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Substitution in Consumer Demand for Coffee Product Categories in Japan

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Abstract

This paper estimates substitution in consumer demand for coffee product categories in Japan using the linear approximate quadratic almost ideal demand system model (LA/QUAIDS). Three expenditure shares and demand equations for coffee beans and powder (beans/powder), canned and bottled coffee (canned/bottled) and coffee drunk at coffee shops (coffee shops) are estimated for two or more person households in forty-nine cities for the period January 2000 through February 2015. The expenditure elasticity estimates indicate that coffee shops are luxury goods while beans/powder and canned/bottled coffee are necessities in the Japanese household. The demographic effects show that persons over the age of 65 and people who earn more consume coffee at coffee shops. Moreover, seasonal effects show demand for canned and bottled coffee as mostly positive while it is mostly negative for coffee drunk at coffee shops in most of the months. The findings of this study indicate that coffee product categories in the Japanese market are substitutes for one another, which is consistent with the reality of coffee consumption in Japan.

Keywords: coffee, elasticity, Japanese household, LA/QUAIDS, temperature effects

1. Introduction

Coffee is one of the most demanded agricultural commodities in the world, with a worlwide market share of $84.5 billion (Euromonitor, 2014). The global coffee consumption has been increasing steadily over the past 4 years at an average annual growth rate of 2.4%, with consumption estimated at 149.8 million bags in 2014 (ICO, 2015b). Japan is among the top coffee-consuming nation globally currently fourth behind the United States, Brazil, and Germany (ICO, 2015a). Coffee demand in Japan grew substantially in the 1960s and in the 1970s by double-digit rate; however, as the market became matured and saturated yearly growth rate dropped to 4.4% in the 1980s and went on to fall to 2.4 % and 0.6% in 1990s and 2000s respectively (Agra-net, 2015). In 2014, Japan's coffee consumption was estimated to be 7.49 million kg bags (Statista, 2015). Japan's per capita coffee consumption has remained steady at 3.5 kg (ICO, 2015a). Moreover, in terms of coffee retail price, Japan ranks higher than most of the importing nations, with approximately 5 US $/kg from 1990 to 2010; As comparison, within the same period of time, coffee retail price for the United States was around 1.5 US $/kg (ICO, 2011).

In the Japanese coffee beverage industry, instant coffee have continuously dominated the total market sales; canned and bottled coffee, which are widely available in vending machine, are the main segments of the overall beverage market (Smil & Kobayashi, 2012). Canned coffee, invented in Japan, provides hot or cold coffee in a can. Since its invention in 1969, demand rosed by 40% from the overall non-instant coffee market (Thurston, Morris, & Steiman, 2013).

Coffee beverage/Instant coffee hold the largest segment with 2.12 billion liters followed by canned coffee with 661.6 million liters, coffee containing milk beverage with 147.9 million liters, and coffee containing soft drinks with 21.3 million liters for the year 2013 (Japan Soft Drink Association, 2014). As for the number of coffee shops in Japan, according to Thurston, Morris, and Steiman (2013), it has declined by 50% since 1982 mainly due to the emergence of fashionable self-service cafes or fast-food restaurant services, in which consumers order and take their coffee beverages across the counter. Moreover, international coffee chains such as Starbucks, Doutor and Tully's, to name a few, brought a serious competition for the largest domestic suppliers of fresh coffee such as Ueshima, Art Coffee, and Key Coffee (Smil & Kobayashi, 2012). Total revenue for coffee shops in Japan was estimated to be worth $2.9 billion in 2013 (Shimbun, 2014). Recently, demand for convenience store coffee, $1 cup of coffee, has become a popular beverage trend in Japan; Convenience store coffee, which has a price equivalent to canned coffee, has spread all over Japan and has impacted not only sales for canned coffee but for coffee shops as well (Family Income Expenditure Survey, 2015). From the start of sales in 2012, the total amount of sales at conveniences store coffee has increased by 500 million cups in less than a year (Kunifuji et al., 2014).

According to a study conducted by All Japan Coffee Association (2015), Japanese coffee consumption per week has risen steadily over the past decade. In 2002, 6.49 cups were consumed at-home and 4.55 cups were consumed out-of-home. By 2014, at-home consumption increased to 7.04 cups. Conversely, out-of-home consumption, which includes office/schools, coffee shops, restaurants and others decreased to 4.03 cups during the same year.

