THE PRICE OF FOOD:
IMPROVING ASSESSMENTS OF COMMUNITY FOOD PRICES AND ACCOUNTING FOR THE TIME COST OF FOOD

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Joseph T. Llobrera

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Dissertation Committee:

Parke E. Wilde, PhD (Chair)
Ephraim Leibtag, PhD
Beatrice L. Rogers, PhD

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Abstract

Household food choices are subject to a budget constraint and a time constraint. To achieve an adequate diet that supports a healthy, active life, households must have sufficient income and time resources. Household purchasing power is directly influenced by the price of food at retailers while household time resources are impacted both by household characteristics and by the time costs related to food. This dissertation addresses both types of household constraints in a series of three articles.

The first article used CEX data to examine the relationship of household characteristics that serve as proxies for household time constraints with food spending behavior. Household structure was the most consistent, and in several cases the most practically significant, predictor of food shopping patterns. Compared to married couple households, single-adult households shopped less frequently and allocated more of their food budget to food away from home and prepared food and less on food at home, vegetables of all forms, and fresh vegetables.

The second article provides empirical evidence of differences in food availability and prices between small and large food retailers based on detailed, localized data from the Boston metropolitan area. This study improved on existing methods of community food price survey research by increasing the representativeness of sampled areas, retailers, and food items and applying novel methods for handling variability in food item availability. Differences in food availability between small and large stores were greatest for fresh meats and produce. Food available at small stores was predominantly shelf stable rather than perishable. The average unit price of individual food items was consistently higher at small stores, although there were a few food items sold at small stores that were priced competitively with large stores. The aggregated cost of food at small stores was higher than at large stores, with the estimated difference ranging from 25 percent higher to 59 percent higher. Adjusting for food item availability resulted in larger estimated price differences.

The third article examined variations in the price of food items due to nutrition and convenience attributes using primary data collected from Boston-area food retailers. It improves on existing methods and studies in three ways. First, systematic research design was implemented to ensure representativeness of sampled areas, retailers, and food items. Second, analyses controlled for store size and neighborhood characteristics when conducting food price comparisons. Third, expenditure weights were applied to assess the overall economic significance of food price differences. Substitutions based on MyPlate guidance typically resulted in price increases while substituting more convenient forms of food resulted in both price increases and price decreases. When put in the context of the overall food budget, we found that the estimated impact of both types of substitutions was substantially tempered but that the net effect was a small increase in the overall cost of the basket of goods.

The methods and analytic tools developed in this dissertation can serve as a template for collecting localized food price data in other communities to address empirical questions about the food price environment, such as the impact of healthy store initiatives on the availability and price of healthful food options. Findings from this dissertation also highlight the tradeoffs between the time costs involved in acquiring and preparing food at home and the monetary cost of the food items themselves.

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Acronyms and Abbreviations

ARS	Agricultural Research Service
ATUS	American Time Use Survey
BLS	Bureau of Labor Statistics
BMI	Body Mass Index
CEX	Consumer Expenditure Survey
CNPP	Center for Nutrition Policy and Promotion
CPI	Consumer Price Index
CSFII	Continuing Survey of Food Intakes by Individuals
ERS	Economic Research Service
FAAA	Food Availability and Affordability Assessment
FNS	Food and Nutrition Service
HFFI	Healthy Food Financing Initiative
NBRM	Negative Binomial Regression Model
NCI	National Cancer Institute
NEMS-S	Nutrition Environment Measures Survey in Stores
NFCS	Nationwide Food Consumption Survey
NHANES	National Health and Nutrition Examination Survey
OLS	Ordinary Least Squares Regression Model
PPS	Probability proportional to size
PRM	Poisson Regression Model
PSU	Primary sampling unit
QFAHPD	Quarterly Food-at-Home Price Database
SNAP	Supplemental Nutrition Assistance Program
TFP	Thrifty Food Plan
USDA	United States Department of Agriculture

CHAPTER 1: INTRODUCTION

The U.S. Department of Agriculture (USDA) defines food security as access by all people at all times to enough food for an active, healthy life. Achieving food security is dependent on households having access to the food they need and sufficient income and time resources to purchase and prepare it. Without sufficient money or time, a household will have difficulty reaching the nutritional recommendations (Davis and You, 2011). Household purchasing power is directly affected by the price of food at retailers, while household time resources are influenced both by household characteristics and by the time costs related to food.

To properly assess household purchasing power, researchers and policymakers need granular data on food availability and price at the geographic scale that households do their food shopping - at the local or community level. Data collected on food prices should be representative of household purchasing patterns, the stores where households spend their food dollars, and the geographic areas where they live. Collecting high-quality data on food prices is not enough. Analytic methods must process detailed food price information in a way that accounts for the wide variability in food item availability from store to store. These methods must also summarize or aggregate prices while accounting for missing price information. To be useful in policy discussions, the output generated by these efforts must be able to efficiently and effectively convey nuanced information about food availability and price, through appropriate metrics or graphical tools.

The role of time costs and convenience in shaping food choices remains understudied in the food environment literature. Do households that are more time-

constrained have different food shopping behavior or food purchasing patterns? Furthermore, what is the connection between income constraints and time constraints? Are there monetary tradeoffs for households that purchase and consume foods that are more convenient and potentially time-saving?

This dissertation seeks to address both types of household constraints. The first goal of this dissertation was to build upon existing methods of community food price studies and improve the quality of food price data collected at the local or community level. In particular, the methods developed in this dissertation aim to increase the representativeness of food price information and provide novel ways of accounting for the variability in food item availability when making price comparisons. Primary data on the food retail environment in the Boston metropolitan area were collected using a community food price survey instrument and protocol developed for this dissertation. The data were used to describe differences in food availability and price across food retailers of different sizes and to determine if spending food dollars at small store or large stores has implications for household purchasing power. Additional data were collected to determine if choosing foods recommended by MyPlate dietary guidance was significantly more expensive than selecting comparable but less healthful foods.

The second aim of this dissertation was to investigate the role of time constraints and convenience in the food environment. Data from the Consumer Expenditure Survey (CEX) were analyzed to determine if households that are potentially time-constrained shop less frequently or allocate a greater share of their food budget to more convenient forms of food in order to reduce the time costs associated with food shopping and preparation. The primary data collected from retailers in the Boston metropolitan area

included information on the price of closely related pairs of food items differing on convenience attributes. The unit prices of these pairs were compared to determine if choosing foods with convenience attributes has an impact on prices and, consequently, on household purchasing power.

Statement of Purpose

Overview

The food environment determines the set of options available to individuals and households deciding what foods to purchase and where to spend their food dollars and their time resources. The food retail environment, which is the focus of this dissertation, is defined to include the various types or formats of food stores, but excludes restaurants, cafeterias serving institutions (such as schools and worksites), and vending machines. Low-income individuals may have difficulty meeting dietary recommendations because of inadequate access to healthful food, such as fruits and vegetables, at affordable prices (Cassady, Jetter and Culp, 2007). Food prices shape what mix or basket of foods is affordable or attainable (Kuchler and Stewart, 2008). If unhealthy foods, such as foods high in refined sugars and starch, are relatively cheaper than healthier foods like fruits and vegetables, then the unhealthy diets consumed by low-income Americans may be a response to these price disparities (Brownell and Horgen, 2004; Drewnowski and Darmon, 2005).

Although it does not show up in the grocery bill, the time cost of shopping for and preparing food at home is another facet of the food environment that influences food choices. Because time is a limited resource for households, failure to account for the

labor and time costs of acquiring and preparing low-cost but healthy meals may lead to underestimates of the cost of nutritious diets and overly optimistic assessments of their feasibility and appropriateness. Households face tradeoffs between monetary costs and time costs at different stages of acquiring and preparing food. Households can choose between foods requiring different amounts of time and labor to prepare. Foods of varying levels of convenience may have differences in monetary price.

A convenience food is any fully or partially prepared food where significant preparation time, culinary skills, or energy inputs are transferred from the household to the food processor or distributor (Traub and Odland, 1979). The convenience attribute of food can be characterized by the amount of preparation that must be performed on a food before it can be consumed (Park and Capps, 1997). Researchers have documented a rise in consumption of food away from home and convenience foods (Stewart, Blisard, Bhuyan, and Nayga, 2004; Jabs and Devine, 2006) and the coincident rise in obesity (Cutler, Glaeser, and Shapiro, 2006). This could be a response of individuals and families to time constraints and the feeling of time pressure. Individuals and families may shift consumption towards relatively unhealthy prepared food, such as certain food from fast food restaurants, and away from relatively healthier ingredients, such as fresh vegetables, that require further preparation (Guthrie, Lin, and Frazao, 2002). This creates a potential tradeoff between nutrition and convenience (Ziol-Guest, DeLeire, and Kalil, 2006).

Household Spending and Time Constraints

Time use surveys like the American Time Use Survey (ATUS) are a rich resource for information on how individuals and families allocate their time across different food-

related activities, such as grocery shopping, food preparation, or restaurant visits, but they lack detailed information on the specific types of foods being purchased, prepared or consumed. Household expenditure data, such as the CEX, or dietary intake data, such as the Continuing Survey of Food Intakes by Individuals (CSFII) or National Health and Nutrition Examination Survey (NHANES), have information on food spending or food intake, but lack direct information on time use or time resources. To bridge this data gap, this dissertation selected household characteristics that are closely tied to the time resources of households to use as proxies for household time constraints. These included household structure, household size, number of children, number of elderly members, full-time work status, and vehicle ownership.

This dissertation advances the literature on time and food choice by introducing new household food spending outcomes. Other studies have examined visits to restaurants and food away from home establishments (Binkley, 2006) or spending allocation among major food groups like fruits and vegetables (Ziol-Guest et al., 2006). This study is one of the first to use CEX information on the date of purchase for food items to calculate the number of shopping days for food at home and examine correlations with proxies for household time constraints. It is also unique in its attention to household food purchases based on convenience attributes. Spending on pairs of food categories requiring different levels of labor and time resources was compared. Food categories were defined broadly and narrowly to determine if associations with household covariates were robust at different levels of data aggregation. Spending on food at home as a share of total food spending represented the broadest level of data aggregation. At an intermediate level, spending on fresh and processed vegetables as a share of food at home

spending was compared with spending on prepared food of all types as a share of food at home spending. At the most detailed level, the share of food at home spending allocated to fresh vegetables was compared to the share allocated to processed vegetables.

Food Retailer Size and Prices

Earlier studies have found that neighborhoods that are lower income and predominantly African American have fewer supermarkets or longer distances to markets (Morland, Wing, Diez Roux, and Poole, 2002; Zenk, Schulz, Israel, James, Bao, and Wilson, 2005). Other researchers have found that supermarkets, and the greater variety and lower prices they tend to offer, are more likely to be located in suburban areas, while costlier small and non-chain stores are more likely to be in inner-city areas (Chung and Myers, 1999). If the range of food available at smaller food retailers is more limited or sold at a higher price than at larger food retailers, then the convenience of and time saved by shopping at nearby smaller retailers may be offset by higher prices paid and potentially worse dietary quality, such as lower fruit and vegetable intake.

A review of the early literature conducted by the Economic Research Service (ERS) concluded that, in general, low-income Americans face slightly higher food prices than the national average (Kaufman, MacDonald, Lutz, and Smallwood, 1997). ERS outlined several key methodological challenges of measuring food price differentials. In particular, it highlighted the important decisions that researchers must make about the choice of geographic areas for analysis, choice of food retailers within those geographic areas, and the composition of the bundle of goods, or market basket, to be used to collect

price data. Another central issue is maintaining comparability across retailers or geographic areas that have different food items available for sale.

This dissertation improves on existing methods of community food price survey research in two ways. First, in response to need for more robust measures cited by ERS and NCI, a systematic research design was developed and implemented to ensure representativeness of sampled geographic areas, food retailers, and food items. Second, this dissertation employed novel methods for handling variability in food item availability and missing price information. Careful attention was paid to food item comparability and distinguishing between differences in food item availability and differences in food prices when aggregating food prices. To further account for variability in the availability of food items in small stores, weights were developed to adjust for lower food item availability at small stores when estimating the aggregated price difference between small and large stores. The Paasche price index approach was adopted to calculate the overall aggregated price difference between small and large stores, controlling for lower food item availability in small stores.

This study is one of the few to provide detailed, granular empirical data on the food retail disparities in the Boston metropolitan area. While the findings of our study are specific to Boston, the methods and analytic tools developed for this study can serve as a template for collecting localized food price data in other cities and communities.

Price Premium for Nutrition and Convenience Attributes in Food

Recent critiques of the Thrifty Food Plan (TFP), the federal government's estimate of the cost of a healthful and affordable diet and basis for Supplemental

Nutrition Assistance Program (SNAP) benefit levels, point out that the TFP does not adequately reflect the time cost involved in purchasing and preparing low cost meals from scratch for time-pressed households (Jabs and Devine, 2006; Mancino and Newman, 2007; Rose, 2007). The TFP assumes that meals are made primarily from scratch, although recent revisions have incorporated some convenience options like canned beans or ready-to-eat breakfast cereal. Some have called for even greater representation of nutritious but convenient forms of food in future revisions of the TFP (Mancino and Newman, 2007). In their 2013 report on the adequacy of SNAP benefit levels, the Institute of Medicine and National Research Council suggested increasing SNAP benefit to provide time-pressed families more resources to purchase more convenient and easy-to-prepare foods by applying a time adjustment multiplier to the cost of the TFP or reviewing options for adjustments to the current cost of the plan and adjusting the earned income deduction to reflect more accurately time pressures for participants who are working (Institute of Medicine [IOM] and National Research Council [NRC], 2013).

Empirical studies to inform policy concerns about the time costs of preparing healthy food at home remain limited. Efforts to estimate the cost of a nutritious diet have focused on the cost of food ingredients and have either ignored or underemphasized the time costs of purchasing and preparing these ingredients. On the issue of nutritional attributes, some studies have estimated the cost of meeting overall food group recommendations or shifting consumption to food groups that Americans consume too little of, such as fruits and vegetables. Carlson and Frazao (2012) estimated that it is less costly to meet MyPlate food group recommendations for grains, dairy, and fruit than for

vegetables or protein foods. Todd, Leibtag, and Penberthy (2011) found that not all healthy foods are more expensive than less healthy alternatives. The literature on convenience attributes in food is even more limited. One study, by Stewart, Hyman, Buzby, Frazao, and Carlson (2011), found that processed fruits and vegetables were not consistently more or less expensive than fresh produce.

This study extends the literature on price differentials for nutrition and convenience attributes in food in three ways. First, a basket of standard food items that is representative of the food spending patterns of American households was constructed and augmented with a set of substitute food items, resulting in a representative bundle of goods that still allows for detailed pairwise comparisons between similar food items that differ primarily on nutritional or convenience attributes. Second, pairwise comparisons in this study controlled for store size and store neighborhood characteristics through stratification or regression analysis, while results from previous studies often rely on food prices averaged across purchases from all retailer types. Third, expenditure weights were attached to substitute food items to estimate the weighted average effect of food substitutions and assess the overall economic significance of food price differences.

Dissertation Outline

This dissertation consists of seven chapters. This introductory chapter provides an overview of the research goals and specific hypotheses explored. Chapter Two summarizes and critiques the relevant literature. Chapter Three provides a detailed explanation of the methods used to collect the primary and secondary data used in this dissertation. The three independent articles addressing the research questions comprise

the next three chapters. The concluding chapter highlights key results from the three articles, discusses implications for nutrition policy, and suggests areas for future research.

Specific Aims and Hypotheses

The first goal of this dissertation was to improve methods of collecting and analyzing community level food price data. The second aim of this dissertation was to investigate the role of time constraints and convenience in the food environment. These aims were addressed in three independent articles. The specific aims and hypotheses of each article are described below.

Article 1: Time-Constraining Household Characteristics are Associated With Less Frequent Shopping and Greater Spending on More Convenient Forms of Food

Using data from the CEX, this article examined several different food spending outcomes that are especially interesting because they may affect the nutrition quality of the diet, and they may be affected by variables that reflect the severity of time constraints on American households. The first outcome was the number of grocery shopping days during a two-week period, which serves as a measure of food shopping frequency. The second outcome was the share of food spending on pairs of food categories requiring contrasting levels of labor and time resources. It was expected that households with time-constraining characteristics, such as full-time employment, presence of children, or lack of vehicle access, would shop less frequently in order to reduce the time and opportunity costs associated with food shopping and allocate a greater share of their food budget to more convenient forms of food categories that require less time to prepare. The food

group definitions and hierarchy developed in this article were used in subsequent articles to identify the most important food spending categories among American consumers and develop a list of representative food items. The food spending shares calculated in this analysis served as expenditure weights for aggregating food prices in later chapters.

Article 2: Measuring Price Differentials Across Small and Large Food Retailers

This article examined differences in food item availability and unit prices between small and large food retailers. Food grouping methods used by the Bureau of Labor Statistics (BLS) were adopted to identify a set of food items that are representative of food at home spending patterns of U.S. households. Primary data on food item availability and price were collected from 120 retailers in the Boston metropolitan area. It was expected that food item availability would be lower at small stores, while individual food item unit prices and aggregated food costs would be higher at small stores.

Article 3: Exploring the Price Premium for Nutritional and Convenience Attributes in Food

This article compared the availability and price of pairs of closely related food items differing on nutritional attributes and on convenience attributes. Primary data on food item availability and price were collected from 120 retailers in the Boston metropolitan area. It was hypothesized that most food substitutions recommended by MyPlate guidance to build a healthy diet would be more expensive than their standard counterparts. It was expected that the price difference for convenience attributes would depend on the food item. Convenient forms of vegetables that are shelf stable and less

perishable were expected to be less expensive than their fresh counterparts, while for other food items, convenience may be a marketable value-added attribute that results in a premium.

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CHAPTER 2: LITERATURE REVIEW

This chapter provides a review of previous studies and methods relevant to this dissertation. There are four sections to this chapter. The first section reviews the existing literature on associations between time resources and food choices. The second section discusses previous methods for collecting detailed information on food availability and price, including existing community food price surveys. The third section reviews existing studies on variations in food availability and price by food retailer size or type and associations with nutritional or health outcomes. The chapter concludes with a discussion of food price differentials due to nutrition and convenience attributes.

Section 1: Time and Food Choices

Theoretical Motivation

Researchers have documented a rise in consumption of food away from home and packaged and ready-to-eat foods (Stewart, Blisard, Bhuyan, and Nayga, 2004; Jabs and Devine, 2006) and a coincident rise in obesity (Cutler, Glaeser, and Shapiro, 2006). Spending on food away from home as a share of total food expenditures has risen from 17 percent in 1929 to 49 percent in 2011 (USDA/ERS, 2013). Individuals and households may be responding to time constraints by altering their food purchasing and consumption behavior.

Eating involves choices about money expenditures on the capital required to engage in this activity, such as kitchen equipment or cooking fuel, and on the nondurable good food itself. It also requires decisions on how much time to spend in acquiring food, preparing it, consuming it, and cleaning up after the meal (Hamermesh, 2007). Even if

the price of all inputs to eating are the same and household incomes are equal, households will choose different combinations of goods and time to generate the same amount of eating (Becker 1965). Household preferences, knowledge, and abilities are factors in these decisions.

Before proceeding, we review some concepts from consumer economics and household production theory. According to consumer economic theory, households select foods and other goods to maximize utility based on their preferences or taste, subject to an income or budget constraint. The cost of goods purchased should not exceed the household's income or ability to pay for those goods. In Becker's (1965) model of household production, a household allocates its time resources between supplying its members' labor to the market and engaging in a variety of activities that it combines with the income generated by its members' labor market time (as well as any non-labor income it may receive). Food acquisition, preparation and consumption at home are some of those activities. A households combines time and goods (food) to produce output that is not sold in the market but is consumed directly by the household.

Food consumption is subject not only to a cash budget constraint (to pay for the direct monetary costs of food) but also a time constraint, since household time resources are used in the process of purchasing, preparing, and consuming food (as well as cleaning up afterwards). The total price of consumption is the combination of the direct and indirect prices for food, where the direct price is the purchase cost, and the indirect price is the value of the time requirements (Becker, 1965). With enough money and time, a household can produce enough food to meet or exceed basic nutritional

recommendations. Without sufficient money or time, a household will have difficulty reaching the nutritional recommendations (Davis and You, 2011).

Households possess technology that can alter the constraints facing the household (Pollak, 2011). The household applies human capital, such as knowledge, technique and skill in food preparation, or physical capital, such as kitchen equipment. Technology determines the form of the production function involved in turning food ingredients into food that can be eaten and whether there are economies of scale in household food production. There may be economies of scale related to household size, with declining marginal costs (in terms of time and money) involved in feeding another household member as meal preparation responsibilities are spread over more individuals (Institute of Medicine [IOM] and National Research Council [NRC], 2013).

Presented more formally using notation adapted from Huffman (2010), households seek to maximize utility (U) based on their preferences or taste (τ), subject to a cash income or budget constraint (I). We consider the simple case of a two-person household.

(1) $U = U(Z_1, Z_2; \tau)$

(2) $Z_i = G_i(X_i, t_i; \varphi_i)$, i = 1, 2

(3) $I = W \cdot h + V = P_1X_1 + P_2X_2$

Each commodity that the household produces, Z_i, requires an input, X_i, purchased at price P_i and the housework of one or more members, t_i. A technology or efficiency parameter, φ_i, modifies the production function. In a simplified example, X_1 refers to a food item purchased at a food store at price P_1, while X_2 refers to a nonfood item such as soap for cleaning clothes. Members earn a wage (W) by working for (h) hours. Unearned income

from financial assets and gifts is represented by V. Cash income is allocated to purchasing X_1 and X_2. The household's time resources, T, are allocated between housework ($t_1 + t_2$) and hours of work for pay (h).

(4) $T = t_1 + t_2 + h$

If the household allocates physical time to work in the market at wage rate (W), the cash income (3) and time (4) constraints can be combined into one full income constraint (F).

(5) $F = W \cdot T + V = P_1X_1 + Wt_1 + P_2X_2 + W \cdot t_2$

Households experiencing time constraints may seek to reduce food-related housework (time spent acquiring and preparing food at home). One way they can do this is by purchasing food away from home or allocating a greater share of their food at home spending to convenience foods. Individuals and households may shift consumption towards relatively unhealthy prepared food, such as certain food from fast food restaurants, and away from relatively healthier ingredients, such as fresh vegetables, that require further preparation (Guthrie, Lin, and Frazao, 2002). This creates a potential tradeoff between nutrition and convenience (Ziol-Guest, DeLeire, and Kalil, 2006).

The interaction between household characteristics, time resources, and food choices is complex and multi-faceted. The existing literature draws on four sources of data on time and food. Time use surveys provide information on the number of occasions and amount of time spent on food-related activities. Food industry and marketing-oriented research surveys describe the interaction of consumers with food retail establishments, such as the frequency of shopping trips and the size of the market basket purchased on a typical shopping trip. Dietary intake surveys provide detailed information on the types and amounts of food individuals consume. Finally, consumer expenditure

surveys provide insights on how households allocate their food budget, particularly on food away from home.

Time Use

Studies using time use surveys, such as the ATUS, have found a downward trend in the amount of time Americans spend preparing food (Zick and Stevens, 2010). Individuals and households with certain characteristics may experience or perceive greater constraints on their time resources that compel them to reduce time spent on food-related activities, such as grocery shopping and food preparation.

The ATUS interviews one person per household. Respondents are asked to recall their activities on the day before their interview, covering a 24-hour period beginning at 4 a.m. when most people are asleep. The Eating and Health Module of ATUS includes information on food-related activities such as time spent on grocery shopping, buying other food, food preparation and cleanup, and eating and drinking. Using data from the 2003-04 ATUS, Mancino and Newman (2007) and Hamrick and Shelley (2005) found that household characteristics such as income, employment status, gender, and family composition, were significantly correlated with time spent on food preparation and other food-related activities. Mancino and Newman found that this association was strongest among full-time workers and single parents and weakest among men. They found that household time resources had a greater effect than an individual's earnings or household income on how much time was allocated to preparing foods. Among women, time spent on food-related activity declined with rising household income, suggesting that higher-income women are able to substitute income for time and labor saving foods and

services. Women living with a partner or children spent significantly more time on food-related activities than women that were single or had no children.

Mancino and Newman (2007) also estimated that following recipes from the TFP would require anywhere from 80 minutes a day to 16 hours a week. Data from ATUS indicated that low-income women who work full-time spend an average of 40 minutes a day on food-related activities, suggesting that there may be a time gap between the amount of time assumed by the TFP and the amount of time people have available to prepare food at home.

Cawley and Liu (2007) used data from the 2003-06 ATUS to explore a plausible mechanism for connecting maternal employment with childhood obesity. They found that maternal employment was associated with a lower probability of grocery shopping and cooking and reduced time spent doing those activities, as well as a higher probability of purchasing prepared foods. They noted that men with working spouses spent significantly less time grocery shopping and were more likely to purchase prepared foods.

Food Shopping Behavior

Retailing and marketing studies provide insight into the shopping behavior of households and their interaction with food retailers. Data sources include the household panel of retailer scanner data and household surveys. These studies characterize consumer shopping behavior through measures like shopping frequency, shopping regularity, and the amount spent on shopping trips. Households that are pressed for time may seek to consolidate shopping trips to minimize time spent traveling to and from retailers.

Kim and Park (1997) used shopping trip behavior from IRI scanner data to explore patterns in frequency and regularity of consumers' grocery store shopping trips. They found that smaller households and household with adults employed full-time, children, or younger household heads tended to shop for groceries less frequently. These households were also more likely to shop on a routine schedule, perhaps due to higher opportunity costs of time and less scheduling flexibility. Frequency of shopping was negatively associated with expenditure per trip (see Bell and Lattin, 1998 also).

Bawa and Ghosh (1999) also based their analysis on shopping trip records from the IRI scanner data. They noted that consumer shopping behavior was extremely varied and complex. Like Kim and Park (1997), they found that smaller households, households with working adults, those with higher income, and those with younger household heads tended to shop less frequently. Frequent shoppers also visited more stores. They observed that for some households grocery shopping may compete directly with wage-earning activity, but for others, such as higher-income retired households, shopping could provide a leisure or recreational dimension. Expenditures per trip were positively correlated with income, household size, and absence of kids. In addition, a negative relationship exists between shopping frequency and market basket size

Food Consumption and Intake

Much of the existing literature on the role of convenience foods comes from food consumption and dietary intake data. These data are typically based on dietary recall interviews, with respondents providing detail on the types and amounts of food consumed over a 24-hour period. Associations between household characteristics and consumption

of food away from home or convenience foods provide insight on how time demands affect food choices.

Binkley (2006) looked at consumption of food away from home using dietary recall data from the 1994-1996 CSFII. Consumption of food away from home was found to be correlated with many factors, including income, household structure, and presence of children. The association was stronger for fast food restaurants compared to table service restaurants. CSFII respondents also provide information on knowledge about and attitudes toward nutrition and health in a follow-up survey called Diet and Health Knowledge Survey. Some of these attitudes were correlated with food consumption behavior. Respondents who were concerned about nutrition had lower demand for fast food, while individuals who placed importance on the ease of food preparation ate out more frequently.

Turning to food at home consumption, Capps, Tedford, and Havlicek (1985) studied the demand for convenience food using the 1977–78 Nationwide Food Consumption Survey (NFCS) data. The NFCS includes data on the money value, quantity and type of food consumed along with household demographic characteristics. They found that the demand for convenience food, measured as a share of the food budget, was highest among white households with household heads of less than 35 years of age.

Using more recent (1987-88) NFCS data, Park and Capps (1997) found that household managers that were male, younger, more educated, and worked more hours were more likely to consume prepared meals. Income had a positive association with the likelihood of consuming prepared meals.

Lee and Lin (2013) used information on dietary intake from the 2003-04 National Eating Trends data of the NPD Group to test the association of demographic characteristics with the level of convenience of food consumed. They found that the presence of children in a household increased the demand for convenience in food, particularly in households that have children of different age groups. White, single, and higher income respondents were more likely to use convenience foods.

Food Expenditures

Many of the studies that have used food expenditure data to explore the association between household time resources and food choices have focused on spending on food away from home. A household may substitute labor at home related to food preparation with eating out at restaurants, freeing up time to do other activities. Stewart et al. (2004) examined household covariates of spending on food away from home using CEX data from 1998-2000. They distinguished between expenditures at fast food and full-service restaurants. They found that household structure was a significant predictor of expenditures at both types of restaurants, with single adults spending more on food away from home compared to other household types. Larger households spent less on food away from home. Per capita income and hours worked by the household manager in the labor force were positively associated with spending at both types of restaurants.

Hamermesh (2007) examined the relationship between the wage rate for two-person households, time spent eating, and the demand for food away from home. Using data on time use from the 1985 Time Use Survey and 2003 ATUS and data on earnings

and food away from home expenditures from the 1985 and 2003 CEX, Hamermesh found that a higher wage rate for the husband and wife increased demand for food away from home significantly.

Less work has been done on sub-categories of food at home spending. One such study was conducted by Ziol-Guest et al. (2006), who compared spending on food away from home and several categories of food at home, including fruits, vegetables, and prepared foods. They found that households headed by a single adult spent more on food away from home and spend less on fruits and vegetables than married couple households. Employment status was an important covariate, with working adults spending more on food away from home and less on fruits, vegetables, milk, and meat and beans.

Gaps in the Literature

To understand how time constraints affect food choices, ideally one would have household demographic characteristics linked to information on time use, types and amounts of food consumed, and the amount paid for those foods. Large-sample surveys are typically missing at least one of these elements due to concerns about respondent burden and costs. Time use surveys like ATUS lack detail on the foods purchased or consumed, while dietary intake data like NHANES lack information on time use and the amount paid for foods consumed. The NFCS was unique in having information on the types and amount of food consumed and the amount paid for those food items. However, the last round of the NFCS was conducted in 1987-88. The CEX has detailed information on food spending but lacks information on time use and amounts of food consumed. Up to now, much of the research using the CEX has focused on spending on food away from

home. More research is needed on sub-categories of food at home, like processed vegetables or prepared foods, which may be important to time-constrained households.

Section 2: Methods (Community Food Price Surveys)

Measuring variations in the availability and price of food is a necessary step to understanding the purchasing power of households and its impact on nutrition and food security. ERS and NCI, among others, have called for more robust measures of the food environment, including improved methods for measuring the availability and price of foods (USDA/ERS, 2009; NCI, 2010). There is now a growing collection of methods and instruments that can be used to assess the food price environment, with varying levels of sophistication and resource requirements. These include the federal government's price monitoring efforts through the Consumer Price Index (CPI), retailer scanner data, and community food price surveys.

An authoritative source of food price information is the CPI, collected by BLS. BLS uses a complex method of sampling areas, retailers and food items (BLS 2013). The market basket of goods and services covered by the CPI is based on detailed expenditure data collected from approximately 14,000 households every quarter, with about half of those households providing detail on frequently purchased items like food and personal care products during a 2-week period.

BLS has a well-developed hierarchical system for aggregating food items. All household expenditures are classified into more than 200 categories and arranged into 8 major groups. Food and beverages comprise one of the major groups. Using statistical sampling procedures, BLS selects samples of several hundred specific items to represent

each of the more than 200 item categories and collects price information on those items at retailers. For example, in a given grocery store, BLS may select a 4-pound plastic bag of U.S. Extra No. 1 grade white potatoes to represent the category for potatoes at that particular retailer.

BLS data collectors visit thousands of retail stores and service establishments across the United States to obtain information on the prices of about 80,000 items each month. BLS has a systematic method for handling missing items, either by substituting comparable items or imputing prices. During each visit, the data collector collects price data on a specific good that was precisely defined during an earlier visit. If the selected item is no longer available at that retailer, or if there have been changes in the quality or quantity or package size of the item since the previous visit, the data collector selects a new item or records the quality change in the current item.

Price information collected by BLS for the CPI is designed to provide extensive coverage of all of the common expenditures made by American households and reliable measurement of changes in these prices over time. The data are representative of expenditures at the national level, for geographic regions, and selected metropolitan areas. CPI data cannot be used to make comparisons in prices across small geographic areas or store formats, which precludes their usefulness for community-level food environment analysis.

Retailer scanner data, such as data from Nielsen Homescan or IRI Infoscan, are an alternative source of food price information. These data are collected directly from food retailers using information on food items scanned at registers or from a panel of households that use handheld scanners to record food purchases from a wide variety of

retailers. Scanner data allow researchers to match detailed information on the products purchased, the actual prices paid by consumers for those products, and, in the case of the household panel data, the characteristics of the households that purchased them. The use of scanner data for community-level food environment research is limited because the data are typically representative only at the national level or for selected geographic areas. There is also some concern about how representative the household sample of Homescan and other scanner data is, especially of low-income households (Fremstad, 2010). Stewart and Blisard (2008) noted that low-income households appear in the Homescan sample in a proportion less than their share of the total population. Scanner datasets may also omit important categories of retailers or companies or lack complete coverage of stores at the local level, especially smaller stores. Granular detail on food availability and price in specific cities or neighborhoods are usually lacking.

Given the limited usefulness of the two previous sources of food price information for community-level analysis, many researchers develop their own list of food items and data collection protocol. These community food price surveys involve selecting a market basket of food items and collecting information on food availability and price at neighborhood stores. Unlike the previously discussed methods, this approach does not necessarily require a large amount of resources to generate granular data on food availability and price levels at the local level. Even a single data collector with a pen and paper can collect rich data on local food retail conditions. This approach is extremely flexible and the geographic areas, stores, and food items covered by a study can be scaled up or down depending on research interest and available time and labor resources.

Researchers are free to decide what items to include in the market basket and the composition of the market basket used is generally motivated by the research questions to be addressed. Researchers interested in representing the typical purchasing patterns of a given population have used a market basket featuring products that are commonly available or commonly purchased (Winkler, Turrell, and Patterson, 2006; Hayes, 2000; Donkin, Dowler, Stevenson, and Turner, 2000). Those interested in the cost of a healthier mix of foods have created market baskets featuring food items with more desirable nutritional attributes or that comprise a diet that is considered healthy (Chung and Myers, 1999; Andrews, Kantor, Lino, and Ripplinger, 2001; Jetter and Cassady, 2006; Anderson et al., 2007).

Several studies base their food item list on the TFP (Hendrickson, Smith, and Eikenberry, 2006; Rose et al., 2009; Cassady, Jetter, and Culp, 2007). The TFP is the federal government's official estimate of the cost of a thrifty but nutritious diet (Carlson, Lino, Juan, Handon, and Basiotis, 2007). A notable example of a market basket based on the TFP is the Food Availability and Affordability Assessment (FAAA) of the Community Food Security Assessment Toolkit (Cohen, 2002). The toolkit was developed through a collaborative process that began at the Community Food Security Assessment Conference sponsored by ERS in June 1999. The food store survey and materials are meant to give community-based nonprofit organizations and business groups, local government officials, private citizens, and community planners the tools to assess the availability and affordability of food in local retail outlets. The toolkit provides steps and materials for collecting price information on 87 different food items that were selected based on the TFP and representative of foods commonly eaten by low-income households

and to meet Federal dietary guidelines and Food Guide Pyramid serving recommendations for a family of four (two adults aged 20 to 50 and two children aged 3 to 5 and 6 to 11) for 1 week (Cohen, 2002). The survey specifies the package size or weight, but not the brand, of food items to be priced. For instance, among the food items to be priced are 5 small apples (or 1.25 pounds), a 26 oz can of spaghetti sauce, and 2 pounds of fish.

Another example of a market basket motivated by an interest in nutritional attributes is the Nutrition Environment Measures Survey in Stores (NEMS-S) developed by Glanz, Sallis, Saelens, and Frank (2007). The NEMS-S collects information on the availability and price for a mixture of broader food groups like fruits and vegetables and more specific food items of nutritional interest, like regular and healthier (reduced fat, low calorie, or whole grain) varieties of milk, ground beef, hot dogs, frozen dinners, baked goods, bread, potato chips and cereal. Special attention is given to differences in the availability and price of regular options and healthier alternatives. In some cases, NEMS-S protocol may specify a reference brand and package size, such as a half-gallon of Minute Maid 100% juice, while in other cases, the data collector has discretion in choosing the brand or package size combination, such as regular muffins (baked goods).

Methodological Issues

Researchers must make several key decisions when conducting a community food price survey. Careful consideration must be given to the method of sampling geographic areas, food retailers, and the list of food items to be used to collect price data. Researchers must also develop ways of aggregating price observations to make

comparisons across stores or geographic areas and how to handle missing price observations when a retailer does not sell a particular food item. We address these issues below.

Selecting Areas and Retailers

The mix and density of food retailers varies across geographic areas, which can lead to sampling differences due to location. Selecting an area near the center of a city or metropolitan area may capture a higher proportion of smaller retailers and fewer large retailers and supermarkets. Observed prices in densely populated urban areas may vary systematically from suburban or rural areas. Researchers need to consider how their sample of geographic areas and food retailers will impact their price observations.

Existing methods, such as the FAAA and NEMS-S, typically lack guidance on procedures for sampling geographic areas and food retailers. There may be a presumption that researchers are primarily interested in a few geographic areas that are small in scope and encompass a small number of food retailers. Procedures for scaling up to citywide or metropolitan-wide coverage are not provided.

Selecting and Defining Food Items

The average U.S. supermarket stocks roughly 40,000 unique food products. These food products vary by product category, brand, flavor, package size, and many other attributes. Because it is not practical or feasible to collect price information on all the food items in even a small sample of stores, researchers must decide on a list of food items to collect price information on and how to define them.

Ideally, the list of food items would be representative of the products that households buy and are available at sample stores so that prices can be collected (Kaufman, MacDonald, Lutz, and Smallwood, 1997). To ensure a high degree of comparability, it would be ideal to collect price information on identical items of the same brand, package size, and quality. This would enable researchers to compare like with like. There is a tradeoff with the identical-item approach or using very narrow definitions for food items. Food stores, even those belonging to the same chain, stock different food items at any given time. Using narrow definitions increases the likelihood that the food item will be missing at a given store. Researchers must be willing to accept that a large proportion of their observations may be missing or have procedures to minimize or replace missing values. They could restrict the food list to a small list of widely available products or restrict the sample of stores to those most likely to carry the food items, such as stores belonging to the same format or the same chain. These *a priori* approaches reduce the representativeness of the food list, as they result in observations that only cover a small fraction of household food purchases.

Given the variability in item availability across stores, most community food price studies use broader and more flexible definitions for food items. This increases the likelihood of finding an appropriate food item to price at sampled stores. Researchers decide on criteria for which to allow flexibility, such as package size, flavor, brand, or a combination of attributes. Instead of requiring an exact match, researchers can pick a suitable item to be priced from a narrow range of closely related items.

The tradeoff of broader food item definitions is that food items will be less comparable across retailers and geographic areas. A balance must be struck between

having narrowly defined group of items that are not so narrow as to preclude selection of items for comparison (Kaufman et al., 1997). For example, BLS places some restrictions on package size and product characteristics and then randomly selects an item from a food category in each sample store, with higher selling items assigned a higher probability of being selected. Other studies use a nationally representative sample of items that allow for brand and package size differences between stores, while limiting the range of acceptable items to avoid unlike comparisons (Kaufman and Handy, 1989). A common decision is to collect price information on the product with the lowest unit price, irrespective of brand and package size. Researchers must recognize that doing so means that they may be comparing the price of private label or generic brand products in large package sizes from larger retailers with national brand products in smaller package sizes from smaller stores.

Food item lists of existing studies may be chosen based on topical interest, such as nutritional quality, rather than representativeness. For example, the NMES-S is designed for detailed comparisons of availability and price for a set of indicator foods that are of particular interest to nutrition and public health audiences. As a result, food lists based on topical interest may not be representative of consumer food spending patterns. Many studies use food item lists based on the TFP. While the TFP framework starts off with a combination of foods based on foods commonly eaten by low-income households, it becomes less representative of consumer food expenditures due to the incorporation of normative elements and other restrictions, such as the need to meet Federal dietary guidelines and Food Guide Pyramid serving recommendations (Wilde and Llobrera 2009; Rose 2007).

Missing Values

The presence of missing values is inevitable given the variability in food item availability across stores. A couple of *a priori* strategies were discussed in the previous section. A common *a posteriori* procedure used in the literature involves imputing missing values using sample means, such as the mean price for the item at similar stores or the overall sample mean price for the item. BLS uses regression techniques to estimate the price of missing items based on a range of product characteristics. Alternatively, some researchers conduct price analyses conditional on item availability, omitting missing items from comparisons. Significant numbers of missing prices reduces the effective sample size available for price comparisons. Missing values convey important information on the availability of food items. It is important that researchers understand the implications of imputing or discarding observations with missing price information.

Aggregation

To synthesize and summarize price information for multiple food items, researchers may want to aggregate price observations. For instance, price information could be aggregated into reference and comparison groups based on store size or format. Expenditure weights reflecting the relative importance of each food item in the overall food budget would help in assessing the overall direction and magnitude of the aggregated price difference for the entire list of food items. Without a connection to actual consumer food spending patterns, reporting average price difference for the entire list of food items gives equal weighting to each food item. Price differences for food items that account for a large share of consumer spending are weighted equally with

those that account for a small share. This makes it difficult to gauge the practical significance of price differences in aggregate.

In the existing literature, aggregated price comparisons either exclude missing observations completely, by performing calculations conditional on item availability, or impute values for these missing observations. By taking an all-or-nothing (excluding or replacing) approach to missing values, existing methods lose some of the nuance that missing values convey about item availability. There is a need for methods that incorporate information about item availability into aggregated price comparisons.

In calculating the CPI, BLS already implements sophisticated methods to account for variations in the availability and price of goods and services over time and variations in aggregate consumer demand. There is potential for community price studies to adopt methods from existing work on consumer price indexes. The task of community food price studies is analogous, except that instead of variations over time, the concern is with variations across retailers. Instead of reference and comparison periods, one has reference and comparison groups of stores or geographic areas. Rather than changing weights to reflect changing consumer demand over time, one could adjust weights to reflect variations in the availability of food items. Below, we draw on the National Research Council report on cost-of-living and price indexes (National Research Council [NRC], 2002) and review some of the concepts from consumer price index construction that are most applicable to community food price studies.

A fixed-basket price index is based on a constant basket of goods and services and measures changes in the cost of purchasing that basket over time. Alternatively, the weights assigned to prices can change as consumers substitute between goods and

aggregate spending patterns change. The concept of the price index market basket is very similar to the food lists used to collect community price information.

