The Impact of Households' Characteristics on Food at Home and Food away from Home

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Introduction

Food, clothing, and housing are essential factors for a good life, but food is the most important component due to the fact that it is directly related to human health. According to the Food and Agriculture Organization (FAO) and International Fund for Agricultural Development (IFAD), approximately 805 million people in the world do not have enough food to eat (Food, et al., 2014). More than 200 diseases occur and up to 9,000 deaths are estimated each year in the U.S due to insufficient food (Mead, et al., 1999). Based on the United States Department of Agriculture, Food and Nutrition Service (USDA. FNS, 2008), Food and Nutrition Act of 2008 provides better levels of nutrition for low-income households from federal-state programs such as the Supplemental Nutrition Assistance Program (SNAP), also called the food stamp program.

The U.S. Bureau of Labor Statistics (BLS, 2015) reports that the percentage changes on average annual food expenditure between 2013 and 2014 are -0.2% for food at home and 6.2% for food away from home, respectively. In addition according to the United States Department of Agriculture, Economic Research Service (USDA. ERS, 2014), the share of annual food consumption outside home is increasing overtime whereas the share of annual food consumption at home is decreasing. The difference can be explained by the increase in per-capita disposable income, female participation in the labor force, two-earner households, work hours, and leisure time (USDA. ERS, 2014). Nayga, Jr. and Capps, Jr. (1992) state that the increasing popularity of food—away-from-home can be contributed to changes in socio-economics, demographic characteristics, and consumer lifestyle. In addition, Davis (2014) mentions that by an increase in the opportunity cost of time, food away from home expenditures increase whereas food at home expenditures decrease.

In this study, we investigate the impact of income and other households' characteristics on food expenditures away from home and at home separately in order to discover the factors that affect total food expenditures, and the differential impacts between food way from home and food at home. We hypothesize that food consumption of people who are in below the poverty threshold are affected differently than those who are above the poverty threshold.

Even though this study focuses mainly on food expenditures away from home and food at home in the U.S., we also investigate the impact of food stamp on total expenditures for food, hypothesizing that food consumption behavior between food way from home and food at home is differently affected by SNAP benefits. This is due to the fact that SNAP benefits, as the main nutrition welfare program, generally targets food at home expenditure (Davis, 2014). Analyzing the different impacts between food expenditures away from home and food at home will provide important information for policy makers and analysts.

Literature Review

Stewart and Yen (2004) identified the impacts of key economic and demographic variables on households' expenditures away from home based on different types of facility such as fast food and full-service restaurants, using Consumer Expenditure Survey. They found that consumers are more likely to spend their money on full-service dining than fast food. In addition, they argued that food expenditures way from home is based on income and demographic developments, especially family structure. A recent paper by Liu, et al. (2013) investigated household expenditures on food away from home by different types of facilities with different household types. They used multivariate sample selection procedure and found different marginal effects on food away from home expenditure for most of the demographic and socio economic variables across different household types and facilities. The main difference between Stewart and Yen

(2004) and Liu, et al. (2013) is that for the variable of household type in Stewart and Yen (2004), children are included for single parents, but excluded in Liu, et al. (2013). Including or excluding children for single parents makes a big difference in estimation of food expenditure away from home due to the fact that children have a high financial burden.

Yen, et al. (2012) investigated food away from home expenditures by focusing on elderly households across different facilities such as full-service restaurants, fast-food restaurants, and other facilities. They found different consuming patterns for food away from home expenditures by the elderly households. In addition, they found economic and socio-demographic characteristics such as income, education, employment status, race, age, and regional difference were the most important factors in estimation of food away from home expenditures.

Davis (2014) has summarized many previous studies relating to food away from home and food at home expenditures by focusing on opportunity cost of time and income variables.[1] Based on Davis (2014), many recent articles address and investigate food expenditures on food away from home except two: Park and Capps (1997) estimate the U.S. households' demand for prepared meals as food at home by using the 1987– 88 Nationwide Food Consumption Survey (NFCS). They used a Heckman two-stage approach and found that households with younger, more educated, and male household managers were more likely to consume prepared meals.

Nayga, Jr. and Capps, Jr. (1992) estimated the demand for food way from home, food at home, and non-food items, using the Almost Ideal Demand System (AIDS) model with monthly time series data from 1970 to 1989. They found that the expenditure elasticity estimate for food away from home was higher than the one for food at home. This indicates that the demand for food away from home is more sensitive than demand for food at home. Furthermore, they found

[1] See Davis (2014) for more details about the previous studies. The author well-summarizes different types of data sources, estimation approaches, and dependent and independent variables used in the previous studies.

that the share of total expenditures for food away from home increased due to increase in labor force participation by women.

