Can non-alcoholic beer be a substitute for beer?
Evidence from differentiated product demand model estimation using scanner data

Toru Nakajima
Graduate School of Bioresources, Mie University
1577 Kurimamachiyacho, Tsu, Mie 514-8507 Japan
nakajima@bio.mie-u.ac.jp

Selected Paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31-August 2

ABSTRACT

Non-alcoholic (NA) beer, a beverage that tastes like beer and contains no/little alcohol, has seen growing world-wide popularity as a potential substitute of beer. To elucidate consumer demand and profitability of NA beer, this study estimated price elasticities and price-cost margins of beer and NA beer at brand level in the case of Japan, using a structural demand model of differentiated products and a purchase data scanned by 30,000 consumers. According to the empirical result, NA beer demand is responsive to prices of some regular and premium beer brands as well as NA beer brands while beer demand is not responsive to NA beer prices. This implies that (1) some consumers of regular and premium beers consider NA beer as a substitute although NA beer consumers do not recognize beer as a replacement; (2) although low-malt, new-genre (alcoholic drinks with beer-like taste), and NA beers have some common product characteristics, consumers of low-malt and new-genre beers have different preference from that of NA beer consumers; (3) unless prices of NA beer brands increase, certain amount of demand for NA beer can be expected to remain irrespective of price levels of beer brands. Price-cost margins of producing NA beer were found to be similar to those of regular and new-genre beers while price-cost margins for premium beer were small and those for low-malt beer were large.

I. Introduction

Non-alcoholic (NA) beer, a beverage that tastes like beer and contains no/little alcohol, has seen growing popularity in many developed countries as well as in some developing countries. People now have an option to drink NA beer when they do not want to or cannot drink alcohol but still wish to get the pleasure of consuming beer. Although some people feel that NA beer does not taste like beer, drinking this beer in certain situations seems to be acceptable to the public, especially one seeks to avoid the potential unfavorable consequences of alcohol consumption such as violence and traffic accidents. Moreover, some people proactively drink NA beer for health reasons. Scientific research has exhibited that NA beer could have a sedative effect (Franco et al. 2012 and Franco et al. 2015) and reduce inflammation (Scherr et al. 2012).

NA beer has been drawing increasing attention from not only the demand side but also the supply side. As the production environment of beer has deteriorated due to the decreasing demand and increasing competition among beer brands, beer producers are trying to differentiate their own products from others' and expand their business to a new market. Promoting sales of NA beer is in line with these strategies. Because NA beer can be categorized and recognized as carbonated soft drinks, beer producers enter this new market

through NA beer. Furthermore, considering the technology of producing NA beer has been developed almost exclusively by beer companies, it should not be easy for soft drink producers to enter this market, which implies beer producers hold a competitive advantage, at least in the short run. Thus, beer producers generally anticipate improved profitability by selling (more) NA beer.

From the perspective of academia, beer has been frequently targeted in demand analysis (see a survey article by Fogarty 2009). Traditional demand analyses of beer employed system demand models such as AIDS, and estimated elasticities of beer demand with respect to its own price and prices of its substitutes such as wine and spirits (Selvanathan 1991, Lee and Tremblay 1992, Gao et al. 1995, Nelson and Moran 1995, Gallet and List 1998). These studies, however, assumed that beer is substituted with other alcoholic drinks but is not substituted within beer types or brands. Because there have been various types of beer products based on contents and flavors, and considering some consumers are loyal to specific brands, beer has been product-differentiated, and ignoring this aspect would have few implications on consumer demand. Accordingly, recent studies on beer demand have estimated differentiated product models, drawing brand-level price elasticities of demand (Hausman et al. 1994, Rojas and Peterson 2008, Lopez and Matschke 2012, Goldberg and

Hellerstein 2013). Lopez and Matschke (2012) and Goldberg and Hellerstein (2013) employed the Berry, Levinsohn, and Pakes' (1995) model (hereinafter mentioned as the BLP model) to estimate brand-level price elasticities without facing the problem of dimensionality, where the number of estimated equations increases by the number of products raised to the second power. On the other hand, describing the competitive environment of the beer industry and estimating its market power have been the topics of contention for empirical industrial organization research on beer, given the highly concentrated nature of the industry. Goldberg and Knetter (1999) estimated degrees of market power of beer exporters using the residual demand model, while Parsons and Vanssay (2014) discussed the firm-level competition scenario in the Japanese beer industry. Goldberg and Hellerstein (2013) drew brand-level markups as well as price elasticities. Previous studies on demand and markup of the beer industry, however, have not considered NA beer in the equation system despite the fact that NA beer has drawn growing attention as a potential substitute of beer.

Based on the above-mentioned backdrops, the objective of this study is to elucidate consumer demand and degrees of market power for brands of beer and NA beer, using the Japanese beer market as a case study. The beer industry in Japan is characterized as a highly concentrated one where the market shares of top four firms exceed 99%. The beer companies

are domestic and produce a variety of beer as well as NA beer brands to compete with each other. By analyzing the substitution patterns of brands, this study aims to show whether Japanese people recognize NA beer as a type of beer and whether switches between beer brands and NA beer brands can be observed. In this study we cover regular beer, premium beer, low-malt beer, and other alcoholic drinks with beer-like taste (called new-genre beer). The current study also provides evidence, using the case of Japan, on the markup level of NA beer as well as that of beer, the former of which has not been revealed till date. Brand-level price-cost margins are then estimated to show whether beer companies profitably produced NA beer compared to producing beer.

The rest of this article is organized as follows. Section II explains the methodology employed in the empirical analysis of consumer demand and markups of beer and NA beer brands. Section III shows the results of the analysis and section IV concludes.

II. Method

To estimate price elasticities and price-cost margins, a differentiated product demand model developed by Berry (1994) and Berry et al. (1995) was employed. The BLP model is a random coefficient logit model using generalized method of moments (GMM)

whose objective function expresses the difference between the observed and estimated market shares of each brand. GMM objective function is minimized by contract mapping as described in Berry (1994) and Berry et al. (1995). The model is suitable for consistently and effectively estimating own- and cross-price elasticities among brands and brand-level price-cost margins because it deals with potential endogeneity problem using instrumental variables and it estimates much smaller number of parameters than do conventional demand models such as the AIDS model and other traditional demand systems.

