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U.S. Households' Demand for Convenience Foods

Abigail M. Okrent and Aylin Kumcu

United States Department of Agriculture

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Abstract

Over the past four decades, demand for foods that save households time in meal preparation and cleanup (i.e., "convenience foods") has grown in the United States. This has implications for dietary quality and health. But little is known about the drivers behind the growth in demand for such foods. One driver might be that Americans are purchasing more processed foods because of those foods' declining market prices relative to their less processed counterparts. Another driver might be that the most advertised foods are those that are the most convenient or that American households have little time for meal preparation because of labor-market participation. How declining incomes affect the demand for convenience may also be a driver. Between 1999 and 2010, changes in prices and total food expenditure drove most food-purchasing patterns. Meals and snacks at fast-food restaurants were also responsive to changes in advertising expenditures, while hours worked had little effect on demand for any foods.

Keywords: convenience food, processed, food expenditure, meal preparation, fast food, snack, advertising, demand

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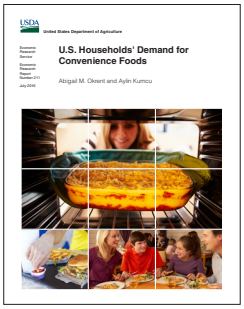

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U.S. Households' Demand for Convenience Foods

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What Is the Issue?

Americans have increased consumption of foods that save time in food preparation. Some observers blame increases in obesity on this consumption because "convenience" foods are generally less healthful and contain more calories than foods prepared from scratch at home. Several mechanisms may have influenced Americans' purchases of convenience foods and the resulting nutritional outcomes. First, Americans may be constrained by labor-force participation and have less time to spend on preparing food. Second, prices of many convenience foods may have fallen relative to their less convenient counterparts. Third, income changes may affect the degree of convenience demanded by households. Lastly, advertising, which is notably more visible for the most convenient foods, may stimulate demand for convenience foods. Understanding the mechanisms that drive demand for convenience foods may prove useful in informing policymakers' decisions about effective ways to address concerns about Americans' diets and health.

What Did the Study Find?

Demand for the six food groups, regardless of their level of convenience to the household, is largely determined by price and income-led changes in total food expenditures, although advertising played a role in demand for fast-food meals and snacks. Using 1999-2010 data, foods were categorized into six groups based on the amount of time the food saved households in meal preparation, or convenience. In ascending order of convenience, these foods include (1) basic ingredients, which are minimally processed and usually composed of one commodity; (2) complex ingredients, which are processed ingredients and usually contain more than one farm commodity; (3) ready-to-cook (RTC) meals and snacks, requiring water and/or heat before consuming; (4) ready-to-eat (RTE) meals and snacks, requiring no preparation; (5) meals and snacks purchased at fast-food restaurants; and (6) meals and snacks purchased at sit-down restaurants.

The least convenient foods, basic and complex ingredients, constituted less than a quarter of the average household food budget. The share of the average household food budget spent on basic ingredients was relatively flat between 1998 and 2010 across all geographic regions, whereas the portion spent on complex ingredients generally declined across these regions prior to the most recent economic downturn (December 2007 to June 2009) and increased during and after it.

Products that offered a greater degree of convenience than basic and complex ingredients, like RTC and RTE meals and snacks, constituted 26 percent of the average household food budget between 1999 and 2010. The portion of the average household food budget spent on RTE meals and snacks began to climb in 2007 across all geographic regions, while the share of the budget spent on RTC meals and snacks was relatively constant.

The most convenient foods—purchased from fast-food and sit-down restaurants—constitute around half of the total food budget. Between 1999 and 2010, the average share of the food budget spent on fast-food meals and snacks grew from 24 to 27 percent, with decreases in this share beginning just before the most recent economic downturn, starting in 2007 across most geographic regions. During this overall period, the average share of the budget spent on sit-down meals and snacks decreased from 25 to 23 percent, led by declines in this share starting around 2004 and 2005 across all geographic areas.

Demand for the six food categories, as noted earlier, is largely determined by price and income-led changes in total food expenditures. Among the findings on the demand drivers:

- Changes in prices explain much of the changes in purchasing patterns between 1999 and 2010 for basic and complex ingredients and RTC and RTE meals and snacks. The average quarterly decline in basic ingredients and RTE meals and snacks is largely driven by changes in their prices, whereas the average quarterly growth in RTC meals and snacks is driven by changes in prices of substitutes, particularly complex ingredients and RTE meals and snacks.

- Spending on meals and snacks purchased at fast-food restaurants are not as responsive to changes in prices as spending on food purchased from retail stores, but are five to six times more responsive to changes in income-led total food expenditures than spending on food from retail stores.

- Advertising is an important determinant of demand for fast foods, such that a 1-percent increase in advertising on fast foods increases demand 0.25 percent. This implies that advertising has been a highly effective tool for the fast-food industry to stimulate demand for its product.

- Even though advertising expenditures on RTE meals and snacks were also relatively substantial between 1999 and 2010, we found it had little effect on this category of food. Likewise, advertising expenditures had little effect on the other foods as well.

- A 1-percent increase in the average number of hours worked by household heads decreases demand for basic ingredients by 0.19 percent; however, average number of hours worked by household heads did not change much between 1999 and 2010, so very little of changes in purchases of basic ingredients is explained by changes in number of hours worked.

- Contrary to past evidence, average hours worked by household heads had very little effect on demand for convenience foods like RTE meals and snacks purchased at fast-food and sit-down restaurants.

How Was the Study Conducted?

Data used in the analysis was compiled from the Consumer Expenditure Survey of the U.S. Bureau of Labor Statistics and the USDA/ERS Quarterly Food-Away-From-Home Prices, as well as the proprietary data sources, to construct a quarterly panel data set of demand-and-supply variables between 1999 and 2010 for four census regions and six types of foods that vary in level of convenience: basic ingredients, complex ingredients, RTC meals and snacks, RTE meals and snacks, fast-food meals and snacks, and sit-down meals and snacks. A vector error correction almost ideal demand system was used to model demand for each food as a function of advertising expenditures, employment hours, total household food expenditures, and market prices.

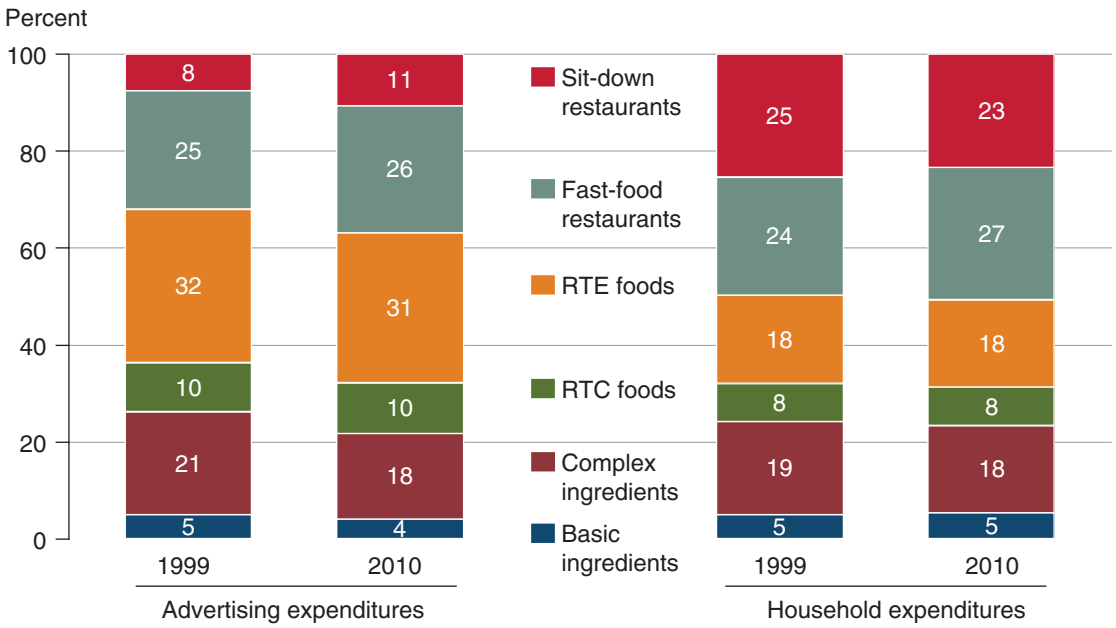
U.S. Households' Demand for Convenience Foods

Introduction

Consumer demand for convenience foods has grown substantially over the past several decades, becoming a staple of a typical American's diet (Kuhn, 2011). Meals and snacks at fast-food and sit-down restaurants constitute nearly half of the U.S. consumer food budget. In 2010, the share of the food budget spent on fast foods had increased almost 13 percent since 1999, while the share spent on sit-down meals and snacks declined by 8 percent over the same period (fig. 1).[1] Food eaten at home also favors foods that save the household time in meal preparation. In 2010, 26 percent of U.S. household expenditures on food and beverages was devoted to "ready to eat" (RTE) and "ready to cook" (RTC) foods, the most convenient types of foods for at-home consumption. Meanwhile, less than a quarter of these expenditures was dedicated to ingredients, both minimally processed (basic ingredients) and processed (complex ingredients).

The term "convenience food" was first coined by Charles Mortimar of General Foods in the 1950s in response to growing demand for foods that were "easy to buy, store, open, prepare, and eat"

Figure 1
Household and advertising expenditures, by food convenience type, 1999 and 2010



Notes: RTC = ready to cook, RTE = ready to eat. See table 1 for definitions of basic and complex ingredients, RTC and RTE foods, and fast-food and sit-down restaurants.
Source: USDA, Economic Research Service calculations based on the Nielsen Homescan, Consumer Expenditure Survey, and Kantar Media.

[1]These estimates are based on proprietary scanner data for food-at-home purchases and on the Consumer Expenditure Survey for food-away-from-home purchases, and differ from those published in the ERS Food Expenditure Series data product by construction. See next section for more details.

(Moss, 2013, p. 56). Since then, "convenience" in foods has been defined several ways by industry analysts and academic researchers. Harrison (1979) defined convenience by the amount of preparation completed by the processor or retailer in food production, such that a convenient food is one that saves time, labor, cost, and skilled handling and reduces the amount of equipment required in preparation. Pepper (1980) suggested categorizing foods by methods of preparation by the consumer (no preparation, mixing, heating, mixing and cooking, and cooking) and noted that methods of preparation often aligned with methods of storage (i.e., ambient storage, heat processing, freezing, chilling, refrigerator chilling, and dehydration). Similarly, Costa et al. (2001) developed a classification that incorporates the level of preparation as well as the shelf life of foods. Park and Capps (1997) argued that, regarding prepared foods, it is time saved that is the heart of the household consumption decision. Many recent changes in food choices and dietary intake have been linked to changes in employment and home production. Hence, convenience in this study is defined along a continuum that increasingly saves the household time in production of meals and snacks—basic ingredients (minimally processed ingredients that are usually composed of one commodity), complex ingredients (processed ingredients and usually contain more than one farm commodity), ready-to-cook (requires water and/or heat before consuming) meals and snacks, ready-to-eat (requires no preparation other than cleanup) meals and snacks, meals and snacks purchased at fast-food restaurants, and meals and snacks purchased at sit-down restaurants.