The two most important versions of price indexes are the Laspeyres index and Paasche index. The Laspeyres index compares the cost of buying the reference period basket at reference period prices and at the new comparison period prices. The Paasche index compares the cost of buying the comparison period basket at comparison period prices to what it used to cost at reference period prices. The two indexes can be written as follows:

Laspeyres Index

$$P_L = \frac{\sum(p_{c,t_n} \cdot q_{c,t_0})}{\sum(p_{c,t_0} \cdot q_{c,t_0})}$$

Paasche Index

$$P_P = \frac{\sum(p_{c,t_n} \cdot q_{c,t_n})}{\sum(p_{c,t_0} \cdot q_{c,t_n})}$$

where P is the relative index of the price levels in two periods, p are the prices, q are the quantities or weights, c is the good or service, t_0 is the reference period, and t_n is the comparison period. The key difference is that the Laspeyres index uses the reference period quantities (weights) while the Paasche index uses the comparison period quantities (weights).

In community food price work, one could replace the reference and comparison period with reference and comparison groups of stores. For instance, the reference group could comprise supermarkets or large food stores, while the comparison group could comprise convenience stores or small food stores. Rather than changing weights or

quantities to reflect changing consumer demand over time, weights could change to reflect variations in availability or quantities across reference and comparison groups of stores.

Applied to the community food price context with large stores serving as the reference group and small stores serving as the comparison group, the Laspeyres index would compare the cost of purchasing the basket of goods available at large stores (reference weights) at large store prices (reference prices) to the cost of the basket of goods available at large stores (reference weights) at small store prices (comparison prices). Because many of the food items available at large stores will be missing at small stores, calculating the cost of the large store basket at small store prices will result in many missing values. In this scenario, adapting the Paasche index construction would be more appropriate. With the Paasche index construction, one would calculate the difference between what it would cost to buy the basket of goods available at small stores (comparison weights) at large store prices (reference prices) and what it would cost to buy that same basket (comparison weights) at small store prices (comparison prices).

Section 3: Price Differentials across Retailer Types

The question of whether low-income Americans face price differentials in the food environment is a more recent strand of a broader area of inquiry concerning the definition and measurement of environmental price differentials. The interest in environmental price differentials was energized a few decades ago by debates over the existence of price discrimination on big expense items like housing, loans, and

automobiles (Hayes, 2000). There was concern that low-income neighborhoods faced price discrimination and paid higher prices for lower quality goods and services.

Current research and policy debates have been driven by an interest in community food access and food deserts. The 2008 Farm Bill defined a food desert as an "area in the United States with limited access to affordable and nutritious food, particularly such an area composed of predominantly lower income neighborhoods and communities" (Title VI, Sec. 7527). Understanding variations in the availability and price of food across different types of retailers can help inform decisions on how to improve individuals' and communities' access to healthful food. The Healthy Food Financing Initiative (HFFI) allocates federal funding to projects that increase access to healthful, affordable food in underserved communities, including developing and equipping grocery stores, small retailers, corner stores, and farmers markets selling healthful food. Information on variations in food availability and price across geographic areas and retailer types can help policymakers target funding to where it is most needed or effective.

An estimated 9.7 percent of the U.S. population, or 29.7 million people, live in low-income areas more than 1 mile from a supermarket (Ver Ploeg et al., 2012). Some researchers have found that neighborhoods that are lower income and predominantly African American have fewer supermarkets or longer distances to markets. Using data from census tracts located in areas of Mississippi, North Carolina, Maryland, and Minnesota, Morland, Wing, Diez Roux, and Poole (2002) found that there were three times more supermarkets in wealthier neighborhoods compared to the lowest-wealth neighborhoods and four times more supermarkets in predominantly white neighborhoods compared to predominantly black neighborhoods. In metropolitan Detroit, Zenk et al.

(2005) found that the average distance to the nearest supermarket was similar among the least impoverished census tracts, regardless of racial composition, but among tracts with the highest poverty rates, the average distance was 1.1 miles greater for predominantly African American tracts compared to predominantly White tracts. Dutko, Ver Ploeg, and Farrigan (2012) looked at the socioeconomic and demographic characteristics of census tracts designated as food deserts over time and found that they tended to have smaller populations, higher rates of abandoned or vacant homes, and residents with lower levels of education, lower incomes, and higher unemployment. Tracts with higher poverty rates were more likely to be food deserts compared to other low-income tracts in rural and very dense urban areas. Surprisingly, they found that racial composition and unemployment rates were not significant predictors of food deserts in very dense urban areas due to lack of variation.

Low-income Americans face slightly higher food prices than the national average, due in part to the higher density of small stores in low-income central city neighborhoods (Kaufman et al., 1997). The difference in food prices by retailer size may be due to differences in demand, fixed costs, such as property prices or cost of refrigeration equipment, transportation, distribution or logistics costs, or other reasons (Bonanno, 2012; USDA/ERS, 2009). For instance, traffic congestion may result in higher delivery costs while inventory theft may increase insurance costs. Smaller stores operating in underserved neighborhoods may enjoy monopoly rents due to lack of competition from larger food retailers (Hayes, 2000).

Policy interest in the food retail environment is motivated by a concern that disparities in food access may have consequences for nutrition and health status. Morland

et al. (2002) found that African-Americans living in census tracts with at least one supermarket were more likely to meet fruit and vegetable recommendations than those living in tracts lacking a supermarket. Rose and Richards (2004) found that households participating in the Food Stamp Program that had easier access to supermarkets tended to use more fruits. Volpe, Okrent, and Leibtag (2013) found that consumers tended to purchase a less healthful basket of food items at supercenters than at supermarkets. Based on an extensive review of 54 studies on the food environment, Larson, Story, and Nelson (2009) concluded that better access to supermarkets and limited access to convenience stores was associated with healthier diets and lower obesity rates. A more recent review by Giskes, van Lenthe, Avendano-Pabon, and Brug (2011) found that better access to supermarkets was associated with lower body mass index (BMI) or prevalence of overweight or obesity, while higher weight status was found among those with limited supermarket access.

Most of the studies reviewed by Larson et al. (2009) and Giskes et al. (2011) were cross-sectional in nature. A few recent studies of the food retail environment apply more sophisticated research design to strengthen causal claims. Chen, Florax, and Snyder (2010) adjusted for the special correlations among households who live closer to each other and found that increased access to chain grocery stores was associated with lower BMI for people in low-income neighborhoods but not higher-income neighborhoods. Using longitudinal data for both weight outcomes and food environment exposure and fixed effects models to control for some of the unobserved heterogeneity, Gibson (2011) demonstrated that the density of small grocery stores was positively and significantly associated with obesity and BMI among residents of urban areas. For individuals who

moved from rural to urban areas over a 2-year period, changes in the density of neighborhood supermarkets and small grocery stores were significantly associated with the change in BMI over that period.

Earlier studies have found that larger food retailers like supermarkets tend to offer greater variety and lower prices and are more likely to be located in suburban areas while smaller stores tend to sell food at higher prices and are more likely to be in inner-city areas. Using data on the price of approximately 50 food items at 55 food retailers in the Minneapolis/St. Paul metropolitan area, Chung and Myers (1999) found that prices at chain stores were 9 percent lower than at smaller non-chain stores, after controlling for poverty, availability, and concentration of chain stores. They concluded that store type is the most important factor in determining the price of food and that lower-income consumers pay more for food not because they live in lower-income neighborhoods but because they shop at smaller non-chain stairs, which tend to be more expensive.

Talukdar (2008) collected price information for a list of 15 food items from 115 food retailers in the Buffalo, New York. Similar to Chung and Myers (1999), an identical item approach was used. He found that prices at small corner stores were 6 to 7 percent higher than at regional and national chain grocery stores. He attributes some of the price difference to the lack of competition in inner city neighborhoods.

Andreyeva, Blumenthal, Schwartz, Long, and Brownell (2008) collected price information for 7 items at 48 food retailers in New Haven, Connecticut. They did not find a significant difference in food prices between lower- and higher income neighborhoods. Store size was a significant determinant of food prices, with small neighborhood stores charging a 51 percent price premium on average compared to supermarkets. Using a

broader range of food items and slightly different classification for stores, they estimated that food sold at small (convenience) stores was 4 percent higher than at large (grocery) stores, on average.

Block and Kouba (2006) compared the price of a basket of 102 food items at 95 food retailers located in a lower middle-income, predominantly African American, inner city neighborhood and an upper middle-income, racially mixed suburban neighborhood of Chicago. They found that discount supermarkets were the least expensive. Smaller independent grocery stores had higher prices for packaged items compared to larger chain supermarkets, but lower prices for fresh produce. They noted that the produce sold at independent grocery stores in the lower middle-income neighborhood was of poor quality.

Using information on food prices paid by a nationally representative sample of consumers in the 2006 Nielsen Homescan panel data, ERS (USDA/ERS, 2009) reported that grocery stores offer a wider range of products (brands, package size, and other attributes) for a given food item and consequently, a wider range of prices. Convenience stores had more limited options and therefore a more constricted range of prices for a given food item. On average, prices were higher at convenience stores than at grocery stores.

Many studies base their food item list on the TFP (Chung and Myers, 1999; Hendrickson et al., 2006; Cassady et al., 2007; Talukdar, 2008; Rose et al., 2009). Because it incorporates normative elements, such as conformance with Federal dietary guidance (Wilde and Llobrera, 2009; Rose, 2007), there are some concerns that the TFP is not representative of foods purchasing patterns among American consumers. Other

studies include food items determined by topical interest, such as nutritional quality, rather than typical consumer food spending patterns.

Without a connection to actual consumer food spending patterns, reporting average price difference for the entire list of food items gives equal weighting to each food item. Price differences for food items that account for a large share of consumer spending are weighted equally with those that account for a small share. This makes it difficult to gauge the practical significance of price differences in aggregate. Expenditure weights reflecting the relative importance of each food item in the overall food budget would help in assessing the overall direction and magnitude of the aggregated price difference for the entire list of food items.

Section 4: Food Price Differentials due to Nutrition and Convenience Attributes

The community food environment literature focused on food price differentials due to food attributes like nutrition or convenience is relatively new. In her review of food and nutrition environment measures, Glanz (2009) notes that few of the existing community food environment measures focused on food prices. The introduction of her NEMS-S survey instrument and protocol in 2007 has spurred some growth in the literature on food price comparisons based on nutrition attributes.

Carlson and Frazao (2012) estimated the cost of meeting overall food group recommendations and shifting consumption to food groups that Americans do not consume enough of, such as fruits and vegetables. Adherence to MyPlate food group recommendations was less costly for the grains, dairy, and fruit food groups compared to the vegetables or protein food groups. They used the NHANES to estimate the types and

quantities of foods consumed. Food quantities were matched to food prices in USDA's Center for Nutrition Policy and Promotion (CNPP) food prices database. Information from USDA Food Pattern Equivalent Database was used to classify foods into their corresponding MyPlate food group.

Rather than comparing costs across broad MyPlate food groups, Todd, Leibtag, and Penberthy (2011) focused on price differences between healthy and less healthy options within specific food groups. They looked at seven healthy food groups, namely whole grains, dark green vegetables, orange vegetables, whole fruit, low-fat milk, fruit juice, and bottled water, and compared their prices with the prices of less healthy alternatives. They found that not all healthy foods are more expensive than less healthy alternatives. While whole grains and fresh and frozen dark green vegetables were more expensive than their less healthy counterparts in all markets (refined grains and starchy vegetables), orange vegetables and low fat milk were less expensive than their less healthy alternatives (starchy vegetables and whole and 2% milk) in some geographic market areas. Price data (price per 100 grams) came from the Quarterly Food-at-Home Price Database (QFAHPD), which are derived from Nielsen Homescan panel data and aggregated into 52 food categories and approximately 30 geographic market areas.

Using scanner data from a supermarket chain in Wellington, New Zealand, Ni Mhurchu and Ogra (2007) compared prices for 45 regular food items and their healthier alternatives and found that in there was no significant price difference between the regular basket of food items and the healthier basket. To create their market baskets, they identified the top 1,000 food items sold by sales volume and then categorized these food items with the system used in the New Zealand Adult National Nutrition Survey.

Dieticians identified additional food items within categories so that each category had 5 representative food items. For each of the food items, a healthier substitute was chosen using a principle of simple substitution. Substitute food item were essentially the same type of food as the standard item in terms of use. Similar to U.S.-based studies that use the TFP as the basis for survey food lists, the unit cost of each food item was multiplied by weekly estimated amounts of food required for a healthy individual from national data and the total for all food items was calculated. They did find that healthier options were more expensive for certain food categories like meat and poultry, butter and margarine, and cheese, while healthier options were less expensive for canned fish.

Some researchers have used community food price surveys, rather than scanner data, to examine food price differentials due to nutrition attributes. Giskes, Van Lenthe, Brug, Mackenbach, and Turrell (2007) used a survey to collect prices for 58 food items (categorized into 14 groups) at 57 Brisbane supermarkets. These food items were considered staple foods in the Australian diet and were available in choices that differed in their nutritional content. Similar to Ni Mhurchu and Ogra (2007), they used a simple substitution principle to identify healthier substitutes for each of the standard items. Nutritionally recommended items included lean or low-fat varieties, reduced salt, whole grains options. Food prices were based on the lowest price for a specified package size. They found very little variability in the availability of recommended food items, with recommended items stocked by almost all supermarkets. Availability for lean options for ground beef and chicken was the lowest among the different food items, but still high at 91 percent. Recommended items were more expensive than the regular choices for most food groups. The price premium for recommended versions of legumes, canned fruit,

beef, canned fish and margarine was 30 percent or more. The price premium was less than 5 percent for whole grain bread, whole grain rice, fat-reduced cheese, low saturated-fat solid cooking fat.

Liese, Weis, Pluto, Smith, and Lawson (2007) used a survey to collect price information on 21 food items at 77 food retailers in a rural county of South Carolina. A subset of these food items formed pairs of more healthful and less healthful options (lower fat, higher fiber). These food items were selected based on recommendations from members of a study team and were considered to be staple foods. They found that more-healthful versions of food items, such as high-fiber bread, lean beef, and lean chicken, were typically more expensive than the corresponding less-healthful version. They found that low fat and nonfat milk was less expensive than reduced-fat and whole milk.

More recently, Banks et al. (2012) used 3-day dietary recall data from a sample of 13 children in the UK with BMI at or above the 98th percentile to identify a menu of food items to be priced at neighborhood food retailers. A menu of healthier alternative food items was developed by modifying the reference menu of items so that it met national dietary guidelines on energy intake and food group recommendations. The standard and healthier food items were priced at a local budget supermarket, a mid-range supermarket, and smaller stores along the neighborhood main street. They found that the overall cost of the healthier menu was 13 percent higher at the budget supermarket, 1 percent higher at the mid-range supermarket, and 5 percent higher at smaller stores on main street.

A number of U.S.-based studies use the NEMS-S survey and protocol to compare prices of standard and healthier food items. Krukowski, West, Harvey-Berino, and Prewitt (2010) used the NMES-S to assess food prices for 10 pairs of standard and

healthier food items at 42 stores in Vermont and Arkansas. In aggregate, the cost of the 10 healthier food items was significantly more expensive than the standard food items. This was driven by higher unit prices for 100% orange juice, lean hot dogs, lean ground beef, baked chips, and whole wheat bread compared to their standard counterparts. Low-fat milk, reduced fat dinners, lower-fat baked goods, and low sugar cereals were significantly less expensive than the regular option, while diet and regular soda were priced equally.

Andreyeva et al. (2008) used the NEMS-S to collect price information for 11 pairs of standard and healthier food items at 75 New Haven food retailers. They found that the price for most of the healthier options to be higher relative to that of the standard. The price premium was greatest for baked chips, lean meat, and whole grain pasta. Healthier options for breakfast cereal, cheese, and milk were not any more expensive than the standard items.

The literature on the price of convenience attributes in food is far more limited. One study, by Stewart, Hyman, Buzby, Frazao, and Carlson (2011), used the 2008 Nielsen Homescan data to determine the price per weight or volume for 153 fruits and vegetables in fresh and processed form. Data on random-weight produce was not available. They found that processed fruits and vegetables were not consistently more or less expensive than fresh produce. For example canned carrots were more expensive than whole fresh carrots, while canned peaches were less expensive than fresh peaches. Other studies on convenience attributes in foods have focused on consumer demand for convenience foods (Capps et al., 1985; Park and Capps, 1997; Lee and Lin, 2013).

Thus far, the small but growing literature on the price premium for food attributes like nutrition and convenience has been dominated by studies based on retailer scanner data. Scanner data has the advantage of being based on actual consumer purchases and therefore representative of consumer food purchasing patterns. Scanner data are often less useful in providing detailed information on the price environment for small geographic areas or neighborhoods, since data are typically representative only at the national level or for selected geographic areas. There is also some concern about how representative the household sample of Homescan and other scanner data is, especially of low-income households (Stewart and Blisard, 2008; Fremstad, 2010).

Research based on community food price surveys is a nascent area of the literature. Because these surveys lack the direct connection to consumer purchasing patterns that scanner data have, careful attention must be paid to the method of selecting representative food items. Many previous studies suffer from non-systematic item selection. Food items are often selected based on ad hoc considerations, resulting in lists of food items that may not be representative of consumer food purchasing patterns. Some rely on expert judgment to nominate staple or commonly consumed foods for the community of interest (Liese et al., 2007) while others rely on dietary intake information from a small sample of individuals or households (Banks et al., 2012). Studies based on the NEMS-S or the TFP use food lists selected primarily for nutritional interest and include indicator foods that may be of interest from a health or nutrition perspective but may not be as important in terms of consumer expenditure.

Conclusion

Gaps remain in the literature on the food price environment, particularly with respect to methods of collecting representative food price data using community food price surveys and the role of convenience and time costs in shaping food spending patterns and food prices. This dissertation examines two of the constraining factors affecting household food choices, namely income and time resources. First, it examines the relationship between household food purchasing behavior and time constraining household characteristics. Next, it examines differences in food item availability and price between small and large food retailers. Finally, it analyzes the price differences of food based on attributes like nutrition and convenience. There is also a need for more rigorous and systematic methods for collecting food price information using community food price surveys. This dissertation addresses several methodological weaknesses in existing research. It improves the method of sampled geographic areas, retailers, and food items to ensure representativeness at each of these levels. It employs novel methods for handling variability in food item availability and missing price information. Careful attention was paid to food item comparability and distinguishing between differences in food item availability and differences in food prices when aggregating food prices.

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CHAPTER 3: RESEARCH METHODS

This chapter describes in detail the data sources and methods used in this study. The first half of this chapter describes the methods used to analyze secondary data on household food expenditures in the United States. The second half of this chapter describes the primary data collection methods used to measure variations in the price of food items by retailer size and by attributes like nutrition and convenience.

Food Spending Patterns

The goal of the first part of this study is explore and describe correlations between household characteristics that serve as proxies for the time constraints facing U.S. consumers and household food spending behavior, such as shopping frequency and food spending allocation. The CEX is conducted by the U.S. Census Bureau under contract with BLS and provides yearly information on the spending habits, income, assets and liabilities, demographic and socioeconomic characteristics of American consumers. The CEX was selected as the secondary dataset for this study because it is the only Federal survey that provides detailed and comprehensive information on the range of consumers' expenditures, as well as the characteristics of those consumers.

The CEX consists of two parts, a quarterly Interview Survey and a weekly Diary Survey, each with its own sample. The Interview component collects information on expenditures that respondents are able to recall over a time period of three months or more. Because of the relatively long time frame, this survey captures larger expenditures, such as spending on property, automobiles, and major durable goods, and those that occur on a regular basis, such as rent or utilities. The Diary component collects information on

spending occurring during two consecutive one-week periods, or a total of 14 consecutive days. This study uses public use microdata from the Diary Survey component of the 2008 CEX, because the shorter time frame of this component is designed to capture smaller, more frequently purchased items, such as food and beverages. Respondents use a diary to record virtually all expenses incurred during the two consecutive one-week periods. Participants receive each weekly diary during a separate visit by a Census Bureau interviewer.

Sampling and Data Collection

Households in the CEX are sampled using multi-stage probability design. CEX samples are designed to provide population estimates that are representative of the total civilian non-institutionalized population in the U.S. at the national and regional level. The regions are defined by the U.S. Census Bureau and include the Northeast, Midwest, South, and West. Each component of the CEX has its own sample, consisting of about 7,500 Consumer Units, or households.

The first stage of sampling involves the selection of 91 Primary Sampling Units (PSUs), which are counties or groups of counties. For the next stage of sampling, a sampling frame for households is constructed based on the 2000 Population Census file. An unclustered sample of households from each PSU is drawn in order to minimize within-PSU and overall variance.

Each household is assigned a weight indicating the number of households it represents in the U.S. population. The weight is the inverse probability of selection of the

household, with some adjustments so that sample estimates match national estimates for age/race, geographic region, and urban status.

In the Diary Survey, respondents use a diary to record virtually all expenses incurred during the two consecutive one-week periods. Participants receive each weekly diary during a separate visit by a Census Bureau interviewer. Households fill out a self-administered paper-and-pencil diary that is returned to BLS. Inconsistencies and irregularities in the data are flagged and corrected, while missing data are imputed.

Data Processing

The Diary Survey sample of the 2008 CEX includes 7,436 Consumer Units. Not all Consumer Units participate in both weeks of the survey. For analysis related to food spending shares, only units participating in both weeks of the survey with valid food expenditure data were retained. The final sample for these analyses consisted of 6,554 Consumer Units. For the analysis examining the number of shopping days, households with missing purchase date information were dropped. The sample for shopping frequency consists of 6,064 Consumer Units, of which 5,920 reported expenditures on food at home UCCs.

Data on 2008 CEX food expenditures was stored in four quarterly expenditure (EXPN) files that were combined. Information on expenditures is recorded using 6-digit Universal Classification Codes (UCC) (see Appendix A of Chapter 4). There are over 600 expenditure UCCs in the 2008 CEX, of which 165 are food and beverage related. With UCCs, it is possible to distinguish between spending on fresh apples and on fresh bananas, but not between spending on different varieties of apples. Furthermore, only

food items that capture a significant share of overall population expenditures are assigned their own distinct UCC. For example, there are distinct UCCs for apples, for bananas and for oranges, but all other fresh fruits are grouped into a single UCC, "other fresh fruit."

The variable for household shopping frequency was based on information on the number of days a Consumer Unit shops for a food item or group of food items during a given time period. CEX Diary Survey respondents record the date of reported expenditures, but not the time. While it is not possible to precisely count the number of times a Consumer Unit shops for a given food item or group of food items, it is possible to determine whether the Consumer Unit made a relevant purchase on a given day. The number of shopping days is defined as the total number of days during the 14-day diary period that the Consumer Unit reported expenditures on food at home.

Food spending shares were calculated for each Consumer Unit by dividing total spending on the food category of interest over the 14-day survey period by the appropriate denominator, either total spending on all food or all food at home. The food category of interest was defined by UCC or an aggregation of UCCs (see Table 3.1).

Table 3.1 Universal Classification Code Ranges for Food Comparison Pairs

	Universal Classification Code Range
Broad Comparison	
All Food	10110-190926
Food at Home	10110-180720
Intermediate Comparison	
Vegetables (excluding juices)	120110-120410; 140110-140340
Prepared Food	180110-180220; 180611-180710
Narrow Comparison	
Fresh Vegetables (excluding juices)	120110-120410
Processed Vegetables (excluding juices)	140110-140340

CEX information on household demographic characteristics are stored in the Family (FMLY) file. Explanatory variables extracted for this study contained information on

household structure, household size, presence of children, presence of elderly members, full-time work status, and vehicle ownership. Additional control variables were extracted containing information on income, participation in SNAP, respondent's age, race/ethnicity, educational attainment, urban/rural residence, and Census region. These demographic variables were merged with expenditure data using the unique Consumer Unit ID.

Analysis

All analyses were performed using STATA version 10.1 (Stata Corp., 2007). The Diary Survey provides 45 different weights for each Consumer Unit. The final weight, which is a weight for the total sample, was used to generate point estimates for demographic characteristics and total and mean expenditures. The other 44 replicate weights were used to estimate variances.

Replicate weights are a set of variables containing the information needed to correctly compute variances of point estimates when analyzing survey data with complex sampling design. The replicate weight method protects the privacy of survey respondents because users of the public use files are still able to account for complex sampling design without knowing the PSU and strata of survey respondents.

The number of shopping days is a count outcome. Estimating this limited dependent variable using linear regression can result in estimators that are inefficient, inconsistent, and biased (Long 1997; Wooldridge 2003). A more appropriate model is the Negative Binomial Regression Model (NBRM), which was used to test the statistical significance of demographic correlates. Multivariate Ordinary Least Squares (OLS)

regression models were used to test the significance of demographic correlates of food spending shares.

Primary Data Collection: Community Food Price Survey

To measure variations in the price of food items by food retailer size and by attributes like nutrition and convenience, primary data was collected from 120 food retailers across the Boston metropolitan area from September 7 to December 16, 2011. The following sections describe the sampling plan, the survey instrument, data collection protocol, and data cleaning process used for this study.

Sampling

A systematic research design was developed and implemented to ensure representativeness of sampled geographic areas, food retailers, and food items. Sampled areas were representative of the areas where people lived. Sampled stores were selected using balanced approach that matched two small stores to a large store from each survey cluster to ensure that the sample of small stores and large stores came from comparable competitive environments. The selected food items were representative of food spending and consumption patterns among U.S. households. We adopted several elements of the BLS price measurement methods, but modified them to make the methods accessible to individuals and community groups with limited time and financial resources.

Sample Size Calculation

At the time that methods for this study were being developed, only one comparable study provided detailed statistics that could be used to calculate the

appropriate sample size for this study. Chung and Myers (1999) estimated that a market basket based on the TFP cost $110 at smaller non-chain food retailers and $93 at larger chain food retailers, or a $17 difference with a reported t-statistic of 2.88. Because separate standard deviations for non-chain and chain food retailers were not reported, the standard deviations were assumed to be roughly equal. The derived standard deviation was 16. A recommended minimum sample size of 28 retailers per comparison group was derived using Magnani's formula for detecting a difference in means and assuming an alpha of 0.05 for a two tailed test, a beta of 0.8 corresponding to the desired power, and a cluster design effect of 2. To allow for denials and store closings, the target sample size for each comparison group was increased to 40. Because the expected variance in prices at small stores was expected to be larger than that for large stores, the target sample size of small stores was doubled to 80. The target sample size was increased by 10 percent to allow for store closures and denials, resulting in a final target sample size of 44 large stores and 88 small stores.

The target sample size for this study was comparable to the sample size of other studies examining food price variations across different retailer types. For instance, Andreyeva, Blumenthal, Schwartz, Long, and Brownell (2008) based their study of food retail prices on a sample of 19 grocery stores and 56 convenience stores.

Selection of Geographic Areas

Geographic areas were sampled in a way that accounts for variations in socioeconomic and demographic characteristics across the study area and prioritizes areas where people tend to live. Census tracts were chosen as the geographic units of analysis

in order to facilitate comparisons with existing policy discussions about food access that rely on tract-level analyses. For instance, USDA's online interactive "Food Desert Locator" uses census tract characteristics to identify food deserts, while the HFFI uses this tract-level food desert classification system to allocate grants and loans to low-income communities with low food access. The New Markets Tax Credit program administered by the Department of Treasury also uses census tracts to allocate broader community development and revitalization tax credits. Census tracts generally have between 1,500 and 8,000 people, with an optimum size of 4,000 people.

The study area is the greater Boston metropolitan area, with Route 128 delineating the outer boundary of the study area. The study area is bounded by the Boston Harbor to the east, Route 128 to the west, the Porter River and Beverly Harbor to the north, and Route 1 and the southern boundary of Quincy to the south. The study area includes Suffolk County and parts of Essex, Middlesex and Norfolk Counties, but excludes the Boston Harbor Islands National Recreation Area.

The sampling frame consisted of the 464 census tracts. Tract-level reference maps, population estimates, and population-weighted centroid coordinates from the U.S. Bureau of Census were used to build the sampling frame. Census tracts with population-weighted centroids falling within the study area boundaries were included in the sampling frame. Using Probability Proportional to Size (PPS), 40 census tracts were selected from the sampling frame to serve as the PSUs for this study. Census tracts with greater population size were given greater probability of selection.

Selection of Food Retailers

Food retailers were sampled in clusters, or triplets of one supermarket and two nearby small retailers, to represent the food retail environment in the study area. This balanced or matched sampling method was meant to ensure that the small and large retailers in each cluster belonged to similar competitive environments.

For each sampled census tract, the coordinates of the tract's population-weighted centroid were converted into a street address using Google Maps. The Food and Nutrition Services (FNS) SNAP Retailer Locator online mapping tool was used to identify authorized SNAP retailers (USDA/FNS, 2010a) located within a 1-mile radius around the tract's population-weighted centroid (using the street address) and a list of authorized SNAP retailers located within that radius was compiled.

The sampling frame for food retailers included large food retailers, namely supermarkets, large grocery stores, and super stores, and small food retailers, namely small and medium grocery stores, convenience stores, and combination grocery/other stores. Each of the included retailer types accounted for at least 1 percent of total SNAP redemptions in 2010. As Table 3.2 shows, SNAP Redemptions at these types of food retailers comprised nearly all (98 percent) of all SNAP redemptions nationally in 2010 (USDA/FNS, 2010b). The sampling frame excluded specialty retailers with a more limited range of products that receive only a small share of expenditures on food for preparation and consumption at home, such as bakeries, seafood specialty stores, meat/poultry specialty stores, and farmers' markets.

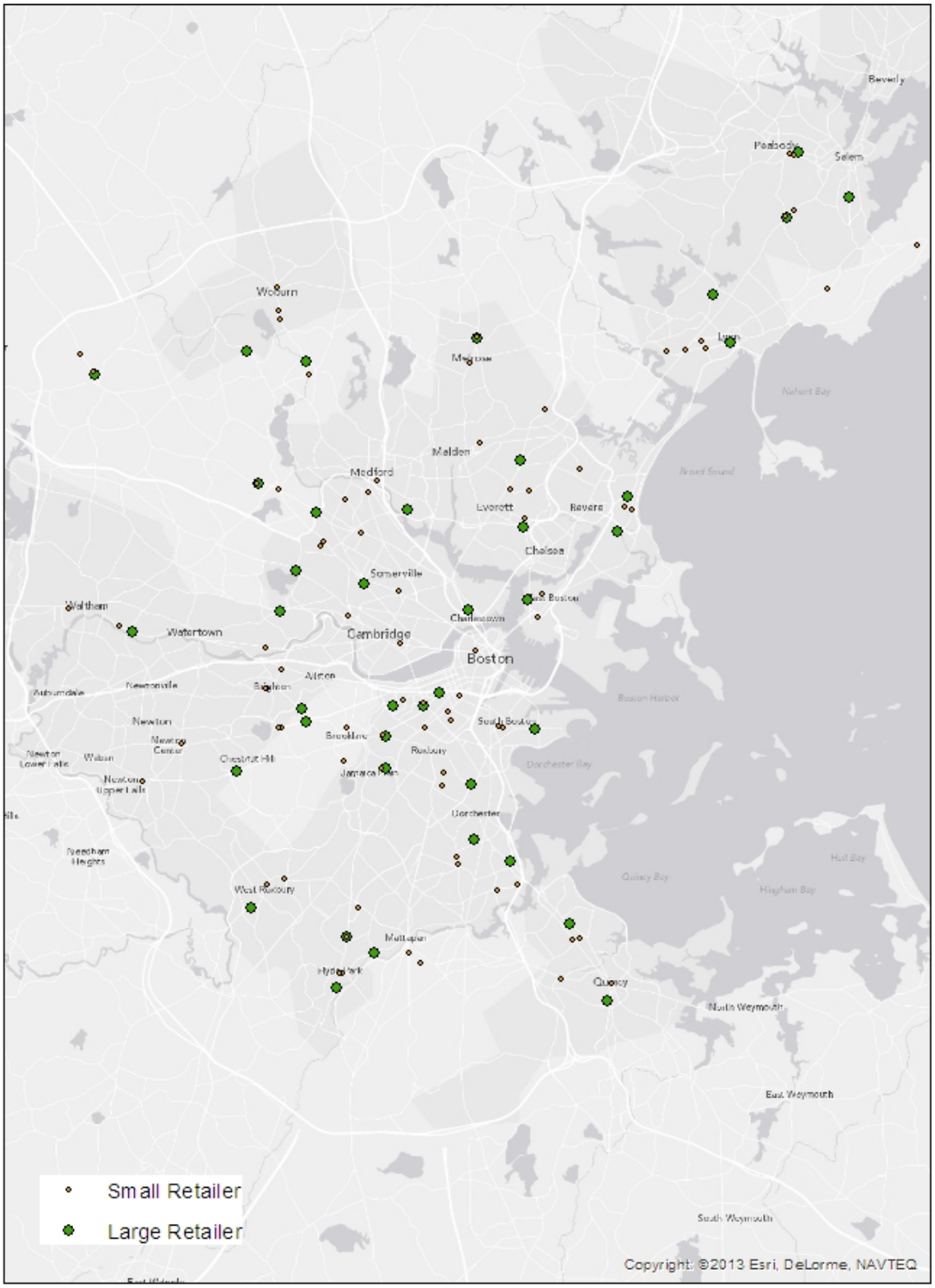
Table 3.2: SNAP Retailer Redemptions in 2010, by Firm Type

Firm Type	Authorized Stores	Share of Retailers	Redemption Amounts	Share of Redemptions	Cumulative Share of Redemptions
Super Store	18,117	8.5%	$31,497,486,673	49.0%	49.0%
Supermarket	18,659	8.8%	22,276,404,205	34.7%	83.7%
Combination Grocery/Other	49,008	23.0%	2,743,081,127	4.3%	87.9%
Convenience Store	78,754	37.0%	2,716,861,801	4.2%	92.2%
Medium Grocery Store	11,182	5.3%	1,455,281,116	2.3%	94.4%
Small Grocery Store	16,994	8.0%	1,194,210,573	1.9%	96.3%
Large Grocery Store	3,582	1.7%	1,072,253,369	1.7%	97.9%
Meat/Poultry Specialty	4,584	2.2%	575,885,252	0.9%	98.8%
Bakery Specialty	4,439	2.1%	215,310,018	0.3%	99.2%
Seafood Specialty	2,370	1.1%	210,031,735	0.3%	99.5%
Delivery Route	1,087	0.5%	146,247,970	0.2%	99.7%
Fruits/Veg Specialty	1,963	0.9%	119,054,142	0.2%	99.9%
Non-Profit Food buying Co-op	463	0.2%	38,877,386	0.1%	100.0%
Farmers' Market	1,611	0.8%	7,547,028	0.0%	100.0%
Wholesaler	21	0.0%	5,725,848	0.0%	100.0%
Total	212,834	100.0%	$64,274,258,243	100.0%	

Source: 2010 Annual Report, SNAP Benefit Redemption Division

The list of retailers located within the 1-mile radius was stratified into large stores and small stores. We used information from the food retailer name, Google Maps, and the Yellow Pages online directory to determine whether the food retailer was a large or small retailer. Large retailers typically belonged to national or regional supermarket chains. From the list of large stores located within the 1-mile radius, one large store was randomly sampled. If there were no large stores within the 1-mile radius, the radius was expanded to 2 miles. For two census tracts, the radius had to be expanded to 2 miles. Similarly, from the list of small stores located within the 1-mile radius, two small stores

Figure 3.1 Map of Study Area and Sampled Stores



Data sources: ESRI and USDA Food and Nutrition Service
SNAP retailer location information from August 2011.

were randomly selected. If an insufficient number of small stores was located within the 1-mile radius, a 2-mile radius was used. The radius had to be expanded to 2 miles for four census tracts.

The final retailer sample included 40 large retailers and 80 small retailers for a total of 120 food retailers. A map of the stores included in the sample is provided in Figure 3.1. Census tracts with larger populations were more likely to be sampled as primary sampling units. This was intended to make the sample representative of the areas where people tend to live. The pattern of triplet or matched sampling of one supermarket and two nearby small retailers is visible in the map. Triplets of stores were sampled to represent the food retail environment in the study area. The balanced or matched sampling method was meant to ensure that the small and large retailers in each cluster belonged to similar competitive environments. This facilitates comparisons across retailer size by holding constant observable and unobservable tract-level confounding variables. All other stores comprising the sampling frame for small and large stores that were not initially sampled were compiled into a list of backup stores. Replacements for store closures, relocations, or denials were drawn from this list, as discussed in the section on data collection below.

Selection of Food Items

The typical U.S. consumer has diverse options when choosing what food items to buy and where to make those purchases. The overall goal was to generate a set of food items that are representative of U.S. food at home spending and consumption patterns and provide sufficient coverage and detail on important categories of food at home spending,

without making data collection excessively burdensome. This required the development of a systematic and replicable method of grouping food items, selection of representative food items for those groups, and collection of information on the availability and price of representative food items across food retailers of different sizes. Food group definitions and hierarchy used by BLS to collect and report on food price data for its CPI series were adopted to identify a manageable set of food items. Further modifications were designed to make the methods more suitable for community price survey data collection by individuals and community groups with an interest in community food access issues but with limited time and financial resources.

The decision to emulate BLS methods was motivated by two main considerations. First, BLS has already developed a hierarchical system of grouping food items, which are used to synthesize and report information on the diversity of food items purchased by U.S. consumers. Household expenditures, including those on food, are grouped by 6-digit Universal Classification Codes (UCCs). This hierarchical system already has existing policy applications and is used by BLS in its annual published Consumer Expenditure Shares tables. BLS also uses this hierarchical system in its published monthly CPI reports. Further detail on the hierarchical system of food grouping used in this study is provided below.

Step 1: Identify broad food groups

In its published Consumer Expenditure Shares tables, BLS disaggregates CEX data on food at home spending by American households into 18 broad categories, which are call broad food groups for the purposes of this study. The spending shares of all 18

broad food groups are mutually exclusive and exhaustive of food at home spending. The first two digits of the UCC indicate the broad food group. They are relatively broad, but are narrower than the 6 MyPlate food groups (fruits, vegetables, grains, protein foods, dairy, and oils). Excluded from this study are expenditures on alcoholic beverages. Some examples of broad food groups are cereal and cereal products, beef, and fresh vegetables. Data collected for this study included at least one representative food item from each of the 18 broad food groups.

Step 2: Identify narrow food groups

The CEX includes expenditure data for multiple narrow food groups within each of the broad food groups, with each one designated by a unique 6-digit UCC. Refer to Appendix A of Chapter 4 for a full list of food expenditure UCCs. Because there are approximately 100 narrow food groups, collecting data for at least one representative food item from each of these narrow food groups would be unmanageable given a nontrivial number of food retailers. This study includes narrow food groups comprising at least 15 percent of spending within their respective broad food group, which reduced the list to 42 narrow food groups. Using this threshold approach captured the most important narrow food groups within each broad food group, but excluded relatively minor narrow food groups to make data collection more feasible. In a few instances, two or more closely related narrow food groups were consolidated to simplify and shorten the list of narrow food groups. For instance, “round steak” (UCC 030510), “sirloin steak” (UCC 03610), and “other steak” (UCC 030710) were combined to form the narrow food group called “steak”. See appendix table 1 for other instances. Note that for a given broad food

group, adding up the spending shares for the top narrow food groups does not sum to 100 percent.

Step 3: Identify representative food items

Narrow food groups were not sufficiently disaggregated to make primary data collection by an individual or small group of individuals practical. Even though each narrow food group, defined by a unique UCC, included closely related foods, there was often enough diversity within most narrow food groups to make data collection challenging. For instance, the narrow food group "pasta, cornmeal, and other cereal products" (UCC 010320) would require data collectors to move back and forth between different aisles or sections of a store in order to make price comparisons. To lessen the burden of primary data collection, representative food items were identified for each narrow food group. The definition of these representative food items had to be sufficiently narrow so that data collectors could scan a contiguous shelf or aisle to make price comparisons.

CEX data were supplemented with dietary intake data from the 2007-2008 NHANES to identify the most commonly consumed food item for each narrow food group. The most commonly consumed food item by weight within each narrow food group was designated as the representative food item for that narrow food group. For example, apple juice was designated as the representative food item for "canned and bottled fruit juice" narrow food group because it was the most consumed fruit juice. NHANES dietary intake data use the 8-digit USDA Food Code to identify food and beverages consumed. The first 3 digits of the USDA Food Code roughly correspond to

the UCC level of the CEX. Appendix Table 3.1 provides a crosswalk between 6-digit UCCs to the first 3 digits of USDA food codes.

In general, each narrow food group has a corresponding representative food. However, for vegetables, more than one representative food item per narrow food group was identified. Additional detail on vegetables, especially fresh vegetables, was collected because they are of particular interest when assessing not only the quality of the food environment, but also the diet quality of individuals.

After developing the hierarchical food grouping system and identifying representative food items for each food group, operational definitions for each food item were created to guide data collection. Food items were narrowly defined but with flexibility on brand and package size attributes. This improved comparability between small and large stores by reducing missing values, but still limited the range of acceptable items to avoid unlike comparisons (Kaufman and Handy, 1989). For instance, the food item "spaghetti" was defined to encompass spaghetti pasta of any brand or package size, including thick, thin, and regular varieties but excluding whole wheat or whole grain varieties.

Appendix Table 5.1 of Chapter 5 lists the 49 food items included in the final list of representative food items. To measure food price variations based on food attributes like nutrition and convenience, information on the availability and price of 19 additional substitute food items was collected. Each of these substitute items was closely related to a standard food item and belonged to the same narrow food group. Preferably, the substitute item was as similar as possible to the standard item in all respects except for nutrition or convenience attributes. In total, information on the availability and price for

68 food items was collected, including 15 pairs of food items for making comparisons based on nutritional attributes and 9 pairs for making comparisons based on convenience attributes.

Instrument and Protocol

After establishing the operational definition for each of the 68 food items, a food price survey instrument and data collection protocol were drafted. Pilot testing was conducted in July 2011 at two small retailers and two large retailers located near the data collector's home. Based on results from the pilot testing, the survey instrument was reorganized to increase data collection efficiency in several respects, such as listing foods by supermarket aisle. Formatting was revised to facilitate clear and efficient note taking. The operational definitions of food items were refined to reduce and simplify the number of decisions necessary during data collection, such as procedures to break ties. Based on the time required to collect data during pilot testing, it was estimated that the entire sample would require roughly 40 days, with each large store requiring 0.5 person-days and each small store requiring 0.25 person-days.

Most community food price studies rely on one set of prices, typically the lowest price option. Using the price of the lowest priced product will often compare small sizes of branded items in small stores to large sizes and private-label items in large supermarkets (Kaufman, MacDonald, Lutz, and Smallwood; 1997). Price information on products with the most shelf space was collected to help control for package size and brand differences between small and large stores without having to explicitly match food items on brand and package size.