The model and procedure of the BLP estimation in this study follows Nevo (2001) where market share of each brand in each market is represented as follows:

$$s_{jt}(x, p_{.t}, \delta_{.t}; \theta_2) = \int_{A_{jt}} dP^*(D, v, \varepsilon) = \int_{A_{jt}} dP^*(\varepsilon) dP^*(v) dP^*(D).$$

Here x is a vector of observable product attributes, p_{jt} is a price vector of product j at market t, $\delta_{jt} = x_j\beta - \alpha p_{jt} + \xi_j + \Delta\xi_{jt}$ (ξ_j is a vector of unobservable product attributes and $\Delta\xi_{jt}$ is difference from ξ_j), $A_{jt}(x, p_{.t}, \delta_{.t}; \theta_2) = \{(D_i, v_i, \varepsilon_{it}) | u_{ijt} \geq u_{ilt}, \forall l = 0,1, \dots, J\}$, D_i is a vector of demographic variables, v_i is unobservable individual characteristics other than demographics and is assumed to be standard normally distributed, ε_{it} is error term and is assumed to be distributed extreme value, and μ_{ijt} is indirect utility

of consumer i for product j in market t. In this study market is defined as the combination of prefecture and quarter and the number of consumers in each market was set to 1,000.

According to Nevo (2001), a price-cost margin (PCM) of a product is derived from the first-order condition of profit maximization of each firm:

$$\frac{p - mc}{p} = \frac{s(p)}{p\Omega},$$

where mc is a vector of marginal costs of producing products, $s(p)$ is a vector of market shares, and Ω is a matrix with $\Omega_{jr} = -\partial s_r / \partial p_j$, $j, r = 1, \ldots, J$ if the product is produced by the firm and is 0 otherwise.

Brand-level individual purchase data from 2012 to 2014 were used, which were scanned by 30,000 consumers sampled from all over the country based on its demographic distribution by Macromill, one of the major survey companies in Japan that acquire consumers purchase data. The data were aggregated into brand-level data of each quarter and prefecture, where the number of brands selected was 38 (6 in regular beer, 3 in premium beer, 4 in low-malt beer, 21 in new-genre beer, and 4 in NA beer), whose total share was 82.5%, and the numbers of quarters and prefectures were 12 and 46 (excluding Okinawa), respectively. As product attributes, alcohol content, calorie, carbohydrate content, and purines content of each brand were used. These data were obtained in the websites of beer

companies. Descriptive statistics of these attributes as well as prices for each brand were shown in Table 1. Demographic data of the consumer panel were also utilized to capture consumer heterogeneity of effects of each brand's attributes on its demand. Prefectural distributions of age, gender, and income were used as demographic variables in this study, which were obtained by the consumers purchase data.

Instrumental variables were used to handle the endogeneity problem of the price variable. Once brand dummy variables are introduced and demographics are controlled, a possible instrument for the price in a market could be prices of the same brand in other markets because they are independent of error term, that is, differences between unobservable product characteristics in each market and the mean brand characteristics (that is, $\Delta\xi_{jt}$), but they can be correlated with the price of the market (Nevo 2001). Lopez and Matschke (2012) included input prices such as wages for supermarket workers, petroleum prices, and housing prices as instruments. In this study, average prices of the same brand in other prefecture, average regional prices other than own prices, population density[1], residential land prices[2],

[1] Population density was calculated using population data obtained from Statistics Bureau, Ministry of Internal Affairs and Communications, and area data for each prefecture obtained from Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism (MLIT).

[2] Annual data for each prefecture were obtained from Prefectural Land Price Survey, MLIT.

retail gasoline prices[3], wage index of total industries[4], and means of demographic variables were used as instruments.

III. Results

According to the estimation result of the BLP model shown in Table 2, means of independent variables affected demand for beer, but the random term and demographic terms did not. This implies that differences in individual preference and characteristics were rarely influential to beer consumption in Japan. Because the mean coefficient of price is significantly negative, people prefer cheaper price for beer. The mean coefficients of calorie, carbohydrate, and purines were significantly negative, which indicates that people prefer less unhealthy beer. The alcohol estimate was positive and significant possibly because most of beer brands have similar alcohol content (5-6%) and market shares of NA beer brands were still smaller than those of beer brands.

[3] Monthly data for prefectural capital cities were obtained from Retail Price Survey, Statistics Bureau, Ministry of Internal Affairs and Communications, and were aggregated into quarterly data.

[4] Monthly data for each prefecture were obtained from Monthly Wage Survey, Ministry of Health, Labour and Welfare, and were aggregated into quarterly data.

Table 3 shows the median brand-level price elasticities during the targeted period. All own-price elasticities were negative while all cross-price elasticities were positive. It is distinguishing that elasticities of demand with respect to prices of major brands such as Super Dry, Nodogoshi Nama, and Kinmugi, whose market shares were larger than those of other brands, were generally high (more than 0.1). This result implies that, along with the emergence of new brands with cheaper prices, people switched beer brands from major ones to new ones. Focusing on category-level substitution situation, some regular beer brands were switched to all types of category, while some premium beer brands were substituted with other regular, premium, and NA beer brands. Some substitutions from low-malt beer brands to new-genre beer brands and within new-genre beer brands were also found. NA beer brands were rarely substituted although some brand substitution were detected within NA beer. The fact that some people who drink regular beer and premium beer switch to drink NA beer depending on the price level implies that at least some people consider NA beer as a substitute for beer. Conversely, NA beer drinkers did not significantly switch to regular and premium (and other categories) beers even if NA beer prices increased. This result is understandable because NA beer prices were much cheaper than regular and premium beers and changes in NA beer prices would hardly affect demand for regular and premium beer. Furthermore,

although NA beer demand responded to price changes in some regular and premium beer brands, it did not react to price changes in low-malt and new-genre beer brands. Because price levels of low-malt and new-genre beers were similar to that of NA beer, consumers may have little incentive to switch brands from low-malt/new-genre to those of NA as a result of relative price increase in low-malt/new-genre beers. From the perspective of product attributes, alcohol content of NA beer is 0 by definition and contents of calorie, carbohydrate, and purines included in NA beer are generally very limited. Specifically, no alcohol and few calorie are not attainable by brands in low-malt and new-genre beers (and also brands in regular and premium beers), hence consumers who prefer no alcohol or few calorie have no choice but to choose NA beer instead of low-malt and new-genre beers. Existence of such consumers could be another possible reason for observing the substitution between regular/premium and NA beers.

