A HOUSEHOLD-LEVEL PERSPECTIVE ON THE 2007 PEANUT BUTTER FOOD SAFETY INCIDENT

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ABSTRACT

A multinomial logit model was estimated to determine the socio-economic profiles associated with three possible actions taken by households in response to the recall of Peter Pan peanut butter. Also, using the Heckman sample selection procedure, the study examined the effects of various socio-economic variables and the change in price on the change in quantity purchased of Peter Pan. Nielsen panel data from January 2006 to December 2009 were used.

Employment status of the household head, region, race, ethnicity, age and presence of children in the household were key drivers associated with the respective actions taken by households in light of the Peter Pan recall. Also, the change in price, region, race, age and presence of children in the household, and household size were key determinants affecting the change in quantity purchased of Peter Pan across the pre- and the post-recall periods.

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Key words: food safety, Heckman procedure, household behavior, multinomial logit model, Nielsen panel data, peanut butter

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EXECUTIVE SUMMARY

A number of household socio-economic characteristics were key drivers associated with three choices of actions taken by households in relation to the recall of Peter Pan peanut butter. In particular, for the households that abandoned purchasing Peter Pan in the post-recall period, employment status of the household head, region, race, ethnicity, and age and presence of children in the household were identified as important factors affecting their demand behavior. For the households that began buying Peter Pan in the post-recall period, the key factors impacting their demand behavior included region, race, and age and presence of children in the household.

In addition, the change in price negatively affected, while region, race, age and presence of children in the household, and household size positively affected the change in quantity purchased of Peter Pan peanut butter across the pre-recall period and the post-recall period. In both the pre- and the post-recall periods the demand for Peter Pan is inelastic (-0.258 and -0.308 in the pre- and the post-recall periods, respectively). These estimates suggest that ConAgra can increase its sales revenues in the short-run by increasing the price, *ceteris paribus*.

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INTRODUCTION

Consumers through their purchasing behavior communicate the level of public trust in the safety of the food system. A survey conducted in January 2009 showed that 82% of the U.S. shoppers are either somewhat or very confident in the safety of food they buy in the grocery stores (Food Marketing Institute, 2009). But one of the factors that can significantly undermine consumer confidence in the safety of the food system is a product recall resulting from pathogen contamination. The negative response of consumers to reports on food recalls covered by various media sources has been linked with eroding consumer trust in the safety of the food system (Kinsey et al., 2009). Similarly, survey results reported in a study by Stinson et al. (2008) indicated a decline in household confidence associated with food safety following highly-publicized food recalls.

Households may respond differently to a recall of a particular brand-name food product. Some households may quit purchasing the affected brand with an anticipation to never come back to it or may return to it after a period of time. Other households may quit purchasing the affected brand and switch to other brands giving rise to spillover effects among brands. Another group of households may continue purchasing the implicated brand-name food product despite the food safety issues. These households constitute the loyal group.

Based on consumers' level of risk perception and risk aversion associated with contracting a disease as a result of food safety crises, Wansink (2004) classifies them into four categories (segments). The low-risk aversion and low-risk perception consumers are deemed risk-seekers and comprise the *accountable* segment. Despite present risk, consumers of this segment keep their consumption habits without any regard for risk information. The *concerned* segment is composed of the low- risk aversion and high-risk perception consumers. These consumers eventually stop the consumption of the affected product with an increase in their perception of the riskiness related to the consumption of that product. High-risk aversion and low-risk perception consumers fall into the *conservative* segment. These consumers are cautious and do not take unnecessary risks. Finally, *alarmist* segment consists of high-risk aversion and high-risk perception consumers who tend to not only overreact but also try to affect others.

Understanding each of these behavior patterns is important from the perspective of the manufacturer of the brand when targeting specific demographic groups for marketing purposes. Also, price elasticity estimates provided in this study can help peanut butter manufacturing firms in designing pricing strategies in the short-run in light of recalls. From a consumer choice perspective, the set of socio-economic characteristics of households considered in this study are expected to account for variations in household tastes and preferences which might impact the demand for peanut butter. Finally, the results of the study can be used to design education programs geared towards specific demographic groups to enhance their awareness of food recalls and to help them adjust their consumption patterns to mitigate potentially adverse consequences of product contamination. To address these issues, the 2007 Peter Pan recall is used as a case

study. The peanut butter industry is a good case to study given the industry's structure, where three national brands (Jif, Peter Pan, and Skippy) account for more than 60% of the market share in terms of dollar sales from 2006 through 2008.

During early February 2007, the Food and Drug Administration (FDA) confirmed that "salmonella" was caused by the consumption of two peanut butter brands, Peter Pan and Great Value, manufactured by ConAgra Foods, Inc., at its Sylvester, Georgia, processing plant (Centers for Disease Control and Prevention, 2007). As a result, on February 14, 2007, ConAgra voluntarily issued a nationwide recall of its Peter Pan and Great Value peanut butter brands (Centers for Disease Control and Prevention, 2007). The Peter Pan brand came back on store shelves in August 2007 (ConAgra Foods Inc., 2007) after being unavailable for purchase for about 27 weeks.

In an effort to restore consumer confidence in the safety of the recalled peanut butter brands, ConAgra undertook repairs of its peanut processing plant in Sylvester, Georgia, and started a large-scale marketing campaign. Particularly, ConAgra claimed that it had spent considerable funds on upgrading machinery, technology, and design throughout the plant before re-opening it and returning the Peter Pan brand peanut butter to store shelves (ConAgra Foods Inc., 2007). During its massive marketing campaign, ConAgra sent out 2 million coupons for free Peter Pan peanut butter, $1-off coupons, and updated the design of Peter Pan peanut butter jars (Dorfman, 2007).

The objectives of this study are: (1) to determine the profiles of households that altered their consumption pattern of Peter Pan around the time of the recall; (2) to identify households that, regardless of the recall, maintained purchases of Peter Pan across the pre- and the post-recall periods; and (3) to assess the influence of socio-economic characteristics and the change in price on the change in quantity purchased of Peter Pan across the pre- and the post-recall periods. These objectives were accomplished by estimating a multinomial logit model and a Heckman sample selection model employing Nielsen Homescan panel data on household purchases from calendar years 2006 through 2008. This study contributes to the current literature in examining responses to negative information by looking at explicit behavior captured by alternative actions taken by households.

The remainder of the paper proceeds as follows. The literature review is presented in the next section. The subsequent section presents the empirical specifications of the multinomial logit and the Heckman sample selection models. Data are described following this presentation. In the ensuing section, the estimation results are presented and discussed. The summary, conclusions, and recommendations for future research are discussed in the final section.

LITERATURE REVIEW

The problem of consumers' responsiveness to product harm crises (recalls, food safety announcements) have been the focus of many empirical studies, where different approaches were utilized to evaluate the impact of negative health information on a demand for a particular food product. In particular, a demand system approach has been used to provide empirical evidence that the demand for the affected products diminished as a result of food safety crises surrounding the products (Burton and Young 1996; Verbeke and Ward 2001; Marsh, Schroeder, and Mintert 2004; Piggott and Marsh 2004; Pritchett et al. 2007). A single-equation demand model has been used to ascertain the demand-distorting effects of food safety crises on the demand for the affected products (Swartz and Strand 1981; Smith, Van Ravenswaay, and Thompson 1988; Van Ravenswaay and Hoehn 1991). Our study is similar to the abovementioned studies in utilizing an empirical approach in studying the influence of the food safety crisis on the demand. Another area of literature related to this study uses experimental design to explore the influence of food safety information on consumer willingness to pay for a product (Buzby et al., 1998; Dillaway et al., 2011). In common with these studies, we incorporate demographic characteristics into the analysis.

