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**Does time spent preparing food affect consumers' food choices?**

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## **Abstract**

Decision-makers often rely on estimates of changes in demand in response to changes in prices to predict the potential effectiveness of a new policy, and an incorporation of the time cost associated with food could lead to better tailored policies. Yet, the cost of time is rarely incorporated into empirical consumer food demand studies due to both convention and the lack of suitable data. Aggregating food categories based on preparation time, demand elasticities for three categories of at-home food and food away from home are estimated. Findings suggest that demand for the category of time-intensive foods is the most elastic, implying that these foods could potentially be effective targets for price-based policies, however, a large segment of the sample did not buy time-intensive foods at all, thus limiting the welfare implications of such a subsidy.

## **Introduction**

Intuitively, people understand that time—or lack thereof—plays a role in their food choices. Yet, due to both convention and the lack of data incorporating both food expenditures and time use, the time factor is frequently neglected when it comes to modeling these economic decisions in empirical consumer demand studies. Would a 10 percent price subsidy have the same effect on the demand for a whole butternut squash as it would for the pre-chopped, peeled, frozen version? Both versions of the food contain the beneficial nutrition of orange vegetables, but the whole squash requires a significant amount of preparation time whereas the frozen version can be ready for consumption in just a few minutes. Additionally, the two variations of squash are not found in the same location in a grocery store which raises the question of whether retailers and consumers even think of the two products as the same food item.

If preparation time is relevant to consumers' decisions about what to eat, then our economic models and policies should reflect its impact. The objective of this study is to empirically explore how food preparation time influences the demand for different foods. Using household-level data, we apply a new approach to aggregating food categories based on associated preparation time. In considering the relevance of time on food demand, two competing hypotheses emerge to be tested.

Hypothesis 1: Demands for foods that require greater preparation time are more price inelastic than for more quickly consumed foods. The intuition behind the first hypotheses is that people will be less responsive to changes in the prices of foods that require greater preparation time because they will be devoting some of their own labor to the end goal of eating. Thus, price changes of the time-intensive ingredients play a smaller role the consumers' overall decisions. An example would be that someone doesn't care much about the price of flour if he's already committed to making cookies from scratch.

Hypothesis 2: Demands for foods that require greater preparation time are more price elastic than for more quickly consumed foods. The intuition here is that people are willing to pay for convenience. An example is when someone who is pressed for time at lunch ends up spending \$20 at a deli bar.

For either hypothesis, we should expect to find an ordinal trend in the own-price elasticities for different food groupings based on food preparation time—own-price elasticities either increasing or decreasing as preparation time changes. Yet, actual results in the existing literature and in the current study show mixed trends, indicating that more research and improvements in data quality and estimation techniques are needed.

## **Background Literature**

While the theory of consumer demand is well-established, its empirical application is plagued with limitations (Deaton and Muellbauer 1980). Several other economic fields including development and labor have made great progress developing theory to examine the relationship between demands for goods and time. Becker's seminal 1965 paper created the analytical foundations to study that tradeoff in the household production model, and a rich literature built on his model has emerged (Pollak and Wachter 1975; Vickery 1977; Gronau 1986; LaFrance 2001). Since the 1970s, a number of studies have used some measure of the opportunity cost of time as a factor to predict food demand. For example, Prochaska and Schrimper (1973) imputed a wage for homemakers, and McCracken and Brandt (1987) used a stochastic sensing model to estimate the value of households' time. However, a review of the empirical literature on food-at-home (FAH) production and consumption and FAFH consumption (Davis 2014) found that only a handful of studies incorporate food expenditures and actual time use (e.g., Aguiar and Hurst 2005; Hamermesh 2007; You and Davis 2010; Huffman 2011; Gelber and Mitchell 2012).

Mincer (1963) pointed out that when opportunity costs—especially opportunity costs of time—are not considered in the framework of demand analysis, their exclusion can cause biased estimates. If used as the basis for policy analysis, biased estimates might show misleading cross-price effects on different food items and lead to misguided decisions. Studies offer evidence where standard demand and elasticity estimates would have predicted quite different behavior than has been actually observed (e.g., Lusk and Tonsor 2016). The discrepancy between theoretical predictions and these empirical observations serves as a prime motivation to improve on the traditional demand system models. In Hamermesh (2007), “eating” is conceptualized as a commodity within a household production framework that involves purchased food, capital, and

time spent preparing food, eating and cleaning up as inputs. As such, “eating” has a time cost component in addition to the food cost.

A particular difficulty for the study of food demand and time is that an ideal data set would contain information on households’ goods expenditures and their time spent eating and in food preparation activities. Currently, no such data set exists for the U.S. on a large scale (Davis 2014). The relatively new data from the American Time Use Survey (ATUS) have enabled a variety of time expenditure studies, but the ATUS data do not have detailed data on food expenditures, and while the Panel Study of Income Dynamics (PSID) Data on Aging and Health supplement tracks time use, food expenditure is an aggregate annual value which is not suitable for demand estimation of different food categories.

