What's Cooking? Demand for Convenience Foods in the United States

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Abstract
Demand for convenience foods has grown in the United States, which has implications for dietary quality and health, but little is known about the drivers behind the growth in purchases of such foods. We construct a novel data set that contains price indexes, budget shares, advertising expenditures, and demographic and time variables for four Census regions between 1999 and 2010 for six types of convenience foods, including 4 food-at-home categories—basic ingredients, complex ingredients, ready to cook and ready to eat—and 2 food-away-from-home categories—fast food and sit down. We use these data to model demand for convenience foods using the almost ideal demand system, and then use the estimates to decompose growth in demand for convenience foods into price, advertising, demographic and time factors.

Consumer demand for prepared foods has grown dramatically over the past several decades becoming a staple of a typical American's diet. In 2010, almost 18 percent of food and beverage expenditures were devoted to ready-to-eat meals and snacks purchased for at-home consumption, while fast-food budget shares represented 27 percent, up from 24 percent in 1999. Budget shares devoted to sit-down meals, however, declined to 23 percent in 2010 from 25 percent in 1999. The growth in consumption of foods purchased at restaurants has been blamed for Americans' poor diet quality (e.g., Todd et al. 2010) and expanding waistlines (e.g., Chen et al. 2012), while recent studies have found a positive association between time spent preparing food at home and diet quality (e.g., Zick et al. 2011; Todd 2014).

Many factors may have contributed to the growth in prepared foods, such as relative prices of foods, time and budget constraints, demographic characteristics, and advertising. A handful of studies have investigated the role of relative prices and income on demand for food away from home and food-at-home composites (Richards and Mancino 2013; Okrent and Alston 2012, 2011; Huffman 2011; Reed, Levendahl, Hallahan 2005). Such studies are useful in investigating substitution patterns between composite foods, and the effects of prices and income-led changes in expenditure on demand for composite foods. With the exception of Richards and Mancino (2013) and Jekanowski et al. (2001), however, these studies can say little about how changes in demographic composition and advertising affects demand for convenience foods. While Richards and Mancino (2013) and Jekanowski et al. (2001) include a number of demographic characteristics in their analyses, they only include a few FAFH products and do not look at substitution patterns between convenience foods at home and away from home.

Several studies have argued that demographic composition and time constraints of households have also played an important role for increased demand for convenience foods, in particular foods from fast-food and sit-down establishments. Using cross-sectional data, these studies found that demand for FAFH is related to household composition (i.e., presence of children) and size, race and ethnicity, education, and marital status (Stewart et al. 2004; Stewart and Yen 2004; Dong et al. 2000; Byrne et al. 1996, 1998; Jensen and Yen 1996; Hiemstra and Kim 1995; Soberon-Ferrer and Dardis 1991; McCracken and Brandt 1987; Prochaska and Schrimper 1973). Own- and cross-price effects on demand for these convenience foods have largely been excluded from these studies because of the nature of cross-sectional data because of difficulties in identifying supply-induced price variation in the data.

Few have examined the role of advertising on demand for convenience foods even though some of the biggest advertisers in the United States are fast-food companies and food manufacturers. Advertising on meals and beverages offered by fast-food and sit-down restaurants is substancial; McDonald's Corporation spent $962.9 million on advertising in 2011 (the 4th largest amount spent by any company on advertising in the United States), closely followed by Yum Brands ($671 million) and Darden Restaurants ($330 million). A few studies that investigate the role of advertising on demand for convenience-type foods focus solely on the effects of television advertising on food consumption and body composition by youth, ignoring the role of prices and the cost of time in food preparation and focus on only a limited number of goods like fast food (Andreyeva, Kelly and Harris 2011; Grossman, Tekin and Wada 2012).

In sum, there has yet to be a study that explores a number of competing hypothesis that explain why demand for convenience foods has increased over the last several decades in the United States. We extend the literature on demand for convenience foods to estimate the effects of advertising in multiple media outlets, prices, demographic characteristics, and value of time on demand for all foods, paying particular attention between substitution patterns between

prepared and unprepared foods. The specific objectives are: (1) model demand for fast food, foods from sit-down restaurants, basic ingredients, complex ingredients, ready-to-cook foods, and ready-to-eat foods as a function of prices, advertising stocks, the time cost of food preparation, and household demographic characteristics; and (2) decompose growth in prepared food purchasing behavior into price, advertising, time cost and demographics effects.

Literature review

Several studies have examined the effects of prices and income-led changes in expenditure on demand for convenience foods but these analyses have largely been limited to a few composite convenience food groups (e.g., FAFH). Some of these previous studies have modeled demand for FAFH as a composite good in a system of all market foods and services and are somewhat limited in what can be said about substitution between purchases of convenience foods for away-from-home and at-home consumption. Okrent and Alston (2011) and Reed et al. (2005) found FAFH products to be statistically significant substitutes with an "other foods" compostite which contains many convenience foods, but Okrent and Alston (2011) found demand for FAFH to be much more price and expenditure elastic than Reed et al. (2005). Consistent with Okrent and Alston (2011) and Reed et al. (2005), Huffman (2011) found the composite foods FAFH and FAH to be substitutes, but Huffman found FAFH and FAH to be both price and income inelastic. Building upon this work, Okrent and Alston (2012) found most convenience-type foods purchased for at-home consumption were price elastic (-1.05 for frozen foods and -1.48 for miscellaneous foods), while food purchased at fast-food restaurants was price inelastic (-(0.13) and food purchased at sit-down restaurants was price elastic (-1.21). They also found both FAFH categories to be much more responsive to changes in total expenditures than the FAH categories but found little evidence of substitution between FAFH and convenience foods for at-home consumption. While these studies provide useful estimates of price and income effects and some evidence of substitution effects between convenience foods for at-home and away-from-home consumption, they are limited in providing evidence on more disaggregated products, which would be of interest to policymakers, and tell us nothing about how demographic characteristics and household time constraints affect demand for convenience foods.

Unlike the previous studies, Jekanowki et al. (1995) and Richards and Mancino (2013) modeled demand for FAFH using factors that affect demand other than prices and income. Using household-level data for 2003-04, Richards and Mancino (2013) found the price elasticity of demand for meals at fast food and various types of sit-down restaurants was between -(0.5 and -(0.9, and that a composite FAH product was a substitute for food from fast-food, casual, fine-dining, and mid-range restaurants. They also found that BMI, physical activity, health status, education and marital status positively affected demand for these disaggregated FAFH categories but age did not. However, using market-level data, Jekanowski et al. (2001) found demand for fast-food restaurants was much more price elastic (-1.02 in 1982 and -1.88 in 1992). The authors found very little evidence of subsitution between fast food and other food establishments (i.e., grocery stores, inexpensive and expensive sit-down restaurants), and they found outlet density positively affect demand for fast food, while demographic characteristics of market areas had little impact on demand.

Another strain of the literature provides detailed impacts of demographic and time effects on demand for FAFH, but these studies either assume supply-induced price variation is constant across the United States using cross-sectional data, or they use regional indicators to proxy for regional variation in prices. With the exception of Capps et al. (1985), these studies focused

primarily on FAFH and provided little evidence on subsitution between convenience foods at home and away from home. Much of the research that investigates the impact of the time constraints on household production and demand for FAFH treated FAFH as a composite.These studies generally found that the value of time for a household manager positively affected demand for total FAFH (Sexauer 1979; Soberon-Ferrer and Dardis 1991; Yen 1993; Byrne, Capps and Saha 1996). Prochaska and Schrimper (1973), Nayga and Capps (1994), and Dong et al. (2000) used the number of meals or visits to FAFH establishments to provide further evidence that demand for FAFH is affected by the value of time of the household. However, a few studies, namely, Redman (1980), and Kinsey (1983), found household time constraints were a less important determinant of demand for FAFH.

A handful of studies investigated whether the value of time has a differential effect on FAFH by establishment and meal type. McCracken and Brandt (1987) and Stewart et al. (2004) found that an increased value of the household food manager's time increased expenditures on fast food more than expenditures on meals from sit-down restaurants. Similarly, Byrne et al. (1998) and Stewart and Yen (2004) found the effect of household manager hours had a positive impact on demand for fast foods but a negative impact on sit-down foods. Jensen and Yen (1996) examined the demand for FAFH by meal type—breakfast, lunch, and dinner—and found the effect of wife's employment was positive on both the probability and level of expenditures on FAFH lunches and dinneres, but wife's employment did not seem to affect FAFH breakfasts.

In addition to the role of time on demand for FAFH, many of the above-mentioned studies found that demand for FAFH is also determined by demographic characteristics and composition of the household. In particular, household size had mixed effects on demand for total FAFH and FAFH by establishment type while the presence of children was associated with decreased demand for FAFH (Prochaska and Schrimper 1973; Soberon-Ferrer and Dardis 1991; Byrne et al. 1996). Also gender of the household manager was also found to have mixed effects on demand for FAFH (Byrne et al. 1996, 1998; Dong et al. 2000).

Capps et al. (1985) also investigate the availability of time and demographic characteristics on demand for convenience foods, but they defined foods by the magnitude of convenience, and they incorporatde price and income effects into their examination. In their study, foods were disaggregated into four classes: (a) nonconvenience—fresh (unprocessed) foods, ingredient foods, or home-produced, home frozen, home-canned, or home-preserved food items, (b) basic convenience—processing is used as a preservation method rather than to ease preparation, they contain a single or limited number of ingredients, and they have time or energy inputs but do not require culinary expertise, (c) complex convenience—multi-ingredient, prepared mixtures and foods which have high levels of time-saving and/or energy inputs and do not require culinary expertise, and (d) manufactured convenience—foods which have no home-prepared counterparts. Our study is most akin to Capps et al. (1985) in that we defined convenience foods for at-home consumption by magnitude of convenience, but we separate FAH and FAFH. We make this distinction to examine substitution patterns between convenience foods at home and away from home which is of some interest to food manufacturer and service industries. They found quite a bit of substitution between convenience types, and also found demographic characteristics and household composition to affect for demand for convenience types differently as well.

In addition to the effects of price, income, demographic and time on demand for convenience foods, some have speculated that advertising plays an important role in the growth of demand for convenience foods, in particular fast foods. Using the Early Childhood

Longitudinal Study Kindegarted Class (ECLS-K) and Nielsen media data, Andreyeva, Kelly and Harris (2011) estimated the effect of advertising for regular and diet carbonated soft drinks (CSDs), fast-food restaurants, and ready-to-eat cereals on consumption CSD, consumption of fast-food, and body weight. They found strong evidence that advertising for soda and fast-food had a complimentry effect on consumption, that is, exposure to soda commercials increased consumption of both soda and fast food (though to a lesser extent). The same was also true of fast-food advertising's effect on soda and fast-food consumption. The authors also found fast-food advertising had a significant effect on body weight for overweight and obese children (body mass index or BMI $\geq 85^{th}$ percentile). Using the National Longitudinal Survey of Youth 1997 (NSLY1997) and data on television advertising from Competitive Media Reporting, Grossman, Tekin and Wada (2012) modeled the effect of exposure to fast-food advertising on body composition as measured by BMI and predicted percent body fat (PBF). They found that banning television advertisements for fast-food would reduce youth BMI by 2 percent and youth PBF by 3 percent. While hese studies make important contributions to the literature, they only examine television advertising, and they focus primarily on fast foods even though FAH substitutes exist.

The studies described above test several hypothesis that could explain demand for convenience foods but generally focus on FAFH. Also, these studies tend to focus on one or a few particular variables of interest (e.g., prices, income, time, demographics, and/or advertising). Our study will be the first to investigate all of these competing hypothesis on the demand for convenience foods.