Over the years, several studies have analyzed the demand for coffee in different countries. To mention some: Goddard and Akiyama (1989), Okunade (1992), Yeboah (1992), Sellen and Goddard (1997), Houston, Santilla, and Marlowe (2003) and Gebrehiwot and Daloonpate (2012) have all analyzed the income and price elasticities using various demand models for coffee products and varieties. However, only few of these studies have analyzed substitution among various coffee product categories. In addition, these studies used different estimation techniques and data sets.

With regards to coffee demand, there are several dynamics that influence its consumption pattern. To name some: income and expenditure, price, demographic factors, taste, and weather. In Japan, there are numerous factors that contributed to the rise and popularity such as: influence from western consumption habits, increase in marketing strategy as well as research and development on coffee products, the continuous expansion for coffee sales outlets, and the presence of typical Japanese coffee shops (All Japan Coffee Association, 2010).

As a popular demand commodity in the Japanese market, understanding the substitution pattern among coffee product categories is significant for coffee beverage manufacturers. However, according to our knowledge, no preceding study exist that examines quantitatively the substitution relationship between coffee product categories in Japan. In this paper, we investigate the substitution pattern among three coffee brands/products: coffee beans and powder (beans/powder), canned and bottled coffee (canned/bottled), and coffee drunk at coffee shops (coffee shops). Coffee beans and powder (beans/powder) can be explained as ground coffee packaged in a large bag type and bag-type dripper presented with a disposable filter. They are usually consumed at home. Canned and bottled coffee (canned/bottled) is a ready-to-drink roasted coffee beverages packaged in plastic bottles and canned as hot or cold beverages. They are usually consumed from vending machine or at convenience store. As for coffee drunk at coffee shops, these are also roasted coffee served as hot or cold beverages at coffee shops. These coffees may differ from the other coffee products by quality and origin.

We incorporate expenditure and prices for the three coffee product categories in a comprehensive demand system model taking into account the effects of demographic and temperature by evaluating the monthly data by city.

The following hypotheses are verified: Are the three coffee product categories substitutes or complements? Does temperature play a significant role on coffee demand in Japan? How does coffee consumption affect demographic group in Japan? How sensitive is coffee demand to expenditure and price changes?

Since Japan is one of the top coffee consuming nations globally, the findings of this study will be crucial for beverage manufacturing companies. Implications of the coffee market of substitute relations of product categories are discussed. Additionally, it is of a great interest to ascertain whether these coffee product categories chosen are a necessity, luxury, or an inferior good.

The rest of the paper is drawn accordingly. Section 2 discusses data set and model, section 3 presents the results discussion and section 4 presents the conclusion.

2. Data and Model

For this study, we apply monthly aggregate pseudo panel data, which is repeated cross-sectional data, for two or more person households from January 2000 to February 2015 for 49 cities, attainted from the Family Income and Expenditure Survey (FIES) of Japan, conducted by the Ministry of Internal Affairs (2015). Pseudo panel data, proposed by Deaton, is an alternative econometric method for estimating demand models of individual behavior; Pseudo panel data has advantage over panel data in that it allows estimating models over a longer period of time. Moreover, it rejects individual-level measurement error (Deaton, 1985).

Using general consumer price index for all 49 cities average in Japan, all expenditure data for beans/powder, canned/bottled, and coffee shops were deflated with consideration of changes in prices. SHAZAM (version 10.2) econometrics software was used to conduct the estimation process. A sample of 8915 observations for two or more person households is used in this study. The iterative seemingly unrelated regression (ISUR) was used to estimate the linear system of the three coffee product demand equations. To ensure non-singularity of the error covariance matrix, we deleted the equation for coffee shops. We can retrieve the parameters of the omitted budget share equations by using the property of adding-up. We apply two types of dummy (1/0) variables into the demand system: monthly dummy variables to adjust the monthly variation and city dummy variables to capture the city variation. Several demographic variables from the FIES were incorporated in the study to understand demand patterns of the coffee product categories in the Japanese households. These variables include size (number of persons per household), elders (number of persons per household over the age of 65), earners (number of earners per household), age (age of the head), and rent (household percentage paying rent). Multicolinearity analysis was tested among the variables by calculating the variance inflation factors (VIF); the VIF are 1.031-3.635 (<< 10) indicating no multicollinearity among the variables. The limitation of the study could be that psychometric analysis, which is an important feature for demand analysis, was not used. To estimate temperature effects, monthly data from January 2000 to February 2015 were outsourced from Japan Meteorological Agency (JMA).