A food item may be sold in one or more forms or products. A product is a unique combination of a brand, product line extension and package size or weight. For each food item, three sets of prices were collected: the price of the lowest priced product, the price of the product with the most shelf space, and the price of the product with the second most shelf space. In many cases, the product with the lowest unit price may also be the product with the most shelf space or the second most shelf space. The lowest unit price was determined using unit price information posted on shelves and double-checked for accuracy using a calculator. Similar to the approach of Farley et al. (2009), shelf space was determined by assessing the width, but not the height or depth, of the shelf space or display case occupied by the product. In many instances, this simply involved a visual inspection of the shelf space. The price recorded was based on the price displayed either on a sticker applied to the product or posted on the display shelf, reflecting any sales or discounts (including store loyalty discounts) but excluding any discounts requiring coupons. Ties for lowest unit price or shelf space were broken by systematically assigning numbers (starting from 1) to products involved in the tie and then using the random number generated by the calculator to select one of the tied products randomly.

The survey included the following fields:

- Check boxes indicating that the product was the product with the lowest unit price, the most shelf space, or the second most shelf space;
- Check boxes indicating that the product was a private label or national brand;
- Space to record the price of the product;
- Space to record the package size and units;

- Space to record the unit price ($/lb or $/gallon);
- Check boxes indicating that the product was on sale or not;
- Check boxes indicating that the product was organic or not (for fresh produce only);
- Space to record additional comments.

See Appendix 1 of this dissertation for the complete survey instrument and field manual. The Tufts University Institutional Review Board (IRB) at Medford deemed the instruments and protocol for this study exempt from review (IRB Study # 1012050)

Data Collection and Management

In general, food retailers were visited one PSU cluster at a time. Data collection was conducted between 9am and 4pm. This schedule helped ensure that items had been stocked for the day and had not sold out. This also facilitated efficient data collection by avoiding busier times of the day (4-7pm). Each PSU cluster typically required one day of fieldwork. Data collection began on September 7, 2011 and ended on December 16, 2011.

For large retailers, data were collected by dictating and recording information using the voice memo feature on a mobile phone. Data were transcribed immediately afterwards, usually in the parking lot of the retailer. A second visit was conducted immediately after transcription to acquire or verify additional information. For small retailers, a cover letter and short verbal introduction was provided to the store manager or employee, explaining the purpose and process of the visit. At five small retailers, store staff ultimately declined participation in the data collection, even after an appeal was

made to the manager. These retailers were replaced by randomly selecting replacements from the appropriate sampling frame.

One retailer had gone out of business and was replaced by randomly sampling another food retailer of the same type from the sampling frame. After in-person visits, we discovered that two retailers were initially assigned to the wrong stratification group (assigned to small retailer group but was actually a large retailer). The sampled stores were replaced by randomly sampling replacement food retailers of the appropriate type.

To ensure accuracy of data entry, survey data were entered twice and discrepancies were flagged, manually inspected and compared with original survey forms. Observations with outlier values were flagged and manually inspected for accuracy. Observations were flagged as outliers if the recorded unit price was more than 1.5 interquartile ranges below the first quartile or 1.5 interquartile ranges above the 3rd quartile for that food item.

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Appendix Table 3.1: Crosswalk between UCC and USDA Food Codes

UCC	USDA Food Code (First 3 Digits)	Narrow Food Group
10210	570-574	Ready-to-eat and cooked cereals
10320	561	Pasta, cornmeal and other cereal products
10310	562	Rice
20210	511	Bread
20310	510-524	Biscuits and rolls
30110	215	Ground beef
30510, 30610, 30710	211	Steak
30210, 30310, 30410	214	Roast
40310	223	Ham, not canned
40210	221	Pork chops
40110	225-226	Bacon
40510	252	Sausage, not canned
50110	252	Frankfurters, not canned
50210	252	Bologna, liverwurst, salami; not canned
60210	241	Fresh and frozen chicken parts
60110	241	Fresh and frozen whole chicken
60310	242-244	Other poultry
70230	261-263	Fresh fish and shellfish
70240	261-263	Frozen fish and shellfish
80110	311	Eggs
90110	111	Fresh milk, all types
100210	140-146	Cheese
100410	131-132	Ice cream and related products
100510	114	Miscellaneous dairy products
110110	631	Apples
110210	631	Bananas
130212	612, 641	Canned and bottled fruit juice
130310	611, 621, 631-632	Frozen, dried, and canned fruits
130211	612, 641	Fresh fruit juice
120110	710-719	Potatoes (starchy)
120310	741	Tomatoes (other)
120410	721-722	Other fresh vegetables (dark green)
	731-734	Other fresh vegetables (orange)
140110, 140220, 140230, 140310, 140340		Frozen, dried and canned vegetables
	721-723	(dark green)
	731-734	(orange)
	710-719	(starchy)
	741-756	(other)
140210, 140320, 140330	411-413	Beans and peas
150110	917-918	Candy and chewing gum
150310	913-914	Jams, preserves, other sweets
160211	811-821	Fats and oils
160212	831-832	Salad dressings
160310	113, 122	Nondairy cream and imitation milk
180310, 180320	421, 544, 712	Potato chips, nuts and other snacks
170110	924	Cola
170532	941-942	Bottled water

CHAPTER 4: TIME-CONSTRAINING HOUSEHOLD CHARACTERISTICS ARE ASSOCIATED WITH LESS FREQUENT SHOPPING AND GREATER SPENDING ON MORE CONVENIENT FORMS OF FOOD

Joseph T. Llobrera

Corresponding Author:

Joseph T. Llobrera

Food Policy and Applied Nutrition Program

Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy

Tufts University

150 Harrison Avenue, Boston MA 02111

Phone: 627-600-8046

Email: Joseph.Llobrera@tufts.edu

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ABSTRACT

Failure to account for the labor and time costs of purchasing and preparing low-cost but healthy meals may lead to underestimates of the full cost of nutritious diets and overly optimistic assessments of their feasibility and appropriateness for certain low-income households. This study used CEX data to examine the relationship of household structure, vehicle access and several other variables that serve as proxies for household time constraints with household food spending behavior. Outcomes included shopping frequency for food at home and food spending shares. For food spending shares, we ran models for food spending at three different levels of aggregation and examined spending on pairs food categories that are expected to be sensitive to time constraints but in opposite directions due to differences in convenience or time-saving attributes. Household structure was the most consistent, and in several cases the most practically significant, predictor of food shopping patterns. Compared to married couple households, single-adult households shopped less frequently and allocated more of their food budget to food away from home and prepared food and less on food at home, vegetables of all forms, and fresh vegetables. Households with more children shopped less frequently, spent more of their food dollars on prepared food and less on vegetables. Vehicle ownership had a positive effect on the number of shopping days and was correlated with increased spending shares on prepared food, while full-time work status was correlated with fewer shopping days and a greater share of the food budget being allocated to food away from home and on processed vegetables.

Introduction

Understanding the relationships between time-constraining household characteristics and food spending behavior is important for policy makers, nutritionists and anti-hunger advocates interested in the cost of a nutritious diet and assessments of the food price environment. If there is a strong relationship between household characteristics that are closely tied to time resources and food spending outcomes, then failure to account for the labor and time costs of purchasing and preparing low-cost but healthy meals may lead to underestimates of the cost of nutritious diets and overly optimistic assessments of their feasibility and appropriateness.

In their 2013 report on the adequacy of the SNAP benefit, the IOM and NRC assert that time-constrained households need more monetary resources to purchase more convenient and easy-to-prepare foods (Institute of Medicine [IOM] and National Research Council [NRC], 2013). In order to evaluate proposals like this, the relationship between household time constraints and food purchasing patterns must be established. Furthermore, policy interventions would benefit from analysis that is able to distinguish households that are comparatively more or less time-constrained.

To address this empirical question, we use data from the Consumer Expenditure Survey (CEX) to investigate the relationship between household time resources household food spending behavior. We compare some food spending outcomes for households that are expected to be comparatively more and less time-constrained. Significant differences in food spending pattern could indicate that time-constrained households purchase a basket of food items different from those that are less time-constrained, with potential cost and nutrition implications. For instance, it may feature a

greater allocation of the budget to more convenient forms of food, which could entail a price premium. A household that is time-constrained could choose to make larger but less frequent shopping trips. This shopping pattern may allow these households to take advantage of quantity or bulk discounts.

First, we identify a set of explanatory variables that serve as proxies for the time constraints facing U.S. consumers and their relationship to household food spending behavior. Our overall strategy is to study several different food spending outcomes that are especially interesting because they may affect the nutrition quality of the diet, and they may be affected by explanatory variables that reflect the severity of time constraints. We identify a set of six household characteristics that are closely tied to the time resources of households. These include characteristics related to the composition of the household, namely household structure, household size, number of children, and number of elderly members, and variables affecting the opportunity cost of time for the household, namely full-time work status and vehicle ownership.

We then estimate regression models where the six variables related to household time constraints are the main explanatory variables of interest and two different food spending outcomes are the dependent variables. The first outcome is the number of grocery shopping days during a two-week period, which serves as a measure of food shopping frequency. Characteristics that constrain household time resources are expected to reduce the number of shopping days. The second outcome is food spending share for selected food groups that may be sensitive to time constraints. For this outcome, we run models for food spending at three different levels of detail. We examine spending on

pairs of food categories requiring contrasting levels of labor and time resources in order to highlight the choices consumers make based on the convenience attributes of food.

- At the broadest level, we look at spending on food at home as a share of total food spending. Time-constraining household characteristics are expected to reduce the share of food at home spending and, by definition, increase the share of food away from home spending.
- At an intermediate level, we compare spending on fresh and processed vegetables as a share of food at home spending with spending on prepared food of all types as a share of food at home spending. Time-constraining household characteristics are expected to increase the share of food at home budget going to prepared food and reduce the share going to vegetables, which generally require more preparation time before they can be eaten.
- Finally, at the most detailed level, we compare the share of food at home spending allocated to fresh vegetables to the share allocated to processed vegetables. Time-constraining household characteristics are expected to increase the share of their food at home budget going to processed vegetables and reduce the share of their food at home budget going to fresh vegetables, which may require more preparation time to clean, slice and prepare.

While this analysis could be conducted for a more comprehensive set of food items or groups, we select pairs of foods that are expected to be sensitive to time constraints but in opposite directions due to differences in convenience or time-saving attributes. Although differentiating the selected food items based on convenience attributes is possible given the structure and detail of the CEX data, not all foods in the

CEX can be distinguished based on convenience or time-saving attributes. For instance, it is not possible using CEX data to distinguish between uncooked grains like rice and their more convenient forms, such as parboiled or instant forms, in the same way one can distinguish between fresh vegetables and canned or frozen vegetables.

This study addresses the issue of household time constraints and their impact on food spending patterns in three novel ways. While there is a long history and deep literature looking at socio-demographic covariates of food expenditures (Houthakker, 1957), this study differs from previous studies by focusing specifically on household characteristics that are closely tied to the time resources of households and that can serve as proxies for household time constraints. We also identify which of the household characteristics are the most consistent predictors of spending behavior across the different food spending outcomes and have the greatest practical or economic significance. To our knowledge, this is one of the first studies to use CEX information on the date of purchase for food items to calculate the number of shopping days for food at home and examine correlations with proxies for household time constraints. While other studies have looked at visits to food away from home establishments (Binkley, 2006) or spending allocation among major food groups like fruits and vegetables (Ziol-Guest, DeLeire, and Kalil, 2006), this study is unique in its attention to consumer choices based on the convenience attributes of food. It does so by comparing spending on food categories requiring different levels of labor and time resources in order to highlight consumer response to time constraints.

One of the existing methods for assessing food costs relies on a market basket approach, which involves selecting a set of food items to be priced at different stores or

locations. Researchers are free to decide what items to include in the market basket and the composition of the market basket used is generally motivated by the research questions to be addressed. Those interested in the cost of a healthier diet have created market baskets featuring food items with more desirable nutritional attributes or that comprise a diet that is considered healthy (see Chung and Myers, 1999; Andrews, Kantor, Lino, and Ripplinger, 2001; Jetter and Cassady, 2006; Anderson et al., 2007). Efforts to estimate the cost of a nutritious diet have generally focused on the cost of food ingredients and have either ignored or underemphasized the time costs of purchasing and preparing these ingredients.

This exploratory research will help researchers identify households that are most likely to experience time constraints, particularly with respect to food-related activities like grocery shopping and cooking. These findings can be used to develop interventions or policies targeted at households that may experience the most time constraints. Methods for measuring food prices could be tailored to better account for the time cost of shopping for and preparing food at home. For instance, market baskets that are more appropriate for time-constrained households could be developed that feature more convenient food items or larger package sizes. The price of these more convenient market baskets could then be compared to reference market baskets to estimate the price premium for convenience attributes in food.

Background

According to consumer economics and household production theory, a household allocates its time resources between supplying its members' labor to the market and a variety of other household activities (Becker, 1965; Hamermesh, 2007). It combines these

activities with income from wages earned from the labor market and along with any other non-labor income it may receive. Households select foods and other goods to maximize utility based on their preferences or taste, subject to income and time constraints. Some of the activities the household engages in are housework devoted to food acquisition, preparation, and consumption, while some of the goods purchased are food and the capital necessary to convert that food into meals that can be eaten by household members. Time spent on other activities, such as labor or childcare, will restrict the time available for food acquisition, preparation, and consumption. Faced with time constraints, households may reduce time spent on food-related activities by purchasing convenience foods or food away from home.

Convenience foods are fully or partially prepared foods where significant preparation time, culinary skills, or energy inputs are transferred from the household to the food processor or distributor (Traub and Odland, 1979). The convenience attribute of food item can be characterized by the amount of preparation that must be performed on a food before it can be consumed (Park and Capps, 1997). Researchers have noted the rise in consumption of food away from home and convenience foods (Stewart, Blisard, Bhuyan, and Nayga, 2004; Jabs and Devine, 2006) and the coincident rise in obesity (Cutler, Glaeser, and Shapiro, 2006). The link has been attributed to the response of individuals and families to time constraints and the feeling of time pressure, seeking to reduce the time involved in acquiring and preparing food. Individuals and families may shift consumption towards relatively unhealthy prepared food, such as certain food from fast food restaurants, and away from relatively healthier ingredients, such as fresh

vegetables, that require further preparation (Guthrie, Lin, and Frazao, 2002). This creates a potential tradeoff between nutrition and convenience (Ziol-Guest et al., 2006).

Studies using time use surveys, such as the ATUS, have found a downward trend in the amount of time Americans spend preparing food (Zick and Stevens, 2010). Individuals and households with certain characteristics may face time constraints that compel them to spend even less time on food-related activities like grocery shopping and food preparation. For example, gender, work status, and presence of children have been found to correlate with time spent on food preparation and other food-related activities (Hamrick and Shelley, 2005; Cawley and Liu, 2007; Mancino and Newman, 2007).

While time use surveys like the ATUS provide information on how individuals and families allocate their time across different food-related activities, such as grocery shopping, food preparation, or restaurant visits, they usually lack detailed information on the specific types of foods being purchased, prepared or consumed. To investigate household food choices in greater detail, other studies, as this study does, rely on household expenditure data, such as the CEX, or dietary intake data, such as the CSFII or NHANES. However, these datasets have their own limitations, since they do not generally collect detailed information on time use or time resources. This study fills an important gap in the literature by using available information on household characteristics in the CEX to infer household time costs and resources and to examine the relationship of these time-related proxies to detailed food spending patterns.

First, we draw on the existing literature to identify household characteristics that can serve as proxies for household time constraints. Household structure is expected to have strong implications for the time resources of households. Others have found that

households headed by a single adult spend less time on food preparation (Mancino and Newman, 2007), spend more on food away from home (Zick, McCullough, and Smith, 1996; Stewart et al., 2004; Ziol-Guest et al., 2006), and spend less on fruits and vegetables than two-adult households (Ziol-Guest et al., 2006). The CEX variable for household structure distinguishes between households headed by married couples and those headed by a single adult. We expect that households headed by single adults will be more time constrained than those headed by married couples, since the latter may have more flexibility and ability to share household responsibilities.

Some studies have found that larger households spend less on food away from home (Stewart et al., 2004) and shop for groceries more frequently (Bawa and Ghosh, 1999), while others have found that larger households have varied schedules that results in less time preparing and eating family meals (Jabs and Devine, 2006). We expect that household size will vary in its effect on a household's time resources. Additional household members allow for greater flexibility in sharing household responsibilities, including shopping and preparing food. In this case, increasing the number of household members could potentially ease time constraints related to food acquisition and preparation. In addition, larger household size may have economies of scale effects that make food preparation at home more economical in terms of both time and cost. It allows for purchasing food in bulk sizing, which tend to cost less per unit. Labor time involved in food preparation per household member also goes down. For instance, preparing and cooking food for four people may not require much more time than cooking for three people. However, after a certain point, increasing the household size further could

increase the time constraints that the household faces as it must manage the increasingly complex task of food acquisition and preparation for a large number of people.

The presence of children and elderly members in the household is expected to influence the time resources of a household. Households with children have been found to shop for groceries less frequently (Kim and Park, 1997) and spend an increased amount of time on housework, including food-related activities (Jabs and Devine, 2006). We expect that caring for children increases the time constraints on households. The presence of elderly member could potentially increase the time resources of a household or be a time-constraining factor. Retired elderly members may have more time to attend to household functions, including food acquisition and preparation (Bawa and Ghosh, 1999). However, certain elderly members may also require additional care from other household members, increasing the time constraints facing the household. We expect that on the whole, elderly members tend to be retired and no longer working, increasing the time resources of the household and reducing household time constraints.

Studies have found that working adults shop for groceries less frequently (Kim and Park, 1997; Bawa and Ghosh, 1999), spend less time on food-related activity (Hamrick and Shelley, 2005; Cawley and Liu, 2007; Mancino and Newman, 2007), are more likely to purchase prepared food (Cawley and Liu, 2007), spend more on food away from home (Stewart et al., 2004; Binkley, 2006; Ziol-Guest et al., 2006), and are more likely to feel that time pressure is a barrier to healthy eating (Welch, McNaughton, Hunter, Hume, and Crawford, 2009). We expect that full time work among household adults will be a time-constraining characteristic, since these adults will have less time for food-related activities such as grocery shopping, food preparation and cleanup.

Vehicle access or ownership has been associated with better health outcomes even after controlling for income (Macintyre, Hiscock, and Ellaway, 2001), food security (Martin, Rogers, Cook, and Joseph, 2004), reduced consumption of fruits and vegetables (Rose and Richards, 2004), increased consumption of vegetables (Bodor, Rose, Farley, Swalm, and Scott, 2007), and less frequent shopping (Clifton, 2004). Vehicles influence the manner in which households interact with the food environment. We expect that vehicle ownership will reduce the time constraints facing a household. Access to a vehicle can reduce the time cost of traveling to and from food retailers and expand the number of food retailers that are accessible to the household. It also increases the cargo-carrying ability of the household compared to other forms of transportation, making trips to food retail more time-efficient.

Next, we consider food spending outcomes in the CEX. The first outcome is the number of shopping days. Retailing and marketing studies have found that households with certain characteristics, such as full-time employment among adults, presence of children, smaller household size, or younger household head, shop for groceries less frequently (Kim and Park, 1997; Bawa and Ghosh, 1999). In addition, a negative relationship exists between shopping frequency and market basket size (Kim and Park, 1997; Bell and Lattin, 1998; Bawa and Ghosh, 1999). We hypothesize that households with time-constraining characteristics, such as full-time employment or presence of children, are expected to consolidate their food shopping activities and shop less frequently in order to reduce the time and opportunity costs associated with food shopping.

The second outcome we look at is food spending share, or the composition of food spending.. A number of studies have looked at covariates of spending on or consumption of food away from home. Demand for food away from home is correlated to many factors, including income, household structure, presence of children, attitudes towards nutrition, and convenience (Stewart et al., 2004; Binkley, 2006). The literature on the relationship between time-constraining household characteristics and spending allocation on food at home is less extensive. Ziol-Guest et al. (2006) found differences in food budget allocation patterns between married, dual-parent households and single-parent households. We expect that households with time-constraining characteristics will allocate a greater share of their food budget to food categories that require less time to prepare and a smaller share of their budget on food categories that require more time to prepare, all else equal.

Data

The CEX is conducted by the U.S. Census Bureau under contract with BLS and provides yearly information on the spending habits, income, assets and liabilities, demographic and socioeconomic characteristics of American consumers (BLS, 2009). The survey sample is designed to provide population estimates that are representative of the total non-institutionalized population in the U.S.

The CEX consists of two parts, the Interview and Diary components, each with its own sample. The sample for each component consists of about 7,500 Consumer Units. In this study we use the terms Consumer Unit and household interchangeably. This study uses public use microdata from the Diary Survey component of the 2008 CEX. The Diary

component collects information on spending occurring during two consecutive one-week periods, or a total of 14 consecutive days. The shorter time frame is designed to capture smaller, more frequently purchased items, such as food and beverages. Respondents use a diary to record virtually all expenses incurred during the two consecutive one-week periods. Participants receive each weekly diary during a separate visit by a Census Bureau interviewer. Information on expenditures in the public use microdata is aggregated at the Universal Classification Code (UCC) level (see Appendix Table 4.1). There are 165 expenditure UCCs in the 2008 CEX related to food and beverage.

The Diary Survey sample of the 2008 CEX consists of 7,436 Consumer Units. Not all Consumer Units participate in both weeks of the survey. For analysis related to food spending shares, only units participating in both weeks of the survey with valid food expenditure data were retained. The final sample for these analyses consisted of 6,554 Consumer Units. For the analysis examining the number of shopping days, households with missing purchase date information were dropped. The sample for shopping frequency consists of 6,064 Consumer Units, of which 5,920 reported expenditures on food at home UCCs.

The CEX uses stratified random sampling with systematic sampling within the strata rather than a simple random sample. To calculate unbiased and design-appropriate standard errors using the CEX, this complex survey design must be accounted for using replication methods. These methods select sub-samples repeatedly from the full sample, calculate the statistic of interest for each sub-sample, and use the variability among the sub-samples to estimate the standard error of the full-sample statistic (Blaha, 2003). The standard errors reported in the Results section of this study were estimated using this

replication method. All regressions described below were run using STATA version 10.1 (Stata Corp., 2007).

Methods

This study examined the relationship between a set of six socio-demographic variables that serve as markers for household time resources and two different household food spending outcomes. The following linear functional form introduces the basic structure of the approach:

$Y_i = \beta_0 + \beta_1 X_i + \beta_2 Z_i + e$, where

Y_i	Food spending outcome for consumer unit *i,*
X_i	Vector of time-related explanatory variables for consumer unit *i,*
Z_i	Vector of consumer unit control variables.

Explanatory Variables

The set of explanatory variables appearing on the right-hand side are the same in each of the regression models. Six variables serve as proxies or markers for the time constraints facing the Consumer Unit and are the explanatory variables of interest. Rather than develop an index of time-constraint, we examine each characteristic individually to see if it is a significant covariate of food shopping days or food spending shares. Because the CEX does not collect actual time use information, it is not possible to estimate the effects or relationships in terms of hours or minutes in this analysis. We include additional variables on the right-hand side to control for other socioeconomic and demographic characteristics.

Time-Related Variable 1: Household Structure

Consumer Units are classified into one of three primary household structures: single-adult, married couple households, and all other households. All else equal, we expect Consumer Units headed by married couples to have more flexibility and ability to share household responsibilities, making it easier to manage demands on their time. Consumer Units with one adult are expected to have fewer shopping days, reduce the share of the food budget going to food at home, and increase the share going to prepared and processed foods.

Time-Related Variable 2: Household Size

The number of members in the Consumer Unit is another variable we expect to affect household time resources. Additional household members increase the overall time resources of the household and allow for more flexibility in sharing household responsibilities, including shopping and preparing food. On the other hand, increasing the household size may add complexity to the household routine and schedule and could increase the time constraint facing the Consumer Unit. We therefore included a quadratic term for household size to capture nonlinear effects. We expect that increasing the household size will increase the number of shopping days but that the marginal effect is decreasing. Increasing household size is also expected to increase the share of the food budget allocated to food at home, and reduce the share going to prepared food and processed vegetables. The marginal effect is expected to be decreasing.

Time-Related Variable 3: Number of Children

We include the count of children below 18 years of age. Increasing the number of dependent children is expected to increase the time constraints faced by the Consumer Unit, reducing the number of shopping days and the share of food at home, while increasing the share of prepared food and processed vegetables.

Time-Related Variable 4: Number of Elderly Members

We include the count of elderly members over the age of 64. The presence of elderly members could reduce the time constraints faced by the Consumer Unit by providing additional help and experience in handling household chores, including food acquisition and preparation. Increasing the number of elderly members is expected to reduce the time constraints faced by the Consumer Unit, increasing the number of shopping days and the share of food at home while decreasing the share of prepared food and processed vegetables.

Time-Related Variable 5: Work Status

We look at the effect of Consumer Unit work status by creating a binary variable indicating that the reference person and spouse, if present, each work 40 or more hours a week. Full-time work status is expected to increase the time constraints on the Consumer Unit, reducing the number of shopping days and the share of food at home, while increasing the share of prepared food and processed vegetables.

Time-Related Variable 6: Vehicle Ownership

The CEX has information on vehicle ownership but not access to a vehicle. We include a binary variable that indicates that the Consumer Unit owns at least one vehicle. Vehicle ownership may provide greater logistical flexibility to carry out household functions and reduce the opportunity cost of traveling to food retail. It may also facilitate travel to different food retailers on different days. In this sense, vehicle ownership could increase the number of shopping days. On the other hand, the cargo-carrying capacity of vehicles may allow Consumer Units to consolidate shopping and make fewer, but larger shopping trips. Vehicle ownership may reduce the opportunity cost of travel, freeing up more time to prepare food at home. It may also increase the ability to participate in activities away from home, including eating out, resulting less time to prepare meals at home.

Other Control Variables

In addition to the time-related explanatory variables that are the primary interest of this study, we control for a number of other demographic and socioeconomic characteristics. These are meant to capture factors such as taste and preferences as well as geographic variations in food prices and food retailer density and distribution. We control for household income by including the percentile ranking of the household income, Food Stamp Program participation in the past month, urban residence, geographic region, and reference person characteristics, namely age, race/ethnicity, and educational attainment.

Outcome Variables

Outcome 1: Number of Shopping Days

The first outcome we consider is the number of shopping days for food at home. We expect that households that are more time-constrained will consolidate their shopping and shop on fewer days in order to reduce the time cost of shopping for food. Shopping frequency has implications for the cost of food. Households that make fewer but larger shopping trips may be better able to take advantage of lower unit costs due to bulk or quantity discounts. To our knowledge, this is one of the first studies to use information on the date of purchase in the CEX to create a measure of shopping frequency for food at home. In this analysis we use the number of days a Consumer Unit shops for a food item or group of food items during a given time period. The number of shopping days is defined as the number of days during the 14-day diary period that the Consumer Unit reported expenditures on food at home.

The number of shopping days is a count outcome. Estimating this limited dependent variable using linear regression can result in estimators that are inefficient, inconsistent, and biased (Long, 1997; Wooldridge, 2003). A common statistical response to this problem is to treat the process as Poisson and estimate the Poisson regression model (PRM) using maximum likelihood. Because the assumptions of the PRM are fairly strong, it may not be realistic for economic processes and often does not fit in practice (Long 1997).

A slightly more flexible variation of the Poisson model is the Negative Binomial Regression Model (NBRM). It is used to fit models of count outcomes where there is more variation than would be expected under Poisson processes. It allows for variation

due to different values of the independent variables but also due to unobserved heterogeneity. It is more appropriate than Poisson if there is overdispersion, where variance is greater than the mean (Long, 1997). We determined that NBRM is more appropriate than PRM in modeling food shopping behavior, given the degree of individual variation. We also ran diagnostic tests and determined that the variance was in fact greater than the mean, indicating that the NBRM is more appropriate for modeling the number of shopping days.

Outcome 2: Food Spending Share

The second outcome we consider is food spending share. The typical market basket of a household that is more time-constrained may differ in composition from that of other households, such as the relative importance of convenience foods. To highlight choices that consumers make based on the convenience attributes of food, we compare spending shares on pairs of foods that require different amounts of labor and time. If more convenient forms of food carry a price premium, this has important implications for the cost of food.

In this model, we compute food spending shares by dividing the total spending for each consumer unit on the food category of interest over the 14-day survey period by the appropriate denominator, either total spending during the 14-day period for all food or all food at home.

We used multivariate linear regression analyses (OLS) to model food spending shares. We conduct our analysis at three levels of aggregation to see if correlations remain robust even as the scope of the comparison groups narrows. This multi-tiered

approach has been used elsewhere to test model robustness to varying degrees of food aggregation (Leibtag, Barker, and Dutko, 2010). At the broadest level of food spending, we examine the share of total food spending allocated to food at home. We expect that households with time-constraining characteristics will allocate a smaller share of their food budget to food at home and, by definition, a greater share on food away from home. Purchasing, preparing and cleaning up food prepared at home represent the less convenient option for time-pressed households.

At the intermediate level of food spending, we compare the share of food at home spending allocated to vegetables and to prepared food. Some examples of prepared food include canned soups, frozen meals, and prepared salads. Preparing vegetables for meals at home will tend to require more preparation time than prepared food, which may require nothing more than reheating. We expect that households with time-constraining characteristics will allocate a greater share of their food budget to prepared food and a smaller share of their budget on vegetables.

At the most detailed level of food spending, we compare the share of food at home spending allocated to fresh vegetables and to processed vegetables. Processed vegetables include frozen, canned and dried vegetables. We expect that households with time-constraining characteristics will allocate a greater share of their food budget to processed vegetables and a smaller share of their budget on fresh vegetables.

Results

Descriptive Statistics

Table 4.1 presents summary statistics for the explanatory variables used in the models. Nearly half of Consumer Units were married couple households. The average Consumer Unit had 2.5 members, lived in an urban area (92 percent) and owned a vehicle (89 percent). About a third of Consumer Units had at least one child under 18. In about a third of Consumer Units, both the reference person and spouse, if present, typically worked 40 hours or more a week. In approximately a quarter of Consumer Units, the reference person was of nonwhite race, and 60 percent of reference persons had more than a high school education.

Table 4.1: Characteristics of CEX Consumer Units

Variable	Description	Mean	S.D.
ONEADULT	1=One adult Consumer Unit	0.33	0.47
TWOADULT	1=Married couple Consumer Unit	0.48	0.50
OTHCU	1=Other Consumer Unit	0.19	0.39
FAM_SIZE	Consumer Unit size	2.51	1.45
FAMSQ	$(FAM\_SIZE)^2$	8.41	10.19
PERSLT18	Number of children under 18	0.65	1.07
PERSOT64	Number of members over 64	0.31	0.62
FTEARN	1=all adults work full-time	0.34	0.47
VEHICLE	1=vehicle owner	0.89	0.31
INC_RNKM	Ranking of Current Income	0.51	0.29
SNAP_MO	1=Food Stamps in past month	0.06	0.24
AGELT35	1=Reference person age < 35	0.24	0.43
AGE3549	1=Reference person age 35-49	0.30	0.46
AGE5064	1=Reference person age 50-64	0.27	0.44
AGEOT64	1=Reference person age > 64	0.20	0.40
NONWHITE	1=Reference person non-white race/ethnicity	0.27	0.45
HSORLESS	1=Reference person education HS or less	0.40	0.49
URBAN	1=Urban	0.92	0.28
NORTHEAST	1=Northeast region	0.18	0.39
MIDWEST	1=Midwest region	0.23	0.42
SOUTH	1=South region	0.36	0.48
WEST	1=West region	0.22	0.41

Source: 2008 CEX Diary Component

Table 4.2 shows the sample distribution for the first outcome, the number of shopping days for food at home. The mean and median number of shopping days were 4.4 days and 4 days, respectively. Given that the time period for the Diary component was 14 days or two weeks, this amounts to roughly 2 shopping days per week for the average Consumer Unit. However, the modal value for shopping days was 2 days. Although this analysis did not examine the time interval between shopping days, this is suggestive of a weekly shopping pattern for many Consumer Units. A little over 2 percent of Consumer Units did not report any food at home spending during Diary period while less than 1 percent shopped every day during the two-week Diary period.

Table 4.2: Distribution of Consumer Unit Shopping Days for Food at Home in a 14-Day Period

# of Shopping Days	Share of all Consumer Units
0	2.4%
1	7.9
2	19.7
3	14.3
4	14.5
5	11.9
6	9.3
7	7.1
8	4.5
9	3.5
10	2
11	1.2
12	0.7
13	0.5
14	0.6

Mean = 4.37 S.D. = 2.72 Median = 4

Source: 2008 CEX Diary Component

Table 4.3 presents descriptive statistics for the second outcome, food spending shares. Nearly 40 cents out of every dollar spent on food went to food away from home. Combined with prepared food, 45 cents, or nearly half, of every food dollar was spent on

food that was prepared by some entity other than the Consumer Unit. In contrast, slightly more than a nickel out of every food dollar was spent on vegetables.

Table 4.3: Average Annual Consumer Unit Food Expenditures, 2008

Food Group	Average Annual Expenditure	Share of Total Food Spending	Share of Food at Home Spending
All Food	$6,256		
Food at Home	3,885	62.1 %	
Cereals and Bakery Products	532	8.5	13.7 %
Cereals and Cereal Products	178	2.8	4.6
Bakery Products	355	5.7	9.1
Meats, Poultry, Fish, and Eggs	866	14.2	22.8
Beef	249	4.0	6.4
Pork	172	2.7	4.4
Other Meats	112	1.8	2.9
Poultry	167	2.7	4.3
Fish and Seafood	133	2.1	3.4
Eggs	53	0.9	1.4
Dairy Products	452	7.2	11.6
Fresh Milk and Cream	176	2.8	4.5
Other Dairy Products	275	4.4	7.1
Fruits and Vegetables	691	11.0	17.8
Fresh Fruits	233	3.7	6.0
Fresh Vegetables	222	3.6	5.7
Processed Fruits	122	2.0	3.1
Processed Vegetables	113	1.8	2.9
Other Food at Home	1,324	21.2	34.1
Sugar and Other Sweets	136	2.2	3.5
Fats and Oils	110	1.8	2.8
Prepared Foods	440	7.0	11.3
Snacks, Condiments, Seasonings	277	4.4	7.1
Nonalcoholic Beverages	361	5.8	9.3
Food Away From Home	2,371	37.9	

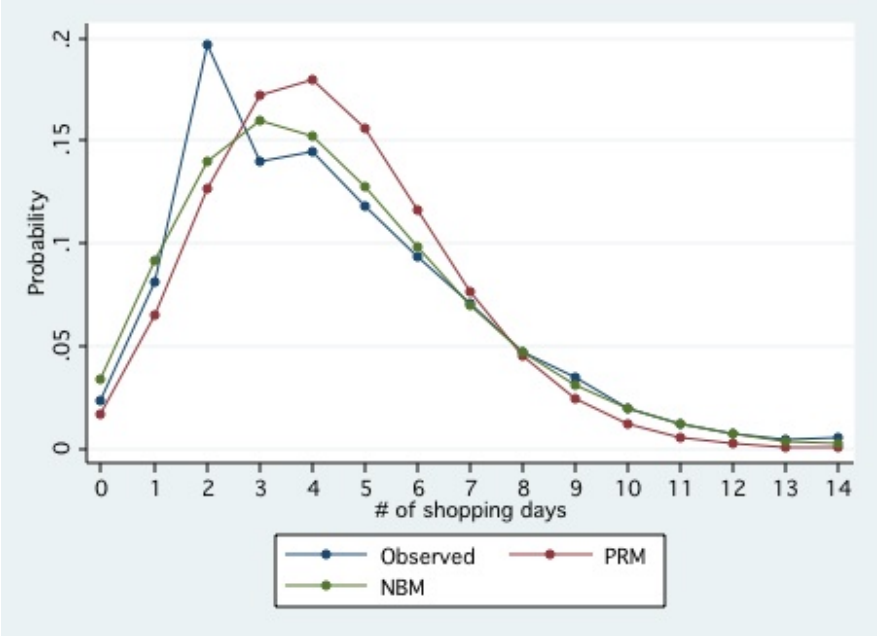
Source: 2008 CEX Diary Component

Regression Model Results

Outcome 1: Shopping Days

Figure 4.1 shows the sample distribution of shopping days for food at home and the expected number of shopping days as predicted by the PRM and NBRM.

Figure 4.1: Distribution of Predicted and Observed Frequencies of Number of Shopping Days for Food at Home



Mean = 4.37 S.D. = 2.72 Median = 4
PRM : Poisson Regression Model
NBRM: Negative Binomial Regression Model
Source: 2008 CEX Diary Component

The NBRM performed better at predicting the sample frequencies throughout the distribution, although neither model was able to predict the spike in observed values for Consumer Units that shop twice during the two-week period. The variance of the number of shopping days for food at home, 7.40 shopping days, was greater than the mean of 4.4 shopping days, indicating that the NBRM may be more appropriate than the PRM in modeling this count variable. Furthermore, post-estimation diagnostic tests confirmed the presence of overdispersion, suggesting that the NBRM may be more appropriate than the PRM in modeling the number of shopping days.

The multivariate results of the NBRM for the number of shopping days for food at home appear in Table 4.4.

Table 4.4: Estimated Effect of Time-Related Variables on the Number of Shopping Days, Food at Home

Time-Related Variables	Coefficient		Standard Error
One adult Consumer Unit [1]	-0.080	***	0.029
Other Consumer Unit [1]	-0.079	***	0.025
Consumer Unit size	0.175	***	0.028
Consumer Unit size, squared	-0.011	***	0.003
Number of children under 18	-0.031	*	0.017
Number of members over 64	0.033		0.036
All adults work full-time	-0.047	**	0.020
Vehicle owner	0.057	*	0.031
Other Control Variables			
Ranking of Current Income	0.037		0.041
Food Stamps in past month	0.108	**	0.043
Reference person age < 35[2]	-0.116	***	0.027
Reference person age 50-64[2]	0.077	***	0.027
Reference person age > 64[2]	0.002		0.056
Reference person non-white	0.010		0.023
Reference person HS or less	-0.077	***	0.019
Urban	-0.046		0.034
Midwest region[3]	-0.097	***	0.027
South region[3]	-0.064	**	0.025
West region[3]	0.004		0.020
Constant	1.221	***	0.073
Pseudo R-square	0.020		

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$
[1]Omitted category: Married couple Consumer Unit
[2]Omitted category: Reference person age 35-49
[3]Omitted category: Northeast region
Source: 2008 CEX Diary Component

All of the time-related explanatory variables, with the exception of the number of elderly household members, were significant at the 10 percent significance level or better. This suggests that each of these time-related variables captured a distinct effect on household time resources. Furthermore, the number of shopping days for food at home responds to time-constraining characteristics in expected ways.

Households headed by a single adult had significantly fewer shopping days than married couple households. Married couple households have more person-hours available to manage household maintenance functions like shopping for food. They are also able to share responsibilities for tasks like shopping for food.

Household size had a positive, but decreasing marginal effect, on the number of shopping days. This suggests that initially having a few more household members may allow for more flexibility in terms sharing food shopping responsibilities and increase the number of shopping days, but eventually, the complexity of managing the needs, logistics, and schedule of a large household may reduce this effect.

A household with more children, all else equal, had fewer shopping days for food at home. The extra time that goes into caring for another child shifts time away from other activities, including shopping for food. Full-time work status among adults in the household was negatively related to the number of shopping days. Full-time work reduces household time resources available to manage other household functions, including shopping for food.

Vehicle ownership had a positive effect on the number of shopping days, suggesting that the convenience and logistical flexibility that a vehicle affords may have a stronger effect in increasing the number of shopping days than the effect of cargo-carrying capacity has on decreasing the number of shopping days.

Turning to the other control variables in the bottom half of the table, the number of shopping days increased with the age and education of the reference person. Households residing in the Northeast shopped on more days than those in the Midwest and South. The bivariate correlation between income and the number of shopping days was positive and significant, but this association was no longer significant after controlling for all the other variables. Consumer Units that received Food Stamp benefits in the past month had more shopping days, all else equal.

Outcome 2: Food Spending Shares

Next we turn to the multivariate results for the second outcome, starting at the broadest level of food spending. The results of the OLS regression models for food at home spending as a share of total food spending are presented in Table 4.5.

Table 4.5: Estimated Effect of Time-Related Variables on Food at Home as a Share of Total Food Spending

	Food at Home Spending Share		
Time-Related Variables	**Coefficient**		**Standard Error**
One adult Consumer Unit [1]	-0.039	**	0.015
Other Consumer Unit [1]	-0.027	**	0.013
Consumer Unit size	0.029	*	0.014
Consumer Unit size, squared	-0.002		0.001
Number of children under 18	0.007		0.010
Number of members over 64	0.000		0.013
All adults work full-time	-0.034	***	0.011
Vehicle owner	-0.009		0.015
Other Control Variables			
Ranking of Current Income	-0.193	***	0.021
Food Stamps in past month	0.070	***	0.021
Reference person age < 35[2]	-0.076	***	0.011
Reference person age 50-64[2]	0.045	***	0.011
Reference person age > 64[2]	0.070	***	0.022
Reference person non-white	0.003		0.011
Reference person HS or less	0.025	***	0.009
Urban	-0.026		0.022
Midwest region[3]	-0.003		0.017
South region[3]	-0.026	*	0.013
West region[3]	0.012		0.017
Constant	0.724	***	0.033
R-square	0.108		

* p < 0.1; ** p < 0.05; *** p < 0.01
[1]Omitted category: Married couple Consumer Unit
[2]Omitted category: Reference person age 35-49
[3]Omitted category: Northeast region
Source: 2008 CEX Diary Component

Because food at home and food away from home comprise mutually exclusive and exhaustive categories for total food spending, both models had the same coefficients and standard errors, with the exception of inverted signs on the coefficients. We expected that households that are more time-constrained would reduce their food budget allocation

to food at home. Among the time-related variables, household structure appeared to have the largest practical significance. As expected, single-adult households spent a smaller share of their total food budget on food at home compared to married couple households. The coefficient of -0.039 for this variable implies that, other factors being equal, households headed by one adult spend about 3.9 percentage points less on food at home as a share of total food spending than households headed by married couples. Household size has a positive and significant effect on food at home spending, suggesting that economies of scale may make food preparation at home more economical. As expected, full-time work had a negative and statistically significant effect on food at home spending share. Vehicle ownership, the number of children, and the number of elderly members were not significant in this model.

Turning to the other control variables, income had a negative and marginally increasing effect on food at home spending. Recipients of Food Stamps were more likely to allocate their food dollars to food at home, which was not surprising given program rules that restrict benefit use to food at home purchases. Households with younger reference persons and more educated reference persons spent less on food at home.

Next we consider the multivariate results for the second outcome, focusing on the intermediate level of food spending. Table 4.6 presents the results of the OLS regression models for spending on vegetables and on prepared food as a share of food at home spending.

