Probability of Shopping among Japanese Consumers: Variations by Storage, Travel, and Opportunity Costs

Tsutomu Toida

Abstract

Shopping is an essential activity for household management, and consumers make shopping decisions nearly every day. Although shopping is necessary for consumers, there is limited information on how shopping is performed in a given day and how the frequency of shopping is affected by consumption cost factors, categorized as storage costs, travel costs, and opportunity cost of time. We examine the effects of storage costs, travel costs, and opportunity costs of time on consumers' shopping decisions on a given day. Using anonymous micro data from the Survey on Time Use and Leisure Activity (STULA) conducted by the Statistics Bureau in 2001, we find that increases in storage costs and decreases in travel costs result in a greater probability of shopping. The other parameter estimates on consumer demographics are palatable in terms of opportunity costs of time and thus support our analysis.

Keywords: Consumer behavior; Housing constraints; Travel costs; Opportunity cost of time; Daily shopping

Introduction

Shopping and storage behavior are primary consumer activities. Individuals purchase various products for consumption by shopping to satisfy their needs and wants. The consumption of products, particularly nondurable ones, requires consumers to make purchases at stores and stock them until consumption.

Economics and marketing researchers have investigated shopping and storage behavior for 30 years on the basis of the assumption that consumers make decisions rationally, based on Becker's (1965) study. They explained shopping behavior through consumer costs, which include storage, travel, and time (opportunity). They primarily focused on the relationships between storage behavior and the following: consumers' responses to price specials (Blattberg et al. 1978; Blattberg et al. 1981; Hendel and Nevo 2006b; Walters and Jamil 2003), interpurchase time (Boizot et al. 2001), and the quantity purchased (Hendel and Nevo 2006a). Although the frequency and probability of shopping have attracted relatively less attention from researchers among the aforementioned aspects of shopping behavior, it deserves greater attention because the first stage in a shopping decision is to decide whether to go shopping. Shopping frequency varies among consumers because some consumers have various reasons to shop more frequently than others. For example, consumers who prefer fresh fish and/or fresh meat, those with small storage space, and those living near a grocery store have an incentive to shop more frequently than others.

In marketing, several studies describe the relationship between shopping frequency and consumer costs, which include storage, travel, and time (opportunity). Kahn and Schmittlein (1989) demonstrate that the distribution of intershopping spells exhibits a seven-day cycle, stemming from the dependence and preference of consumers' shopping decisions on a specific day of the week. Bawa and Ghosh (1999) investigate the effects of these costs on shopping frequency and per trip expenditure using a simultaneous equation model. They demonstrate that cost factors affect shopping behavior and that there is a complex relationship between cost factors and shopping behavior.

In economics, empirical work focuses primarily on the effects of storage costs on consumers' frequency of shopping and firms' pricing behavior because storage costs are a key assumption in constructing theoretical models that describe consumer behavior. For example,

Salop and Stiglitz (1982) have developed a model for explaining price dispersion among stores by using consumer storage costs. Many researchers such as Boizot, Robin, and Visser (2001); Hong, McAfee, and Nayyar (2002); Hendel and Nevo (2006a, b); and Bell and Hilber (2006) also analyze the effects of storage costs on consumer behavior in their models. Among these studies, Bell and Hilber (2006) investigate the effects of consumer storage costs on shopping frequency, expenditure per shopping, and firms' pricing behavior to test the model proposed by Salop and Stiglitz (1982). They indicate that an increase in consumer storage constraints leads to an increase in shopping frequency and offered retail prices, as well as a decrease in expenditure per shopping trip. They also demonstrate that these findings are consistent with those of the model of Salop and Stiglitz (1982).

As the cost factors examined by marketing and economics affect the probability of shopping, Japanese culture is also crucial to it. The results of the STULA (Statistics Bureau 2003) data reveal the factor of individual time use in Japan, demonstrating that Japanese people go shopping more on weekends than on weekdays and that the participation rate in shopping in a given day varies considerably by gender. In addition, previous studies on housework participation within families (Matsuda and Suzuki 2002; Nishioka 1998; Ueda 2005) reveal substantially unequal housework responsibility within families in Japan. That is, married women take on a large portion of housework responsibility, including cooking, caring, nursing, shopping, and child care, especially on weekdays, irrespective of their employment status. Therefore, these facts relating to the factor of domestic labor in Japan is considered in the present study's empirical analysis.

Analyzing individual shopping behavior is also important, considering the unit of observation of time use records, although earlier studies on the frequency of shopping focused on household shopping[1]. For example, from casual observation and previous studies on intrafamily time allocation of housework, we find that shopping decisions vary among characteristics such as gender, age group, and employment status. These findings result from shopping decisions being made primarily individually, depending on storage costs, travel costs, opportunity cost of time, and time constraints, which might be at least partly associated with household characteristics. In addition to this possibility, as cultural background could affect the men's and women's shopping

[1] For example, Bawa and Ghosh (1999) and Bell and Hilber (2006) exploit the dataset collected over a one-year and two-year period, respectively.

probabilities in a different manner, it is meaningful to examine shopping activity using individual time use data. However, no previous research has used individual time use records to empirically study the probability of shopping.

In this study, we use an individual-level dataset to investigate the correlation of storage costs, travel costs, opportunity cost of time with the probability of shopping in a given day. We take into account individuals' time constraints, such as the length of time occupied by other activities, including those reflecting Japanese culture, that might affect shopping probability primarily through the change in the opportunity cost of time. Therefore, we evaluate the relationship between these costs and the probability of shopping after controlling for time constraints as well as taking Japanese culture into account. This is now feasible because for each sampled individual, we have a two-day activity diary reported in 15-min units and including many personal and household characteristics. To the best of our knowledge, this is the first empirical study using individual-level data to analyze consumers' shopping decisions.