The increase in consumption of foods that require less time to prepare has received recent attention because these foods are associated with being less healthful. First, the growth in consumption of restaurant foods has been blamed for Americans' poor diet quality and increasing body weight. As Americans began to purchase more food away from home (FAFH), they also increased their away-from-home share of caloric intake from 17.7 percent in 1977-78 to 31.6 percent in 2005-08, mainly from sit-down and fast-food restaurants (Lin and Guthrie, 2012). One additional meal eaten away from home increased daily intake by about 134 calories and lowered diet quality by about 2 points on the Healthy Eating Index-2005, enough to shift the average adult's diet quality from a classification of fair to poor (Todd et al., 2010). In addition, increased FAFH consumption resulted in higher intakes of sugar, saturated fat, and sodium as well as lower intakes of fiber and calcium (Nguyen and Powell, 2014; Lin and Guthrie, 2012). The poor diet quality of FAFH products may also be linked to increased obesity in the United States (Currie et al., 2010; Chen et al., 2013).

Second, recent studies have also found a positive association between time spent preparing food at home (FAH) and diet quality. Between 2003 and 2011, women and men spent 48 and 18 minutes, respectively, in meal preparation, whereas in the 1920s, married women in the rural United States spent an average of 122 minutes cooking and an additional 68 minutes in meal clearing and cleanup on an average day (Hamrick and Okrent, 2014). In addition, Mancino and Newman (2007) found that nonworking women spend about 70 minutes per day preparing food, whereas women who work part time spend around 50 minutes preparing food, and women working full time spend about 40 minutes preparing food. One of the most commonly reported barriers to meal preparation is lack of time, which is related to the positive association between fast-food consumption and perceived convenience of fast foods (Larson et al., 2006; Larson et al., 2009; Chu et al., 2012; Glanz et al., 1998; Rydell et al., 2008; Dave et al., 2009). As households substituted meal preparation time for purchased labor-saving convenience foods, diet quality declined and obesity increased (Larson et al., 2006; Zick et al., 2011; Pollan, 2013; Warner, 2013; Moss, 2013). In particular, evidence suggests that the increased consumption of processed foods was the primary driver of increased sodium, fat, and sugar for many developed countries (Monteiro, 2009; Webster et al., 2010; Monteiro et al., 2011; Moubarac et al., 2012; Stuckler et al., 2012; Moodie et al., 2013). The *Dietary Guidelines for*

Americans, 2010 recommends decreasing consumption of added sugar, saturated fats, and sodium, and many processed foods are the primary source of these components.

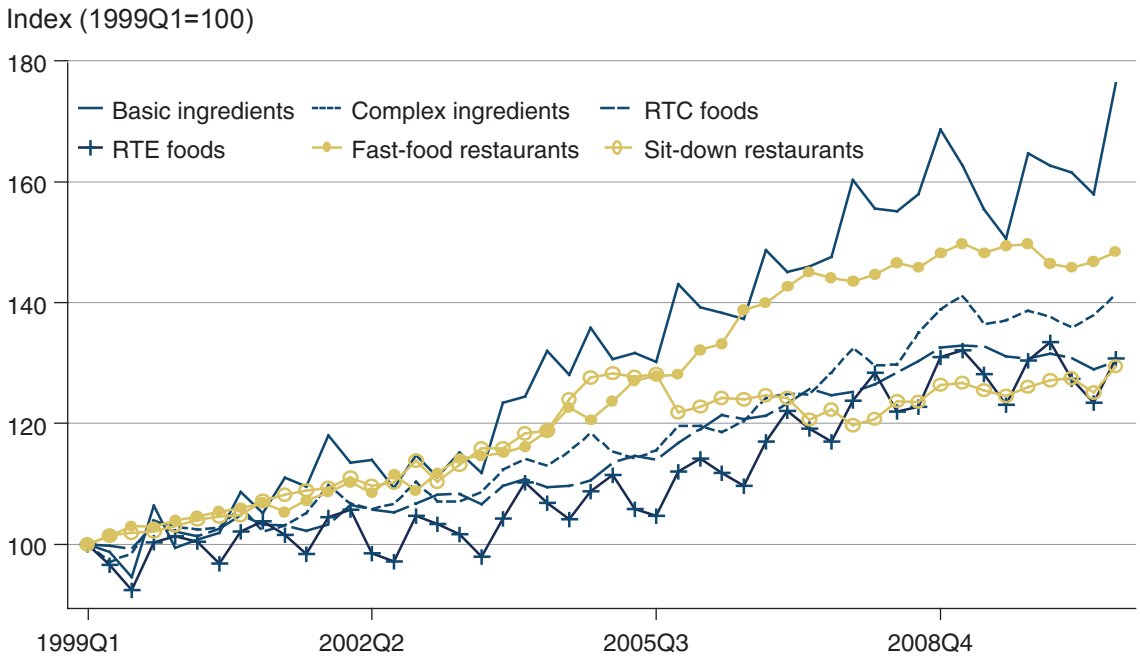
The relationship between substitution of meal preparation and consumption of convenience foods and overall healthfulness of purchases becomes even more apparent during economic downturns, as previous research shows that body weight is inversely related to economic conditions. Ruhm (2000, 2005) argued that declining work hours during a weakening economy may provide one reason why individuals engage in healthier behavior, possibly due to the increased nonmarket time available for lifestyle investments. During the most recent economic recession (December 2007–June 2009), Americans increased meal preparation and cleanup time, with 10-11 percent of forgone market work hours reallocated to core home production (cooking, cleaning, and shopping) (Hamrick and Okrent, 2014; Aguiar et al., 2013). During the same period, evidence suggests that Americans purchased more healthful foods for at-home consumption and fewer foods for away-from-home consumption (Kuhns and Volpe, 2014; Todd, 2014). Hence, the change in labor force participation may be related to the recent decline in body weight and, subsequently, the declining rate of obesity among some Americans (Flegal et al., 2012). However, others have found little evidence that the most recent economic downturn has had any impact on healthfulness of consumption (Dave and Kelly, 2012). Some have even argued that the downward trend in the caloric content of food purchases for at-home consumption may be a long-term trend that started before December 2007 (Ng et al., 2014).

It is not just household time constraints that may drive changes in demand for convenience foods. An important determinant of the demand for all food is market price. Over the last decade, the price of basic and complex ingredients grew at a faster rate than RTC and RTE meals and snacks (fig. 2). While price growth of fast foods kept pace with basic ingredients, the growth in the price of meals and snacks at sit-down restaurants began to slow in 2005. This uneven price growth may be symptomatic of supply-side factors that have made processed foods cheaper over time compared to less processed foods. For instance, food manufacturers that produce many more-processed foods have experienced multifactor productivity gains between 0.23 and 0.75 per year, whereas producers of many basic and complex ingredients have had very little or even negative productivity gains (Bureau of Labor Statistics, 2013).[2] In addition, Moss (2013) argues that more-processed foods tend to use ingredients that are cheaper than their less-processed counterparts (sugar, fats and oils, and sodium). In any case, it is likely that the differential price growth between convenience foods and less-convenient counterparts has caused some substitution away from the less-processed FAH products to more-processed FAH products.

In addition to time constraints and market prices as determinants of demand for convenience, some have argued that advertising has played a substantial role in stimulating demand for convenience foods. Advertising expenditures for meals and beverages offered by fast-food and sit-down restaurants are substantial; McDonald's Corporation spent $962.9 million on advertising for its McDonald's brand in 2011—the fourth-largest advertising expenditure on any brand in the United States. That amount was closely followed by Yum Brands (Taco Bell, Pizza Hut, and KFC) with $671.3 million and Darden Restaurants (Olive Garden and Red Lobster) with $330 million

[2]The food-manufacturing industries that produce the most-processed foods are: fruit and vegetable preserving and specialty food manufacturing—frozen dinners, soups, rice mixes, and so on (North American Industry Classification System (NAICS) 3114); other foods—snack foods and refrigerated prepared foods (NAICS 3119); sugar and confectionary products—candy (NAICS 3113); and beverage manufacturing (NAICS 3121). Animal-food manufacturing (NAICS 3111), grain and oilseed milling (NAICS 3112), dairy product manufacturing (NAICS 3115), seafood-product preparation and packaging (NAICS 3117), and bakeries and tortilla manufacturing (NAICS 3118) produce much of the basic and complex ingredients.

Figure 2
Quarterly price indices for food products by convenience type, 1999-2010



Notes: RTE = ready-to-eat meals and snacks, RTC = ready-to-cook meals and snacks.
Source: USDA, Economic Research Service based on ERS' Quarterly Food-Away-From-Home Price series and Nielsen Homescan.

(*Advertising Age*, 2012). Not far down the list of most advertised brands is Campbell ($235.7 million), Coca-Cola ($232.1 million), and Hershey's ($202.3 million) (*Advertising Age*, 2012). None of the top 200 brands advertised in the United States in 2012 are for basic ingredients, and only a few are for complex ingredients. Indeed, inspection of total advertising expenditures on food and beverages by convenience type shows that advertising on RTE food products was the largest share of ad spending in 1999 at 32 percent, and fell slightly in 2010 to 31 percent (see fig. 1). Not far behind advertising was fast foods at 25 percent, which increased slightly in 2010 to 26 percent. Advertising expenditures on basic and complex ingredients was relatively small in comparison, 4 percent and 18 percent in 1999 and 2010, respectively. It has been found that the most heavily advertised foods tend to be the ones overconsumed relative to the *Dietary Guidelines* (Gallo, 1999). In addition, the lopsided promotion of food products that are deemed unhealthy versus healthy, in particular, carbonated beverages, fast foods and breakfast cereals, has long been associated with children's poor dietary intake (Cairns et al., 2009; Federal Trade Commission, 2012). Lastly, some evidence suggests that advertising plays an important role in the growth of demand for convenience foods, in particular fast foods, soda, and candy (Andreyeva et al., 2011; Grossman et al., 2012; Huang and Yang, 2013).