Table 4.6: Estimated Effect of Time-Related Variables on Vegetable and Prepared Food Spending as a Share of Food at Home Spending

	Vegetables			Prepared Food		
Time-Related Variables	**Coefficient**		**Standard Error**	**Coefficient**		**Standard Error**
One adult Consumer Unit [1]	-0.009	**	0.004	0.019	***	0.006
Other Consumer Unit [1]	-0.005	*	0.003	0.008	*	0.005
Consumer Unit size	-0.007	*	0.003	0.002		0.005
Consumer Unit size, squared	0.001	***	0.000	-0.001		0.001
Number of children under 18	-0.006	***	0.002	0.006	*	0.003
Number of members over 64	0.007	*	0.004	-0.004		0.005
All adults work full-time	0.000		0.002	0.002		0.004
Vehicle owner	0.001		0.004	0.016	***	0.006
Other Control Variables						
Ranking of Current Income	0.007		0.005	0.001		0.008
Food Stamps in past month	-0.005		0.004	0.012		0.009
Reference person age < 35[2]	-0.006		0.003	0.016		0.006
Reference person age 50-64[2]	0.004	*	0.003	-0.007	***	0.005
Reference person age > 64[2]	-0.006		0.007	-0.002		0.009
Reference person non-white	0.008		0.003	-0.024		0.005
Reference person HS or less	0.000	***	0.002	-0.009	***	0.004
Urban	-0.003		0.004	-0.003	**	0.011
Midwest region[3]	-0.010		0.003	0.009		0.007
South region[3]	-0.007	***	0.003	0.005		0.004
West region[3]	0.003	**	0.003	0.009		0.006
Constant	0.097		0.007	0.092		0.015
One adult Consumer Unit [1]	0.000	***	0.002	0.002	***	0.004
R-square	0.022			0.025		

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$
[1]Omitted category: Married couple Consumer Unit
[2]Omitted category: Reference person age 35-49
[3]Omitted category: Northeast region
Source: 2008 CEX Diary Component

We expected that households that are more time-constrained would reduce their food budget allocation to vegetables, which require more time and labor to prepare, and increase the allocation to prepared food, which may only need reheating before they are ready to eat. Again, household structure was statistically significant and had the greatest practical significance among the time-related variables. Households headed by one adult spent more on prepared food and less on vegetables than households headed by married couples. All else equal, households headed by one adult allocated nearly a percentage

point less of their food at home budget on vegetables and 1.9 percentage points more on prepared food than households headed by married couples.

Household size mattered for vegetable spending, where it had a negative but marginally decreasing effect, while it had a positive, but not statistically significant, effect for prepared food. The time and labor required to clean and prepare vegetables may be cumulative, so that preparing one pound of vegetables for four household members takes approximately twice as long as preparing half a pound for two members. This effect may be enough to reduce vegetable consumption as the household size increases. The same cumulative effect may not matter as much for prepared food, such as frozen microwaveable dinners, which require minimal preparation time to begin with.

The effect of the number of children was statistically significant in both models and has the expected direction. Increasing the number of children was correlated with reduced spending on vegetables and increased spending on prepared food. The number of elderly members had a positive and marginally significant effect on spending on vegetables and a negative but insignificant effect on spending on prepared food. Elderly members may have the time and culinary experience working with vegetables that encourages more spending on vegetables compared to households with fewer or no elderly members.

Full-time work was not significant in either model. One interpretation of this result is that households in which all adults are working full-time shift more of their food dollars to food away from home (from Table 4.5), but that their allocation of food at home does not change significantly, at least at this intermediate level. Vehicle ownership had a positive effect in both models, but was only statistically significant for spending on

prepared food. It is possible that the mobility that a vehicle affords reduces the opportunity cost of non-food-related activities even more than it reduces the opportunity cost of food-related activities. For instance, vehicle ownership may make it easier for household members to participate in social activities outside of the home, reducing the time resources available to prepare food at home and, in turn, making prepared food more attractive.

Turning to the other control variables, households with younger reference persons spent less on vegetables and more on prepared food, as did households with white reference persons. Geographic binary variables were significant in the model for vegetable spending, but not for prepared food, suggesting that regional variations in the availability or price of vegetables could have been a factor.

Finally, we consider the multivariate results for the second outcome at the most detailed level of food spending. Table 4.7 presents the results of the OLS regression models for spending on fresh vegetables and on processed vegetables as a share of food at home spending.

We expected that households that are more time-constrained would reduce their food budget allocation to fresh vegetables and increase the allocation to processed vegetables. As expected, single-adult households spent less on fresh vegetables than married couple households. All else equal, single-adult households spent 1 percentage point less on fresh vegetables than married couple households. Although the coefficient appears to be small, it was actually a substantive effect. Spending on fresh vegetables as a share of food at home spending is about 3 percent. Single-adult households spent more on processed vegetables, but this effect did not rise to statistical significance.

Table 4.7: Estimated Effect of Time-Related Variables on Fresh and Processed Vegetable Spending as a Share of Food at Home Spending

Time-Related Variables	Fresh Vegetables Coefficient		Fresh Vegetables Standard Error	Processed Vegetables Coefficient		Processed Vegetables Standard Error
One adult Consumer Unit [1]	-0.010	***	0.003	0.001		0.002
Other Consumer Unit [1]	-0.006	**	0.003	0.001		0.001
Consumer Unit size	-0.008	***	0.003	0.002		0.002
Consumer Unit size, squared	0.001	***	0.000	0.000		0.000
Number of children under 18	-0.004	**	0.002	-0.002	*	0.001
Number of members over 64	0.002		0.003	0.005	*	0.003
All adults work full-time	-0.003		0.002	0.003	*	0.001
Vehicle owner	-0.001		0.004	0.002		0.002
Other Control Variables						
Ranking of Current Income	0.007		0.005	-0.001		0.002
Food Stamps in past month	-0.007	**	0.003	0.002		0.002
Reference person age < 35[2]	-0.004		0.003	-0.002	*	0.001
Reference person age 50-64[2]	0.004		0.003	-0.001		0.002
Reference person age > 64[2]	0.000		0.005	-0.007		0.005
Reference person non-white	0.007	***	0.003	0.001		0.001
Reference person HS or less	-0.003		0.002	0.003	**	0.001
Urban	0.004		0.004	-0.006	***	0.002
Midwest region[3]	-0.011	***	0.003	0.001		0.002
South region[3]	-0.009	***	0.003	0.003	*	0.001
West region[3]	0.006	*	0.003	-0.002		0.002
Constant	0.075	***	0.007	0.023	***	0.004
R-square	0.031			0.014		

* p < 0.1; ** p < 0.05; *** p < 0.01
[1]Omitted category: Married couple Consumer Unit
[2]Omitted category: Reference person age 35-49
[3]Omitted category: Northeast region
Source: 2008 CEX Diary Component

Increasing household size was correlated with reduced spending on fresh vegetables, although this effect was marginally diminishing. Like household structure, household size was not statistically significant for processed vegetables. The effect of the number of children was negative and significant in both instances, although the reduction in fresh vegetable spending was twice that of processed vegetable spending. The number of elderly members had a positive and significant effect on processed vegetable spending.

The effect of full-time work had the expected direction, with a positive effect on spending on processed vegetables and a negative effect on spending on fresh vegetables. Only the effect on processed vegetables was statistically significant, however. Like full-time work, vehicle ownership had a positive effect on spending on processed vegetables and a negative effect on spending on fresh vegetables. Neither result was statistically significant, however.

Turning to the other control variables, recipients of Food Stamps allocated less of their food at home spending on fresh vegetables, while households with a non-white reference person spent more. Urban households and households with the youngest reference persons spent less on processed vegetables. The educational level of the reference person mattered for processed vegetables, with lower education increasing spending. Geographic binary variables were significant in the model for fresh vegetable spending, but not for processed vegetables, suggesting that regional variations in the availability or price of fresh vegetables could have been a factor.

Discussion

Our findings suggest that the key issue for time-constrained households may be the presence of other adult household members with whom to share and delegate food-related tasks. We found that household structure was the most consistent, and in several cases the most practically significant, predictor of food shopping patterns across the different regression models. Household structure was a significant covariate in all the regression models except for processed vegetables. These findings suggest that single-adult households allocate their food budget differently from married couple households,

favoring choices that have the potential of reducing time spent on food acquisition and preparation. Compared to married couple households, single-adult households shopped on fewer days, conforming to the hypothesis that time constraints may lead households to consolidate their food shopping and shop on fewer days. Single-adult households allocated more of their total food budget to food away from home and less to food at home. Furthermore, they also allocated more of their food at home budget to prepared and less to vegetables, especially fresh vegetables.

The effect of household size indicated a nuanced relationship with food spending patterns. Larger households shopped on more days, perhaps due to increased flexibility afforded by additional household members. However, the quadratic term was negative and statistically significant, suggesting that at some point the added complexity of schedules and logistics for large households may become a time-constraining factor. Larger households also allocated a greater share of their overall food budget to food at home, which could be consistent with the economies of scale thesis, both in terms of purchasing bulk food and reduced amount of food preparation time on a per household member basis. Household size had a negative affect on vegetable spending shares and a positive effect on prepared food spending shares, but only the effect on vegetables was significant. Similarly, household size was associated with a reduction in budget allocation to fresh vegetables and an increase for processed vegetables, but only the effect on fresh vegetables was significant.

Household composition with respect to adult and child membership also mattered. All else equal, a household with more children shopped less frequently, spent more of its food dollars on prepared food and less on vegetables. This was consistent with the

hypothesized effect. However, given associational nature of this analysis, it is difficult to separate the effect of children's preference and taste from the effect of time constraints. It is entirely plausible that the higher spending on prepared food and lower spending on vegetables could be a reflection of children's relative preferences as well as an effect of constrained time resources. This interpretation is reinforced by the fact the number of children was negatively and significantly related to food spending on both fresh and processed vegetables.

Based on the existing literature, we expected that full-time work status and vehicle ownership would be significant covariates in most of the models. However, the effects of full-time work status and vehicle ownership were statistically significant in only a few models after controlling for household structure, size, and composition. For the few models in which full-time work was statistically significant, the effect was in the expected direction. Vehicle ownership had a positive effect on the number of shopping days, suggesting that the convenience and logistical flexibility that a vehicle affords may outweigh the effect of cargo-carrying capacity. In other words, having a car could reduce the opportunity cost of shopping for food, by making travel to and from food retail more convenient. However, vehicle ownership was correlated with increased spending shares on prepared food, which runs counter to this time-saving argument. The correlation of vehicle ownership may be capturing wealth or affluence effects rather than the vehicle's role in accessing food retail. Other studies have found that access to car, rather than ownership, is the more critical factor affecting food access (Martin et al., 2004). Information on car access, rather than car ownership, may provide a clearer picture of the interrelation between vehicles, food spending patterns, and time constraints.

Although we attempted to control for differences in taste and preference by including demographic control variables for education, age, and race, the cross-sectional design of this analysis limits the ability to assess to what extent food preferences or other confounding factors are affecting either the explanatory variables or the food spending outcomes. We have already discussed the possible confounding effect of taste and preference in the relationship between the number of children and vegetable spending.

Another limitation of this analysis was the 14-day time frame of the Diary component of the CEX. The analysis neither captures nor properly reflects households that shop for food relatively infrequently, such as once a month. Another limitation was that CEX data do not indicate the time and location of purchases, making it impossible to distinguish between one large trip to a food retailer and several smaller trips to various food retailers made on the same day. These food shopping patterns represent different demands on the time resources of households, but the analysis in this study treats them the same way.

These findings highlight the need to take account of household characteristics that have a bearing on a household's time resources, such as household composition and full-time work status, when assessing the cost of acquiring and preparing a low cost but healthful meal. Our findings reinforce the conclusions reached by the IOM and NRC in their report on the adequacy of the SNAP benefit. They concluded that the time requirements for food acquisition and preparation assumed by the TFP are inconsistent with the time resources of most households at all income levels, but the time gap may be particularly salient for single working heads of household (Institute of Medicine [IOM] and National Research Council [NRC], 2013).

One of the criticisms of the TFP is that it does not adequately reflect the time cost involved in purchasing and preparing low cost meals from scratch for time-pressed households (Jabs and Devine, 2006; Mancino and Newman, 2007; Rose, 2007). When faced with declining financial resources, low-income populations increasingly focus on price and quantity instead of preference and quality (Dachner et al., 2010; Wiig Damman and Smith, 2009). Davis and You (2011) monetized the time costs associated with the TFP and found that time was much more constraining than money in terms of reaching the TFP. A binding time constraint may have a similar effect as a binding income constraint on food choices. Meeting recommendations on the consumption of healthful foods, like vegetables, may be a challenge not only from a taste perspective, but also from a time perspective, if the households believe that they do not have the time, motivation or energy to prepare healthful meals from scratch. Additional research is needed to estimate the impact that using nutritious but more convenient forms of food (at home) has on time use, food costs, and dietary quality for different types of households. An important first step would be to estimate the impact of increasing the proportion of more convenient, but still healthful, food items in future revisions of the Thrifty Food Plan on food costs and nutritional quality.

The correlations between proxies for household time resources and food shopping frequency raises interesting questions about the consequences of store format preference on food choices. Our findings suggest that time-constrained households are more likely to consolidate food at home shopping into fewer shopping days. Certain store formats may be more convenient food shopping destinations for some consumers. For example, supercenters have grown as an important food retail format in the last two decades

(Leibtag, 2006), due in part to the low prices, a wide range of food and nonfood products offered, and the convenience of the one-stop shopping experience they offer to consumers. Despite other studies showing fruit and vegetable prices to be lower at supercenters than at supermarkets (Leibtag, Barker, and Dutko, 2010), Volpe, Okrent, and Leibtag (2013) found that consumers tended to purchase less healthful foods at supercenters, like Walmart, than at supermarkets. Establishing the causal link between household preferences and resources (monetary and time), allocation of household food expenditures across different store formats, and diet quality and other nutrition and health outcomes is an important area for future research.

The results from this study indicate that the tradeoff between time costs and monetary costs in food products merits further examination. Does convenience in food cost more? In attempting to answer this question, one could envision collecting information on two versions of a market basket. The reference basket would assume more time and resources to shop and prepare food while the alternative or comparison basket would be geared towards households that are more time-constrained, such as households headed by a single adult, and feature more convenient but healthful substitutions, such as precut or pre-packaged vegetables, frozen vegetables, canned beans, or parboiled brown rice. The price of these more convenient market baskets could be compared to the reference market basket to estimate the price premium for convenience attributes in food.

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Appendix Table 4.1: Food Expenditure Universal Classification Codes (UCC)

UCC	Title
10110	FLOUR
10120	PREPARED FLOUR MIXES
10210	CEREAL
10310	RICE
10320	PASTA CORNMEAL OTH CEREAL PRODS
20110	WHITE BREAD
20210	BREAD OTHER THAN WHITE
20310	FRESH BISCUITS, ROLLS, MUFFINS
20410	CAKES AND CUPCAKES
20510	COOKIES
20610	CRACKERS
20620	BREAD AND CRACKER PRODUCTS
20710	DOUGHNUTS,SWEETROLLS,COFFECAKE
20810	FROZEN & REFRIG. BAKERY PROD.
20820	FRESH PIES, TARTS, TURNOVERS
30110	GROUND BEEF EXCLUDE CANNED
30210	CHUCK ROAST
30310	ROUND ROAST
30410	OTHER ROAST
30510	ROUND STEAK
30610	SIRLOIN STEAK
30710	OTHER STEAK
30810	OTHER BEEF (EXCLUDE CANNED)
40110	BACON
40210	PORK CHOPS
40310	HAM (EXCLUDE CANNED)
40410	OTHER PORK
40510	PORK SAUSAGE
40610	CANNED HAM
50110	FRANKFURTERS
50210	BOLOGNA, LIVERWURST, SALAMI
50310	OTHER LUNCHMEAT
50410	LAMB AND ORGAN MEATS
50900	MUTTON, GOAT, GAME
60110	FRESH & FROZEN WHOLE CHICKEN
60210	FRESH OR FROZEN CHICKEN PARTS
60310	OTHER POULTRY
70110	CANNED FISH AND SEAFOOD

70230	FRESH FISH & SHELLFISH
70240	FROZEN FISH & SHELLFISH
80110	EGGS
90110	FRESH MILK ALL TYPES
90210	CREAM
100110	BUTTER
100210	CHEESE
100410	ICE CREAM AND RELATED PRODUCTS
100510	OTHER DAIRY PRODUCTS
110110	APPLES
110210	BANANAS
110310	ORANGES
110410	OTHER FRESH FRUITS
110510	CITRUS FRUITS EXCL. ORANGES
120110	POTATOES
120210	LETTUCE
120310	TOMATOES
120410	OTHER FRESH VEGETABLES
130110	FROZEN ORANGE JUICE
130121	FROZEN FRUITS
130122	FROZEN FRUIT JUICES
130211	FRESH FRUIT JUICE
130212	CANNED/BOTTLE FRUIT JUICE
130310	CANNED FRUITS
130320	DRIED FRUITS
140110	FROZEN VEGETABLES
140210	CANNED BEANS
140220	CANNED CORN
140230	CANNED VEGETABLES MISC
140310	OTHER PROCESSED VEGETABLES
140320	OTHER PEAS
140330	OTHER BEANS
140340	OTHER VEGETABLES MISC
140410	FROZEN VEGETABLE JUICES
140420	FRESH & CANNED VEGETABLE JUICES
150110	CANDY AND CHEWING GUM
150211	SUGAR
150212	ARTIFICIAL SWEETENERS
150310	OTHER SWEETS
160110	MARGARINE

160211	FATS & OILS
160212	SALAD DRESSINGS
160310	NON-DIARY CREAM SUBSTITUTES
160320	PEANUT BUTTER
170110	COLA DRINKS
170210	OTHER CARBONATED DRINKS
170310	ROASTED COFFEE
170410	INSTANT/FREEZE DRIED COFFEE
170510	NONCARB FRUT FLAV/LEMADE NONFROZ
170520	TEA
170530	OTHER NONCARB. BEVERAGES/ICE
170531	OTHER NONCARB. BEVERAGES/ICE
170532	BOTTLED WATER
170533	SPORTS DRINKS
180110	SOUP
180210	FROZEN MEALS
180220	FROZ/PREP. FOOD OTH THAN MEALS
180310	POTATO CHIPS AND OTHER SNACKS
180320	NUTS
180410	SALT/OTHER SEASONINGS & SPICES
180420	OLIVES, PICKLES, RELISHES
180510	SAUCES AND GRAVIES
180520	OTHER CONDIMENTS
180611	PREPARED SALADS
180612	PREPARED DESSERTS
180620	BABY FOOD
180710	MISC. PREPARED FOODS
180720	VITAMIN SUPPLEMENT
190111	LUNCH AT FAST FOOD
190112	LUNCH AT FULL SERVICE
190113	LUNCH AT VENDING MACHINE
190114	LUNCH AT EMPLOYER
190115	LUNCH AT BOARD
190116	LUNCH AT CATERED AFFAIRS
190211	DINNER AT FAST FOOD
190212	DINNER AT FULL SERVICE
190213	DINNER AT VENDING MACHINE
190214	DINNER AT EMPLOYER
190215	DINNER AT BOARD
190216	DINNER AT CATERED AFFAIRS

190311	SNACKS AT FAST FOOD
190312	SNACKS AT FULL SERVICE
190313	SNACKS AT VEND MACHINE
190314	SNACKS AT EMPLOYER
190315	SNACKS AT BOARD
190316	SNACKS AT CATERED AFFAIRS
190321	BREAKFAST AT FAST FOOD
190322	BREAKFAST AT FULL SERVICE
190323	BREAKFAST AT VENDING MACHINE
190324	BREAKFAST AT EMPLOYER
190325	BREAKFAST AT BOARD
190326	BREAKFAST AT CATERED AFFAIRS
190911	BOARD AT FAST FOOD
190912	BOARD AT FULL SERVICE
190913	BOARD AT VENDING MACHINE
190914	BOARD AT EMPLOYER
190915	BOARD AT BOARD
190916	BOARD AT CATERED AFFAIRS
190921	CATERED AFF AT FAST FOOD
190922	CATERED AFF AT FULL SERVICE
190923	CATERED AFF AT VEND MACHINE
190924	CATERED AFF AT EMPLOYER
190925	CATERED AFF AT BOARD
190926	CATERED AFF AT CATERED AFF
200111	BEER AND ALC AT HOME
200112	NON ALCOHOLIC BEER
200210	WHISKEY AT HOME
200310	WINE AT HOME
200410	OTHER ALCOHOLIC BEV. AT HOME
200511	BEER AT FAST FOOD
200512	BEER AT FULL SERVICE
200513	BEER AT VENDING MACHINE
200514	BEER AT EMPLOYER
200515	BEER AT BOARD
200516	BEER AT CATERED AFFAIRS
200521	WINE AT FAST FOOD
200522	WINE AT FULL SERVICE
200523	WINE AT VENDING MACHINE
200524	WINE AT EMPLOYER
200525	WINE AT BOARD

200526	WINE AT CATERED AFFAIRS
200531	ALC. BEV EXC BEER/WINE FAST FD
200532	ALC. BEV EXC B/W FULL SERV
200533	ALC. BEV B/W VEND MACH
200534	ALC BEV EXC B/W AT EMP
200535	ALC BEV EXC B/W AT BOARD
200536	OTH ALC. BEV AWAY FROM HOME

CHAPTER 5: MEASURING PRICE DIFFERENTIALS ACROSS SMALL AND LARGE RETAILERS

Joseph T. Llobrera

Corresponding Author:

Joseph T. Llobrera

Food Policy and Applied Nutrition Program

Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy

Tufts University

150 Harrison Avenue, Boston MA 02111

Phone: 627-600-8046

Email: Joseph.Llobrera@tufts.edu

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ABSTRACT

This study provides empirical evidence of differences in food availability and prices between small and large food retailers based on detailed, localized data from the Boston metropolitan area. We improved on existing methods of community food price survey research in two ways: systematic research design meant to ensure representativeness of sampled geographic areas, food retailers, and food items; and novel methods for handling variability in food item availability and missing price information. We found that food availability differences between small and large stores were greatest for fresh meats and produce and that the food available at small stores was predominantly shelf stable rather than perishable. We found that the average unit price of individual food items was consistently higher at small stores, although there were a few food items sold at small stores that were priced competitively with large stores. The aggregated cost of food at small stores was higher than at large stores, with the estimated difference ranging from 25 percent higher to 59 percent higher depending on how one controlled for product variability across store size. Adjusting for food item availability resulted in larger estimated price differences. The methods and analytic tools developed for this study can serve as a template for collecting localized food price data in other cities and communities. They can also be adapted to address other empirical questions about the food price environment, such as the impact of healthy store initiatives on the availability and price of healthful food options like fresh fruits and vegetables.

Introduction

Food retailers and the decisions they make regarding the range of food products to sell and the prices to charge for those products play a critical role in the issue of food access. A review of the early literature on the food environment conducted by ERS concluded that, in general, low-income Americans face slightly higher food prices than the national average, due in part to the higher concentration of small stores in low-income central city neighborhoods (Kaufman, MacDonald, Lutz, and Smallwood, 1997). Variations in the availability and price of food across retailers of different sizes may be due to differences in demand, fixed costs, such as property prices or cost of refrigeration equipment, transportation, distribution or logistics costs, or other reasons (Bonanno, 2012: USDA/ERS, 2009). More recent studies continue to find the evidence of higher prices at smaller food stores (Andreyeva, Blumenthal, Schwartz, Long, and Brownell, 2008; Chung and Myers, 1999; Talukdar, 2008).

If retailers present in urban neighborhoods do not offer a healthful mix of food or sell food at prices that are too high, then disparities in food retail access may have implications for nutritional and health outcomes. A popular policy response is to change the mix of retailers, perhaps by encouraging the entry of a large retailer that can offer a healthful mix of foods at low prices. Other policy initiatives recognize the value of the high density of small stores in urban neighborhoods and seek to encourage existing small food stores to change the mix of foods they offer.

The first step in formulating an appropriate policy response is to document and quantify the extent of food access disparities. National food price datasets, including those collected from scanner data, generally lack granularity at the local level. To

characterize the local food retail environment, many researchers conduct community food price surveys, which involve selecting a set of representative food items, visiting local food stores, and recording the availability and price of those food items. This study provides empirical evidence of differences in food availability and prices between small and large food retailers based on detailed, localized data from the Boston metropolitan area. We found that food availability differences between small and large stores were greatest for fresh meats and produce and that the food available at small stores was predominantly shelf stable rather than perishable. We found that the average unit price of individual food items was consistently higher at small stores, although there were a few food items sold at small stores that were priced competitively with large stores. The aggregated cost of food at small stores was higher than at large stores, with the estimated difference ranging from 25 percent higher to 59 percent higher depending on the metric used.

This study is one of the few to provide detailed, granular empirical data on the food retail disparities in the Boston metropolitan area. While the findings of our study are specific to Boston, the methods and analytic tools developed for this study can serve as a template for collecting localized food price data in other cities and communities. This study improves on existing methods of community food price survey research in two ways. First, we developed a systematic research design to ensure representativeness of sampled geographic areas, food retailers, and food items. Sampled areas were representative of the areas where people lived. Sampled stores were selected using a balanced approach that matched two small stores to a large store from each survey cluster to ensure that the sample of small stores and large stores came from comparable

competitive environments. The selected food items were representative of food spending and consumption patterns among U.S. households. We adopted several elements of BLS price measurement methods, but modified them to make the methods accessible to individuals and community groups with limited time and financial resources.

Second, this study employed novel methods for handling variability in food item availability and missing price information. We paid careful attention to food item comparability and distinguishing between differences in food item availability and differences in food prices when aggregating food prices. We used food items with relatively narrow definitions but with flexibility on brand and package size attributes. This improved comparability between small and large stores by reducing missing values, but still limits the range of acceptable items to avoid unlike comparisons (Kaufman and Handy, 1989). To further account for variability in the availability of food items in small stores, we adjusted the expenditure weights to reflect lower food item availability at small stores. Items that were commonly found at both types of stores and therefore highly comparable across store types received greater weights, while items that were difficult to find at small stores and therefore less comparable were given smaller (or zero) weights. Incorporating information on availability into the weights avoids the need to impute price information or discard observations based on missing values. We adapted the Paasche price index approach and used the availability-adjusted weights to calculate the overall aggregated price difference between small and large stores, controlling for lower food item availability in small stores.

Background

There is growing recognition that the food environment influences food choice and nutrient intake (French, Story and Jeffery, 2001). One possible explanation for the unhealthful diets consumed by low-income Americans is that unhealthful foods, such as foods high in refined sugars and starch, are relatively cheaper and more readily available than fruits and vegetables (Brownell and Horgen, 2004; Drewnowski and Darmon, 2005). Because food budgets are finite, food prices will influence what mix or basket of foods is affordable or attainable (Kuchler and Stewart, 2008). There is some concern that low-income individuals may have difficulty meeting dietary recommendations because of inadequate access to healthful food, such as fruits and vegetables, at affordable prices (Cassady, Jetter and Culp, 2007).

Access to healthful food at affordable prices may be mediated by the type or size of retailers present in the environment. Smaller retailers are plentiful in most urban areas and access to them is relatively easy. Larger retailers are more sparsely distributed, require more travel time, and may be less accessible without a car. If retailers that are more conveniently accessed in urban neighborhoods do not offer a healthful mix of food or sell food at prices that are too high, then disparities in food retail access may have implications for nutritional and health outcomes. Supermarkets and other large stores may be more likely to stock fresh fruits and vegetables and sell them at lower prices compared to small stores. Bodor, Rice, Farley, Swalm, and Rose (2010) found that higher BMI rates were associated with the presence of fewer supermarkets and the presence of more small stores and prepared food sources. Larson, Story, and Nelson (2009) reviewed 54 studies and found that households with better access to supermarkets and limited

access to convenience stores tended to have healthier diets and lower obesity rates. A review of the literature by Giskes, van Lenthe, Avendano-Pabon, and Brug (2011) found a consistent association between environment and weight status, with better access to supermarkets and more limited access to fast food restaurants associated with lower BMI or prevalence of overweight or obesity and higher weight status associated with limited supermarket access or greater accessibility to fast food restaurants.

Understanding variations in the availability and price of food across different types of retailers can help inform decisions on how to improve individuals' and communities' access to healthful food. The HFFI allocates federal funding to projects that increase access to healthful, affordable food in underserved communities, including developing and equipping grocery stores, small retailers, corner stores, and farmers markets selling healthful food. Information on food availability and price differences across retailer types can help policymakers decide where funding is most needed or effective.

There is an array of methods available for collecting information on food prices, including sophisticated methods used by BLS to maintain its CPI series, food retailer scanner data, and community food price surveys. First, in collecting price data for the CPI, BLS uses a complex method of sampling areas, retailers and food items. BLS has a systematic method for handling missing items, either by substituting comparable items or imputing prices. BLS also has a well-developed hierarchical system for aggregating food items. However, these methods are designed to measure price changes for items and group of items over time, not to make comparisons across areas or store formats.

Second, other researchers have used food retailer scanner data, such as Nielsen Homescan data, as a strategy for measuring the food price environment and consumer purchasing patterns. These data are collected directly from food retailers using information on food items scanned at registers or from a panel of households that use handheld scanners to record food purchases from a wide variety of retailers. While scanner data methods allow researchers to match detailed information on the products purchased, the actual prices paid for them and, in the case of the household panel data, the characteristics of the households that purchased them, the data are typically representative only at the national level or for selected geographic areas. Granular detail on food availability and price in specific cities or neighborhoods may be lacking. There is also some concern about how representative the household sample of Homescan and other scanner data is, especially of low-income households (Stewart and Blisard, 2008; Fremstad, 2010). Scanner datasets may also lack complete coverage of stores at the local level, especially smaller stores.

Third, community food price surveys involve selecting a set of food items and collecting information on food availability and price at neighborhood stores. Unlike the previously discussed methods, this approach does not necessarily require a large amount of resources to generate granular data on food availability and price levels at the local level. A single data collector can collect rich data on local food retail conditions. The flexibility of the approach is another key advantage. The geographic areas, stores, and food items covered by a study can be scaled up or down depending on research interest and available time and labor resources.

Examples of this approach are studies that base their food item list on the TFP. The TFP is the federal government' official estimate of the cost of a thrifty but nutritious diet (Carlson, Lino, Juan, Handon, and Basiotis, 2007). While many studies use food lists based on the TFP (Hendrickson, Smith, and Eikenberry, 2006; Rose et al., 2009; Cassady et al., 2007), others have developed their own list of healthy food items (Anderson et al., 2007). The TFP is designed to be representative of foods commonly eaten by low-income households but it also incorporates normative elements by imposing other restrictions, such as the need to meet Federal dietary guidelines and Food Guide Pyramid serving recommendations (Wilde and Llobrera, 2009; Rose, 2007).

A potential shortcoming of using food item lists based on the TFP or other health or nutrition considerations is that they use a normative or prescriptive framework to conduct a positive exercise of describing food price differentials. In its review of the early literature on the food price environment, ERS outlined the key methodological challenges of measuring food price differentials using community food price surveys (Kaufman et al., 1997). These survey methods are vulnerable to ad hoc or non-systematic selection of geographic areas, food retailers within those geographic areas, the food item list to be used to collect price data, and the weights assigned to those items. Non-probabilistic considerations, such as convenience or research interest, may influence sampling decisions and result in a non-representative sample. For example, a food item list based on the TFP may not be representative of the foods people actually buy or consume.

Other areas of weakness in previous studies using community food price survey methods pertain to maintaining comparability across retailers or geographic areas that

have different food items available for sale and handling missing values that arise from variations in item availability across stores and areas. Previous community food price studies have either restricted the list of food items to a narrow set of items that are widely available at stores visited in order to limit the occurrence of missing values or used larger lists of food items, but with the increased likelihood of missing values. The former approach results in a list of foods that understates the differences in food item availability across retailers of different sizes and its narrow focus is less representative of the foods that people actually purchase. Studies using latter approach must handle a large number of missing values, by either excluding them from analysis at the cost of limiting the usable sample, replacing them with zeros, or imputing them with average price data from other stores. As a result, market basket studies and the food indices that are based on them tend to capture differences in item availability rather than differences in price for comparable items (Kaufman et al., 1997). We adapted techniques from price index methods and used availability-adjusted weights to control for lower food item availability at small stores when calculating the overall aggregated price difference between small and large stores.

Methods

Area Selection

The study area is the greater Boston metropolitan area. The study area is bounded by the Boston Harbor to the east, Route 128 to the west, the Porter River and Beverly Harbor to the north, and Route 1 and the southern boundary of Quincy to the south.

We sampled geographic areas in a way that accounts for variations in socioeconomic and demographic characteristics across the study area and prioritizes areas where people tend to live. The sampling frame consisted of the 464 census tracts with population-weighted centroids falling within the study area boundaries. Census tracts generally have between 1,500 and 8,000 people, with an optimum size of 4,000 people. Using PPS, 40 census tracts were selected from the sampling frame to serve as the PSUs for this study.

Retailer Selection

We sampled retailer clusters, or triplets of one supermarket and two nearby small retailers, to represent the food retail environment in the study area. The balanced or matched sampling method was meant to ensure that the small and large retailers in each cluster belonged to similar competitive environments. This facilitates comparisons across retailer size by holding constant observable and unobservable tract-level confounding variables. Without this matching research design, our sample of small stores could have been disproportionately drawn from central city areas, while our sample of large stores could have been disproportionately drawn from more suburban areas.

For each sampled census tract, a 1-mile radius was drawn around the tract's population-weighted centroid and a list of authorized SNAP retailers located within that radius was compiled. The sampling frame for food retailers included large food retailers, namely supermarkets, large grocery stores, and super stores, and small food retailers, namely small and medium grocery stores, convenience stores, and combination grocery/other stores. SNAP Redemptions at these types of food retailers comprised nearly

all (98 percent) of all SNAP redemptions nationally in 2010 (USDA/FNS, 2010). The sampling frame excluded specialty retailers with a more limited range of products that receive only a small share of expenditures on food for preparation and consumption at home, such as bakeries, seafood specialty stores, meat/poultry specialty stores, and farmers' markets.

The list of retailers located within the 1-mile radius was stratified into large stores and small stores. We used information from the food retailer name and Google Maps to determine whether the food retailer was a large or small retailer. Large retailers typically belonged to national or regional supermarket chains. From the list of large stores located within the 1-mile radius, one large store was randomly sampled. If there were no large stores within the 1-mile radius, the radius was expanded to 2 miles. Similarly, from the list of small stores located within the 1-mile radius, two small stores were randomly selected. If an insufficient number of small stores was located within the 1-mile radius, a 2-mile radius was used.

The final retailer sample included 40 large retailers and 80 small retailers for a total of 120 food retailers.

Food Item Selection

We adopted definitions and grouping methods used by BLS to collect food price data for its CPI series to identify our set of representative food items, but modified them to make the methods more suitable and accessible to individuals and community groups with limited time and financial resources. We emulated BLS methods in generating a set of 49 food items that are representative of U.S. food spending and consumption patterns and provide sufficient coverage and detail on important categories of food at home

spending, without making data collection excessively burdensome. These methods minimize burden on data collectors and food retail staff and ensure their suitability for research conducted by individuals and groups interested in community food security and the neighborhood food retail environment.

1) Broad food groups (18): In its published Consumer Expenditure Shares tables, BLS disaggregates CEX data on food at home spending by American households into 18 categories, which we call broad food groups. The spending shares of all 18 broad food groups are mutually exclusive and exhaustive of food at home spending. Some examples of these broad food groups are cereal and cereal products, beef, and fresh vegetables. Data collected for this study included at least one representative food item from each of the 18 broad food groups.

2) Narrow food groups (42): The CEX includes expenditure data for multiple narrow food groups within each of the broad food groups, with each one assigned a unique Universal Classification Code. Because there are approximately 100 narrow food groups, collecting data for at least one food item from each of these narrow food groups would be unmanageable given a nontrivial number of food retailers. Instead, we set a threshold and include only the most important narrow food groups within each broad food group. We chose to include narrow food groups comprising at least 15 percent of spending within their respective broad food group, which reduced the list to 42 narrow food groups. Note that for a given broad food group, adding up the spending shares for narrow food groups will not add up to 100 percent.

3) Representative food items (49): There were 49 food items included in the final list of representative food items (see Appendix Table 3.1). We supplement the CEX data with consumption data from the NHANES to identify the most commonly consumed food item for each narrow food group, which serves as the representative food item for that narrow food group. In general, each narrow food group has a corresponding representative food. However, for vegetables, we included more than one representative food item per narrow food group. We collected additional detail on vegetables, especially fresh vegetables, because they are of particular interest when assessing not only the quality of the food environment, but also the diet quality of individuals.. We developed operational definitions for each of the 49 food items to facilitate data collection. For instance, the food item "spaghetti" was defined to encompass spaghetti pasta of any brand or package size, including thick, thin, and regular varieties but excluding whole wheat or whole grain varieties.

Data Collection

In general, we visited food retailers one PSU cluster at a time. One retailer had gone out of business and was replaced by randomly sampling another food retailer of the same type from the sampling frame. After in-person visits, we discovered that two retailers were initially assigned to the wrong stratification group (assigned to small retailer group but was actually a large retailer). The sampled stores were replaced by randomly sampling replacement food retailers of the appropriate type.

For large retailers, we collected data by dictating and recording information using the voice memo feature on a mobile phone. We transcribed the data immediately afterwards,

usually in the parking lot of the retailer. We conducted a second visit immediately after transcription to acquire or verify additional information. For small retailers, we provided a cover letter and short verbal introduction to the store manager or employee, explaining the purpose and process of the visit. At five retailers, store staff ultimately declined participation in the data collection, even after making an appeal to the manager. These retailers were replaced by randomly selecting replacement retailers from the appropriate sampling frame.

A food item may be sold in one or more forms or products. A product is a unique combination of a brand, product line extension and package size or weight. For each food item, we collected information on the price and package size of the product with the lowest unit price and the product with the most shelf space in that particular store. Similar to the approach used by Farley et al. (2009), we measured shelf space by considering the width, but not the height or depth, of the shelf space or display case occupied by the product. In many instances, this simply involved a visual inspection of the shelf space. The price recorded was based on the price displayed either on a sticker applied to the product or posted on the display shelf, reflecting any sales or discounts (including store loyalty discounts) but excluding any discounts requiring coupons.

To ensure accuracy of data entry, survey data were entered twice and discrepancies were flagged, manually inspected and compared with original survey forms. Observations with outlier values were flagged and manually inspected for accuracy. Survey data on food items and store characteristics were merged with PSU (census tract) socioeconomic and demographic data from the 2006-2010 American Community Survey 5-year estimates (Census Bureau, 2011). Graphical analysis was

conducted using Microsoft Excel 2004 for Mac. Statistical analysis was conducted using StataIC 10.1.

The Tufts University Institutional Review Board (IRB) at Medford deemed the instruments and protocol for this study exempt from review.

Analysis

First, we compared differences in the availability and price of individual food items across small and large retailers. To help explain some of the price difference between retailer sizes, we compared the average package size at small and large stores. In order to make more general conclusions about the overall price level at small and large stores, we compared aggregated food costs at small and large stores. As a robustness check, we conducted price comparisons using two sets of prices, the unit price of the lowest priced product and the unit price of the product with the most shelf space.

Individual Item Comparisons.

We defined availability as the share of stores selling the food item. We used unit prices, either price per pound, price per gallon, or price per 100 count (eggs), to make price comparisons. With the exception of eggs, items sold by the piece, such as fruit sold by the piece, were assigned the average weight for that food item based on data from the National Nutrient Database for Standard Reference Release 24 (USDA/ARS, 2011).

We graphed the ratio of the average unit price for a food item at small food stores to the average unit price at large food stores for all food items that were available in at least 50 percent of each store type. In other words, we limited graphical comparisons to

food items that were available at the median small store and median large store. We chose the 50 percent threshold because it provides a good balance of communicating information on both item availability and price differentials. A lower threshold would display food items with relatively low availability at small stores and permit price comparisons based on small sample sizes and potential outlier observations from small stores. A higher threshold would not provide sufficient information, as price differentials would only be shown for a few food items. We conducted t-tests on all representative food items to detect significant differences in availability and unit prices, using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS). We ran the regression of the logged unit price on the small store indicator variable. The coefficient on the small store indicator variable is the t-test. We considered results to be significant at $p<0.05$.

Aggregated Food Costs

Before aggregating food prices, we define and calculate four intermediate values: a) large store price, b) small store price, c) large store expenditure weight, and d) small store expenditure weight.

Large store prices are the average unit prices for food items at large stores. Small store prices are the average unit prices for food items at small stores. We converted all unit prices to the price per pound and all volumetric measures and egg counts to weights using data from the National Nutrient Database for Standard Reference Release 24.

Expenditure weights reflect the relative importance of each narrow food group in food at home spending among American households We derived these weights from food

at home spending shares from the CEX data. Large store expenditure weights are composite weights based on the broad food group share of food at home spending, the narrow food group share of the broad food group, and the food item share of the narrow food group. The size of a food item's large store expenditure weight reflects the relative importance of the narrow food group represented by that food item.

For example, consider the food item "frozen white potatoes," which includes frozen french fries, tater tots and hash browns. This food item belongs to the broad food group "processed vegetables," which as a group comprised 2.9 percent of all food at home spending. "Frozen white potatoes" also belongs to the "frozen vegetable" narrow group, which accounted for 32 percent of spending on the broad food group "processed vegetables." One other narrow group within the "processed vegetable" group met the 15 percent threshold ("canned vegetables," comprising 40 percent of spending on "processed vegetables"). Because the spending shares for narrow food groups within a broad food group do not add up to 100 percent, we rescaled so that the narrow food group spending shares included in this study add up to 100 percent.

The item share of the narrow food group is generally equal to 100 percent, because for most narrow food groups, we have included one representative food item to collect price information on. However, because of the significant role that the vegetable food group plays as an indicator of food access in the food environment literature, we included more than one representative food item for the vegetable narrow food groups "fresh vegetables," "canned vegetables," and "frozen vegetables." The narrow food group "frozen vegetables" includes three food items, "frozen white potatoes," "frozen broccoli," and "frozen carrots." Here, the food item share of the narrow food group is divided

equally among the three food items and “frozen white potatoes” has a 33 percent share of the narrow food group “frozen vegetables.”

The size of a food item’s large store expenditure weight reflects the relative importance of the narrow food group represented by that food item, but the expenditure weight is not identical to the spending share. So the 0.43 weight for “frozen white potatoes” indicates the relatively small share of food at home spending comprised by the narrow food group it represents “frozen vegetables.,” but it does not mean that “frozen white potatoes” comprises 0.43 percent of food at home spending. Meanwhile, the large store expenditure weight for “potato chips” is 18.46, which reflects the fact that “potato chips” represents the most important narrow group (and only one meeting the 15 percent threshold) within the broad food group “miscellaneous foods.”