The extent of health issues posed by foodborne illnesses varies across different groups of people. While most of the adult population may not experience serious health issues caused by a foodborne illness, other groups of people with compromised immune systems (children, pregnant women, elderly) can sustain serious health damages, which may even lead to lethal outcomes. Hence, undertaking a household-level study, which takes into consideration household characteristics in the light of a recall, is of utmost significance. To the best of our knowledge, among the empirical studies concerning food recalls and using discrete choice models, to date, relatively little attention has been given to recall effects on individuals or households. Taylor (2010) examined the impact of publicly available food safety information on the demand for fresh and frozen meat (beef, veal, and pork) and poultry (chicken and turkey) through the estimation of a multinomial logit model. The study used biweekly data from the Nielsen Homescan panel from January 1998 to December 2005. A commodity-specific food safety index was developed by aggregating the number of newspaper articles regarding food safety issues found in the Lexis-Nexis using the following as keywords: "food safety," "contamination," "product recall," "outbreak," "salmonella," "listeria," "E. coli," "trichinae," "staphylococcus," and "foodborne." Articles from these search results were further sorted by the terms "beef" or "hamburger," "pork" or "ham," and "chicken" or "turkey" or "poultry." The findings of the study showed that household heads that have a college education, households with elderly heads, and households with children are more likely to avoid buying meat and poultry in the presence of an increasing food safety information in the media.

Based on the case of the 2006 spinach recall, Onyango et al. (2007) conducted a micro-level analysis of the public's perceptions of food safety by estimating a binary choice model. The data used in the study were collected via telephone interviews and included a sample of 1,200 adult Americans. The findings of the study suggested that food safety perceptions are affected by the type of the products being analyzed, the extent of the public's knowledge of food pathogens and illnesses, the trust in private and public institutions dealing with food safety, and a set of socio-economic variables such as income, age, education, gender, and race.

Using aggregate data prior studies contributed to our understanding of the commodity market aspects of peanut products (Zhang, Fletcher, and Carley, 1995; Rimal, Fletcher, and Deodhar, 2001; Revoredo, Nadolnyak, and Fletcher, 2004). Other studies estimated discrete choice models to investigate the impact of household socio-economic characteristics and nutritional content on the demand for various peanut products (He, Fletcher, and Rimal, 2004; 2005). In another study by Rimal and Fletcher (2002), double hurdle, Tobit, and Complete Dominance (Heckman type specification) models were estimated to study the effect of household socio-economic factors and nutritional considerations on market participation- and purchase level decisions concerning snack peanuts.

The 2007 Peter Pan recall has been extensively studied by Bakhtavoryan, Capps, and Salin using demand systems approach (2012, 2014a), and single-equation model (2014b). In particular, using the Barten synthetic model Bakhtavoryan, Capps and Salin (2012) showed that the Peter Pan recall contributed to structural change in consumer demand for peanut butter brands. In another study (2014a), applying Barten's synthetic model, Bakhtavoryan, Capps, and Salin empirically ascertained the recall's demand-distorting effects on Peter Pan and demand-enhancing effects on a leading peanut butter brand, suggestive of spillover effects among brands in the presence of recall. Finally, by estimating a single-equation demand model for peanut butter category, Bakhtavoryan, Capps, and Salin (2014b) provided empirical evidence that the recall led to an increased consumption of peanut butter as a product category.

Using the Nielsen Homescan panel data on household purchases, this study estimates a multinomial logit model to determine the profile of households that altered as well as maintained their consumption pattern of peanut butter in light of the Peter Pan recall. In addition, by estimating a Heckman sample selection model, this study empirically assesses the influence of different socio-economic variables on the change in the quantity purchased of peanut butter across the pre- and the post-recall periods for those households that made purchases of peanut butter in both periods.

Previous studies did not attempt to profile households corresponding to a particular purchasing pattern associated with a peanut butter brand in light of a recall. Also, the profiling of households in this research is differentiated by time periods associated with the recall event allowing us to track the purchasing behavior of the same households across the pre-recall and the post-recall periods. In this way, we introduce dynamics into the analysis. Yet another unique feature of this study is that brand-specific household-level data were used to study the response to the recall.

EMPIRICAL SPECIFICATIONS

Choice Variable

In this section the multinomial logit model initially is described followed by the description of the Heckman sample selection model. In multinomial logit model the interest lies in capturing choices made by households. Here, the choices correspond to:

- *choice 1*: buying Peter Pan in the pre-recall period but not buying in the post-recall period. This type of household behavior is consistent with food safety considerations or erosion of confidence in case of a food safety event.
- *choice 2*: not buying Peter Pan in the pre-recall period but buying in the post-recall period. This type of demand behavior is exhibited by households that are non-responsive to food safety issues.
- *choice 3*: buying Peter Pan in both the pre- and the post-recall periods. This behavior is consistent with brand loyalty or with households finding some attribute of the product so attractive that no food safety event can stop them from purchasing the product.

The group of households that never purchased the Peter Pan brand was omitted from the analysis. To qualify for our sample, households must have bought Peter Pan at least once over the three-year period (2006, 2007, and 2008). While recognizing the possibility of sample selection bias due to not considering households that did not buy Peter Pan in either period, a *conditional* analysis was done (conditional on household behavior associated with buying Peter Pan at least once over the study period). In other words, in this study the main focus is to explain the behavior of those households that are actual Peter Pan consumers, which is reflected by the fact that they made at least one purchase of Peter Pan over the three-year study period.

By estimating the Heckman sample selection model, the impact of socio-economic variables on the change in quantity purchased of Peter Pan is assessed conditional on the decision by households to purchase Peter Pan in the pre-recall period and the post-recall period. As such, the Heckman sample selection model deals with the households corresponding to *choice 3*.

The Multinomial Logit Model

With the multinomial logit model, interest centers on the aforementioned three choices associated with household behavior in light of the Peter Pan recall as a function of household socio-economic characteristics. In the conventional multinomial logit model, there are *m* choices and the dependent variable *y* takes on integer values 1, 2,...,m (Cameron and Trivedi, 2005). Defining p_{ij} as the probability that the *i*th individual or household (for *i*=1,...,n) chooses alternative *j*, the multinomial logit specifies

$$p_{ij} = \frac{e^{\mathbf{x_i'\beta_j}}}{\sum_{l=1}^{m} e^{\mathbf{x_i'\beta_l}}}, j = 1, \dots, m. \quad (1)$$

Setting y_{ij} equal to one if the *i*th observation corresponds to alternative *j*, and setting y_{ij} to zero otherwise, the log-likelihood function for the multinomial logit becomes

$$\log L = \sum_{i=1}^{n} \sum_{j=1}^{m} y_{ij} \log p_{ij}, \quad (2)$$

where the parameter estimates of β are obtained by maximizing the log-likelihood function in (2).

Household demand behavior may be influenced by socio-economic characteristics such as age, employment status, education, region, race, ethnicity, age and presence of children in the

household, gender, household size, and income. For instance, educated household heads might tend to exercise more caution when it comes to food safety, since they may be more knowledgeable about the potential hazards associated with recalls. Or, heads of households with children may be more alert to food recall information, since children are more vulnerable to health issues caused by the contaminated food products relative to adults.

Hence, to capture the effects of these socio-economic characteristics on demand behavior associated with Peter Pan conditional on buying Peter Pan at any time over calendar years 2006 and 2008, the following empirical specification of the multinomial logit model is estimated:

$$Pr(Y_{ij} = j) = \Phi(\mathbf{x_i'\beta}) + \varepsilon_{ij}, \quad (3)$$

where Y_{ij} is the choice variable denoting that the *i*th household has available three *j* choices (*choice 1*, *choice 2*, and *choice 3*), Φ is the cumulative distribution function associated with $\mathbf{x_i'}$ vector of socio-economic variables that enter the model as binary variables with the exception of the multi-category household income variable (see Table 1). $\boldsymbol{\beta}$ is a vector of parameters to be estimated, and ε_{ij} is the error term.