Our dataset includes variables that directly relate to storage constraints and travel costs, such as the number of rooms and the possession of private cars. It also includes an extremely rich set of consumer characteristic variables. The datasets used by earlier studies did not contain direct measures that could be used as proxies for storage and travel costs. As compared to the previous studies, our study contributes a more precise evaluation of the correlation between cost factors and shopping decisions in a given day by using more detailed data and variables to examine the issue. Furthermore, our results suggest managerial and public policy implications that are expected to be important among all developed countries, especially for Japan.

The rest of this paper is organized as follows. It begins with a brief theoretical background in the next section. Section 3 provides a description of the data. Section 4 describes the empirical model. Section 5 summarizes the empirical results, and the last section provides conclusions and suggestions for future research.

Theoretical Background

In this section, we present the theoretical background of the effects of consumer storage costs, travel costs, and opportunity cost of time on the frequency of shopping. We primarily focus on nondurable products that are storable, at least for a short period. The theoretical background

represented in this section is common in economics and marketing literature represented by Blattberg et al. (1978) and Bawa and Ghosh (1999), which are based on Becker's (1965) seminal work.

Assume that consumers make decisions rationally and consume a predetermined basket of products to maximize their utility in any time interval by determining the frequency of shopping, quantity of products purchased, and consumption rates for each product. The composition and quantity of the predetermined basket of products depend on consumer demographics such as household composition and income. This is assumed to be constant over a short term.

Consumers visit stores that sell the products they plan to consume, purchase the product, store it for a certain period, and then consume it when needed. By doing so, they incur three main types of costs: monetary, transaction, and storage. Monetary costs relate to the money expended to procure the predetermined basket of products. Storage costs include the costs to hold the physical space available for inventory and interest on capital. Interest on capital, which is an important economic cost, is part of storage costs because storing products until consumption eliminates the opportunity to acquire interest if the money expended to procure the products were invested in stocks or deposited in a bank. Transaction costs from shopping are factored into travel costs incurred during shopping trips and the opportunity cost of time.

Monetary costs and interest on capital are assumed as proportionate to the predetermined basket of products, because these pecuniary costs stem from procuring and storing a basket with a specific composition and volume. Thus, we designate storage costs as the cost of holding the physical space available for inventory, excluding the interest on capital.

Storage costs and the interest on capital, which stem from the gap between the time of purchase and that of consumption, should affect a consumer's shopping behavior and a firm's pricing behavior. If consumers find that the retail price of a product is set lower than its past prices, they may purchase large quantities of the product to stockpile it for future consumption. They may also consume the stockpiled product if they find that its price is set relatively high than past prices. Consequently, inventory behavior enables consumers to save money and mitigates the effects of pricing on products by retailers. While inventory behavior enables consumers to avoid purchasing products at a high price, it causes them to incur storage costs, which include the cost of physical storage space, the cost of storage equipment, and so on.

Consumers with higher storage costs are expected to shop more frequently than those with lower storage costs, holding other factors constant, because the former tend to avoid storing purchased products as they face relatively higher storage costs than the latter. Although we cannot always directly observe storage costs, several variables are considered a proxy for storage costs: number of rooms, type of residence, and land prices around residential areas. For example, a consumer living in an urban district is expected to shop more often than the one living in a rural district because higher land prices in urban districts lead to relatively higher storage costs than those in rural districts.

When consumers shop, they incur transaction costs, which consist of travel costs and opportunity cost of time taken for shopping trips. These also include search costs. Recently, online shopping has become popular in developed countries, and consumers can purchase products online without going on a shopping trip; however, they incur delivery costs and opportunity cost of time to select and purchase products using computers, smart phones, or telephones.

Travel costs associated with the costs incurred on shopping trips affect consumer shopping probability because their increase reduces the probability of shopping. Three important components determine travel costs. The first is called shoe leather costs, which relate to the transportation fare charged for shopping trips and the cost of gasoline. The second is the possession of private cars. Consumers owning private cars can easily access stores and choose their means of visiting stores from more alternatives, implying that they experience lower travel costs for additional shopping trips as compared to consumers without private cars. However, note that owning an automobile incurs the costs of acquiring and maintaining an automobile before the decision on shopping trips. The third is the residential area. In urban districts, stores tend to be more clustered together than in rural districts, implying that consumers living in urban areas might require less time to shop than do consumers living in rural areas. In addition, urban areas' public transportation can lower shopping-related travel costs.

Consumers with a higher opportunity cost of time are expected to shop less frequently than those with a lower opportunity cost of time. Although the opportunity cost of time is unobservable, it varies across consumers depending on individual time constraints and demographic characteristics including age, gender, income, employment status, education, household composition, and the presence of preschool children. For example, other things being equal, a consumer employed by a firm who works forty hours per week has a higher opportunity

cost of time for additional shopping trips than an unemployed consumer, because an employed consumer has much less time available to perform activities other than work and commuting. Consequently, we treat these variables as a proxy for the opportunity cost of time.

In summary, the theory indicates that shopping behavior depends on monetary costs, storage costs, travel costs, and opportunity cost of time for shopping. An increase in storage costs and a decrease in travel costs and opportunity cost of time increase the probability of shopping.