There found some substitution patterns within new-genre beer brands produced by the same firms (from Kirin Nodogoshi Nama to Kirin Sumikiri, from Suntory Kinmugi to Suntory Jokki Nama, and so on). This kind of substitutions indicates existence of the cannibalization effect, which means that emergence of a brand produced in a company absorbs some shares of other brands produced in the same company. This effect can be mainly

found in new-genre beer brands, which is due to the fact that beer companies tried to attract consumers by selling these brands with cheaper prices than those of brands in other categories and that it is relatively easy for beer companies to add originality such as low calorie, low carbohydrate, low purines, and the combinations of them. Producing many varieties of brands may attract consumers who prefer brands with specific characteristics although it may also induces competition not only with other firms but also with brands produced in the same firm.

The estimation result of brand-level PCM (net of consumer tax and alcohol tax) are shown in Table 4. Among brands, PCM of low-malt beer brands were relatively high compared to PCM of brands in other categories while PCM of premium beer brands were found to be slightly low. Simple means of category-wise PCM were 0.162 for regular beer, 0.139 for premium beer, 0.233 for low-malt beer, 0.156 for new-genre beer, and 0.159 for NA beer. Higher profitability of producing low-malt beer than other categories may be due to lower production cost, especially low material cost. On the other hand, lower profitability of producing premium beer possibly stems from higher production cost compared to other categories. Meanwhile, median PCM for each beer producer were shown in Table 5. PCM of major four firms, that is Asahi, Kirin, Suntory, and Sapporo, were around 0.16 while PCM of Aeon was higher than those major firms. Aeon is the largest retailer in Japan, producing

Barreal brand, which is a private-label product. Although the price level of Barreal was the lowest among brands (Table 1), high profitability is potentially attributable to the production of its own brand, which is consistent with Steiner (2004).

IV. Conclusions

This study analyzed substitution patterns and PCM of beer and NA beer brands in the case of Japan using a structural demand model developed by Berry et al. (1995) and Nevo (2001). The empirical result indicates that NA beer demand is responsive to prices of some regular and premium beer brands as well as NA beer brands while beer demand is not responsive to NA beer prices. The implications of this result are; (1) some consumers of regular and premium beers consider NA beer as a substitute although NA beer consumers do not recognize beer as a replacement; (2) although low-malt, new-genre, and NA beers have some common product characteristics such as low price and relatively low contents of calorie, carbohydrate, and purines, consumers of low-malt and new-genre beers have different preference from that of NA beer consumers; (3) unless prices of NA beer brands increase, certain amount of demand for NA beer can be expected to remain irrespective of price levels of beer brands. In the meantime, PCM of producing NA beer were found to be similar to

those of regular and new-genre beers while PCM for premium beer were small and those for low-malt beer were large. According to these findings, although PCM of beer brands are not very small compared to those of NA beer, producing more NA beer will potentially make the profits of beer companies larger, considering that the alcohol tax will probably be increased in the near future.

The novelty of this study is to show substitution to or from NA beer brands and to provide PCM of producing NA beer as well as conventional beer, which could have important implications for both beer producers and consumers, considering the growing consumption of NA beer in the world, especially in developed countries. Increasing opportunity to drink NA beer might have positive effects on consumers' health and reduction of unfavorable consequences of alcohol consumption mentioned above, which induces improvement of social welfare. Accumulation of empirical studies on the topic of this study will be necessary to reach consensus on the effect of NA beer. Analyzing causal effects of increasing NA beer consumption on social level of health and social welfare is another potential area of interest, which should be considered in future research.

References

Berry, S.T. 1994. Estimating discrete-choice models of product differentiation. *RAND Journal of Economics*, 25(2), 242–262.

Berry, S., Levinsohn, J., and Pakes, A. 1995. Automobile Prices in Market Equilibrium. *Econometrica*, 63(4), pp. 841–890.

Fogarty, J. 2009. The Demand for Beer, Wine and Spirits: a Survey of the Literature. *Journal of Economic Surveys*, 24(3), 428–478.

Franco, L., Sánchez, C., Bravo, R., Rodríguez, A. B., Barriga, C., Romero, E., and Cubero, J. 2012. The Sedative Effect of Non-Alcoholic Beer in Healthy Female Nurses. *PLoS ONE*, 7(7), 1–6.

Franco, L., Galán, C., Bravo, R., Bejarano, I., Peñas-Lledo, E., Rodríguez, A.B., Barriga, C., Cubero, J. 2015. Effect of non-alcohol beer on anxiety: Relationship of 5-HIAA. *Neurochemical Journal*, 9(2), 149–152.

Gallet, C.A. and List, J.A. 1998. Elasticities of beer demand revisited. *Economics Letters*, 61(1), 67–71.

Gao, X.M., Wailes, E.J., and Cramer, G.L. 1995. A microeconometric model analysis of US consumer demand for alcoholic beverages. *Applied Economics*, 27(1), 59–69.

Goldberg, P.K. and Knetter, M.M. 1999. Measuring the intensity of competition in export markets. *Journal of International Economics*, 47(1), 27–60.

Hausman, J., Leonard, G., and Zona, J.D. 1994. Competitive Analysis with Differenciated Products. *Annales d'Économie et de Statistique*, 34, 159–180.

Lee, B., and Tremblay, V.J. 1992. Advertising and the US market demand for beer. *Applied Economics*, 24(1), 69–76.

Lopez, R.A., and Matschke, X. 2012. Home Bias in US Beer Consumption. *Pacific Economic Review*, 17(4), 525–534.

Nelson, J.P. and Moran, J.R. 1995. Advertising and US alcoholic beverage demand: System-wide estimates. *Applied Economics*, 27(12), 1225–1236.