While multinomial model parameter estimates indicate which socio-economic variables are statistically significant, they do not allow direct measurement of the impact of these socio-economic variables. To that end, marginal effects are computed by taking the partial derivative of p_{ij} with respect to any explanatory variable as follows:

$$\frac{\partial p_{ij}}{\partial x_{ik}} = p_{ij}(\delta_{jk} - p_{ik})\beta, \quad (4)$$

where $\delta_{jk}$is an indicator variable equal to 1 if $j=k$ and equal to 0 if $j\neq k$.

Equation (4) coupled with equation (3) results in marginal effects as non-linear combinations of the estimated parameters. Therefore, it is possible to obtain opposite signs as well as to draw different conclusions regarding statistical significance for the marginal effect and the parameter estimate associated with the same variable.

Table 1. Explanatory Variables Used in the Empirical Analyses, Calendar Years, 2006 to 2008

Category	Variable Name	Description
Age of the household head	less than 25	Age of household head less than 25 years (base category)
	25-29	Age of household head between 25-29 years
	30-34	Age of household head between 30-34 years
	35-44	Age of household head between 35-44 years
	45-54	Age of household head between 45-54 years
	55-64	Age of household head between 55-64 years
	greater than 64	Age of household head greater than 64 years
Employment status of the household head	not employed for full pay	Household head not employed for full pay (base category)
	part-time	Household head part-time employed
	full-time	Household head full-time employed
Education level of the household head	less than high school	Education of household head: less than high school (base category)
	high school	Education of household head: high school only
	undergraduate	Education of household head: undergraduate only
	post-college	Education of household head: some post-college
Region	East	Region: east (base category)
	Midwest	Region: Midwest
	South	Region: South
	West	Region: West
Race	white	Race: white (base category)
	black	Race: black
	oriental	Race: oriental
	other	Race: other (non-black, non-white, non-oriental)
Ethnicity	non-Hispanic	Non-Hispanic ethnicity (base category)
	Hispanic	Hispanic ethnicity

Table 1. continued

Category	Variable Name	Description
Age and presence of children in the household	no children less than 18	No child less than 18 years (base category)
	pre-school	Age and presence of children less than 6 years
	pre-adolescent	Age and presence of children between 6-12 years
	adolescent	Age and presence of children between 13-17 years
	pre-school and pre-adolescent	Age and presence of children less than 6 and 6-12 years
	pre-school and adolescent	Age and presence of children less than 6 and 13-17 years
	pre-adolescent and adolescent	Age and presence of children between 6-12 and 13-17 years
	pre-school, pre-adolescent and adolescent	Age and presence of children less than 6, 6-12 and 13-17 years
Presence of male and/or female household heads	female and male	Household head both male and female (base category)
	male	Household head male only
	female	Household head female only
Household size	one member	Household size: one member
	two members	Household size: two members
	three members	Household size: three members
	four members	Household size: four members
	greater than five members	Household size: at least five members (base category)
Household income	income	Household income

Notes: The categories of age of the household head, employment status of the household head, and education level of the household head contain information on the age, employment, and education of the female household head. However, in cases where there was no female household head, the age, employment, and education of the male household head were used.

Source: Nielsen Homescan panel data on household purchases from calendar years 2006 through 2008.

The Heckman Sample Selection Model

The first stage of the Heckman procedure is a framework of consumer choice where the household is faced with the decision to buy in the pre- and the post-recall periods. In other words, the first stage actually represents two choices made over a fairly long period of time: purchasing in the pre-recall period (58 weeks) and again in the post-recall period (71 weeks) interrupted by 27 weeks where the household head was unable to buy the brand even if she chose to (the recall period). Having chosen to buy in both periods, the household is in the *choice 3* group. In the second stage, the household decision concerns the amount of Peter Pan to buy, represented by the change in quantity purchased. The Heckman procedure estimates these two stages accounting for the sample selection bias stemming from the fact that not all the households made a purchase of Peter Pan in the pre-recall period and in the post-recall period.

<u>First Stage of the Heckman Sample Selection Model</u>

In the first stage of the Heckman procedure, a probit model is estimated with a set of household socio-economic characteristics as explanatory variables. Also, sample selection bias is accounted for by estimating the inverse Mills ratio (*IMR*), also known as non-selection hazard, which is later used in the second stage as an additional explanatory variable. The *IMR* is computed as

$$IMR_i = \frac{\phi(\mathbf{x_i'}\hat{\boldsymbol{\beta}}_\mathbf{i})}{\Phi(\mathbf{x_i'}\hat{\boldsymbol{\beta}}_\mathbf{i})}, \tag{5}$$

where $\phi(.)$ is the probability density function of the standard normal distribution, $\Phi(.)$ is the cumulative distribution function associated with the $\mathbf{x_i'}$ vector of socio-economic variables presented in Table 1, and $\widehat{\boldsymbol{\beta}}_\mathbf{i}$ is a vector of parameter estimates. According to Heckman (1976, 1979), the second-stage parameter estimates are obtained by incorporating the IMR_i into the regression equation, which accounts for sample selection bias.

The first stage of the Heckman procedure dealing with predicting the decision to purchase Peter Pan in the pre- and the post-recall periods estimates probit regression. The empirical specification of the first-stage probit model is as follows:

$$Pr(y_i = 1) = \Phi(\mathbf{x_i'}\boldsymbol{\beta}) + v_i, \tag{6}$$

where *y* corresponds to the decision to buy Peter Pan in both the pre- and the post-recall periods that is equal to 1 if households bought Peter Pan in both periods, and 0 otherwise, Φ is the normal cumulative distribution function, $\mathbf{x_i'}$ is the vector of socio-economic variables given in Table 1, $\boldsymbol{\beta}$ is a vector of parameters to be estimated, and v_i is the error term. In addition, in (6), i=1,...,n denotes the number of observations (households).

<u>Second Stage of the Heckman Sample Selection Model</u>

In the second stage of the Heckman procedure, the change in quantity purchased of Peter Pan is modeled as a function of changes in price of all the leading brands, a set of socio-economic variables, and IMR_i. This portion of the analysis is conditional on the decision by households to

buy Peter Pan in both the pre-recall and the post-recall periods. The empirical specification of the second-stage model for Peter Pan is represented as

$$\Delta Qppan_i = \gamma_0 + \gamma_1 \Delta Pppan_i + \gamma_2 \Delta Pjif_i + \gamma_3 \Delta Pskippy_i + \mathbf{x_i'\gamma_i} + \alpha\widehat{IMR}_i + \tau_{i,} \qquad (7)$$

where $\Delta Qppan_i$ is the change in quantity purchased of Peter Pan by the *i*th household, $\Delta Pppan_i$, $\Delta Pjif_i$, and $\Delta Pskippy_i$ are the changes in price of Peter Pan, Jif, and Skippy, respectively, for the *i*th household defined as the difference between the corresponding post- and the pre-recall prices paid. $\mathbf{x_i'}$ is the same vector of socio-economic variables as in the cases of the multinomial logit and the probit models presented in Table 1. $\boldsymbol{\gamma_i}$ is a conformable vector of parameters to be estimated, $\widehat{IMR}_i$ is the computed inverse Mills ratio from the first stage, and τ_i is the error term. The second-stage equation is estimated using a maximum likelihood approach (ML) conditional on y =1. As such, only non-zero observations are used in the second stage. That is, only those households that bought Peter Pan in the pre- and the post-recall periods are examined.