Several methods to address the data limitations have been developed. One approach has been to utilize separate datasets and analyses of food and time expenditures (Aguiar and Hurst 2005; Gelber and Mitchell 2012). Huffman (2011) addresses the problem on a macro level using the Bureau of Economic Analysis data and many imputations; You and Davis (2010) collected their own data; and Hamermesh (2007) used demographic matching to combine data from the ATUS and the Consumer Expenditure Survey (CE). Yet another approach is to aggregate expenditures into food group categories based on convenience to endogenize the time factor within the demand estimation (Capps et al. 1985; Park and Capps 1997). The current study refines their approach.

Among the few studies that do take into account the relevance of preparation time within a demand system context, results are mixed regarding support for the two competing hypotheses being examined in the current study. Park and Capps (1997) compare categories of meals that are Ready-to-cook (RTC) with those that are Ready-to-eat (RTE). They found that consumers are

less price sensitive to the more time-intensive RTC meals (own-price elasticity of -0.2303) compared to the more convenient RTE meals (own-price elasticity of -0.6570) which is supportive of Hypothesis 1. A more recent paper, García-Enríquez and Echevarría (2016), studying food demand in Spain, found own price elasticities for the category of raw fruits and vegetables to be -0.76 and processed fruits and vegetables to be -0.22, which is supportive of Hypothesis 2. Another recent paper by the USDA also finds results supportive of Hypothesis 2 with the own-price elasticities of RTC meals/snacks being slightly more elastic (-0.99) than that of RTE meals/snacks (-0.90) (Okrent and Kumcu 2016).

None of these studies use the same estimation techniques, definitions, or food group categories, however, so the results are not directly comparable. Rather, they help illustrate that the question of how food preparation time influences food demand is far from settled in the literature. Our research expands this previous work by using a simple categorization designed to highlight and isolate the effect of preparation time within the demand system analysis.

### **Conceptual Framework**

Recalling the two competing hypotheses: on the one hand, consumers might be less price sensitive to foods requiring significant preparation time compared to more convenient foods, because price is just one component that they must factor into the purchase decision (Hypothesis 1). Other factors include whether they have the time to prepare the food, if they have the necessary kitchen space and tools, and if they have the background knowledge. On the other hand, consumers might be less price sensitive to convenience foods compared to foods requiring preparation time (Hypothesis 2). If time is a constraining factor in the purchase decision, a consumer might be willing to pay much higher prices to avoid food preparation and cooking.

To examine the two competing hypotheses, we aggregate foods into categories based on amount of preparation time required, which is different than the conventional aggregation based on nutritional food groups such as meat and dairy. Figure 1 provides a visual depiction of the budget tree with the new food group categories.

Capps et al. (1985) examined demand for food-at-home by grouping food in categories based on convenience related to the extent and type of processing that a food undergoes before hitting the grocery store shelves. While this approach does seek to reflect the labor saving nature of processed foods, it does not necessarily reflect the amount of preparation and cooking time that the consumer must ultimately contribute before eating. As can be seen in Richardson et al. (1985), such particular classification system includes foods like rice and apples in the same category of non-convenience foods because both are considered unprocessed. However, rice clearly takes a great deal more preparation and cooking time before it is eaten as opposed to an apple which is actually quite convenient to eat. Park and Capps (1997) refined the categorization system by addressing the fact that convenience from the perspective of the consumer is different than that of the food processor, although they ultimately only focused on meals that were ready-to-cook or ready-to-eat. The current paper extends the previous analysis by examining the full spectrum of foods sorted by associated preparation time. The categories are based upon a degree-of-readiness classification scheme for foods used in at-home consumption developed and tested by Pearson et al. (1985). This classification is one the only approaches that looks at food categories from the consumer's perspective rather than the manufacturer/processor's perspective. Table 1 provides descriptions and examples of the three FAH categories (raw ingredients, ready-to-cook, ready-to-eat) used in the current analysis, and Appendix 1 lists all CE food items with their respective category.



The household demands for five different categories (Non-food, raw ingredients, ready-to-cook, ready-to-eat, and FAFH) are specified using the Working Lesser model as outlined in Chern et al. (2002), with the additional inclusion of the inverse Mills ratio to correct for censored observations (Heckman 1976).

$$w_i = \alpha_0 + \alpha_i \ln(x) + \sum_j \beta_{ij} \ln(p_j) + \sum_k \gamma_{ik} H_k + \theta_i \lambda_i + \varepsilon_i, \quad \forall i = 1, \dots, 5 \quad (1)$$

where  $i, j \in \{1, 2, \dots, 5\}$  represents the categories of food and non-food goods in the model.