Data Used in the Analysis

The data used in this study were collected from the anonymous nonpublic microdata of the Survey of Time Use and Leisure Activities (STULA) conducted in October 2001 by the Statistics Bureau, Ministry of Internal Affairs and Communications of Japan. In the STULA, approximately 77,000 households were randomly selected from consumer households in Japan[2] by using a stratified two-stage sampling. Roughly 270,000 people over 9 years of age, which include school children, in the sample households were asked to complete a questionnaire on how they utilized their time in a two-day period. The survey respondents were asked to identify their activities and the people who accompany them in these activities during the designated consecutive two-day period in 15-min units. The activities were divided into 20 mutually exclusive categories, which included shopping, commuting, working, moving, and sleeping. In addition to this survey, the heads of the sampled households were asked to complete a questionnaire on their household demographic characteristics such as age, gender, marital status, income, employment status, and education. Our dataset consisted of 80% anonymous households randomly resampled from all STULA sample households.

Our data have several strengths. First, our data's target population and sample size are more diverse and described in more detail than those used in previous studies. The population covers virtually all consumer households and people in Japan, enabling us to examine the entire country's shopping activities. Second, the data include information associated with storage constraints and travel costs, such as the number of rooms, type of residence, and possession of

[2] Unfortunately, our data are anonymized by eliminating geographical information of sampled households, such as a prefecture, municipality, and district.

cars. These characteristics, which directly relate to storage and travel costs, are not available in previous studies and enable us to evaluate more precisely their association with the probability of shopping[3]. Third, our data contain information about the days of the week, enabling us to observe variations in shopping activity across weekdays and weekends, as well as analyze the relationship between these and demographic characteristics. Fourth, the data include information about time utilization for each individual, enabling us to investigate shopping probability after controlling for time constraints within a given day. Fifth, because the data contain more detailed demographic information relating to the opportunity cost of time for the sample households and persons as compared to earlier studies, we can examine the relationship between shopping activity and the opportunity cost of time, and control for demographic characteristics to closely evaluate the relationship between cost factors and shopping probability in a given day.

Our data do, however, have several limitations. First, because the activities in our data are reported every 15 min, any activity lasting less than 15 min would not be reported in the STULA. Therefore, shopping activities such as buying a newspaper at a kiosk or getting a soft drink from a vending machine would not be reported in our data. Winkler and Ireland (2009) demonstrate that the underestimation of total activity time can likely occur in analyzing time use records for time spent in household management. However, this is not a severe drawback because our study focuses on the buying behavior of nondurable storable products, and the purchasing activities mentioned above fulfill short-term individual wants for immediate consumption. Second, our dataset does not include the places where the activities occur, and so a shopping activity cannot be identified as either online or offline. However, the data from STULA were surveyed in 2001, and at that time, online shopping was less prevalent than it is today. Therefore, the shopping activities

[3] Bawa and Ghosh (1999) used home ownership as a proxy for storage constraints and the age of the head of household and household income as a proxy for travel costs. Bell and Hilber (2006) estimated the size of a housing unit for each zip code using the American Housing Survey and the U.S. Census, and used these as a proxy for storage costs. They used the distance to stores as a proxy for travel costs.

reported in our data primarily consist of offline shopping[4]. Third, because the types of products the respondents purchased during shopping are not reported in the STULA, durable and nondurable goods shopping are mixed and indistinguishable in the reported shopping activity. However, because we focus on the relationships among storage costs, travel costs, the opportunity cost of time, and the frequency of shopping, we prefer only nondurable shopping to be reported in our data. Fortunately, the 2001 Family Income and Expenditure Survey (FIES), conducted by the Statistical Bureau of Japan, indicates that the ratio of expenditure on durable goods to that on all goods was 11.9%. In addition, durable goods' shopping is less frequently performed than nondurable goods' shopping because of the former products' durability. Therefore, a large proportion of the reported shopping activities were nondurable goods shopping[5].

Our sample consists of single day activities and the consumer demographics of survey respondents. Because a large part of the survey respondents reported two-day activities, they are included in our sample as two distinct records with identical demographic characteristics and probably different daily activities. Each daily activity record is checked for whether it contains shopping activities, and we equate "yes" with 1 and "no" with 0. We use this as a dependent variable in our probit model.

We impose several restrictions on the data. Because we are interested in shopping activities preformed on regular weekdays and weekends, we exclude records on special days including "travel (at least one overnight stay)"; "day excursion (more than half a day)"; "event, wedding, or funeral (more than half a day)"; "business trip or training"; and "under medical treatment." We also exclude individuals younger than 20 years of age and those attending school, because their shopping behavior would be different from that of adults. We exclude individual

---

[4] The 2004 National Survey of Family Income and Expenditure (NSFIE), conducted by the Statistics Bureau of Japan, reported that on average two or more person households made 96% of their household expenditure on commodities at conventional retail stores, which included general retail stores, supermarkets, convenience stores, department stores, cooperative stores, and discount stores.

[5] The 2001 FIES reported that the annual average of monthly consumption expenditure per household for goods was 154,497 yen and that for durable goods was 18,359 yen.

records whose households receive caring assistance from anyone outside the household, and those with missing values in one or more variables included in the probit model introduced in the fourth section, obtaining a common sample for estimating all parameters. After these initial exclusions from the original 285,815 records, we retain 208,764 single-day activity records[6].

Table 1 reports selected sample statistics by gender and shopping, indicating that the frequency of shopping differs across individual characteristics such as working and commuting hours. All characteristics used in this article are demonstrated in the Appendix.

Those over 80 years of age are less likely to shop compared to younger people. There is also a remarkable difference in the frequency of shopping between married and unmarried women, while there is no such difference between married and unmarried men. We also found that the longer the working and commuting hours, the lower the frequency of shopping.

Household characteristics such as residential area and the details of household composition also affect the frequency of shopping, correlating with each other in a complex manner. Therefore, the relationship between these characteristics and shopping frequency should be examined after controlling for other characteristics. We analyze this relationship in the following section using a probit model.