The presence of the sample selection bias is ascertained by carrying out a test of statistical significance on the parameter estimate of IMR_i, α. If α is not statistically significant, then omitting observations for zero consumption levels does not result in a sample selection bias; however, if α is statistically significant, then sample selection bias exists.

Changes in price for Jif and Skippy were included in the model to capture the spillover effects in the presence of the recall. These changes in price had to be imputed because none of the households that bought Peter Pan in both the pre-recall and the post-recall periods also bought Jif or Skippy in both periods. Using Nielsen Homescan panel data, the price imputation was done based on auxiliary regressions for the corresponding periods (see Table A3 in the Appendix A). In these auxiliary regressions, the log of price for Jif and Skippy was regressed on variables associated with region, household size, and income for the pre-recall period and the post-recall period. Then, using region, household size, and income characteristics of the households that bought Peter Pan in the pre-recall and the post-recall periods, the predicted values for changes in price for Jif and Skippy were generated. The predicted changes in price for Jif and Skippy were included as explanatory variables in the second stage of the Heckman sample selection model. However, the inclusion of these cross-price effects led to irreconcilable collinearity issues. Consequently, they were not used in the second stage.

Another issue addressed in this study is the potential for price endogeneity in the unit values for Peter Pan (Dong, Shonkwiler, and Capps, 1998). To ascertain the existence of price endogeneity in the change for price of Peter Pan, the Hausman specification was conducted. Instruments chosen for the Hausman test included age, employment status, education, region, race, ethnicity, age and presence of children in the household, presence of male and/or female household heads, household size, and income. The residuals generated by the use of the auxiliary regression were included as an additional explanatory variable in the second stage of the Heckman sample selection model. The p-value associated with the coefficient of the residuals was 0.381 implying that endogeneity of the change in the price of Peter Pan did not exist in the second stage of the Heckman procedure.

There are two major estimation approaches for Heckman sample selection models: the two-step estimator (Heckman, 1976; 1979) and the full-information maximum likelihood estimator (Amemiya, 1985). Puhani (2000) recommends using the two-step estimator over the full-information maximum likelihood approach when there is a strong collinearity arising from having nearly the same variables in both stages (the first stage and the second stage). However, Shonkwiler and Yen (1999) present a discussion of the relative inefficiencies of the two-step procedure compared to the full-information maximum likelihood approach. In our analysis, the maximum likelihood estimator was used for obtaining parameter estimates in the Heckman sample selection model using the version 8 of the STATA software package.

To directly assess the influence of the socio-economic variables in (7), marginal effects were calculated according to the methodology proposed by Saha, Capps, and Byrne (1997). Let X_{kj} denote the *j*th regressor that is common to both the first-stage regressors $\mathbf{W_k}$ and the second-stage regressors $\mathbf{X_k}$. The estimated marginal effect (ME) of a change in X_{kj} is calculated as

$$\widehat{ME}_{kj} = \hat{\gamma}_j + \hat{\alpha}\frac{\partial \widehat{IMR}_k}{\partial X_{kj}}. \quad (8)$$

The ME consists of two parts: a direct effect on the expected change in quantity of Peter Pan purchased, given by $\hat{\gamma}_j$, and a change in the *IMR* with respect to a unit change in X_{kj} multiplied by the parameter estimate of the *IMR* in the second stage, $\hat{\alpha}$. After some simplification, the ME equation (8) can be rewritten as

$$\widehat{ME}_{kj} = \hat{\gamma}_j - \hat{\alpha}\hat{\beta}_j\left[\mathbf{W_k}\hat{\beta}\widehat{IMR}_k + \left(\widehat{IMR}_k^2\right)\right], \quad (9)$$

where $\hat{\boldsymbol{\beta}}$ is a conformable vector of parameter estimates associated with the regressors in the first stage. Since the estimated ME is observation dependent, we use the sample means to evaluate these effects.

Marginal effects were used in calculations of the uncompensated own-price elasticities of demand and income elasticities corresponding to the pre-recall period and the post-recall period in the second stage of the Heckman sample selection model. The uncompensated pre-recall (post-recall) own-price elasticity of demand was calculated by multiplying the marginal effect associated with the change in price ($\Delta Pppan_i$) variable by the ratio of the average pre-recall (post-recall) price to the average pre-recall (post-recall) quantity. The pre-recall (post-recall) income elasticity was computed by multiplying the marginal effect associated with the household income variable (*income*) by the ratio of the average income to the average pre-recall (post-recall) quantity.

DATA

The data for this analysis were obtained from Nielsen Homescan panel for calendar years 2006, 2007 and 2008. The Nielsen Homescan panel is the largest on-going household scanner data survey system, tracking purchases made by households in the United States. The categories,

variable names, and description of the socio-economic explanatory variables used in this study are depicted in Table 1.

The categories age of the household head, employment status of the household head, and education level of the household head contain information on the age, employment, and education of the female household head. However, in cases where there was no female household head, the age, employment, and education of the male household head were used. The categories region, race, age and presence of children in the household, presence of male and/or female household heads, and household size are self-explanatory. The category ethnicity refers to the presence of a Hispanic household. In Nielsen data, household income was reported as an interval and we represent it as the midpoint of the relevant interval. For example, if household income was reported to be between $8,000 and $9,999, then $9,000 was recorded for that household. Any income level above $200,000 was recorded as $200,000.
The construction of the corresponding dependent variables for this study involved several steps. First, from the combined data sets for 2006, 2007, and 2008, information on total ounces of peanut butter purchased by the households that were common to those three years and had bought peanut butter at least once was carved out. Further, these data were broken down by brands and then were aggregated across households for each brand. The following timeline associated with the Peter Pan recall event was used to group the total quantity purchased:

- the pre-recall period, January 4, 2006 through February 13, 2007, for a total of 58 weeks;
- the recall period, when Peter Pan was not available on the shelves of the stores, February 14, 2007, through August 21, 2007 for a total of 27 weeks; and
- the post-recall period, when Peter Pan came back to the stores, August 22, 2007 through December 30, 2008, for a total of 71 weeks.

The dependent variables for the multinomial logit and probit models were constructed based on the corresponding purchasing patterns exhibited by households in relation to Peter Pan. For example, if a household purchased Peter Pan in the pre-recall period and did not buy Peter Pan in the post-recall period then it was in *choice 1* group.

The number of households that purchased Peter Pan at least once over the study period was 10,795 out of which:

- more than 22% (or 2,388) of the households bought Peter Pan in the pre-recall period but did not buy in the post-recall period (*choice 1*),
- about 45% (or 4,835) of the households did not buy Peter Pan in the pre-recall period but bought in the post-recall period (*choice 2*), and
- approximately 33% (3,572) of the households bought Peter Pan in both the pre- and the post-recall periods (*choice 3*).

Of the three choices, *choice 1*, which is consistent with expected behavior of a sensitive consumer losing confidence due to recall, had the lowest frequency, while *choice 2* had the highest frequency. In Table 2 the percentage of households associated with each choice scenario and in association with each of the explanatory variables corresponding to purchases of Peter Pan is exhibited. Household income is broken down into three groups: low-income, which includes

households with an annual income below $30,000, medium-income, which includes households whose income ranges from $30,000 through $80,000, and high-income, which includes households with an annual income over $80,000.