Based on our knowledge, most of the previous studies investigated food away from home and food at home expenditures separately. However, it is reasonable to compare and contrast different consumption patterns between food away from home and food at home simultaneously. We hypothesize the two consumption patterns are differently affected by socio-economic and demographic characteristics. This study contributes to the existing literature by investigating the two different consumption patterns simultaneously using recent data sources.

Conceptual Frameworks

Discrete Random Utility Theory

In this research, the theoretical framework for discrete random utility follows Liu, et al. (2013), which was motivated by the discrete random utility theory of Pudney (1989). Maximizing the random utility function by a household subject to income constraint can be defined as the following: $max_{q,c,l}\, U(Dq, C, L; H)|P'Q\ s.t\ C = w(T - L) + N$

where Q and P are vectors of quantities and prices, respectively, C is composite goods with normalized prices, L is leisure time, w is wage, H is a vector of demographic variables, T is total time available, N is endowed income, and D is a diagonal matrix. Each binary indicator d_i refers to a potential consumer of q_i in the diagonal matrix. The utility function is assumed to be strictly quasi-concave and increasing in C, L, and positive elements of Dq. The optimal demand quantity q^* is derived from the utility maximization equation by solving it as a function of prices, wage earnings, and endowed income. In this study, q^* represents either quantity demanded for food away from home (FAFH) or quantity demanded for food at home (FAH) based on the two

dependent variable estimations. Two important conditions need to be held for the demand functions derived from the constrained utility maximization. First, all individuals are assumed to be potential consumers of q_i so that $d_i = 1$ for individual *I*, and censoring of each q_i relates to a corner solution in a Tobit model. Second, $d_i = 1$ and utility is maximized in the interior of the choice set; for the individuals who are not potential consumers, $d_i = 0$ and $q_i = 0$ due to the assumption of positive prices.

The Tobit Model

The Tobit model was initially proposed by Tobin (1958), and the conceptual framework for the Tobit model follows Haab and McConnell (2002). The basic structural equation for the Tobit model can be defined as the following: $y_i^* = X_i\beta + u_i$

where $u_i \sim N(0,\sigma^2)$ and y^* is a latent variable, which is observed if observed values are greater than γ,otherwise y^* is censored. The observed *y* is defined as following measurement equation:

$$y_i = \begin{cases} y^* \; if \; y^* > \gamma \\ \gamma_y \; if \; y^* \leq \gamma \end{cases}$$

In general, the Tobit model assumes $\gamma = 0$, which means the data are censored at 0, then the measurement equation is rewritten as: $y_i = \begin{cases} y^* \; if \; y^* > \gamma \\ 0 \; if \; y^* \leq 0 \end{cases}$

The likelihood function for the censored normal distribution is defined as the following:

$$L = \prod_i^N \left[1 - \Phi\left(\frac{\mu - \gamma}{\sigma} \right) \right]^{1-d_i} \left[\frac{1}{\sigma} \Phi\left(\frac{y - \mu}{\sigma} \right) \right]^{d_i}$$

where γ is the censoring point. In general Tobit model, $\gamma = 0$ and parameterize μ is set as $X_i\beta$. Then the likelihood function for the Tobit model can be rewritten as:

$$L = \prod_{i}^{N} \left[1 - \Phi\left(\frac{X_i \beta}{\sigma}\right) \right]^{1-d_i} \left[\frac{1}{\sigma} \Phi\left(\frac{y - X_i \beta}{\sigma}\right) \right]^{d_i}$$

Finally, the log-likelihood function for the Tobit model is:

$$\ln L = \sum_{i=1}^{N} \left\{ (1 - d_i) \ln\left(1 - \Phi\left(\frac{X_i \beta}{\sigma}\right) \right) + d_i \left(\ln\left(f\left(\frac{X_i \beta}{\sigma}\right) \right) - \ln(\sigma) \right) \right\}.$$

According to Wooldridge (2000), there are two main cases in which the censored Tobit regression model is used. First, the Ordinary Least Squares (OLS) can be applied to estimate population regression E (y^*) if variable y^*, which has a quantitative meaning, is observable for all individuals in the population. However, OLS cannot be used if y^* is unobservable (i.e., censored) in part of the population. Second, there exists a corner solution, which refers to $y = 0$ in the maximization problem if observable choice of y is either continuous random variable or 0 with a positive probability. In this case OLS cannot be used due to the theoretical fact that E(y|**x**) is not linear in x. The only different between the OLS estimation and the Tobit model is that the Tobit likelihood function has additional term of $\sum_{i=1}^{N} (1 - d_i) \ln[1 - \Phi(X_i \beta / \sigma)]$.