Empirical Model

We select variables on the basis of the foregoing theoretical background. The empirical specification we estimate to describe the probability of shopping takes the following form:

$$y_i^* = \beta * STORAGE_i + \gamma * TRAVEL_i + X_i\kappa + u_i$$

$$y_i = 1[y_i^* > 0],$$

where *STORAGE, TRAVEL,* and *X* correspond, respectively, to the set of variables that relate to storage costs, travel costs, and consumer demographic characteristics associated with the opportunity cost of time. However, note that this classification of variables is not rigid because certain variables are related to two or more cost factors.

---

[6] We analyze the data using STATA 11.

Although the theoretical background suggests ways in which differences in consumers' storage costs, travel costs, and opportunity costs of time affect the probability of additional shopping in a given day, we here provide a more detailed consideration and definition of the variables serving as proxies for the cost factors in our empirical analysis.

STORAGE includes the number of rooms and the type of residence. The number of rooms means how many rooms exist in the respondent's family residence excluding entrance, kitchen, washroom, bathroom, corridors, shop, or office space used for commercial purpose, or rooms used by member of other families. The type of residence designates whether the respondent's family owns or rents the house in which they live. In Japan, owner-occupied houses tend to be larger than rented houses even if the number of rooms is same, because the size of rooms tends to be large in owner-occupied houses. Therefore, these variables directly relate to the storage costs. Those living in an owner-occupied house with many rooms face smaller space constraints than do those living in a rented house with the same number of rooms. Therefore, homeowners would be expected to shop less frequently than renters.

TRAVEL includes the residential area and the possession of private cars. The residential area is considered as a proxy for storage and travel costs because it relates to retail store density and population density. In urban areas, because retail stores are likely to be located close to residential areas, travel costs are lower than those in other areas. In addition, storage costs in urban areas tend to be higher than those in other areas because higher land rent and land price lead to higher costs for more rooms that could be utilized for storage space. Therefore, urban dwellers are more likely to encounter higher storage costs and lower travel costs, implying that they tend to shop more frequently. The possession of cars, assumed to be a predetermined factor in a shopping decision, has mixed effects that might increase or decrease additional shopping probability, for two reasons. On one hand, because the possession of cars adds an alternative means of transportation to the set of other means, it could decrease travel costs and the opportunity cost of time. On the other hand, because shopping trips by private cars enable consumers to purchase more products per trip, it could decrease shopping frequency.

X includes working hours, commuting hours, and the set of consumer demographics. We assume working and commuting hours to be a predetermined factor in shopping decisions. Working and commuting hours are proxies for the opportunity cost of time. Because these time constraints create difficulty in going shopping, more time constraints are expected to reduce

shopping probability. All variables contained in X except for working hours, commuting hours, number of persons, and number of rooms are categorically measured and included in our model as dummies[7].

Consumer demographics in X include age, marital status, education, annual household income, number of fulltime workers, existence of preschool children, number of people over 10 years of age, and number of children under 10 years of age. These variables serve as proxies for the opportunity cost of time and as determinants for the predetermined basket of products.

Because consumer age is a proxy for the physical status that affects individuals' geographical area of activity, it naturally pertains to travel costs and the opportunity cost of time. Because physical decline associated with old age could cause their shopping trip to be more cumbersome and time consuming, older people might incur higher travel costs and higher opportunity cost of time compared to younger people, and these higher costs would prevent shopping trips.

As the annual household income pertains to the opportunity cost of time and the composition of the predetermined basket of products, ways in which income relates to additional shopping probability could not be predicted for the following reason. Higher income leads to a higher consumption level and a more diversified set of products through a change in the composition of the predetermined basket of products, contributing to a positive correlation between income and the frequency of shopping. However, higher income also means higher opportunity cost of time, which might cause a negative association between them. Similarly, education's relationship with the probability of shopping could not be examined exclusively, because highly educated people could, on one hand, prefer a greater variety of products, associated with more shopping activity, but, on the other hand, they face higher opportunity cost of time for shopping, similar to those with higher incomes.

Other consumer demographics, such as the existence of preschool children, number of children under 10 years of age, number of people over 10 years of age, marital status, and number of fulltime workers, could also affect additional shopping probability through the change in opportunity cost of time for shopping and the change in size and variety of the composition of the predetermined basket of products. For example, as the existence of preschool children and the

---

[7] See Appendix.

number of children under 10 years of age pertain to childcare and demand considerable time, it should negatively associate with the probability of shopping, because those who perform the job of child rearing have a relatively high opportunity cost of time for shopping as compared to those without that responsibility.

Simultaneously, variations in opportunity cost of time and time allocation for shopping could stem at least partially from Japanese culture. Empirical studies on time use in Japan indicate that there is markedly unequal housework duty between genders in Japan. Married women tend to have relatively greater housework responsibility as compared to their husbands (Matsuda and Suzuki 2002; Nishioka 1998; Ueda 2005). Married men help reduce their wives' housework if it seems to be necessary for their family, as when they are rearing children (Nishioka 1998). This means it is possible for married men to help with their wife's housework only on weekends, because a large proportion of working men have a regular holiday on Saturday and Sunday. Therefore, we can expect that marital status, combined with the existence of preschool children, affects shopping probability positively for men and negatively for women.