Choice 1

As depicted in Table 2, c*hoice 1* constitutes the smallest group with 22% (or 2,388) of the sample households. As the age of the household head goes above 45, roughly 78% of households discontinued their purchases of Peter Pan in the post-recall period. About 44% and 40% of households that quit purchasing Peter Pan in the post-recall period have heads employed full-time and not employed for full pay, respectively. Around 70% of households that stopped buying Peter Pan in the post-recall period have heads with at least an undergraduate degree. About 54% of households from the South and about 22% from the Midwest quit buying Peter Pan in the post-recall period.

A large majority of households (84%) that quit purchasing Peter Pan in the post-recall period were white. Approximately 94% of households giving up buying Peter Pan in the post-recall period were non-Hispanic. Around 77% of households that discontinued buying Peter Pan in the post-recall period had no children less than 18 years of age. Also, 67% of households that had male and female heads quit purchasing Peter Pan in the post-recall period. About 44% of households that quit purchasing Peter Pan in the post-recall period had two members. The average income of households that stopped buying Peter Pan in the post-recall period was $20,065, $48,261, and $103,492 for the low-, medium-, and high-income households, respectively.

Choice 2

According to Table 2, c*hoice 2* is the largest group with 45% (or 4,835) of the sample households. About three-quarters (77%) of households that started purchasing Peter Pan in the post-recall period have heads aged 45 or older. About 41% and 43% of households that started buying Peter Pan in the post-recall period have heads employed full-time and not employed for full pay, respectively. Two-thirds (66%) of households that began buying Peter Pan in the post-recall period have heads with at least an undergraduate degree. Almost 30% and 43% of households that began purchasing Peter Pan in the post-recall period were from the Midwest and the South, respectively.

The majority of households (87%) that started buying Peter Pan in the post -recall period were white and of non-Hispanic ethnicity (96%). Nearly 76% of households that began buying Peter Pan in the post-recall period had no children less than 18 years of age. Almost 69% of households that started purchasing Peter Pan in the post-recall period had male and female heads. Approximately 44% of households that began purchasing Peter Pan in the post-recall period were two-member households. The average income of households that started buying Peter Pan in the post-recall period was $19,632, $47,922, and $101,821 for the low-, medium-, and high-income households, respectively.

Choice 3

As shown in Table 2, one-third (or 3,572) of the sample households fell under *choice 3*. The majority (79%) of households that bought Peter Pan in the pre-recall period and the post-recall period have heads aged 45 or older. Forty and 44% of households that bought Peter Pan in the pre- and the post-recall periods have heads employed full-time and not employed for full pay, respectively. Slightly less than two-thirds (64%) of households that purchased Peter Pan in the pre- and the post-recall periods have heads with at least an undergraduate degree. About 20% and 59% of households that purchased Peter Pan in the pre-recall period and the post-recall period were from the Midwest and the South, respectively.

The vast majority of households that bought Peter Pan in the pre-recall period and the post-recall period were white (89%) and of non-Hispanic ethnicity (96%). More than three-quarters (76%) of households that purchased Peter Pan in the pre- and the post-recall periods had no children less than 18 years of age. Less than three-quarters (72%) of households that bought Peter Pan in the pre- and the post-recall periods had male and female heads. Less than half (46%) of households that purchased Peter Pan in the pre-recall period and the post-recall period had two members. The average income of households that bought Peter Pan in the pre-recall period and the post-recall period was $20,084, $48,200, and $102,786 for the low-, medium-, and high-income households, respectively.

Overall, the results in Table 2 reveal that, across all the choices, a typical household head is aged 45 or older, has at least an undergraduate degree, is from the South, is white, is non-Hispanic, has no children less than 18 in the household, and has a two-member household headed by a female and a male.

Table 2. Percentage of Households Associated with Each Choice Scenario for the Respective Explanatory Variables

	choice 1 (22% or 2,388)	***choice 2 (45% or 4,835)***	***choice 3 (33% or 3,572)***
Age of the household head			
less than 25	0.17	0.04	0.08
25-29	1.34	1.39	0.95
30-34	3.69	4.05	2.38
35-44	16.42	17.50	17.16
45-54	28.18	28.67	28.78
55-64	26.42	25.73	26.43
greater than 64	23.79	22.63	24.22
Employment status of the household head			
part-time	16.25	15.41	15.76
full-time	44.10	41.37	40.12
not employed for full pay	39.66	43.23	44.12
Education level of the household head			
less than high school	3.35	3.70	3.67
high school	26.97	29.87	32.47
undergraduate	58.04	57.13	54.37
post-college	11.64	9.31	9.49
Region			
East	15.49	16.90	16.46
Midwest	21.73	29.76	20.21
South	53.52	43.39	59.07
West	9.25	9.95	4.26
Race			
white	84.46	87.22	89.00
black	10.26	7.49	6.86
oriental	1.38	1.51	0.95
other	3.89	3.78	3.19
Ethnicity			
Hispanic	5.57	3.99	3.61
non-Hispanic	94.43	96.01	96.39

Table 2. continued

	choice 1 (22% or 2,388)	*choice 2 (45% or 4,835)*	*choice 3 (33% or 3,572)*
Age and presence of children in the household			
pre-school	2.18	3.25	2.18
pre-adolescent	5.70	5.48	5.71
adolescent	7.66	7.78	8.31
pre-school and pre-adolescent	2.39	2.79	2.16
pre-school and adolescent	0.34	0.68	0.53
pre-adolescent and adolescent	4.36	3.78	4.20
pre-school, pre-adolescent and adolescent	0.29	0.68	0.78
no children less than 18	77.09	75.55	76.12
Presence of male and/or female household heads			
female	24.83	23.10	20.94
male	7.83	8.11	6.69
female and male	67.34	68.79	72.37
Household size			
one member	22.99	22.07	19.06
two members	44.18	43.78	45.88
three members	14.36	14.48	14.92
four members	11.81	12.18	12.37
greater than five members	6.66	7.49	7.75
Household income (mean)			
low	20,065	19,632	20,084
medium	48,261	47,922	48,200
high	103,492	101,821	102,786

Notes: *Choice 1*represents the case where households bought Peter Pan in the pre-recall period but did not buy in the post-recall period; *choice 2* corresponds to the case where households did not buy Peter Pan in the pre-recall period but bought in the post-recall period; and *choice 3* refers to the case where households bought Peter Pan in both the pre- and the post-recall periods. Number of households is 10,795.

Source: computations by the authors.

Price and Quantity Variables

In addition to the foregoing socio-economic variables, two additional variables also were considered in the second stage of the Heckman's procedure: the change in quantity purchased and the change in price (unit values) of Peter Pan across the pre-recall and the post-recall periods.

The change in quantity purchased is calculated by subtracting the total pre-recall quantity from the total post-recall quantity for Peter Pan for each household. It needs to be pointed out that before the subtraction, the pre-recall quantity was divided by 58 (the number of the weeks before the recall) and the post-recall quantity was divided by 71 (the number of the weeks after the recall) to render them to a comparable level across the pre-recall and the post-recall periods.

Unit values of Peter Pan were calculated by dividing total expenditure that also includes coupons by total quantity for the pre- and the post-recall periods; consequently, unit values account for coupon effects. Then the change in the prices (unit values) was calculated by subtracting the pre-recall price from the corresponding post-recall price. No adjustment for inflation for the change in price variable was done since the average rate of inflation over the studied period (January 1, 2006 to January 1, 2009) was rather small, comprising about 2% per year (U.S. Department of Labor, Bureau of Labor Statistics, 2004). The change in unit value used to represent price changes was included in the second stage of the Heckman sample selection procedure as an explanatory variable.