The quadratic almost ideal demand system (QUAIDS) model, which was originated from utility maximization by Banks, Blundell, and Lewbel (1997), not only holds the desirable properties of Deaton and Muellbauer's (1980) almost ideal demand system (AIDS) model but also is more versatile in modeling consumer expenditure patterns. The QUAIDS model gives rise to quadratic logarithmic engel curves that is allowing such circumstances where incremental in expenditure would change a luxury to a necessity, whereas for the AIDS model, it gives rise to engel curves that are linear in logarithm of total expenditure. For the QUAIDS model, the expenditure elasticity is contingent on the level of expenditure while for the AIDS model the elasticities are not dependent of expenditure level (Banks et al., 1997). The recent applied studies on QUAIDS can be found in Matsuda (2006). For this study, we employ the linear version of QUAIDS (LA/QUAIDS) model by Matsuda (2006). We designated this specific model, LA/QUAIDS, because it features the characteristics of 'Closure Under Unit Scaling' (CUUS) even with demand shifters such as demographic variables and monthly and city dummies (Alston, Chalfant, & Piggott, 2001). With demand shifters, the original QUAIDS of Banks et al. (1997) does not fulfill CUUS. CUUS is a property that ensures that estimated economic effects are constant to the scaling of the data (Pollack & Wales, 1992). Furthermore, Pollack and Wales (1980) stated that only demand systems consistent with CUUS should be used for empirical demand analysis.

Following Matsuda (2006), we can derive the LA/QUAIDS model as:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \log p_j + \beta_i \log \frac{y}{P^C} + \frac{\lambda_i}{P^Z}\left(\log \frac{y}{P^C}\right)^2 \qquad i = 1,2,\ldots,n \tag{1}$$

Where, w_i is the expenditure share of good i, y is total expenditure within the system, p_j is the price of good j, α_i, β_i, γ_{ij}, and λ_i are parameters to be estimated.

$$\log P^C = \sum_i \overline{w}_i \log p_j \tag{2}$$

The loglinear analogue of the Laspeyres price index can be shown in Equation 2. P^C is invariant to changes in units. $-$ stands for the sample mean.

We employ index P^Z as proposed by Matsuda (2006) in Equation 3:

$$\log P^Z = \sum_{i=1}^{n} \left(w_i - \overline{w}_i\right) \log \frac{p_i}{\overline{p}_i} \tag{3}$$

Where, P^Z could be seen as a zero degree homogenous analogue of the Törnqvist price index analogue.

We posited the estimated LA/QUAIDS model using expenditures shares and prices for the demand of beans/powder, canned/bottled, and coffee shops with regards to demographic, temperature, and other dummy variables as follow:

$$\begin{aligned} w_i = {} & \alpha_{i0} + \alpha_{i1} t + \sum_{k=1}^{5} \alpha_{1,1+k} z_k + \sum_{m=1}^{11} \alpha_{1,6+m} D_m + \alpha_{1,18} h + \sum_{r=1}^{48} \alpha_{1,18+r} M_r \\ & + \sum_{j=1}^{3} \gamma_{ij} \log p_j + \beta_i \log \frac{y}{P^C} + \frac{\lambda_i}{P^Z}\left(\log \frac{y}{P^C}\right)^2 \qquad i = 1,2,3 \end{aligned} \tag{4}$$

Where, t indexes the time in months, z_k are demographic variables, D_m are monthly dummy variables, h is temperature, M_r are city dummy variables. The parameters consequently are expected to meet the following restrictions:

$$\sum_{i=1}^{3}\alpha_{i0}=0 \qquad \sum_{i=1}^{3}\alpha_{ik}=0 \qquad k = 1,2,\ldots,66 \tag{5}$$

$$\sum_{i=1}^{3}\beta_i=0 \tag{6}$$

$$\sum_{i=1}^{3}\lambda_i=0 \tag{7}$$

$$\sum_{i=1}^{3}n_{ij}=0 \qquad j = 1,2,3 \tag{8}$$

$$\sum_{j=1}^{3}\gamma_{ij}=0 \qquad i = 1,2,3 \tag{9}$$

The ensuing demand system jointly ensures that it fulfills adding up and homogeneity. In addition, symmetry is guaranteed by the additional restriction:

$$\gamma_{ij}=\gamma_{ji} \qquad i, j = 1,2,3 \tag{10}$$

The expenditure, uncompensated, and compensated price elasticities can be defined as follows:

$$\varepsilon_i = 1+\frac{\beta_i}{w_i}+\frac{2\lambda_i}{w_i P^Z}\log\frac{y}{P^C} \qquad i = 1,2,3 \tag{11}$$

$$\varepsilon_{ij} = -\partial_{ij}+\frac{\gamma_i}{w_i}+\frac{\beta_i \bar{w}_j}{w_i}-\frac{\lambda_i}{w_i P^Z}\left[2\bar{w}_j+\left(w_j-\bar{w}_j\right)\log\frac{y}{P^C}\right]\log\frac{y}{P^C} \qquad i, j = 1,2,3 \tag{12}$$

$$\varepsilon^C_{ij} = \varepsilon_{ij} + \varepsilon_{iwj} \text{ (Slutsky equation)} \qquad i, j = 1,2,3 \tag{13}$$

