| Brand 2 | B | 1.37616 | -2.64561 | 0.01466 | 0.25905 | 0.38380 | 0.03222 | 0.14920 | 0.00221 | 0.02644 | 0.01700 | 0.00186 |
| Brand 3 | B | 1.37616 | 0.07694 | -2.90842 | 0.25905 | 0.38380 | 0.03222 | 0.14920 | 0.00221 | 0.02644 | 0.01700 | 0.00186 |
| Brand 4 | B | 1.37616 | 0.07694 | 0.01466 | -2.47998 | 0.38380 | 0.03222 | 0.14920 | 0.00221 | 0.02644 | 0.01700 | 0.00186 |
| Brand 5 | B | 1.37616 | 0.07694 | 0.01466 | 0.25905 | -2.30301 | 0.03222 | 0.14920 | 0.00221 | 0.02644 | 0.01700 | 0.00186 |
| Brand 6 | B | 1.37616 | 0.07694 | 0.01466 | 0.25905 | 0.38380 | -3.06346 | 0.14920 | 0.00221 | 0.02644 | 0.01700 | 0.00186 |
| Brand 7 | B | 1.37616 | 0.07694 | 0.01466 | 0.25905 | 0.38380 | 0.03222 | -2.86285 | 0.00221 | 0.02644 | 0.01700 | 0.00186 |
| Brand 8 | B | 1.26337 | 0.08879 | 0.02225 | 0.32601 | 0.40352 | 0.03328 | 0.14355 | -2.57063 | 0.02520 | 0.01672 | 0.00279 |
| Brand 9 | B | 1.37616 | 0.07694 | 0.01466 | 0.25905 | 0.38380 | 0.03222 | 0.14920 | 0.00221 | -3.43490 | 0.01700 | 0.00186 |
| Brand 10 | H | 0.10317 | 0.00589 | 0.00119 | 0.01923 | 0.02960 | 0.00242 | 0.01184 | 0.00019 | 0.00201 | -1.66228 | 0.02071 |
| Brand 11 | H | 0.10317 | 0.00580 | 0.00114 | 0.01999 | 0.02943 | 0.00240 | 0.01173 | 0.00017 | 0.00200 | 0.20186 | -1.84129 |
| Brand 12 | H | 0.10317 | 0.00589 | 0.00119 | 0.01923 | 0.02960 | 0.00242 | 0.01184 | 0.00019 | 0.00201 | 0.20343 | 0.02071 |
| Brand 13 | H | 0.10317 | 0.00589 | 0.00119 | 0.01923 | 0.02960 | 0.00242 | 0.01184 | 0.00019 | 0.00201 | 0.20343 | 0.02071 |
| Brand 14 | H | 0.10317 | 0.00589 | 0.00119 | 0.01923 | 0.02960 | 0.00242 | 0.01184 | 0.00019 | 0.00201 | 0.20343 | 0.02071 |
| Brand 15 | H | 0.10317 | 0.00589 | 0.00119 | 0.01923 | 0.02960 | 0.00242 | 0.01184 | 0.00019 | 0.00201 | 0.20343 | 0.02071 |
| Brand 16 | H | 0.10317 | 0.00589 | 0.00119 | 0.01923 | 0.02960 | 0.00242 | 0.01184 | 0.00019 | 0.00201 | 0.20343 | 0.02071 |
| Brand 17 | H | 0.10137 | 0.00580 | 0.00293 | 0.02296 | 0.03074 | 0.00229 | 0.01066 | 0.00017 | 0.00176 | 0.18990 | 0.03568 |
| Brand 18 | H | 0.10317 | 0.00589 | 0.00119 | 0.01923 | 0.02960 | 0.00242 | 0.01184 | 0.00019 | 0.00201 | 0.20343 | 0.02071 |
| Brand 19 | T | 0.10317 | 0.00589 | 0.00119 | 0.01923 | 0.02960 | 0.00242 | 0.01184 | 0.00019 | 0.00201 | 0.01700 | 0.00186 |
| Brand 20 | T | 0.10317 | 0.00587 | 0.00119 | 0.01986 | 0.02958 | 0.00240 | 0.01184 | 0.00017 | 0.00200 | 0.01697 | 0.00190 |
| Brand 21 | T | 0.10317 | 0.00589 | 0.00119 | 0.01923 | 0.02960 | 0.00242 | 0.01184 | 0.00019 | 0.00201 | 0.01700 | 0.00186 |

Note: Each entry in row i and column j shows the percentage change in the market share of brand i with respect to a change in the price of brand j.