Variables include  $w_i$  the expenditure share of the  $i$ -th good category out of total expenditure (budget share);  $p_j$  is the price of good category  $j$ ; and  $x$  is the total expenditure of all good categories included in the model;  $H_k$  represents demographics where  $k \in \{1, 2, \dots, K\}$  demographic variables. The inverse Mills ratio is  $\lambda_i$ , and  $\varepsilon_i$  are random disturbances assumed with zero mean and constant variance. Parameters estimated include  $\alpha_0$ ,  $\alpha_i$ ,  $\beta_{ij}$ ,  $\gamma_{ik}$ , and  $\theta_i$ .

With the Heckman correction, the coefficients from the demand system estimation do not directly represent the marginal effects. As such, the inverse Mills ratio,  $\lambda_i$ , marginal effects, and elasticities are calculated utilizing the Saha, Capps, and Byrne (1997) method for a system of equations Heckman procedure. Expenditure elasticity of category  $i$  is:

$$e_i = 1 + \left( \frac{\left( \frac{\partial E[w_i]}{\partial x_i} \right) \text{ at sample mean}}{\bar{w}_i} \right) \quad (2)$$

and price elasticities are:

$$e_{ij} = -\delta_{ij} + \left( \frac{\left( \frac{\partial E[w_i]}{\partial p_j} \right) \text{ at sample mean}}{\bar{w}_i} \right) \quad (3)$$

where  $\delta$  is the Kronecker delta that is 1 if  $i = j$ , and 0 otherwise.

## Data and Model Estimation

The Consumer Expenditure Survey (CE) is a continuous cross-sectional survey designed to represent the expenditures of the total U.S. civilian non-institutional population (U.S. Department of Labor, Bureau of Labor Statistics).<sup>1</sup> Participants keep a “diary” of all expenditures made over a two-week period. They are first visited by an interviewer who administers a demographic questionnaire and drops off the diary for the first week. After the first week the interviewer returns to pick up the diary, review entries, answer any questions, and drop off the second week’s diary. After the second week, the interviewer returns again to pick up the diary, clarify things and administer a questionnaire. The response rate for the diary survey in the year utilized in the current analysis, 2006, was 74.2%. Table 2 presents summary statistics for selected demographics of the CE sample which include after-tax income, family size, education, age, and race/ethnicity. The CE after-tax income variable includes non-positive values, which are recoded as 1 so that the observations are not lost when calculating the log of income to use in the regressions.

Respondents record expenditure information for the CE diary survey by listing every expenditure made over a two-week period with an associated CE UCC (Uniform Commercial Code). In the current study, expenditures are aggregated for each consumer unit (CU) to create group-level expenditures in five categories (non-food goods, raw ingredients, ready-to-cook foods, ready-to-eat foods, and food-away-from-home), as well as a variable for total expenditures. These expenditures are then used to create food-group budget shares for each CU

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<sup>1</sup> As well as that portion of the institutional population living in boarding houses, housing facilities for students and workers, staff units in hospitals and homes for the aged, infirm, or needy, permanent living quarters in hotels and motels, and mobile home parks.

by dividing each group expenditure by the total expenditure. Table 3 presents sample statistics for budget shares and group expenditures.

Prices, which were not collected in the CE, were specified using the January 2006 - December 2006 U.S. city average, seasonally adjusted, monthly Consumer Price Index (CPI) for all urban consumers. We match all CU food purchases with the index price for the item in the month that particular CU diary survey was completed. Since expenditures are aggregated to the food-group level, we create a unique food-group price for each CU by calculating a weighted average of that CU's prices based on its own within-group budget shares. This process ensures price variability for the model since each consumer has a particular different bundle of goods with different prices. A comprehensive list of the CE UCC codes and corresponding CPI food categories for all food items is presented in the appendix.

One major limitation with the CE data in the context of this analysis is that many of the UCC codes are not disaggregated enough to accurately separate some foods into the correct categories. For example, the category "other poultry" could include a whole frozen turkey which should be categorized as "time-intensive" as well as potentially precooked, breaded chicken tenders which should be categorized as "ready-to-eat."

As is to be expected in household survey data, there are a significant number of censored observations when expenditures equal zero for legitimate non-purchases. In this sample, the occurrence of censoring (budget shares of zero) ranged from 2% for non-food to 37% for time intensive foods (Table 3). The Heckman two-step correction is applied using the same variables in both stages plus an additional demographic variable in the first stage. The resulting inverse Mills ratios are incorporated in the SUR estimation of the complete system following Saha, Capps, and Byrne (1997).

## Results

Table 4 presents the SUR results for the three food-at-home categories (time intensive, ready-to-cook, and ready-to-eat foods) and food-away-from-home for the entire sample. Many coefficients are significant at the 1% level. Results were mostly consistent with expectations based on theory and other literature. The coefficients on the log of total expenditure are negative and significant at the 1% level across all regression which is consistent with Engel's law that indicates the share of expenditures on food decreases as wealth (expenditures) increase.