Where, δ_{ij} is the Kronecker delta: $\delta_{ij}=1$ for $i=j$; $\delta_{ij}=0$ for $i\neq j$.

3. Results

Table 1 reports Wald test statistics for coefficients of regressors other than log prices and log expenditure. The linear approximate AIDS (Deaton & Muellbauer, 1980) is rejected by the LA/QUAIDS. Homothetic preferences and omission of the other regressors are also rejected.

Table 1. Wald test statistics for coefficients

Regressor	Degrees of freedom	Wald	*p*-value
Squared log real expenditure	2	67.725	[0.000]
Homothetic preferences	2	813.867	[0.000]
Linear time trend	2	461.548	[0.000]
Number of persons per household	2	93.437	[0.000]
Number of persons per household over the age of 65	2	8.205	[0.017]
Number of earners per household	2	8.838	[0.012]
Age of the head	2	33.678	[0.000]
Rate of those paying rent	2	6.287	[0.043]
Temperature	2	195.380	[0.000]
Monthly dummies	22	1875.666	[0.000]
Temperature × Monthly dummies	22	606.008	[0.000]
City dummies	96	3206.116	[0.000]

Note. H_0: All coefficients of the regressor(s) are zeroes; H_1: Not all coefficients of the regressor(s) are zeroes.

The descriptive statistics is shown on Table 2. The expenditure share for beans/powder (0.410) and coffee shops

(0.329) have the highest mean expenditure whereas canned/bottled (0.261) have the lowest mean among the coffee product categories group.

Table 2. Descriptive statistics of variables

Variable	Mean	Std. deviation	Minimum	Maximum
Number of persons per household (z_1)	3.1169	0.18384	2.58	4.13
Number of persons per household over the age of 65 (z_2)	0.628	0.134	0.21	1.38
Number of earners per household (z_3)	1.345	0.164	0.54	2.15
Age of the head (z_4)	55.202	2.706	47.0	64.2
Rate of those paying rent (z_5)	23.405	9.402	0.0	56.8
Expenditure share of beans/powder (w_1)	0.410	0.118	0	0.934
Expenditure share of canned/bottled (w_2)	0.261	0.103	0	1.000
Expenditure share of coffee shops (w_3)	0.329	0.122	0	0.950
Price of beans/powder (p_1)	109.85	49.410	1.00	915.00
Price of canned/bottled (p_2)	107.68	7.662	54.00	133.11
Price of coffee shops (p_3)	99.26	3.408	18.30	123.98

The estimates of expenditure and price coefficients at the mean shares are reported in Table 3. The price coefficients for beans/powder (-0.010) and coffee shops (-0.062) are statistically significant at the 1% level, whereas canned/bottled is not significant among the coffee group. The total expenditure for all three coffee products: beans/powder (-0.040), canned/bottled (-0.086) and coffee shops (0.126) are significant at the 1% level, indicating a significant influence of prices on the budget shares. Moreover, the quadratic log-linear expenditure for beans/powder (-0.031) and coffee shops (0.032) are significant at the 1% level. The sign of price and expenditure are consistent with the theory and their magnitudes were within expected range. The R^2 indicates the results are satisfactory.

Table 3. Estimates of expenditure and price coefficients

Left-hand variable w_i	Regressor					R^2
	$\log p_1$	$\log p_2$	$\log p_3$	$\log \frac{y}{P^C}$	$\frac{1}{P^Z}\left(\log \frac{y}{P^C}\right)^2$	
Beans/Powder	-0.010** (-2.023)	-0.037* (-1.767)	0.047*** (2.239)	-0.040*** (-8.291)	-0.031*** (-7.610)	0.463
Canned/Bottled		0.004 (0.254)	0.023 (1.416)	-0.086*** (-23.198)	-0.002 (-0.572)	0.587
Coffee shops			-0.062*** (-3.885)	0.126*** (24.861)	0.032*** (7.651)	

Note. The degrees of freedom of the demand system are 17,611. The corresponding critical values of the t-distribution for 1%, 5%, 10% significance levels are 2.576, 1.960, and 1.645 respectively. ***, **, and * mean that the estimate is different from zero at the 1%, 5%, and 10% significance levels, respectively. R means that the estimate is derived from adding-up restriction. Defined as the squared correlation between the observed and predicted shares, R2 is computed for each single equation. t-values are in parentheses.