Nevo, A. 2001. Measuring Market Power in the Ready-to-Eat Cereal Industry. *Econometrica*, 69(2), 307–342.

Parsons, C.R., and Vanssay, X. 2014. Detecting Market Competition in the Japanese Beer Industry. *Journal of Industry, Competition and Trade*, 14(1), 123–143.

Rojas, C. and Peterson, E.B. 2008. Demand for differentiated products: Price and advertising evidence from the U.S. beer market. *International Journal of Industrial Organization*, 26(1), 288–307.

Selvanathan, E.A. 1991. Cross-country alcohol consumption comparison: an application of the Rotterdam demand system. *Applied Economics*, 23(10), 1613–1622.

Scherr, J., Nieman, D.C., Schuster, T., Habermann, J., Rank, M., Braun, S., Pressler, A., Wolfarth, B., and Halle, M. 2012. Nonalcoholic Beer Reduces Inflammation and Incidence of Respiratory Tract Illness. *Medicine & Science in Sports & Exercise*, 44(1), 18–26.

Steiner, R. L. (2004). The nature and benefits of national brand/private label competition. *Review of Industrial Organization*, *24*(2), 105–127.

Table 1 Descriptive statistics

No.	Brand	Firm	Category	Share	Markets	Price in JPY		Alcohol	Calorie	Carbohydrate	Purines
				%		Mean	s.d.	%	kcal	g	mg
1	Super Dry	As	R	7.84	552	182.8	10.2	5.0	42	3.0	5.5
2	Super Dry Premium	As	P	0.57	259	219.6	47.8	6.0	48	3.3	8.2
3	Super Dry Black	As	R	1.10	500	188.9	13.5	5.5	45	3.1	5.2
4	Dry Zero	As	NA	2.23	551	111.8	8.3	0.0	0	0.0	1.0
5	Style Free	As	LM	1.88	547	131.9	16.5	4.0	24	0.0	3.6
6	Blue Label	As	NG	0.37	397	110.6	14.0	4.0	27	0.0	1.3
7	Off	As	NG	2.06	544	106.6	6.9	4.0	26	0.7	0.3
8	Clear Asahi	As	NG	4.78	552	107.7	6.9	5.0	45	3.2	4.4
9	Clear Asahi Prime Rich	As	NG	1.88	368	107.6	6.2	6.0	51	3.8	4.3
10	Lager	K	R	1.27	543	184.5	17.3	5.0	42	3.2	6.9
11	Ichiban Shibori	K	R	3.77	552	186.2	18.1	5.0	41	2.7	8.8
12	Tanrei Green Label	K	LM	2.83	551	127.2	7.1	4.5	29	0.9	2.3
13	Kirin Tanrei	K	LM	2.92	550	129.1	8.7	5.5	45	3.4	3.4
14	Koiaji Deluxe	K	NG	0.58	343	110.3	15.4	6.0	48	3.1	4.3
15	Koiaji 0 Carbohydrate	K	NG	1.54	538	109.2	12.0	3.0	19	0.0	1.2
16	Nodogoshi Nama	K	NG	7.37	552	107.4	5.4	5.0	43	3.1	1.1
17	Sumikiri	K	NG	1.44	321	108.6	8.7	5.0	43	2.8	6.8
18	Free	K	NA	0.71	526	118.0	21.2	0.0	11	2.7	1.4
19	Mugi-no-gochiso	K	NG	0.55	319	111.1	10.7	5.0	43	3.0	4.6
20	All Free	Su	NA	2.76	551	111.4	7.6	0.0	0	0.0	0.1
21	Premium Malts	Su	P	3.48	552	208.9	11.0	5.5	47	3.8	9.5
22	Jokki Nama	Su	NG	0.50	458	106.5	9.4	5.0	35	1.5	0.5
23	Kinmugi	Su	NG	7.58	552	105.2	3.5	5.0	43	3.2	3.5
24	Kinmugi Clear Label	Su	NG	0.51	138	107.5	4.9	5.0	42	2.8	1.7
25	Kinmugi Carbohydrate 75% Off	Su	NG	2.32	507	105.4	5.4	4.0	33	0.7	1.5
26	Yebisu	Sa	P	2.84	552	210.6	14.7	5.0	42	3.0	11.0
27	Black Label	Sa	R	1.44	511	190.7	26.8	5.0	40	2.9	7.5
28	Classic	Sa	R	0.38	294	201.8	22.3	5.0	40	2.9	11.0
29	Draft One	Sa	NG	0.59	446	105.7	13.6	5.0	42	3.3	0.8
30	Mugi-to-Hop	Sa	NG	3.24	457	106.6	10.5	5.0	44	3.3	10.0
31	Mugi-to-Hop (Black)	Sa	NG	1.20	508	109.5	10.2	5.0	46	3.8	9.0
32	Mugi-to-Hop (Red)	Sa	NG	0.52	277	108.2	8.1	5.0	43	3.2	10.0
33	Mugi-to-Hop The Gold	Sa	NG	1.46	184	106.7	5.9	5.0	44	3.3	10.0
34	Hokkaido Premium	Sa	NG	0.73	386	108.9	19.4	5.0	42	3.1	4.9
35	Goku Zero	Sa	LM	1.04	320	112.0	10.7	4.0	26	0.0	0.0
36	Premium Alcohol Free	Sa	NA	0.83	521	102.6	16.8	0.0	18	4.3	4.0
37	Barreal	Ae	NG	4.46	548	85.8	7.7	5.0	43	3.6	3.7
38	Seven Premium The Brew	Su	NG	0.96	452	119.1	8.9	5.0	42	3.1	3.4

Note 1: Firm As, K, Su, Sa, and Ae represent Asahi, Kirin, Suntory, Sapporo, and Aeon, respectively.

Note 2: Category R, P, LM, NG, and NA represent regular, premium, low-malt, new-genre, and non-alcohol beer, respectively.

Note 3: Values of price, calorie, carbohydrate, and purines are in 350ml (11.83 fl oz) can equivalent.

Note 4: “Share” was calculated using sales quantity of each brand divided by total sales quantity of all brands during the survey period.