Several studies in the economics literature have analyzed demand for convenience foods, with a particular focus on FAFH products, and how their demand is affected by household time constraints and income (e.g., Prochaska and Schrimper, 1973; Sexauer, 1979; McCracken and Brandt, 1987; Soberon-Ferrer and Dardis, 1991; Yen, 1993; Jensen and Yen, 1996; Byrne et al., 1996; Stewart and Yen, 2004; Stewart et al., 2004), market prices and income (e.g., Jekanowski et al., 2001; Reed et al., 2005; Okrent and Alston, 2011; Richards and Mancino, 2013), or in one case, market prices, time, and income (Huffman, 2011). However, demand for convenience foods extends beyond just FAFH

products, as food manufacturers increasingly offer more convenient types of FAH products sold at retail stores as a means to compete with FAFH products and regain part of the food dollar (Park, 1998; Smith, 2010). Only a handful of studies look at substitition betweeen convenience foods for at-home and away-from-home consumption, and the estimates from these studies are based on data from the 1980s and 1990s (Capps et al., 1985; Nayga, 1996; Park and Capps, 1997).

We extend what has previously been done in the literature by looking at substitution patterns between convenience foods for both at-home and away-from-home expenditures, controlling for the effects of the most recent economic downturn (the Great Recession, December 2007 to June 2009). In addition, to our knowledge, no study has yet to simultaneously investigate the effects of the household time constraints, market prices, and advertising on the demand for convenience foods in the United States.

Knowledge of how market prices, advertising, household time constraints, and income affect consumer food choices may help policymakers design more effective nutrition policies. For example, if demand for foods is responsive to advertising, then a policy that limits expenditure on advertising could be an effective tool in changing consumers' purchasing behavior. Or if working hours are found to affect demand for different types of foods, then policymakers could encourage manufacturers to develop healthy food options that are more convenient. This study addresses whether: (1) the amount of hours worked affect demand for convenience in foods; (2) advertising is an important determinant of food purchasing behavior; and (3) consumers readily substitute between different types of convenience foods.

Data Description

Before discussing construction of the data, it is important to define what is meant by convenience, and how foods are classified by varying levels of convenience. This study uses some salient features of the Park and Capps (1997) convenience classification scheme but adjusts the classification to align better with Americans' current consumption behaviors. Park and Capps (1997) defined three types of foods:

1. "unprepared" (no to little processing other than for preserving, or basic ingredients to other foods);
2. "semi-prepared" (significant effort or culinary skill is required prior to consuming the food other than heating or thawing); and
3. "prepared" (only heating and/or thawing required).

The unprepared, semi-prepared, and prepared food types are then broken into the context in which they were consumed: meal, snack, or a component of a meal. Our food categories are:

1. basic ingredients;
2. complex ingredients;
3. RTC meals and snacks;
4. RTE meals and snacks;
5. fast-food meals and snacks; and
6. sit-down meals and snacks (table 1).

Basic ingredients are 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, fresh meat, poultry, and seafood. This is similar to how Park and Capps (1997) defined "unprepared" foods, but in our classification scheme, these foods are ingredients in a meal or snack. Complex ingredients refers to processed foods used in producing a meal or 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. Complex ingredients are similar to the Park and Capps (1997) "semi-prepared" category, but these foods are rarely eaten alone or as a meal. We break apart the Park and Capps (1997) "prepared" food category into RTC meals and snacks, RTE meals and snacks, fast foods, and sit-down foods. Unlike Park and Capps (1997), we combine meals with snacks because, increasingly, Americans are snacking throughout the day rather than eating three square meals a day (Hamrick and Okrent, 2014). Hence, meals and snacks are more and more interchangeable. The RTC meals and snacks category constitutes foods 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. The RTE meals and snacks category refers to foods 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.

Table 1
Description of data

Variable	Data source	Variable description	Food product description
Basic ingredients			Raw or minimally processed foods used in producing a meal or snack that are generally composed of a single ingredient. Examples: milk, dried beans, rice, grains, butter, cream, fresh meat, fruits, vegetables, poultry, and seafood
Budget share	Nielsen Homescan	Expenditure on basic ingredients divided by total expenditure on food	
Price	Nielsen Homescan	Region-quarter Laspeyres price index using brand-level prices	
Advertising	Ad$pender	National-quarter advertising deflated by advertising index	
Complex ingredients			Processed foods used in producing a meal/snack that generally, though not always, are composed of multiple ingredients. Examples: bread, pasta, sour cream, sauce, canned vegetables, canned beans, pickles, cereal, frozen meat/poultry/seafood, canned meat/poultry/seafood, and lunch meat
Budget share	Nielsen Homescan	Expenditure on complex ingredients divided by total expenditure on food	
Price	Nielsen Homescan	Region-quarter Laspeyres price index using brand-level prices	
Advertising	Ad$pender	National-quarter advertising deflated by advertising index	
RTC meals and snacks			Meals and snacks that require minimal preparation involving heating, cooking, or adding hot water. Examples: frozen entrees, frozen pizzas, dry meal mixes, pudding mixes, soup, chili, and powdered drinks
Budget share	Nielsen Homescan	Expenditure on RTC divided by total expenditure on food	
Price	Nielsen Homescan	Region-quarter Laspeyres price index using brand-level prices	
Advertising	Ad$pender	National-quarter advertising deflated by advertising index	
RTE meals and snacks			Meals and snacks that are intended to be consumed as is and require no preparation beyond opening a container, including refrigerated entrees and sides, canned fruit, yogurt, candy, snacks, liquid drinks, and flavored milk
Budget share	Nielsen Homescan	Expenditure on RTE divided by total expenditure on food and beverage	
Price	Nielsen Homescan	Region-quarter Laspeyres price index using brand-level prices	
Advertising	Ad$pender	National-quarter advertising deflated by advertising index	
Fast-food meals and snacks			Meals and snacks at establishments where customer orders and pays for food at a counter
Budget share	CEX	Expenditure at limited-service restaurants divided by total expenditure on food	
Price	QFAFHPS	Region-quarter Laspeyres price index using average prices for homogenous products at the division level	
Advertising	Ad$pender	National-quarter advertising deflated by advertising index	
Sit-down meals and snacks			Meals and snacks at establishments where customer orders and pays for food from waitstaff
Budget share	CEX	Expenditure at full-service restaurants divided by total expenditure on food	
Price	QFAFHPS	Region-quarter Laspeyres price index using average prices for homogenous products at the division level	
Advertising	Ad$pender	National-quarter advertising deflated by advertising index	
Working hours	CEX	Total weekly hours worked by all wage and salary earners in a household divided by number of wage earners	Hours per week

Notes: RTC = ready to cook, RTE = ready to eat, CEX = Consumer Expenditure Survey, QFAFHPS = Quarterly Food-Away-From-Home Price Series.

Source: USDA, Economic Research Service.

We also include two FAFH products: meals and snacks from fast-food and meals and snacks from sit-down restaurants. We depart from nomenclature of Park and Capps (1997) here because of increased interest in the competition between food-service and grocery-store establishments in providing convenience foods, especially during the most recent economic downturn (Smith, 2010). Fast-food restaurants are those in which the customer orders and pays for food at a counter. Sit-down restaurants are those in which the customer orders food from waitstaff and pays for the food in the restaurant.

Moving down table 1 from basic ingredients to sit-down meals and snacks, convenience increases in terms of saving the homemaker time and energy in meal preparation.[3] Based on this convenience classification scheme, we use publicly available and proprietary data to construct price indexes, expenditure shares, advertising expenditures, and employment hours for each quarter and census region in the United States between 1999 and 2010.

Budget shares. Average quarterly household budget shares are calculated using two data sets: the Consumer Expenditure Survey (CEX) and the Nielsen Homescan panel.[4,5] Average household expenditures on basic ingredients, complex ingredients, RTC meals and snacks, and RTE meals are calculated using the sample-weighted Nielsen Homescan data while average household expenditures on fast-food and sit-down meals and snacks are calculated using the sample-weighted CEX.[6] 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.

Household food spending by convenience categories varied substantially across regions and over time. Households in all regions allocated the largest budget shares to meals and snacks purchased at fast-food and sit-down restaurants on average between 1999 and 2010. Households in the Northeast allocated more to sit-down meals and snacks than households in other regions (29 percent) but less to fast-food meals and snacks than others (24 percent). Households spent about the same on RTE

[3]This classification scheme may not save the homemaker time in terms of consuming the food because the average time spent at sit-down restaurants is 70 minutes per day versus 12 minutes per day at fast-food restaurants, which includes waiting time for the food to be prepared (Hamrick and Okrent, 2014). However, our convenience classification is only concerned with meal preparation time, which includes shopping for ingredients; washing, peeling, and combining ingredients into a meal or snack; cooking or baking the meal or snack; serving the meal or snack; and cleanup. Hence, for meals and snacks served at sit-down restaurants, the homemaker does not spend time in any of these activities other than travel to the restaurant.

[4]The Nielsen Homescan data contain price and expenditure data on universal product code (UPC)-coded purchases of 40,000 to 60,000 households per year in the United States. Nielsen recruits and continuously maintains its panel using population and demographic targets to balance the raw sample. Nielsen then uses demographic data from each household for calculation of poststratification sample weights, which are used to project the sample to be representative of the overall U.S. population. 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 et al., 2007).

[5]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 2-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.

[6]Total expenditure estimates of FAH and its constituent parts based on the weighted Nielsen Homescan sample are generally found to be less than the weighted CEX largely because of underreporting of random-weight products in the sample. Hence, the budget-share distributions for FAH products are smaller in magnitude than those reported for FAH in the CEX. However, over time, the trends in total expenditures on FAH and categories within FAH based on the Nielsen Homescan mimic those based on the CEX (Muth et al., 2007). Since this study explains the variation rather than the magnitude of the budget shares over time, this discrepancy should not affect the findings of the analysis.

meals and snacks and complex ingredients (17-18 percent). Across census regions, they spent the least on RTC meals and snacks (7-8 percent) and basic ingredients (5 percent) (table 2).