According to McDonald and Moffitt (1980), the linear effect is on the uncensored latent variable instead of the observed variable, even though the estimated coefficients from the Tobit model provide similar interpretation as OLS. We have three possible marginal effects from the Tobit model (Sigelman and Zeng 1999):

(1) $\frac{\partial E(y^*)}{\partial x_k} = \beta_k$

(2) $\frac{\partial E(y|y>0)}{\partial x_k} = \beta_k \left\{ 1 - \lambda(\alpha) \left[\frac{X_i \beta}{\sigma} + \lambda(\alpha) \right] \right\}$ where $\lambda(\alpha) = \frac{\emptyset\left(\frac{X_i \beta}{\sigma}\right)}{\Phi\left(\frac{X_i \beta}{\sigma}\right)}$, which indicates how uncensored observation y is affected by one unit change in independent variable x.

(3) $\frac{\partial E(y^*)}{\partial x_k} = \Phi\left(\frac{X_i}{\sigma}\right)\beta_k$ where $\Phi\left(\frac{X_i}{\sigma}\right)$ indicates a probability that an observation is different from zero. If observation is not different from zero, then the Tobit is the same as OLS.

The first equation represents the latent variable marginal effect, whereas the second equation shows the expected value of uncensored-observation marginal effect. The last equation shows the marginal effects of expected value of both censored and uncensored observations. Wooldridge (2000) argues that the latent dependent variable marginal effect is not useful unless we have a corner solution. Greene (2003) mentions that there is no agreement on estimating different marginal effects, and depends on the purpose of the research. In this paper, we use the expected-value marginal effects for censored and uncensored observations to interpret the results in table 2, as suggested by Greene (2003).

Data Description

In this study, we use the 2013 Consumer Expenditure Survey data by the U.S. Department of Labor, Bureau of Labor Statistics. Based on the U.S. BLS (2015), the consumer expenditure surveys are defined as specific studies on data associated with day-to-day family expenditures for goods and services. The nationwide expenditure survey was initially conducted during the periods of 1888-1891, and the major expenditures survey was conducted between 1972 and 1973 to collect information on the buying habits of U.S. households. The survey mainly collects data on income, expenditure, and consumer characteristics.

The CE generally contains two different surveys: the weekly survey and quarterly interview survey. Each survey has its own data collection method drawn separately, and data is released with one year lag from the data collected. Information about 7,500 to 8,000 consumer

unit, which is defined as families and single consumers, is obtained by CE interviews every three months over five consecutive quarters. The survey collects information on expenditures, including large purchases, recurring expenditures, continuing expenses, and other expenses except nonprescription drugs, housekeeping supplies, and personal care products (Mabli and Malsberger, 2013). In this study, we use and focus on weekly survey dataset, which mainly includes consumer unit characteristics and income. The data used in this study is 12,275 households out of 12,335 total surveys, due to missing observations. Table 1 shows the summary statistics and description of dependent and independent variables with expected signs.

<Insert Table 1 Here>

Empirical Models

In this study, we measure two equations with two different dependent variables in order to compare and contrast how each dependent variable is differently affected by household characteristics and food stamp benefits. Since the dependent variable is censored and general OLS estimation is biased and inconsistent, we employ the Tobit model. The dependent variables used in this study are weekly total expenditures on food at home and away from home. Based on the BLS, the expenditure on food at home includes total expenditures at grocery stores and food stores for foods prepared by consumers. On the other hands, the expenditure for food away from home includes all foods consumed outside of home at full-service restaurants, fast-food restaurants, hotels, and schools. The independent variables used in this study are income, education, working hours, spouse working hours, age, age of children, family size, marital status, male, white, food stamp, poverty-threshold, north, south, and west. The east region is excluded from the analysis due to the fact that it is used as baseline dummy since four regions are used as

dummy variable. The same independent variables are used for both equations. The Tobit model is defined as the following:

$$Food_{away\ from\ Home\ or\ at\ Home}$$
$$= \beta_0 + \beta_1 Income + \beta_2 Education + \beta_3 Woking\ Hour$$
$$+ \beta_4 Spouse\ Working\ Hour + \beta_5 Age + \beta_6 Child\ Age + \beta_7 Family\ size$$
$$+ \beta_8 Marital + \beta_9 Wite + \beta_{10} Male + \beta_{11} Food\ Stamp + \beta_{12} Poverty$$
$$+ \beta_{13} North + \beta_{14} South + \beta_{15} West + \varepsilon.$$

For income, the expected sign is positive based on micro economic theory that budget constraint shifts outward as income increases. A household with negative income can be explained by borrowing/dissaving or investment, or people borrowing money to attend college. Age is expected to have a negative impact on total expenditures on food away from home and food at home, as age increases. Total food expenditure at home is expected to be positive as family size incases, but the sign for food expenditure away from home is uncertain. The expected sign for education level is positive due to the fact that higher education level is directly related to higher income.