Data Description

Because no data set contains price, expenditure, advertising, time and demographics variables for both FAH and FAFH we constructed a data set of quarterly observations for each Census region in the United States between 1999 and 2010. FAH prices and expenditures come from the Nielsen Homescan data, a panel of households who recorded all UPC purchases using an in-home scanner from 1999 to 2010. FAFH prices come from the Quarterly Food-Away-From-Home Prices (QFAFHP) database, produced by the U.S. Department of Agriculture (USDA), which provides average quarterly prices for FAFH products by Census division and region from 1998 to 2012. FAFH expenditures, time and demographic variables come from the Bureau of Labor Statistics, Consumer Expenditure Survey, a two-week diary recall survey which collects household expenditures on a variety of consumer goods, including FAH and FAFH. Advertising data come from Kantar Media's Ad$pender database, which provides advertising expenditures for thousands of branded products in eighteen media outlets.

We categorized foods purchased for at-home consumption into four categories based on level of covenience proposed by Costa et al. (2001): basic ingredients, complex ingredients, ready to cook, and ready to eat (table 1). Basic ingredients refers to raw or minimally processed foods used in producing a meal or snack that are generally composed of a single ingredient, such as milk, dried beans, rice, grains, butter, cream, and fresh meat, poultry and seafood. Complex ingredients refers to processed foods used in producing a meal snack that generally, though not always, are composed of multiple ingredients. Examples include bread, pasta, sour cream, sauce, canned vegetables, canned beans, pickles, cereal, frozen meat/poultry/seafood, canned meat/poultry/seafood, and lunch meat. Ready to cook constitutes meals or snacks that require minimal preparation involving heating, cooking, or adding hot water, such as frozen entrees, frozen pizzas, dry meal mixes, pudding mixes, soup, chili, and powdered drinks. Ready to eat

refers to meals and snacks that are intended to be consumed as is and require no preparation beyond opening a container, including refrigerated entrees and sides, canned fruit, yogurt, candy, snacks, liquid drinks, and flavored milk. We also include two FAFH products—foods from fast-food and sit-down restaurants.

[Insert table 1]

Price indexes. We constructed price indexes for food category I at time t using a fixed-weight Laspeyres price index formula:

$$p_{It} = \frac{\sum_{i \in I} p_{it} q_{i0}}{\sum_{i \in I} p_{i0} q_{i0}}, \tag{1}$$

where p_{it} and p_{i0} are the ith prices in I at t and at base period 0, respectively, q_{i0} is the quantity of i in the base year. We used a fixed-weight formula because the quantity weights for the FAFH categories are based on the 2007 Economic Census. Hence, our base period for all price index calculations is 2007.

We estimated the price indexes for each FAFH category using the Quarterly Food-Away-From-Home Prices data (Kumcu and Okrent 2014). The QFAFHP data provide average quarterly prices without tax for meals at full-service and limited-service establishments for each Census division and quarter between 1998 and 2012. Instead of quantity weights, we use expenditure weights in (1) where the weights for each Census division are based on total sales for meals and beverages for on-premise consumption in NAICS industries 72211 and 72221 (full-service and limited-service establishments) collected in the 2007 Economic Census.

We estimated price indexes for each FAH category using Nielsen Homescan and Nielsen Fresh Foods panels for 1999 through 2010 purchased by the USDA Economic Research Service (ERS). For Homescan, Nielsen reports price and expenditure data on UPC-coded purchases of 40,000 to 60,000 households per year in the United States.[1] The Fresh Foods panel is a subset of the Homescan data consisting of approximately 8,000 households who use a code book to report non-UPC-coded perishable items. Nielsen recruits and continuously maintains their panel using population and demographic targets to balance the raw sample. Nielsen then uses demographic data from each household for calculation of post-stratification sample weights, which are used to project the sample to be representative of the overall U.S. population.[2] The Nielsen data set covers 52 markets that are similar to the metropolitan statistical areas used in the U.S. Census plus 9 additional areas (Muth, Siegel, and Zhen 2007).

To use the UPC-coded price data in (1), we first identified and deleted outlier prices at the household level using the interquartile range for food category, year, and quarter. We also eliminated zero prices that were not associated with coupon usage. We then calculated simple average prices and summed quantities for each brand of food purchased within a food category

[1] Since 2005 Nielsen recruited 125,000 households but only households that participated in at least 10 of 12 months in that year are included in the purchased data (Muth, Siegel, and Zhen 2007).

[2] The post-stratification sample weights are based on a raking technique that forces the weighted sample totals to equal the population totals for nine demographic variables, including household size, income, age, male and female education, and occupation, presence of children, race and ethnicity along with county size and key county population targets (Muth, Siegel, and Zhen 2007).

by household, region, year, and quarter. Using the Nielsen post-stratification sample weights, we estimated the quantity and average price for each brand purchased in each region and time period and used those values to estimate (1).

Price growth was generally highest in the Midwest on average between 1999 and 2010, though this varied by convenience food category (table 2). For example, the Midwest had the highest price growth in full-service meals (average price index of 132), while the South had the highest growth in basic ingredients (average price index of 182.5). Among national level price indexes, basic ingredients saw the largest overall price increase (76%), followed by limited-service meals (48%), while full-service restaurant meals and ready-to-eat meals saw the smallest overall increases (29% and 30%, respectively) (figure 1).

[Insert table 2]
[Insert figure 1]

Budget shares. Average quarterly household budget shares are calculated using two data sets: the Consumer Expenditure Survey (CEX) and the Nielsen Homescan panel. To do this, we first estimated average household expenditures for each quarter, region, and food category as total expenditures divided by total population for each quarter, region and food category using the weighted Nielsen Homescan and CEX sample. The budget shares are then calculated as average household expenditures for each quarter, region and food category divided by the total average household expenditures for each quarter and region.

The CEX is a nationwide household survey administered every year since 1984 and designed to represent the total U.S. civilian noninstitutionalized population. The CEX consists of two surveys: a diary survey and a quarterly interview survey. The diary survey collects detailed data on household expenditures for items that are purchased frequently, such as food and apparel, over a two-week period (U.S. Department of Labor, Bureau of Labor Statistics 2010). The CEX diary data are from cross sections of households, representative of the Census region. When weighted with the CEX sample weights, the data can be aggregated to construct quarterly series of average expenditures per household per region.

Household food spending by convenience categories varied substantially across regions and over time. Households in all regions allocated the largest budget shares to limited-service and full-service meals on average between 1999 and 2010. Households in the Northeast allocated more to full-service meals than households in other regions (29%), but less to limited-service meals than others (24%). Households spent about the same on ready-to-eat meals and complex ingredients (17-18%). They spent the least on ready-to-cook meals (7-8%) and basic ingredients (5%) (table 2). Over time, budget shares devoted to FAFH convenience food categories varied more than FAH categories (figure 2). In 1999, average quarterly budget shares for limited- and full-service meals were 24% and 25%, respectively. Limited-service budget shares peaked at 30% in 2006, and full-service budget shares peaked at 27% in 2004. By 2010, limited-service budget shares were 27%, still above 1999 figures, while full-service budget shares declined slightly to 23%. Average budget shares for FAH home categories varied 1-3 percentage points throughout the period. Prices and household expenditures were generally postively correlated as expected, particularly for basic ingredients, complex ingredients, and ready-to-cook meals (figure 3).

[Insert figure 2]

[Insert figure 3]

Demographic and Time Variables. The demographic and time variables are also derived from the CEX diary survey. The demographic and time variables used in our analysis are averages of household-level demographic characteristics and hours worked by region, weighted by the CEX sample weights. Demographic variables include average household size, number of household members less than 18 years of age, number of members greater than 64, and weekly hours worked by wage earners, as well as percentage of the population that is married, black, white, Asian, have female household earners, no high school degree and have a high school degree.

From table 2, we see that wage-earners generally worked an average of 30-32 hours, and there were 1.3-1.4 wage earners per household on average (table 2). Households in the West were the youngest (47 compared to 48-50 in other regions), had slightly larger families (2.6 compared to 2.4-2.5), and more children under 18 (0.73 compared to 0.59 to 0.67). The Midwest and South had higher rates of highschool diplomas, while the West had higher rates of marriage. The South had the lowest concentration of White households and the highest concentration of Black households, while the West had the highest concentration of Asian households.

Advertising expenditures. Kantar Media produces a database called Ad$pender that contains nominal expenditures on advertising for eighteen media outlets, including print, radio, television, internet, and billboard advertising, for thousands of branded products. Advertising expenditures at market-level are only available for Hispanic newspaper, local magazine, local radio, national spot radio, local newspaper, outdoor, spot television, and internet display, and advertising expenditures on B-to-B, cable TV, Hispanic magazines, magazines, national newspaper, network radio, network TV, satellite TV, Sunday magazines, and syndication are only available at national level. Hence we included two advertising variables in our analysis: "local" advertising which varies across regions and time and "national" advertising that only varies across time.

Through cross promotion and sponsorships, some advertisements in the data set are for multiple branded products that were in different food categories. For these cases, the advertising expenditures reported for that particular advertisement for a given time period and region was split evenly between the food categories in that period and region. For example, Coca-Cola and theme parks were frequently advertised together. An advertising expenditure for this combination was split evenly between the ready-to-eat foods and nonfood.

Advertising expenditures varied greatly across regions (table 2). Firms in the South generally spent the most on advertising, particularly on limited-service meals. On average between 1999 and 2010, firms spent $134 million on fast-food advertising (among funds that could be allocated to regions), more than 2.5 times the amount spent on fast-food advertising in the Northeast ($50 million). While national-level advertising expenditures did not experience large overall growth between 1998 and 2010, there was substantial quarter-to-quarter change and a significant temporary increase in FAH advertising in 2009 (figure 4). Throughout the period, U.S. firms spent the most funds on advertising limited-service restaurants (quarterly average of $967 million in 2010) and ready-to-eat meals and snacks ($924 million). They spent the least on basic ingredients ($106 million) and ready-to-cook meals and snacks ($319 million). In 2009, advertising on FAH skyrocketted, reaching a quarterly average of $1,606 million on ready-to-eat

meals and snacks – up 113% from the average in the prior decade (1999-2008). Advertising expenditures on complex ingredients increased even more, by 157%, to reach a high of $976 million in 2009. These levels declined again in 2010. Advertising expenditures tended to vary positively with household expenditures, though to an even lesser degree than with prices (figure 5).

[Insert figure 4]
[Insert figure 5]

Empirical Model and Estimation

An issue with modeling demand using panel data are unit roots, and evidence of a unit root problem suggests specification of a demand system that is linear so that a first, fourth or twelth-difference of the variables will render the data stationary. We applied the Phillips-Perron (PP) unit-root test (PPERRON in Stata 12) (with trend and 8 lags) to the advertising data that varies only over time (i.e., national advertising data), and we apply a Fisher-type approach (XTUNITROOT in Stata 12) using the PP test (with trend and 8 lags) to the budget shares, and the logarthimic transformations of prices and local advertising which vary over time and region. The Fisher-type approach conducts the PP unit-root tests for each panel individually, and then combines the p-values from these tests to produce an overall test. We assumed that T tends to infiinity while the number of panels is fixed so that the Fisher-type PP test are consistent against the alternative that at least one panel is stationary (table 3). For most of the series we rejected the unit root hypothesis in favor of stationarity except for the prices of fast food and sit-down meals. Hence, we found little evidence of unit roots and were not constrained to specifying the demand system as a set of linear equations.