To better highlight the trends in the budget shares over time, we show the 4-month moving average of share of food expenditures in each census region over time in figure 3, where the graphs are

Table 2
Summary statistics

	Northeast		Midwest		South		West	
Budget shares								
Basic ingredients	0.05	(0.00)	0.05	(0.00)	0.05	(0.00)	0.05	(0.00)
Complex ingredients	0.17	(0.01)	0.18	(0.01)	0.18	(0.01)	0.17	(0.01)
RTC meals and snacks	0.07	(0.01)	0.08	(0.01)	0.08	(0.00)	0.08	(0.01)
RTE meals and snacks	0.18	(0.01)	0.18	(0.01)	0.18	(0.01)	0.17	(0.01)
Fast-food meals and snacks	0.29	(0.03)	0.25	(0.02)	0.26	(0.03)	0.27	(0.03)
Sit-down meals and snacks	0.24	(0.02)	0.24	(0.02)	0.25	(0.01)	0.25	(0.02)
Price index (1999Q1=100)								
Basic ingredients	133.46	(22.91)	138.90	(24.87)	124.11	(20.55)	134.61	(25.24)
Complex ingredients	119.70	(15.31)	117.62	(13.80)	115.57	(13.34)	120.26	(12.25)
RTC meals and snacks	117.23	(12.34)	114.45	(11.43)	115.08	(11.95)	114.68	(10.19)
RTE meals and snacks	113.20	(13.05)	112.39	(11.99)	108.44	(11.38)	113.26	(11.25)
Fast-food meals and snacks	129.67	(18.74)	118.85	(13.39)	125.50	(19.30)	129.84	(23.06)
Sit-down meals and snacks	120.40	(12.37)	125.28	(15.97)	116.62	(8.06)	111.51	(6.29)
Advertising expenditures (million $)								
Basic ingredients	113.37	(37.29)	113.37	(37.29)	113.37	(37.29)	113.37	(37.29)
Complex ingredients	493.07	(149.51)	493.07	(149.51)	493.07	(149.51)	493.07	(149.51)
RTC meals and snacks	284.28	(114.83)	284.28	(114.83)	284.28	(114.83)	284.28	(114.83)
RTE meals and snacks	900.44	(268.27)	900.44	(268.27)	900.44	(268.27)	900.44	(268.27)
Fast-food meals and snacks	451.32	(60.08)	451.32	(60.08)	451.32	(60.08)	451.32	(60.08)
Sit-down meals and snacks	142.93	(52.13)	142.93	(52.13)	142.93	(52.13)	142.93	(52.13)
Employment (hours per week per household head)								
	30.94	(0.89)	32.27	(0.99)	32.46	(0.84)	32.72	(1.16)
Total food expenditure (household expenditure per quarter), $								
	1,013.48	(110.27)	933.64	(72.62)	940.12	(108.45)	1,038.38	(126.08)

Notes: RTC = ready to cook, RTE = ready to eat. Standard errors are in parentheses.

Source: USDA, Economic Research Service calculations based on Nielsen Homescan, Quarterly Food-Away-From-Home Price Series, Consumer Expenditure Survey, and Ad$pender (see table 1 for more details).

grouped into three panels according to scale. We also highlight recessions as defined by the National Bureau of Economic Research (NBER) (NBER, 2014). Just before the recession that started in late 2007, the share of the total food budget purchased at fast-food restaurants decreased in all regions except for the Northeast. The share peaked in 2007 at around 0.31 in the South and West and 0.28 in the Midwest, respectively, then fell thereafter to around 0.23 in the Midwest and 0.26 in the South and 0.28. A downturn in the share of the budget spent on sit-down meals and snacks occurred as well, although this trend seems to have started earlier (around 2004 and 2005). Conversely, an uptick occurs in the share of the budget spent on complex ingredients and RTE meals and snacks at the same time as the share of the food budget spent on FAFH declines. The share of the food budget spent on basic ingredients is relatively flat across regions.

Price indexes. Price indexes for the foods are constructed using a fixed-weight Laspeyres price index formula. A fixed-weight formula is used because the quantity weights for the FAFH categories are based on the 2007 Economic Census. Hence, the base period for all price index calculations is 2007. In table 2, all price indexes are rebased to 1999 quarter 1.

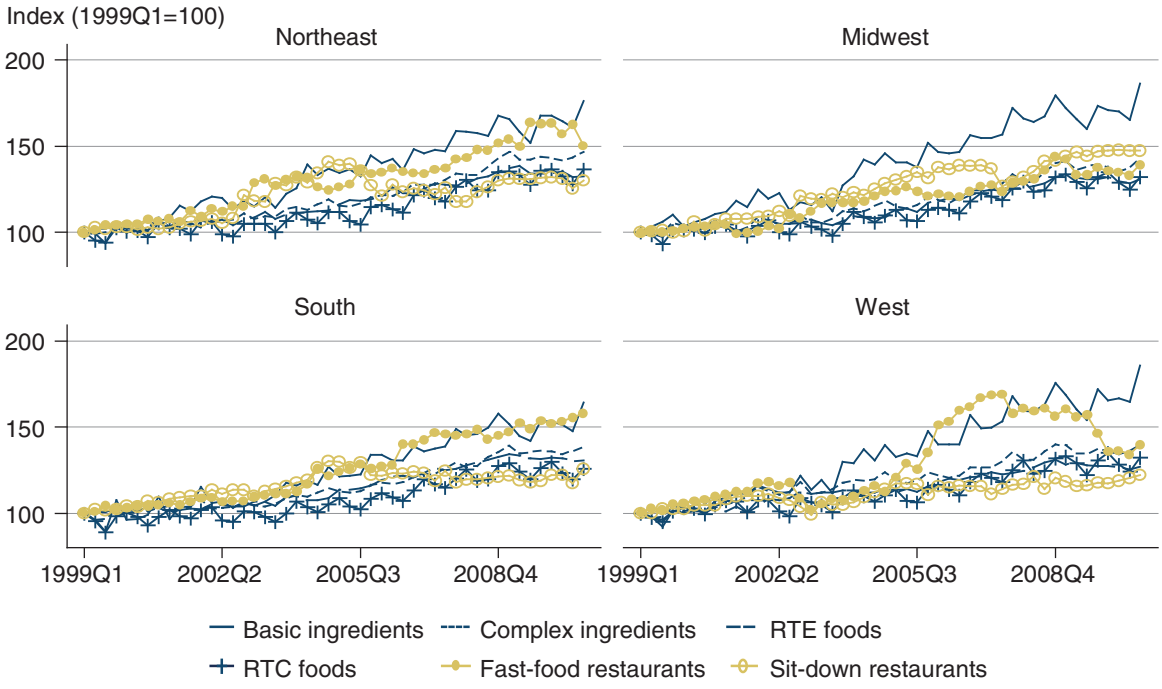
The price indexes for each FAFH category are estimated using the Quarterly Food-Away-From-Home Prices data (Kumcu and Okrent, 2014). The QFAFHP data provide average quarterly prices without tax for meals and snacks at fast-food and sit-down restaurants for each census division and quarter between 1999 and 2012. Instead of quantity weights, we use expenditure weights for each census division based on total sales for meals and beverages for on-premise consumption for full- and limited-service restaurants collected in the 2007 Economic Census.

We estimate price indexes for each FAH category using the Nielsen Homescan data, which provides UPC-level prices and expenditures (see footnote 5 for more details). To use the UPC-coded price data, we first identify and delete outlier prices at the household level that are 1.5 times above or below the interquartile range (i.e., the difference between the third and first quartiles of the data) for food category, year, and quarter. Zero prices are eliminated that were not associated with coupon usage, and simple average prices and summed quantities for each brand of food purchased within a food category by household, region, year, and quarter are calculated. Using the Nielsen poststratification sample weights, we estimate the quantity and average price for each brand purchased in each region and time period and used those values in the Laspeyres price index formula.

Price growth was generally highest in the Midwest on average between 1999 and 2010, though this varied by convenience-food category (see table 2). For example, the Midwest had the highest price growth in meals and snacks at sit-down restaurants (average price index of 132), while the South had the highest growth in basic ingredients (average price index of 182.5). Over time, prices of basic ingredients grew at a faster rate for all the regions except in the South, and in some time quarters in the West (fig. 4). Hence, a potential cause of increased purchases of more convenient foods may be price-induced substitution out of basic ingredients into more convenient counterparts.

Working Hours. Average hours worked by household heads based on the CEX is the variable to capture the household time constraints. The logic here is that the more hours worked by the household heads, the less time available to prepare food and the greater demand for convenience-type foods. In the absence of a full household production model, the hours-worked variable serves as a proxy for time constraints faced by the household, which is a common way to deal with this in food-demand studies (Davis, 2014). Female labor-force participation and average wage of house-

Figure 3
Variation in prices for food by convenience type and region, 1999-2010



Note: RTE = ready to eat, RTC = ready to cook.
Source: USDA, Economic Research Service based on ERS' Quarterly Food-Away-From-Home Price Series and Nielsen Homescan.

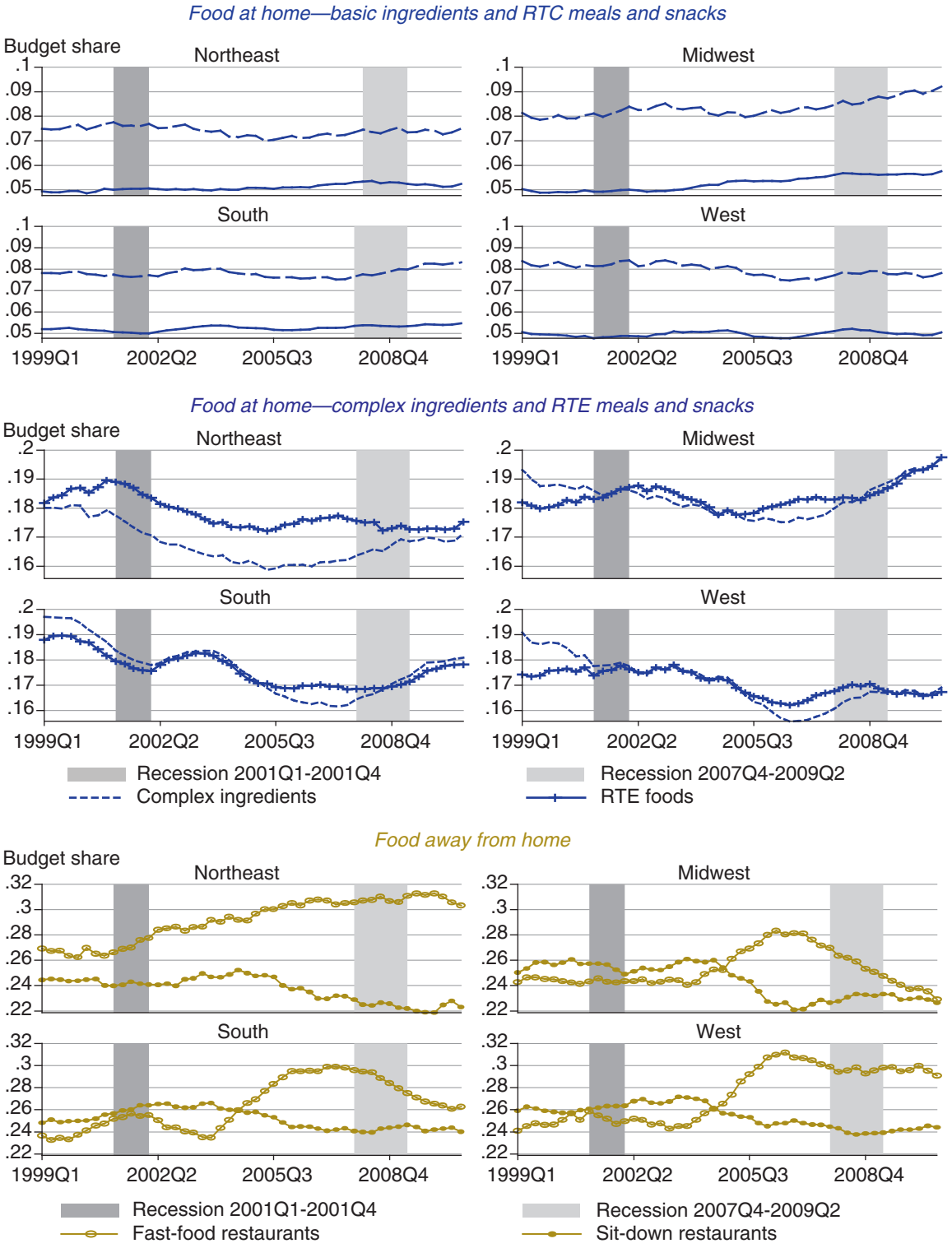
hold heads were also used to proxy for household time constraints but did not yield substantial differences in the estimates.