Table 4 shows the estimates of expenditure and uncompensated price elasticities. Our model in this study is a conditional demand system. Expenditure is just for coffee product categories. The expenditure price elasticity for beans/powder (0.902), canned/bottled (0.670), and coffee shops (1.384) are all significant at the 1% level. The positive expenditure elasticities indicate that the coffee product categories under consideration are normal goods. More precisely, the expenditure elasticity for coffee shops are elastic, while expenditure for beans/powder and canned/bottled are expenditure inelastic. This implies that coffee shops are luxuries good while beans/powder and canned/bottled are necessities. For example, the demand for coffee shops increases by 1.384% when expenditure increases by 1%. These results are consistent with two previous studies on coffee demand in Japan. Yohannes and

Matsuda (2016), analyzed weather effect on household demand for coffee and tea in Japan, and Yohannes and Matsuda (2015), analyzed demand for non-alcoholic beverages in Japan. Both studies using the LA/QUAIDS model found coffee (beans/powder) and coffee beverage (canned/bottled) to be necessity goods.

Table 4. Estimates of expenditure and uncompensated price elasticities at the mean shares

Demand q_i	Expenditure y	Price p_j		
		Beans/Powder	Canned/Bottled	Coffee shops
Beans/Powder	0.902*** (76.535)	-0.985*** (-88.067)	0.032** (2.385)	-0.044*** (-3.056)
Canned/Bottled	0.670*** (47.347)	-0.040*** (-4.008)	-0.907*** (-15.475)	-0.024 (-0.511)
Coffee shops	1.384*** (89.605)	0.123*** (8.642)	0.205*** (3.510)	-1.316*** (-26.430)

Note. The same as Table 3.

The uncompensated own-price elasticity show that demand for beans/powder (-0.985), canned/bottled (-0.907), and coffee shops (-1.316) are all significant at the 1% level. All own-price elasticities for the coffee product items show negative signs, which is consistent with consumer demand theory. Negative own-price elasticity indicates that an increase in the price of the coffee product items results in a decrease in demand for the same group. Coffee shops are own-price elastic while beans/powder and canned/bottled are own-price inelastic. Coffee shops's own-price elasticity of -1.316 suggest that when the price of coffee shops increases by 1%, demand for coffee shops will reduce by 1.316%. The high own-price elasticity demand for coffee shops is perhaps due to the quality of coffee products served at coffee shops, such as premium organic coffee, coffee roasted by types or blends, since coffee shops is regarded as luxuries product item in Japan. The own-price elasticity of beans/powder and canned/bottled are close to unity. The result suggests that Japanese consumers are more responsive to coffee shops price than to the price of beans/powder or canned/bottled. Our findings are consistent with previous studies with regards to coffee expenditure of beans/powder and canned/bottled elasticities. In their studies, Goddard and Akiyama (1989), Okunade (1992) and Yeboah (1992) found demand for coffee to be price inelastic. Dharmasena et al. (2009), applying the LA/QUAIDS model for non-alcoholic beverages in the United States, also found coffee to be price inelastic (0.462). In addition, Yohannes and Matsuda (2016) found beans/powder (coffee) and canned/bottled (coffee beverage) to be price inelastic at -0.302 and -0.790 respectively.

Regarding uncompensated cross-price elasticities, all coffee product categories are inelastic. This implies that there is a weak response of one coffee product item to changes in the price of other coffee products. This outcome is anticipated since there is less substitutability between coffee product groups; substitutability occurs within coffee product groups. Three pairs are found to be substitutes: beans/powder with canned/bottled (0.032), coffee shops with beans/powder (0.123), and coffee shops with canned/bottled (0.205). These three pairs are gross substitutes since they show positive elasticities. As for complementary goods is concerned, the two pairs: beans/powder with coffee shops (-0.044) and canned/bottled with beans/powder (-0.040) show negative elasticities implying gross complementarity among these beverage items. For the first pair, beans/powder with coffee shops, as the price of coffee shops decrease demand for beans/powder increases. For the second pair, canned/bottled with beans/powder, as the price of beans/powder decreases demand for canned/bottled increases. However, the cross-price elasticities for both pairs are just slight.