[Insert table 3]

We used the almost ideal demand system (AIDS) (Deaton and Muellbauer 1980) to model demand for the N foods, such that the budget share for the ith food is

$$(2) \qquad w_i = \alpha_i + \sum_{j=1}^{N} \gamma_{ij} \ln p_j + \beta_i \ln(M / P^*),$$

and $\ln P^*$ is the price index defined by

$$(3) \qquad \ln P_t^* = \alpha_0 + \sum_{j=1}^{N} \alpha_j \ln p_j + 1/2 \sum_{k=1}^{N} \sum_{j=1}^{N} \gamma_{kj} \ln p_k \ln p_j .$$

In equations (2) and (3) p_j denotes the price of good j and M is the per-household expenditure on beverages. Using translation (Pollak and Wales 1981), we introduce the effects of N local advertising expenditures, $AL_1,\ldots,AL_N$, N national advertising expenditures, $AN_1,\ldots,AN_N$, L demographic characteristics, $D_1,\ldots,D_L$, and a time trend, t, into (2)–(3) through augmented share equation intercepts, α_i:

$$(4) \qquad \alpha_i = \alpha_i^* + \omega_i t + \sum_{j=1}^{N} a_{ij}^L \ln AL_{jt} + \sum_{j=1}^{N} a_{ij}^N \ln AN_{jt} + \sum_{j=1}^{L} d_{ij} \ln D_{jt} .$$

We incorporated advertising, and the other demand shifters in this manner because it preserves adding-up conditions, shifts the demand curves in an intuitively appealing way and does not increase the number of parameters excessively.

The following restrictions on the parameters allow the AIDS model with translation to conform with demand theory including adding up, homogeneity and symmetry:

$$\sum_i \alpha_i^* = 1, \sum_i \beta_i = \sum_i a_{ij}^L = \sum_i a_{ij}^N = \sum_i d_{ij} = 0, \tag{5}$$

$$\sum_j \gamma_{ij} = 0, \forall j, \tag{6}$$

$$\gamma_{ij} = \gamma_{ji}, \forall i, j \ . \tag{7}$$

For the model given by equations (2), (3), and (4), the elasticities of demand with respect to total expenditure, price, demographics, advertising are

$$\eta_{iM} = 1 + \frac{\beta_i}{w_i} \ , \tag{8}$$

$$\eta_{ip_j} = -\delta_{ij} + \frac{\gamma_{ij} - \beta_i(\alpha_j + \sum_k \gamma_{kj} \ln p_k)}{w_i}, \tag{9}$$

$$\eta_{iA_j^m} = \frac{a_{ij}^m - \beta_i(\sum_k a_{kj}^m \ln p_k))}{w_i}, m = L, N, \tag{10}$$

$$\eta_{iD_j} = \frac{d_{ij} - \beta_i(\sum_k d_{kj} \ln p_k))}{w_i}, \tag{11}$$

where and δ_{ij} is Kroneker's delta , and α_i is defined in (4). We evaluated the logarithmic transformations of the prices, and the budget shares in the elasticity formulas at the mean of the data.

We estimated *N*–1 equations to avoid singularity of variance-covariance matrix using a two-step feasible nonlinear generalized least squares estimator (NLSUR in Stata 12). In our analysis we dropped the sit-down equation and recover the parameters for this equation using the adding up conditions (equation 5). We also imposed homogeneity and symmetry constraints in estimation (equations 6 and 7) and assumed that α_0 in (3) is zero to identify the system. The standard errors on the elasticities of demand are calculated using the delta method (NLCOM in Stata 12).

We first estimated the linear approximate version of (2) using Stone's Price index, i.e., $\sum_{i=1}^{N} w_{it} \ln p_{it}$ to obtain starting values for (1). To avoid endogeneity from using Stone's price index in (2) we used lagged budget shares in Stone's Price index instead of current budget shares (Eales and Unnevehr 1988).

Results

For brevity the parameter estimates are posted in the appendix. We first tested whether the trend, advertising and demographic parameters are jointly statistically significantly different from zero in each equation and for the entire model using Wald tests (table 4). The trend was not significant in any of the equations. We rejected the null hypothesis that the advertising variables

(local or national) were jointly zero in all of the equations except for national advertising in the complex ingredients and ready-to-cook equations and for local advertising for the ready-to-cook equation at the 10-percent level of significance. For the overall system we concluded that the advertising and demographics variables should be included in the model.

[Insert table 4]

Table 5 presents the price and expenditure elasticities of demand calculated using the parameter estimates in the appendix and equations (8) and (9). All of the own-price elasticities of demand are negative which is consistent with the law of demand, and all the own-price elasticities are statistically different from zero at the 1 percent level of significance. Ready-to-cook and sit-down foods are the most price elastic with a one-percent increase in price decreasing demand by 1.37 and 1.31 percent, respectively. We found some cross-price relationships between the foods. Basic ingredients is a gross substitute for sit-down foods. Ready- to-cook foods is a gross substitute for ready-to-eat foods and complex ingredients but a gross complement for sit-down meals and snacks. And fast food is a gross substitute for ready-to-cook foods but a gross complement for ready-to-eat foods. These price relationships are somewhat different from those found in Capps et al. (1985) in that they found all convenience types to be net substitutes with each other and the own-price responsiveness to decrease with increasing convenience. It is likely that the differences between our study and Capps et al. (1985) are a function of the sample period (1977-78 versus 1999-2010) and also the type of data (cross section versus panel).

[Insert table 5]

All of the expenditure elasticities are statistically different from zero, and range between 0.92 for basic ingredients and 1.06 for sit-down foods. This finding is consistent with Okrent and Alston (2011, 2012) who found FAFH to be more expenditure elastic than FAH. This finding implies that as household total expenditures declined during the recession of 2007-2009 then this decline in income would have affected demand for FAFH much more than FAH products. This may have been one contributing factor to declining budget shares on sit-down foods during and post-recession but demand for fast foods remained somewhat constant or even increased during this same period. Changes in other factors like advertising may explain this divergence in trends between foods from fast food and sit-down restaurants.

Indeed, table 6 shows that demand for fast food increases by a statistically significant 0.05 percent with a one-percent increase local advertising and 0.02 percent with national advertising (although this is not statistically significant). Even though the magnitude of the the advertising elasticities of demand are much smaller than the price and expenditure elasticities this does not imply that the contribution of advertising to the growth in fast-food purchases is smaller than that of price or expenditure. In fact the percentage change in demand for fast food attributable to prices, expenditures or advertising is a factor of not just the elasticity of demand with respect to prices, expenditure or advertising but also percentage change in that factor. And since prices and expenditures change very little from quarter-to-quarter but advertising expenditures (both local and national) change quite a bit more than it may be that during the recession that the positive effect of advertising on demand for fast food was much greater than the negative effect of falling expenditures on fast food.

[Insert table 6]

Many of the own-advertising elasticities of demand are statistically different from zero at the 10-percent level or lower, and are positive which is consistent with expectations. A one-percent increase in national advertising on basic ingredients increases demand for basic ingredients and ready-to-eat foods by 0.44 and 0.03 percent, respectively but local advertising seems to have no effect on demand. Conversely, local advertising increases demand for complex ingredients but there appears to be no statistically significant relationship between national advertising and complex ingredients. Demand for fast foods appears to be positively affected by local advertising (.05) but negatively affected by national advertising (-.09), whereas sit-down foods are negatively impacted by an increase in advertising (-0.08). Negative own-advertising elasticities, although counterintuitive, are prevalent in the economics literature (e.g., Zheng and Kaiser 2008; Green, Carman and McManus 1991; Kinnucan et al. 2001; Duffy 2003; Rickertsen, Chalfant, and Steen 1995; Piggott et al. 1996). Baye, Jansen and Lee (1992) found 4 of 6 own-advertising effects to be negative and argued that individual firms find it in their own interest to advertise even though in the aggregate it does not positively affect demand for the commodity. In addition, Forker and Ward (1993) argued that over some range of low advertising expenditures, there may be a minimal response to the advertising, which may be the case for the local advertising which is much smaller than the national advertising.

In addition to the own-advertising effects, we also found several spillover effects from advertising. Many of the statistically significant cross-advertising effects are negative indicating that a increase in advertising expenditures for a food will decrease demand for a competing food. This is the case for most of the cross-advertising effects. Alternatively we find statistically significant evidence of positive spillover effects for demand for basic and complex ingredients, ready to eat and ready to cook with respect to local advertising on fast food. Fast-food establishments often advertise foods that can be purchased in the grocery store like Coke or french fries, and hence it may be the case that fast-food advertisements stimulate demand for FAH counterparts.

Table 7 highlights the elasticities of demand with respect to the demographics and time variables. Recall that we incorporated the average number of hours worked for the wage earners in each household as a proxy for the time constraints of family because many studies found that household time constraints were a factor in demand for FAFH. We found evidence that average number of hours worked by wage earners in a household decreased demand for basic and complex ingredients but increased demand for fast foods. Also, some studies have used women's labor force partipation to proxy for household time constraints arguing that the more women take on market employment the less time they have to spend in work at home including preparing food (e.g., Nayga and Capps 1992). Similarly, in our study we include percentage of households with female heads but did not find there to be any statisical relationships between percentage of female household heads and demand for any of the foods.

[Insert table 7]

Other interesting relationships between demand for convenience foods and the demographic characteristics of the population emerged as well. The average number of persons greater than 64 in a household has a statistically significant impact on demand for convenience

foods; the older an average household becomes, the more they demand basic ingredients and the less they demand more convenient FAH products. This implies that with the aging U.S. population demand for more convenient FAH products may decline. However, it should be noted that we find no statistically significant relationship between average age of household heads and demand for any of the products which is likely due to collinearity between the age and number of persons greater than 64 variables. The percentage of the population that are married increases demand for sit-down foods, which may be a function of date night. And having no high school degree also increases demand for sit-down foods.

Discussion

Even though the magnitude of the advertising elasticities of demand are smaller in magnitude compared with the price, expenditure and demographic elasticities of demand, this does not necessarily mean that most of the changes in demand for the foods between 1999 and 2010 can only be attributable to prices, expenditures, and demographics. We decompose the growth in demand for the foods into price, expenditure, demographic and advertising effects using the following reduced-form model of demand, Q_n:

$$(12) \qquad w_n = \frac{p_n q_n(\mathbf{p}, \mathbf{AL}, \mathbf{AN}, \mathbf{D}, M)}{M}, \forall n = 1,..., N,$$

where the budget shares of the N goods are a function of **p**, **AL, AN** and **D,** or vectors of food prices, local and national advertising, and demographic characteristics respectively, and M is total expenditure on the N goods. Taking the total derivative of this general equation and converting the partial derivatives into elasticities yields:

$$(13) \qquad \mathrm{E}\,\mathbf{w}_t = \boldsymbol{\eta}^P\,\mathrm{E}\,\mathbf{p}_t + \boldsymbol{\eta}^M\,\mathrm{E}\,M_t + \mathbf{w}\boldsymbol{\eta}^{AL}\,\mathrm{E}\,\mathbf{AL}_t + \mathbf{w}\boldsymbol{\eta}^{AN}\,\mathrm{E}\,\mathbf{AN}_t + \mathbf{w}_t\boldsymbol{\eta}^D\,\mathrm{E}\,\mathbf{D}_t,$$

where E$\mathbf{w}_t$, E$\mathbf{p}_t$, E$\mathbf{AL}_t$, E$\mathbf{AN}_t$, and E$\mathbf{D}_t$ are vectors and EM is a scalar, both of which contain the approximate proportional changes in *w, p, AL, AN, D, and M* (i.e., $d\,w/w \approx d \ln w$) at time period *t*, $\boldsymbol{\eta}^p$ is an N × N matrix of price elasticities of demand, $\boldsymbol{\eta}^M$ is an N × 1 vector of expenditure elasticities of demand, and $\boldsymbol{\eta}^{AN}$, $\boldsymbol{\eta}^{AL}$ and $\boldsymbol{\eta}^D$ are matrices of elasticities of demand with respect to local and national advertising and demographics, respectively, and $\mathbf{w}_t$ is an N × N diagonal matrix of budget shares. The first and second terms on the right-hand side of (13) gives the net price and expenditure effects which is the sum of own- and cross-price, and expenditure effects on demand for each product. The third and fourth terms fives the net advertising effects, which includes the own effect as well as spillover effects. And the last term gives the net demographic effect.