Furthermore, from Table 1 and also casual observations, because women perform a large share of the duty of shopping as well as other activities related to household management, a significant portion of women's shopping might be grocery shopping to satisfy household needs. Thus, their shopping activities have few recreational aspects. In contrast, because men tend to share a relatively small part of household responsibility, they would shop for groceries less frequently and might perform shopping with recreational aspects more frequently, especially on weekends. Men's shopping is expected to result partially from an increase in the demand for product variety and an expansion in the discretionary activities that they are willing to perform. Consequently, these differences in genders' motivations and purposes for shopping could affect the opportunity cost of time for shopping positively for men and negatively for women.

Empirical evidence in Japan demonstrates that there is a considerable difference in time allocation of housework between weekdays and weekends (Statistics Bureau of Japan 2003) and between genders (Matsuda and Suzuki 2002; Nishioka 1998; Ueda 2005). For this reason, we estimate our probit model separately by weekdays and weekends, as well as by genders.

Results and Discussion

The correlations of number of rooms and type of residence with shopping probability are primary dimensions along which households with smaller storage constraints differ from other households. Table 2 lists the four sets of estimates: parameter estimates, p-values, and mean partial effects (MPEs).

As demonstrated in Table 2, the parameter estimates that relate to storage costs have the expected signs, but certain coefficients are not statistically significant at the conventional 5% significance level. The coefficients of the number of rooms have the expected signs, but they are not statistically significant ($p = 0.488$) for men. For women, having many rooms tends to decrease shopping probability ($p < 0.001$). Using MPEs, those living in houses with eight rooms go shopping 9.9% and 8.3% less frequently than those living in one room houses. Coefficients of the type of residence are estimated as statistically significant at the 5% level with the expected sign. Rented houses increase the probability of shopping by 1.5% to 3.2% over owner-occupied houses. These results indicate that people with greater space constraints tend to shop more frequently. That is, an increase in storage costs correlates with an increase in the probability of shopping.

The coefficients of proxy variables for travel costs are also aligned reasonably with the theoretical expectation. The coefficients of the three metropolitan areas have positive sign and are statistically significant at the 5% level. These MPEs vary from 0.8% for men on weekdays to 3.0% for women on weekdays. Because those living in the metropolitan area have relatively lower travel costs and simultaneously higher storage costs, these signs coincide with the theoretical prediction. The possession of cars is significant at the 5% level for the four sets of estimates, while the signs of the estimates differ between genders. Men with no private cars shop 1.9% and 3.3% less frequently on weekdays and weekends, respectively, than do men with cars, while women with no cars shop 5.8% and 4.8% more frequently on weekdays and weekends, respectively. In Japan, women assume relatively greater housework responsibility than men. The different signs of the parameter estimates suggest that shopping behavior and shopping purpose differ between genders.

The coefficients of working and commuting hours, as proxies for the opportunity cost of time, have negative sign and are statistically significant at the 5% level, except for commuting hours for women on weekends. This result suggests that individuals with large time constraints, incurring a high opportunity cost of time for shopping, tend to shop less frequently.

As consumer demographics are also proxies for the opportunity cost of time, the parameter estimates of consumer demographics are also reasonable. The MPEs of age approximately tend to increase from the 30–40 age group to the 40–50 age group, and then decrease sharply to the age group 80 and over. These declines in the probability of shopping are remarkable: the MPEs for the 70–80 age group vary from −9.1% for men to −22.3% for women on weekends.

Income, which is one of the most important factors in economic analysis, has a statistically significant and complex relationship with the probability of additional shopping. These coefficients for men on weekdays have a relatively small variation across annual income classes. Contrary to this finding, for men on weekends and for women, the coefficients of income tend to increase considerably from the low income group to the high income group. The MPEs of the income class 10,000,000 and above are approximately twice as large as those of the income class 2,000,000–4,000,000. Bell and Hilber (2006) demonstrate that the effect of income on the frequency of shopping is positive, while Bawa and Ghosh (1999) demonstrate that it is negative, although their model includes fewer demographic variables as compared to our model. Our findings add new evidence to the literature, controlling for many demographic variables[8]. The coefficients on education are significantly positively estimated ($p < 0.001$). Individuals educated above the high school level tend to shop more frequently than those educated under the junior high school level. Estimate coefficients of income and education suggest that these two variables correlate more closely with the volume and content of the predetermined basket of products than with the opportunity cost of time for shopping.

Other demographic variables also correlate meaningfully with the probability of shopping. Marital status relates shopping probability more tightly for women than for men. While married men tend to shop 5.8% less frequently compared with unmarried men on weekdays, they tend to shop 4.1% more frequently on weekends. In contrast, married women tend to shop 19.8% and 17.0% more frequently than unmarried women on weekends and weekdays, respectively. Women who belong to a household with two or more fulltime workers tend to shop less frequently

[8] However, it is also possible that unobserved variables that correlate to income, such as taste, could affect the probability of shopping. Because measuring the taste of consumers is usually difficult or even impossible for any researcher, this factor is not considered in our analysis.

than women who belong to a household with no fulltime worker. The MPEs of the presence of preschool children for men on weekends and women on weekdays are 3.7% and −3.6%, respectively. The coefficients of the number of children under 10 years of age are significantly negatively estimated, particularly for women. However, the coefficients of number of people over 10 years of age are significantly positively estimated for both men and women.

These results suggest that the opportunity cost of time correlates with additional shopping probability depending on the consumer demographics and the purpose of shopping. However, ways in which the variables included in the consumer demographics correlate with shopping probability differ between genders. This is supported by the fact that among the variables, the possession of private cars, the existence of preschool children, and marital status have opposite statistically significant sign between genders. Accordingly, for the case of the existence of preschool children, we might interpret that because men with preschool children participate more in shopping and other housework on weekends to help their wives, the difference in shopping probability among marital status for women on weekends decreases ($p = 0.340$).