We computed the small store expenditure weights by multiplying the large store expenditure weights by the small store availability percentage. A food item that is only available in 50 percent of small stores has a small store expenditure weight that is half that of the large store expenditure weight, while a food item not available at any of the small stores has a small store weight of zero. The net effect of this adjustment is to weight more heavily food items that small stores are more likely to sell and weight less heavily items that are not typically sold at small stores.

Food items that are available at all small and large stores have large store and small store expenditure weights that are the same. Food items that are available at large stores but not commonly found at small stores are less comparable and therefore have small store expenditure weights that are smaller than their large store expenditure

weights. In the extreme case of an item that is not available at any small stores, that food item would get a small store expenditure weight of zero.

With these prices and weights, we calculated the following market baskets:

(1) Cost of Large Store Basket (Large Store Prices, Large Store Expenditure Weights)
(2) Cost of Small Store Basket (Small Store Prices, Small Store Expenditure Weights)
(3) Cost of Small Store Basket at Large Store Prices: (Large Store Prices, Small Store Expenditure Weights)

From the literature on price indexes, we recognize that market baskets (2) and (3) are analogous to the components of a Paasche price index. The Paasche index compares the cost of buying the comparison period basket at comparison period prices to what it used to cost at reference period prices. The index can be written as follows:

$$P_P = \frac{\sum(p_{c,t_n} \cdot q_{c,t_n})}{\sum(p_{c,t_0} \cdot q_{c,t_n})}$$

where P is the relative index of the price levels in two periods, p are the prices, q are the quantities or weights, c is the good or service, t_0 is the reference period, and t_n is the comparison period. In this study, we replace the reference and comparison period with a reference group of large stores and a comparison group of small stores. Rather than changing weights or quantities to reflect consumer demand, we adjust expenditure weights to reflect variations in availability across small and large stores.

To test the robustness of our findings and to improve comparability across store types, we used two sets of prices: the price of the lowest priced product and the price of the product with the most shelf space. Most studies rely on one set of prices, typically the lowest price option. Using the price of the lowest priced product will often compare small sizes of branded items in small stores to large sizes and private-label items in large supermarkets (Kaufman et al., 1997). We collected price information on the product with

most shelf space to help control for package size and brand differences between small and large stores without having to explicitly match food items on brand and package size. This is similar in spirit to the approach used by BLS in collecting price information for the CPI. BLS places some restrictions on package size and product characteristics and then randomly selects an item from a food category in each sample store, with higher selling items having a higher probability of being selected. Since we did not collect sales information for food items, we used shelf space as a proxy for sales.

The cost of each of these baskets is the weighted average cost per pound of food. Basket 1 is the weighted average cost per pound of food purchased at large store prices. Basket 2 is the weighted average cost per pound of food purchased at small store prices, subject to availability at small stores. Items that are less commonly available at small stores were given a lower weight. Basket 3 is the weighted average cost per pound of food if purchased at small stores, but using the average price for that item at large store prices.

A shortcoming of the literature so far has been the tendency to focus on the total price difference using aggregated market basket costs, without accounting for differences in item availability. To address this, we decompose the total price difference into two components:

Pure Price Difference + Item Availability Adjustment = Total Price Difference

where:

Basket 2 – Basket 3 = ***Pure Price Difference*** *(same small store weights, different prices)*
Basket 3 – Basket 1 = ***Item Availability Adjustment*** *(same large store prices, different weights)*
Basket 2 – Basket 1 = ***Total Price Difference*** *between baskets*

The Pure Price Difference uses the same weights (small store expenditure weights) when comparing the aggregate price at small and large stores. This represents the set of food items that are most comparable across retailer type, emphasizing items that can be found at both small and large stores and discounting items that are not typically available at small stores. This is analogous to the Paasche price index. Similar to the Paasche index, we calculate the difference between what it would cost to buy the basket of goods available at small stores (comparison period weights) at large store prices (reference period prices) and what it would cost to buy that same basket (comparison period weights) at small store prices (comparison period prices).

By adjusting the weights to reflect variability in availability at small stores but using the same set of prices from large stores, the Item Availability Adjustment shows the effect of variability in item availability on aggregated costs and captures the weighted average cost of food items at large stores that are not typically available at small stores. Adding these up yields the Total Price Difference, which reflects both item availability differences and price differences.

Results

Descriptives

Our sampling method generated a representative list of census tracts. The 40 census tracts sampled in this study were similar to the Boston metropolitan area in several important respects relevant to food purchasing behavior, such as median household income and educational attainment (Table 5.1). We found lower rates of vehicle ownership and higher population density in sampled areas compared to the metropolitan

area as a whole. A map of sampled stores and census tract household median income is provided in Figure 5.1. Census tracts with larger populations were more likely to be sampled as primary sampling units. This was intended to make the sample representative of the areas where people tend to live. The pattern of triplet or matched sampling of one supermarket and two nearby small retailers is visible in the map. Triplets of stores were sampled to represent the food retail environment in the study area. The balanced or matched sampling method was meant to ensure that the small and large retailers in each cluster belonged to similar competitive environments. Sampled stores were drawn from a diverse areas of Boston, including areas with relatively low and high median household income.

The density of small stores around each PSU centroid was higher than that of large stores. On average, there were 22.9 small stores and 2.3 large stores in the sampling frame for retailers located within a 1-mile radius of the population-weighted centroid of PSU tracts. Small stores were more accessible in terms of linear distance. In the retailer sampling frame, the nearest small store was 0.25 miles away from the PSU centroid on average, while the nearest large store was twice as far away at 0.53 miles on average.

Large stores differ from small stores in the range of services they offered (Appendix Table 5.2). Large stores had more registers and were more likely to offer amenities like express lanes and self-checkout lanes. Larger stores were more likely to have the space, staffing, equipment, and sourcing necessary to provide fresh produce, meat, and seafood sections. While none of the small stores had a fresh meat or seafood counter, about one in six featured a prepared food counter, typically a sandwich counter selling sandwiches and other quick order items. Virtually all stores had refrigeration

equipment, but in small stores this equipment was primarily used to chill beverages. Over a third of small stores offered some fresh produce, but this was usually limited to apples, bananas, and the occasional tomato sold by the piece.

Individual Item Comparisons

The typical full-service American supermarket is well stocked, carrying nearly 40,000 items on average (Food Marketing Institute, 2011). Finding the representative food items at large stores was not difficult. Of the 49 representative food items, 33 were available at all 40 large stores visited. Only two food items had availability below 90 percent at large stores, with frozen carrots and fresh bunch of spinach available at 78 percent and 15 percent of large stores, respectively. The low availability of fresh bunch of spinach was due to the fact that most large stores stock spinach in its pre-washed and packaged form.

Food items available at small stores were predominantly shelf stable rather than perishable. About a third (16) of the representative food items were available in at least three-quarters of small stores while just under half (23) of the food items were available in half of the small stores (Figure 5.2). A handful of items were nearly ubiquitous at small stores, such as potato chips and regular cola (100 percent availability), bottled water (99 percent), and gumdrop candy (98 percent). Nine items, all of which were fresh meat or produce items, were not available at any of the 80 small stores visited.

Availability was significantly different between small and large stores for most food items (Appendix Table 5.3). Seven items (low fat milk, orange juice, gumdrop

candy, salad dressing, potato chips, regular cola, and bottled water) were highly available across both retailer types and had no statistically significant difference in availability.

Figure 5.3 compares the average unit price of the lowest priced product at small stores compared to large stores. For food items available at the median small and large store, the average price of the lowest priced product was consistently higher at small stores, with ratios exceeding 1.00. The ratio in average prices was highest for reduced fat yogurt (2.69), vanilla ice cream (2.38), and tub margarine (2.36). The price difference ratio was lowest for low fat milk (1.10), fresh 100% orange juice (1.28), and fresh eggs (1.30). We ran t-tests comparing the average unit price of the lowest priced product for all 49 food items. The price difference was statistically significant for 35 of the 40 items with enough observations to conduct an analysis of variance (Appendix Table 5.4). The difference in price for whole chicken, frozen fish sticks or fillets, white potatoes, frozen carrots, and soymilk was not statistically significant.

For food items available at the median small and large store, the average price of the product with most shelf space was consistently higher at small stores, with ratios exceeding 1.00 (see Appendix Figure 5.1). The ratio in average prices was highest for reduced fat yogurt (2.52), bottled water (2.40), and vanilla ice cream (2.04). The price difference ratio was lowest for fresh 100% orange juice (1.02), fresh eggs (1.03), and bacon (1.04). We ran t-tests comparing the average unit price of the product with the most shelf space for all 49 food items. The price difference was statistically significant for 30 of the 40 items with enough observations to conduct an analysis of variance (Appendix Table 5.5). The difference in price for spaghetti, bacon, whole chicken, frozen

fish sticks or fillet, fresh eggs, fresh 100% orange juice, white potatoes, tomatoes, frozen carrots, and soymilk was not statistically significant.

A few food items sold at small stores were priced competitively with large stores. The price difference ratio was lowest for low fat milk, fresh 100% orange juice, and fresh eggs. These food items are commonly sold as loss leaders at small stores and priced competitively with large food retailers. Loss leader items are sold at a low price in order to get people in the door and encourage the sale of other higher-margin items. They are usually prominently advertised and displayed inside and outside the storefront.

The price differential between small stores and large stores may be attributed in part to differences in package size options. Large stores offer a wider range of package size options, including family or bulk size packaging that may be cheaper on a per unit basis. Small stores, with their limited shelf space, tend to sell items in smaller and more convenient packaging that may be more expensive on a per unit basis. Figure 5.4 shows the ratio of the mean package size of the lowest priced product at large stores compared to small stores. Items typically sold by random weight have been excluded. For 21 of the 23 food items available in at least half of each store type, the package size of the lowest priced product was larger at large stores. For example, the average package size for the lowest priced reduced fat yogurt option was 3.85 times greater at large stores compared to small stores. Large stores typically 32 ounce containers while the most common package option at small stores was 6 oz single serve containers.

We ran t-tests comparing the average package size of the lowest priced product for food items that are not typically sold by random weight (Appendix Table 5.6). The average package size was larger and statistically significant for 20 of the 29 items with

enough observations to conduct an analysis of variance. The difference in package size was not statistically significant for corn flake cereal, spaghetti, white bread, bacon, low fat milk, apple juice, canned refried beans, frozen carrots, and bottled water.

Aggregated Food Costs

We aggregated food costs to compare the overall price level at small stores and large stores. The cost of each basket is the weighted average cost per pound of food. First we examined the price differential across store type based on the price of the lowest priced product (Table 5.2). The cost of the large store basket was $2.28/lb. The size of a food item's contribution to the overall basket cost may be attributed to the relative importance of the broad and narrow food group represented by the food item, a relatively high unit cost of the food item itself, or a combination of the two. The price of potato chips, chunk cheddar cheese, and fresh salmon (steak or fillet) contributed the most to the cost of the large store basket (Appendix Table 5.7). Potato chips represent "miscellaneous foods," which is the broad food group that accounts for the largest share of overall food at home spending. Fresh salmon is the priciest food item in the basket, costing an average of $8.73/lb at large stores. Chunk cheddar cheese represents another important broad food group, "other dairy products," and also has a relatively high average unit price of $4.64/lb.

The cost of the small store basket was $3.18/lb. The price of potato chips, chunk cheddar cheese, and white bread contributed the most to the cost of the large store basket. Potato chips and chunk cheddar are important in the small store basket for the same reasons that they are important in the large store basket. White bread is important in the

small store basket because it represents the broad food group “bakery products,” which accounts for the third largest share of food at home spending.

The cost of the small store basket at large store prices was $2.00/lb. As in the case of the small store basket, the price of potato chips, chunk cheddar cheese, and white bread contributed the most to the cost of this basket.

The cost of the small store basket was $0.90/lb, or 39 percent, higher than the cost of the large store basket. This reflects the price difference for comparable items but also captures differences in item availability across store type. To compare prices, conditional on availability, we look at the pure price difference, which was $1.18/lb. For the mix of food items that are most comparable across retailer type, the weighted average cost of a pound of food was 59 percent higher at small stores compared to large stores. The pure price differential is greater than the total price differential, demonstrating how food item availability influences price comparisons. The item availability adjustment was -$0.28/lb. This adjustment is negative because many of the food items present in the large store basket but missing from the small store basket, such as fresh meats and fresh produce, tend to have relatively higher unit costs compared to processed and shelf stable food items that are more readily available at small stores.

Next, we examined the price differential across store type based on the price of the product with the most shelf space (Table 5.2). Using the price of items with most shelf space instead of the lowest priced product results in higher average weighted costs for all three baskets, but smaller differences between small and large stores. The cost of the large store basket was $2.75/lb. The price of potato chips, chunk cheddar cheese, and fresh salmon (steak or fillet) contributed the most to the cost of the large store basket

(Appendix Table 5.8). The cost of the small store basket was $3.44/lb. The price of potato chips, chunk cheddar cheese, and corn flake cereal contributed the most to the cost of the large store basket. The cost of the small store basket at large store prices was $2.59/lb. As in the case of the small store basket, the price of potato chips, chunk cheddar cheese, and corn flake cereal contributed the most to the cost of this basket.

The total price difference between the two baskets was $0.69/lb. The weighted average cost of a pound of food was 25 percent higher at small stores compared to large stores. Using the pure price difference to focus on the mix of food items that were most comparable across retailer type in terms of availability, the weighted average cost of a pound of food was $0.85/lb, or 33 percent, higher at small stores compared to large stores. The item availability adjustment was -$0.16/lb.

Discussion

In popular media and even in the food environment literature, there is a stereotype of small stores selling predominantly unhealthful food items. While we found potato chips, gumdrop candy, and soda at virtually all small stores visited, not all food items with high availability at small stores could be criticized as being unhealthful. Low fat milk was sold at all but one of the 80 small stores visited, while fresh 100% orange juice and fresh eggs were available at 98 percent and 91 percent of small stores, respectively. Availability of canned vegetables like green beans and tomatoes was relatively high, found in 89 percent and 78 percent of small stores, respectively. By the same token, large stores carry more than just foods that can be considered healthful. Federal nutrition guidance suggests limiting intake of foods that are high in calories from added sugars or

fats, but food items like regular ice cream, potato chips, regular cola, and candy are significantly less expensive at large stores compared to small stores.

The aggregated cost of food at small stores was higher than at large stores. Using the price of the products with the lowest unit price, the aggregated cost of food at small stores was 39 percent higher than at large stores. This understates the price difference between small stores and large stores because it does not account for differences in food item availability. Adjusting for food item availability resulted in even greater price differences. Using the pure price difference and focusing on the mix of food items that are most comparable across small and large stores, the aggregated cost of food at small stores was 59 percent higher than at large stores. Although using the price of items with most shelf space resulted in a smaller estimated price difference between small and large stores, adjusting for food item availability had the same effect of increasing the estimated price difference. After accounting for food item availability, the estimated price difference based on the price of the product with the most shelf space rose from 25 percent to 33 percent.

If one is interested in describing the full extent of the price advantage of large stores relative to small stores, then one should use the prices of products with the lowest unit price. If one is interested in a higher degree of comparability between small and large store market baskets, comparisons should be made based on the prices of products with the most shelf space. The pure price differential between small and large stores was 33 percent based on prices for products with the most shelf space, but almost doubled to 59 percent when based on prices for products with the lowest unit price. The low unit prices

at large stores reflect their ability to offer larger package size and low-cost private label brands.

The product with the most shelf space was more likely to be consistent in brand and package size across store types compared to the product with the lowest unit price. In both types of stores, the brands of products with the most shelf space were often popular national brands, such as Frito Lay (potato chips), Barilla (spaghetti), Mott's (applesauce), and Coca Cola (soda). In contrast, the lowest priced product at large stores was typically the store's private label brand. Small stores that are part of national chains do offer private label products, but small stores as a whole are less likely to offer lower cost private label products.

A similar situation existed with respect to package size. The product with the most shelf space at both store types was typically a popular package size that was neither the smallest or largest package size, such as the 10.5 oz bag of chips, 16 oz box of spaghetti, or 2 liter bottle of soda. The lowest priced products are less similar on the basis of package size because these are usually sold in the largest package size option at large stores, such as "family" or "economy" packages, which small stores are less likely to carry.

In general, previous community food price studies have found much smaller price differences between small and large food stores. Andreyeva et al. (2008) estimated a 4 percent price premium at small neighborhood stores compared to supermarkets in New Haven, Connecticut. Talukdar (2008) found a 6 to 7 percent price premium at corner stores compared to regional and national chain grocery stores in Buffalo, New York. In the Minneapolis/St. Paul metropolitan area, Chung and Myers (1999) found that prices at

chain stores were 9 percent lower than non-chain (smaller) stores. The lower estimated price differences in these studies may be due, in part, to methods that tend to understate differences in the range and price of foods sold in small and large stores. These studies used an identical-item approach and specified the brand and package size. While this helps with comparability, it also obscures the fact that small stores tend to stock different brands and package sizes compared to large stores. Large stores often stock more economical options, such as private label brands or large package items, that are not typically available at small stores. Using the identical-item approach also requires adjustments to handle the high proportion of missing values. Previous studies may impute missing values using survey-wide average prices, which tends to understate price differences between small and large stores.

Policy Implications

Increasing access to healthful food, particularly fresh produce, has been a focal point of federal and local initiatives like the federal HFFI, New York City's Healthy Bodegas program, Boston's Healthy on the Block initiative, Baltimore's Healthy Stores program, and Philadelphia's Healthy Corner Store initiative. HFFI supports projects that increase access to healthful, affordable food in communities with low access to these foods. One way HFFI does this is by providing incentives to supermarkets to locate in underserved communities. However, the level of consumer demand required to support a large store precludes having a supermarket in every neighborhood. Other efforts are aimed at building the capacity of small stores already located in these communities to

offer fresh produce and a healthier mix of foods and stimulating community awareness of and demand for these foods.

On the demand side, there is a need to assess consumer sensitivity to the price differential across retailer types. Even if fresh fruits and vegetables are made available at small stores but at a high cost, consumers may opt not to purchase any or will choose to make their purchases at large stores located further away, leaving small store operators to absorb the cost of spoiled produce. The cost for consumers also includes time cost of traveling to and from more distant supermarkets. Would it be more effective to support small stores already present in neighborhoods and build their capacity to offer a wider range of food items (particularly perishable foods) at a price that is competitive with large stores perhaps located further away? Is it better to subsidize the entry of a new large store (supermarket) in a neighborhood lacking one or subsidize transportation to a nearby supermarket?

The methods and analysis developed in this study are well-suited to compare the availability and price level at stores participating in a healthy corner store intervention and those that did not. To our knowledge, very little research has been done to evaluate the impact of such initiatives on food availability and prices. One study, by Song et al. (2008), found that stores participating in the Baltimore Healthy Stores program experienced an increase in the availability and sales of promoted foods (fresh produce) during and post-intervention. However, this evaluation did not monitor food prices between participating and non-participating small stores.

Implications for Future Research

Based on data from stores across the Boston metropolitan area, the availability of representative food items was significantly lower at small stores compared to large stores. This was particularly true for perishable items like fresh produce. The sampling frame we used to select stores consisted of authorized SNAP retailers, which are subject to regulations that are meant to improve the availability of certain food items, including perishable foods. To be eligible as a SNAP retailer, a store must sell on a daily basis at least three different varieties of food in each of four staple food groups (bread/grains, dairy, fruit/vegetables, meat/poultry/fish), with perishable foods in at least two categories. Otherwise, at least half of total sales (both food and non-food) at the store must be from the sale of eligible staple food (USDA/FNS, 2009). Despite the emphasis on perishable foods, we still found availability of perishable food items like fresh meats and fresh produce to be very low in small stores. Future research should examine the issue of perishability and the price differential between perishable food items and their more processed and shelf-stable forms, such as fresh vegetables and canned or frozen versions.

Limitations

The project did not capture the contribution of specialty retailers, farmers markets, or fruit and vegetable stands to the availability and price of food items in neighborhoods. As discussed earlier, the use of a sampling frame consisting of authorized SNAP retailers may have influenced the availability of certain food items. For certain areas, retailers like farmers markets and fruit and vegetable stands could be important sources of fresh produce. Their price competitiveness remains an open question. Because only one visit to

each food retailer was conducted, this study did not account for variations in availability or price due to seasonality or delivery/restocking schedules. Our observations did not account for differences in the quality of food items or the shopping experience. Price differences may reflect both differences in food prices and differences in food item quality or store amenities and services. Finally, this study did not collect data from a household survey and it was therefore not possible to know where people live, work and shop or what prices households actually pay when shopping. The geographic units used in this study are only convenient approximations of the space in which consumers live and shop.

Conclusion

This study provides rich detail on food availability and price at food stores in the Boston metropolitan area. We found that food availability was lower at small stores, while individual food item prices and aggregated food costs were higher at small stores. Fresh meats and produce were rarely available at small stores, which tend to stock less perishable and usually more processed food items. Our findings indicate that small stores were not completely lacking in healthful foods, with a majority of small stores stocking food items such as low fat milk, fresh 100% orange juice, and canned vegetables. Large stores were not just devoted to stocking healthful foods like fresh produce and were inexpensive source of many food items whose intake nutrition guidance recommends that Americans limit. The method of collecting and analyzing food prices developed for this study provides policy makers with detailed descriptions of the availability and price for a

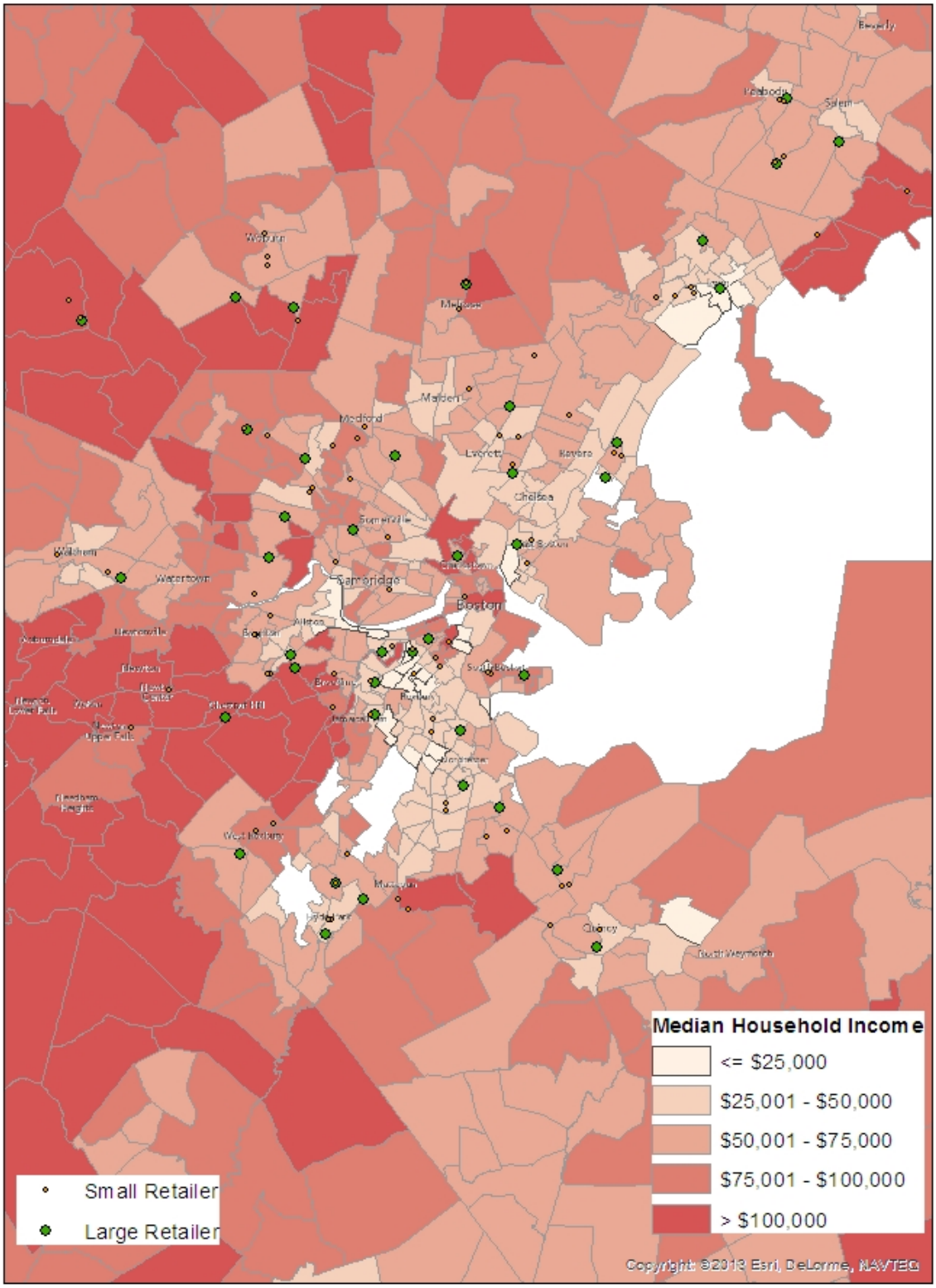
representative list of food items at community stores, which can be used to assess the potential impacts of the food retail environment on nutrition and health outcomes.

Our methods and analysis improve on the literature by addressing several of the concerns raised by Kaufman et al. (1997) regarding sampling method and the tradeoff between comparability and missing values. We selected representative samples of geographic areas, stores, and food items. We used food items with relatively narrow definitions but with flexibility on brand and package size attributes to maintain a high degree of comparability but still limiting the range of acceptable items to avoid unlike comparisons (Kaufman and Handy, 1989). We developed weights that reflect lower food item availability at small stores and avoid the need to impute price information or discard observations based on missing values. We applied the Paasche price index approach to compare aggregated food prices between small and large stores conditional on food item availability and found that overall food prices were 59 percent higher at small stores for mix of food items that were most comparable across retailer size. Without adjusting for low availability of food items at small stores, the estimated difference was much lower at This price difference dropped to 33 percent when the price of the product with the most shelf space was used instead of the lowest unit price, showing the effect of package size and brand on estimated price differences.

The methods used in this study are based on primary and secondary data tools and resources that are readily available to the public at minimal cost. The systematic design will enable other researchers to replicate this type of analysis in other geographic areas and adapt it to address other empirical questions about the food price environment, such as the impact of healthy store initiatives on the availability and price of healthful food

options like fresh fruits and vegetables. Research in this area is needed to guide and evaluate decisions that impact food retail capacity to provide healthful foods like fresh fruits and vegetables in an economically sustainable manner.

Figure 5.1: Map of Sampled Stores and Census Tract Median Household Income



Data sources: ESRI, US Census Bureau, and USDA Food and Nutrition Service.
SNAP retailer location information from August 2011.
Household income information from American Community Survey, 2006-2010.

Figure 5.2: Food Item Availability at Small Stores

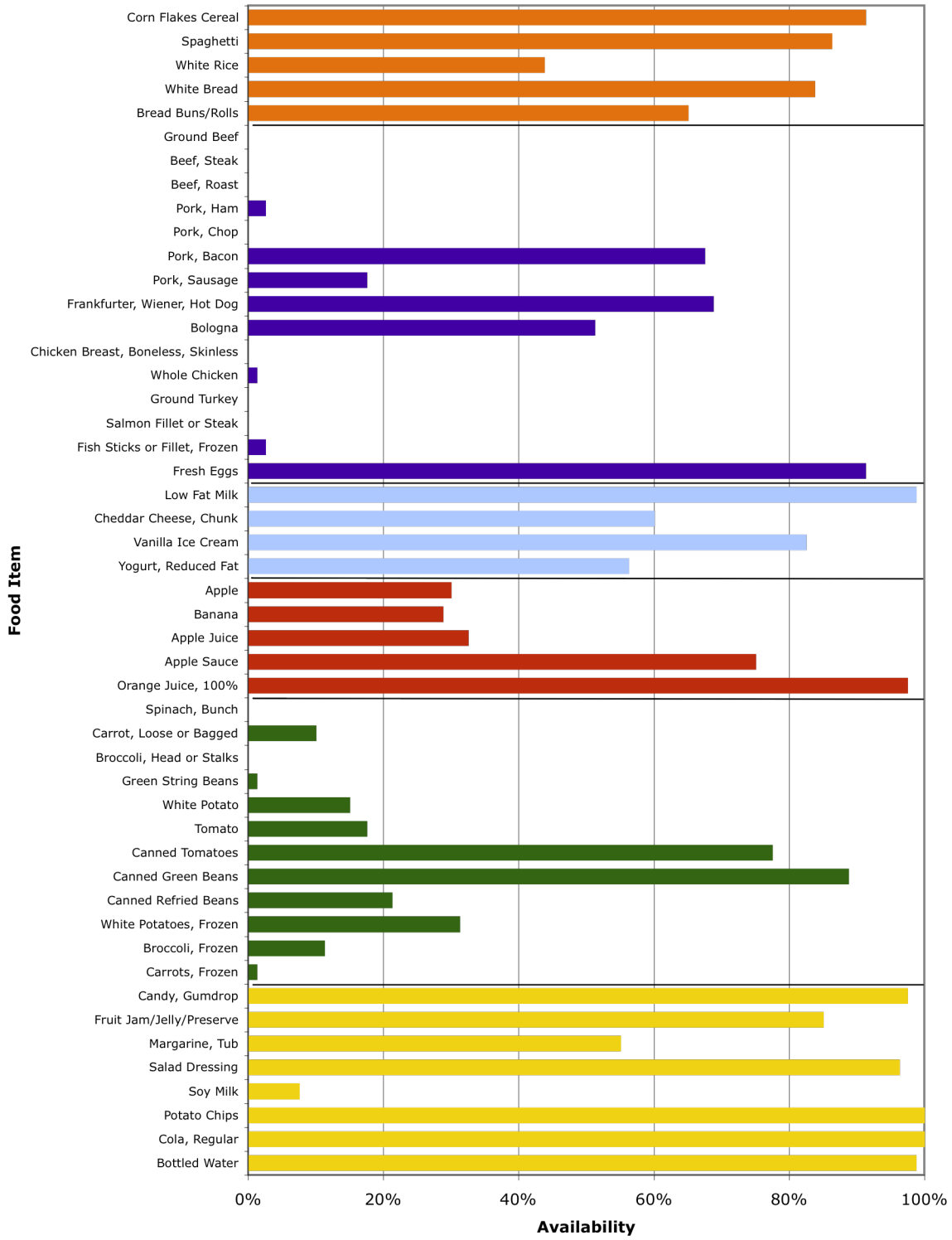


Figure 5.3: Ratio of Unit Price of Lowest Priced Product, Small Stores Relative to Large Stores (Items Available in at Least 50% of Each Store Type)

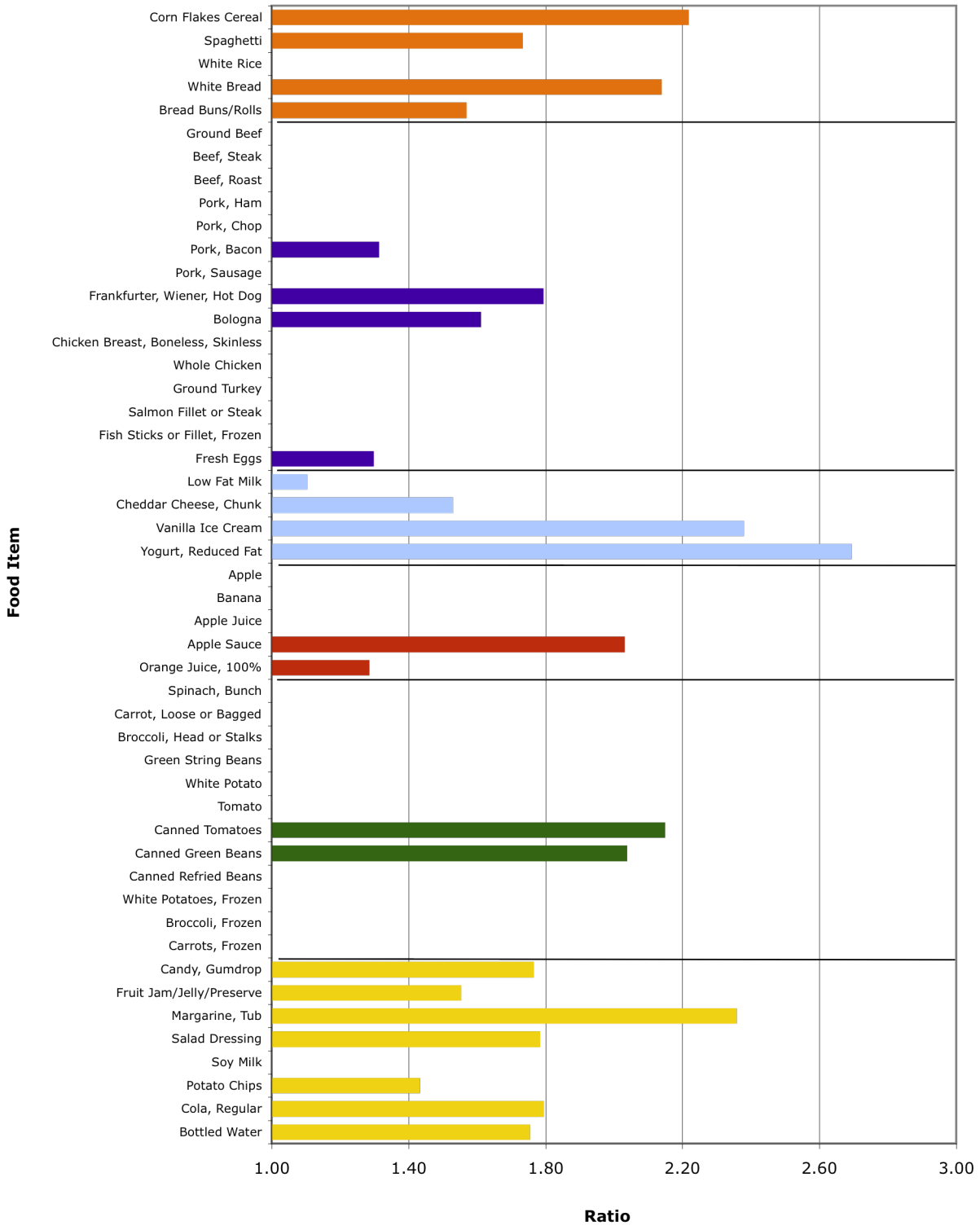


Figure 5.4: Ratio of Mean Package Size of Lowest Priced Product Large Stores Relative to Small Stores (items available in at least 50% of each store type)

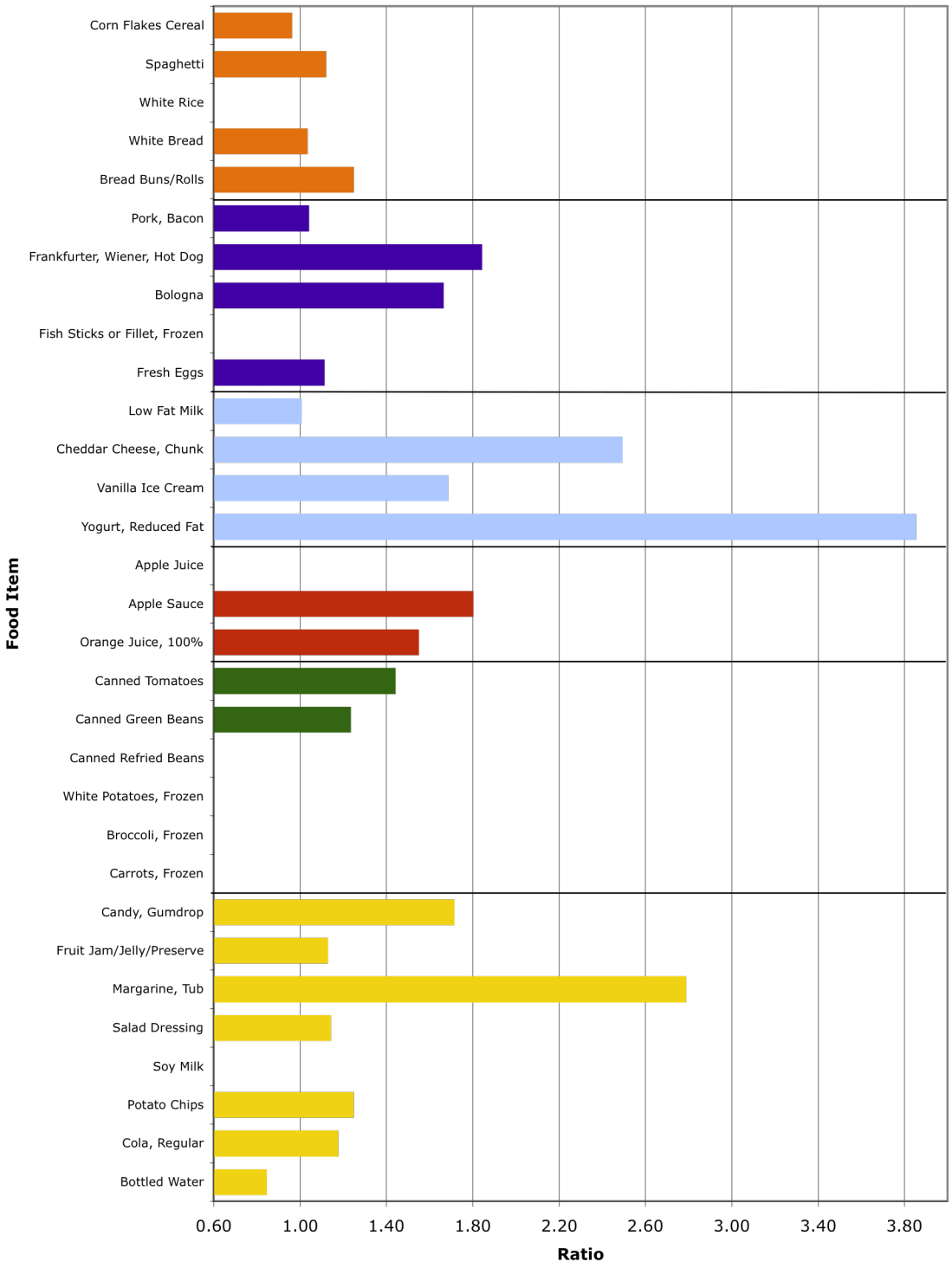


Table 5.1: Population-Weighted Demographic Characteristics of Sampled Census Tracts

Variable	N	Mean	St. Dev	Min	Max	Boston Metro Area
Percent HS grad or higher (population 25 years and older)	40	88.4%	10.2%	52.0%	100%	90.6%
Percent unemployed (persons 16 years and over)	40	7.4%	4.1%	0.6%	17.5%	9.5%
Median household income (2010 dollars)	40	$68,507	$31,045	$23,632	$167,833	$68,020
Percent of housing units with no vehicle available	40	20.5%	14.1%	1.3%	62.6%	13.5%
Percent white (alone or in combination with one or more other races)	40	74.0%	20.1%	7.7%	99.0%	81.7%
Population density per square mile of land area	40	13,436	12,421	1,766	50,961	1,305

Census Tract data: 2006-2010 ACS
Boston Metro Area: Boston-Cambridge-Quincy, MA-NH Metro Area data from 2010 ACS

Table 5.2: Difference in Weighted Average Cost per Pound of Food, Small Stores Relative to Large Stores

	(1) Large Store Basket	(2) Small Store Basket	(3) Small Store Basket at Large Store Prices	(2) – (3) Pure Price Difference	(3) – (1) Item Availability Adjustment	(2) – (1) Total Price Difference
Lowest priced product	$2.28	$3.18	$2.00	$1.18	-$0.28	$0.90
Product with most shelf space	$2.75	$3.44	$2.59	$0.85	-$0.16	$0.69

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Appendix Table 5.1: Food Groups and Representative Food Items

MyPlate Group (6)	Broad Food Group (18)	Narrow Food Group (42)	Representative Food Item (49)
Grains	Cereal and cereal products	Ready-to-eat and cooked cereals	Corn flakes
		Pasta	Spaghetti
		Rice	White rice
	Bakery products	Bread	White bread
		Biscuit and rolls	Rolls
Protein Foods	Beef	Ground beef	Regular ground beef
		Steak	Beef steak
		Roast	Beef roast
	Pork	Ham (not canned)	Ham
		Pork chops	Pork chops
		Bacon	Pork bacon
		Sausage (not canned)	Pork sausage
	Other meats	Frankfurters (not canned)	Frankfurter, wiener, or hot dog
		Bologna, liverwurst, salami (not canned)	Bologna
	Poultry	Fresh and frozen chicken parts	Boneless skinless chicken breast
		Fresh and frozen whole chicken	Fresh or frozen whole chicken
		Other poultry	Ground turkey
	Fish and seafood	Fresh fish and shellfish	Fresh salmon, fillet or steak
		Frozen fish and shellfish	Frozen fish stick or fillet
	Eggs	Eggs	Eggs
Dairy	Fresh milk and cream	Fresh milk, all types	Low-fat milk
	Other dairy products	Cheese	Chunk cheddar cheese
		Ice cream and related products	Regular ice cream
		Miscellaneous dairy products	Low-fat yogurt
Fruits	Fresh fruits	Apples	Apples
		Bananas	Bananas
	Processed fruits	Canned and bottled fruit juice	Bottled apple juice
		Frozen, dried, and canned fruits	Applesauce
		Fresh fruit juice	100% orange juice, refrigerated
Vegetables	Fresh vegetables	Other fresh vegetables	Carrots
			Broccoli
			String beans
			Spinach, bunch

Continued

Appendix Table 5.1: *Continued*

MyPlate Group (6)	**Broad Food Group (18)**	**Narrow Food Group (42)**	**Representative Food Item (49)**
Vegetables	Fresh vegetables	Potatoes (starchy)	White potatoes
		Tomatoes (other)	Tomatoes
	Processed vegetables	Canned vegetables	Canned refried beans
			Canned green beans
			Canned tomatoes
		Frozen vegetables	Frozen white potatoes
			Frozen broccoli
			Frozen carrots
Other Food at Home	Sugar and other sweets	Candy and chewing gum	Gumdrops
		Jams, preserves, and other sweets	Fruit jelly
	Fats and oils	Fats and oils	Margarine and margarine-like spread, tub
		Salad dressings	Salad dressing
		Nondairy cream and imitation milk	Soy milk
	Miscellaneous food	Potato chips, nuts, and other snacks	Potato chips
	Nonalcoholic beverages	Cola	Regular cola
		Bottled water	Bottled water