We evaluated (13) for each quarter using price indexes, demographics, and advertising expenditures for the entire United States, and present the predicted changes in budget shares from the net price, advertising and demographic effects in figure 6, panels a-e. The percentage changes are stack in the positive and negative direction to show a clear picture of the dominant effects. For example in panel a, between 1999q1 and 1999q2 the net demographic effect caused demand for basic ingredients to decline around 2 percent but the net price and advertising effects cause demand to increase less than one percent for price and local advertising and about 3 percent for national advertising.

Price and expenditure effects dominate the advertising and demographic effects except for the ready-to-cook category, and seemed to drive down demand pre-recession and increase demand during and post-recession. Demand for basic ingredients is largely driven by demographic/time effects and national advertising, although the net effect of national advertising appears to diminish over time. For complex ingredients demographics play a large role in quarterly demand followed closely by local advertising. It is difficult to determine the prominent driver of demand for fast food. The net national advertising effects dominant until 2003 and thereafter demographics/time and net local advertising appear to be the biggest drivers of demand for fast food. This also appears to be the case for sit-down foods as well. Indeed much of the decline in sit-down demand appears to be caused by negative net demographics/time and net advertising effects.

[Insert figure 6, panels a-f]

Conclusion

The demand for convenience foods has increased over the last several decades in the United States. Several studies argued that demand for these convenience foods may be a function of household characteristics like composition and time constraints of households while others have argued that growing advertising expenditures may also be an important contributor to growth in demand of these foods. Prices and expenditures have also been found to affect demands for these foods as well. Most of these studies have focused on one particular convenience food, FAFH, and have paid little attention to convenience attributes of FAH products. Also none of these studies have been able to test all competiting hypothesis as to why demand for convenience foods has increased because of data limitations.

In this study we construct a novel data set that allows us to analyze the primary drivers of the demand for convenience foods in the United States. We construct quarterly-regional observations on market prices and average household expenditures, advertising expenditures, and demographic characteristics using several cross-sectional and time-series data sets including the QFAFHP, Nielsen Homescan, CEX, and Ad$pender data. We then use these data to estimate an almost ideal demand system for FAH (basic ingredients, complex ingredients, ready-to-cook foods and ready-to-eat foods) and FAFH (fast food and sit-down food) that incorporates the advertising and demographic variables through demographic translation.

We find evidence that price and expenditures are important factors that explain demand for convenience foods but this is only one side of the story. Advertising and demographics play an important role in demand as well. In particular, we find some evidence that demand for FAH convenience can be attributed to household time constraints. We also find advertising to play a pretty big role in demand for fast foods and ready-to-eat foods. Only a few of the demographic variables were found to affect demand including average number of persons greater than 64 and the race variables. The greater the number of persons aged 64 or older increased demand for basic ingredients and sit-down foods and decreased demand for the other categories, which is consistent with other findings in the literature, and implies that demand for many of the convenience foods other than sit-down foods may decrease with the aging U.S. population.

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Table 1: Convenience FAH categorization

Food group	Description	Examples
Basic ingredient	Raw or minimally processed foods used in producing meals and snacks; single ingredient	Produce, milk, dried beans, rice, flour, sugar, butter, fresh meat/poultry/seafood
Complex ingredient	Processed foods used in producing a meal or snack; generally multiple ingredients	Bread, dry pasta, sour cream, cheese, sauce, canned vegetables/beans, pickles, cereal, frozen/canned meat/poultry/seafood
Ready to cook	Meals and snacks that require minimal preparation beyond heating or hot water	Frozen entrees, dry meal mixes, pudding mixes, soup, chili, powdered drinks, juice concentrate
Ready to eat	Meals and snacks to be consumed as is	Refrigerated entrees, canned fruit, yogurt, snacks, fruit juice/drinks, flavored milk

Table 2. Summary statistics

	Northeast		Midwest		South		West	
Price index (1999Q1=100)								
Basic Ingredients	169.6	(29.1)	171.2	(30.7)	182.5	(30.2)	178.0	(33.4)
Complex Ingredients	121.9	(15.6)	126.0	(14.8)	114.5	(13.2)	124.8	(12.7)
Ready to cook	125.1	(13.2)	125.0	(12.5)	113.0	(11.7)	130.2	(11.6)
Ready to eat	155.3	(17.9)	155.7	(16.6)	141.5	(14.8)	152.2	(15.1)
Fast Food	130.1	(18.8)	125.2	(14.1)	128.4	(19.7)	134.0	(23.8)
Sit down	122.9	(12.6)	132.4	(16.9)	124.2	(8.6)	114.5	(6.5)
Budget Shares								
Basic Ingredients	0.051	(0.003)	0.053	(0.004)	0.053	(0.002)	0.050	(0.003)
Complex Ingredients	0.168	(0.010)	0.184	(0.010)	0.177	(0.013)	0.171	(0.013)
Ready to cook	0.074	(0.007)	0.083	(0.008)	0.078	(0.005)	0.080	(0.007)
Ready to eat	0.178	(0.009)	0.184	(0.008)	0.176	(0.009)	0.171	(0.009)
Fast Food	0.292	(0.026)	0.252	(0.022)	0.264	(0.029)	0.274	(0.034)
Sit down	0.237	(0.020)	0.243	(0.022)	0.251	(0.015)	0.255	(0.019)
Local advertising expenditures (mill $)								
Basic Ingredients	5.804	(2.445)	4.872	(1.586)	8.727	(2.665)	12.266	(3.446)
Complex Ingredients	23.284	(6.557)	18.978	(5.624)	28.276	(8.226)	22.002	(6.900)
Ready to cook	7.685	(4.873)	6.776	(3.638)	10.152	(5.167)	8.125	(4.006)
Ready to eat	28.422	(9.984)	24.093	(8.466)	39.560	(12.683)	36.677	(13.339)
Fast Food	50.274	(7.022)	79.574	(10.605)	134.450	(16.048)	96.022	(8.361)
Sit down	29.577	(3.773)	40.299	(5.425)	66.296	(6.735)	45.699	(5.758)
National advertising expenditures (mill $)								
Basic Ingredients	58.641	(41.075)	58.641	(41.075)	58.641	(41.075)	58.641	(41.075)
Complex Ingredients	345.245	(165.671)	345.245	(165.671)	345.245	(165.671)	345.245	(165.671)
Ready to cook	241.316	(114.855)	241.316	(114.855)	241.316	(114.855)	241.316	(114.855)
Ready to eat	709.321	(285.647)	709.321	(285.647)	709.321	(285.647)	709.321	(285.647)
Fast Food	485.042	(92.713)	485.042	(92.713)	485.042	(92.713)	485.042	(92.713)
Sit down	156.159	(64.831)	156.159	(64.831)	156.159	(64.831)	156.159	(64.831)
Demographics								
Hours worked	29.901	(0.940)	31.788	(0.962)	31.408	(0.923)	31.918	(1.199)
Age	49.963	(1.113)	48.076	(0.991)	48.088	(0.835)	46.994	(1.007)
Family size	2.446	(0.070)	2.464	(0.062)	2.541	(0.052)	2.649	(0.062)
Number of earners	1.308	(0.051)	1.369	(0.058)	1.307	(0.048)	1.392	(0.051)
Number <18 years old	0.594	(0.058)	0.651	(0.046)	0.672	(0.034)	0.728	(0.051)
No high school diploma (%)	0.327	(0.034)	0.315	(0.030)	0.319	(0.025)	0.254	(0.030)
High school diploma (%)	0.464	(0.032)	0.506	(0.034)	0.480	(0.023)	0.451	(0.030)
Female household heads (%)	0.506	(0.035)	0.543	(0.027)	0.516	(0.024)	0.512	(0.031)
Married (%)	0.519	(0.027)	0.533	(0.021)	0.537	(0.018)	0.550	(0.031)
White (%)	0.857	(0.020)	0.875	(0.015)	0.758	(0.015)	0.843	(0.021)
Black (%)	0.091	(0.015)	0.088	(0.010)	0.200	(0.013)	0.040	(0.009)
Asian(%)	0.032	(0.009)	0.018	(0.006)	0.016	(0.004)	0.068	(0.014)

Table 3. Phillips-Perron tests for unit roots

	Budget shares		Log transformed prices		Log transformed local ads		Log transformed national ads	
Basic ingredients	72.33	[0.00]	82.56	[0.00]	76.35	[0.00]	-3.85	[0.01]
Complex ingredients	32.72	[0.00]	23.30	[0.00]	21.39	[0.01]	-3.57	[0.03]
Ready to cook	103.16	[0.00]	16.59	[0.03]	55.41	[0.00]	-5.64	[0.00]
Ready to eat	43.82	[0.00]	33.09	[0.00]	69.79	[0.00]	-4.70	[0.00]
Fast food	59.01	[0.00]	11.36	[0.18]	86.09	[0.00]	-8.50	[0.00]
Sit down	56.03	[0.00]	11.89	[0.16]	30.12	[0.00]	-5.17	[0.00]

p-values are in brackets. Phillips-Perron tests are based on regression that includes 8 lags and trend.

Table 4. Wald tests of restrictions

	Local Advertising $a_{ij}^{L} = 0$		National Advertising $a_{ij}^{N} = 0$		Demographics $d_{ij} = 0$		Trend $\omega_i = 0$	
Equation $(\forall j)$								
Basic ingredients	137.57	[0.00]	32.79	[0.00]	35.61	[0.00]	1.25	[0.26]
Complex ingredients	69.80	[0.00]	5.90	[0.43]	33.16	[0.00]	1.03	[0.31]
Ready to cook	8.01	[0.24]	11.08	[0.09]	24.95	[0.02]	2.09	[0.15]
Ready to eat	15.43	[0.02]	17.02	[0.01]	27.13	[0.01]	1.08	[0.30]
Fast food	15.86	[0.01]	39.77	[0.00]	29.03	[0.01]	1.65	[0.20]
Overall $(\forall i, j)$	372.15	[0.00]	215.57	[0.00]	232.74	[0.00]	4.54	[0.47]

p-values are in brackets.