Advertising expenditures. Kantar Media produces a database called Ad$pender that contains nominal expenditures on advertising for 18 media outlets, including print, radio, television, Internet, and billboard advertising, for thousands of branded products. Data on advertising expenditures at the regional level are only available for local magazine, local radio, national spot radio, local newspaper, outdoor, spot television, Internet display, and Hispanic newspapers. Advertising expenditures at the national level are only available on business-to-business magazines, cable TV, Hispanic magazines, magazines, national newspaper, network radio, network TV, satellite TV, Sunday magazines, and syndication. Since the majority of advertising expenditure data are on media outlets that are only available at the national level, advertising expenditures in this analysis are at the national level.[7]

[7]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 were split evenly between the food categories in that period and region. For example, Coca-Cola and theme parks were sometimes advertised together. An advertising expenditure for this combination was split evenly between the RTE meals and snacks and nonfood.

Figure 4

Four-month moving average of budget shares for food by convenience type and census region, 1999-2010

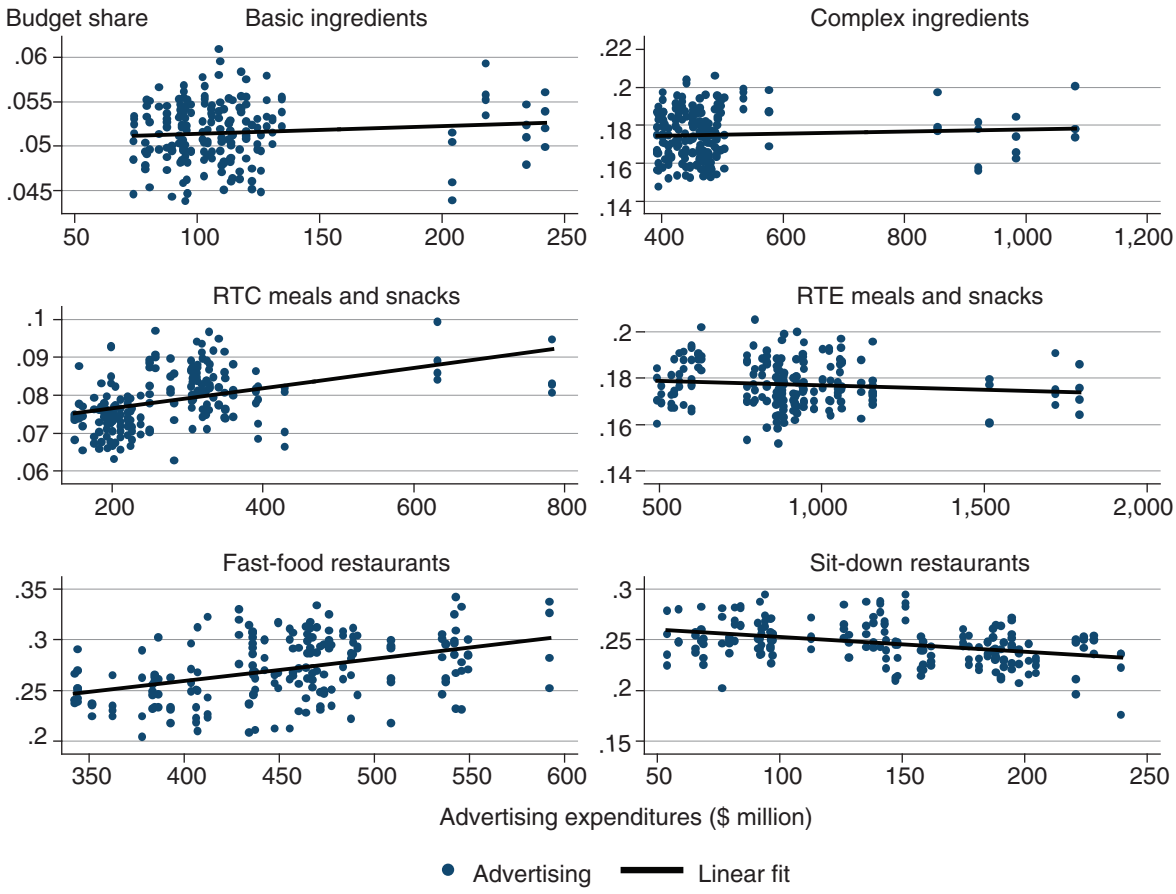


Notes: RTE = ready to eat, RTC = ready to cook. The 4-month moving average includes four lags and leads of each budget share and its current value, each of which are given equal weight.
Source: USDA, Economic Research Service based on ERS' Quarterly Food-Away-From-Home Price Series and Nielsen Homescan.

We deflate the advertising expenditure variables with a Laspeyres index of producer price indexes for cable and television broadcasting and newspaper and magazine publishers (Bureau of Labor Statistics, 2013).[8] This produces a quantity index for advertising.

Some interesting relationships emerge between advertising and the budget-share data (fig. 5). There appears to be a strong positive correlation between advertising and the share of the food budget spent on fast foods and RTC foods. However, the relationship appears to be negative for sit-down foods. The question arises as to whether these relationships will still be apparent after we control for prices, hours worked, and the recession.

Figure 5
Correlation between budget shares and advertising expenditures



Notes: RTE = ready to eat, RTC = ready to cook.
Source: USDA, Economic Research Service based on U.S. Bureau of Labor Statistics, Consumer Expenditure Survey, and Nielsen Homescan (for budget shares) and Kantar Ad$pender (for advertising expenditures).

[8]The producer price indexes (PPIs) for the North American Industry Classification System (NAICS) industries 515 (broadcasting), 51111 (newspaper publishing) and 51112 (periodical publishing) were prices received by these industries primarily for advertising activities. We used advertising revenues generated by the three NAICS industries from the 2007 Economic Census as weights in the Laspeyres index formula. The PPI for NAICS 515 is only available from 2003, so to obtain the PPI for 1999-2002 for NAICS 515, we extrapolated backwards the 2003 PPI value for NAICS 515 using the average rate of change for Standard Industry Classification (SIC) industries 4832 (radio broadcasting) and 484 (cable broadcasting).

Empirical Methods

The almost ideal demand system is used to model demand for the *N* foods (Deaton and Muellbauer, 1980). Thus, the budget share for the *I*th food category in region *r* at time *t* is

$$(1) \qquad w_{I,r,t} = \alpha_I + \sum_{J=1}^{N} \gamma_{I,J} \ln P_{J,r,t} + \beta_I \ln(M_{r,t} / P^*_{r,t}),$$

and $\ln P^*_{r,t}$ is Stone's price index defined by

$$(2) \qquad \ln P^*_{r,t} = \sum_{J=1}^{N} w_{J,r,t} \ln P_{J,r,t} .$$

In equations (1) and (2) $P_{J,\,r,\,t}$ denotes the price index of food category *J* in region *r* at time *t*, and *M* is total household expenditures on food. Using translation (Pollak and Wales 1981), we introduced the effects of *N* advertising variables, *ADS*, household hours worked, *HOURS*, and indicators for region (*R*), season (*Q*) and the most recent economic downturn (*RECESS*) as defined by NBER into (3) through augmented share equation intercepts, α_I:

$$(3) \qquad \alpha_I = \alpha^*_I + \sum_{J=1}^{N} a_{I,J} \ln ADS_{J,r,t} + \kappa_I \ln HOURS_{r,t} + \sum_{j=1}^{3} r_I R_{jr} + \sum_{j=1}^{3} q_I Q_{jt} + \phi_I RECESS_t .$$

The regional dummies capture hetereogeniety across the panels that are fixed over time and that are unaccounted for by the other variables. Seasonality is assumed to be deterministic and is picked up by the quarterly dummies. We also controlled for most recent the NBER-defined recession by including a recession dummy that is equal to one between quarter 4 of 2007 and quarter 2 of 2009, and zero otherwise.[9]

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

$$(4) \qquad \sum_I \alpha^*_I = 1, \sum_I \beta_I = \sum_I a_{I,J} = \sum_I \kappa_I = \sum_I \gamma_{I,J} = 0,$$

$$(5) \qquad \sum_J \gamma_{I,J} = 0, \forall j, \text{ and}$$

$$(6) \qquad \gamma_{I,J} = \gamma_{I,J}, \forall i, j.$$

For the model given by equations (1), (2), and (3), the elasticities of demand are

$$(7) \qquad \eta_{I,M} = 1 + \frac{\beta_I}{w_I}, \qquad \text{(Expenditure elasticity)}$$

$$(8) \qquad \eta_{I,P_J} = -\delta_{I,J} + \frac{\gamma_{I,J}}{w_I} + w_J, \qquad \text{(Compensated price elasticity)}$$

$$(9) \qquad \eta_{I,ADS_J} = \frac{a_{I,J}}{w_I}, \qquad \text{(Advertising elasticity)}$$

[9]We also included a dummy variable for the recession between the first and fourth quarters of 2001 but did not find this had a statistically significant effect on the budget share allocation (table 4).

(10) $\eta_{I,HOURS} = \frac{\kappa_I}{w_I}$, (Hours-worked elasticity)

where $\delta_{I,J}$ is Kroneker delta. This model just described is sometimes referred to as the static almost ideal demand system, and it shows the longrun relationship between the allocation of the food budget and prices, total expenditure, hours worked, advertising, and the indicator variables.