Table 5 shows the estimates of compensated price elasticities at the mean shares. The compensated price elasticity measures the strength of the substitution effects that affect demand for the coffee product categories under consideration. The absolute values for the compensated price elasticties are normally smaller than the uncompensated price elasticities. All three compensated own-price elasticities are significantly negative, which is theoretical consistent. This means that a change in the price of any coffee product items will result in more than proportionate change in quantity demanded of the coffee product category. Based on the compensated cross-price elasticities, all coffee product categories are substitutes for one another. The result is not surprising, however, it is consistent with the reality of coffee consumption in Japan. Among these beverages group, the top pair of substitutes are beans/powder with coffee shops (0.523). This means that a 1% increase in the price of beans/powder increases demand for coffee shops by 0.523%. Yohannes and Matsuda (2016) also found beans/powder (coffee) and canned/bottled (coffee beverage) as substitutes for one another. Table 4 shows beans/powder to be both complementary with both coffee shops and canned/bottled but Table 5 shows they are substitutes for one another. It seems reasonable that substitutes are more dominant.

Table 5. Estimates of compensated price elasticities at the mean shares

Demand q_i	Price p_j		
	Beans/Powder	Canned/Bottled	Coffee shops
Beans/Powder	-0.614*** (-50.663)	0.307*** (21.254)	0.523*** (33.235)
Canned/Bottled	0.195*** (21.254)	-0.732*** (-12.552)	0.338*** (7.337)
Coffee shops	0.419*** (33.235)	0.425*** 7.337)	-0.861*** (-17.629)

Note. The same as Table 3.

The estimates of the monthly rate of shift and demographic effects at the mean shares are reported in Table 6. The monthly rate of shift is the effect of the linear time trend (t) on demand. All three of the coffee product categories show significant effect on quantity demanded. As time goes by, demand for beans/powder and coffee shops decreases while demand for canned/bottled increase. When the household size (z_1) increases demand for beans/powder and canned/bottled is positive while demand for coffee shops is negative. When there are more elders in the household (z_2), demand for coffee shops increases while demand for beans/powder decreases. We can speculate that people over the age of 65 may prefer drinking their coffee at coffee shops since coffee shops are places for leisure gathering. In Japan, coffee shops are mostly popular in Nagasaki, Kobe, and Yokohama, as all three cities are known to have international trade port. When there are more earners in the household (z_3), demand is positive for coffee shops while it is negative for canned/bottled coffee. This is also true as far as Japan is concerned since people who earn more will tend to drink outside of their home such as at coffee shops. When the household head is older (z_4), demand for beans/powder is positive while demand for canned/bottled and coffee shops are negative.

Table 6. Estimates of monthly rates of shift and demographic effects at the mean shares

Demand q_i	Monthly rate of shift (%/month)	Demographic variable z_k				
		Number of persons per household (%/person)	Number of persons per household over the age of 65 (%/person)	Number of earners per household (%/person)	Age of the head (%/year old)	Rate of those paying rent (%/%)
Beans/Powder	-0.043*** (-6.770)	10.061*** (4.793)	-6.942* (-1.789)	-3.598 (-1.454)	1.279*** (5.701)	-0.057 (-1.371)
Canned/Bottled	0.239*** (21.355)	16.305*** (6.455)	-7.283 (-1.559)	-5.960** (-2.002)	-0.764*** (-2.828)	0.122** (2.424)
Coffee shops	-0.137*** (-12.944)	-25.522*** (-9.268)	14.456*** (2.840)	9.230*** (2.844)	-0.990*** (-3.364)	-0.025 (-0.464)

Note. The same as Table 3.

The estimates of temperature effects at the mean shares are shown in Table 7. For beans/powder, temperature shows positive signs from the month of February to July and negative signs from August to November. For canned/bottled, with the exception of January, temperature is positive in every month. In contrast, for coffee shops, with the exception of January, temperature shows negative signs in each month. As far as Japan is concerned, this is perhaps because beans/powder is usually consumed as a hot beverage. The positive temperature effect for canned/bottled is mostly high in July and September. Studies by Yohannes and Matsuda (2016) and Yohannes and Matsuda (2015), found temperature to have a positive effect on demand for beans/powder (coffee), which is consistent with this study. The negative temperature effects for coffee shops is high in May and August, but is relatively even during the season. This means that, for example, as temperature rises by 1 degree Celsius in the month of May, demand for coffee shops decreases by 1.235%. This is perhaps because coffee is usually served hot at coffee shops in Japan.