Table 5. Price and expenditure elasticities of demand

Percentage change in quantity	With respect to price of												With respect to expenditure	
	Basic ingredients		Complex ingredients		Ready to cook		Ready to eat		Fast food		Sit down			
Basic ingredients	-1.11	***	0.02		-0.24		-0.06		-0.04		0.52	**	0.92	***
Complex ingredients	-0.08		-0.77	***	-0.11		-0.03		-0.03		0.09		0.94	***
Ready to cook	-0.09		0.17	*	-1.38	***	0.94	***	0.16		-0.72	**	0.93	***
Ready to eat	-0.01		0.01		0.42	***	-0.83	***	-0.33	***	-0.26	***	0.99	***
Fast food	0.03		-0.01		0.12	*	-0.20	***	-0.90	***	-0.08		1.02	***
Sit down	0.08		-0.23	***	-0.19		-0.17	***	0.11		-1.31	***	1.06	***

***, **, * denotes significance at 1%, 5%, and 10%.

Table 6. Local and national elasticities of demand

Percentage change in quantity	With respect to advertising on: Basic ingredients		Complex ingredients		Ready to cook		Ready to eat		Fast food		Sit down	
Local												
Basic ingredients	0.01		-0.06		-0.17	***	0.09	***	0.10	***	-0.20	***
Complex ingredients	0.09	***	0.05	***	-0.05	**	-0.01		-0.04	***	0.02	
Ready to cook	0.01		-0.07		-0.11	*	-0.00		0.07	*	0.02	
Ready to eat	0.02		-0.01		0.07		-0.03		-0.08	***	0.04	
Fast food	-0.01	*	-0.02		-0.03		-0.04	*	0.05	*	0.07	**
Sit down	-0.06	***	0.03		0.09		0.05		-0.01		-0.08	***
National												
Basic ingredients	0.44	***	-0.42	***	-0.46	*	-0.72	***	2.04	***	0.01	
Complex ingredients	-0.00		0.00		-0.01		-0.00		-0.00		-0.01	
Ready to cook	0.02		0.00		0.01		-0.04	*	-0.03		0.03	
Ready to eat	0.00		-0.00		-0.03		0.03	***	-0.01		-0.04	**
Fast food	0.03	*	0.06	***	0.05	*	-0.06	***	-0.09	***	0.01	
Sit down	-0.13	***	0.02		0.06		0.21	***	-0.31	***	0.01	

***, **, * denotes significance at 1%, 5%, and 10%.

Table 7. Demographic and time elasticities of demand

Percentage change in quantity of	With respect to the average: Hours worked		Age		Family size		Number of earners		Number <18		Number >64	
Basic ingredients	-0.28		0.20		0.01		-0.27		0.52		0.66	***
Complex ingredients	-0.30	***	0.03		-0.01		-0.00		-0.24		0.05	
Ready to cook	0.15		-0.16		0.12	***	0.00		-0.15		-0.25	
Ready to eat	0.09		-0.06		0.02		0.13		0.01		-0.30	*
Fast food	0.14	***	0.01		-0.03	*	-0.15		-0.03		0.00	
Sit down	0.00		0.03		-0.01		0.13		0.14		0.12	

	With respect to the percentage of: No high school diploma		High school diploma		Female household heads		Married		White		Black		Asian	
Basic ingredients	-0.03		-0.12		-0.16		-1.06		0.04		0.06		2.49	
Complex ingredients	-0.01		0.02		-0.10		-0.06		0.10		-0.00		0.49	*
Ready to cook	-0.65	**	-0.00		-0.02		-0.76	*	0.27		0.09		-0.24	
Ready to eat	0.08		0.06	*	0.00		-0.05		-0.05		2.32	***	-0.09	
Fast food	-0.12	*	0.03		-0.00		-0.01		0.03		-0.74		-0.08	
Sit down	0.29	**	-0.06		0.11		0.56	***	-0.16		-0.90		-0.64	

***, **, * denotes significance at 1%, 5%, and 10%.

Figure 1. U.S. quarterly price indexes for convenience food categories, 1999q1-2010q4

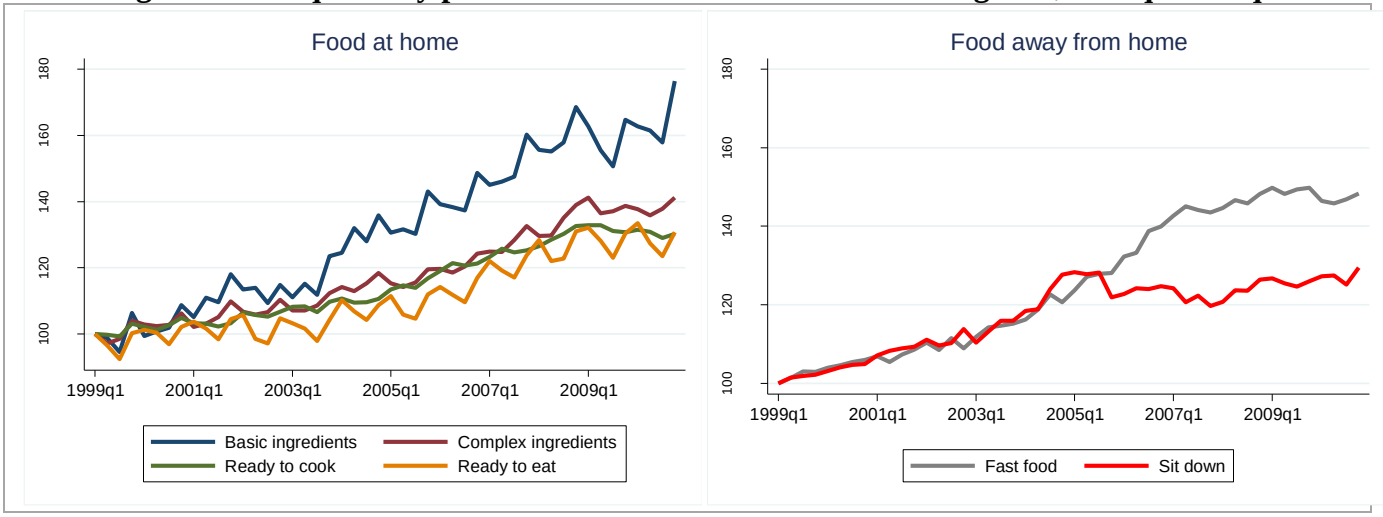


Figure 2. Average quarterly U.S. household expenditures on convenience food categories, 1999-2010

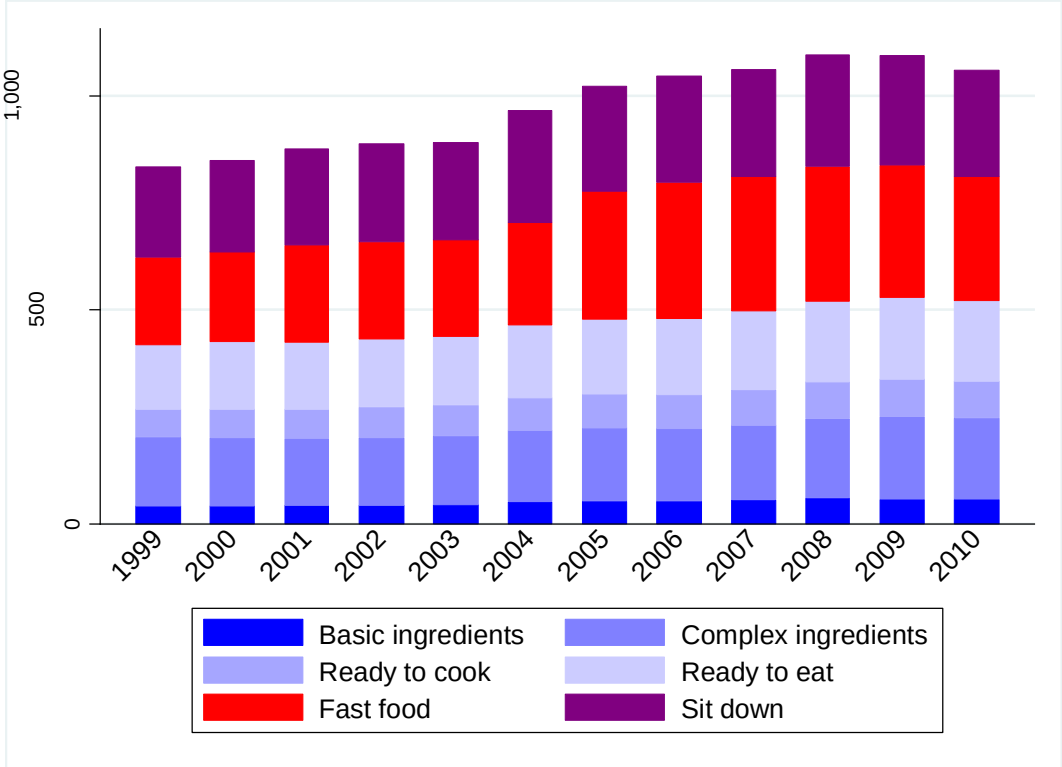


Figure 3. Quarterly price indexes and household expenditures, 1999q1-2010q4

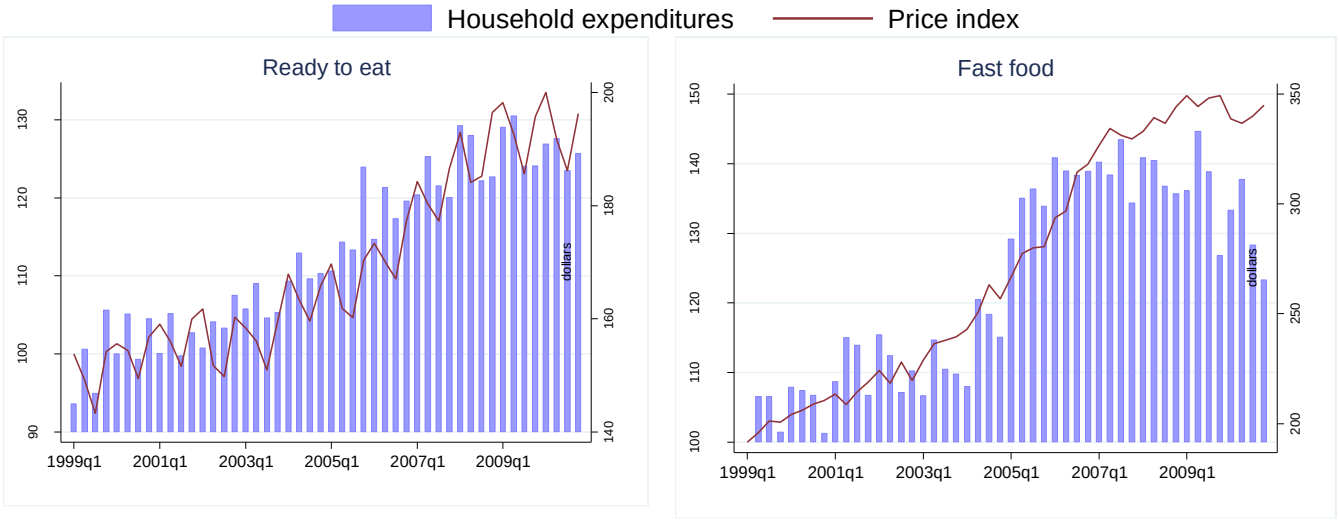


Figure 4. Average quarterly advertising expenditures on convenience food categories by year, 1999-2010