A concern with using the panel data described in the previous section with the static almost ideal demand system is nonstationarity of the variables, which may cause invalid estimates. Nonstationarity may lead to variables that are economically unrelated having a statically significant relationship (i.e., spurious regression of Granger and Newbold, 1974). The variables are tested for nonstationary using two tests of the null hypothesis that all panels are nonstationary versus some panels are stationary (table 3). The first panel test assumes that heterogeneity but independence across the panels, while the second test relaxes the assumption of independence across panels (Im et al., 2003; Pesaran, 2007).[10] The augmented Dickey-Fuller test tests for stationarity of the advertising variables because they are at the national rather than regional level. All test statistics include four lags and no trend. Using the first panel test, the FAFH prices are nonstationary, while the second panel test finds overwhelming evidence of nonstationarity among all the price and budget share variables. The Dickey-Fuller test finds nonstationarity in the RTE, RTC, and sit-down advertising variables. First-differencing the data makes most of the variables stationary. With nonstationarity in mind, we next test the exogeneity of the right-hand side variables.

Table 3
Univariate tests of stationarity of data

	Budget shares				Prices				Advertising	
	IPS		Pesaran's CADF		IPS		Pesaran's CADF		Augmented Dickey-Fuller	
Foods	Levels	First difference	Levels	First difference	Levels	First difference	Levels	First difference	Levels	First difference
Basic ingredients	-4.99	-10.55	-2.18	-4.17	-5.05	-10.50	-2.85	-4.14	-3.60	-3.40
Complex ingredients	-4.83	-10.49	-1.58	-3.75	-2.87	-8.37	-2.65	-3.40	-2.32	-4.38
RTC meals and snacks	-4.81	-10.56	-0.87	-3.74	-4.20	-10.12	-2.44	-3.73	-1.53	-2.48
RTE meals and snacks	-4.89	-10.92	-1.74	-3.28	-5.83	-13.07	-3.16	-4.10	-1.57	-2.95
Fast-food meals and snacks	-5.83	-12.94	-1.73	-3.91	-1.87	-6.97	-2.68	-3.13	-3.76	-3.77
Sit-down meals and snacks	-5.80	-10.01	-2.95	-3.47	-1.93	-9.64	-2.34	-2.71	-1.44	-1.48

Notes: RTC = ready to cook, RTE = ready to eat. Critical value for Pesaran's covariate augmented Dickey-Fuller (CADF) test (2007) and Im-Pesaran-Shin (IPS) test (2003) are -2.2 and -2.6, respectively. Critical values for the augmented Dickey-Fuller test for 4 lags is -1.91. IPS, CADF and augmented Dickey-Fuller tests do not include trend terms and include 4 lags.

Source: USDA, Economic Research Service calculations.

[10]We performed both tests varying the lag length and including and excluding a trend, which had no appreciable effect on the conclusion of this analysis.

In the static almost ideal demand system, prices, advertising, working hours, and total food expenditures are assumed to be exogenous. Price rigidities in the presence of shocks, including menu costs, price contracts, and imperfect competition, lend some credence to the treatment of prices as exogenous (Duffy, 2003). Similarly, advertising may also be treated as exogenous in that advertising on food is a small percentage of total advertising in the United States, making the supply of advertising services perfectly elastic (Kinnucan et al., 2001). However, both prices and advertising may also be simultaneously determined by both supply and demand decisions by companies and consumers, respectively.

Exogeneity of the prices, advertising, and total food-expenditure variables are tested by applying the Hausman specification test on the static almost ideal demand system with first-differenced data to account for nonstationarity of the data. It was difficult to identify a good set of instruments for advertising, so higher order moments and lags of advertising are used as instruments (Lewbel, 1997). For prices, we used instruments that are correlated with supply of the foods but not their demand, including measures of input prices (e.g., producer price indexes for farm commodities and manufactured food products, wages in fast-food and sit-down restaurants), and labor and multifactor productivity measures for foodservice and manufacturing, respectively. To instrument for the total food-expenditure variable, regional total per-capita income and lags of per-capita income (see appendix for more details on instruments) are used. We could not reject the null hypothesis that the estimates treating the prices, advertising, and total food expenditure as exogenous are consistent and maintain exogeneity of prices and advertising (table 4).

Table 4
Hausman and Wald tests

	Test statistic	p-value
Wald tests for joint significance of control variables		
Region	67.76	[0.00]
Season	241.84	[0.00]
Recession 2007Q4-2009Q2	20.31	[0.00]
Recession 2001Q1-2001Q4	5.61	[0.35]
Hausman specification test		
Prices only	6.70	[0.99]
Advertising only	6.43	[0.99]
Total expenditure only	0.23	[1.00]
Prices, advertising, and total expenditure	16.86	[0.72]

Notes: The Hausman test is based on iterative 3-stage least squares of the first-differenced almost ideal demand system with input prices and productivity measures as instruments for prices, higher order moments, and lags of advertising as instruments for advertising and income per capita, and lags of total expenditure as instruments for total expenditure. See appendix table 1 for more details.

Source: USDA, Economic Research Service calculations based on vector error correction almost ideal demand system described in equations in the Empirical Methods chapter.

While first-differencing takes care of the nonstationarity of the variables, it may be that a linear combination of the nonstationary variables is stationary, which is called cointegration (Engle and Granger, 1987).[11] Intuitively, variables in a set are cointegrated if they follow the same longrun path (even though the individual variables appear to go their separate ways), and deviations in the set of variables from this path will ultimately return back to the longrun relationship. If cointegration is detected, then the system of equations in (3)-(5) should be set up in a vector error correction model (VECM) that models this longrun relationship between the variables.

There are several methods for testing for cointegration of panel data (e.g., Westerlund, 2007; Pedroni, 1999) but, unfortunately, the critical values for these tests have only been developed for a limited number of variables. Similarly, critical values for cointegration tests that include exogenous variables have not been published for the number of exogenous variables in our analysis (Pesaran et al., 2000). We assume a cointegrating relationship among the demand variables, and we transform the static almost ideal demand system as an error correction model that accounts for longrun cointegration relationships between the variables with shortrun dynamic adjustments.

Following Duffy (2003), we rewrite the static almost ideal demand system in vector notation as

$$\boldsymbol{w}_t \equiv \boldsymbol{\Pi}\mathbf{x}_t,$$

where $\mathbf{w}_t$ is a $N \times 1$ vector of budget shares at time t, $\mathbf{x}_t$ is a $K \times 1$ vector of explanatory variables, and $\boldsymbol{\Pi}$ is a $N \times K$ matrix of longrun parameters from the static almost ideal demand system. Shocks may cause a disequilibrium in the longrun, cointegrating relationships between the variables but after a shortrun period of adjustment, the disequilibrium will disappear. This dynamic adjustment can be modeled as a vector autoregressive distributed lag model, i.e., VARDL(r, q):

$$\mathbf{B}(L)\mathbf{w}_t = \Gamma(L)x_t + \mathbf{e}_t, \quad (11)$$

where $\mathbf{B}(L)$ and $\boldsymbol{\Gamma}(L)$ are matrices of r- and q-order polynomials, respectively in the lag operator L, and $\mathbf{e}_t$ is an independent, identically distributed error. In this setup, $\mathbf{x}_t$ is considered "longrun forcing," in that it has a direct influence on demand but is unaffected by the equilibrium relationships between the budget shares (Pesaran et al., 2000). The lag order for the budget shares and exogenous variables are assumed to be equal (i.e., $r = q$), and based on Schwartz's Bayesian information criteria of (11), an order of 1 is chosen. Hence, equation (11) as a VARDL(1,1) is:

$$\left[\mathbf{I} + \mathbf{B}_1(L)\right]\mathbf{w}_t = \left[\Gamma_0 + \Gamma_1(L)\right]\mathbf{x}_t + \mathbf{e}_t, \quad (12)$$

where $\mathbf{B}_1$ is an $N \times N$ matrix and $\boldsymbol{\Gamma}_0$ and $\boldsymbol{\Gamma}_1$ are $N \times K$ matrices of coefficients. By subtracting $\mathbf{w}_{t-1}$ from both sides and rearranging, equation (12) becomes

$$\Delta\mathbf{w}_t = \Gamma_0\Delta\mathbf{x}_t + \left(\Gamma_0 + \Gamma_1\right)\mathbf{x}_{t-1} - \left(\mathbf{I} + \mathbf{B}_1\right)\mathbf{w}_{t-1} + \mathbf{e}_t. \quad (13)$$

[11]Ordinary least squares (OLS) estimates on nonstationary series that are cointegrated are superconsistent but have non-normal distributions so that standard inference is misleading. A vector error correction model that models the cointegrating relationships and the dynamics of the system has standard asymptotics so that standard t-statistics can be used (Verbeek, 2008).

Equation (13) can be written as a vector error correction model such that:

$$(14) \quad \Delta \mathbf{w}_t = \mathbf{A}_0 \Delta \mathbf{x}_t + \mathbf{D}\left[\mathbf{w}_{t-1} - \Pi \mathbf{x}_{t-1}\right] + \mathbf{e}_t,$$

where $\mathbf{A}_0 = \boldsymbol{\Gamma}_0$, $\mathbf{D} = -(\mathbf{I} - \mathbf{B}_1)$, and $\Pi = [\mathbf{I} + \mathbf{B}_1]^{-1}[\boldsymbol{\Gamma}_0 + \boldsymbol{\Gamma}_1]$.

The VECM almost ideal demand system captures the longrun cointegrating relationships directly by the coefficients in $\boldsymbol{\Pi}$, where the coefficients in $\boldsymbol{\Pi}$ can be constrained to be consistent with demand theory in terms of homogeneity and symmetry (i.e., equations (5) and (6)). The VECM form of the almost ideal demand system is sometimes referred to as the dynamic almost ideal demand system.

The impact of prices and advertising affect the budget share allocation in the shortrun through the $\mathbf{A}_0$ coefficients. The $\mathbf{D}$ matrix measures the speed of adjustment of budget share allocation towards the equilibrium after a shock to the system, and the on-diagonal terms are expected to be negative. The off-diagonal terms measure the adjustments of the *i*th budget share to deviations from the equilibrium of *j*th budget shares in the system (i.e., spillover effects). The term $\mathbf{D}[\mathbf{w}_{t-1} - \boldsymbol{\Pi}\mathbf{x}_{t-1}]$ is the error correction term, being the deviation of the actual budget shares ($\mathbf{w}_{t-1}$) in the previous period from the equilibrium budget shares ($\mathbf{w}^*_{t-1} = \boldsymbol{\Pi}\mathbf{x}_{t-1}$). Also interesting to note is that the effects of the exogenous variables affect demand not only in the shortrun through $\mathbf{A}_0$ but also continue to influence them in subsequent periods through the lagged budget shares.