Note 5: “Markets” indicates combination of observed numbers of prefecture and quarter (max. 552).

Table 2 Estimation result of the BLP model

	Coef. (mean)	Coef. (s.d.)	Cross-terms with demographic variables		
			Age	Female	Income
Price	-64.483***	15.310	-0.138	-6.410	5.541
	15.578	17.952	2.039	106.781	54.494
Alcohol	27.839***	-4.143	0.256	48.606	
	2.874	85.234	7.320	284.445	
Calorie	-29.906***	1.694	0.269	-78.977	
	3.075	137.187	12.023	456.426	
Carbohydrate	-14.745***	-1.122	-0.388	8.536	
	2.415	56.549	4.863	189.602	
Purines	-1.293***	0.439	0.006	-1.457	-1.302
	0.440	6.941	0.847	26.209	12.948
Constant	-5.878***	-0.681	-0.110	7.769	-0.070
	0.723	7.421	0.320	18.425	9.261
GMM objective	606.624				
Obs.	17,279				

Note 1: Values in lower rows are standard errors.

Note 2: *** indicates significance at 1% level.

Table 3 Price elasticities

No.	Brand	Firm	Category	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Super Dry	As	R	-11.03	0.03	0.01	0.02	0.03	0.00	0.02	0.08	0.03	0.03	0.10	0.04	0.04
2	Super Dry Premium	As	P	0.40	-12.96	0.01	0.02	0.03	0.00	0.02	0.07	0.03	0.04	0.14	0.03	0.03
3	Super Dry Black	As	R	0.32	0.03	-11.75	0.02	0.04	0.00	0.03	0.08	0.03	0.03	0.10	0.04	0.05
4	Dry Zero	As	NA	0.27	0.02	0.01	-6.74	0.05	0.00	0.04	0.01	0.01	0.03	0.08	0.06	0.05
5	Style Free	As	LM	0.18	0.02	0.01	0.03	-8.16	0.01	0.08	0.02	0.02	0.02	0.06	0.13	0.07
6	Blue Label	As	NG	0.14	0.01	0.01	0.01	0.10	-6.96	0.09	0.02	0.02	0.01	0.05	0.14	0.08
7	Off	As	NG	0.13	0.01	0.01	0.02	0.09	0.01	-6.76	0.02	0.02	0.01	0.04	0.13	0.09
8	Clear Asahi	As	NG	0.19	0.02	0.01	0.00	0.01	0.00	0.01	-6.72	0.09	0.02	0.05	0.01	0.06
9	Clear Asahi Prime Rich	As	NG	0.15	0.01	0.00	0.00	0.01	0.00	0.02	0.18	-6.85	0.01	0.04	0.02	0.07
10	Lager	K	R	0.34	0.04	0.01	0.03	0.03	0.00	0.02	0.07	0.03	-11.39	0.11	0.04	0.04
11	Ichiban Shibori	K	R	0.35	0.04	0.01	0.03	0.03	0.00	0.02	0.07	0.03	0.04	-11.26	0.04	0.04
12	Tanrei Green Label	K	LM	0.15	0.01	0.01	0.02	0.10	0.01	0.09	0.02	0.02	0.01	0.05	-8.02	0.08
13	Kirin Tanrei	K	LM	0.16	0.01	0.01	0.02	0.05	0.01	0.05	0.09	0.05	0.02	0.04	0.07	-8.22
14	Koiaji Deluxe	K	NG	0.13	0.01	0.00	0.01	0.04	0.01	0.06	0.11	0.08	0.01	0.04	0.08	0.08
15	Koiaji 0 Carbohydrate	K	NG	0.17	0.01	0.01	0.04	0.09	0.01	0.08	0.02	0.02	0.02	0.05	0.12	0.07
16	Nodogoshi Nama	K	NG	0.15	0.01	0.01	0.01	0.03	0.01	0.04	0.12	0.07	0.01	0.04	0.06	0.08
17	Sumikiri	K	NG	0.21	0.02	0.01	0.01	0.02	0.00	0.02	0.14	0.09	0.02	0.06	0.03	0.06
18	Free	K	NA	0.36	0.02	0.01	0.16	0.02	0.00	0.02	0.04	0.01	0.04	0.10	0.02	0.04
19	Mugi-no-gochiso	K	NG	0.17	0.00	0.01	0.01	0.02	0.00	0.03	0.13	0.06	0.02	0.05	0.04	0.07
20	All Free	Su	NA	0.26	0.02	0.01	0.26	0.05	0.00	0.04	0.01	0.01	0.03	0.08	0.06	0.05
21	Premium Malts	Su	P	0.42	0.05	0.02	0.01	0.01	0.00	0.01	0.08	0.03	0.04	0.14	0.01	0.03
22	Jokki Nama	Su	NG	0.10	0.01	0.01	0.01	0.08	0.01	0.10	0.03	0.03	0.01	0.03	0.14	0.10
23	Kinmugi	Su	NG	0.16	0.01	0.01	0.01	0.03	0.00	0.04	0.13	0.08	0.02	0.04	0.05	0.07
24	Kinmugi Clear Label	Su	NG	0.16	0.02	0.00	0.02	0.04	0.00	0.05	0.10	0.07	0.01	0.05	0.07	0.08
25	Kinmugi Carbohydrate 75% Off	Su	NG	0.19	0.02	0.01	0.01	0.07	0.01	0.06	0.07	0.04	0.02	0.06	0.09	0.07
26	Yebisu	Sa	P	0.47	0.05	0.02	0.02	0.02	0.00	0.01	0.06	0.02	0.05	0.17	0.02	0.03
27	Black Label	Sa	R	0.31	0.03	0.01	0.05	0.06	0.01	0.04	0.04	0.02	0.03	0.11	0.06	0.05
28	Classic	Sa	R	0.37	0.04	0.01	0.05	0.05	0.00	0.03	0.04	0.02	0.04	0.17	0.05	0.04
29	Draft One	Sa	NG	0.13	0.01	0.01	0.02	0.04	0.01	0.06	0.08	0.05	0.01	0.03	0.08	0.09
30	Mugi-to-Hop	Sa	NG	0.21	0.02	0.01	0.00	0.01	0.00	0.01	0.15	0.08	0.02	0.06	0.01	0.05
31	Mugi-to-Hop (Black)	Sa	NG	0.22	0.02	0.01	0.00	0.00	0.00	0.00	0.17	0.08	0.02	0.06	0.01	0.05
32	Mugi-to-Hop (Red)	Sa	NG	0.22	0.02	0.01	0.01	0.02	0.00	0.02	0.13	0.08	0.02	0.06	0.02	0.06
33	Mugi-to-Hop The Gold	Sa	NG	0.23	0.02	0.00	0.00	0.01	0.00	0.01	0.16	0.08	0.02	0.07	0.01	0.05
34	Hokkaido Premium	Sa	NG	0.16	0.01	0.01	0.01	0.04	0.00	0.04	0.10	0.06	0.02	0.05	0.06	0.07
35	Goku Zero	Sa	LM	0.15	0.01	0.00	0.02	0.10	0.01	0.09	0.02	0.02	0.01	0.05	0.15	0.08
36	Premium Alcohol Free	Sa	NA	0.43	0.02	0.01	0.00	0.00	0.00	0.00	0.09	0.02	0.05	0.12	0.00	0.03
37	Barreal	Ae	NG	0.12	0.01	0.01	0.01	0.03	0.01	0.05	0.12	0.08	0.01	0.03	0.06	0.09
38	Seven Premium The Brew	Su	NG	0.17	0.01	0.01	0.02	0.04	0.01	0.05	0.09	0.05	0.02	0.05	0.06	0.08
	Outside Option			0.22	0.02	0.01	0.02	0.04	0.01	0.04	0.09	0.04	0.02	0.07	0.05	0.06