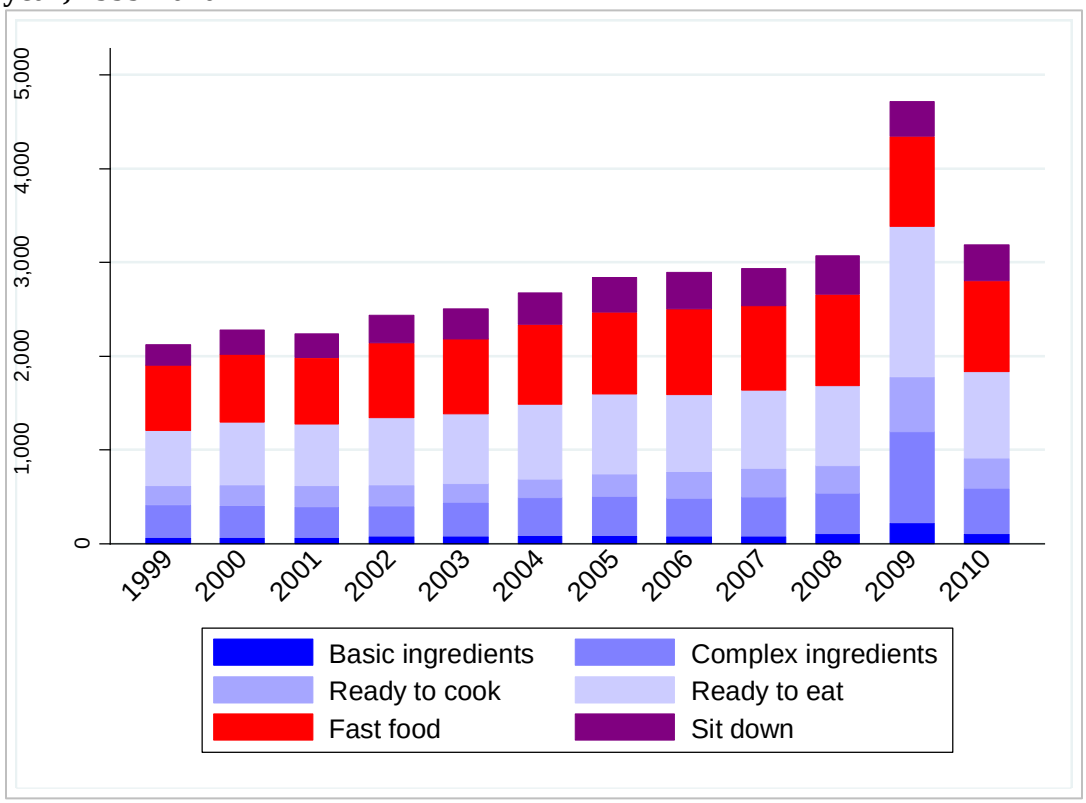


Figure 5. Quarterly household expenditures and advertising expenditures, 1999q1-2010q4

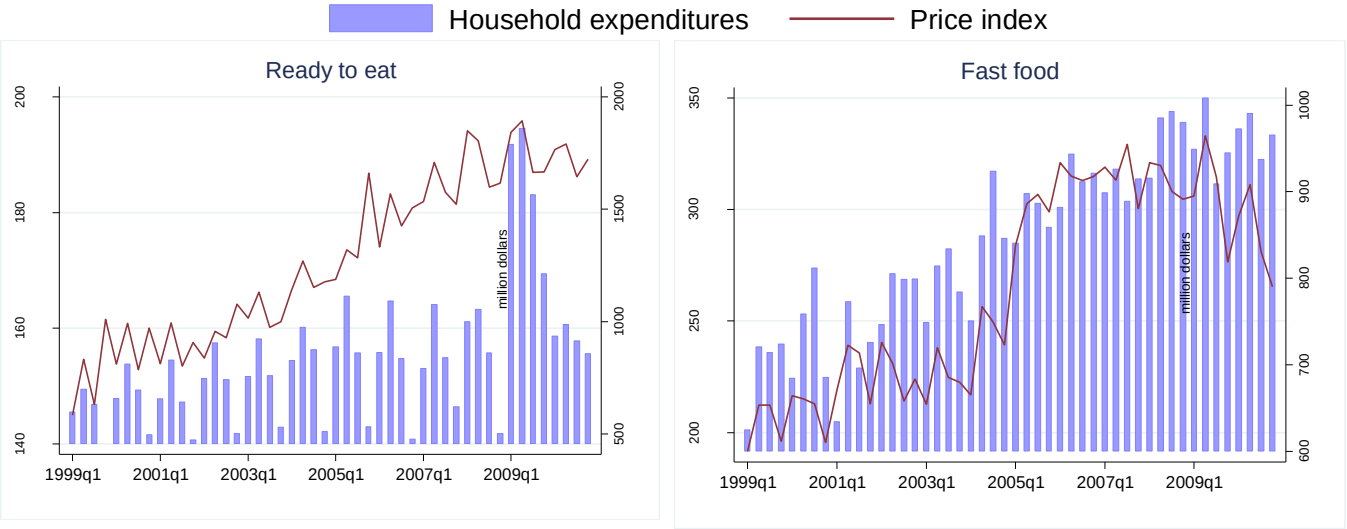
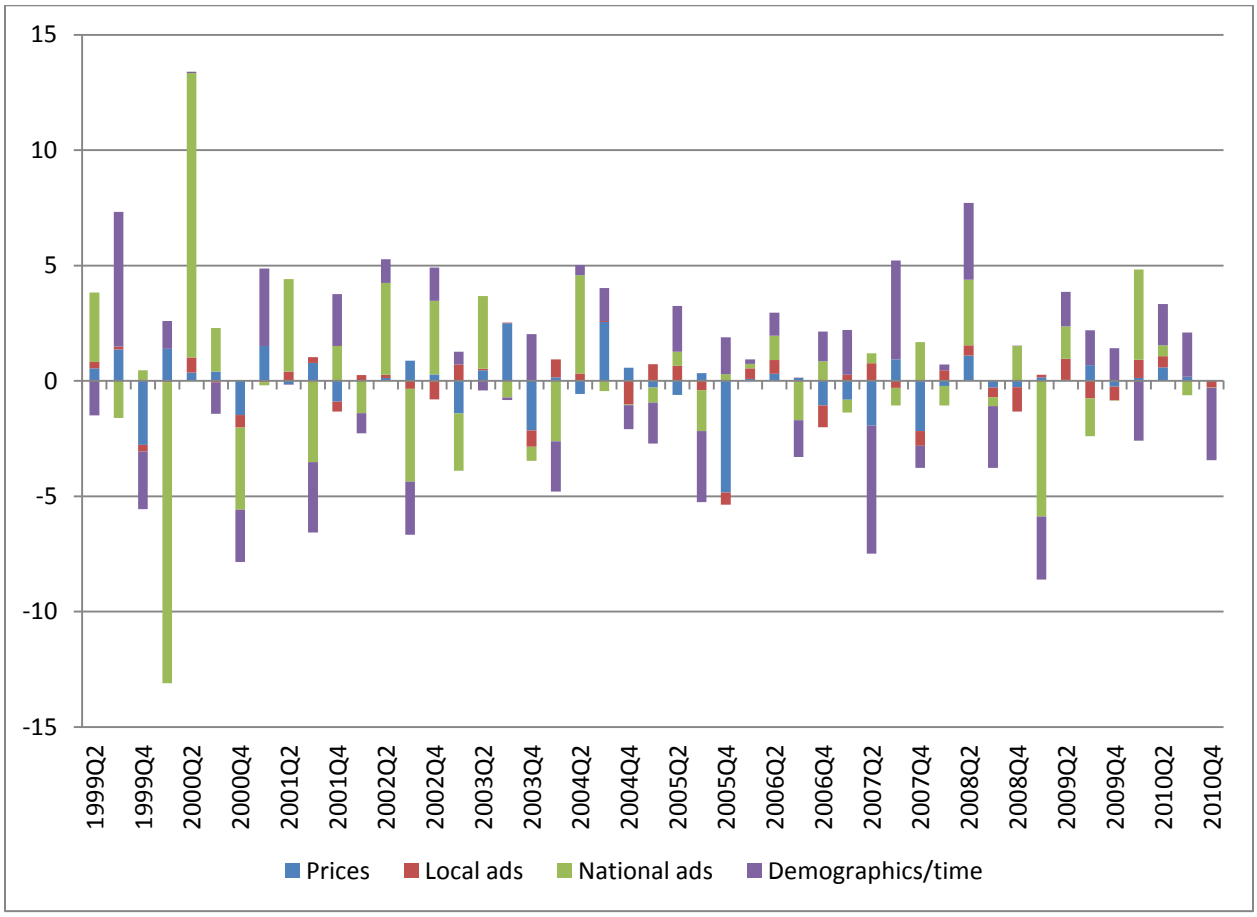
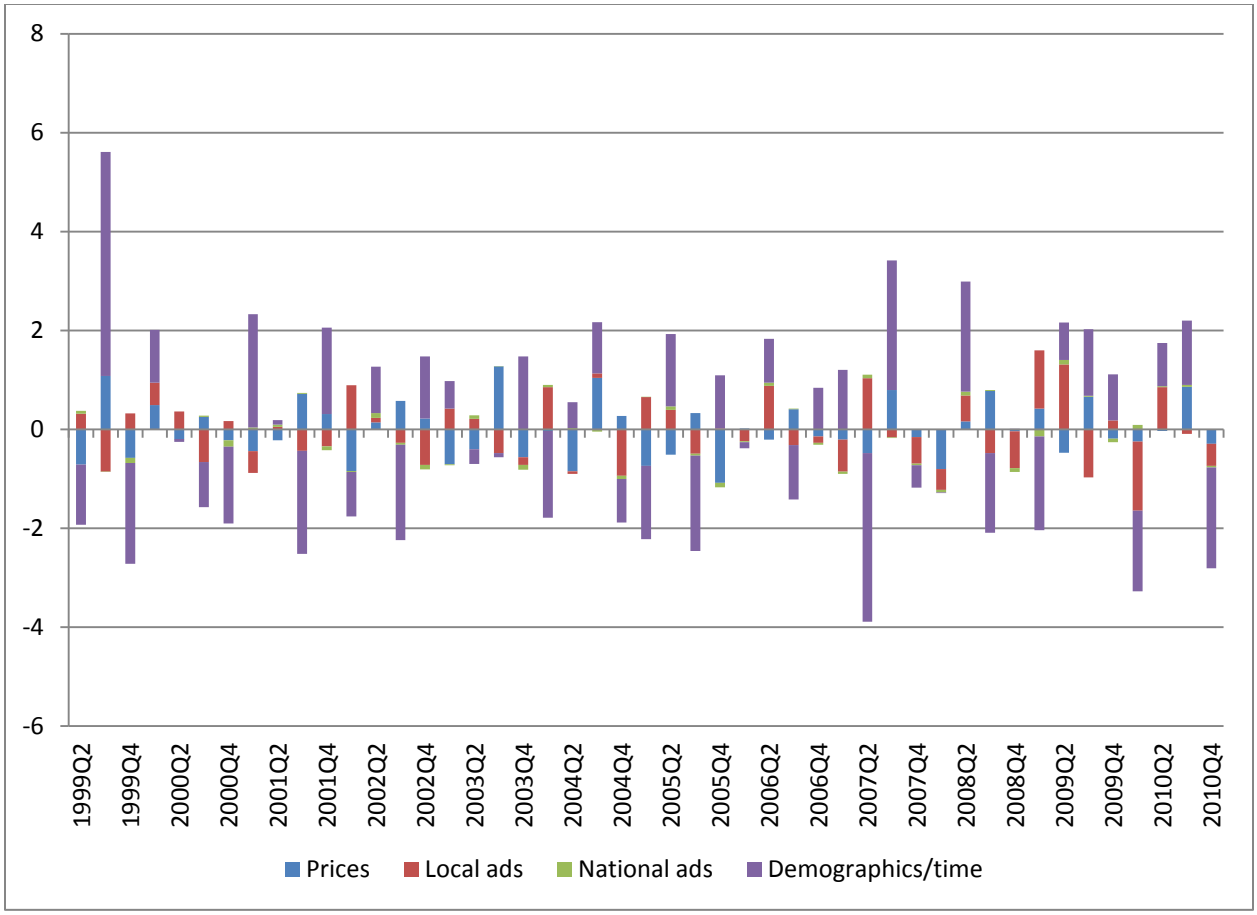