To avoid singularity of the covariance matrix in estimation, we delete the *N*th row of $\mathbf{w}_t$ and $\boldsymbol{\Pi}$ and recover the *N*th parameters through adding up. We use iterative feasible generalized nonlinear least squares to estimate the VECM almost ideal demand system, which is equivalent to maximum likelihood estimation (Poi, 2008). Maximum likelihood estimation allows for the coefficient estimates to be invariant to the equation dropped (Barten, 1969).

The residuals of the estimated model are checked for autocorrelation, normality, and heteroskedasticity to test the validity of the chosen lag specification. We cannot reject the null hypothesis of no autocorrelation, normality, and no heteroskedasticity (table 5), which reveals that the choice of lag length of 1 for the VECM almost ideal demand system is appropriate. Overall, the adjusted R^2 for

Table 5
Residual diagnostic tests and goodness of fit of VECM almost ideal demand system

	Equation					
Residual test/goodness of fit	Basic ingredients	Complex ingredients	RTC meals and snacks	RTE meals and snacks	Fast-food meals and snacks	System
Doornik-Hansen normality test	3.98	3.75	3.13	2.48	1.68	4.46
	[0.14]	[0.15]	[0.21]	[0.28]	[0.43]	[0.92]
Harvey LM autocorrelation test	0.91	0.44	0.23	2.81	1.43	5.83
	[0.34]	[0.50]	[0.63]	[0.09]	[0.23]	[0.32]
Engle LM ARCH test	0.11	1.31	1.56	1.62	0.55	-
	[0.74]	[0.25]	[0.21]	[0.20]	[0.46]	-
McElroy's R^2	0.87	0.91	0.95	0.92	0.77	0.88

Notes: RTC = ready to cook, RTE = ready to eat, VECM = vector error correction model, LM = Lagrange multiplier, ARCH = autoregressive conditional heteroskedasticity, P-values are in brackets.

Source: USDA, Economic Research Service calculations based on data described in table 1.

the system of equations shows a good fit to the data with about 89 percent of the variation in the system of equations explained by the VECM almost ideal demand system. Wald tests of the null hypothesis that (1) regional indicators are jointly zero, (2) seasonal indicators are jointly zero, and (3) the recession indicator for 2007 quarter 4 through 2009 quarter 2 is zero are rejected, showing the importance of controlling for these variables in estimation.

Shortrun-Demand Parameters and Dynamic Adjustment

We report the shortrun and dynamic adjustment parameters in table 6. The speed of adjustment parameters (matrix **D**) measure how the budget share allocation adjusts with respect to disequilibrium errors (e.g., $w_{i,t-1} - w^{*}_{j,t-1}$). Each expenditure share adjusts significantly and negatively in response to its own deviations from the longrun equilibrium level, which is to be expected. The adjustment process of the budget share back to equilibrium is fastest for fast-food meals and snacks, where about 75 percent of the disequilibrium is compensated for in the following quarter.

Table 6
Shortrun parameters and speed of adjustment parameters

	Equation				
Variable	Basic ingredients	Complex ingredients	RTC meals and snacks	RTE meals and snacks	Fast foods
Prices					
Basic ingredients	0.02***	0.01	-0.01**	0.01	-0.04
Complex ingredients	0.00	0.01	0.01	-0.05	-0.06
RTC meals and snacks	0.00	0.03	0.02**	0.04**	-0.04
RTE meals and snacks	0.00	0.05**	0.01	0.07***	-0.12*
Fast-food meals and snacks	-0.02***	-0.04***	-0.02***	-0.03***	0.07*
Sit-down meals and snacks	-0.01***	-0.04***	-0.03***	-0.05***	0.09**
Advertising					
Basic ingredients	0.00	0.00	0.00	0.00	-0.00
Complex ingredients	0.00	0.01*	0.01**	-0.00	-0.04**
RTC meals and snacks	-0.00	-0.00	-0.00	0.01	0.01
RTE meals and snacks	0.00	-0.01	-0.00*	0.00	0.02
Fast-food meals and snacks	-0.00	-0.01	0.00	-0.01*	0.06***
Sit-down meals and snacks	0.00	0.01	0.00	0.01**	-0.03**
Hours worked	0.01	-0.00	-0.00	-0.00	0.02
Speed of adjustment					
Basic ingredients	-0.63***	0.13	0.11	0.23	-0.27
Complex ingredients	-0.062*	-0.69***	-0.21***	-0.27**	0.49
RTC meals and snacks	0.02	-0.29*	-0.59***	-0.33**	0.29
RTE meals and snacks	-0.01	-0.09	0.06	-0.55***	-0.34
Fast–food meals and snacks	-0.01	-0.04	-0.01	-0.02	-0.75***
Sit-down meals and snacks	0.13	0.11	0.23	-0.27	0.02***

Notes: RTC = ready to cook, RTE = ready to eat.

Source: USDA, Economic Research Service calculations based on the vector error correction almost ideal demand system using the data described in table 1.

Only a few of the off-diagonal parameters are statistically significant. For example, the basic ingredients equation adjusts not only with respect to its own disequilibrium but also with respect to disequilibrium in the complex ingredients equation. Similarly, the complex ingredients equation adjusts with the RTC meals and snacks equation and vice versa, and the share of the budget on RTC meals and snacks adjusts with disequilibria in complex ingredients and RTC meals and snacks. This demonstrates some inter-relatedness between the different food markets in the dynamic adjustment process.

Few of the shortrun coefficients are statistically significant (matrix $\mathbf{A}_0$) in table 6. This indicates that most of the effects of the variables are delayed and come through gradually over several periods via the error correction terms in each equation.

Longrun Elasticities of Demand

For ease of interpretation, the longrun elasticities of demand based on equations (7)-(10) computed at the mean of the data are presented rather than the longrun coefficients. Table 7 shows the price and total food expenditure elasticities of demand. Consistent with other studies, fast-food and sit-down meals and snacks are the most expenditure elastic (i.e., Okrent and Alston, 2012). Both FAFH products are considered "luxury" items with the expenditure elasticity of demand for fast-food and sit-down meals and snacks being 1.93 and 1.44, respectively. Within the FAH categories, basic ingredients are the most expenditure elastic (0.31) and RTC meals and snacks are the least (0.19).

All of the own-price effects are negative and statistically significant. The RTE and RTC meals and snacks are price-elastic with a 1-percent increase in price decreasing demand for each product by 0.90 and 1.00 percent, respectively. Fast-food meals and snacks and basic ingredients are the most price inelastic at -0.38 and -0.54.

Many of the cross-price relationships are also statistically significant, and as expected, most of the foods are net substitutes (i.e., compensated elasticity of demand greater than zero). Most of the statistically significant substitution relationships hold along the diagonal of table 6, indicating substitution between foods with varying degrees of convenience. The only exception to this is that basic and complex ingredients are not found to be statistically related. RTE and sit-down meals and snacks are found to be net substitutes for all of the products. Fast-food meals and snacks are found to be net substitutes to RTE and sit-down foods, and no other cross-price effects are significant at 10 percent. RTC meals and snacks are net substitutes for RTE meals and snacks but net complements to basic ingredients, the only statistically significant complementary relationship.

Table 7
Longrun price and expenditure elasticities of demand

	With respect to price of						
Demand for	Basic ingredients	Complex ingredients	RTC meals and snacks	RTE meals and snacks	Fast-food meals and snacks	Sit-down meals and snacks	Total expenditure
Basic ingredients	-0.55	0.13	-0.18	0.53	-0.03	0.09	0.31
	(0.07)	(0.14)	(0.11)	(0.13)	(0.05)	(0.06)	(0.08)
Complex ingredients	0.04	-0.51	0.15	0.21	-0.02	0.14	0.23
	(0.04)	(0.15)	(0.09)	(0.11)	(0.05)	(0.05)	(0.07)
RTC meals and snacks	-0.12	0.33	-0.99	0.60	0.05	0.12	0.18
	(0.07)	(0.21)	(0.20)	(0.17)	(0.06)	(0.07)	(0.10)
RTE meals and snacks	0.15	0.21	0.27	-0.90	0.09	0.18	0.30
	(0.04)	(0.11)	(0.08)	(0.13)	(0.04)	(0.05)	(0.07)
Fast-food meals and snacks	-0.01	-0.01	0.01	0.06	-0.38	0.32	1.93
	(0.01)	(0.03)	(0.02)	(0.03)	(0.08)	(0.07)	(0.13)
Sit-down meals and snacks	0.02	0.10	0.04	0.13	0.35	-0.64	1.44
	(0.01)	(0.04)	(0.02)	(0.04)	(0.07)	(0.09)	(0.14)

Notes: Standard errors are below each elasticity in parentheses. RTC = ready to cook, RTE = ready to eat.

Source: USDA, Economic Research Service calculations.

The advertising and hours-worked elasticities of demand are in table 8. The own-advertising effects are generally consistent with expectations being positive with the exception of RTC meals and snacks. Negative own-advertising elasticities, although counterintuitive, are prevalent in the economics literature (e.g., Rickertsen et al., 1995; Baye et al., 1992). As Baye et al. (1992) argued, individual firms find it in their own interests to advertise, even though in the aggregate it does not positively affect demand for the commodity. The negative result conceivably reflects that this convenience category consists of several firms that compete with each other, so that the effects of advertising by the individual firms are masked in the overall category. Only two of the own-advertising effects are significant at 10 percent, including complex ingredients (0.15) and fast-food meals and snacks (0.25).

Only a few of the cross-advertising elasticities of demand are statistically significant. Negative spillover effects can be expected in that increases in advertising on one product will likely decrease advertising for substitute products. For example, a 1-percent increase in advertising expenditures on fast-food meals and snacks decreases demand for sit-down meals and snacks by 0.27 percent. Similarly, statistically significant negative spillover effects are also found with basic ingredients and RTC meals and snacks, complex ingredients and RTE meals and snacks, and sit-down meals and snacks. However, positive spillover effects are also found; namely between basic and complex ingredients and fast-food and sit-down meals and snacks. Positive spillover effects may occur when advertising for one type of food may stimulate demand for a particular food (rather than a convenience type).

The last column of table 8 shows the elasticities of demand with respect to hours worked by the household. Most of the relationships are not statistically significant except for basic ingredients. A 1-percent increase in the average hours worked by household heads decreased demand for basic ingredients by -0.19 percent. Unlike some previous studies discussed here, we did not find that hours worked affected demand for fast foods.