Table 3 presents the summary statistics associated with the pre- and the post recall prices, quantities, and income as well as their changes across the two periods. The average pre-recall quantity of Peter Pan on a per household basis was 1.5 ounces and the average post-recall quantity of Peter Pan on a per household basis was 1.3 ounces. Hence, on average, households decreased their consumption of Peter Pan going from the pre-recall period to the post-recall period by 0.2 ounces (or about 13%). The average pre-recall price of Peter Pan was 9.7 cents per ounce and the average post-recall price of Peter Pan was 10.1 cents per ounce. On average, the price for Peter Pan increased by 0.4 cents (or 4%) per ounce across the pre-recall and the post-recall periods. The average income was $55,118 for both the pre-recall and the post-recall periods.

Table 3. Descriptive Statistics of the Quantity, Price, and Income Variables for Peter Pan by the Pre-Recall and the Post-Recall Periods for Households Associated with *Choice 3*

		Peter Pan				
Variable	Unit	Obs	Mean	Std. Dev.	Min	Max
Quantity_pre-recall	oz	3,572	1.547	2.003	0.207	29.407
Quantity_post-recall	oz	3,572	1.346	1.615	0.197	19.493
Change_quantity	oz	3,572	-0.201	1.978	-27.886	16.861
Price_pre-recall	cents/oz	3,572	9.665	1.928	3.111	22.222
Price_post-recall	cents/oz	3,572	10.064	2.624	3.225	28.778
Change_price	cents/oz	3,572	0.399	2.840	-14.167	18.333
Income	dollars	3,572	55,118	34,708	2,500	200,000

Notes: Change_quantity = Quantity_post-recall - Quantity_pre-recall and *Change_price = Price_post-recall - Price_pre-recall*.

Source: computations by the authors.

ESTIMATION RESULTS

Marginal Effects from the Multinomial Logit Model

The multinomial logit parameter estimates are presented in Table A1 and in this section the results are presented only for the statistically significant marginal effects (at the 0.05 significance level). The Hausman-McFadden (1984) test of the null hypothesis that the odds ratios are unaffected by the characteristics of alternatives other than the pair of choices under consideration (assumption of independence of irrelevant alternatives or IIA) supports the null hypothesis, or that IIA holds. The marginal effects, showing changes in probabilities of observing a particular choice of demand behavior resulting from unit changes in the explanatory variables, are presented in Table 4.

Relative to households with heads less than 25 years old, for households with heads aged up to 55 years old, the probability of ending purchases of Peter Pan in the post-recall period decreases. This probability increases for households with heads aged 55 and older, relative to households with heads less than 25 years old. For households with heads aged between 30 and 34, the probability of starting to buy Peter Pan in the post-recall period increases by 0.3437, compared to households with heads aged less than 25. The probability of ending purchases of Peter Pan in the post-recall period increases by 0.0302 and 0.0304 for households with heads employed part-time and full-time, respectively, compared to households with heads not employed for full pay.

The probability of stopping buying Peter Pan in the post-recall period for households from the West increases by 0.0477, relative to households located in the East. In relation to households located in the East, the probability of starting to buy Peter Pan in the post recall period increases by 0.0752 and 0.1018 for households from the Midwest and the West, respectively. But this probability decreases by 0.0811 for households from the South, relative to households from the East. The probability of buying Peter Pan in both the pre-recall and the post-recall periods decreases by 0.061 and 0.1495 for households from the Midwest and the West, respectively, compared to households located in the East. This probability increases by 0.0615 for households from the South in relation to households from the East.

For black households, the probability of stopping purchasing Peter Pan in the post-recall period increases by 0.0623 relative to white households. For black and oriental households, the probability of purchasing Peter Pan in both the pre- and the post-recall periods declines by 0.0626 and 0.0877, respectively, compared to white households. The probability of stopping purchases of Peter Pan in the post-recall period increases by 0.0893 for Hispanic households, compared to non-Hispanic households.

For households with pre-school children and for households with pre-school, pre-adolescent, and adolescent children, the probability of discontinuing purchases of Peter Pan in the post-recall period declines by 0.055 and 0.1162, respectively, relative to households with no children less than 18 years of age. Relative to households with no children less than 18 years of age, for households with pre-school children, the probability of starting to purchase Peter Pan in the post-recall period increases by 0.0985.

In summary, based on the parameter estimates, for the households that quit buying Peter Pan in the post-recall period, employment status, region, race, ethnicity, and age and presence of children in the household were determined as key drivers influencing their demand behavior. For the households that started purchasing Peter Pan in the post-recall period, the important factors affecting their demand behavior were region, race, and age and presence of children in the household.

Table 4. Multinomial Logit Marginal Effects and Associated p-values

	Marginal Effects	**p-value**	**Marginal Effects**	**p-value**	**Marginal Effects**	**p-value**
Variables	***choice 1***		***choice 2***		***choice 3***	
Age of the household head (less than 25)						
25-29	-0.1464*	0.013	0.3041	0.058	-0.1577	0.217
30-34	-0.1575*	0.005	0.3437*	0.019	-0.1862	0.102
35-44	-0.1864*	0.006	0.2997	0.101	-0.1133	0.463
45-54	-0.2015*	0.019	0.3005	0.112	-0.0990	0.535
55-64	-0.1893*	0.024	0.2859	0.133	-0.0966	0.546
greater than 64	-0.1728*	0.038	0.2587	0.181	-0.0859	0.597
Employment status of the household head (not employed for full pay)						
part-time	0.0302*	0.022	-0.0272	0.067	-0.0030	0.832
full-time	0.0304*	0.005	-0.0238	0.060	-0.0066	0.576
Education level of the household head (less than high school)						
high school	-0.0056	0.807	-0.0238	0.384	0.0294	0.256
undergraduate	0.0171	0.455	-0.0156	0.564	-0.0014	0.955
post-college	0.0437	0.129	-0.0441	0.151	0.0004	0.990
Region (East)						
Midwest	-0.0142	0.270	0.0752*	0.000	-0.0610*	0.000
South	0.0197	0.091	-0.0811*	0.000	0.0615*	0.000
West	0.0477*	0.013	0.1018*	0.000	-0.1495*	0.000
Race (white)						
black	0.0623*	0.000	0.0003	0.987	-0.0626*	0.000
oriental	0.0061	0.864	0.0816	0.060	-0.0877*	0.018
other	-0.0253	0.272	0.0530	0.086	-0.0277	0.326

Table 4. continued

Variables	Marginal Effects *choice 1*	p-value	Marginal Effects *choice 2*	p-value	Marginal Effects *choice 3*	p-value
Ethnicity (non-Hispanic)						
Hispanic	0.0893*	0.001	-0.0504	0.071	-0.0389	0.134
Age and presence of children in the household (no child less than 18)						
pre-school	-0.0550*	0.030	0.0985*	0.005	-0.0434	0.173
pre-adolescent	0.0004	0.985	-0.0022	0.933	0.0018	0.942
adolescent	-0.0065	0.728	0.0063	0.783	0.0002	0.993
pre-school and pre-adolescent	-0.0092	0.773	0.0443	0.261	-0.0351	0.326
pre-school and adolescent	-0.0827	0.087	0.1166	0.092	-0.0339	0.586
pre-adolescent and adolescent	0.0275	0.340	-0.0183	0.576	-0.0092	0.761
pre-school, pre-adolescent and adolescent	-0.1162*	0.005	0.0415	0.545	0.0747	0.267
Presence of male and/or female household heads (both male and female)						
female	0.0131	0.394	0.0074	0.689	-0.0205	0.232
male	-0.0030	0.880	0.0264	0.284	-0.0234	0.304
Household size (five and more members)						
one member	0.0148	0.620	0.0384	0.279	-0.0532	0.093
two members	0.0072	0.763	0.0287	0.310	-0.0359	0.175
three members	0.0073	0.752	0.0105	0.700	-0.0178	0.474
four members	0.0058	0.783	0.0019	0.937	-0.0077	0.735
Household income						
income	0.0000001	0.350	-0.0000002	0.282	0.00000005	0.763

*Notes: Choice 1*represents the case where households bought Peter Pan in the pre-recall period but did not buy in the post-recall period; *choice 2* corresponds to the case where households did not buy Peter Pan in the pre-recall period but bought in the post-recall period; and *choice 3* refers to the case where households bought Peter Pan in both the pre- and the post-recall periods. * Indicates significance at the 0.05 level. Reference groups are given in parentheses next to the categories.