Figure 6. Decomposition of Change in Budget Shares into Advertising, Prices and Demographic Effects

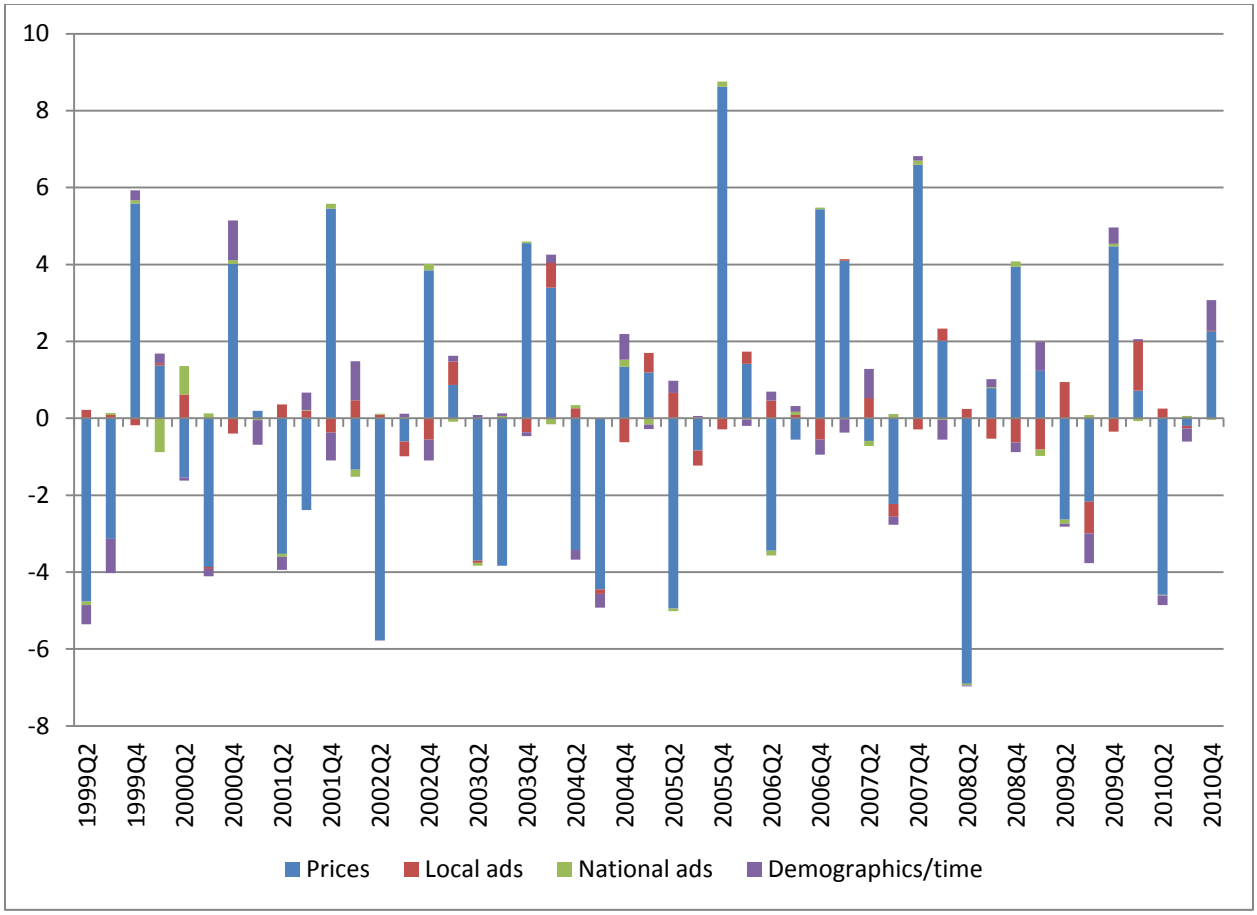
a. Basic Ingredients



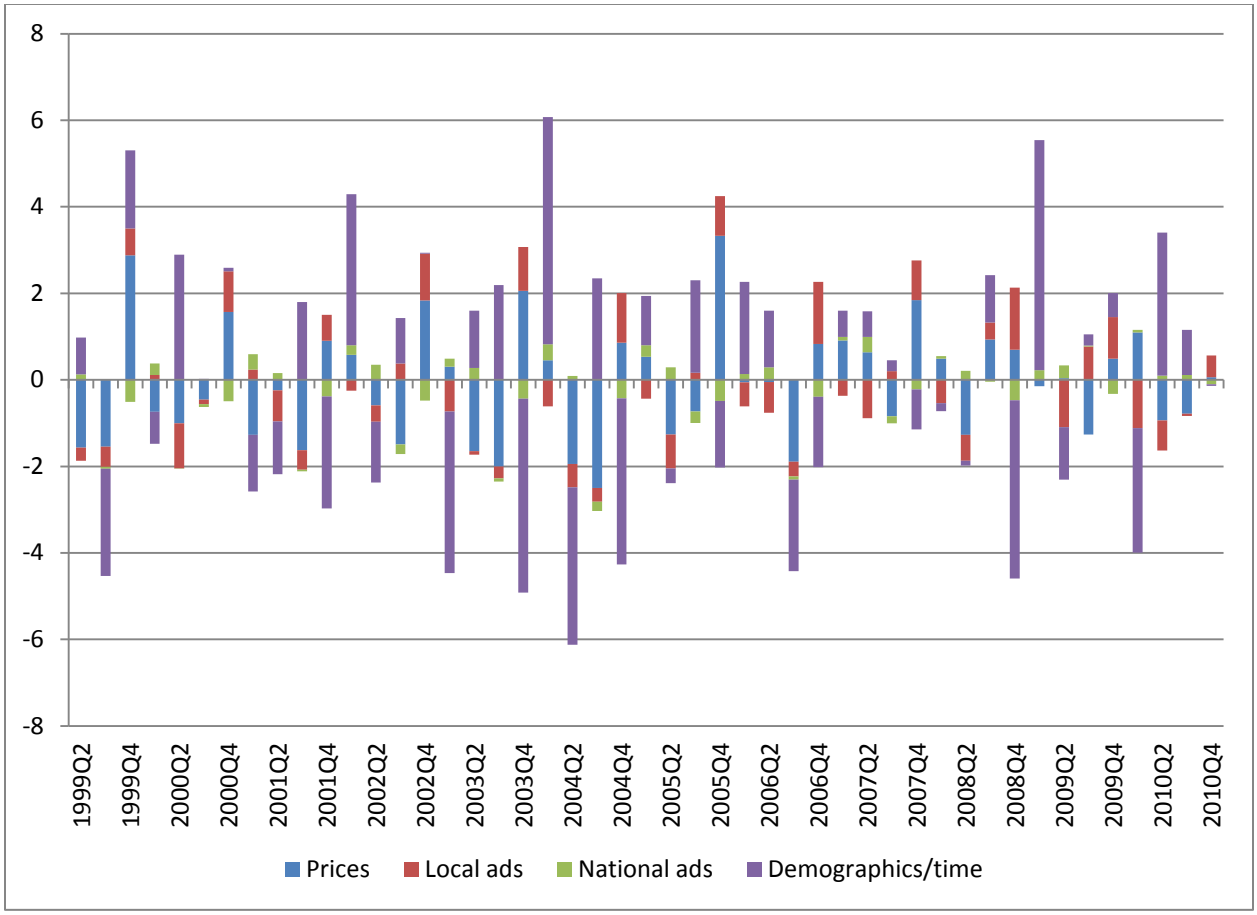
b. Complex Ingredients



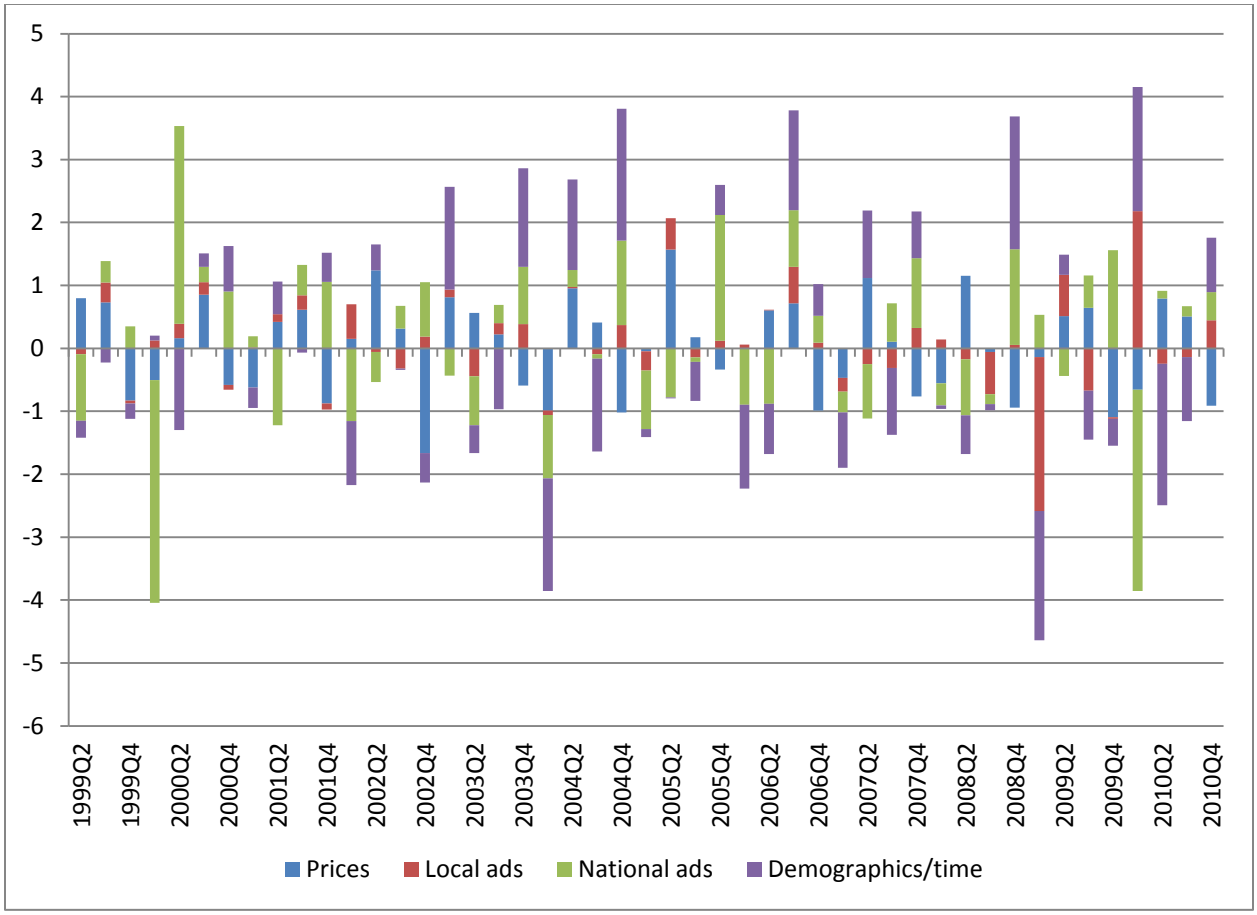
c. Ready to Cook



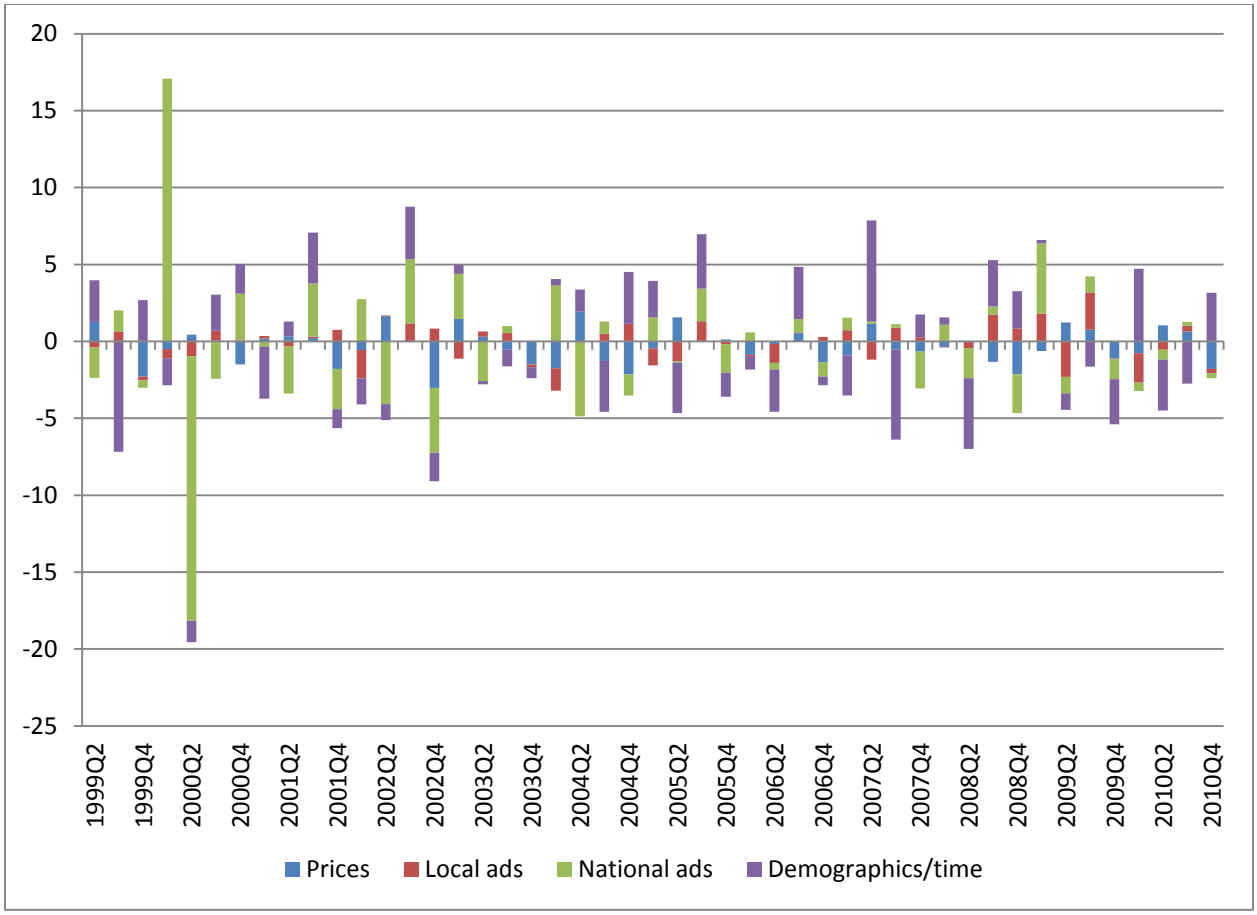
d. Ready to eat



e. Fast Food


5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
1999Q2
1999Q4
2000Q2
2000Q4
2001Q2
2001Q4
2002Q2
2002Q4
2003Q2
2003Q4
2004Q2
2004Q4
2005Q2
2005Q4
2006Q2
2006Q4
2007Q2
2007Q4
2008Q2
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4
Prices
Local ads
National ads
Demographics/time

f. Sit Down


20
15
10
5
0
-5
-10
-15
-20
-25
1999Q2
1999Q4
2000Q2
2000Q4
2001Q2
2001Q4
2002Q2
2002Q4
2003Q2
2003Q4
2004Q2
2004Q4
2005Q2
2005Q4
2006Q2
2006Q4
2007Q2
2007Q4
2008Q2
2008Q4
2009Q2
2009Q4
2010Q2
2010Q4
Prices
Local ads
National ads
Demographics/time

Appendix Table 1a. Parameter Estimates for Almost Ideal Demand System

	Basic ingredients	Complex ingredients	Ready to cook	Ready to eat	Fast food	Sit down
Prices						
Basic ingredients	-0.0003	-0.0005	-0.0003	0.0002	0.0002	0.0006
	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0005)	(0.0005)
Complex ingredients	-0.0005	0.0358	0.0115	0.0021	0.0009	-0.0498
	(0.0002)	(0.0035)	(0.0048)	(0.0042)	(0.0048)	(0.0086)
Ready to cook	-0.0003	0.0115	-0.0135	0.0785	0.0158	-0.0919
	(0.0001)	(0.0048)	(0.0033)	(0.0128)	(0.0082)	(0.0179)
Ready to eat	0.0002	0.0021	0.0785	0.0307	-0.0580	-0.0536
	(0.0002)	(0.0042)	(0.0128)	(0.0105)	(0.0099)	(0.0181)
Fast food	0.0002	0.0009	0.0158	-0.0580	0.0238	0.0173
	(0.0005)	(0.0048)	(0.0082)	(0.0099)	(0.0098)	(0.0147)
Sit down	0.0006	-0.0498	-0.0919	-0.0536	0.0173	0.1774
	(0.0005)	(0.0086)	(0.0179)	(0.0181)	(0.0147)	(0.0465)
Local ads						
Basic ingredients	0.0004	0.0151	0.0005	0.0034	-0.0039	-0.0156
	(0.0004)	(0.0021)	(0.0008)	(0.0040)	(0.0021)	(0.0057)
Complex ingredients	-0.0030	0.0093	-0.0055	-0.0010	-0.0065	0.0067
	(0.0021)	(0.0030)	(0.0040)	(0.0057)	(0.0103)	(0.0109)
Ready to cook	-0.0086	-0.0090	-0.0090	0.0115	-0.0074	0.0226
	(0.0027)	(0.0040)	(0.0051)	(0.0077)	(0.0132)	(0.0149)
Ready to eat	0.0047	-0.0019	-0.0000	-0.0060	-0.0100	0.0132
	(0.0010)	(0.0030)	(0.0020)	(0.0058)	(0.0051)	(0.0089)
Fast food	0.0050	-0.0070	0.0054	-0.0134	0.0136	-0.0036
	(0.0016)	(0.0024)	(0.0031)	(0.0046)	(0.0075)	(0.0083)
Sit down	-0.0105	0.0032	0.0013	0.0071	0.0188	-0.0212
	(0.0017)	(0.0024)	(0.0032)	(0.0063)	(0.0085)	(0.0060)
National ads						
Basic ingredients	0.0226	-0.0001	0.0017	0.0007	0.0072	-0.0320