(continue on next page)

Table 3 Price elasticities (cont'd)

No.	Brand	Firm	Category	14	15	16	17	18	19	20	21	22	23	24	25	26
1	Super Dry	As	R	0.01	0.02	0.10	0.03	0.01	0.01	0.04	0.12	0.00	0.10	0.02	0.03	0.09
2	Super Dry Premium	As	P	0.00	0.01	0.08	0.02	0.00	0.00	0.03	0.19	0.00	0.08	0.02	0.03	0.14
3	Super Dry Black	As	R	0.01	0.02	0.10	0.03	0.00	0.00	0.03	0.11	0.01	0.10	0.02	0.03	0.08
4	Dry Zero	As	NA	0.00	0.04	0.07	0.01	0.04	0.00	0.39	0.03	0.00	0.06	0.02	0.02	0.04
5	Style Free	As	LM	0.01	0.05	0.11	0.01	0.00	0.00	0.04	0.02	0.02	0.10	0.03	0.06	0.02
6	Blue Label	As	NG	0.02	0.05	0.14	0.02	0.00	0.01	0.02	0.01	0.03	0.12	0.03	0.07	0.01
7	Off	As	NG	0.02	0.05	0.16	0.02	0.00	0.01	0.03	0.01	0.02	0.13	0.04	0.06	0.01
8	Clear Asahi	As	NG	0.01	0.00	0.19	0.05	0.00	0.01	0.00	0.06	0.00	0.20	0.03	0.03	0.03
9	Clear Asahi Prime Rich	As	NG	0.02	0.01	0.22	0.05	0.00	0.00	0.00	0.04	0.01	0.22	0.04	0.04	0.02
10	Lager	K	R	0.01	0.02	0.09	0.02	0.01	0.00	0.04	0.13	0.00	0.10	0.02	0.03	0.10
11	Ichiban Shibori	K	R	0.00	0.02	0.08	0.02	0.01	0.00	0.04	0.14	0.00	0.09	0.02	0.03	0.11
12	Tanrei Green Label	K	LM	0.02	0.05	0.14	0.01	0.00	0.00	0.03	0.01	0.02	0.12	0.04	0.06	0.01
13	Kirin Tanrei	K	LM	0.02	0.03	0.18	0.03	0.00	0.01	0.02	0.03	0.01	0.17	0.04	0.04	0.02
14	Koiaji Deluxe	K	NG	-7.05	0.02	0.21	0.04	0.00	0.00	0.01	0.03	0.02	0.19	0.05	0.06	0.02
15	Koiaji 0 Carbohydrate	K	NG	0.01	-6.85	0.13	0.01	0.00	0.00	0.06	0.01	0.02	0.11	0.03	0.05	0.02
16	Nodogoshi Nama	K	NG	0.02	0.02	-6.73	0.04	0.00	0.01	0.02	0.03	0.01	0.20	0.04	0.04	0.02
17	Sumikiri	K	NG	0.01	0.01	0.17	-6.89	0.00	0.00	0.01	0.07	0.00	0.18	0.03	0.04	0.04
18	Free	K	NA	0.00	0.02	0.07	0.01	-7.13	0.00	0.26	0.13	0.00	0.08	0.01	0.01	0.11
19	Mugi-no-gochiso	K	NG	0.02	0.02	0.18	0.05	0.00	-7.08	0.01	0.04	0.01	0.18	0.03	0.03	0.03
20	All Free	Su	NA	0.00	0.04	0.07	0.01	0.04	0.00	-6.58	0.03	0.00	0.07	0.02	0.02	0.04
21	Premium Malts	Su	P	0.00	0.01	0.07	0.03	0.01	0.00	0.01	-12.43	0.00	0.09	0.01	0.02	0.17
22	Jokki Nama	Su	NG	0.03	0.05	0.20	0.02	0.00	0.01	0.02	0.01	-6.85	0.16	0.05	0.07	0.01
23	Kinmugi	Su	NG	0.02	0.02	0.20	0.04	0.00	0.01	0.01	0.04	0.01	-6.65	0.04	0.04	0.02
24	Kinmugi Clear Label	Su	NG	0.01	0.02	0.20	0.02	0.00	0.00	0.02	0.04	0.01	0.18	-6.93	0.05	0.02
25	Kinmugi Carbohydrate 75% Off	Su	NG	0.02	0.03	0.15	0.03	0.00	0.00	0.02	0.04	0.02	0.14	0.03	-6.69	0.03
26	Yebisu	Sa	P	0.00	0.01	0.06	0.02	0.01	0.00	0.03	0.24	0.00	0.07	0.01	0.02	-12.30
27	Black Label	Sa	R	0.01	0.03	0.08	0.02	0.01	0.00	0.07	0.09	0.01	0.08	0.02	0.03	0.08
28	Classic	Sa	R	0.00	0.02	0.06	0.02	0.01	0.00	0.07	0.15	0.00	0.07	0.01	0.03	0.14
29	Draft One	Sa	NG	0.02	0.03	0.21	0.03	0.00	0.01	0.02	0.02	0.02	0.19	0.05	0.05	0.01
30	Mugi-to-Hop	Sa	NG	0.01	0.01	0.16	0.05	0.00	0.01	0.01	0.07	0.00	0.18	0.03	0.03	0.04
31	Mugi-to-Hop (Black)	Sa	NG	0.01	0.00	0.16	0.05	0.00	0.01	0.00	0.08	0.00	0.19	0.03	0.02	0.05
32	Mugi-to-Hop (Red)	Sa	NG	0.01	0.01	0.16	0.05	0.00	0.00	0.01	0.08	0.00	0.18	0.03	0.03	0.05
33	Mugi-to-Hop The Gold	Sa	NG	0.01	0.00	0.16	0.03	0.00	0.00	0.01	0.09	0.00	0.18	0.03	0.03	0.05
34	Hokkaido Premium	Sa	NG	0.02	0.02	0.18	0.03	0.00	0.00	0.02	0.04	0.01	0.18	0.04	0.04	0.02
35	Goku Zero	Sa	LM	0.01	0.05	0.14	0.02	0.00	0.00	0.03	0.01	0.02	0.12	0.04	0.07	0.01
36	Premium Alcohol Free	Sa	NA	0.00	0.00	0.08	0.02	0.06	0.00	0.01	0.23	0.00	0.10	0.01	0.01	0.16
37	Barreal	Ae	NG	0.02	0.02	0.23	0.04	0.00	0.01	0.02	0.03	0.01	0.22	0.04	0.04	0.01
38	Seven Premium The Brew	Su	NG	0.01	0.03	0.18	0.03	0.00	0.01	0.03	0.04	0.01	0.17	0.04	0.04	0.02
	Outside Option			0.01	0.02	0.13	0.03	0.00	0.01	0.03	0.06	0.01	0.14	0.03	0.04	0.04