As family size increases, budget shares for all at-home food categories increase and the budget share for food-away-from-home decreases, all else equal. Family size has the largest impact on budget share for ready-to-eat food, suggesting the importance of convenience when preparing food for a large family. Similar overall effects are seen for age of the individual with the impacts getting larger for each successive age category across all categories. These results are also statistically significant at the 1% level with the exception of food-away-from-home for family size which is significant at the 10% level.

The coefficients on the log of income and on the education variables show the opposite pattern, negative for all at-home food categories and positive for food-away-from-home. These results are significant and consistent with literature showing that as income (and education as a proxy for earning potential) increase, people eat out relatively more than eating at home (e.g., McCracken and Brandt 1987).

Some interesting demographic differences emerge from the coefficient estimates. Households with small children are less likely to eat food-away-from-home than couples with no children. Compared to whites, people who identify as Black or African American buy higher shares of time-intensive and ready-to-cook foods and lower shares of ready-to-eat foods and

food-away-from-home, all else equal. These results are mostly significant at the 1% level with the time intensive significant at the 5% level. People identifying as Asian or Hispanic also buy higher shares of time-intensive foods than whites with significance at the 1% level. The magnitude of the coefficient for Asians' budget share for time intensive foods is in fact twice as large as that of Hispanics or Blacks, and the budget share for eating out is also higher for Asians than that for whites. The coefficients for the inverse Mills ratios are also all significant at the 1% level.

Expenditure and price elasticity results are shown in tables 5 and 6. Expenditure elasticities show the expected sign (positive). The magnitudes for all food categories are less than one, indicating that food is a necessary good. Like any normal good, demand rises with income, but the rise is less than proportional with the rise in income.

In Table 6, columns represent the responsiveness of a category's budget shares (change in demand) to a 1% change in the price of the row categories. Standard errors are not currently available for elasticity estimates since the Heckman correction procedure required additional calculations to derive the SUR marginal effects and elasticities. The own-price elasticity of time intensive foods is -3.535 which is highly elastic—more so than most elasticity estimates for foods generally. This could be due in part to the large number of corner solutions since 37% of consumer units in the sample did not purchase any foods in this category. All other categories have inelastic own-price elasticities.

Comparing the own-price elasticities of ready-to-cook foods (-0.429) and ready-to-eat foods (-0.620) reveals similar magnitudes and the same pattern as in Park and Capps (1997): RTC meals (-0.2303), RTE meals (-0.6570). In isolation, this pattern is supportive of Hypothesis 1: that foods requiring greater preparation time are less elastic than more convenient foods.

However, the very high elasticity of the most time intensive foods tends to support Hypothesis 2. Either way, there is not a consistent ordinal trend in the own-price elasticity results as would be desired. The three at-home food categories are generally substitutes for each other, except for the relationship of time intensive prices on ready-to-cook budget shares which shows a complementary relationship.

## **Discussion**

Public policies regarding food often rely on estimates of demand response to changes in prices and income or expenditure to predict their potential effectiveness ahead of time. Increased accuracy in these elasticity measurements by incorporating time could lead to improved policy design. Current demand estimates for food, however, do not control for food preparation time.

Many studies have examined increasing patterns in the demand for convenience food and food-away-from-home (FAFH), but we lack a solid understanding of how food demand responds to inherent differences in preparation time across foods. Critical U.S. food policies such as the Supplemental Nutrition Assistance Program (SNAP) are based on assumptions that largely ignore the time cost of food preparation. Two such examples from the SNAP program are (i) the restriction on using SNAP funds to purchase hot foods or foods sold for on-premise consumption at stores, and (ii) the fact that the amount of funds provided to recipients is calculated based on the “Thrifty Food Plan,” which research has shown to be more time-intensive than the average American’s typical food preparation (Davis and You 2010).

Revisiting the original question posed in the introduction: would a 10 percent price subsidy have the same effect on the demand for a whole butternut squash as it would for the pre-chopped, peeled, and frozen version? Although Consumer Expenditure Survey data are not disaggregated enough to answer this specific question, results from the current analysis suggest

that the answer is no. The time intensive category that the whole squash would fall under seems to be highly elastic, whereas the ready-to-cook category is inelastic. Consumers' price sensitivities would likely differ for the two specific foods, and a subsidy for the more elastic food could potentially have a greater impact on welfare—among those who are willing to purchase time intensive foods. Given the high number of zeros for the budget shares of time intensive foods, it is possible that a large segment of consumers would never buy the time intensive food regardless of a price subsidy.

Further investigation will likely provide additional insight into the nuances involved with food demand as it relates to time use. The ideal data set would contain fully disaggregated food product expenditures, prices, quantities, and qualities as well as time use related to shopping, food preparation, and cooking. Primary data collection efforts specifically tailored for demand analysis are currently underway and will improve upon many of the current study's limitations. These data will eliminate the need for imputations and the CPI which will improve the quality of analysis and justify the use of more refined econometric techniques to examine the hypothesis presented here. The additional inclusion of time use data will enable the creation of a separate “leisure” good category and allow comparison of the substitution between leisure and different categories of food.