	(0.0081)	(0.0003)	(0.0013)	(0.0008)	(0.0038)	(0.0094)
Complex ingredients	-0.0214	0.0004	0.0001	-0.0005	0.0156	0.0058
	(0.0054)	(0.0013)	(0.0018)	(0.0038)	(0.0055)	(0.0106)
Ready to cook	-0.0235	-0.0024	0.0012	-0.0047	0.0146	0.0148
	(0.0124)	(0.0016)	(0.0024)	(0.0049)	(0.0074)	(0.0149)
Ready to eat	-0.0373	-0.0001	-0.0032	0.0054	-0.0162	0.0513
	(0.0098)	(0.0006)	(0.0018)	(0.0019)	(0.0056)	(0.0120)
Fast food	0.1050	-0.0005	-0.0023	-0.0024	-0.0252	-0.0748
	(0.0259)	(0.0010)	(0.0015)	(0.0029)	(0.0045)	(0.0274)
Sit down	0.0005	-0.0010	0.0024	-0.0063	0.0020	0.0014
	(0.0008)	(0.0010)	(0.0023)	(0.0031)	(0.0013)	(0.0043)

Table 1a. Parameter Estimates for Almost Ideal Demand System (cont.)

Demographics and time						
Hours worked	-0.0146	-0.0526	0.0115	0.0167	0.0390	0.0001
	(0.0102)	(0.0147)	(0.0195)	(0.0150)	(0.0119)	(0.0259)
Age	0.0104	0.0046	-0.0124	-0.0112	0.0024	0.0063
	(0.0082)	(0.0139)	(0.0174)	(0.0098)	(0.0053)	(0.0190)
Family size	0.0006	-0.0009	0.0095	0.0030	-0.0090	-0.0031
	(0.0029)	(0.0024)	(0.0036)	(0.0046)	(0.0047)	(0.0065)
Number of earners	-0.0137	-0.0002	0.0002	0.0235	-0.0409	0.0311
	(0.0106)	(0.0011)	(0.0006)	(0.0253)	(0.0430)	(0.0503)
Number <18 years old	0.0267	-0.0428	-0.0119	0.0019	-0.0082	0.0343
	(0.0536)	(0.0301)	(0.0163)	(0.0090)	(0.0075)	(0.0328)
Number >64 years old	0.0342	0.0079	-0.0195	-0.0540	0.0012	0.0302
	(0.0111)	(0.0143)	(0.0145)	(0.0325)	(0.0034)	(0.0381)
No high school diploma (%)	-0.0014	-0.0018	-0.0516	0.0146	-0.0312	0.0715
	(0.0018)	(0.0137)	(0.0233)	(0.0291)	(0.0163)	(0.0353)
High school diploma (%)	-0.0064	0.0035	-0.0001	0.0103	0.0068	-0.0141
	(0.0088)	(0.0049)	(0.0040)	(0.0060)	(0.0077)	(0.0132)
Female household heads (%)	-0.0085	-0.0175	-0.0015	0.0000	-0.0004	0.0278
	(0.0078)	(0.0177)	(0.0019)	(0.0010)	(0.0261)	(0.0334)
Married (%)	-0.0543	-0.0101	-0.0598	-0.0090	-0.0037	0.1369
	(0.0444)	(0.0553)	(0.0310)	(0.0168)	(0.0093)	(0.0516)
White (%)	0.0023	0.0167	0.0214	-0.0086	0.0085	-0.0403
	(0.0077)	(0.0115)	(0.0147)	(0.0150)	(0.0335)	(0.0359)
Black (%)	0.0030	-0.0014	0.0069	0.4117	-0.1992	-0.2210
	(0.0035)	(0.0019)	(0.0683)	(0.1157)	(0.1438)	(0.2049)
Asian(%)	0.1281	0.0857	-0.0192	-0.0156	-0.0207	-0.1583
	(0.0807)	(0.0438)	(0.0243)	(0.0202)	(0.0300)	(0.1193)
Expenditure	-0.0042	-0.0105	-0.0057	-0.0012	0.0061	0.0155
	(0.0008)	(0.0021)	(0.0013)	(0.0021)	(0.0035)	(0.0054)
Trend	-0.0430	0.0397	-0.1241	-0.0096	-0.0064	0.1434
	(0.0384)	(0.0390)	(0.0859)	(0.0092)	(0.0050)	(0.1046)
Constant	-0.1255	-0.1557	0.0565	0.4783	-1.1451	1.8914
	(0.0834)	(0.2536)	(0.1394)	(0.2604)	(0.6506)	(0.5191)

Standard errors in parentheses.