(continue on next page)

Table 3 Price elasticities (cont'd)

No.	Brand	Firm	Category	27	28	29	30	31	32	33	34	35	36	37	38
1	Super Dry	As	R	0.02	0.00	0.00	0.05	0.01	0.01	0.07	0.00	0.02	0.01	0.04	0.00
2	Super Dry Premium	As	P	0.03	0.01	0.00	0.03	0.01	0.01	0.07	0.00	0.02	0.00	0.03	0.00
3	Super Dry Black	As	R	0.02	0.00	0.00	0.05	0.01	0.01	0.07	0.00	0.02	0.01	0.04	0.00
4	Dry Zero	As	NA	0.04	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.00	0.04	0.00
5	Style Free	As	LM	0.02	0.00	0.01	0.01	0.00	0.00	0.02	0.01	0.08	0.00	0.05	0.01
6	Blue Label	As	NG	0.02	0.00	0.01	0.01	0.00	0.00	0.02	0.01	0.09	0.00	0.07	0.01
7	Off	As	NG	0.02	0.00	0.01	0.01	0.00	0.00	0.02	0.01	0.08	0.00	0.09	0.01
8	Clear Asahi	As	NG	0.01	0.00	0.01	0.10	0.02	0.01	0.13	0.01	0.01	0.01	0.10	0.01
9	Clear Asahi Prime Rich	As	NG	0.01	0.00	0.01	0.08	0.01	0.01	0.13	0.01	0.01	0.00	0.13	0.01
10	Lager	K	R	0.02	0.00	0.00	0.05	0.01	0.01	0.07	0.00	0.02	0.01	0.04	0.00
11	Ichiban Shibori	K	R	0.02	0.00	0.00	0.05	0.01	0.01	0.07	0.00	0.02	0.01	0.03	0.00
12	Tanrei Green Label	K	LM	0.02	0.00	0.01	0.01	0.00	0.00	0.02	0.01	0.08	0.00	0.07	0.01
13	Kirin Tanrei	K	LM	0.01	0.00	0.01	0.05	0.01	0.01	0.07	0.01	0.04	0.00	0.10	0.01
14	Koiaji Deluxe	K	NG	0.01	0.00	0.01	0.05	0.01	0.01	0.08	0.01	0.05	0.00	0.12	0.01
15	Koiaji 0 Carbohydrate	K	NG	0.02	0.00	0.01	0.01	0.00	0.00	0.02	0.01	0.06	0.00	0.06	0.01
16	Nodogoshi Nama	K	NG	0.01	0.00	0.01	0.06	0.01	0.01	0.09	0.01	0.03	0.00	0.11	0.01
17	Sumikiri	K	NG	0.01	0.00	0.00	0.07	0.01	0.01	0.11	0.00	0.02	0.00	0.09	0.01
18	Free	K	NA	0.03	0.01	0.00	0.03	0.01	0.01	0.05	0.00	0.01	0.06	0.04	0.00
19	Mugi-no-gochiso	K	NG	0.01	0.00	0.01	0.09	0.02	0.01	0.10	0.01	0.02	0.00	0.08	0.01
20	All Free	Su	NA	0.04	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.00	0.04	0.00
21	Premium Malts	Su	P	0.02	0.00	0.00	0.06	0.01	0.01	0.08	0.00	0.00	0.02	0.03	0.00
22	Jokki Nama	Su	NG	0.01	0.00	0.01	0.02	0.00	0.00	0.02	0.01	0.09	0.00	0.11	0.01
23	Kinmugi	Su	NG	0.01	0.00	0.01	0.07	0.01	0.01	0.09	0.01	0.03	0.00	0.11	0.01
24	Kinmugi Clear Label	Su	NG	0.02	0.00	0.01	0.00	0.01	0.01	0.07	0.00	0.04	0.00	0.12	0.01
25	Kinmugi Carbohydrate 75% Off	Su	NG	0.01	0.00	0.01	0.04	0.01	0.01	0.05	0.01	0.05	0.00	0.07	0.01
26	Yebisu	Sa	P	0.03	0.01	0.00	0.05	0.01	0.01	0.07	0.00	0.01	0.02	0.02	0.00
27	Black Label	Sa	R	-11.64	0.00	0.00	0.03	0.00	0.01	0.05	0.00	0.03	0.01	0.03	0.00
28	Classic	Sa	R	0.05	-12.21	0.00	0.04	0.01	0.01	0.05	0.00	0.02	0.01	0.02	0.00
29	Draft One	Sa	NG	0.01	0.00	-6.71	0.05	0.01	0.01	0.06	0.01	0.05	0.00	0.13	0.01
30	Mugi-to-Hop	Sa	NG	0.01	0.00	0.00	-6.64	0.02	0.01	0.13	0.01	0.01	0.01	0.08	0.00
31	Mugi-to-Hop (Black)	Sa	NG	0.01	0.00	0.00	0.10	-6.92	0.01	0.14	0.01	0.00	0.01	0.09	0.01
32	Mugi-to-Hop (Red)	Sa	NG	0.01	0.00	0.00	0.07	0.01	-6.88	0.12	0.00	0.01	0.01	0.09	0.01
33	Mugi-to-Hop The Gold	Sa	NG	0.01	0.00	0.00	0.02	0.01	0.01	-6.71	0.00	0.01	0.00	0.09	0.01
34	Hokkaido Premium	Sa	NG	0.01	0.00	0.01	0.05	0.01	0.01	0.08	-6.90	0.03	0.00	0.11	0.01
35	Goku Zero	Sa	LM	0.02	0.00	0.01	0.01	0.00	0.00	0.02	0.00	-6.89	0.00	0.08	0.01
36	Premium Alcohol Free	Sa	NA	0.02	0.00	0.00	0.07	0.02	0.01	0.10	0.00	0.00	-6.22	0.04	0.00
37	Barreal	Ae	NG	0.01	0.00	0.01	0.07	0.01	0.01	0.09	0.01	0.03	0.00	-5.33	0.01
38	Seven Premium The Brew	Su	NG	0.01	0.00	0.01	0.06	0.01	0.01	0.07	0.01	0.04	0.00	0.10	-7.85
	Outside Option			0.01	0.00	0.01	0.05	0.01	0.01	0.07	0.01	0.03	0.01	0.07	0.01