In summary, these findings indicate that storage costs, travel costs, and the opportunity cost of time correlate with consumer shopping probability. The parameter estimates related to storage and travel costs have the theoretically expected sign. Moreover, the parameter estimates on demographic variables are also sensibly explained by the difference in the predetermined basket of products, the opportunity cost of time, and the gender role, which includes the purpose of shopping. This supports our analysis.

Conclusion

Shopping is an important part of housework, unavoidable for consumers in managing households, and so people decide whether they should go shopping in a given day. Although shopping day selection plays an essential role in economic activity, few studies have examined how shopping day decisions are made and what factors affect the decision. This study focuses on the relationships among cost factors, including storage costs, travel costs, and the opportunity cost of time, as well as the probability of shopping, using individual-level data from the 2001 Survey on Time Use and Leisure Activity in Japan.

As a general contribution to the literature, the results suggest that the correlation between the cost factors and probability of shopping are consistent with the theory. That is, other factors held constant, storage costs correlate positively with the probability of shopping, while travel and opportunity costs correlate negatively with the probability of shopping. In particular, consumer storage constraints are important characteristics of market structure, and the assumption that consumer storage constraints affect consumer shopping behavior has often been used in theoretical models. Therefore, it is meaningful that their relevance is empirically demonstrated after controlling for other factors. In addition, the results demonstrate that travel costs and opportunity cost of time are important factors in economic and marketing research. These findings also provide useful managerial implications, such as stores' potential to attract more customers with relatively low costs by distributing fliers in regions where people have large storage constraints.

We estimate the empirical models for men and women separately, revealing complex interactions between gender and several variables, interpreted in terms of intrafamily time allocation in Japan. The result indicates possible remarkable differences in shopping behavior between genders because of gender role, housework responsibility, and the purpose and motivation for shopping. Women with preschool children tend to shop less, suggesting that higher child care costs (higher opportunity costs for shopping) might prevent them from going shopping frequently. This finding suggests that retail stores would profit by improving facilities and services for women who prefer to shop with their children.

The study also provides empirical contributions. First, we use better data compared to previous research, in that our dataset contains sufficient individual and household characteristics for us to estimate the correlations between variables, controlling for many variables. Second, our data include variables that pertain directly to storage costs: number of rooms and type of residence. To the authors' best knowledge, these factors are the best measurements of households' storage costs. Furthermore, the signs of estimated coefficients are consistent with the theoretical prediction.

In addition to the aforementioned managerial implications, the results bear upon management and public policy. First, for policy makers, one tactic to improve men's housework participation rate is to enact policies that encourage reduced commuting time for men because of the relatively large negative correlation between shopping probability and commuting time. From the opposite perspective, women who commute long distances are not relieved from the burden of

shopping. These women's housework burdens seem to be mitigated by their partners, particularly on weekends, because men with preschool children tend to shop more frequently than men without children. This behavior implies that preschool children demand so much of their mother's time that men with preschool children assist their partner by shopping on weekends. This is consistent with Matsuda and Suzuki (2002). However, additional empirical scrutiny must confirm how housework is divided within families. Second, assuming that older consumers are less likely to shop than younger consumers with other factors held constant, because of the physical decline caused by aging, retail stores would profit by facilitating older consumers' shopping activities. A supporting public policy would simultaneously promote the public interest by, for example, encouraging stores to deliver purchased goods, receive orders via telephone, open stores in residential areas, and alleviate transport inconvenience. These services could help older consumers satisfy their latent demand and thus increase their utility. Therefore, supporting older consumers' shopping is an important response to the rapidly increasing aging demographic in Japan and other developing countries.

Because online shopping has become more popular among consumers, this tactic might also affect consumer shopping behavior through a change in shopping utility and costs to some extent. This topic also warrants further research.

Appendix

Observed store characteristics included in the analysis are listed as follows.

Quantitative measures

Working hours (1 h)

Commuting hours (1 h)

Persons aged 10 and above

Children aged below 10

Number of rooms

Categorical measures

Geographical region of Japan: three metropolitan areas (Tokyo, Osaka, and Nagoya), other areas

Age Group: 20–30, 30–40, 40–50, 50–60, 60–70, 70–80, 80 and above

Marital status: unmarried, married, others

Education: junior high school and below; high school, junior college or technological college; college or university, including graduate school

Annual income of the household (yen): –2,000,000; 2,000,000–4,000,000; 4,000,000–6,000,000; 6,000,000–8,000,000; 8,000,000–10,000,000; 10,000,000 and above

Fulltime workers in the household: 0 workers, 1worker, 2 or more workers

Preschool children: no preschool children, 1 or more preschool children

Possession of cars: 1 or more cars, no car

Type of residence: owner-occupied house, rented house

References

Bawa, K., & Ghosh, A. (1999). A model of household grocery shopping behavior, *Marketing Letters*, 10, 149–160.

Becker, G. S. (1965). A theory of allocation of time, *Economic Journal*, 75, 493–517.

Bell, D. R., & Hilber, C. A. L. (2006). An empirical test of the theory or sales: Do household storage constraints affect consumer and store behavior?, *Quantitative Marketing and Economics*, 4, 87–117.

Blattberg, R., Buesing, T., Peacock, P., & Sen, S. (1978). Identifying the deal prone segment, *Journal of Marketing Research*, 15, 369–377.

Blattberg, R., Eppen, G. D., & Lieberman, J. (1981). A theoretical and empirical evaluation of price deals for consumer non-durables, *Journal of Marketing*, 45, 116–129.

Boizot, C., Robin, J-M., & Visser, M. (2001). The demand for food products: An analysis of interpurchase times and purchased quantities, *Economic Journal*, 111, 391–419.