The expected sign for the age of children is uncertain due to uncertainty of children's characteristics. Weekly working hours by both household and spouse are expected to be positive since it directly relates to income. The signs for other demographics such as sex, race, marital status, and regional dummies are uncertain. The expected sign for food stamp is positive on food expenditures at home but negative on food expenditures way from home. According to Schnepf and Richardson (2013), lower income households are more willing to spend their food budget on food at home consumption compared to higher income households. Finally, we expect

households who are below current poverty threshold to be negatively affected by food expenditures away from home compared to households who are above the poverty threshold.

Empirical Results and Discussion

Table 2 shows the Tobit model estimated coefficients with the marginal effects. Most of the independent variables have the expected signs. The F-statistics of 40.46 for food away from home and 90.40 for food at home with p-values of 0.00 indicate each model as a good fit and statistically significant. We assumed the presence of heteroscedasticity and used robust standard errors to capture incorrect standard errors caused by heteroskedasticity. The estimated robust standard errors are also presented in table 2.

<Insert Table 2 Here>

For both models, income, education, age, age of children, family size, marital status, food stamp, poverty, and south variables were statistically significant. However, working, male, north, and west variables were only statistically significant in the food expenditure away-from-home model. The white variable was only significant for the food expenditures at home equation. Based on the results of the marginal effects, one thousand dollars increase in annual income, on average, increases total food expenditures away from home and at home by $0.30 and $0.21, respectively, holing other factors constant. An increase in one level of education will lead to $5.71 increase in food expenditures away from home, and $2.92 increase in food expenditures at home. That is, there is a positive relationship between education level and income. In addition, households with higher education level tend to spend more money on food expenditure away from home. If reference household usually worked per week, total food expenditure away from home increases by $4.03 compared to household who do not work.

An increase in age is negatively related to total food expenditures away from home, but total food expenditure at home is positively affected. As people get older, they more likely spend money on food at home. Increasing children's age by 5 years will increase both total food expenditures away from home and at home. One increase in family size will result in $2.72 increase in food expenditures away from home, and $13.14 increase at home. As number of family size increases, people tend to spend more money on food at home, whereas white people tend to spend more money on food away from home.

If people are above the poverty threshold, then both total food expenditure away and at home increase by $13.04 and $16.72, respectively, compared to people whose income is below poverty threshold. For households living in north, south, or west, the total food expenditures away from home increase by $5.58, $5.44, or $11.83, respectively. For the food stamp variable we find that total food expenditure away from home is negatively affected by $9.68, whereas food expenditure at home is positively affected by $5.79. This is due to the fact that those who receive food stamp are low income people, and many full-service restaurants or fast food stores do not accept food stamp.

Summary and Conclusions

In this study, we investigated the impact of income and other household socio-economic characteristics on food expenditures at home and away. In addition, we investigated the role of food stamp benefits; and hypothesized that food consumption of people under the poverty threshold is affected differently than those who are above the poverty threshold. We also examined the impact of SNAP (food stamp benefits) on food expenditures away from home and at home. We used 2013 Consumer Expenditure Survey data provided by BLS. The data used in

this study was 12,275 households out of 12,335 total surveys. To estimate each regression model, we employed the Tobit model because the dependent variable in each model is censored and the estimated coefficients from general OLS would be biased and inconsistent. Since the direct estimated coefficients from the Tobit model only provide the effects of the repressors on the latent variables, we further calculated the marginal effects from those estimates.

The results of this study show how households with different characteristics are affected differently when considering food expenditures at home and away from home. In this research, we found differential impacts of employment, age, race, sex, and region on total food expenditures away from home and at home. These findings help in designing social and food marketing strategies. Single male households are more likely to consume food away from home compared to female households. Hence, the female households could be targeted to increase food expenditure on food away from home, and male households could be targeted to reduce expenditure on food away from home to induce more home-prepared foods. White households are more likely to spend food at home.