Table 7. Estimates of temperature effects at the mean shares

Demand q_i	January	February	March	April	May	June
Beans/Powder	-1.116***	0.510***	0.538***	0.389***	0.492***	0.118
	(-3.833)	(10.165)	(8.741)	(6.891)	(6.823)	(1.379)
Canned/Bottled	-0.179	0.527***	0.572***	0.696***	0.780***	1.226***
	(-0.509)	(8.468)	(7.572)	(9.972)	(8.863)	(11.778)
Coffee shops	1.536***	-1.055***	-1.127***	-1.039***	-1.235***	-1.122***
	(4.020)	(-15.829)	(-13.821)	(-13.862)	(-12.965)	(-9.957)
Demand q_i	July	August	September	October	November	December
Beans/Powder	0.038	-0.138	-0.320***	-0.232***	-0.551***	0.204***
	(0.388)	(-1.282)	(-3.218)	(-2.612)	(-8.777)	(4.472)
Canned/Bottled	1.332***	1.785***	1.984***	1.808***	1.201***	0.635***
	(11.123)	(13.728)	(16.485)	(16.788)	(15.573)	(11.215)
Coffee shops	-1.106***	-1.247***	-1.177***	-1.147***	-0.266***	-0.760***
	(-8.514)	(-8.834)	(-9.013)	(-9.820)	(-3.207)	(-12.497)

Note. The same as Table 3.

4. Conclusion

This study applying the LA/QUAIDS model analyzed substitution among three coffee product categories in Japan using monthly data obtained from FIES. The empirical results reveal that expenditure elasticities for coffee shops are elastic while demand for beans/powder and canned/bottled are inelastic. The implication is that coffee shops are luxuries good, while beans/powder and canned/bottled are necessities. The uncompensated own-price elasticities show that coffee shops are own-price elastic whereas beans/powder and canned/bottled are own-price inelastic. The uncompensated cross-price elasticity shows it is mostly significant for all coffee product categories. As for the compensated cross-price elasticity, it reveals that all coffee product categories: beans/powder, canned/bottled and coffee shops are substitutes for one another, which is consistent with reality of coffee demand in Japan. Demographic effects are found to play a significant role in the Japanese coffee consumption. As householde size increases, consumers prefer to drink beans/powder and canned/bottled. As for elderly and people who earn more, the results indicate that they prefer to drink at coffee shops. This is true since coffee shops are known as a leisure place. Seasonal effects also play an important role on the responsiveness of coffee consumption in Japan. The findings suggest that when temperature rises people consume more of canned/bottled beverages, whereas when temperature drops consumers prefer to drink at coffee shops. This result makes sense since canned/bottled beverages are usually served as a cold beverage through vending machine in Japan whereas for coffee shops, it is usually served as hot beverage.

The findings of our study carry a useful implication. We find substitution among the three coffee products, which implicates competition among suppliers of coffee products. Such competititon will help the growth of coffee consumption in Japan.

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References

Agra-net. (2015). Outlook for the World Coffee Market 2014. *F.O. Licht Commodity Analysis*. Retrieved from http://foodchemicalnewspromo.agra-net.com/files/2015/02/World-Coffee-Market-2014-SAMPLE.pdf

All Japan Coffee Association. (2010). *History of Japan's coffee market and outline of the three neighboring countries market situation*. Retrieved from http://ico.org/event_pdfs/wcc2010/presentations/wcc2010-ohta-e.pdf

All Japan Coffee Association. (2015). *Basic survey on coffee demand trends in Japan*. Retrieved from http://coffee.ajca.or.jp/wp-content/uploads/2011/08/data04_2015-06b.pdf

Alston, J. M., Chalfant, J. A., & Piggott, N. E. (2001). Incorporating demand shifters in the almost ideal demand system. *Economics Letters, 70*, 73-78. http://dx.doi.org/10.1016/S0165-1765(00)00322-0

Banks, J., Blundell, R. W., & Lewbel, A. (1997). Quadratic Engel curves and consumer demand. *Review of Economics and Statistics, 79*, 527-539. http://dx.doi.org/10.1162/003465397557015

Deaton, A. (1985). Panel data from time series of cross-sections. *Journal of Econometrics, 30*, 109-126. http://dx.doi.org/10.1016/0304-4076(85)90134-4

Deaton, A. S., & Muellbauer, J. (1980). An almost ideal demand system. *The American Economic Review, 70*, 312-326.