Table 8
Advertising and hours worked elasticities of demand

	With respect to advertising on						
Demand for	Basic ingredients	Complex ingredients	RTC meals and snacks	RTE meals and snacks	Fast-food meals and snacks	Sit-down meals and snacks	Hours worked
Basic ingredients	0.02	0.13	-0.12	0.04	0.02	0.00	-0.19
	(0.05)	(0.06)	(0.03)	(0.06)	(0.08)	(0.02)	(0.03)
Complex ingredients	-0.02	0.15	-0.07	-0.05	0.01	-0.09	-0.01
	(0.04)	(0.05)	(0.03)	(0.05)	(0.07)	(0.02)	(0.12)
RTC meals and snacks	0.02	-0.05	-0.06	0.10	0.10	-0.01	-0.08
	(0.05)	(0.07)	(0.04)	(0.07)	(0.10)	(0.03)	(0.16)
RTE meals and snacks	-0.02	-0.03	0.01	0.06	-0.07	-0.06	-0.06
	(0.04)	(0.05)	(0.03)	(0.05)	(0.07)	(0.02)	(0.12)
Fast-food meals and snacks	-0.06	-0.12	0.17	-0.01	0.25	0.09	0.37
	(0.08)	(0.10)	(0.05)	(0.10)	(0.14)	(0.04)	(0.23)
Sit-down meals and snacks	0.12	0.03	-0.10	-0.03	-0.27	0.00	-0.37
	(0.08)	(0.11)	(0.05)	(0.11)	(0.15)	(0.04)	(0.23)

Notes: Standard errors below each elasticity,RTC = ready to cook, RTE = ready to eat.

Source: USDA, Economic Research Service calculations.

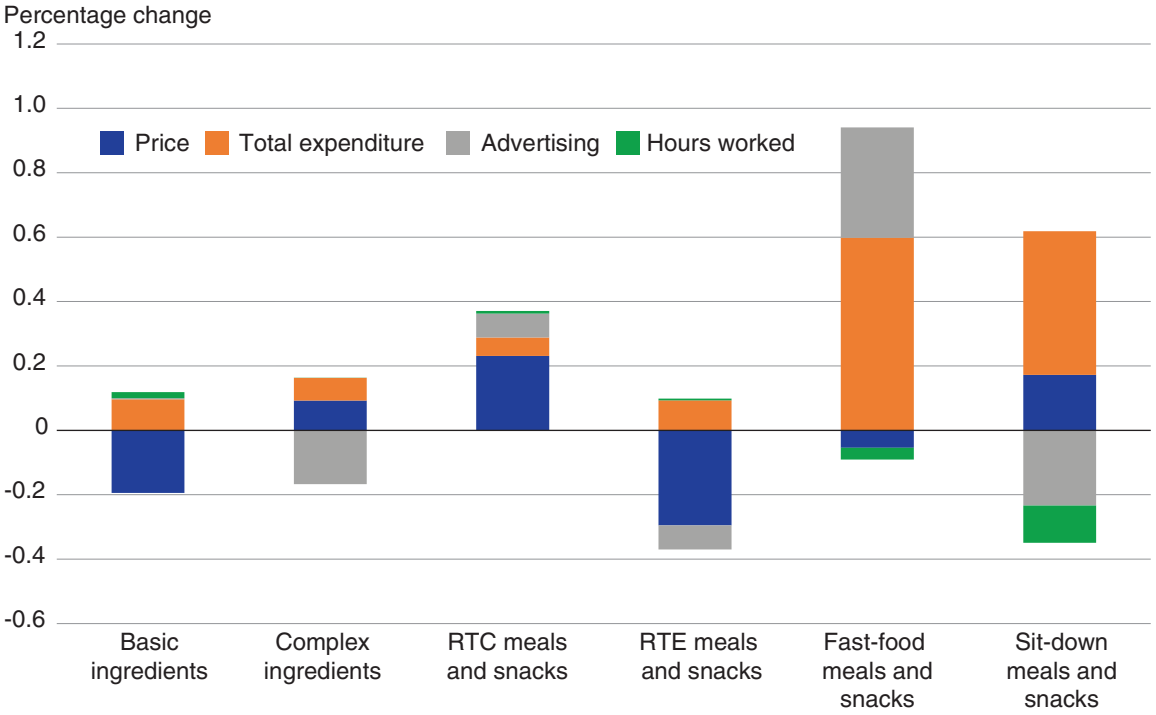
Overall, prices and total expenditure affect demand for all the foods, and many of the foods are net substitutes. Statistically significant relationships between consumers' demand for foods and advertising and hours worked are only found for meal and snack purchases at fast-food restaurants and basic ingredients, respectively. In addition, the advertising and hours-worked elasticities of demand are much smaller in magnitude. While consumers are more responsive to prices and total food expenditure compared to advertising and hours worked, actual changes in purchasing behaviors are a function of not only the elasticity of demand but also the magnitude of the price, expenditure, and advertising changes.

Discussion

To demonstrate the total effect of prices, advertising, and time constraints on American households' demand for foods by convenience type, we decompose predicted changes in food demand into price, expenditure, advertising, and hours-worked effects. For example, the effect of price *j* on food *I* is the elasticity of demand for food *I* with respect to price *j* (i.e., from table 7) multiplied by the average quarterly percentage change in price *j* across the sample period. Figure 6 shows this decomposition.

The price effect dominates in all the FAH categories. For basic ingredients, the price and total expenditure effects are almost completely offset, leading to a modest 0.08-percent decline in demand per quarter over the sample period. As shown in figures 2 and 4, prices of basic ingredients grew the fastest compared with the products, so the price effect is largely driven by the relative price growth. Also, as we noted in table 7, households also substitute out of basic ingredients and into RTE and sit-down meals and snacks as the price of basic ingredients grows faster relative to these substitutes. Average changes in demand for RTE and RTC meals and snacks are driven by the price effect as well; however, own-price effects drive the average quarterly decline in RTE meals and snacks, whereas the cross-price effects (substitution relationships) drive the average quarterly growth in RTC meals and snacks. Not surprisingly, the price effect for fast-food meals and snacks is small, which is caused by a very small own-price elasticity of demand coupled with very little overall average quarterly change in price of fast food during this period. This gives evidence that much of the changes in FAH purchasing behavior over the sample period may be attributable to changes in prices. This

Figure 6
Decomposition of demand into price, total food expenditure, advertising, and hours-worked effects



Notes: RTE = ready to eat, RTC = ready to cook.
Source: USDA, Economic Research Service calculations based on elasticities of demand in tables 7 and 8.

implies that policy-induced changes in prices can be an effective tool for changing purchasing behavior for FAH but not so much for FAFH.

The total-expenditure effect dominates in the FAFH categories, which is consistent with other studies (Stewart et al., 2004). This is not surprising in that both fast-food and sit-down meals and snacks are quite expenditure-elastic, so that a 1-percent increase in total food expenditures would increase demand for these products by more than 1 percent. The expenditure effect offsets the price effect for basic ingredients and RTE meals and snacks but reinforces the price effect for complex and RTC meals and snacks. Hence, policies aimed at increasing the income of Americans will likely lead to an increase in purchases at fast-food and sit-down establishments but will have a smaller effect on FAH purchases.

The advertising and hours-worked effects are relatively modest compared to the price and total expenditure effects. While advertising generally stimulates demand between brands in the same convenience food category, making most of the advertising effects small and sometimes insignificant, we do find that advertising expenditures increase demand for fast-food meals and snacks, with about a third of the 0.85 percent growth in average total predicted quarterly growth being from advertising. This is similarly the case for complex ingredients, although the advertising effect is negative and mainly driven by spillover advertising effects. This implies that policies directed at limiting advertising expenditures on fast-food meals and snacks could be effective in decreasing consumption of fast food.

Average hours worked constitutes only a small proportion of total predicted average quarterly growth or decline for most of the foods except for sit-down meals and snacks. Some have argued that Americans increased consumption of more convenience foods because of time constraints but we find little evidence of this. However, we note that the hours-worked variable we use to capture the time constraints of the household is blunt, and a more rigorous treatment of household production would be better at capturing the effect of time constraints on purchasing behavior.

Conclusion

This study examined the demand for convenience foods in the United States. We derived a food classificiation that categorized foods by the amount of time they saved households in meal preparation—basic ingredients, complex ingredients, RTC meals and snacks, RTE meals and snacks, fast-food meals and snacks, and sit-down meals and snacks. Using this classification, we constructed a unique panel data set of food expenditures and price indexes and examined trends in these data. We found that the share of the food budget spent on fast foods grew from 1999 to 2007. Around 2007, Americans began to purchase more FAH items, including complex ingredients and RTE meals and snacks, while the share of the budget for basic ingredients was generally flat. We tested if demand for convenience foods was a function of prices, total food expenditure, advertising expenditures, and employment hours while controlling for the economic downturn between quarter 4 of 2007 and quarter 2 of 2009, as well as seasonal and regional fixed effects.

With the newly constructed data set, we tested several hypothesis put forth in the food demand, public health, and nutrition literature. First, we found that the amount of hours worked only affected the least convenient food type—basic ingredients. This finding is somewhat surprising because some prior evidence had found that household time constraints were a large determinant of demand for fast food. However, as some other evidence suggests, other drivers of demand for convenience may be more important for food-budget allocation. Second, we find that advertising is an important determinant of fast-food purchasing behavior. This is not surprising, in that advertising expenditures on this category are somewhat large, so that even small changes in aggregated advertising expenditures will be noticed by consumers. Lastly, we find that overall changes in prices and total food expenditures over time and between regions were the biggest drivers of demand for convenience over the sample period of 1999 and 2010. In addition, American consumers readily substitute between foods of varying levels of convenience. This information provides insight into Americans' food purchasing behaviors and the potential for policy-induced changes in prices, advertising, and income in changing food consumption.

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Appendix table 1

Appendix table 1
Instruments for Hausman Specification Test

Variable	Instrument description	Instrument source
Prices	Average monthly wages in food manufacturing, retail grocery stores, full- and limited-service restaurants	Current Employment Statistics, BLS, wages of production and nonsupervisors
	Interpolated annual measures of multifactor and labor productivity (via Denton method with Federal Reserve Bank of San Francisco quarterly, national labor and MFP indexes as indicator) for food manufacturers and full- and limited-service restaurants	Multifactor productivity (MFP) for NAICS 3112, 3113, 3114, 3115, 3116, 3117, 3118, 3119, and 3121 and labor productivity for NAICS 722511 and 72251A, BLS
	Average monthly producer prices of farm products, manufactured foods and beverages	Producer price indexes, BLS
Advertising	First and second moments for advertising	Lewbel, 1997
	Lagged advertising	
Total food expenditure	Average quarterly personal income per capita by state	State and Local Area Personal Income, BEA

Notes: BLS = U.S. Bureau of Labor Statistics; NAICS = North American Industry Classification System; BEA = Bureau of Economic Analysis.

Source: USDA, Economic Research Service.