SUMMARY OF DOCTORAL THESIS

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Title: **Demand System Analysis of Coffee in the Japanese Households**
（日本の家計におけるコーヒーの需要システム分析）

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Coffee is one of the most demanded agricultural commodities in the world. The coffee beverage market is one of the biggest industries globally. Over the past 4 years, global coffee consumption has been increasing by 2.4% annually. Japan, which has seen its coffee demand increase significantly over the past few years, is one of the top coffee-consuming nations, after the United States, Brazil, and Germany. The Japanese coffee beverage market consist of several coffee product categories; mainly, coffee beans and powder, canned and bottled coffee, coffee containing milk beverage, and coffee containing soft drinks.

As a popular beverage, coffee has been an interest of study for many researchers, economists, and policy makers over the past few decades. Several studies were conducted using various estimation models for coffee product categories analyzing mostly income and price elasticities in different countries. With regards to Japanese coffee demand, however, studies have been few to none. This thesis, therefore, attempts to provide a comprehensive demand system analysis of coffee consumption in the Japanese household from a regional, city level point of view, taking into account factors such as expenditure and price changes, demographic, and weather effects among others.

The quadratic almost ideal demand system (QUAIDS) model, which was developed from utility maximization by Banks et al. (1997), not only applies 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, whereas in the case of AIDS, the elasticities are not dependent of expenditure level. This thesis employs the linear version of QUAIDS (LA/QUAIDS) model by Matsuda (2006). We chose this specific model, LA/QUAIDS, because it has the characteristics of 'Closure Under Unit Scaling' (CUUS), even with demand shifters such as demographic variables, monthly and city dummies (Alston et al., 2001). With demand shifters, the original QUAIDS of Banks et al. (1997) does not satisfy CUUS. According to Pollack and Wales (1992), CUUS is a property that ensures that estimated economic effects are constant to the scaling of the data. In addition, Pollack and Wales (1980) stated that only demand systems consistent with CUUS should be used for empirical demand analysis.

Monthly aggregate pseudo panel data, which is repeated cross sectional data, for two or more person households for 49 cities, was attainted from the Family Income and Expenditure Survey (FIES) of Japan for this thesis. The use of aggregate pseudo panel data enables us to analyze the impact of the important demographic and weather variables affecting coffee and other non-alcoholic beverages consumption patterns in Japan. Considering the changes in prices, all expenditure data for coffee and other non-alcoholic beverages were deflated using the consumer price index. To evaluate the temperature effects, monthly data were outsourced from Japan Meteorological Agency (JMA).

Using the LA/QUAIDS model, we attained the following results; The estimated results for the

non-alcoholic beverages in Japan reveal that expenditure for green tea, black tea, coffee, and fruit and vegetable juice was found to be elastic implying a luxury goods, whereas tea beverage, coffee beverage, and milk was found to be inelastic implying necessity goods in the household. The uncompensated own-price elasticity show that demand for green tea, black tea, tea beverage, coffee, coffee beverage, and carbonated beverage are own-price elastic while demand for fruit and vegetable juice and milk are own-price inelastic. As for the cross-price elasticities both uncompensated and compensated show the beverages as mostly complementary goods. As for demographic effects, the results shows that people under the age of 18 prefer milk and fruit and vegetable juice than any other beverages whereas people over the age of 65 prefer green tea, in addition to milk. The findings indicate a strong correlation between consumer behavior and health against its dietary implication in the Japanese household. As for seasonal effects, the results indicate that when temperature rises by 1 degree Celsius, consumers drink more tea beverage, coffee beverage, fruit and vegetable juice, and carbonated beverage whereas when temperature drops by 1 degree Celsius, consumers prefer more green tea, black tea, and coffee. This is probably because in Japan green tea, black tea, and coffee are usually served as a hot beverage and are usually consumed at home whereas beverages such as tea beverage, coffee beverage, fruit and vegetable juice and carbonated beverage are served cold and are available in convenience shops and through vending machines. The implication regarding this study is that milk demand could increase if the government taxes coffee beverage and carbonated beverage, as both beverages are substitutes for milk.

Regarding weather effects on household demand for coffee and tea in Japanese household, the estimated result shows that expenditure elasticities for green tea and black tea as elastic, implying luxury goods, whereas tea beverage, coffee and coffee beverage show they are inelastic, implying a necessity good. The uncompensated own-price elasticities reveals that green tea has the most own-price elastic demand and coffee has the most own-price inelastic. The compensated cross-price elasticities show most of the beverages as complementary goods.

As for demographic effects, the result shows green tea as a preferred beverage among elderly people, while adults prefer mostly tea beverage and coffee beverage. In reality the finding makes sense since green tea is usually consumed for its health benefits whereas tea beverage and coffee beverage are drinks accessible through vending machine. Global warming, which is the gradual rise of temperature has a significant impact on household demand for coffee in Japan throughout the year. The result reveals that when temperature rises by 1 degree Celsius consumers drink more green tea, black tea, and coffee whereas when temperature drops by 1 degree Celsius consumers drink more tea beverage and coffee beverage. Consequently, our findings have implications for beverage marketing strategy. Based on our results, particularly the temperature findings, beverage manufacturers can produce and supply their beverages according to the seasonal changes.

As for the study regarding substitution in consumer demand for coffee product categories in Japan, the estimation results show the expenditure elasticities for coffee shops to be elastic implying a luxury good, while demand for beans/powder and canned/bottled as inelastic indicating a necessity good. The uncompensated own-price elasticities reveal that coffee shops are own-price elastic whereas beans/powder and canned/bottled as own-price inelastic. As for the compensated cross-price elasticity the study reveals that all coffee product categories are substitutes for one another.

As for demographic effects is concerned, elderly person and people who earn more tend to consume coffee at coffee shops. Temperature effects also play a significant role on the responsiveness of coffee consumption in Japan. The result shows that when temperature rises by 1 degree Celsius, people consume more canned/bottled beverages, whereas when temperature drops by 1 degree Celsius, consumers favor coffee at coffee shops. As for implication is concerned, our study reveals that all coffee categories are substitutes for one another. Therefore, coffee manufacturers can endorse all forms of coffee product categories for household consumption and out-of-home coffee consumption.