Dharmasena, S., Capps Jr, O., & Clauson, A. (2009). *Nutritional contributions of non-alcoholic beverages to the U.S. Diet: 1998-2003*. Southern Agricultural Economics Association Annual Meeting, Atlanta, GA.

Euromonitor International. (2014). *State of the Coffee Market in North America*. Retrieved from http://www.hawaiicoffeeassoc.org/Resources/Documents/State-of-Coffee-Market-Euromonitor.pdf

Family Income and Expenditure Survey. (2015). *Revision of the CPI Items for the 2015-base*. Retrieved from http://www.stat.go.jp/english/info/meetings/og2015/pdf/t6s10p32_pap.pdf

Gebrehiwot, W., & Daloonpate, A. (2012). Demand analysis of Ethiopian coffee in Japan. *Kasetsart Journal, 33*, 142-151.

Goddard, E. W., & Akiyama, T. (1989). United States demand for coffee imports. *Agricultural Economics, 3*(2), 147-159. http://dx.doi.org/10.1016/0169-5150(89)90023-6

Houston, J. E., Santillan, M., & Marlowe, J. (2003). US demand for mild coffees: Implications for Mexican coffee. *Journal of Food Distribution Research, 34*(1), 92-98.

International Coffee Organization. (2011). *Volatility of Retail Prices of Roasted Coffee in Selected Countries*. Retrieved from http://www.ico.org/presents/1011/icc-106-12-volatility.pdf

International Coffee Organization. (2015a). *Japan Joins the International Coffee Organization*. Retrieved from http://www.ico.org/documents/cy2014-15/pr-282e-accession-japan.pdf

International Coffee Organization. (2015b). The Current State of the Global Coffee Trade. Retrieved from http://www.ico.org/monthly_coffee_trade_stats.asp?section=Meetings

Japan Soft Drink Association. (2014). *Statistical Beverage Data on Coffee items 2013*. Retrieved from http://www.j-sda.or.jp/about-jsda/business-scheme.php

Kunifuji, S., Papadopoulos, G. A., Skulimowski, A. M., & Kacprzyk, J. (Eds.). (2016). *Knowledge, Information and Creativity Support Systems* (Vol. 416). Selected Papers from KICSS'2014-9th International Conference, held in Limassol, Cyprus, on November 6-8, 2014, Springer. http://dx.doi.org/10.1007/978-3-319-27478-2

Matsuda, T. (2006). Linear approximations to the quadratic almost ideal demand system. *Empirical Economics, 33*, 663-675. http://dx.doi.org/10.1007/s00181-005-0044-3

Okunade, A. A. (1992). Functional forms and habit effects in the US demand for coffee. *Applied Economics, 24*(11), 1203-1212. http://dx.doi.org/10.1080/00036849200000130

Pollak, R. A., & Wales, T. J. (1980). Comparison of the quadratic expenditure system and translog demand systems with alternative specifications of demographic effects. *Econometrica,* 595-612. http://dx.doi.org/10.2307/1913125

Pollak, R. A., & Wales, T. J. (1992). *Demand System Specification and Estimation*. Oxford University Press Catalogue. http://dx.doi.org/10.1007/978-94-011-1795-1_6

Sellen, D., & Goddard, E. (1997). Weak separability in coffee demand systems. *European Review of Agricultural Economics, 24*(1), 133-44. http://dx.doi.org/10.1093/erae/24.1.133

Smil, V., & Kobayashi, K. (2012). *Japan's Dietary Transition and Its Impacts*. MIT Press.

Statista. (2015). *Total coffee consumption in Japan from 1990 to 2014*. Retrieved from http://www.statista.com/statistics/314986/japan-total-coffee-consumption

Thurston, R. W., Morris, J., & Steiman, S. (Eds.). (2013). *Coffee: A Comprehensive Guide to the Bean, the Beverage, and the Industry*. Rowman & Littlefield Publishers.

Yeboah, D. (1992). Forecasting coffee consumption with a flexible consumer demand function. *UNCTAD Review, 3*, 71-96.

Yohannes, M. F., & Matsuda, T. (2015). Demand Analysis of Non-Alcoholic Beverages in Japan. *Journal of Agricultural Science, 7*(5), 143-153. http://dx.doi.org/10.5539/jas.v7n5p143

Yohannes, M. F., & Matsuda, T. (2016). Weather Effects on Household Demand for Coffee and Tea in Japan. *Agribusiness, 32*, 33-44. http://dx.doi.org/10.1002/agr.21434

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