Source: computations by the authors.

Second-Stage Maximum Likelihood Analysis of the Heckman Sample Selection Model

This section provides analysis of the households that were loyal to the Peter Pan brand. The parameter estimates and the associated p-values for the first and second stages of the Heckman sample selection procedure obtained from the maximum likelihood estimation approach are provided in Table A2 (see Appendix A). However, in this section only the interpretation of the second-stage results is presented focusing on the corresponding marginal effects.

The coefficient associated with the inverse Mills ratio (*IMR*), lambda, was statistically significant suggesting that sample selection bias was an issue. Hence, the marginal effects were corrected using the procedure developed by Saha, Capps, and Byrne (1997) (Table 5). Due to the unavailability of p-values associated with the marginal effects, it is not possible to discern their statistical significance. Hence, we focus only on those marginal effects whose corresponding second-stage parameter estimates were statistically significant at the 0.05 level.

Table 5 shows that a one unit increase in the change in price of Peter Pan decreases the change in quantity purchased by 0.04 ounces, holding everything else constant. Compared to households from the East, moving from the pre-recall period to the post-recall period, the change in quantity purchased of Peter Pan is greater by 0.4 ounces for households from the Midwest. Relative to households from the East, going from the pre-recall period to the post-recall period, the change in quantity purchased of Peter Pan increases by 0.7 ounces for households from the West. From the pre-recall period to the post-recall period, relative to white households, the change in quantity purchased of Peter Pan for black households goes up by 0.02 ounces.

Across the pre-recall and the post-recall periods, the change in quantity purchased of Peter Pan increases by 0.7 ounces for households with pre-school and pre-adolescent children relative to households with no children less than 18 years of age. From the pre-recall period to the post-recall period, the change in quantity purchased of Peter Pan goes up by 1 ounce for households with pre-school and adolescent children compared to households with no children less than 18 years of age. Compared to households with at least five members, across the pre- and the post-recall periods, the change in quantity purchased of Peter Pan increases by 0.3 ounces for two-member households.

The own-price elasticities of demand calculated in the second stage of the Heckman procedure indicated that a 1% increase in the price of Peter Pan results in a decrease of 0.258% and 0.308% in the quantity purchased of Peter Pan in the pre-recall and the post-recall periods, respectively, *ceteris paribus*. Both the pre-recall and the post-recall own-price elasticities are less than 1 in absolute values, suggesting that the demand for Peter Pan is inelastic in both the pre- and the post-recall periods.

In summary, across the pre-recall and the post-recall periods, an increase in price results in a decline of quantity purchased. Also, region, race, age and presence of children in the household, and household size were associated with increases in quantities purchased among those households that returned to the brand after the recall.

Table 5. Marginal Effects Corresponding to the Second-Stage Parameter Estimates from the Heckman Sample Selection Procedure [a]

Variables	Marginal Effects	Variables	Marginal Effects
Price		Race (white)	
change_price	-0.0412*	black	0.0221*
		oriental	0.1555
Age of the household head (less than 25)		other	0.0229
25-29	0.6007		
30-34	0.7242	Ethnicity (non-Hispanic)	
35-44	0.3396	Hispanic	-0.2984
45-54	0.3884		
		Age and presence of children in the household (no child less than 18)	
55-64	0.2634		
greater than 64	0.2663	pre-school	0.2764
		pre-adolescent	0.2168
Employment status of the household head (not employed for full pay)		adolescent	0.1995
part-time	-0.0437	pre-school and pre-adolescent	0.6529*
full-time	-0.0364	pre-school and adolescent	1.0035*
		pre-adolescent and adolescent	0.2338
Education level of the household head (less than high school)		pre-school, pre-adolescent and adolescent	0.3276
high school	0.1450		
		Presence of male and/or female household heads (both male and female)	
undergraduate	0.0066		
post-college	-0.0357	female	0.0748
		male	0.0827
Region (East)			
Midwest	0.3870*	Household size (five and more members)	
South	0.1361	one member	0.1644
West	0.6769*	two members	0.2931*
		three members	0.0477
Household income		four members	0.0763
income	-0.000001		

Notes: [a]The computation of the marginal effects is done with adjustment through the use of the procedure developed by Saha, Capps, and Byrne (1997).
* Indicates significance at the 0.05 level. The significant coefficients correspond to those of the second-stage parameter estimates in the Heckman sample selection procedure. Reference groups are given in parentheses next to the categories.

Source: computations by the authors.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

A number of household socio-economic characteristics were key drivers associated with three choices of actions taken by households in relation to the recall of Peter Pan peanut butter. In particular, for the households that abandoned purchasing Peter Pan in the post-recall period, employment status of the household head, region, race, ethnicity, and age and presence of children in the household were identified as important factors affecting their demand behavior. For the households that began buying Peter Pan in the post-recall period, the key factors impacting their demand behavior included region, race, and age and presence of children in the household.

In addition, the change in price negatively affected, while region, race, age and presence of children in the household, and household size positively affected the change in quantity purchased of Peter Pan peanut butter across the pre-recall period and the post-recall period. In both the pre- and the post-recall periods the demand for Peter Pan is inelastic (-0.258 and -0.308 in the pre- and the post-recall periods, respectively). These estimates suggest that ConAgra can increase its sales revenues in the short-run by increasing the price, *ceteris paribus*. Future research should concentrate on spillover effects associated with the recall by replicating the multinomial logit analysis for the competing peanut butter brands.

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APPENDIX

Table A1. Multinomial Logit Parameter Estimates and Associated p-values

	Coefficients	p-value	Coefficients	p-value
Variables	***choice 1***		***choice 2***	
Age of the household head (less than 25)				
25-29	-0.405	0.617	1.172	0.216
30-34	-0.348	0.658	1.396	0.134
35-44	-0.813	0.295	0.970	0.295
45-54	-0.814	0.294	0.945	0.308
55-64	-0.767	0.323	0.900	0.331
greater than 64	-0.715	0.357	0.802	0.386
Employment status of the household head (not employed for full pay)				
part-time	0.139	0.089	-0.053	0.445
full-time	0.156*	0.026	-0.033	0.574
Education level of the household head (less than high school)				
high school	-0.114	0.455	-0.142	0.255
undergraduate	0.082	0.588	-0.030	0.807
post-college	0.182	0.290	-0.103	0.474
Region (East)				
Midwest	0.130	0.140	0.356*	0.000
South	-0.099	0.194	-0.369*	0.000
West	0.775*	0.000	0.784*	0.000
Race (white)				
black	0.461*	0.000	0.209*	0.019
oriental	0.337	0.177	0.477*	0.026
other	-0.032	0.848	0.200	0.164
Ethnicity (non-Hispanic)				
Hispanic	0.468*	0.002	0.008	0.955