Note 1: The notation of firm and category is the same as in Table 1.

Note 2: Values are elasticities of demand for brands in rows with respect to prices of brands in columns.

Table 4 Brand-level price-cost margins

No.	Brand	Firm	Category	Median	LB	UB
1	Super Dry	As	R	0.173	0.149	0.197
2	Super Dry Premium	As	P	0.135	0.100	0.155
3	Super Dry Black	As	R	0.159	0.129	0.196
4	Dry Zero	As	NA	0.157	0.136	0.180
5	Style Free	As	LM	0.212	0.131	0.247
6	Blue Label	As	NG	0.152	0.122	0.166
7	Off	As	NG	0.156	0.132	0.172
8	Clear Asahi	As	NG	0.157	0.133	0.168
9	Clear Asahi Prime Rich	As	NG	0.155	0.131	0.167
10	Lager	K	R	0.167	0.130	0.223
11	Ichiban Shibori	K	R	0.169	0.122	0.204
12	Tanrei Green Label	K	LM	0.219	0.170	0.254
13	Kirin Tanrei	K	LM	0.211	0.159	0.240
14	Koiaji Deluxe	K	NG	0.150	0.124	0.161
15	Koiaji 0 Carbohydrate	K	NG	0.154	0.126	0.165
16	Nodogoshi Nama	K	NG	0.157	0.139	0.169
17	Sumikiri	K	NG	0.154	0.129	0.165
18	Free	K	NA	0.148	0.120	0.168
19	Mugi-no-gochiso	K	NG	0.148	0.116	0.174
20	All Free	Su	NA	0.160	0.137	0.191
21	Premium Malts	Su	P	0.140	0.117	0.156
22	Jokki Nama	Su	NG	0.155	0.126	0.174
23	Kinmugi	Su	NG	0.159	0.147	0.168
24	Kinmugi Clear Label	Su	NG	0.156	0.135	0.162
25	Kinmugi Carbohydrate 75% Off	Su	NG	0.158	0.135	0.165
26	Yebisu	Sa	P	0.141	0.113	0.161
27	Black Label	Sa	R	0.161	0.111	0.231
28	Classic	Sa	R	0.147	0.109	0.194
29	Draft One	Sa	NG	0.157	0.124	0.169
30	Mugi-to-Hop	Sa	NG	0.158	0.132	0.170
31	Mugi-to-Hop (Black)	Sa	NG	0.153	0.124	0.163
32	Mugi-to-Hop (Red)	Sa	NG	0.154	0.128	0.167
33	Mugi-to-Hop The Gold	Sa	NG	0.160	0.142	0.169
34	Hokkaido Premium	Sa	NG	0.153	0.126	0.167
35	Goku Zero	Sa	LM	0.288	0.201	0.328
36	Premium Alcohol Free	Sa	NA	0.169	0.128	0.237
37	Barreal	Ae	NG	0.198	0.152	0.223
38	Seven Premium The Brew	Su	NG	0.135	0.124	0.156

Note 1: The notation of firm and category is the same as in Table 1.

Note 2: LB and UB represent, respectively, the lower bound and the upper bound of the 95% confidence interval for the simulation of price-cost margins.

Table 5 Firm-level price-cost margins

Firm	Median	LB	UB
Asahi	0.159	0.124	0.227
Kirin	0.159	0.127	0.231
Suntory	0.156	0.122	0.298
Sapporo	0.154	0.126	0.175
Aeon	0.198	0.152	0.223

Note: LB and UB represent, respectively, the lower bound and the upper bound of the 95% confidence interval for the simulation of price-cost margins.