Hendel, I., & Nevo, A. (2006a). Measuring the implications of sales and consumer inventory behavior, *Econometrica*, 74, 1637–1673.

Hendel, I., & Nevo, A. (2006b). Sales and inventory, *RAND Journal of Economics*, 37, 543–561.

Hong, P., McAfee, R. P., & Nayyar, A. (2002). Equilibrium price dispersion with consumer inventories, *Journal of Economic Theory*, 105, 503–517.

Kahn, B., & Schmittlein, D. C. (1989). Shopping trip behavior: An empirical investigation, *Marketing Letters*, 1, 55–69.

Matsuda, S., & Suzuki, Y. (2002). Relation of labor time and domestic labor time of the couple, *Japanese Journal of Family Sociology* (Kazoku Shakaigaku Kenkyu), 13, 73–84 (in Japanese).

Nishioka, H. (1998). Men's domestic role and the gender system: Determinants of husband's household labor in Japan, *Journal of Population Problem* (Jinko Mondai Kenkyu), 54, 56–71.

Salop, S., & Stiglitz, J. E. (1982). The theory of sales: A simple model of equilibrium price dispersion with identical agents, *American Economic Review*, 72, 1121–1130.

Statistics Bureau, Managements and Coordination Agency, Government of Japan. (2003). 2001 Survey on Time Use and Leisure Activities, Japan Statistics Association.

Ueda, A. (2005). Intrafamily time allocation of housework: Evidence from Japan, *Journal of the Japanese and International Economies*, 19, 1–23.

Walters, R., & Jamil, M. (2003), Exploring the relationships between shopping trip type, purchases of products on promotion, and shopping basket profit, *Journal of Business Research*, 56, 17–29.

Winkler, A. E., & Ireland, T. R. (2009), Time spent in household management: Evidence and implications, *Journal of Family and Economic Issues*, 30, 293–304.

TABLE 1. Summary statistics: Characteristics of shopping sample and other sample by gender.

	Men				Women			
	Shopping in a given day							
	No	Yes	Difference	p-value	No	Yes	Difference	p-value
Geographical region								
Three metropolitan areas	0.310	0.352	-0.043	0.000	0.277	0.342	-0.065	0.000
Other areas	0.690	0.648	0.043	0.000	0.723	0.658	0.065	0.000
Age Group								
20–30	0.137	0.125	0.012	0.000	0.151	0.105	0.046	0.000
30–40	0.150	0.168	-0.018	0.000	0.126	0.171	-0.045	0.000
40–50	0.183	0.177	0.006	0.058	0.135	0.212	-0.077	0.000
50–60	0.222	0.196	0.026	0.000	0.166	0.227	-0.062	0.000
60–70	0.162	0.188	-0.026	0.000	0.167	0.170	-0.003	0.196
70–80	0.111	0.121	-0.010	0.000	0.165	0.095	0.070	0.000
80 and above	0.035	0.025	0.010	0.000	0.089	0.020	0.070	0.000
Marital status								
Unmarried	0.187	0.186	0.001	0.000	0.172	0.097	0.075	0.000
Married	0.764	0.741	0.023	0.000	0.595	0.767	-0.172	0.000
Others	0.049	0.073	-0.024	0.000	0.233	0.136	0.097	0.000
Education								
Junior high school and below								
High school	0.273	0.226	0.047	0.000	0.340	0.227	0.113	0.000
Junior college or technological college	0.532	0.533	-0.001	0.841	0.600	0.706	-0.107	0.000
College or University, including graduate school	0.195	0.241	-0.046	0.000	0.060	0.066	-0.006	0.000
Working hours (1 h)	5.605	1.880	3.725	0.000	3.237	1.802	1.435	0.000
Commuting hours (1 h)	0.535	0.166	0.369	0.000	0.273	0.159	0.114	0.000
Annual income of the								

	Men				Women			
	Shopping in a given day							
	No	Yes	Difference	p-value	No	Yes	Difference	p-value
household								
Below 2,000,000	0.095	0.097	-0.002	0.264	0.148	0.121	0.027	0.000
2,000,000–4,000,000	0.251	0.269	-0.018	0.000	0.247	0.248	-0.001	0.610
4,000,000–6,000,000	0.235	0.234	0.001	0.723	0.211	0.222	-0.011	0.000
6,000,000–8,000,000	0.168	0.167	0.001	0.684	0.156	0.164	-0.008	0.000
8,000,000–10,000,000	0.120	0.113	0.008	0.002	0.112	0.119	-0.007	0.000
10,000,000 and above	0.131	0.120	0.010	0.000	0.127	0.125	0.001	0.498
Full time workers in the household								
0 workers	0.096	0.166	-0.070	0.000	0.148	0.158	-0.010	0.000
1worker	0.393	0.451	-0.058	0.000	0.335	0.422	-0.087	0.000
2 or more workers	0.512	0.383	0.129	0.000	0.517	0.420	0.097	0.000
Preschool children								
No preschool children	0.894	0.877	0.017	0.000	0.926	0.881	0.045	0.000
1 or more preschool children	0.106	0.123	-0.017	0.000	0.074	0.119	-0.045	0.000
Persons aged 10 and above	3.198	2.815	0.383	0.000	3.207	2.992	0.215	0.000
Children aged below 10	0.304	0.302	0.003	0.618	0.278	0.326	-0.048	0.000
Possession of cars								
1 or more cars	0.883	0.870	0.013	0.000	0.842	0.840	0.003	0.242
No car	0.117	0.130	-0.013	0.000	0.158	0.160	-0.003	0.242
Number of Rooms	5.606	5.298	0.308	0.000	5.787	5.409	0.378	0.000
Type of residence								
Owner-occupied house	0.809	0.756	0.053	0.000	0.840	0.778	0.062	0.000
Rented house	0.191	0.244	-0.053	0.000	0.160	0.222	-0.062	0.000
Number of Obs.	74872	22961			52411	58520		

TABLE 2. The coefficients of the variables on the probability of shopping.