Table 11: Own- and Cross-Price Elasticities for 2006 (continued)

| | Group | Brand 12 | Brand 13 | Brand 14 | Brand 15 | Brand 16 | Brand 17 | Brand 18 | Brand 19 | Brand 20 | Brand 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Brand 1 | B | 0.02125 | 0.00058 | 0.00598 | 0.03510 | 0.04958 | 0.00034 | 0.01044 | 0.06348 | 0.01508 | 0.00500 |
| Brand 2 | B | 0.02125 | 0.00058 | 0.00598 | 0.03510 | 0.04958 | 0.00034 | 0.01044 | 0.06348 | 0.01508 | 0.00500 |
| Brand 3 | B | 0.02125 | 0.00058 | 0.00598 | 0.03510 | 0.04958 | 0.00034 | 0.01044 | 0.06348 | 0.01508 | 0.00500 |
| Brand 4 | B | 0.02125 | 0.00058 | 0.00598 | 0.03510 | 0.04958 | 0.00034 | 0.01044 | 0.06348 | 0.01508 | 0.00500 |
| Brand 5 | B | 0.02125 | 0.00058 | 0.00598 | 0.03510 | 0.04958 | 0.00034 | 0.01044 | 0.06348 | 0.01508 | 0.00500 |
| Brand 6 | B | 0.02125 | 0.00058 | 0.00598 | 0.03510 | 0.04958 | 0.00034 | 0.01044 | 0.06348 | 0.01508 | 0.00500 |
| Brand 7 | B | 0.02125 | 0.00058 | 0.00598 | 0.03510 | 0.04958 | 0.00034 | 0.01044 | 0.06348 | 0.01508 | 0.00500 |
| Brand 8 | B | 0.02148 | 0.00052 | 0.00617 | 0.03383 | 0.04843 | 0.00015 | 0.01063 | 0.06469 | 0.01721 | 0.00503 |
| Brand 9 | B | 0.02125 | 0.00058 | 0.00598 | 0.03510 | 0.04958 | 0.00034 | 0.01044 | 0.06348 | 0.01508 | 0.00500 |
| Brand 10 | H | 0.23839 | 0.00644 | 0.06901 | 0.39870 | 0.56377 | 0.00337 | 0.11801 | 0.06348 | 0.01508 | 0.00500 |
| Brand 11 | H | 0.24036 | 0.00650 | 0.06934 | 0.39269 | 0.56234 | 0.00337 | 0.11754 | 0.06337 | 0.01533 | 0.00512 |
| Brand 12 | H | -1.61331 | 0.00644 | 0.06901 | 0.39870 | 0.56377 | 0.00337 | 0.11801 | 0.06348 | 0.01508 | 0.00500 |
| Brand 13 | H | 0.23839 | -1.95308 | 0.06901 | 0.39870 | 0.56377 | 0.00337 | 0.11801 | 0.06348 | 0.01508 | 0.00500 |
| Brand 14 | H | 0.23839 | 0.00644 | -2.04536 | 0.39870 | 0.56377 | 0.00337 | 0.11801 | 0.06348 | 0.01508 | 0.00500 |
| Brand 15 | H | 0.23839 | 0.00644 | 0.06901 | -1.46841 | 0.56377 | 0.00337 | 0.11801 | 0.06348 | 0.01508 | 0.00500 |
| Brand 16 | H | 0.23839 | 0.00644 | 0.06901 | 0.39870 | -1.26654 | 0.00337 | 0.11801 | 0.06348 | 0.01508 | 0.00500 |
| Brand 17 | H | 0.26783 | 0.00688 | 0.06839 | 0.36705 | 0.56234 | -1.80657 | 0.11303 | 0.06759 | 0.01571 | 0.00442 |
| Brand 18 | H | 0.23839 | 0.00644 | 0.06901 | 0.39870 | 0.56377 | 0.00337 | -1.76122 | 0.06348 | 0.01508 | 0.00500 |
| Brand 19 | T | 0.02125 | 0.00058 | 0.00598 | 0.03510 | 0.04958 | 0.00034 | 0.01044 | -0.55748 | 0.25095 | 0.07843 |
| Brand 20 | T | 0.02129 | 0.00058 | 0.00598 | 0.03492 | 0.04932 | 0.00034 | 0.01044 | 1.06958 | -1.35421 | 0.08172 |
| Brand 21 | T | 0.02125 | 0.00058 | 0.00598 | 0.03510 | 0.04958 | 0.00034 | 0.01044 | 1.07611 | 0.25095 | -1.44550 |

Note: Each entry in row i and column j shows the percentage change in the market share of brand i with respect to a change in the price of brand j.