Appendix Table 5.2: Characteristics of Sampled Food Stores

	Small Stores	Large Stores	All Stores
N	80	40	120
Number of registers			
Mean	3.5	11.1	6
Median	2	11	4
Share with			
Express Checkout Lane	13.8%	92.5%	40.0%
Self-Checkout Lane	11.3%	40.0%	20.8%
Fresh Produce	36.3%	100.0%	57.5%
Refrigeration	98.8%	100.0%	99.2%
Fresh Meat Counter	0.0%	42.5%	14.2%
Fresh Seafood Counter	0.0%	75.0%	25.0%
Prepared Food Counter	16.3%	85.0%	39.2%

Appendix Table 5.3: Food Item Availability, by Store Type

Food Item	Percent of Stores Selling Food Item				p-value
	Large Stores	Linearized SE	Small Stores	Linearized SE	
Grains					
Corn Flakes Cereal	100.0	0.0	91.3	3.0	0.01
Spaghetti	100.0	0.0	86.3	3.6	0.00
White Rice	100.0	0.0	43.8	5.7	0.00
White Bread	100.0	0.0	83.8	3.8	0.00
Bread Buns/Rolls	100.0	0.0	65.0	5.1	0.00
Protein Foods					
Ground Beef	100.0	0.0	0.0	0.0	n.a.
Beef, Steak	100.0	0.0	0.0	0.0	n.a.
Beef, Roast	97.5	2.5	0.0	0.0	0.00
Pork, Ham	97.5	2.5	2.5	1.7	0.00
Pork, Chop	100.0	0.0	0.0	0.0	n.a.
Pork, Bacon	97.5	2.5	67.5	4.6	0.00
Pork, Sausage	100.0	0.0	17.5	4.6	0.00
Frankfurter, Wiener, Hot Dog	100.0	0.0	68.8	4.6	0.00
Bologna	92.5	4.2	51.3	5.8	0.00
Chicken Breast, Boneless, Skinless	100.0	0.0	0.0	0.0	n.a.
Whole Chicken	97.5	2.5	1.3	1.3	0.00
Ground Turkey	90.0	4.8	0.0	0.0	0.00
Salmon Fillet or Steak	90.0	4.8	0.0	0.0	0.00
Fish Sticks or Fillet, Frozen	100.0	0.0	2.5	1.7	0.00
Fresh Eggs	100.0	0.0	91.3	3.0	0.01
Dairy					
Low Fat Milk	100.0	0.0	98.8	1.3	0.32
Cheddar Cheese, Chunk	100.0	0.0	60.0	5.4	0.00
Vanilla Ice Cream	100.0	0.0	82.5	4.2	0.00
Yogurt, Reduced Fat	100.0	0.0	56.3	5.1	0.00
Fruits					
Apple	100.0	0.0	30.0	5.3	0.00
Banana	100.0	0.0	28.8	5.0	0.00
Apple Juice	90.0	4.8	32.5	5.5	0.00
Apple Sauce	100.0	0.0	75.0	4.4	n.a.
Orange Juice, 100%	100.0	0.0	97.5	1.7	n.a.[1]
Vegetables					
Spinach, Bunch	15.0	5.7	0.0	0.0	0.01
Carrot, Loose or Bagged	100.0	0.0	10.0	3.7	0.00
Broccoli, Head or Stalks	97.5	2.5	0.0	0.0	0.00
Green String Beans	95.0	3.5	1.3	1.3	0.00

Continued

Appendix Table 5.3: *Continued*

Food Item	Percent of Stores Selling Food Item				p-value
	Large Stores	Linearized SE	Small Stores	Linearized SE	
Vegetables					
White Potato	100.0	0.0	15.0	4.5	0.00
Tomato	100.0	0.0	17.5	4.9	0.00
Canned Tomatoes	100.0	0.0	77.5	4.0	0.00
Canned Green Beans	100.0	0.0	88.8	3.3	0.00
Canned Refried Beans	100.0	0.0	21.3	4.7	0.00
White Potatoes, Frozen	100.0	0.0	31.3	5.6	0.00
Broccoli, Frozen	100.0	0.0	11.3	3.8	0.00
Carrots, Frozen	77.5	6.7	1.3	1.3	0.00
Other Foods					
Candy, Gumdrop	90.0	4.8	97.5	1.7	0.16
Fruit Jam/Jelly/Preserve	100.0	0.0	85.0	3.7	0.00
Margarine, Tub	95.0	3.5	55.0	5.0	0.00
Salad Dressing	100.0	0.0	96.3	2.1	0.08
Soy Milk	92.5	4.2	7.5	2.9	0.00
Potato Chips	100.0	0.0	100.0	0.0	n.a.[1]
Cola, Regular	95.0	3.5	100.0	0.0	0.16
Bottled Water	100.0	0.0	98.8	1.3	0.32

Appendix Table 5.4: Mean Unit Price of Lowest Priced Product, by Store Type

Food Item	Mean Unit Price of Lowest Priced Product ($)*				
	Large Stores	Linearized SE	Small Stores	Linearized SE	p-value
Grains					
Corn Flakes Cereal	2.12	0.13	4.69	0.21	0.00
Spaghetti	1.01	0.03	1.76	0.08	0.00
White Rice	0.73	0.04	1.21	0.08	0.00
White Bread	1.15	0.07	2.46	0.07	0.00
Bread Buns/Rolls	2.32	0.12	3.63	0.12	0.00
Protein Foods					
Ground Beef	3.41	0.15	n.a.	n.a.	n.a.
Beef, Steak	4.30	0.22	n.a.	n.a.	n.a.
Beef, Roast	4.12	0.16	n.a.	n.a.	n.a.
Pork, Ham	2.26	0.25	8.52	0.00	0.00
Pork, Chop	3.39	0.20	n.a.	n.a.	n.a.
Pork, Bacon	4.48	0.24	5.88	0.17	0.00
Pork, Sausage	3.66	0.15	5.15	0.29	0.00
Frankfurter, Wiener, Hot Dog	1.82	0.21	3.26	0.15	0.00
Bologna	2.95	0.27	4.74	0.27	0.00
Chicken Breast, Boneless, Skinless	2.95	0.18	n.a.	n.a.	n.a.
Whole Chicken	1.43	0.08	1.49	0.00	0.48
Ground Turkey	3.30	0.20	n.a.	n.a.	n.a.
Salmon Fillet or Steak	8.73	0.37	n.a.	n.a.	n.a.
Fish Sticks or Fillet, Frozen	3.76	0.26	5.82	2.19	0.35
Fresh Eggs[1]	15.83	0.37	20.53	0.82	0.00
Dairy					
Low Fat Milk[2]	3.44	0.07	3.79	0.07	0.00
Cheddar Cheese, Chunk	4.64	0.18	7.09	0.23	0.00
Vanilla Ice Cream[2]	6.41	0.37	15.23	0.93	0.00
Yogurt, Reduced Fat	1.18	0.04	3.18	0.17	0.00
Fruits					
Apple	1.18	0.06	2.36	0.25	0.00
Banana	0.68	0.01	1.60	0.17	0.00
Apple Juice[2]	4.21	0.24	7.14	0.43	0.00
Apple Sauce	0.88	0.05	1.78	0.05	0.00
Orange Juice, 100%[2]	4.53	0.16	5.81	0.20	0.00
Vegetables					
Spinach, Bunch	2.59	0.18	n.a.	n.a.	n.a.
Carrot, Loose or Bagged	0.77	0.03	1.97	0.44	0.01
Broccoli, Head or Stalks	1.77	0.06	n.a.	n.a.	n.a.
Green String Beans	2.16	0.07	1.69	0.00	0.00

Continued

Appendix Table 5.4: *Continued*

Food Item	Mean Unit Price of Lowest Priced Product ($)*				
	Large Stores	Linearized SE	Small Stores	Linearized SE	p-value
Vegetables					
White Potato	0.62	0.04	0.83	0.13	0.14
Tomato	2.18	0.09	2.74	0.20	0.02
Canned Tomatoes	0.71	0.03	1.52	0.06	0.00
Canned Green Beans	0.80	0.03	1.64	0.06	0.00
Canned Refried Beans	1.22	0.03	1.73	0.12	0.00
White Potatoes, Frozen	0.97	0.04	2.25	0.16	0.00
Broccoli, Frozen	1.42	0.07	2.59	0.26	0.00
Carrots, Frozen	1.50	0.06	1.49	0.00	0.93
Other Foods					
Candy, Gumdrop	1.63	0.06	2.88	0.54	0.02
Fruit Jam/Jelly/Preserve	1.23	0.13	1.92	0.11	0.00
Margarine, Tub	1.37	0.10	3.22	0.12	0.00
Salad Dressing[2]	16.67	1.12	29.71	0.78	0.00
Soy Milk[2]	6.67	0.15	8.39	0.82	0.05
Potato Chips	3.64	0.15	5.21	0.17	0.00
Cola, Regular[2]	1.77	0.06	3.17	0.11	0.00
Bottled Water[2]	0.90	0.03	1.58	0.13	0.00

*Units are in pounds unless otherwise specified.

[1]Unit is 100 count.

[2]Unit is a gallon.

Appendix Table 5.5: Mean Unit Price of Product with Most Shelf Space, by Store Type

Food Item	Mean Unit Price of Product with Most Shelf Space ($)*				
	Large Stores	Linearized SE	Small Stores	Linearized SE	p-value
Grains					
Corn Flakes Cereal	3.13	0.17	4.99	0.20	0.00
Spaghetti	1.62	0.14	1.83	0.07	0.11
White Rice	0.82	0.06	1.22	0.08	0.00
White Bread	1.27	0.10	2.57	0.06	0.00
Bread Buns/Rolls	2.44	0.11	3.68	0.13	0.00
Protein Foods					
Ground Beef	3.45	0.15	n.a.	n.a.	n.a.
Beef, Steak	5.47	0.49	n.a.	n.a.	n.a.
Beef, Roast	4.44	0.17	n.a.	n.a.	n.a.
Pork, Ham	2.71	0.26	8.52	0.00	0.00
Pork, Chop	3.75	0.24	n.a.	n.a.	n.a.
Pork, Bacon	5.63	0.27	5.88	0.17	0.47
Pork, Sausage	3.92	0.17	5.25	0.31	0.00
Frankfurter, Wiener, Hot Dog	2.81	0.28	3.75	0.21	0.01
Bologna	3.83	0.32	4.94	0.28	0.01
Chicken Breast, Boneless, Skinless	3.09	0.21	n.a.	n.a.	n.a.
Whole Chicken	1.53	0.10	1.49	0.00	0.72
Ground Turkey	3.49	0.22	n.a.	n.a.	n.a.
Salmon Fillet or Steak	9.00	0.37	n.a.	n.a.	n.a.
Fish Sticks or Fillet, Frozen	4.30	0.37	5.82	2.19	0.49
Fresh Eggs[1]	20.02	0.90	20.59	0.82	0.64
Dairy					
Low Fat Milk[2]	3.56	0.10	3.82	0.06	0.05
Cheddar Cheese, Chunk	4.83	0.21	7.14	0.23	0.00
Vanilla Ice Cream[2]	7.53	0.56	15.36	0.90	0.00
Yogurt, Reduced Fat	1.29	0.05	3.25	0.17	0.00
Fruits					
Apple	1.34	0.08	2.36	0.25	0.00
Banana	0.68	0.01	1.61	0.17	0.00
Apple Juice[2]	5.00	0.23	7.14	0.43	0.00
Apple Sauce	1.11	0.05	1.87	0.04	0.00
Orange Juice, 100%[2]	7.11	0.22	7.26	0.28	0.67
Vegetables					
Spinach, Bunch	2.59	0.18	n.a.	n.a.	n.a.

Continued

Appendix Table 5.5: *Continued*

Food Item	Mean Unit Price of Product with Most Shelf Space ($)*				
	Large Stores	Linearized SE	Small Stores	Linearized SE	p-value
Vegetables					
Carrot, Loose or Bagged	0.84	0.04	1.97	0.44	0.01
Broccoli, Head or Stalks	1.88	0.08	n.a.	n.a.	n.a.
Green String Beans	2.16	0.07	1.69	0.00	0.00
White Potato	0.73	0.04	0.83	0.13	0.52
Tomato	2.64	0.10	2.74	0.20	0.68
Canned Tomatoes	0.86	0.03	1.59	0.06	0.00
Canned Green Beans	1.04	0.06	1.67	0.06	0.00
Canned Refried Beans	1.31	0.06	1.76	0.11	0.00
White Potatoes, Frozen	1.14	0.06	2.30	0.16	0.00
Broccoli, Frozen	1.46	0.07	2.59	0.26	0.00
Carrots, Frozen	1.61	0.06	1.49	0.00	0.06
Other Foods					
Candy, Gumdrop	1.87	0.13	3.01	0.54	0.03
Fruit Jam/Jelly/Preserve	1.61	0.15	2.09	0.11	0.02
Margarine, Tub	1.85	0.12	3.32	0.12	0.00
Salad Dressing[2]	22.70	1.30	32.28	1.01	0.00
Soy Milk[2]	6.95	0.18	8.39	0.82	0.10
Potato Chips	4.97	0.25	5.85	0.18	0.00
Cola, Regular[2]	3.25	0.13	3.99	0.20	0.01
Bottled Water[2]	1.00	0.04	2.40	0.20	0.00

*Units are in pounds unless otherwise specified.
[1]Unit is 100 count.
[2]Unit is a gallon.

Appendix Table 5.6: Mean Package Size of Lowest Priced Product, by Store Type
Excludes items that are typically random weight

Food Item	Mean Package Size of Lowest Priced Product*				
	Large Stores	Linearized SE	Small Stores	Linearized SE	p-value
Grains					
Corn Flakes Cereal	0.99	0.06	1.03	0.04	0.54
Spaghetti	1.10	0.06	0.98	0.01	0.06
White Rice	14.83	1.05	6.24	0.93	0.00
White Bread	1.29	0.02	1.25	0.02	0.15
Bread Buns/Rolls	0.99	0.03	0.80	0.02	0.00
Protein Foods					
Pork, Bacon	0.96	0.02	0.92	0.02	0.18
Frankfurter, Wiener, Hot Dog	1.83	0.19	1.00	0.00	0.00
Bologna	0.90	0.06	0.54	0.03	0.00
Fish Sticks or Fillet, Frozen	1.88	0.16	1.11	0.30	0.02
Fresh Eggs[1]	13.25	0.56	11.92	0.08	0.02
Dairy					
Low Fat Milk[2]	1.00	0.00	0.99	0.01	n.a.[3]
Cheddar Cheese, Chunk	1.35	0.08	0.54	0.02	0.00
Vanilla Ice Cream[2]	0.60	0.05	0.36	0.02	0.00
Yogurt, Reduced Fat	2.00	0.00	0.52	0.07	0.00
Fruits					
Apple Juice[2]	0.51	0.01	0.49	0.01	0.16
Apple Sauce	2.78	0.09	1.54	0.04	0.00
Orange Juice, 100%[2]	0.92	0.03	0.60	0.02	0.00
Vegetables					
Canned Tomatoes	1.73	0.02	1.20	0.06	0.00
Canned Green Beans	1.12	0.06	0.91	0.00	0.00
Canned Refried Beans	1.05	0.03	1.06	0.05	0.90
White Potatoes, Frozen	3.86	0.24	1.82	0.07	0.00
Broccoli, Frozen	1.47	0.10	0.79	0.07	0.00
Carrots, Frozen	1.00	0.00	1.00	0.00	n.a.[3]
Other Foods					
Candy, Gumdrop	0.90	0.07	0.53	0.05	0.00
Fruit Jam/Jelly/Preserve	1.88	0.06	1.67	0.05	0.01
Margarine, Tub	2.73	0.10	0.98	0.05	0.00
Salad Dressing[2]	0.12	0.00	0.11	0.00	0.00
Soy Milk[2]	0.51	0.01	0.42	0.05	0.05
Potato Chips	0.62	0.02	0.50	0.02	0.00
Cola, Regular[2]	0.69	0.02	0.59	0.02	0.00
Bottled Water[2]	1.09	0.07	1.30	0.09	0.06

*Units are in pounds unless otherwise specified.
[1]Unit is 100 count.
[2]Unit is a gallon.
[3]Variance matrix is nonsymmetric or highly singular.

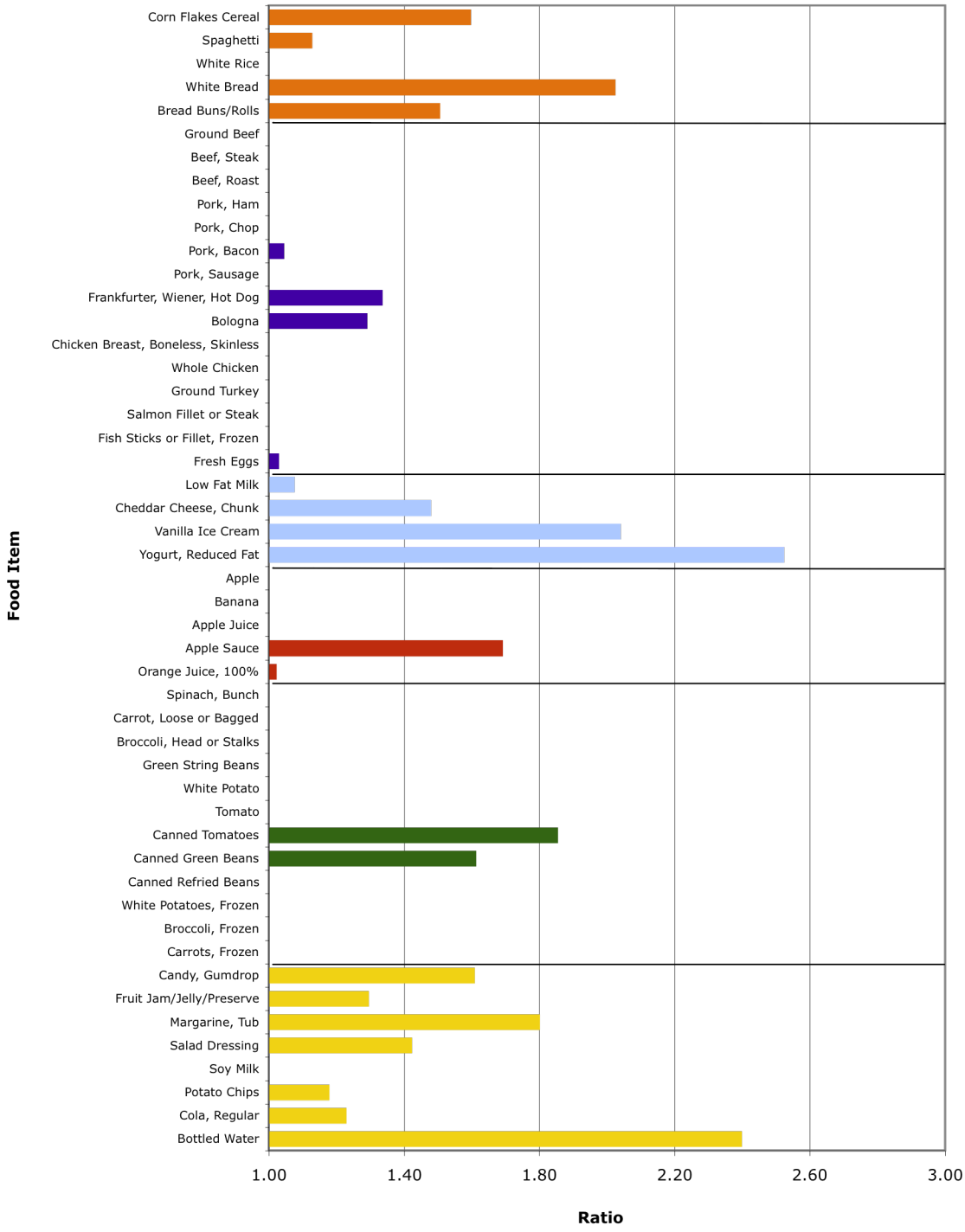
Appendix Table 5.7: Aggregated Food Costs, Lowest Priced Product

	(1) Large Store Basket			(2) Small Store Basket			(3) Small Store Basket at Large Stores Price		
Food Item	**Large Store Expenditure Weight**	**Large Store Unit Price ($/lb)**	**Large Store Prices, Large Store Expenditure Weights**	**Small Store Expenditure Weight**	**Small Store Unit Price ($/lb)**	**Small Store Prices, Small Store Expenditure Weights**	**Small Store Expenditure Weight**	**Large Store Unit Price ($/lb)**	**Large Store Prices, Small Store Expenditure Weights**
	100.0000	$98.14	$2.28	100.0000	$108.25	$3.18	100.0000	$98.14	$2.00
Corn Flakes Cereal	2.8650	$2.12	$6.07	4.2334	$4.69	$19.86	4.2334	$2.12	$8.96
Spaghetti	0.9339	$1.01	$0.95	1.3043	$1.76	$2.29	1.3043	$1.01	$1.32
White Rice	0.7745	$0.73	$0.56	0.5487	$1.21	$0.66	0.5487	$0.73	$0.40
White Bread	6.0634	$1.15	$6.98	8.2231	$2.46	$20.24	8.2231	$1.15	$9.47
Bread Buns/Rolls	3.0648	$2.32	$7.10	3.2259	$3.63	$11.72	3.2259	$2.32	$7.47
Ground Beef	2.6721	$3.41	$9.10	0.0000	.		0.0000	$3.41	$0.00
Beef, Steak	2.5851	$4.30	$11.12	0.0000	.		0.0000	$4.30	$0.00
Beef, Roast	1.1578	$4.12	$4.77	0.0000	.		0.0000	$4.12	$0.00
Pork, Ham	1.1932	$2.26	$2.70	0.0483	$8.52	$0.41	0.0483	$2.26	$0.11
Pork, Chop	1.1542	$3.39	$3.91	0.0000	.		0.0000	$3.39	$0.00
Pork, Bacon	1.0480	$4.48	$4.69	1.1455	$5.88	$6.73	1.1455	$4.48	$5.13
Pork, Sausage	1.0215	$3.66	$3.74	0.2895	$5.15	$1.49	0.2895	$3.66	$1.06
Frankfurter, Wiener, Hot Dog	1.5199	$1.82	$2.77	1.6920	$3.26	$5.52	1.6920	$1.82	$3.08
Bologna	1.3660	$2.95	$4.03	1.1337	$4.74	$5.38	1.1337	$2.95	$3.34
Chicken Breast, Boneless, Skinless	2.5425	$2.95	$7.49	0.0000	.		0.0000	$2.95	$0.00
Whole Chicken	0.8839	$1.43	$1.27	0.0179	$1.49	$0.03	0.0179	$1.43	$0.03
Ground Turkey	0.8813	$3.30	$2.91	0.0000	.		0.0000	$3.30	$0.00
Salmon Fillet or Steak	2.0868	$8.73	$18.21	0.0000	.		0.0000	$8.73	$0.00
Fish Sticks of Fillet, Frozen	1.3301	$3.76	$5.00	0.0538	$5.82	$0.31	0.0538	$3.76	$0.20
Fresh Eggs	1.3711	$1.26	$1.73	2.0260	$1.64	$3.32	2.0260	$1.26	$2.56
Low Fat Milk	4.5374	$0.40	$1.81	7.2557	$0.44	$3.20	7.2557	$0.40	$2.90
Cheddar Cheese, Chunk	3.9717	$4.64	$18.42	3.8589	$7.09	$27.34	3.8589	$4.64	$17.90
Vanilla Ice Cream	1.7771	$1.38	$2.44	2.3741	$3.27	$7.77	2.3741	$1.38	$3.27
Low Fat Yogurt	1.3419	$1.18	$1.58	1.2223	$3.18	$3.88	1.2223	$1.18	$1.44
Apple	3.3242	$1.18	$3.93	1.6149	$2.36	$3.81	1.6149	$1.18	$1.91
Banana	2.6855	$0.68	$1.83	1.2502	$1.60	$2.00	1.2502	$0.68	$0.85
Apple Juice	1.6698	$0.48	$0.80	0.8788	$0.82	$0.72	0.8788	$0.48	$0.42
Apple Sauce	0.9654	$0.88	$0.85	1.1724	$1.78	$2.09	1.1724	$0.88	$1.03
Orange Juice, 100%	0.5090	$0.52	$0.26	0.8036	$0.66	$0.53	0.8036	$0.52	$0.42
Spinach, Bunch	0.8560	$2.59	$2.22	0.0000	.		0.0000	$2.59	$0.00
Carrot, Loose or Bagged	0.8560	$0.77	$0.66	0.1386	$1.97	$0.27	0.1386	$0.77	$0.11
Broccoli, Head or Stalks	0.8560	$1.77	$1.51	0.0000	.		0.0000	$1.77	$0.00
Green String Beans	0.8560	$2.16	$1.85	0.0173	$1.69	$0.03	0.0173	$2.16	$0.04
White Potato	1.1644	$0.62	$0.72	0.2828	$0.83	$0.23	0.2828	$0.62	$0.17
Tomato	1.1372	$2.18	$2.48	0.3223	$2.74	$0.88	0.3223	$2.18	$0.70
Canned Tomatoes	0.5372	$0.71	$0.38	0.6741	$1.52	$1.02	0.6741	$0.71	$0.48
Canned Green Beans	0.5372	$0.80	$0.43	0.7720	$1.64	$1.26	0.7720	$0.80	$0.62
Canned Refried Beans	0.5372	$1.22	$0.66	0.1848	$1.73	$0.32	0.1848	$1.22	$0.23
White Potatoes, Frozen	0.4299	$0.97	$0.42	0.2176	$2.25	$0.49	0.2176	$0.97	$0.21
Broccoli, Frozen	0.4299	$1.42	$0.61	0.0783	$2.59	$0.20	0.0783	$1.42	$0.11
Carrots, Frozen	0.4299	$1.50	$0.64	0.0087	$1.49	$0.01	0.0087	$1.50	$0.01
Candy, Gumdrop	2.6784	$1.63	$4.37	4.2287	$2.88	$12.16	4.2287	$1.63	$6.89
Fruit Jam/Jelly/Preserve	0.8287	$1.23	$1.02	1.1407	$1.92	$2.18	1.1407	$1.23	$1.41
Margarine, Tub	1.3399	$1.37	$1.83	1.1933	$3.22	$3.85	1.1933	$1.37	$1.63
Salad Dressing	0.9259	$2.01	$1.86	1.4432	$3.58	$5.17	1.4432	$2.01	$2.90
Soy Milk	0.5527	$0.78	$0.43	0.0671	$0.98	$0.07	0.0671	$0.78	$0.05
Potato Chips	18.4585	$3.64	$67.23	29.8901	$5.21	$155.77	29.8901	$3.64	$108.87
Cola, Regular	5.3477	$0.20	$1.09	8.6597	$0.37	$3.17	8.6597	$0.20	$1.77
Bottled Water	3.9446	$0.11	$0.42	6.3077	$0.19	$1.19	6.3077	$0.11	$0.68

Appendix Table 5.8: Aggregated Food Costs, Product with Most Shelf Space

	(1) Large Store Basket			(2) Small Store Basket			3) Small Store Basket at Large Stores Price		
Food Item	**Large Store Expenditure Weight**	**Large Store Unit Price ($/lb)**	**Large Store Prices, Large Store Expenditure Weights**	**Small Store Expenditure Weight**	**Small Store Unit Price ($/lb)**	**Small Store Prices, Small Store Expenditure Weights**	**Small Store Expenditure Weight**	**Large Store Unit Price ($/lb)**	**Large Store Prices, Small Store Expenditure Weights**
	100.0000	$113.56	$2.75	100.0000	$111.74	$3.44	100.0000	$113.56	$2.59
Corn Flakes Cereal	2.8650	$3.13	$8.96	4.2334	$4.99	$21.13	4.2334	$3.13	$13.25
Spaghetti	0.9339	$1.62	$1.52	1.3043	$1.83	$2.39	1.3043	$1.62	$2.12
White Rice	0.7745	$0.82	$0.63	0.5487	$1.22	$0.67	0.5487	$0.82	$0.45
White Bread	6.0634	$1.27	$7.69	8.2231	$2.57	$21.12	8.2231	$1.27	$10.44
Bread Buns/Rolls	3.0648	$2.44	$7.49	3.2259	$3.68	$11.87	3.2259	$2.44	$7.88
Ground Beef	2.6721	$3.45	$9.23	0.0000	.		0.0000	$3.45	$0.00
Beef, Steak	2.5851	$5.47	$14.13	0.0000	.		0.0000	$5.47	$0.00
Beef, Roast	1.1578	$4.44	$5.14	0.0000	.		0.0000	$4.44	$0.00
Pork, Ham	1.1932	$2.71	$3.23	0.0483	$8.52	$0.41	0.0483	$2.71	$0.13
Pork, Chop	1.1542	$3.75	$4.33	0.0000	.		0.0000	$3.75	$0.00
Pork, Bacon	1.0480	$5.63	$5.90	1.1455	$5.88	$6.73	1.1455	$5.63	$6.45
Pork, Sausage	1.0215	$3.92	$4.00	0.2895	$5.25	$1.52	0.2895	$3.92	$1.13
Frankfurter, Wiener, Hot Dog	1.5199	$2.81	$4.28	1.6920	$3.75	$6.35	1.6920	$2.81	$4.76
Bologna	1.3660	$3.83	$5.23	1.1337	$4.94	$5.60	1.1337	$3.83	$4.34
Chicken Breast, Boneless, Skinless	2.5425	$3.09	$7.87	0.0000	.		0.0000	$3.09	$0.00
Whole Chicken	0.8839	$1.53	$1.35	0.0179	$1.49	$0.03	0.0179	$1.53	$0.03
Ground Turkey	0.8813	$3.49	$3.07	0.0000	.		0.0000	$3.49	$0.00
Salmon Fillet or Steak	2.0868	$9.00	$18.79	0.0000	.		0.0000	$9.00	$0.00
Fish Sticks of Fillet, Frozen	1.3301	$4.30	$5.72	0.0538	$5.82	$0.31	0.0538	$4.30	$0.23
Fresh Eggs	1.3711	$1.60	$2.19	2.0260	$1.64	$3.33	2.0260	$1.60	$3.24
Low Fat Milk	4.5374	$0.41	$1.88	7.2557	$0.44	$3.22	7.2557	$0.41	$3.00
Cheddar Cheese, Chunk	3.9717	$4.83	$19.18	3.8589	$7.14	$27.54	3.8589	$4.83	$18.64
Vanilla Ice Cream	1.7771	$1.62	$2.87	2.3741	$3.30	$7.83	2.3741	$1.62	$3.84
Low Fat Yogurt	1.3419	$1.29	$1.73	1.2223	$3.25	$3.98	1.2223	$1.29	$1.58
Apple	3.3242	$1.34	$4.46	1.6149	$2.36	$3.81	1.6149	$1.34	$2.16
Banana	2.6855	$0.68	$1.83	1.2502	$1.61	$2.01	1.2502	$0.68	$0.85
Apple Juice	1.6698	$0.57	$0.96	0.8788	$0.82	$0.72	0.8788	$0.57	$0.50
Apple Sauce	0.9654	$1.11	$1.07	1.1724	$1.87	$2.19	1.1724	$1.11	$1.30
Orange Juice, 100%	0.5090	$0.81	$0.41	0.8036	$0.83	$0.67	0.8036	$0.81	$0.65
Spinach, Bunch	0.8560	$2.59	$2.22	0.0000	.		0.0000	$2.59	$0.00
Carrot, Loose or Bagged	0.8560	$0.84	$0.72	0.1386	$1.97	$0.27	0.1386	$0.84	$0.12
Broccoli, Head or Stalks	0.8560	$1.88	$1.61	0.0000	.		0.0000	$1.88	$0.00
Green String Beans	0.8560	$2.16	$1.85	0.0173	$1.69	$0.03	0.0173	$2.16	$0.04
White Potato	1.1644	$0.73	$0.86	0.2828	$0.83	$0.23	0.2828	$0.73	$0.21
Tomato	1.1372	$2.64	$3.00	0.3223	$2.74	$0.88	0.3223	$2.64	$0.85
Canned Tomatoes	0.5372	$0.86	$0.46	0.6741	$1.59	$1.07	0.6741	$0.86	$0.58
Canned Green Beans	0.5372	$1.04	$0.56	0.7720	$1.67	$1.29	0.7720	$1.04	$0.80
Canned Refried Beans	0.5372	$1.31	$0.70	0.1848	$1.76	$0.33	0.1848	$1.31	$0.24
White Potatoes, Frozen	0.4299	$1.14	$0.49	0.2176	$2.30	$0.50	0.2176	$1.14	$0.25
Broccoli, Frozen	0.4299	$1.46	$0.63	0.0783	$2.59	$0.20	0.0783	$1.46	$0.11
Carrots, Frozen	0.4299	$1.61	$0.69	0.0087	$1.49	$0.01	0.0087	$1.61	$0.01
Candy, Gumdrop	2.6784	$1.87	$5.01	4.2287	$3.01	$12.72	4.2287	$1.87	$7.91
Fruit Jam/Jelly/Preserve	0.8287	$1.61	$1.34	1.1407	$2.09	$2.38	1.1407	$1.61	$1.84
Margarine, Tub	1.3399	$1.85	$2.47	1.1933	$3.32	$3.97	1.1933	$1.85	$2.20
Salad Dressing	0.9259	$2.74	$2.54	1.4432	$3.89	$5.62	1.4432	$2.74	$3.95
Soy Milk	0.5527	$0.81	$0.45	0.0671	$0.98	$0.07	0.0671	$0.81	$0.05
Potato Chips	18.4585	$4.97	$91.78	29.8901	$5.85	$174.97	29.8901	$4.97	$148.62
Cola, Regular	5.3477	$0.37	$2.00	8.6597	$0.46	$3.99	8.6597	$0.37	$3.25
Bottled Water	3.9446	$0.12	$0.47	6.3077	$0.29	$1.81	6.3077	$0.12	$0.76

Appendix Figure 5.1: Ratio of Unit Price of Item with Most Shelf Space, Small Stores Relative to Large Stores (Items Available in at Least 50% of Each Store Type)



CHAPTER 6: EXPLORING THE PRICE PREMIUM FOR NUTRITION AND CONVENIENCE ATTRIBUTES IN FOOD

Joseph T. Llobrera

Corresponding Author:

Joseph T. Llobrera

Food Policy and Applied Nutrition Program

Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy

Tufts University

150 Harrison Avenue, Boston MA 02111

Phone: 627-600-8046

Email: Joseph.Llobrera@tufts.edu

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ABSTRACT

This study examined variations in the price of food items due to nutrition and convenience attributes using detailed, localized data from food retailers in the Boston metropolitan area. It extends the literature on price differentials related to nutrition and convenience attributes in food while improving on existing community food price survey methods in three ways. First, systematic research design was implemented to ensure representativeness of sampled areas, retailers, and food items. A basket of standard food items was constructed to be representative of national household food spending and consumption patterns. This basket was augmented by a set of substitute food items that allowed for detailed pairwise comparisons between similar food items that differ on nutritional or convenience attributes. Second, this study improves upon existing studies based on community food price surveys by conducting pairwise comparisons of foods while controlling for store size and store environment characteristics. Third, expenditure weights derived from nationally representative food expenditure and consumption data were applied to substitute food items to estimate the weighted average effect of food substitutions and assess the overall economic significance of food price differences. We found that substitutions recommended by MyPlate guidance typically resulted in price increases while substituting more convenient forms of food resulted in both price increases and price decreases. When put in the context of the overall food budget, we found that the estimated impact of both types of substitutions was substantially tempered but that the net effect was a small increase in the overall cost of the basket of goods for both types of substitutions.

Introduction

By many accounts, Americans are not meeting Federal dietary recommendations. One possible explanation for the unhealthful diets consumed by Americans is that unhealthful foods, such as foods high in refined sugars and starch, are relatively cheaper and more readily available than fruits and vegetables (Brownell and Horgen, 2004; Drewnowski and Darmon, 2005). Even the perception that healthful foods are more expensive may pose a significant barrier to consumption for households.

A related explanation is that Americans lack the time to prepare healthful meals from scratch. Time use studies have found a downward trend in the amount of time Americans spend preparing food (Zick and Stevens, 2010). Researchers have noted the rise in consumption of food away from home and packaged and ready-to-eat foods (Stewart, Blisard, Bhuyan, and Nayga, 2004; Jabs and Devine, 2006) and the coincident rise in obesity (Cutler, Glaeser, and Shapiro, 2006). The link has been attributed to the response of individuals and households to time constraints and the feeling of time pressure, seeking to reduce the time involved in acquiring and preparing food. Individuals and families may shift consumption towards relatively unhealthy prepared food, such as certain food from fast food restaurants, and away from relatively healthier ingredients, such as fresh vegetables, that require further preparation (Guthrie, Lin, and Frazao, 2002). This creates a potential tradeoff between nutrition and convenience (Ziol-Guest, DeLeire, and Kalil, 2006).

The literature on food price differentials due to nutritional or convenience attributes is relatively sparse, particularly in the U.S. context. Some studies have estimated the cost of meeting overall food group recommendations or shifting

consumption to food groups that Americans consume too little of, such as fruits and vegetables. Carlson and Frazao (2012) found that in adhering to MyPlate food group recommendations, it is less costly to meet grains, dairy, and fruit recommendations than to meet those for vegetables or protein foods. A few studies have looked at price differences for foods based on nutritional attributes. Todd, Leibtag, and Penberthy (2011) used the Quarterly Food at Home Price Database (QFAHPD) and found that not all healthy foods are more expensive than less healthy alternatives. For instance, they found that skim and 1% milk were less expensive than whole and 2% milk. Using price data from 57 Brisbane supermarkets, Giskes, Van Lenthe, Brug, Mackenbach, and Turrell (2007) found that nutritionally recommended items were more expensive than the regular choices for most food groups. Using scanner data from a supermarket chain in Wellington, New Zealand, Ni Mhurchu and Ogra (2007) compared prices for 88 regular food items and their healthier alternatives and found that in there was no significant price difference between the regular basket of food items and the healthier basket. They did find that healthier options were more expensive for certain food categories like meat and poultry, butter and margarine, and cheese, while healthier options were less expensive for canned fish.

To our knowledge, the literature on convenience attributes in food is even more limited. One study, by Stewart, Hyman, Buzby, Frazao, and Carlson (2011), found that processed fruits and vegetables were not consistently more or less expensive than fresh produce.

This study extends the literature on price differentials for nutrition and convenience attributes in food by collecting and analyzing detailed, localized food price

data from food retailers in the Boston metropolitan area. The simple substitutions examined in this study are similar to those that households may conceivably make in attempts to improve their diets or save on time. Research efforts at estimating the cost of nutritious diets that are feasible given the time and budgetary constraints facing low-income households will require an understanding the price implications of these types of substitutions, both on an item-by-item basis and in the context of the overall food budget.

The methods developed and employed in this study improve on existing community food price survey methods in three ways. First, we seek to ensure that the price information is representative of food retailers dispersed over a large metropolitan area through systematic sampling of geographic areas and food retailers. We systematically constructed a basket of standard food items that is representative of the food spending patterns of American households and augmented this with a set of substitute food items that allows for detailed pairwise comparisons between similar food items that differ on nutritional or convenience attributes. Second, we improve the literature based on community food price surveys by conducting pairwise comparisons using descriptive statistics and hedonic regression analysis to control for store size and store environment characteristics. Third, we attach expenditure weights to our substitute food items and estimated weighted average effect of food substitutions to assess the overall economic significance of food price differences. While we recognize that our selection of substitute items is somewhat more ad hoc than other elements of our sampling method, we use a standard basket of representative food items as a benchmark and guide for selecting substitute items. This allows us to attach relevant expenditure

weights to price differences to estimate the combined impact of these substitutions in the context of the overall food budget.

Background

For a subset of the standard representative food items, we identified close substitutes belonging to the same narrow food group. We developed two sets of substitute items, one to capture nutritional attributes and another to capture convenience attributes. The Dietary Guidelines for Americans and the consumer-oriented MyPlate guidance differentiate more and less healthful options within broad food groups, such as grains, dairy, meat, fruits, and vegetables. These recommended substitutions within food groups emphasize foods with nutrients that Americans need more of and deemphasize foods with nutrients that American consume in excess, like fats, sugars, and sodium. For instance, MyPlate guidance recommends substituting regular ground beef and regular spaghetti with extra lean ground beef and whole grain spaghetti, respectively. We refer to these as MyPlate substitutions.

The items on our list of MyPlate substitutes are similar to those used in other community food price survey studies. For instance, the NEMS-S developed by Glanz, Sallis, Saelens, and Frank (2007) and adopted by Andreyeva, Blumenthal, Schwartz, Long, and Brownell (2008), features many similar pairs of foods like whole and low fat milk, regular and reduced fat cheddar, regular and lean ground beef, white and brown rice, and regular and diet soda. We improve on existing methods by applying expenditure shares to food items in order to assess the economic significance of price differences. If

the spending share for one food pair is small, even a relatively large price difference between the standard item and substitute may not matter.

Other researchers have estimated the cost of a nutritious bundle of goods, such as market baskets based on the TFP (Hendrickson, Smith, and Eikenberry 2006; Rose, Bodor, Swalm, Rice, Farley, and Hutchinson, 2009; Cassady, Jetter, and Culp, 2007). The TFP is the federal government's estimate of the cost of a healthful and affordable diet and is the basis for SNAP benefit levels. However, many of these studies only collect information on the TFP basket and lack a benchmark basket that is based on current food spending and consumption patterns. We improve on this by collecting price information on a standard basket and a comparison basket with substitute items.

Convenience foods are fully or partially prepared foods where significant preparation time, culinary skills, or energy inputs are transferred from the household to the food processor or distributor (Traub and Odland 1979). The convenience attribute of food item can be characterized by the amount of preparation that must be performed on a food before it can be consumed (Park and Capps 1997). For our second set of substitutes, we identified close substitutes that are in slightly more convenient form than the standard food item, such as canned green beans and shredded cheddar cheese in place of fresh green beans and chunk cheddar cheese, respectively. Selecting standard and substitute items in this way emulates some of the smaller and perhaps more realistic changes that consumers can make in order to improve the nutritional quality of their diet or save on time during food preparation. More convenient forms of food may also mean that they are less perishable, such as canned or frozen vegetables. Foods in these forms can be stocked up to have on hand when needed and do not require replacement due to spoilage.

We used multivariate regression models inspired by the rich literature on hedonic price analysis in food economics. Hedonic price analysis assumes that a consumer's utility is not derived from the purchased product itself, but from the qualities and characteristics it contains (Costanigro and McCluskey, 2011). The Boston food retail environment was the subject of one of the earliest applications of hedonic price analysis. Using price data collected from vegetable lots in Boston produce markets, Waugh (1928) regressed the price of asparagus on characteristics like color and size of stalks. BLS uses hedonic regression models in its CPI calculations to assign monetary values to differences in the particular characteristics of a type of product and adjust for changes in the mix and quality of goods over time (NRC, 2002). We adopt a hedonic approach by regressing food prices on nutritional and convenience attributes in food, to separate out the monetary value of these food attributes while controlling for variations in the food retail environment, like differences in store size, neighborhood median income, and vehicle access.