In addition, as population gets older, food expenditure away from home decreases and food at home increases. The white population might be targeted for local food restaurants or stores to induce more expenditure on food away from home. The local food restaurants could also have different food menus or prices for different age groups to increase profits. Finally, the results from the regional dummy variables show that households who are living in the North and West areas are more willing to spend on food way from home than those in other areas. This finding could be useful to reginal and local policy makers, and regional economic developers.

A limitation of this study is that we could not capture time variant effects given the fact that consumers' behaviors and lifestyles are continuously changing with time. Further research in

needed to incorporate these time-variant changes with the release of the new updated BLS dataset.

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Table 1: Descriptions of Independent Variables for the Two Model Estimations (N=12,275)

Variable	Type	Description	Mean	Std. Dev.	Exp. Sign
Foodaway	Continuous	Weekly expenditure for food outside home between $0 - $4058.227	44.48	75.54	
Foodhome	Continuous	Weekly expenditure for food at home between $0 - 1192.5	76.30	85.70	
Income	Continuous	Amount of income after taxes in past 12 months between -$165,563 - $550,379	49.75	59.84	+
Age	Continuous	Age of household between 15 -88	50.70	17.19	-
Famsize	Continuous	Number of family size between 1-11	2.43	1.42	+/-
Education	Categorical	4 if graduate level; 3 if some college; 2 if high school; 1 if less than high school	2.62	0.85	+
Childage	Categorical	4 if age is greater than 17; 3 if between 12-17; 2 if 6-11; 1 if less than 6	1.69	1.11	+/-
Working	Binary	1 if reference person usually worked per week; 0 if otherwise	0.65	0.48	+
Working2	Binary	1 if spouse usually worked per week; 0 if otherwise	0.34	0.47	+
Urban	Binary	1 if households are living in urban; 0 if rural	0.94	0.23	+
Marital	Binary	1 if reference household is married; 0 if otherwise	0.51	0.50	+
White	Binary	1 if reference household is white; 0 if otherwise	0.81	0.39	+/-
Male	Binary	1 if male; 0 if female	0.46	0.50	+/-
Foodstamp	Binary	1 if reference household receives food stamp; 0 otherwise	0.11	0.31	+/-
Poverty	Binary	1 if income is above poverty threshold in current year; 0 if below poverty threshold	0.67	0.47	+
South	Binary	1 if reference households live in South;0 otherwise	0.36	0.48	+/-
West	Binary	1 if reference households live in West; 0 otherwise	0.21	0.41	+/-
North	Binary	1 if reference households live in Northeast; 0 otherwise	0.19	0.39	+/-

Table 2: Estimated Coefficients with Marginal Effects from Tobit Model for Food Expenditures Away from Home and Food at Home

	Food away from Home				Food at Home			
Variable	Coef.		Robust Std. Err	Marginal Effect	Coef.		Robust Std. Err	Marginal Effect
Income	0.31	***	0.03	0.18	0.21	***	0.02	0.16
Education	9.69	***	1.24	5.71	3.95	***	1.09	2.92
Work	6.89	***	2.22	4.03	-1.53		2.23	-1.14
Work2	2.16		2.71	1.28	-1.79		2.85	-1.32
Age	-0.37	***	0.06	-0.22	0.45	***	0.07	0.33
Childage	2.35	***	1.01	1.38	2.30	***	1.13	1.70
Urban	-0.78		3.13	-0.46	-1.64		3.43	-1.22
Famsize	4.62	***	1.14	2.72	17.75	***	1.18	13.14
Marital	8.99	***	2.61	5.30	15.49	***	2.64	11.51
White	3.54		2.23	2.07	5.18	***	2.20	3.81
Male	5.85	***	1.72	3.45	0.26		1.78	0.19
Foodstmap	-17.25	***	2.98	-9.70	7.72	***	3.25	5.79
Poverty	22.67	***	4.33	13.04	22.90	***	2.31	16.72
North	9.31	***	2.54	5.58	-0.25		2.74	-0.19
South	9.16	***	2.06	5.44	-9.67	***	2.26	-7.12
West	19.37	***	3.41	11.83	-0.71		2.65	-0.53
Constant	-51.62	***	10.16		-47.11	***	7.31	
Sigma	90.85		11.32		92.28		1.78	
Observations			12275				12275	
Log likelihood			-53339.82				-61341.92	
Pseudo R2			0.02				0.02	
F-stat			40.46				90.40	
Prob > chi2			0.00				0.00	

***,**,* Significant at p = 0.01,0.05, and 0.10, respectively