Table A1. continued

Variables	Coefficients *choice 1*	p-value	Coefficients *choice 2*	p-value
Age and presence of children in the household (no child less than 18)				
pre-school	-0.141	0.497	0.340*	0.038
pre-adolescent	-0.004	0.979	-0.010	0.932
adolescent	-0.030	0.808	0.013	0.898
pre-school and pre-adolescent	0.071	0.748	0.207	0.258
pre-school and adolescent	-0.356	0.424	0.340	0.278
pre-adolescent and adolescent	0.146	0.410	-0.013	0.932
pre-school, pre-adolescent and adolescent	-0.942*	0.038	-0.118	0.689
Presence of male and/or female household heads (both male and female)				
female	0.122	0.225	0.080	0.351
male	0.060	0.656	0.131	0.255
Household size (five and more members)				
one member	0.236	0.220	0.254	0.118
two members	0.143	0.360	0.174	0.180
three members	0.088	0.556	0.079	0.527
four members	0.050	0.715	0.028	0.804
Household income				
income	0.0000004	0.626	-0.0000005	0.478
constant	-0.033	0.966	-0.664	0.478
McFadden's R^2	0.02			
Wald chi2	453.02			
Prob > chi2	0.000			
Log likelihood	-11210.053			
Number of obs	10,795			

*Notes: Choice 1*represents the case where households bought Peter Pan in the pre-recall period but did not buy in the post-recall period and *choice 2* corresponds to the case where households did not buy Peter Pan in the pre-recall period but bought in the post-recall period. * Indicates significance at the 0.05 level. Number of observations is 10,795. Reference groups are given in parentheses next to the categories.

Source: computations by the authors.

Table A2. Parameter Estimates and Associated p-values Associated with Peter Pan Obtained in the First and Second Stages of the Heckman Sample Selection Procedure

Variables	Coefficients	Variables	Coefficients
First-stage probit results		***First-stage probit results***	
Age of the household head (less than 25)		Education level of the household head (less than high school)	
25-29	-0.193	high school	0.054
	(0.666)		(0.439)
30-34	-0.283	undergraduate	-0.028
	(0.518)		(0.688)
35-44	-0.014	post-college	-0.021
	(0.975)		(0.797)
45-54	0.007	Region (East)	
	(0.988)	Midwest	-0.178*
55-64	0.022		(0.000)
	(0.959)	South	0.163*
greater than 64	0.033		(0.000)
	(0.939)	West	-0.463*
Employment status of the household head (not employed for full pay)			(0.000)
part-time	-0.006	Race (white)	
	(0.886)	black	-0.201*
full-time	-0.002		(0.000)
	(0.940)	oriental	-0.249*
			(0.035)
		other	-0.041
			(0.609)
		Presence of male and/or female household heads (both male and female)	
Ethnicity (non-Hispanic)			
Hispanic	-0.123	female	-0.063
	(0.100)		(0.186)
		male	-0.037
			(0.563)

Table A2. continued

Variables	Coefficients	Variables	Coefficients
First-stage probit results		***First-stage probit results***	
Age and presence of children in the household (no child less than 18)		Household size (five and more members)	
pre-school	-0.106	one member	-0.202*
	(0.249)		(0.026)
pre-adolescent	-0.004	two members	-0.135
	(0.950)		(0.062)
adolescent	-0.004	three members	-0.089
	(0.944)		(0.203)
pre-school and pre-adolescent	-0.075	four members	-0.047
	(0.465)		(0.457)
pre-school and adolescent	-0.053	Household income	
	(0.770)	*income*	-0.00000003
			(0.947)
pre-adolescent and adolescent	-0.005	constant	-0.296
	(0.951)		(0.502)
pre-school, pre-adolescent and adolescent	0.28		
	(0.101)		

Table A2. continued

Variables	Coefficients	Variables	Coefficients
Second-stage ML results		***Second-stage ML results***	
Price		Education level of the household head (less than high school)	
change_price	-0.041*	high school	0.064
	(0.000)		(0.759)
Age of the household head (less than 25)		undergraduate	0.048
25-29	0.892		(0.815)
	(0.507)	post-college	-0.005
30-34	1.151		(0.984)
	(0.381)	Region (East)	
35-44	0.36	Midwest	0.656*
	(0.781)		(0.000)
45-54	0.378	South	-0.11
	(0.770)		(0.301)
55-64	0.23	West	1.375*
	(0.859)		(0.000)
greater than 64	0.217	Race (white)	
	(0.867)	black	0.325*
Employment status of the household head (not employed for full pay)			(0.029)
part-time	-0.035	oriental	0.532
	(0.758)		(0.157)
full-time	-0.033	other	0.084
	(0.739)		(0.731)
Ethnicity (non-Hispanic)			
Hispanic	-0.113		
	(0.627)		

Table A2. continued

Variables	Coefficients	Variables	Coefficients
Second-stage ML results		***Second-stage ML results***	
Age and presence of children in the household (no child less than 18)		Household size (five and more members)	
pre-school	0.436	one member	0.47
	(0.126)		(0.084)
pre-adolescent	0.223	two members	0.497*
	(0.267)		(0.020)
adolescent	0.206	three members	0.181
	(0.234)		(0.379)
pre-school and pre-adolescent	0.766*	four members	0.147
	(0.014)		(0.434)
pre-school and adolescent	1.084*	Household Income	
	(0.049)	*income*	-0.000001
pre-adolescent and adolescent	0.242		(0.387)
	(0.330)	constant	1.286
pre-school, pre-adolescent and adolescent	-0.095		(0.332)
	(0.846)	lambda (inverse Mills ratio) (z statistic is below)	-2.271*
Presence of male and/or female household heads (both male and female)			(-35.408)
female	0.17	rho[a] (z statistic is below)	-0.843*
	(0.239)		(-88.547)
male	0.139	sigma[b] (z statistic is below)	2.694*
	(0.482)		-53.6
		McFadden's R^2 (first stage)	0.014
		R^2 (second stage)	0.012
		Wald chi2(33)	182.17
		Prob > chi2	0.000
		Log likelihood	-13995.69

Notes: [a]rho is the correlation coefficient between the unobservables in the probit model and the unobservables in the second-stage model.
[b]sigma is the standard error of the residual in the first-stage equation.
Number of observations is 10,795 with 7,223 censored observations and 3572 uncensored observations.
* Indicates significance at the 0.05 level which is ascertained by the p-values presented in the parentheses below. Reference groups are given in parentheses next to the categories.

Source: computations by the authors.

Table A 3. Auxiliary Regressions to Obtain Predicted Values for Changes in Price for Jif and Skippy

	JIF		SKIPPY	
	Pre-recall Coefficient	Post-recall Coefficient	Pre-recall Coefficient	Post-recall Coefficient
Region (East)				
Midwest	-0.0003	-0.010	0.010	-0.045*
	(0.962)	(0.097)	(0.275)	(0.000)
South	-0.005	-0.011	0.045*	0.018*
	(0.393)	(0.059)	(0.000)	(0.038)
West	0.058*	0.035*	0.091*	0.011
	(0.000)	(0.000)	(0.000)	(0.161)
Household size (five and more members)				
one member	0.066*	0.090*	0.107*	0.109*
	(0.000)	(0.000)	(0.000)	(0.000)
two members	0.030*	0.039*	0.048*	0.061*
	(0.000)	(0.000)	(0.000)	(0.000)
three members	0.031*	0.033*	0.050*	0.050*
	(0.001)	(0.000)	(0.001)	(0.000)
four members	0.009	0.025*	0.029	0.037*
	(0.360)	(0.003)	(0.054)	(0.005)
Household income				
income	0.0000002*	0.0000003*	0.0000004*	0.0000002*
	(0.001)	(0.000)	(0.000)	(0.004)
_cons	2.300*	2.401*	2.182*	2.378*
	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.02	0.02	0.03	0.02

Notes: * Indicates significance at the 0.05 level which is ascertained by the p-values presented in the parentheses below. Reference groups are given in parentheses next to the categories.

Source: computations by the authors.