Indeed, a majority of demand analysis in food economics focuses on refining econometric techniques to address data limitation issues. The research presented here acknowledges the importance of those innovations, but hopes to challenge the consumer field to also continue development of theory as it relates to everyday life and policy.

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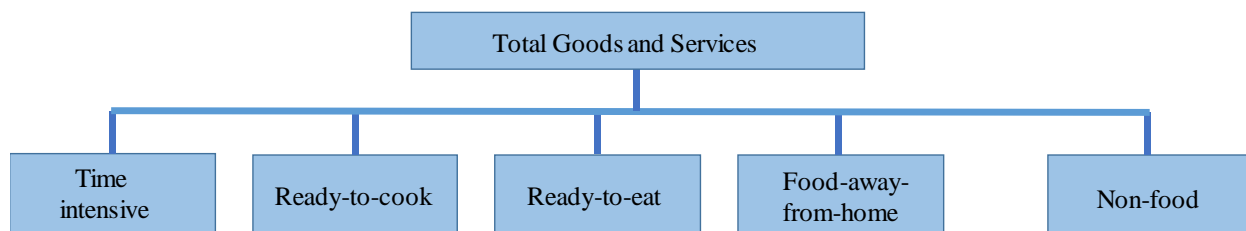
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**Figure 1. Budget tree**

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**Table 1. Food Group Categorization**

Food Group	Description	Pearson et al. Categories	Examples
1. Time intensive	Foods that typically need a significant amount of preparation time and cooking prior to consumption	Hydrate then cook; cut/peel/shape, then cook; Add other ingredients then cook; Eviscerate, prepare for cooking, then cook	Flour, prepared flour mixes, dried beans, raw vegetables for cooking, meat roasts, frozen meat, etc.
2. Ready-to-cook	Foods that require a limited amount of cooking or preparation time	Cut/slice/shell; thaw; hydrate; ready to heat; thaw then heat; hydrate then heat; ready to cook; thaw then cook	Bacon, eggs, rice, pasta, canned vegetables frozen vegetables or meals, coffee and tea, fresh fish or shellfish, etc.
3. Ready-to-eat	Foods that can be eaten without preparation or cooking	Eat as is; ready to use	Fruits and vegetables for eating raw, bread, cereal, cheese, dairy products, lunchmeat, condiments, chips, cookies, soda, juice, etc.

**Table 2. Descriptive Characteristics for CU reference person**

Observations: 13,348		N	% of sample
Education of reference person	Less than high school diploma	1,880	14
	High school diploma	6,156	46
	College/associates degree	5,312	40
Age of reference person	16-24	783	6
	25-49	6659	50
	50-65	3442	26
	65+	2464	18
Family type	Husband and wife (H/W) only	2985	22
	H/W, own children only, oldest child <6	666	5
	H/W, own children only, oldest child 6-17	1968	15
	H/W, own children only, oldest child >17	922	7
	All other H/W CUs	565	4
	One parent, male, own children only	115	1
	One parent, female, own children only	629	5
	Single persons	3645	27
	Other CUs	1853	14
Sex of reference person	Male	6286	47
	Female	7062	53
Race/ethnicity	White, non-Hispanic	9532	71
	Black, or African American	1545	12
	American Indian/Alaskan Native	65	0
	Asian	481	4
	Hawaiian/Pacific Islander Native	30	0
	Multi-race	135	1
	Hispanic	1560	12

Source: Consumer Expenditure Survey (CE) 2006

**Table 3. Descriptive statistics, income, budget shares and expenditures**

		Mean	SD	Min	Max	% Observed 0's
Household	After tax income for CU	49961.07	55298.9	1	726342	NA
	Family size	2.6	1	1	15	NA
Expenditures	Total expenditure	805.74	1477.23	1	46181	NA
	Non-food	686.34	1444.86	0	45910	2%
	Time intensive	7.47	13.71	0	408	37%
	Ready-to-cook	19.34	25.72	0	637	22%
	Ready-to-eat	44.02	43.52	0	637	9%
	Food-away-from-home	48.58	67.48	0	2705	19%
Budget shares	Non-food	0.70	0.24	0	1	2%
	Time intensive	0.02	0.04	0	0.70	37%
	Ready-to-cook	0.05	0.07	0	1	22%
	Ready-to-eat	0.12	0.14	0	1	9%
	Food-away-from-home	0.11	0.15	0	1	19%

