Measuring the Impacts of Age and Consumer Cohorts on the Consumption of Alcoholic Beverages: The Japan Case

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Introduction

The 1989-91 USDA Survey of Food Intakes endorses one's casual observation that older American adults consume much more coffee than younger ones while the latter drink much more (soda) pops than the former (Table 1).

Table 1. Mean intakes per person per day, by age, 1989-91.

Age (Years) Males	Coffee	Carbonated Soft Drinks (regular)
	---grams---	
20-29	166	311
30-39	353	256
40-49	524	207
50-59	483	124
60-69	501	67
70 and over	410	57

Source: Interagency Board for Nutrition Monitoring and Related Research, Third Report on Nutrition Monitoring in the United States, Appendix, VA-68.

Original Source: USDA Continuing Survey of Food Intakes by Individuals, 1989-91.

These distinct differences in consumption of beverages between age groups tend to lead one to two opposed predictions concerning the consumption of beverages in the future as the total U.S. population proceeds to age.

If those in their twenties and thirties in 1990 come to drink much more coffee and much less pops as they reach their forties and fifties, the consumption of coffee will increase and that of pops might decrease as a whole. On the contrary, if they keep their beverage consumption habits formed during their “coming of age” into the middle age of their life cycle, the consumption of coffee will decrease as currently older adults fade away and that of pops might increase.

The first prediction is based on the assumption of prevalence of age effects and the second on the predominance of cohort effects in the human consumption behavior which might vary by commodities and countries.

Cohort analysis is a newly developed discipline designed to identify the relative strength of effects of age and (birth) cohort in addition to the effect of period on human behavior.

As everyone may agree, a consumption survey at one time point only, whatever the sample size or survey design may be, or surveys conducted during a short span of time, say 5 to 10 years, are not sufficient to determine relative influences of age (in a narrow sense) and cohort in consumption changes and will not provide effective information for making predictions concerning the future.

Japanese Government Management and Coordination Agency (MCA) began, in 1979, to publish consumption data classified by age groups of household head (HH) in its annual report of *Family Income and Expenditure Survey (FIES)*. Mori and Inaba developed a unique solution to derive consumption of individual household members by age by incorporating a matrix of estimated age structure of members by HH age groups (1997). Indirect as it may be in approach, their’s is unquestionably superior to the traditional way of simply dividing household consumption by HH age groups by respective number of members to deduce individual consumption of corresponding age groups (Mori, 1998).

With individual consumption data by age of five years interval for the past 20 years available from the reinforced Mori and Inaba model (Mori and Gorman, 1999), an experimental cohort analysis has been conducted to identify age, cohort and period effects in changes of consumption, at home, of various food products in Japan. The cases of sake, traditional alcoholic beverage and beer, fairly recent one are presented in this paper.

Research Method

Suppose that the data relating to individual consumption (of a selected product) is provided as shown in Table 2, by five-year interval for age groups and every five years for survey periods, respectively. Those in their early twenties in 1980, for example, grew to their late twenties in 1985 and finally to their late thirties in 1995, respectively. Each cell along the diagonal line thus represents the same (birth) cohort.

Table 2. Standard Cohort Table Relating to Per Capita Consumption by Age Groups, 1975 to 1995.

Year	Age (Years)			
	20-24	25-29	30-34	35-39
1975	c_{75}	d_{75}	e_{75}	f_{75}
1980	c_{80}	d_{80}	e_{80}	f_{80}

1985	c_{85}	d_{85}	e_{85}	f_{85}
1990	c_{90}	d_{90}	e_{90}	f_{90}
1995	c_{95}	d_{95}	e_{95}	f_{95}

According to Rentz and Reynolds and T. Nakamura, we begin with the following model:

(1) $$\mu_{it} = \beta_o + \beta^A_i + \beta^P_t + \beta^C_k + \__{it}$$

where

μ_{it} = the consumption of age group i in period t

β_o = the grand mean of the dependent variable

β^A_i = the effect attributable to age i

β^P_t = the effect attributable to period t

β^C_k = the effect attributable to cohort k

$\__{it}$ = the random error

Because of the linear dependency in most common cases, the linear effects of age, period and cohort are confounded and theoretically not possible to separate from each other. This is called "the identification problem" in cohort analysis (Mason & Fienberg). In an effort to overcome this problem, Nakamura introduced Bayesian approach into the analysis, i.e., the assumption of *zenshin teki henka* (gradual changes between adjacent parameters) which is described as fellows (Nakamura).

(2) $$\beta^A_i - \beta^A_{i+1} \approx 0$$

$$\beta^P_t - \beta^P_{t+1} \approx 0$$

$$\beta^C_k - \beta^C_{k+1} \approx 0$$

$$\Sigma\beta^{A}_{i} = \Sigma\beta^{P}_{t} = \Sigma\beta^{C}_{k} = 0$$

We estimate parameters, β_o, β^A_i, β^P_t and β^C_k in equation (1) by minimizing $\Sigma(\_{it})^2$ in equation (1) while attempting to minimize the following equation (3) relating to *zenshin teki henka*.