We compared differences in the availability and price of 15 pairs of closely related food items that differed on nutritional attributes and 9 pairs of closely related food items that differed on convenience attributes. Next, for each pair of comparison food items we used multivariate regression analysis to determine whether these MyPlate or convenience substitutions accounted for a significant difference in the unit price.

Focusing on pairs of substitutions may overstate the cost impact of these substitutions in the context of an overall diet. Many of the food items in the standard set can be considered wise nutritional choices in accordance with MyPlate guidance, such as boneless and skinless chicken breast, or are already in convenient, ready-to-eat form,

such as dried pasta, bread rolls, or ice cream. MyPlate or convenience substitutions comprise only a small fraction of overall food spending. To put MyPlate or convenience substitutions into proper context, we examined aggregated food costs. We compared aggregate food costs for the standard set of 49 food items to a comparison set in which 15 of the 49 food items have been substituted for food items that would be considered wiser nutritional choices under MyPlate guidance. Similarly, we compared aggregate food costs for the standard set to a comparison set in which 4 of the 49 food items have been substituted with more convenient form.

We hypothesize that most MyPlate substitutes will be more expensive than their standard counterparts. For many food items, nutritional attributes like whole grain content or low fat content are marketing tools that potentially command a premium. The price difference for convenience attributes will depend on the food item. Shelf stable and less perishable forms of vegetables will tend to be less expensive. For other foods, convenience may be a marketable value-added attribute that can command a premium. When weighted by expenditure shares and combined with the other standard items, we hypothesize that these substitutions will result in a small but positive increase in the aggregated cost of the basket of goods.

Methods

This chapter builds upon the methods explained in detail in Chapters 3 and 5. We developed a systematic research design to ensure representativeness of sampled geographic areas, food retailers, and food items. We adopted several elements of BLS

price measurement methods, but modified them to make the methods accessible to individuals and community groups with limited time and financial resources.

We sampled geographic areas in a way that accounts for variations in socioeconomic and demographic characteristics across the study area and prioritizes areas where people tend to live. We use census tracts as the geographic units of analysis to facilitate comparisons with existing policy discussions about food access that rely on tract-level analyses. The study area was the greater Boston metropolitan area. The sampling frame for geographic areas consisted of the 464 census tracts with population-weighted centroids falling within the study area boundaries. Census tracts generally have between 1,500 and 8,000 people, with an optimum size of 4,000 people. Using probability proportional to size, 40 census tracts were selected from the sampling frame to serve as the PSUs for this study.

We sampled retailer clusters, or triplets of one supermarket and two small retailers, located within 1 to 2 miles of the population-weighted centroid of the sampled census tract to represent the food retail environment. The balanced or matching sampling method was meant to ensure that both small and large food retailers were properly represented in our sample. The sampling frame for food retailers included large food retailers, namely supermarkets, large grocery stores, and super stores, and small food retailers, namely small and medium grocery stores, convenience stores, and combination grocery/other stores. SNAP Redemptions at these types of food retailers comprised nearly all (98 percent) of all SNAP redemptions nationally in 2010 (USDA/FNS, 2010). The sampling frame excluded specialty retailers with a more limited range of products that receive only a small share of expenditures on food for preparation and consumption at

home, such as bakeries, seafood specialty stores, meat/poultry specialty stores, and farmers' markets. The final retailer sample included 40 large retailers and 80 small retailers for a total of 120 food retailers.

Food Item Selection

We adopted definitions and grouping methods used by BLS to collect food price data for its CPI series to identify our set of representative food items, but modified them to make the methods more suitable and accessible to individuals and community groups with limited time and financial resources. We emulated BLS methods in generating a set of 49 food items that are representative of U.S. food spending and consumption patterns and provide sufficient coverage and detail on important categories of food at home spending, without making data collection excessively burdensome.

1) Broad food groups (18): In its published Consumer Expenditure Shares tables, BLS disaggregates CEX data on food at home spending by American households into 18 categories, which we call broad food groups. The spending shares of all 18 broad food groups are mutually exclusive and exhaustive of food at home spending. Some examples of these broad food groups are cereal and cereal products, beef, and fresh vegetables. Data collected for this study included at least one representative food item from each of the 18 broad food groups.

2) Narrow food groups (42): The CEX includes expenditure data for multiple narrow food groups within each of the broad food groups, with each one assigned a unique Universal Classification Code (UCC). Because there are approximately 100 narrow food groups, collecting data for at least one food item from each of

these narrow food groups would be unmanageable given a nontrivial number of food retailers. Instead, we set a threshold and include only the most important narrow food groups within each broad food group. We chose to include narrow food groups comprising at least 15 percent of spending within their respective broad food group, which reduced the list to 42 narrow food groups. Note that for a given broad food group, adding up the spending shares for narrow food groups will not add up to 100 percent.

3) Representative food items (49): There were 49 food items included in the final list of representative food items (Appendix Table 6.1). We supplement the CEX data with consumption data from the NHANES to identify the most commonly consumed food item for each narrow food group, which serves as the representative food item for that narrow food group. In general, each narrow food group has a corresponding representative food. However, for vegetables, we included more than one representative food item per narrow food group. We collected additional detail on vegetables, especially fresh vegetables, because they are of particular interest when assessing not only the quality of the food environment, but also the diet quality of individuals.

Many of the food items in the standard set are already in a form that is recommended by federal dietary guidance or in a form that is convenient and ready-to-heat or ready-to-eat. For 19 food items, we determined that there were closely related substitute food items that conform more closely to dietary guidance or represent a more convenient form of the food item. The substitute food items were identified using a principle of simple substitution, requiring that the substitute food item be essentially the

same type of food as the standard item in terms of use. Substitute items were closely related food items belonging to the same narrow food group and were as similar as possible to the standard item in all respects except for nutrition or convenience attributes. This method of assigning foods to different market baskets and identifying comparison pairs based on food attributes like nutrition has been used in previous studies (Volpe, Okrent, and Leibtag, 2013; Turrell and Kavanagh 2006; Ni Mhurchi and Ogra 2007; Giskes et al., 2007). This system allowed us to assign the same expenditure weight to the standard and substitute food item for the purposes of aggregating food prices. In total, we collected information on the availability and price for 68 food items, including 15 pairs of food items for making comparisons based on nutritional (MyPlate) attributes and 9 pairs for making comparisons based on convenience attributes.

For 15 of the 49 food items, we identified close substitutes recommended by nutritional tips and guidance on the ChooseMyPlate.gov website. ChooseMyPlate.gov guidance encourages substitutions within each MyPlate food group with the goal of improving nutritional value, such as substituting whole grain bread for white bread or low fat milk for whole milk. For instance, the section on "Tips to Help You Eat Whole Grains" suggests that one "snack on ready-to-eat, whole grain cereals such as toasted oat cereal" while the section on "What are Empty Calories" suggests that "you can choose water, milk, or sugar-free soda instead of drinks with sugar."

We identified close substitutes for 4 of the 49 food items that were in slightly more convenient form, based on shelf stability or food preparation time and effort. For example, we selected shredded cheddar cheese as a more convenient substitute for block cheddar cheese. In addition, the standard set of 49 food items already included 5 pairs of

vegetables that can be compared based on convenience attributes, such as fresh tomatoes and canned (chopped or diced) tomatoes. Refer to Appendix Table 6.1 for more detail on the grouping of foods and the complete list of standard and substitute food items.

We developed operational definitions for each of the 68 food items to facilitate data collection. For instance, the food item "spaghetti" was defined to encompass spaghetti pasta of any brand or package size, including thick, thin, and regular varieties but excluding whole wheat or whole grain varieties. The latter varieties comprised the food item "whole grain spaghetti."

Data Collection

For large retailers, we collected data by dictating and recording information using the voice memo feature on a mobile phone. We transcribed the data immediately afterwards, usually in the parking lot of the retailer. We conducted a second visit immediately after transcription to acquire or verify additional information. For small retailers, we provided a cover letter and short verbal introduction to the store manager or employee, explaining the purpose and process of the visit.

A food item may be sold in one or more forms or products. A product is a unique combination of a brand, product line extension and package size or weight. For each food item, we collected information on the price and package size of the product with the lowest unit price and the product with the most shelf space in that particular store. Shelf space was determined by assessing the width of the shelf space or display case occupied by the product. In many instances, this simply involved a visual inspection of the shelf space. The price recorded was based on the price displayed either on a sticker applied to

the product or posted on the display shelf, reflecting any sales or discounts (including store loyalty discounts) but excluding any discounts requiring coupons.

To ensure accuracy of data entry, survey data were entered twice and discrepancies were flagged, manually inspected and compared with original survey forms. Observations with outlier values were flagged and manually inspected for accuracy. Survey data on food items and store characteristics were merged with PSU (census tract) socioeconomic and demographic data from the 2006-2010 American Community Survey 5-year estimates (Census Bureau, 2011). Graphical analysis was conducted using Microsoft Excel 2004 for Mac. Statistical analysis was conducted using StataIC 10.1.

The Tufts University Institutional Review Board (IRB) at Medford deemed the instruments and protocol for this study exempt from review.

Analysis

Availability of food items was uniformly high at large stores, with almost all items available at 75 percent or more of large stores. For pairwise comparisons of availability, we limited our analysis to the 80 small stores, where variability of availability was high. Because our pairwise and aggregated comparisons of food prices were conditional on food item availability, we limited our analysis sample to the 40 large retailers where food items were most likely to be available. In our regression models, we included a binary variable for store size and used the complete sample of 120 stores, using statistical procedures that control for the complex survey design.

Pairwise Comparisons

We defined availability as the share of sampled stores selling the food item. We used unit prices, either price per pound, price per gallon, price per cup equivalent, or price per 100 count (eggs), to make price comparisons. For the price comparison between the tub margarine (standard item) and the olive oil (MyPlate substitute), we converted the unit price of margarine from price per pound to price per gallon based on information from the National Nutrient Database for Standard Reference Release 24 (USDA/ARS, 2011). For the comparison between fresh vegetables and their convenience substitutes, we converted price per pound into price per cup equivalent as defined by the MyPyramid Equivalents Database, 2.0 for USDA Survey Foods, 2003-2004 (Bowman, Friday, and Moshfegh, 2008). Converting to price per cup equivalent takes into account the portion of the fresh vegetable's weight that is not typically eaten and lost as refuse, such as stems, roots, or seeds. In the case of canned green beans, we considered only the weight of the packed solids. With the exception of eggs, items sold by the piece, such as fruit sold by the piece, were assigned the average weight for that food item based on data from the National Nutrient Database for Standard Reference Release 24 (USDA/ARS, 2011).

For MyPlate and convenience substitutions, we graphed the availability for each pairwise comparison consisting of the standard item and the substitute item. We graphed the ratio of the average unit price for each substitute item to the average unit price of the standard food item. We conducted t-tests on all pairs of food items to detect significant differences in availability and unit prices, using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).

Multivariate Regression Analysis

For each pairwise comparison (standard item and substitute item), we regressed the natural logarithm of unit price on the binary variable indicating that the food item was a substitute item and other explanatory variables. These models test whether quality attributes, such as MyPlate or convenience characteristics, accounted for a significant difference in the unit price of selected foods. The logged functional form is commonly used to transform product prices to handle product prices that may be skewed to the right by high-priced outliers. The log-linear model is the most prevalent specification in the literature of applied hedonic models (Costanigro and McCluskey, 2011). The standard errors were corrected for clustering and we considered results to be significant at $p<0.05$.

(1) $Log(\$ \text{ per unit}) = \beta 0 + \beta 1\ (MyPlate) + \beta 2\ (Small\ Store) + \beta 3\ Log(Income) + \beta 4\ (Share\ Lacking\ Vehicle\ Access) + u$

(2) $Log(\$ \text{ per unit}) = \beta 0 + \beta 1\ (Convenience) + \beta 2\ (Small\ Store) + \beta 3\ Log(Income) +\backslash \beta 4\ (Share\ Lacking\ Vehicle\ Access) + u$

We included a binary variable indicating whether the price information came from a small food retailer. In Chapter 5, we found that retailer size is a significant predictor of food price variation. If one or both of the food items in the pairwise comparison was not typically available at small stores, the small store binary variable dropped out of the model. We included the logged value of the census tract median income and the share of the tract population without vehicle access to capture variations in food prices related to the competitive environment of the food retailers. Shoppers in areas with higher median income may be more willing and able to pay a premium for

food items with desirable attributes. Food retailers in areas with low vehicle access may face less pressure to be price competitive because nearby residents are less likely to travel further away in search of lower prices.

For the explanatory variables expressed in level terms, 100 * β can be interpreted as the percentage change in the unit price given a unit increase in the explanatory variable, all else equal. This is approximately true for small coefficients ($-0.1<\beta<0.1$)[1]. For the tract median household income variable, which has been transformed by taking the natural logarithm, β3 can be interpreted as the percent change in the unit price given a one percent increase in the tract median household income, all else equal.

Aggregated Food Costs

Before aggregating food prices, we define and calculate two intermediate values: a) store price and b) expenditure weight.

The store prices are the average unit prices for food items at sampled stores. We converted all unit prices to the price per pound and all volumetric measures and egg counts to weights using data from the National Nutrient Database for Standard Reference Release 24.

Expenditure weights reflect the relative importance of the food spending group represented by the food item in spending on food at home among American households. We derived these weights from food at home spending shares from the CEX data. The expenditure weights are composite weights based on the broad food group share of food

[1] Technically, $\%y = [100(\exp(\beta)-1]$.

at home spending, the narrow food group share of the broad food group, and the food item share of the narrow food group.

With these prices and weights, we calculated the following market baskets:

(1) Cost of Standard Basket[2]
(2) Cost of Comparison Basket

The cost of each of these baskets is the weighted average cost per pound of food. The difference in cost between the comparison basket and standard basket is the weighted average cost premium for the food substitutions. While the weighted average costs serve as a proxy for food purchasing patterns among U.S. households by emphasizing food items selected from food groups that comprise a large share of food expenditures, they are not intended to model the actual diet or food purchasing behavior of American households.

Results

Table 6.1 presents descriptive statistics of socioeconomic characteristics for the sampled census tracts and the Boston metropolitan area. Our sampling method proved to be effective, with the 40 census tracts sampled in this study similar to the Boston metropolitan area in several important respects relevant to food purchasing behavior, such as median household income and educational attainment. We found lower rates of vehicle ownership and higher population density in sampled areas compared to the metropolitan area as a whole.

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[2] For the purposes of estimating aggregated costs in the MyPlate comparison, we include whole milk and regular yogurt in the standard basket and low fat milk and reduced fat yogurt in the comparison basket. For the convenience comparison, low fat milk and reduced fat yogurt are included in the standard basket.

The availability of MyPlate substitutes was lower than standard items, while the availability for convenience substitutes was higher than standard items. MyPlate substitutes also tended to be more expensive on a per unit basis compared to standard items, while the price difference for convenience substitutes depended on the food item. Most of these price differences remained significant even after controlling for store size and geographic area characteristics through multivariate regressions. However, when weighted by food group expenditure shares, the weighted average price difference was relatively small. Below, we examine the pairwise comparisons.

Availability of Comparison Pairs

Among the standard items in the MyPlate comparison pairs, availability at small stores ranged from 0 percent for regular ground beef and regular yogurt to 99 percent or more for whole milk, potato chips and regular cola. With respect to MyPlate substitute items, virtually all small stores in the sample lacked whole grain rolls and extra lean ground beef but carried low fat milk and diet cola (Table 6.2). In general, it was more difficult to find MyPlate substitute items than standard items at small food retailers (Figure 6.1). For 8 of the 15 MyPlate comparison pairs, availability of the substitute item was significantly lower than for the standard item. Three MyPlate substitute items, reduced fat yogurt, 100% apple juice, and olive oil, were easier to find than their standard counterparts at food retailers. There was no difference in availability for cereal, ground beef, milk, and cola. Both the standard and comparison items for milk and cola were available at nearly all small food retailers.

Among the standard items in the convenience comparison pairs, availability was lowest for ground beef, fresh broccoli, fresh green beans, and fresh bunch spinach at 1 percent or less and highest for chunk cheddar cheese at 60 percent (Table 6.3). The availability of convenience substitutes ranged from 1 percent or less for ground beef patties, frozen carrots, and bagged spinach to 89 percent for canned green beans. Most of the convenience substitute items were easier to find than standard items in sampled small stores (Figure 6.2). Instant rice, frozen potatoes, canned tomatoes, frozen broccoli, and canned green beans were significantly more available than their standard counterparts. Chunk cheddar cheese and fresh carrots were the only standard items more widely available than their convenience substitutes.

Price Differences between Comparison Pairs

The MyPlate substitute item was more expensive than the standard item for 12 of the 15 pairs (Figure 6.3), although this difference was not significant for apple juice or cola (Table 6.4). The price difference ratio was highest for the MyPlate substitute for fats and oils and bread. A couple of the MyPlate substitute items, reduced fat yogurt and unsalted nuts, were less costly on unit price basis than their standard counterpart. There was no significant difference in price for milk, apple juice, and cola.

The pattern in price differences among the convenience comparison pairs was not as straightforward as it was for the MyPlate substitutions. Substitute items were more costly than their standard counterparts for 3 of the 9 pairs (Figure 6.4). Instant rice and frozen carrots had the highest price ratios, costing 1.7 times more than the standard item, while tomatoes were 60 percent less expensive in their canned form compared to their

fresh form. For rice, ground beef, and carrots, the more convenient form was more significantly expensive on a per unit basis (Table 6.5). For tomatoes, broccoli, and green beans, the more convenient form was significantly less expensive. There was no significant difference in the unit price for cheese, potatoes, or spinach.

Multivariate Regression Analysis

Ten of the fifteen MyPlate substitute items were significantly more expensive than their standard counterparts, after controlling for store size and neighborhood socioeconomic characteristics (Appendix Table 6.7). For instance, the unit price for brown rice was 51 percent higher ($\beta = 0.41$) than for white rice, while extra lean ground beef was 46 percent more expensive ($\beta = 0.38$) than regular ground beef, all else equal. Although the univariate t-tests were not significant, after controlling for other explanatory variables, whole grain pasta, whole grain rolls, and light ice cream were significantly more expensive than their standard counterpart. Low fat milk, reduced fat yogurt, and unsalted nuts were significantly less expensive than their standard counterparts. Although t-tests indicated that reduced fat yogurt was more expensive than regular yogurt, controlling for other explanatory variables reversed the sign. Reduced fat yogurt was 26 percent cheaper ($\beta = -0.30$) than regular yogurt. T-tests were significant for fruit juice and canned fruits, but statistical significance disappeared after we controlled for other explanatory variables.

For all but one comparison pair,[3] the small store binary variable was significant and positive. The store effect was large and practically significant. For instance, the unit price of yogurt at small stores was 1.6 times ($\beta = 0.95$) that at large stores, all else equal. Store size had the smallest effect for fresh milk, but even so, the unit price of milk sold at small stores was 12 percent higher ($\beta = -0.04$) on average than at large stores. Median income had a significant and positive effect for 4 of the 15 pairs, but was not significant otherwise. For instance, a 10 percent increase in the median income of the census tract was correlated with a 2.1 percent increase in the unit price of rice, all else equal. Lack of vehicle access was significant and positive for 6 of the 15 pairs, but not significant otherwise. A 10 percentage point increase in the share of census tract population lacking access to vehicles was correlated with a 7.3 percent increase ($\beta = 0.55$) in the unit price for cereal, all else equal.

Four of the nine convenience substitute items were significantly more expensive than their standard counterparts while three of the nine were significantly less expensive, after controlling for store size and neighborhood socioeconomic characteristics (Appendix Table 6.8). Instant rice, ground beef patties, frozen potatoes, and frozen carrots were more expensive than their standard counterparts, all else equal. Instant rice was 92 percent more expensive ($\beta = 0.65$) than regular white rice. Canned tomatoes, frozen broccoli, and canned green beans were less expensive than their standard counterparts on a per cup equivalent basis.

[3] The small store dummy variable was dropped for ground beef because none of the small stores in the sample sold the product.

For all but two comparison pairs,[4] the small store binary variable was significant and positive. Similar to the MyPlate comparisons, the store effect was large and practically significant. For instance, the unit price of rice was 98 percent higher (β = 0.68) at small stores, all else equal. Median income had a significant and positive effect for 4 of the 9 pairs, but was not significant otherwise. Lack of vehicle access was significant and positive for 2 of the 9 pairs, but not significant otherwise.

Aggregated Food Costs

Applying expenditure weights derived from the CEX, we aggregated food costs to put these price differences in the context of broader food purchasing patterns. The cost of the standard basket in the MyPlate comparison was $2.28/lb (Appendix Table 6.8). The cost of the comparison basket, with the 15 MyPlate substitutions, was $2.40/lb, or 5.3 percent higher. Even though many of the MyPlate substitute items were significantly more expensive than their standard counterparts and the combined expenditure weights for the substitute items comprised 55 percent of the total expenditure weight of the basket, the net effect of the substitutions on the cost of the overall basket was substantially tempered when put in the context of the overall food at home budget. Nevertheless, for low-income households facing budget constraints, a 5.3 percent increase in the overall food budget is not negligible. Snacks had the largest expenditure weight (18 percent) and so the MyPlate substitution of unsalted snacks for potato chips exerted the greatest influence on the overall cost of the basket. Because the cost of

[4] The small store binary variable was dropped for ground beef because none of the small stores in the sample sold the product.

unsalted nuts ($3.03/lb) was much lower than that for potato chips ($3.64/lb), this attenuated the effect of price increases due to other MyPlate substitutions[5].

The cost of the standard basket in the convenience comparison was $2.28/lb (Appendix Table 6.9). The cost of the comparison basket, with the 4 convenience substitutions, was $2.32/lb, or 1.7 percent higher. The net effect of the convenience substitutions was even more tempered than the MyPlate substitutions when put in the context of the overall food at home budget. Still, for low-income households facing budget and time constraints, a 1.7 percent increase in the overall food budget is not negligible and illustrates the potential tradeoffs between time costs and monetary costs of food. While a majority of the substitute items were more expensive than the standard items, the expenditure weights for the substitute items comprised 8 percent of the total expenditure weight of the basket. This meant that even relatively large price differences for individual substitute items were attenuated by the relatively small expenditure weights applied.

Discussion

This study set out to compare the availability and price of food items based on nutrition and convenience attributes. These simple substitutions mirror the choices that low-income households face when seeking to improve their diets or save on food preparation time, given budget and time constraints. Our findings indicate that most of the MyPlate substitute items we examined were less widely available at Boston area food retailers.While many large stores offered whole grain options, such as whole grain spaghetti, bread, and rolls, availability at small food retailers was extremely limited. A

[5] The typical serving size for unsalted nuts and potato chips is 28 grams or 1 ounce.

few MyPlate substitutes, namely olive oil, reduced fat yogurt, and 100% apple juice, were significantly easier to find than their standard counterparts. Olive oil is more widely available than its standard counterpart, tub margarine, because the former is sold in shelf stable bottles while the latter requires refrigeration. The wider availability of reduced fat yogurt and 100 percent apple juice may reflect higher supply and demand for these products. Marketing for yogurt and fruit juice typically focus on attributes like reduced fat content or the absence of added sweeteners to project a healthful and wholesome image.

The relatively low availability of MyPlate substitutes could indicate that some households may face nontrivial time and travel costs in purchasing a healthier basket of goods. Following MyPlate guidance to “make half your grains whole” or “make lean or low-fat choices” from the protein or dairy food groups may require that households have good access to a large food retailer, either by living in close proximity to one or having the means of traveling to one further away.

Overall, convenience substitutes were more widely available than their standard counterparts. Perishability may play a role in this disparity, since convenience foods are often more processed and less perishable than their standard counterparts. With the exception of carrots, frozen and canned vegetables were more widely available than their fresh forms. Both large and small retailers stock canned green beans and tomatoes, resulting in high availability of 93 and 85 percent respectively. The food manufacturing industry and food retail environment cater to the demand for convenience among households. Households seeking to save on food preparation time by purchasing more

convenient forms of food may not face the same challenges that are involved in improving the nutritional quality of their food purchases.

We found that applying MyPlate guidance and making nutritional upgrades within MyPlate food groups typically involved a significant increase in the unit price for substituted items. This was particularly true for whole grain substitutions. With the exception of pasta, whole grain products were more expensive than their standard counterparts. This was in line with the findings of Todd et al. (2011), who found that whole grains were more expensive than refined grains in the Boston market area as well as across the United States. Policy efforts to increase the dietary fiber intake of Americans through promotion of whole grain foods must take into consideration the low availability of these products and the relatively higher prices.

Not all MyPlate substitutions resulted in higher prices. Low fat dairy options, such as low fat milk and reduced fat yogurt, were significantly less expensive than their standard counterparts. Low fat milk often serves as a loss leader for food retailers in the Boston area, sold at a low price in order to get people in the door and encourage the sale of other higher-margin items. We found low fat milk to be 4 percent less expensive than whole milk among our sampled stores. Todd et al. (2011) estimated that low fat milk was about 20 percent less expensive than whole and 2% milk in the Boston market. The difference may be due to the fact that we used the lowest priced items rather than an aggregation of all possible purchase prices. In addition, our sample may have captured more stores, such as convenience stores, that use low fat milk as a loss leader.

We found that reduced fat yogurt was less expensive that regular yogurt, which was an unexpected result. The lowest priced option for yogurt tends to be the large (32

oz) containers and many Boston area supermarkets offered private label reduced fat yogurt in this package size, but not regular yogurt. Large containers of yogurt tend to be more expensive national or regional brands.

The sign of the price difference for convenience substitutions was not as consistent. With the exception of potatoes and carrots, which are relatively less perishable fresh vegetables, the frozen or canned forms of vegetables were less expensive than their fresh form. Spoilage and waste in the supply chain for fresh vegetables may play a role in the higher unit price compared to processed forms of vegetables. Stewart et al. (2011) found that processed fruits and vegetables were not consistently more or less expensive than fresh produce. Similar to our results, they found that canned forms of tomatoes and green beans to be less expensive than their fresh forms on a cup equivalent basis.

The impact of both types of substitutions on costs was substantially tempered when put in the context of the overall food at home budget. Taken together, the MyPlate substitutions raised the cost of the market basket of food by 5.3 percent. The convenience substitutions raised the cost of the market basket by 1.7 percent. While relatively small in magnitude, these cost increases are nontrivial, especially for low-income households that are faced with tight budget constraints. Efforts to estimate the cost of affordable and healthful diets must take into account the monetary tradeoffs involved in improving dietary quality or reducing the time demands related to food preparation.

Policy Implications

We found the relatively high availability and inexpensive prices of several processed vegetables to be promising from a public health and nutrition perspective.

Many small stores in our sample stocked some shelf stable forms of vegetables. These findings underscore the potential of promoting shelf stable vegetables as an early or stand-alone goal in small store interventions. Gittelsohn, Rowan, and Gadhoke (2012) conducted a review of recent small store interventions aimed at improving the food environment. Of the 16 trials they reviewed, about a third focused exclusively on promoting fresh produce. A key concern among small store owners and operators in stocking fresh produce is the effect of spoilage on the bottom line.

According to federal dietary guidance, consumption of fresh, frozen, canned, or dried/dehydrated vegetables count towards meeting dietary recommendations on vegetable consumption (USDA, 2013). Interventions aimed at increasing access to vegetables among American consumers should consider encouraging small stores that are reluctant to stock fresh produce to increase the availability of processed vegetables (with minimal added sodium) on their shelves. Canned and frozen vegetables have low perishability and increasing their availability in small stores may be a more feasible goal for these interventions, particularly in the short term.

For these supply side changes to be sustainable, there needs to be strong consumer demand for promoted foods. Local nutrition education initiatives should be coordinated with small store interventions to encourage consumers to purchase both fresh and canned or frozen forms of vegetables. Highlighting the reduced losses due to spoilage and time saving attributes of low sodium and unsweetened processed fruits and vegetables may help reduce perceived barriers to increased fruit and vegetable consumption. Federal nutrition education efforts like MyPlate guidance are already doing this. Consumers are encouraged to “consider convenience when shopping” and to “try pre-cut packages of

fruit (such as melon or pineapple chunks) for a healthy snack in seconds" and "stock up on frozen vegetables for quick and easy cooking in the microwave."

As our regression results showed, the food environment plays a key role in determining the magnitude of the price difference for MyPlate and convenience substitutes. Consumers living in areas with a relatively high concentration of smaller stores and low concentration of large stores may be faced with significantly higher unit prices for food. Individual consumers and households must consider the tradeoff between higher food costs at nearby stores and the monetary and time costs of traveling further away in search of lower prices. We found that as the share of the area without access to a vehicle increased, the unit prices of food items increased, all else equal. This suggests that lower mobility among residents results in lower price competition among neighborhood stores and higher prices. Policies could be designed to assist those without access to vehicles living in areas with a low concentration of large retailers. This could take the form of a voucher or additional SNAP benefits to help subsidize transportation costs to large retailers located further away (Andrews, Bhatta, and Ver Ploeg, 2013).

The TFP assumes that meals are mostly made from scratch, although it allows some convenience options. One of the criticisms of the TFP is that it does not adequately reflect the time cost involved in purchasing and preparing low cost meals from scratch for time-pressed households (Jabs and Devine, 2006; Mancino and Newman, 2007; Rose, 2007). Some have suggested that future revisions of the TFP include greater representation of nutritious but convenient forms of food (Mancino and Newman, 2007). Even the Institute of Medicine has weighed in on the issue of nutritional recommendations and time constraints. In their 2013 report on the adequacy of the SNAP

benefit, the IOM and NRC suggested increasing SNAP benefit to provide time-pressed families more resources to purchase more convenient and easy-to-prepare foods by applying a time adjustment multiplier to the cost of the TFP or reviewing options for adjustments to the current cost of the plan and adjusting the earned income deduction to reflect more accurately time pressures for participants who are working (Institute of Medicine [IOM] and National Research Council [NRC], 2013). The cost and nutrition implications of these proposed changes to the TFP would be a valuable area for future research.

Implications for Future Research

Our analysis suggests that there are direct price tradeoffs, measured by unit prices, when making substitutions that enhance the nutritional or convenience attributes of food purchases. In many cases, these characteristics are desirable and marketable attributes which tend to increase the unit cost of these foods. Our static model focused on a relatively short list of one to one substitutions within narrowly defined food groups. In reality, households select substitutes within and across food group groups, which we did not attempt to model. Future research in this area could expand and modify the food list used in this study to capture a wider range of potential substitutions, including those across narrow food group categories. For instance, estimates of a wider range of convenience food substations could help inform future revisions of the Thrifty Food Plan that incorporate a greater proportion of more convenient, but still healthful, food items on food costs and nutritional quality.

The methods developed for this study could be applied to several other areas of empirical inquiry related to food prices, such as the price implications of substituting

animal-based products with vegetarian options or conventional products with organic substitutes.

Information on local food retail price conditions collected using community food price survey methods will benefit from links to household-level data collected from the communities served by the retailers. A national survey currently being conducted by ERS of USDA, called the National Food Study (USDA/ERS, 2012), could be adapted to collect household data at a more localized level. Connecting food price data from retailers with household patterns of food expenditure, time use, and dietary intake are necessary to determine the implications of these substitutions on time spent preparing food and on dietary quality.

Limitations

Our research is not an exhaustive analysis of all possible MyPlate or convenience substitutions. The substitutions we selected were meant to be illustrative, highlighting the price effect of substitutions for food items representing food expenditure groups that comprise a significant share of food at home spending. This study was based on retailer data rather than household survey data and it was not possible to know what food items households actually purchased and the prices they paid for those items. The study focused on mainstream food retailers and did not reflect the contribution of specialty retailers, farmers markets, or fruit and vegetable stands to the availability and price of food items in sampled neighborhoods. Because only one visit to each food retailer was conducted, this study does not account for variations in availability or price due to seasonality or delivery/restocking schedules. Our observations do not account for differences in the

quality of food items or the shopping experience. Price differences may reflect both differences in food prices and differences in food item quality or store amenities and services.

Conclusion

Using expenditure shares derived from nationally representative food spending and food consumption data and detailed, localized food price data from the Boston-area food retailers, we found that substitutions recommended by MyPlate guidance typically resulted in price increases while substituting more convenient forms of food resulted in both price increases and price decreases. When put in the context of the overall food budget, we found that the estimated impact of both types of substitutions was substantially tempered but that the net effect was a small increase in the overall cost of the basket of goods. Additional work could include a broader range of nutrition or convenience substitutions that are linked to household survey data from the surrounding community to determine which substitutions local households are most likely to make when seeking to improve nutritional status or save on time spent on food preparation. Further examination of the tradeoff between food price, nutritional content, and convenience would help inform future revisions of the TFP and assessments of the adequacy of SNAP benefit levels. Methods developed in this study can also be applied to measure the price implications of other food choices, such as substituting vegetarian options or food produced with organic production methods, using price data that are representative of small geographic areas and communities.

Figure 6.1: Availability of Standard Items and MyPlate Substitutes at Small Stores

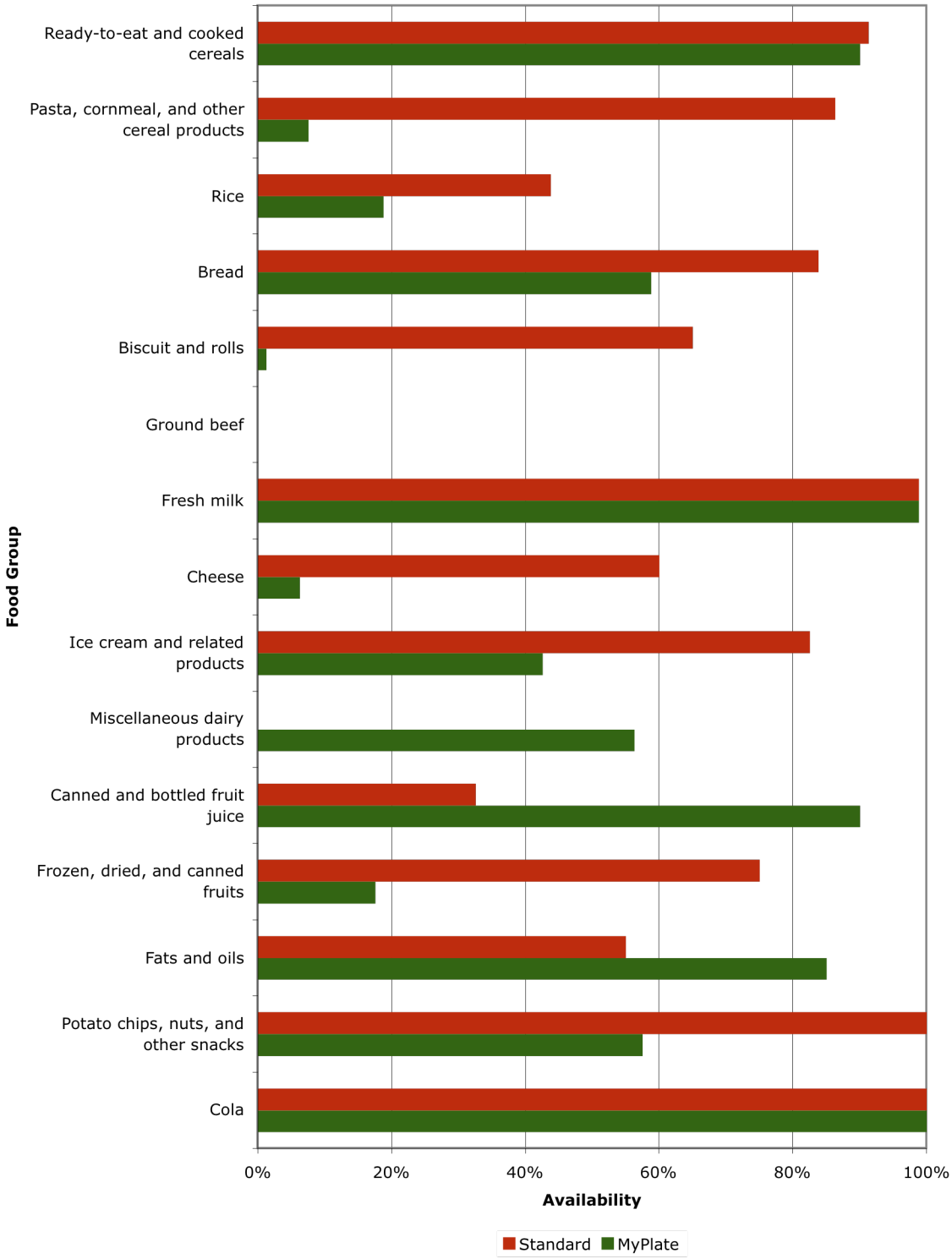


Figure 6.2: Availability of Standard Items and Convenience Substitutes at Small Stores

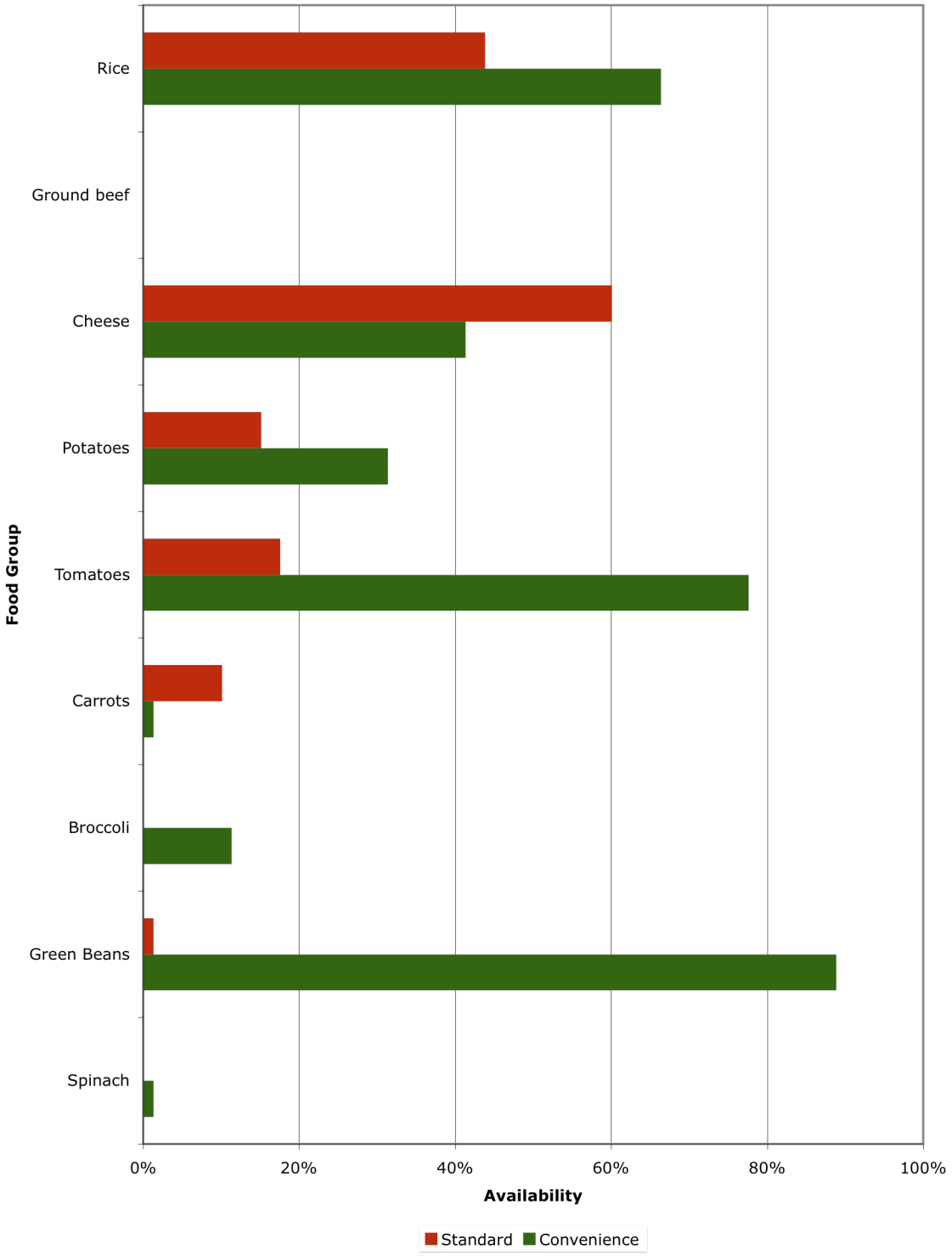
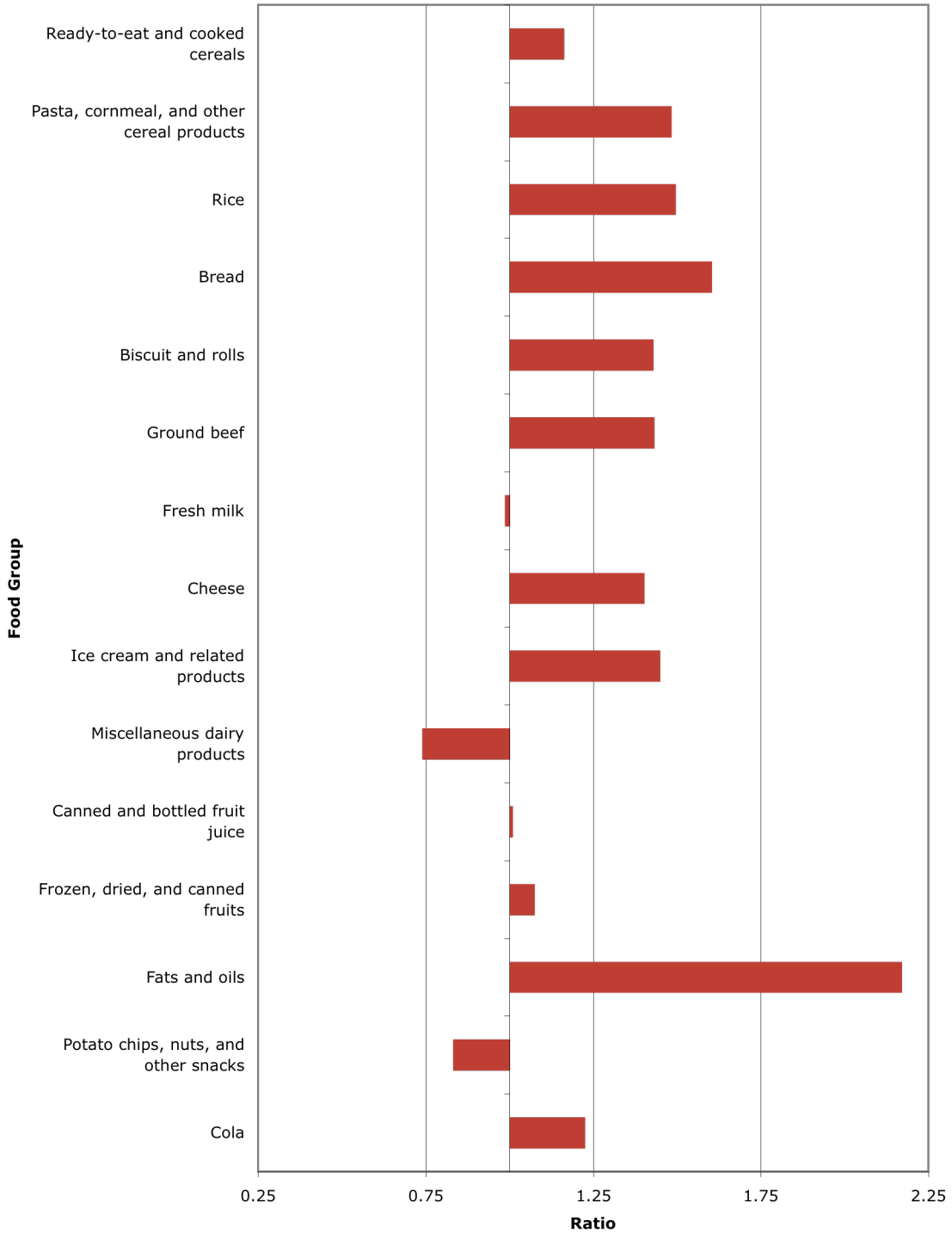
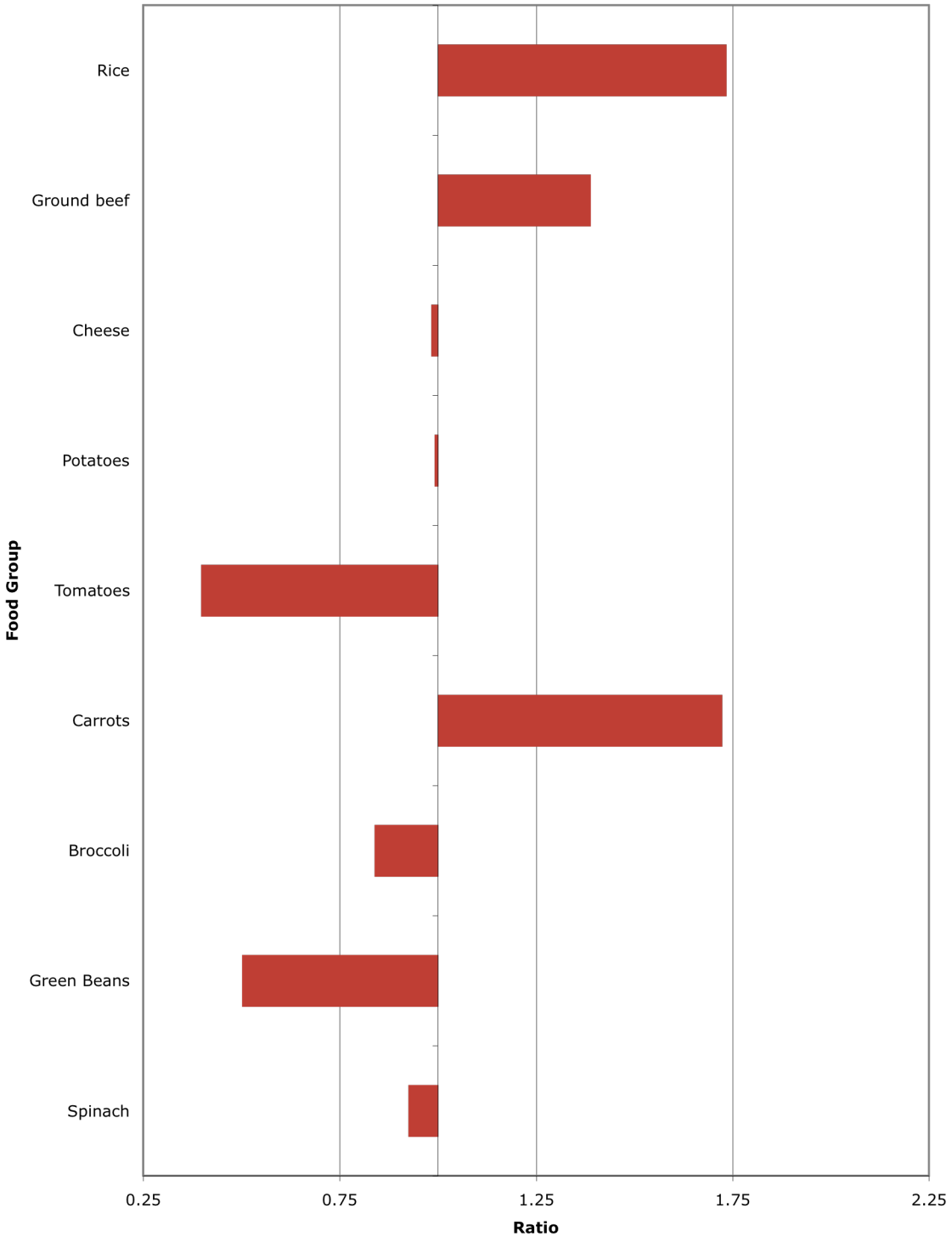


Figure 6.3: Ratio of Unit Price of Lowest Priced Item at Large Stores, MyPlate Substitutes to Standard Items



Price comparisons are conditional on availability.