Source: CE 2006 Diary, BLS CPI U.S. City Averages 2006

**Table 4. Heckman corrected SUR estimation**

Observations	12,915	Budget shares Time intensive foods		Budget shares Ready-to-cook foods		Budget shares Ready-to-eat foods		Budget shares Food away from home	
		Coeff.	(SE)	Coeff.	(SE)	Coeff.	(SE)	Coeff.	(SE)
Ln(price index) Time intensive		-0.048***	(0.003)	-0.024***	(0.005)	0.017**	(0.008)	0.005	(0.009)
Ln(price index) Ready-to-cook		0.022***	(0.003)	0.029***	(0.006)	0.040***	(0.010)	0.004	(0.012)
Ln(price index) Ready-to-eat		0.037***	(0.003)	0.035***	(0.005)	0.044***	(0.008)	-0.046***	(0.010)
Ln(price index) FAFH		-0.025***	(0.008)	-0.018	(0.014)	-0.043*	(0.023)	0.041	(0.029)
Ln(price index) Non-food		-0.017***	(0.003)	-0.007	(0.005)	-0.005	(0.009)	0.014	(0.011)
Ln(total expenditure)		-0.008***	(0.000)	-0.022***	(0.001)	-0.060***	(0.001)	-0.045***	(0.001)
Ln(income)		-0.000**	(0.000)	-0.001***	(0.000)	-0.001***	(0.000)	0.001*	(0.000)
Family size		0.002***	(0.000)	0.006***	(0.001)	0.012***	(0.001)	-0.003*	(0.002)
H/W, own children only, oldest child <6		-0.003	(0.002)	-0.007**	(0.003)	0.002	(0.005)	-0.016**	(0.007)
H/W, own children only, oldest child 6-17		-0.002	(0.001)	-0.005**	(0.003)	0.004	(0.004)	0.004	(0.005)
H/W, own children only, oldest child >17		0.001	(0.002)	0.000	(0.003)	0.007	(0.005)	0.002	(0.006)
All other H/W CUs		-0.000	(0.002)	-0.002	(0.004)	-0.003	(0.006)	0.002	(0.008)
One parent, male, own children only		0.004	(0.004)	0.009	(0.006)	0.011	(0.011)	-0.017	(0.013)
One parent, female, own children only		-0.007***	(0.002)	0.002	(0.003)	-0.001	(0.005)	-0.017***	(0.007)
Single persons		-0.005***	(0.001)	-0.003	(0.002)	-0.010***	(0.003)	-0.016***	(0.004)
Other CUs		-0.004***	(0.001)	0.001	(0.002)	-0.002	(0.004)	-0.009**	(0.004)
Age 25-49		0.006***	(0.001)	0.017***	(0.003)	0.024***	(0.004)	-0.034***	(0.005)
Age 50-65		0.009***	(0.002)	0.019***	(0.003)	0.035***	(0.005)	-0.053***	(0.006)
Age 65+		0.010***	(0.002)	0.023***	(0.003)	0.045***	(0.005)	-0.071***	(0.006)
High school diploma		-0.005***	(0.001)	-0.005**	(0.002)	-0.010***	(0.003)	0.023***	(0.004)
College/associates degree		-0.005***	(0.001)	-0.008***	(0.002)	-0.006*	(0.003)	0.036***	(0.004)
Black, or African American		0.002**	(0.001)	0.006***	(0.002)	-0.014***	(0.003)	-0.013***	(0.004)
American Indian/Alaskan Native		-0.001	(0.005)	0.004	(0.008)	0.004	(0.014)	-0.010	(0.017)
Asian		0.018***	(0.002)	0.013***	(0.003)	0.005	(0.005)	0.028***	(0.007)
Multi-race		0.006*	(0.003)	-0.004	(0.006)	-0.020**	(0.010)	0.014	(0.012)
Hispanic		0.008***	(0.001)	0.003*	(0.002)	0.002	(0.003)	-0.012***	(0.004)
Female		0.002**	(0.001)	0.002	(0.001)	0.005**	(0.002)	-0.022***	(0.002)
Inverse Mills Ratio		-0.002***	(0.001)	-0.013***	(0.001)	-0.021***	(0.001)	-0.017***	(0.002)
Constant		0.235***	(0.042)	0.088	(0.074)	0.157	(0.124)	0.335**	(0.154)
R-squared		0.135		0.177		0.304		0.154	

Notes: Standard errors in parentheses

\*\*\* denotes significance at the 1% level, \*\* denotes significance at the 5% level, \* denotes significance at the 10% level

Source: Consumer Expenditure Survey (CE) 2006 Diary, BLS Consumer Price Index (CPI) U.S. City Average 2006

**Table 5. Expenditure elasticity**

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Time intensive	0.588
Ready-to-cook	0.593
Ready-to-eat	0.503
Food-away-from-home	0.608
Non-food	1.183

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**Table 6. Uncompensated, unconditional own-price elasticity of demand**

	Shares				
	<i>Time intensive</i>	<i>Ready-to-cook</i>	<i>Ready-to-eat</i>	<i>Food-away-from-home</i>	<i>Non-food</i>
Time intensive	-3.535	-0.507	0.160	0.048	0.071
Ready-to-cook	1.221	-0.429	0.348	0.022	-0.137
Ready-to-eat	2.037	0.837	-0.620	-0.443	-0.108
Food-away-from-home	-1.397	-0.489	-0.446	-0.581	0.065
Non-food	-0.875	-0.140	-0.036	0.145	-0.985



