**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 and 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).

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

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:

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

and price elasticities are:

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

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).[1] 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 dairy, 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

[1] 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.

References

Aguiar, M., & Hurst, E. 2005. "Consumption versus expenditure." Journal of Political Economy, 113, 919–948.

Becker, G. S. 1965. "A Theory of the Allocation of Time." The Economic Journal, 75(299) 493-517.

Capps, O., J.R. Tedford, and J. Havlicek. 1985. "Household Demand for Convenience and Nonconvenience Foods." American Journal of Agricultural Economics 67(4): 862-869.

Chern, W. S., K. Ishibashi, K. Taniguchi, and Y. Tokoyama. 2002. "Analysis of Food Consumption Behavior by Japanese Households." Agricultural and Development Economics Division the Food and Agriculture Organization of the United Nations, ESA Working Paper No. 02-06.

Costa, A.I.A., M. Dekker, R.R. Beumer, F.M. Rombouts, W.M.F. Jongen. 2001. "A Consumer-Oriented Classification System for Home Replacement Meals," Food Quality and Preference 12(4): 229-242.

Davis, G. C. 2014. "Food at home production and consumption: Implications for nutrition quality and policy." Review of Economics of the Household, 12(3), 565-588.

Davis, G. C., and W. You. 2010. "The time cost of food at home: general and food stamp participant profiles." Applied Economics, 42(20), 2537-2552.

Deaton, A. and J. Muellbauer. 1980. Economics and Consumer Behavior. Cambridge University Press.

Gelber, A. M., & Mitchell, J. W. 2012. "Taxes and time allocation, evidence from single women and men." Review of Economic Studies, 79, 863–897.

Gronau, R. 1986. "Home production-a survey." Handbook of Labor Economics, 1, 273-304.

Hamermesh, D. S. 2007. "Time to Eat: Household Production under Increasing Income Inequality." American Journal of Agricultural Economics, 89(4), 852–893.

Heckman JJ (1976) The common structure of statistical models of truncation, sample selection and limited dependent variables. Ann Econ Soc Measure 5:475–492

Huffman, W. E. 2011. "Household production and the demand for food and other inputs: US evidence." Journal of Agricultural and Resource Economics, 36(3), 465-487.

LaFrance, J. T. 2001. "Duality for the Household: Theory and Applications." Handbook of Agricultural Economics, 1B, edited by B. L. Gardner and G. C. Rausser, 1025-1081.

Lusk, J. L. and G. T. Tonsor. 2016. "How Meat Demand Elasticities Vary with Price, Income, and Product Category." Applied Economic Perspectives and Policy, 38(1).

McCracken, V. A. and J. A. Brandt. 1987. "Household Consumption of Food Away from Home: Total Expenditure and by Type of Food Facility." American Journal of Agricultural Economics, 69(2), 274–284.

Mincer, J. 1963. “Market Prices, Opportunity Costs, and Income Effects” in C. F. Christ, ed., Measurement in Economics: Studies in Mathematical Economics and Econometrics in Memory of Yehuda Grunfeld, Stanford, California, 67-82.

Okrent, A. M. and A. Kumcu. 2016. “U.S. Households' Demand for Convenience Foods.” USDA ERS Economic Research Report Number 211.

Park, J. L., & Capps, O. 1997. “Demand for prepared meals by US households.” American Journal of Agricultural Economics, 79(3), 814-824.

Pearson J. M., O. Capps, C. Gassman, and J. Axelson. 1985. “Degree-of-readiness classification system for foods: development, testing and use.” Journal of Consumer Studies and Home Economics 9:133-145.

Pollak, R. A., & Wachter, M. L. 1975. “The relevance of the household production function and its implications for the allocation of time.” The Journal of Political Economy, 83(2), 255-278.

Prochaska, F. J. and R. A. Schrimper. 1973. “Opportunity Cost of Time and Other Socioeconomic Effects on Away-From-Home Food Consumption.” American Journal of Agricultural Economics, 55(4), 595–603.

Richardson, S., Pearson, J. M., & Capps, O. 1985. “Convenience and Nonconvenience Food Use in Single-Person and Multi-Person Households.” Home Economics Research Journal, 14(1), 11-20.

Saha, A., O. Capps, and P. J. Byrne. 1997. “Calculating marginal effects in models for zero expenditures in household budgets using a Hecman-type correction.” Applied Economics 29: 1311-1316.

U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey, Diary Survey, 2006-2008.

Vickery, C. 1977. “The time-poor: A new look at poverty.” Journal of Human Resources, 12(1), 27-48.

You, W. and G. C. Davis. 2010. “Household food expenditures, parental time allocation, and childhood overweight: An integrated two-stage collective model with an empirical application and test.” American Journal of Agricultural Economics, 92(3), 859-872.

**Figure 1. Budget tree**

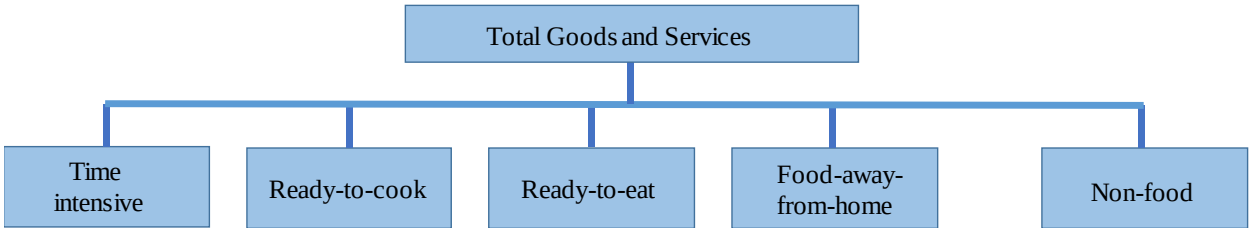

**Table 1. Food Group Categorization**

| 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

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

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

| | Shares | | | | |
|---|---|---|---|---|---|
| | Time intensive | Ready-to-cook | Ready-to-eat | Food-away-from-home | Non-food |
| 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 |