(3) $$1/\sigma^2_A\, \Sigma(\beta^A_i - \beta^A_{i+1})^2 + 1/\sigma^2_P\, \Sigma(\beta^P_t - \beta^P_{t+1})^2 + 1/\sigma^2_C\, \Sigma(\beta^C_k - \beta^C_{k+1})^2$$

where σ^2_A, σ^2_P and σ^2_C are hyper-parameters to be selected within some range strictly by ABIC (Akaike's Bayesian Information Criterion) only in Nakamura's analyses and a few more judgements based on common sense in our study (Mori and Gorman, 1999).

Results

Estimates of individual consumption of sake by selected age groups for selected years from 1979 to 1997 are shown in Table 3. During the survey period of 20 years, younger Japanese adults decreased their sake consumption at home conspicuously while older ones maintained their consumption at relatively high levels.

Table 3. Estimates of Individual Consumption of Sake at Home by Age, 1979 to 1997, liters/year (only selected age groups and years shown due to limited space).

Year	Age (Years)			
	25-29	35-39	45-49	60-64
1979	6.01	8.22	8.66	8.28
1984	4.22	5.57	7.07	7.91
1989	2.83	4.28	6.49	7.98
1994	2.35	3.63	5.61	7.42
1997	1.74	2.87	4.94	8.23

Those of beer are shown in Table 4. At the start of 1979, younger adults consumed substantially more beer at home than older ones. During the course of time afterwards, older ones increased their beer consumption significantly to almost comparable levels with younger ones, consumption of which did not change much over time.

Table 4. Estimates of Individual Consumption of Beer at Home by Age, 1979 to 1997, liters/year (only selected age groups and years shown due to limited space).

Year	Age (Years)			
	25-29	35-39	45-49	60-64
1979	23.75	25.95	15.76	10.05
1984	21.25	22.48	17.01	12.43
1989	23.93	25.77	19.37	14.35
1994	24.91	32.03	26.66	20.71
1997	24.46	26.31	24.61	24.72

These consumption estimates by 11 age groups from 20-24 to 70 and over for every year from 1979 to 1997 are analyzed by our cohort model to produce Figure 1 for sake and Figure 2 for beer, respectively.

When the differences in sake consumption by age in a broader sense ("pure" age plus generation cohort) shown in Table 3 are separated by our analysis, it is demonstrated that cohort overwhelms age in Japanese sake consumption. The difference is consumption to be attributed to age, *per se*, is relatively small, ranging from -0.51 liters for the age group 25-29 to 0.4 liters for the age groups 60-69. What accounts is cohort effects, ranging from -3.0 liters for those born after 1965 to 2.0 liters for those born before 1939. It is quite impressive that newer cohorts in Japan, those born after 1950 who came of age in the 1970s and 1980s show increasingly negative cohort effects as shown in Figure 1.

In contrast to sake, beer shows a different picture, in respect to cohort effects. Newer cohorts, those born after 1945 or so, have distinctly positive cohort effects as much as 5.0 liters (on top of 19.3 liters of grand mean), whereas older cohorts, those born before 1940, demonstrate increasingly negative effects as much as -10.0 liters for the oldest cohorts under consideration. As one of the authors, Mori, recalls it, beer cost 150 yen per bottle at the ordinary tavern in the late 1950s when a day laborer earned 254 yen (*ni ko yon*) a day. Now McDonald's pays 750 yen per hour to part-time workers and beer costs 500 yen, at the most, per bottle at the tavern.

Conclusion and Implications

Bayesian cohort model was applied to analyze changes in consumption over the past 20 years of two most popular alcoholic beverages in Japan, sake, traditional and beer, relatively modern. In both cases, it was found that cohort effects predominate "pure" age effects, i.e., older cohorts show distinctly positive cohort effects, whereas the newer cohorts increasingly negative effects in the case of sake and the just opposite is the case with beer.

Unless no effective measures are taken by the sake industry to alter this increasingly negative cohort effects of the newer cohorts, overall consumption of sake will further decline as the currently older cohorts move away from population. In the case of beer, overall consumption will continue to grow, if the period effects set aside, as the newer cohorts with distinctly positive effects replace the older ones with increasingly negative effects. However, an increase due to the replacement of cohorts will come to cease in 10 to 20 years when there won't be many people left belonging to negative cohorts. Recall that all newer cohorts born after 1945 are estimated to have positive effects but of almost equal magnitude.

Figure 1. Estimates of Age, Cohort and Period Effects for Sake

(A) Age **(Grand Mean – 5.7 liters)**

(B) Cohort

(C) Period

Figure 2. Estimates of Age, Cohort and Period Effects for Beer

(A) Age **(Grand Mean – 19.3 liters)**

(B) Cohort

(C) Period

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