## Appendix 1: Categorization of foods

CE_UCC	CE_item	CPI_item	CPI_seriesID	food_group
120410	OTHER FRESH VEGETABLES	Other fresh vegetables	CUSR0000SEFL04	1
120110	POTATOES	Potatoes	CUSR0000SEFL01	1
010110	FLOUR	Flour and prepared flour mixes	CUSR0000SEFA01	1
010120	PREPARED FLOUR MIXES	Flour and prepared flour mixes	CUSR0000SEFA01	1
030210	CHUCK ROAST	Beef and veal	CUSR0000SEFC	1
060110	FRESH & FROZEN WHOLE CHICKEN	Fresh whole chicken	CUSR0000SS06011	1
050410	LAMB AND ORGAN MEATS	Other meats	CUSR0000SEFE	1
050900	MUTTON, GOAT, GAME	Other meats	CUSR0000SEFE	1
030810	OTHER BEEF (EXCLUDE CANNED)	Beef and veal	CUSR0000SEFC	1
040410	OTHER PORK	Pork	CUSR0000SEFD	1
060310	OTHER POULTRY	Poultry	CUSR0000SEFF	1
030410	OTHER ROAST	Beef and veal	CUSR0000SEFC	1
030310	ROUND ROAST	Beef and veal	CUSR0000SEFC	1
040310	HAM (EXCLUDE CANNED)	Ham, excluding canned	CUSR0000SS04031	1
140330	OTHER BEANS (dried)	Fruits and vegetables	CUSR0000SAF113	1
140320	OTHER PEAS (dried)	Fruits and vegetables	CUSR0000SAF113	1
030110	GROUND BEEF EXCLUDE CANNED	Uncooked ground beef	CUSR0000SEFC01	2
070240	FROZEN FISH & SHELLFISH	Frozen fish and seafood	CUSR0000SS07021	2
130121	FROZEN FRUITS	Fruits and vegetables	CUSR0000SAF113	2
130122	FROZEN FRUIT JUICES	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	2
130110	FROZEN ORANGE JUICE	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	2
140410	FROZEN VEGETABLE JUICES	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	2
140210	CANNED BEANS	Fruits and vegetables	CUSR0000SAF113	2
140220	CANNED CORN	Fruits and vegetables	CUSR0000SAF113	2
140230	CANNED VEGETABLES MISC	Fruits and vegetables	CUSR0000SAF113	2
180110	SOUP	Soups	CUSR0000SEFT01	2
170410	INSTANT/FREEZE DRIED COFFEE	Coffee	CUSR0000SEFP01	2
170310	ROASTED COFFEE	Roasted coffee	CUSR0000SS17031	2
170520	TEA	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	2
040110	BACON	Bacon and related products	CUSR0000SS04011	2
080110	EGGS	Eggs	CUSR0000SEFH	2
050110	FRANKFURTERS	Frankfurters	CUSR0000SS05011	2
070230	FRESH FISH & SHELLFISH	Fish and seafood	CUSR0000SEFG	2
060210	FRESH OR FROZEN CHICKEN PARTS	Poultry	CUSR0000SEFF	2
020810	FROZEN & REFRIG. BAKERY PROD.	Frozen and refrigerated bakery products, pies, tarts, turnovers	CUSR0000SS0206B	2
140310	OTHER PROCESSED VEGETABLES	Fruits and vegetables	CUSR0000SAF113	2
030710	OTHER STEAK	Beef and veal	CUSR0000SEFC	2
140340	OTHER VEGETABLES MISC (not fresh, not canned corn or beans, ...)	Fruits and vegetables	CUSR0000SAF113	2
040210	PORK CHOPS	Pork chops	CUSR0000SEFD03	2