	Male						Female					
	Weekday			Weekend			Weekday			Weekend		
	Coeff.	MPE.	p-value	Coeff.	MPE.	p-value	Coeff.	MPE.	p-value	Coeff.	MPE.	p-value
Geographical region (base: other areas)												
Three metropolitan areas	0.042	0.008	0.030	0.059	0.019	0.000	0.076	0.030	0.000	0.064	0.025	0.000
Age (base: 20–30)												
30–40	0.108	0.022	0.004	0.050	0.016	0.037	0.206	0.082	0.000	0.154	0.061	0.000
40–50	0.163	0.033	0.000	0.050	0.016	0.050	0.349	0.138	0.000	0.249	0.097	0.000
50–60	0.131	0.027	0.002	-0.061	-0.020	0.022	0.245	0.097	0.000	0.102	0.040	0.000
60–70	0.140	0.029	0.002	-0.131	-0.041	0.000	-0.018	-0.007	0.580	-0.166	-0.066	0.000
70–80	0.048	0.010	0.322	-0.305	-0.091	0.000	-0.416	-0.163	0.000	-0.569	-0.223	0.000
80 and above	-0.254	-0.042	0.000	-0.613	-0.158	0.000	-0.921	-0.327	0.000	-1.106	-0.392	0.000
Marital status (base: unmarried)												
Married	-0.277	-0.058	0.000	0.130	0.041	0.000	0.503	0.198	0.000	0.430	0.170	0.000
Others	0.090	0.018	0.047	0.264	0.091	0.000	0.284	0.112	0.000	0.242	0.095	0.000
Education (base: under junior high school)												
High school, Junior college or technological college	0.103	0.020	0.000	0.130	0.042	0.000	0.226	0.090	0.000	0.153	0.061	0.000
College or University,	0.132	0.027	0.000	0.214	0.072	0.000	0.144	0.057	0.000	0.119	0.047	0.000

	Male						Female					
	Weekday			Weekend			Weekday			Weekend		
	Coeff.	MPE.	p-value	Coeff.	MPE.	p-value	Coeff.	MPE.	p-value	Coeff.	MPE.	p-value
including graduate school												
Working hours (1 h)	-0.104	-0.020	0.000	-0.107	-0.035	0.000	-0.082	-0.033	0.000	-0.090	-0.036	0.000
Commuting hours (1 h)	-0.163	-0.032	0.000	-0.142	-0.046	0.000	-0.062	-0.025	0.000	-0.022	-0.009	0.157
Annual income of the household (base: below 2,000,000 yen)												
2,000,000–4,000,000	0.121	0.024	0.000	0.055	0.018	0.014	0.058	0.023	0.012	0.053	0.021	0.003
4,000,000–6,000,000	0.120	0.024	0.001	0.074	0.024	0.002	0.061	0.024	0.014	0.061	0.024	0.002
6,000,000–8,000,000	0.105	0.021	0.007	0.115	0.038	0.000	0.073	0.029	0.007	0.057	0.022	0.008
8,000,000–10,000,000	0.120	0.024	0.005	0.106	0.035	0.000	0.113	0.045	0.000	0.099	0.039	0.000
10,000,000 and above	0.083	0.017	0.055	0.118	0.039	0.000	0.134	0.053	0.000	0.074	0.029	0.001
Full time workers in the household (base: 0 workers)												
1 worker	-0.022	-0.004	0.462	0.019	0.006	0.379	-0.037	-0.015	0.108	-0.070	-0.028	0.000
2 or more	0.008	0.001	0.829	-0.056	-0.018	0.021	-0.053	-0.021	0.047	-0.075	-0.030	0.000
Preschool children (base: no preschool children)												
1 or more preschool children	0.013	0.003	0.778	0.111	0.037	0.000	-0.090	-0.036	0.005	-0.025	-0.010	0.340
Persons aged 10 and above	-0.112	-0.022	0.000	-0.096	-0.031	0.000	-0.046	-0.018	0.000	-0.048	-0.019	0.000
Children aged below 10	-0.006	-0.001	0.739	-0.040	-0.013	0.002	-0.088	-0.035	0.000	-0.068	-0.027	0.000
Possession of cars (base: yes)												

	Male						Female					
	Weekday			Weekend			Weekday			Weekend		
	Coeff.	MPE.	p-value	Coeff.	MPE.	p-value	Coeff.	MPE.	p-value	Coeff.	MPE.	p-value
No car	-0.105	-0.019	0.000	-0.104	-0.033	0.000	0.145	0.058	0.000	0.121	0.048	0.000
Rooms (base: 1 room)	-0.005	-0.001	0.488	-0.008	-0.003	0.054	-0.036	-0.014	0.000	-0.030	-0.012	0.000
Type of residence (base: owner-occupied house)												
Rented house	0.158	0.032	0.000	0.066	0.022	0.000	0.055	0.022	0.008	0.037	0.0145	0.024
Constant	-0.110			-0.129			-0.00164			0.197		
Number of Obs.	38006			59827			43027			67904		
Pseudo R-square	0.139			0.119			0.107			0.101		
Log-likelihood	-13615			-31789			-26635			-42060		
Chi-square	4397			8569			6377			9492		
p-value (chi-square)	0			0			0			0		
AIC	27285			63632			53325			84175		