040510	PORK SAUSAGE	Pork	CUSR0000SEFD	2
030510	ROUND STEAK	Beef and veal	CUSR0000SEFC	2
030610	SIRLOIN STEAK	Beef and veal	CUSR0000SEFC	2
180220	FROZ/PREP. FOOD OTH THAN MEALS	Frozen and freeze dried prepared foods	CUSR0000SEFT02	2
180210	FROZEN MEALS	Frozen and freeze dried prepared foods	CUSR0000SEFT02	2
140110	FROZEN VEGETABLES	Frozen vegetables	CUSR0000SS14011	2
010320	PASTA CORNMEAL OTH CEREAL PRODS	Rice, pasta, cornmeal	CUSR0000SEFA03	2
010310	RICE	Rice, pasta, cornmeal	CUSR0000SEFA03	2
110510	CITRUS FRUITS EXCL. ORANGES	Fresh fruits	CUSR0000SEFK	3
110310	ORANGES	Oranges, including tangerines	CUSR0000SS11031	3
120310	TOMATOES	Tomatoes	CUSR0000SEFL03	3
110110	APPLES	Apples	CUSR0000SEFK01	3
110210	BANANAS	Bananas	CUSR0000SEFK02	3
170532	BOTTLED WATER	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	3
020620	BREAD AND CRACKER PRODUCTS	Crackers, bread, and cracker products	CUSR0000SS0206A	3
020210	BREAD OTHER THAN WHITE	Crackers, bread, and cracker products	CUSR0000SS0206A	3
020410	CAKES AND CUPCAKES	Cakes, cupcakes, and cookies	CUSR0000SEFB03	3
150110	CANDY AND CHEWING GUM	Sugar and sweets	CUSR0000SEFR	3
130310	CANNED FRUITS	Fruits and vegetables	CUSR0000SAF113	3
130212	CANNED/BOTTLE FRUIT JUICE	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	3
100210	CHEESE	Cheese and related products	CUSR0000SEFJ02	3
170110	COLA DRINKS	Carbonated drinks	CUSR0000SEFN01	3
020510	COOKIES	Cookies	CUSR0000SS02042	3
020610	CRACKERS	Crackers, bread, and cracker products	CUSR0000SS0206A	3
020710	DOUGHNUTS,SWEETROLLS,COFFECAKE	Bakery products	CUSR0000SEFB	3
130320	DRIED FRUITS	Fruits and vegetables	CUSR0000SAF113	3
140420	FRESH & CANNED VEGETABLE JUICES	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	3
020310	FRESH BISCUITS, ROLLS, MUFFINS	Bakery products	CUSR0000SEFB	3
130211	FRESH FRUIT JUICE	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	3
090110	FRESH MILK ALL TYPES	Fresh whole milk	CUSR0000SS09011	3
020820	FRESH PIES, TARTS, TURNOVERS	Bakery products	CUSR0000SEFB	3
100410	ICE CREAM AND RELATED PRODUCTS	Ice cream and related products	CUSR0000SEFJ03	3
170510	NONCARB FRUT FLAV/LEMADE NONFROZ	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	3
180320	NUTS	Snacks	CUSR0000SEFT03	3
170210	OTHER CARBONATED DRINKS	Carbonated drinks	CUSR0000SEFN01	3
110410	OTHER FRESH FRUITS	Fresh fruits	CUSR0000SEFK	3
170530	OTHER NONCARB. BEVERAGES/ICE	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	3
170531	OTHER NONCARB. BEVERAGES/ICE	Nonalcoholic beverages and beverage materials	CUSR0000SAF114	3
150310	OTHER SWEETS	Sugar and sweets	CUSR0000SEFR	3
180310	POTATO CHIPS AND OTHER SNACKS	Snacks	CUSR0000SEFT03	3
180612	PREPARED DESSERTS	Bakery products	CUSR0000SEFB	3
180611	PREPARED SALADS	Other fresh vegetables	CUSR0000SEFL04	3
020110	WHITE BREAD	Crackers, bread, and cracker products	CUSR0000SS0206A	3
150212	ARTIFICIAL SWEETENERS	Sugar and artificial sweeteners	CUSR0000SEFR01	3
050210	BOLOGNA, LIVERWURST, SALAMI	Other meats	CUSR0000SEFE	3

100110	BUTTER	Butter	CUSR0000SS10011	3
070110	CANNED FISH AND SEAFOOD	Shelf stable fish and seafood	CUSR0000SS07011	3
040610	CANNED HAM	Ham	CUSR0000SEFD02	3
010210	CEREAL	Breakfast cereal	CUSR0000SEFA02	3
090210	CREAM	Dairy and related products	CUSR0000SEFJ	3
160211	FATS & OILS	Fats and oils	CUSR0000SEFS	3
120210	LETTUCE	Lettuce	CUSR0000SEFL02	3
160110	MARGARINE	Margarine	CUSR0000SS16011	3
180710	MISC. PREPARED FOODS	Frozen and freeze dried prepared foods	CUSR0000SEFT02	3
160310	NON-DIARY CREAM SUBSTITUTES	Dairy and related products	CUSR0000SEFJ	3
180420	OLIVES, PICKLES, RELISHES	Other condiments	CUSR0000SS1804B	3
180520	OTHER CONDIMENTS	Other condiments	CUSR0000SS1804B	3
100510	OTHER DAIRY PRODUCTS (yogurt, cottage cheese, kefir, etc. ?)	Dairy and related products	CUSR0000SEFJ	3
050310	OTHER LUNCHMEAT	Other meats	CUSR0000SEFE	3
160320	PEANUT BUTTER	Fats and oils	CUSR0000SEFS	3
160212	SALAD DRESSINGS	Fats and oils	CUSR0000SEFS	3
180410	SALT/OTHER SEASONINGS & SPICES	Spices, seasonings, condiments, sauces	CUSR0000SEFT04	3
180510	SAUCES AND GRAVIES	Spices, seasonings, condiments, sauces	CUSR0000SEFT04	3
150211	SUGAR	Sugar and artificial sweeteners	CUSR0000SEFR01	3