Figure 6.4: Ratio of Unit Price of Lowest Priced Item at Large Stores, Convenience Substitutes to Standard Items



Price comparisons are conditional on availability.

Table 6.1: Population-Weighted Demographic Characteristics of Sampled Census Tracts

Variable	N	Mean	St. Dev	Min	Max	Boston Metro Area
Percent HS grad or higher (population 25 years and older)	40	88.4%	10.2%	52.0%	100%	90.6%
Percent unemployed (persons 16 years and over)	40	7.4%	4.1%	0.6%	17.5%	9.5%
Median household income (2010 dollars)	40	$68,507	$31,045	$23,632	$167,833	$68,020
Percent of housing units with no vehicle available	40	20.5%	14.1%	1.3%	62.6%	13.5%
Percent white (alone or in combination with one or more other races)	40	74.0%	20.1%	7.7%	99.0%	81.7%
Population density per square mile of land area	40	13,436	12,421	1,766	50,961	1,305

Census Tract data: 2006-2010 American Community Survey
Boston Metro Area: Boston-Cambridge-Quincy, MA-NH Metro Area data from 2010 ACS

Table 6.2: Food Item Availability at Small Stores, Standard Items and MyPlate Substitutes

Food Group	Comparison Pair	Percent of Stores Selling Food Item				
		Standard Item	Linearized SE	Substitute Item	Linearized SE	p-value
Cereal	*Corn Flakes Cereal* *Toasted Oats Cereal*	91%	3.0%	90%	3.2%	0.74
Pasta	*Spaghetti* *Whole Grain Spaghetti*	86%	3.6%	8%	2.9%	0.00
Rice	*White Rice* *Brown Rice*	44%	5.7%	19%	5.0%	0.00
Bread	*White Bread* *Whole Grain Bread*	84%	3.8%	59%	5.6%	0.00
Rolls	*Buns/Rolls* *Whole Grain Buns/Rolls*	65%	5.1%	1%	1.3%	0.00
Ground Beef	*Ground Beef* *Extra Lean Ground Beef*	0%	0.0%	0%	0.0%	n.a.
Milk[1]	*Whole Fat Milk* *Low Fat Milk*	99%	1.3%	99%	1.3%	n.a.
Cheese	*Chunk Cheddar Cheese* *Reduced Fat Chunk Cheddar Cheese*	60%	5.4%	6%	3.2%	0.00
Ice Cream	*Ice Cream* *Light Ice Cream*	83%	4.2%	43%	5.5%	0.00
Misc. Dairy	*Yogurt* *Reduced Fat Yogurt*	0%	0.0%	56%	5.1%	0.00
Fruit Juice	*Apple Juice* *100% Apple Juice*	33%	5.5%	90%	3.2%	0.00
Canned Fruits	*Apple Sauce* *Unsweetened Apple Sauce*	75%	4.4%	18%	4.2%	0.00
Fats/Oils	*Tub Margarine* *Olive Oil*	55%	5.0%	85%	4.1%	0.00
Snacks	*Potato Chips* *Unsalted Nuts*	100%	0.0%	58%	5.5%	0.00
Cola	*Regular Cola* *Diet Cola*	100%	0.0%	100%	0.0%	n.a.

Statistical tests were conducted using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).
n.a.: Variance matrix was nonsymmetric or highly singular.

Table 6.3: Food Item Availability at Small Stores, Standard Items and Convenience Substitutes

Food Group	Comparison Pair	Percent of Stores Selling Food Item				
		Standard Item	Linearized SE	Substitute Item	Linearized SE	p-value
Rice	*White Rice* *Instant Rice*	44%	5.7%	66%	4.9%	0.00
Ground Beef	*Ground Beef* *Ground Beef Patties*	0%	0.0%	0%	0.0%	n.a.
Cheese	*Chunk Cheddar Cheese* *Shredded Cheddar Cheese*	60%	5.4%	41%	5.0%	0.00
Potatoes	*Fresh White Potatoes* *Frozen White Potatoes*	15%	4.5%	31%	5.6%	0.02
Tomatoes	*Fresh Tomatoes* *Canned Tomatoes*	18%	4.9%	78%	4.0%	0.00
Other Fresh Vegetables	*Fresh Carrots* *Frozen Carrots*	10%	3.7%	1%	1.3%	0.03
	Fresh Broccoli *Frozen Broccoli*	0%	0.0%	11%	3.8%	0.01
	Fresh Green Beans *Canned Green Beans*	1%	1.3%	89%	3.3%	0.00
	Fresh Bunch Spinach *Bagged Spinach*	0%	0.0%	1%	1.3%	0.32

Statistical tests were conducted using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).
n.a.: Variance matrix was nonsymmetric or highly singular.

Table 6.4: Mean Unit Price of Lowest Priced Product at Large Stores, Standard Items and MyPlate Substitutes

Food Group	Comparison Pair	Mean Unit Price of Lowest Priced Product ($)*				
		Standard Item	Linearized SE	Substitute Item	Linearized SE	p-value
Cereal	*Corn Flakes Cereal* *Toasted Oats Cereal*	2.12	0.13	2.46	0.13	0.01
Pasta	*Spaghetti* *Whole Grain Spaghetti*	1.01	0.03	1.50	0.06	0.00
Rice	*White Rice* *Brown Rice*	0.73	0.04	1.09	0.05	0.00
Bread	*White Bread* *Whole Grain Bread*	1.15	0.07	1.84	0.07	0.00
Rolls	*Buns/Rolls* *Whole Grain Buns/Rolls*	2.32	0.12	3.31	0.14	0.00
Ground Beef	*Ground Beef* *Extra Lean Ground Beef*	3.41	0.15	4.87	0.13	0.00
Milk	*Whole Fat Milk*[1] *Low Fat Milk*[1]	3.49	0.08	3.44	0.07	0.15
Cheese	*Chunk Cheddar Cheese* *Reduced Fat Chunk Cheddar Cheese*	4.64	0.18	6.50	0.19	0.00
Ice Cream	*Ice Cream*[1] *Light Ice Cream*[1]	6.41	0.37	9.27	0.55	0.00
Misc. Dairy	*Yogurt* *Reduced Fat Yogurt*	1.60	0.05	1.18	0.04	0.00
Fruit Juice	*Apple Juice*[1] *100% Apple Juice*[1]	4.21	0.24	4.24	0.16	0.91
Canned Fruits	*Apple Sauce* *Unsweetened Apple Sauce*	0.88	0.05	0.94	0.05	0.01
Fats/Oils	*Tub Margarine*[1] *Olive Oil*[1]	10.96	0.83	23.77	0.89	0.00
Snacks	*Potato Chips* *Unsalted Nuts*	3.64	0.15	3.03	0.09	0.00
Cola	*Regular Cola*[1] *Diet Cola*[1]	1.77	0.06	2.17	0.26	0.07

Statistical tests were conducted using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).
*Units are in pounds unless otherwise specified.
[1]Unit is a gallon.

Table 6.5: Mean Unit Price of Lowest Priced Product at Large Stores, Standard Items and Convenience Substitutes

Food Group	Comparison Pair	Mean Unit Price of Lowest Priced Product ($)*				
		Standard Item	Linearized SE	Substitute Item	Linearized SE	p-value
Rice	*White Rice* *Instant Rice*	0.73	0.04	1.26	0.08	0.00
Ground Beef	*Ground Beef* *Ground Beef Patties*	3.41	0.15	4.72	0.14	0.00
Cheese	*Chunk Cheddar Cheese* *Shredded Cheddar Cheese*	4.64	0.18	4.56	0.21	0.59
Potatoes	*Fresh White Potatoes*[1] *Frozen White Potatoes*[1]	0.39	0.02	0.38	0.02	0.87
Tomatoes	*Fresh Tomatoes*[1] *Canned Tomatoes*[1]	0.95	0.04	0.38	0.01	0.00
Other Fresh Vegetables	*Fresh Carrots*[1] *Frozen Carrots*[1]	0.24	0.01	0.42	0.02	0.00
	Fresh Broccoli[1] *Frozen Broccoli*[1]	0.58	0.02	0.49	0.02	0.00
	Fresh Green Beans[1] *Canned Green Beans*[1]	0.54	0.02	0.27	0.01	0.00
	Fresh Bunch Spinach[1] *Bagged Spinach*[1]	0.48	0.03	0.44	0.03	0.28

Statistical tests were conducted using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).
*Units are in pounds unless otherwise specified.
[1]Unit is a cup equivalent.

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Appendix Table 6.1: List of Standard Food Items and Substitute Items (MyPlate and Convenience)

MyPlate Group (6)	Broad Food Group (18)	Narrow Food Group (42)	Standard Food Item (49)	MyPlate Substitute Item (15)	Convenience Substitute Item (4)
Grains	Cereal and cereal products	Ready-to-eat and cooked cereals	Corn flakes	Toasted oats cereal	
		Pasta	Spaghetti	Whole grain spaghetti	
		Rice	White rice	Brown rice	Instant rice
	Bakery products	Bread	White bread	Whole grain bread	
		Biscuit and rolls	Rolls	Whole grain rolls	
Protein Foods	Beef	Ground beef	Regular ground beef	Extra lean ground beef	Ground beef patties
		Steak	Beef steak		
		Roast	Beef roast		
	Pork	Ham (not canned)	Ham		
		Pork chops	Pork chops		
		Bacon	Pork bacon		
		Sausage (not canned)	Pork sausage		
	Other meats	Frankfurters (not canned)	Frankfurter, wiener, or hot dog		
		Bologna, liverwurst, salami (not canned)	Bologna		
	Poultry	Fresh and frozen chicken parts	Boneless skinless chicken breast		
		Fresh and frozen whole chicken	Fresh or frozen whole chicken		
		Other poultry	Ground turkey		
	Fish and seafood	Fresh fish and shellfish	Fresh salmon, fillet or steak		
		Frozen fish and shellfish	Frozen fish stick or fillet		
	Eggs	Eggs	Eggs		

Continued

Appendix Table 6.1: *Continued*

MyPlate Group (6)	Broad Food Group (18)	Narrow Food Group (42)	Standard Food Item (49)	MyPlate Substitute Item (15)	Convenience Substitute Item (4)
Dairy	Fresh milk and cream	Fresh milk, all types	Whole fat milk	Low fat milk[1, 7]	
	Other dairy products	Cheese	Chunk cheddar cheese	Reduced fat chunk cheddar cheese	Shredded cheddar cheese
		Ice cream and related products	Regular ice cream	Light ice cream	
		Miscellaneous dairy products	Regular yogurt	Reduced fat yogurt[7]	
Fruits	Fresh fruits	Apples	Apples		
		Bananas	Bananas		
	Processed fruits	Canned and bottled fruit juice	Apple juice	100% apple juice	
		Frozen, dried, and canned fruits	Apple sauce	Unsweetened apple sauce	
		Fresh fruit juice	100% orange juice, refrigerated		
Vegetables	Fresh vegetables	Other fresh vegetables	Carrots[2]		
			Broccoli[3]		
			String beans[4]		
			Spinach, bunch		Bagged spinach
		Potatoes (starchy)	White potatoes[5]		
		Tomatoes (other)	Tomatoes[6]		
	Processed vegetables	Canned vegetables	Canned refried beans		
			Canned green beans[4]		
			Canned tomatoes[6]		
		Frozen vegetables	Frozen white potatoes[5]		

Continued

Appendix Table 6.1: *Continued*

MyPlate Group (6)	Broad Food Group (18)	Narrow Food Group (42)	Standard Food Item (49)	MyPlate Substitute Item (15)	Convenience Substitute Item (4)
Vegetables	Processed vegetables	Frozen vegetables	Frozen broccoli[3]		
			Frozen carrots[2]		
Other Food at Home	Sugar and other sweets	Candy and chewing gum	Gumdrops		
		Jams, preserves, and other sweets	Fruit jelly		
	Fats and oils	Fats and oils	Tub margarine	Olive oil	
		Salad dressings	Salad dressing		
		Nondairy cream and imitation milk	Soy milk		
	Miscellaneous food	Potato chips, nuts, and other snacks	Potato chips	Unsalted nuts	
	Nonalcoholic beverages	Cola	Regular cola	Diet cola	
		Bottled water	Bottled water		

[1]Low fat milk includes 1% and skim milk.

[2, 3, 4, 5, 6]For these convenience pairwise comparisons, the substitute item counts among the items in the standard basket.

[7]For the purposes of comparing the aggregated cost of the standard and convenience baskets, low fat milk and reduced fat yogurt were considered standard food items.

Appendix Table 6.2: Food Item Availability at Large Stores, Standard Items and MyPlate Substitutes

Food Group	Comparison Pair	Percent of Stores Selling Food Item				
		Standard Item	Linearized SE	Substitute Item	Linearized SE	p-value
Cereal	*Corn Flakes Cereal* *Toasted Oats Cereal*	100%	0.0%	100%	0.0%	n.a.
Pasta	*Spaghetti* *Whole Grain Spaghetti*	100%	0.0%	98%	2.5%	0.32
Rice	*White Rice* *Brown Rice*	100%	0.0%	98%	2.5%	0.32
Bread	*White Bread* *Whole Grain Bread*	100%	0.0%	100%	0.0%	n.a.
Rolls	*Buns/Rolls* *Whole Grain Buns/Rolls*	100%	0.0%	75%	6.9%	0.00
Ground Beef	*Ground Beef* *Extra Lean Ground Beef*	100%	0.0%	98%	2.5%	0.32
Milk[1]	*Whole Fat Milk* *Low Fat Milk*	100%	0.0%	100%	0.0%	n.a.
Cheese	*Chunk Cheddar Cheese* *Reduced Fat Chunk Cheddar Cheese*	100%	0.0%	95%	3.5%	0.16
Ice Cream	*Ice Cream* *Light Ice Cream*	100%	0.0%	85%	5.7%	0.01
Misc. Dairy	*Yogurt* *Reduced Fat Yogurt*	90%	4.8%	100%	0.0%	0.04
Fruit Juice	*Apple Juice* *100% Apple Juice*	90%	4.8%	100%	0.0%	0.04
Canned Fruits	*Apple Sauce* *Unsweetened Apple Sauce*	100%	0.0%	98%	2.5%	0.32

Continued

Appendix Table 6.2: *Continued*

Food Group	Comparison Pair	Percent of Stores Selling Food Item				p-value
		Standard Item	Linearized SE	Substitute Item	Linearized SE	
Fats/Oils	*Tub Margarine* *Olive Oil*	95%	3.5%	100%	0.0%	0.16
Snacks	*Potato Chips* *Unsalted Nuts*	100%	0.0%	98%	2.5%	0.32
Cola	*Regular Cola* *Diet Cola*	95%	3.5%	95%	3.5%	n.a.

Statistical tests were conducted using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).
n.a.: Variance matrix was nonsymmetric or highly singular.

Appendix Table 6.3: Food Item Availability at Large Stores, Standard Items and Convenience Substitutes

Food Group	Comparison Pair	Percent of Stores Selling Food Item				p-value
		Standard Item	Linearized SE	Substitute Item	Linearized SE	
Rice	*White Rice* *Instant Rice*	100%	0.0%	98%	2.5%	0.32
Ground Beef	*Ground Beef* *Ground Beef Patties*	100%	0.0%	95%	3.5%	0.16
Cheese	*Chunk Cheddar Cheese* *Shredded Cheddar Cheese*	100%	0.0%	100%	0.0%	n.a.
Potatoes	*Fresh White Potatoes* *Frozen White Potatoes*	100%	0.0%	100%	0.0%	n.a.
Tomatoes	*Fresh Tomatoes* *Canned Tomatoes*	100%	0.0%	100%	0.0%	n.a.
Other Fresh Vegetables	*Fresh Carrots* *Frozen Carrots*	100%	0.0%	78%	6.7%	0.00
	Fresh Broccoli *Frozen Broccoli*	98%	2.5%	100%	0.0%	0.32
	Fresh Green Beans *Canned Green Beans*	95%	3.5%	100%	0.0%	0.16
	Fresh Bunch Spinach *Bagged Spinach*	15%	5.7%	98%	2.5%	0.00

Statistical tests were conducted using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).
n.a.: Variance matrix was nonsymmetric or highly singular.

Appendix Table 6.4: Mean Unit Price of Lowest Priced Product at Small Stores, Standard Items and MyPlate Substitutes

Food Group	Comparison Pair	Mean Unit Price of Lowest Priced Product ($)*				
		Standard Item	Linearized SE	Substitute Item	Linearized SE	p-value
Cereal	*Corn Flakes Cereal* *Toasted Oats Cereal*	4.69	0.21	5.22	0.24	0.08
Pasta	*Spaghetti* *Whole Grain Spaghetti*	1.76	0.08	1.92	0.14	0.26
Rice	*White Rice* *Brown Rice*	1.21	0.08	1.69	0.16	0.01
Bread	*White Bread* *Whole Grain Bread*	2.46	0.07	2.62	0.04	0.02
Rolls	*Buns/Rolls* *Whole Grain Buns/Rolls*	3.63	0.12	2.66	0.00	0.00
Ground Beef	*Ground Beef* *Extra Lean Ground Beef*	n.a.	n.a.	n.a.	n.a.	n.a.
Milk	*Whole Fat Milk*[1] *Low Fat Milk*[1]	4.00	0.08	3.79	0.07	0.01
Cheese	*Chunk Cheddar Cheese* *Reduced Fat Chunk Cheddar Cheese*	7.09	0.23	7.62	0.54	0.33
Ice Cream	*Ice Cream*[1] *Light Ice Cream*[1]	15.23	0.93	13.42	0.61	0.08
Misc. Dairy	*Yogurt* *Reduced Fat Yogurt*	n.a.	n.a.	3.18	0.17	n.a.
Fruit Juice	*Apple Juice*[1] *100% Apple Juice*[1]	7.14	0.43	8.08	0.38	0.10
Canned Fruits	*Apple Sauce* *Unsweetened Apple Sauce*	1.78	0.05	1.94	0.19	0.40
Fats/Oils	*Tub Margarine*[1] *Olive Oil*[1]	25.81	0.95	52.17	2.22	0.00

Continued

Appendix Table 6.4: *Continued*

Food Group	Comparison Pair	Mean Unit Price of Lowest Priced Product ($)*				
		Standard Item	Linearized SE	Substitute Item	Linearized SE	p-value
Snacks	*Potato Chips* *Unsalted Nuts*	5.21	0.17	4.80	0.43	0.36
Cola	*Regular Cola*[1] *Diet Cola*[1]	3.17	0.11	3.28	0.09	0.04

Statistical tests were conducted using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).
n.a.: Variance matrix was nonsymmetric or highly singular.
*Units are in pounds unless otherwise specified.
[1]Unit is a gallon.

Appendix Table 6.5: Mean Unit Price of Lowest Priced Product at Small Stores, Standard Items and Convenience Substitutes

Food Group	Comparison Pair	Mean Unit Price of Lowest Priced Product ($)*				
		Standard Item	Linearized SE	Substitute Item	Linearized SE	p-value
Rice	*White Rice* *Instant Rice*	1.21	0.08	2.76	0.17	0.00
Ground Beef	*Ground Beef* *Ground Beef Patties*	n.a.	n.a.	n.a.	n.a.	n.a.
Cheese	*Chunk Cheddar Cheese* *Shredded Cheddar Cheese*	7.09	0.23	7.40	0.37	0.31
Potatoes	*Fresh White Potatoes*[1] *Frozen White Potatoes*[1]	0.52	0.08	0.88	0.06	0.00
Tomatoes	*Fresh Tomatoes*[1] *Canned Tomatoes*[1]	1.19	0.09	0.81	0.03	0.00
Other Fresh Vegetables	*Fresh Carrots*[1] *Frozen Carrots*[1]	0.63	0.15	0.42	0.00	0.21
	Fresh Broccoli[1] *Frozen Broccoli*[1]	n.a.	n.a.	0.89	0.10	n.a.
	Fresh Green Beans[1] *Canned Green Beans*[1]	0.42	0.00	0.55	0.02	0.00
	Fresh Bunch Spinach[1] *Bagged Spinach*[1]	n.a.	n.a.	0.42	n.a.	n.a.

Statistical tests were conducted using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).
n.a.: Variance matrix was nonsymmetric or highly singular.
*Units are in pounds unless otherwise specified.
[1]Unit is a cup equivalent.

Appendix Table 6.6: Effect of MyPlate Substitution on the Natural Logarithm of the Mean Unit Price for Selected Foods

	Regression Coefficient Estimate (Linearized Standard Error)							
Variable	**Cereal**	**Pasta**	**Rice**	**Bread**	**Rolls**	**Ground Beef**	**Milk[1]**	**Cheese**
MyPlate Substitution	0.13* (0.04)	0.33* (0.03)	0.41* (0.05)	0.26* (0.03)	0.36* (0.06)	0.38* (0.03)	-0.04* (0.01)	0.30* (0.04)
Small Store	0.75* (0.05)	0.48* (0.05)	0.50* (0.08)	0.59* (0.05)	0.41* (0.06)	(dropped)	0.11* (0.03)	0.37* (0.05)
Median Income, logged	0.16* (0.05)	0.11 (0.06)	0.21* (0.10)	0.05 (0.04)	-0.01 (0.10)	0.18* (0.09)	0.03 (0.03)	0.05 (0.06)
Share w/out Vehicle Access	0.55* (0.25)	0.35 (0.18)	0.50 (0.35)	0.43* (0.17)	0.27 (0.22)	0.22 (0.29)	0.30* (0.07)	0.26 (0.19)
Constant	-1.13 (0.63)	-1.24 (0.69)	-2.80* (1.17)	-0.42 (0.48)	0.90 (1.09)	-0.86 (0.99)	0.89* (0.37)	0.90 (0.67)
N	225	154	129	194	123	79	238	131
R-squared	0.54	0.43	0.44	0.56	0.26	0.50	0.18	0.41

Continued

Appendix Table 6.6: *Continued*

Variable	Regression Coefficient Estimate (Linearized Standard Error)						
	Ice Cream[1]	Misc. Dairy	Fruit Juice[1]	Canned Fruits	Fats/ Oils[1]	Snacks	Cola[1]
MyPlate Substitution	0.14* (0.06)	-0.30* (0.03)	0.07 (0.05)	0.06 (0.04)	0.75* (0.05)	-0.18* (0.05)	0.06* (0.02)
Small Store	0.62* (0.06)	0.95* (0.07)	0.58* (0.04)	0.72* (0.06)	0.82* (0.05)	0.33* (0.05)	0.52* (0.06)
Median Income, logged	0.18* (0.08)	0.07 (0.06)	0.10 (0.06)	0.12 (0.07)	0.08 (0.06)	-0.01 (0.05)	-0.01 (0.09)
Share w/out Vehicle Access	0.74* (0.23)	0.22 (0.16)	0.48* (0.19)	0.46 (0.29)	0.40* (0.19)	-0.01 (0.23)	0.34 (0.32)
Constant	-0.24 (0.87)	-0.37 (0.69)	0.11 (0.71)	-1.62 (0.80)	1.42 (0.72)	1.42* (0.57)	0.58 (1.07)
N	174	121	174	153	190	205	236
R-squared	0.36	0.70	0.47	0.63	0.79	0.24	0.41

Statistical tests were conducted using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).

* Significant at $p < 0.05$.

Unit price is $/pound unless otherwise specified.

[1] Unit price is $/gallon.

Appendix Table 6.7: Effect of Convenience Substitution on the Natural Logarithm of the Mean Unit Price for Selected Foods

	Regression Coefficient Estimate (Linearized Standard Error)								
Variable	**Rice**	**Ground Beef**	**Cheese**	**Potatoes[1]**	**Tomatoes[1]**	**Carrots[1]**	**Broccoli[1]**	**Green Beans[1]**	**Spinach[1]**
Convenience Substitution	0.65* (0.05)	0.34* (0.04)	0.00 (0.03)	0.15* (0.05)	-0.73* (0.05)	0.52* (0.07)	-0.20* (0.06)	-0.65* (0.06)	-0.13 (0.06)
Small Store	0.68* (0.08)	(dropped)	0.44* (0.05)	0.63* (0.08)	0.59* (0.06)	0.70* (0.20)	0.63* (0.12)	0.66* (0.06)	0.04 (0.07)
Median Income, logged	0.28* (0.12)	0.25* (0.08)	0.09 (0.07)	0.36* (0.09)	0.21* (0.07)	0.08 (0.06)	0.14 (0.11)	0.09 (0.07)	0.08 (0.16)
Share without Vehicle Access	0.15 (0.28)	0.22 (0.27)	0.43 (0.22)	0.70* (0.30)	0.32 (0.16)	0.34 (0.20)	0.20 (0.28)	0.32* (0.14)	0.19 (0.65)
Constant	-3.53* (1.31)	-1.62 (0.94)	0.38 (0.81)	-5.19* (1.00)	-2.57* (0.84)	-2.33* (0.73)	-2.14 (1.29)	-1.71* (0.74)	-1.64 (1.85)
N	167	78	161	117	156	80	88	150	46
R-squared	0.60	0.48	0.47	0.47	0.59	0.49	0.30	0.53	0.03

Statistical tests were conducted using the software procedures in STATA that compute standard errors that are corrected for clustering (SVYSET and SVY: REGRESS).

* Significant at $p < 0.05$.

Unit price is $/pound unless otherwise specified.

[1] Unit price is $/cup equivalent.

Appendix Table 6.8: Aggregated Food Costs, MyPlate Substitutions

		(1) Standard Basket					(2) Comparison Basket			
Food Item	**Expenditure Weight**	**Large Stores, Mean Lowest Price**	**Unit**	**Large Store Unit Price ($/lb)**	**Weighted Average Prices**	**Food Item**	**Large Stores, Mean Lowest Price**	**Unit**	**Large Store Unit Price ($/lb)**	**Weighted Average Prices**
	100.0000			$98.56	$2.28				$105.95	$2.40
Corn Flakes Cereal	2.8650	$2.12	lb	$2.12	$6.07	**Toasted Oats Cereal**	$2.46	lb	$2.46	$7.05
Spaghetti	0.9339	$1.01	lb	$1.01	$0.95	**Whole Grain Spaghetti**	$1.50	lb	$1.50	$1.40
White Rice	0.7745	$0.73	lb	$0.73	$0.56	**Brown Rice**	$1.09	lb	$1.09	$0.84
White Bread	6.0634	$1.15	lb	$1.15	$6.98	**Whole Grain Bread**	$1.84	lb	$1.84	$11.18
Bread Buns/Rolls	3.0648	$2.32	lb	$2.32	$7.10	**Whole Grain Rolls**	$3.31	lb	$3.31	$10.14
Ground Beef	2.6721	$3.41	lb	$3.41	$9.10	**Extra Lean Ground Beef**	$4.87	lb	$4.87	$13.01
Beef, Steak	2.5851	$4.30	lb	$4.30	$11.12	Beef, Steak	$4.30	lb	$4.30	$11.12
Beef, Roast	1.1578	$4.12	lb	$4.12	$4.77	Beef, Roast	$4.12	lb	$4.12	$4.77
Pork, Ham	1.1932	$2.26	lb	$2.26	$2.70	Pork, Ham	$2.26	lb	$2.26	$2.70
Pork, Chop	1.1542	$3.39	lb	$3.39	$3.91	Pork, Chop	$3.39	lb	$3.39	$3.91
Pork, Bacon	1.0480	$4.48	lb	$4.48	$4.69	Pork, Bacon	$4.48	lb	$4.48	$4.69
Pork, Sausage	1.0215	$3.66	lb	$3.66	$3.74	Pork, Sausage	$3.66	lb	$3.66	$3.74
Frankfurter, Wiener, Hot Dog	1.5199	$1.82	lb	$1.82	$2.77	Frankfurter, Wiener, Hot Dog	$1.82	lb	$1.82	$2.77
Bologna	1.3660	$2.95	lb	$2.95	$4.03	Bologna	$2.95	lb	$2.95	$4.03
Chicken Breast, Boneless, Skinless	2.5425	$2.95	lb	$2.95	$7.49	Chicken Breast, Boneless, Skinless	$2.95	lb	$2.95	$7.49
Whole Chicken	0.8839	$1.43	lb	$1.43	$1.27	Whole Chicken	$1.43	lb	$1.43	$1.27
Ground Turkey	0.8813	$3.30	lb	$3.30	$2.91	Ground Turkey	$3.30	lb	$3.30	$2.91
Salmon Fillet or Steak	2.0868	$8.73	lb	$8.73	$18.21	Salmon Fillet or Steak	$8.73	lb	$8.73	$18.21
Fish Sticks or Fillet, Frozen	1.3301	$3.76	lb	$3.76	$5.00	Fish Sticks or Fillet, Frozen	$3.76	lb	$3.76	$5.00
Fresh Eggs	1.3711	$15.83	100ct	$1.26	$1.73	Fresh Eggs	$15.83	100ct	$1.26	$1.73
Whole Milk	4.5374	$3.49	gal	$0.41	$1.84	**Low Fat Milk**	$3.44	gal	$0.40	$1.81
Cheddar Cheese, Chunk	3.9717	$4.64	lb	$4.64	$18.42	**Reduced Fat Chunk Cheddar Chees**	$6.50	lb	$6.50	$25.80
Vanilla Ice Cream	1.7771	$6.41	gal	$1.38	$2.44	**Light Vanilla Ice Cream**	$9.27	gal	$1.73	$3.07
Yogurt	1.3419	$1.60	lb	$1.60	$2.14	**Low Fat Yogurt**	$1.18	lb	$1.18	$1.58
Apple	3.3242	$1.18	lb	$1.18	$3.93	Apple	$1.18	lb	$1.18	$3.93
Banana	2.6855	$0.68	lb	$0.68	$1.83	Banana	$0.68	lb	$0.68	$1.83
Apple Juice	1.6698	$4.21	gal	$0.48	$0.80	**100% Apple Juice**	$4.24	gal	$0.49	$0.81
Apple Sauce	0.9654	$0.88	lb	$0.88	$0.85	**Unsweetened Apple Sauce**	$0.94	lb	$0.94	$0.91
Orange Juice, 100%	0.5090	$4.53	gal	$0.52	$0.26	Orange Juice, 100%	$4.53	gal	$0.52	$0.26
Spinach, Bunch	0.8560	$2.59	lb	$2.59	$2.22	Spinach, Bunch	$2.59	lb	$2.59	$2.22
Carrot, Loose or Bagged	0.8560	$0.77	lb	$0.77	$0.66	Carrot, Loose or Bagged	$0.77	lb	$0.77	$0.66
Broccoli, Head or Stalks	0.8560	$1.77	lb	$1.77	$1.51	Broccoli, Head or Stalks	$1.77	lb	$1.77	$1.51
Green String Beans	0.8560	$2.16	lb	$2.16	$1.85	Green String Beans	$2.16	lb	$2.16	$1.85
White Potato	1.1644	$0.62	lb	$0.62	$0.72	White Potato	$0.62	lb	$0.62	$0.72
Tomato	1.1372	$2.18	lb	$2.18	$2.48	Tomato	$2.18	lb	$2.18	$2.48
Canned Tomatoes	0.5372	$0.71	lb	$0.71	$0.38	Canned Tomatoes	$0.71	lb	$0.71	$0.38
Canned Green Beans	0.5372	$0.80	lb	$0.80	$0.43	Canned Green Beans	$0.80	lb	$0.80	$0.43
Canned Refried Beans	0.5372	$1.22	lb	$1.22	$0.66	Canned Refried Beans	$1.22	lb	$1.22	$0.66
White Potatoes, Frozen	0.4299	$0.97	lb	$0.97	$0.42	White Potatoes, Frozen	$0.97	lb	$0.97	$0.42
Broccoli, Frozen	0.4299	$1.42	lb	$1.42	$0.61	Broccoli, Frozen	$1.42	lb	$1.42	$0.61
Carrots, Frozen	0.4299	$1.50	lb	$1.50	$0.64	Carrots, Frozen	$1.50	lb	$1.50	$0.64
Candy, Gumdrop	2.6784	$1.63	lb	$1.63	$4.37	Candy, Gumdrop	$1.63	lb	$1.63	$4.37
Fruit Jam/Jelly/Preserve	0.8287	$1.23	lb	$1.23	$1.02	Fruit Jam/Jelly/Preserve	$1.23	lb	$1.23	$1.02
Margarine, Tub	1.3399	$1.37	lb	$1.37	$1.83	**Olive Oil**	$23.77	lb	$3.12	$4.18
Salad Dressing	0.9259	$16.67	gal	$2.01	$1.86	Salad Dressing	$16.67	gal	$2.01	$1.86
Soy Milk	0.5527	$6.67	gal	$0.78	$0.43	Soy Milk	$6.67	gal	$0.78	$0.43
Potato Chips	18.4585	$3.64	lb	$3.64	$67.23	**Unsalted Nuts**	$3.03	lb	$3.03	$55.92
Cola, Regular	5.3477	$1.77	gal	$0.20	$1.09	**Diet Cola**	$2.17	gal	$0.26	$1.39
Bottled Water	3.9446	$0.90	gal	$0.11	$0.42	Bottled Water	$0.90	gal	$0.11	$0.42

Appendix Table 6.9: Aggregated Food Costs, Convenience Substitutions

		(1) Standard Basket					(2) Comparison Basket			
Food Item	**Expenditure Weight**	**Large Stores, Mean Lowest Price**	**Unit**	**Large Store Unit Price ($/lb)**	**Weighted Average Prices**	**Food Item**	**Large Stores, Mean Lowest Price**	**Unit**	**Large Store Unit Price ($/lb)**	**Weighted Average Prices**
	100.0000			$98.14	$2.28				$100.65	$2.32
Corn Flakes Cereal	2.8650	$2.12	lb	$2.12	$6.07	Corn Flakes Cereal	$2.12	lb	$2.12	$6.07
Spaghetti	0.9339	$1.01	lb	$1.01	$0.95	Spaghetti	$1.01	lb	$1.01	$0.95
White Rice	0.7745	$0.73	lb	$0.73	$0.56	**Instant Rice**	$1.26	lb	$1.26	$0.97
White Bread	6.0634	$1.15	lb	$1.15	$6.98	White Bread	$1.15	lb	$1.15	$6.98
Bread Buns/Rolls	3.0648	$2.32	lb	$2.32	$7.10	Bread Buns/Rolls	$2.32	lb	$2.32	$7.10
Ground Beef	2.6721	$3.41	lb	$3.41	$9.10	**Ground Beef Patties**	$4.72	lb	$4.72	$12.62
Beef, Steak	2.5851	$4.30	lb	$4.30	$11.12	Beef, Steak	$4.30	lb	$4.30	$11.12
Beef, Roast	1.1578	$4.12	lb	$4.12	$4.77	Beef, Roast	$4.12	lb	$4.12	$4.77
Pork, Ham	1.1932	$2.26	lb	$2.26	$2.70	Pork, Ham	$2.26	lb	$2.26	$2.70
Pork, Chop	1.1542	$3.39	lb	$3.39	$3.91	Pork, Chop	$3.39	lb	$3.39	$3.91
Pork, Bacon	1.0480	$4.48	lb	$4.48	$4.69	Pork, Bacon	$4.48	lb	$4.48	$4.69
Pork, Sausage	1.0215	$3.66	lb	$3.66	$3.74	Pork, Sausage	$3.66	lb	$3.66	$3.74
Frankfurter, Wiener, Hot Dog	1.5199	$1.82	lb	$1.82	$2.77	Frankfurter, Wiener, Hot Dog	$1.82	lb	$1.82	$2.77
Bologna	1.3660	$2.95	lb	$2.95	$4.03	Bologna	$2.95	lb	$2.95	$4.03
Chicken Breast, Boneless, Skinless	2.5425	$2.95	lb	$2.95	$7.49	Chicken Breast, Boneless, Skinless	$2.95	lb	$2.95	$7.49
Whole Chicken	0.8839	$1.43	lb	$1.43	$1.27	Whole Chicken	$1.43	lb	$1.43	$1.27
Ground Turkey	0.8813	$3.30	lb	$3.30	$2.91	Ground Turkey	$3.30	lb	$3.30	$2.91
Salmon Fillet or Steak	2.0868	$8.73	lb	$8.73	$18.21	Salmon Fillet or Steak	$8.73	lb	$8.73	$18.21
Fish Sticks or Fillet, Frozen	1.3301	$3.76	lb	$3.76	$5.00	Fish Sticks or Fillet, Frozen	$3.76	lb	$3.76	$5.00
Fresh Eggs	1.3711	$15.83	100ct	$1.26	$1.73	Fresh Eggs	$15.83	100ct	$1.26	$1.73
Low Fat Milk	4.5374	$3.44	gal	$0.40	$1.81	Low Fat Milk	$3.44	gal	$0.40	$1.81
Cheddar Cheese, Chunk	3.9717	$4.64	lb	$4.64	$18.42	**Cheddar Cheese, Shredded**	$4.56	lb	$4.56	$18.11
Vanilla Ice Cream	1.7771	$6.41	gal	$1.38	$2.44	Vanilla Ice Cream	$6.41	gal	$1.38	$2.44
Low Fat Yogurt	1.3419	$1.18	lb	$1.18	$1.58	Low Fat Yogurt	$1.18	lb	$1.18	$1.58
Apple	3.3242	$1.18	lb	$1.18	$3.93	Apple	$1.18	lb	$1.18	$3.93
Banana	2.6855	$0.68	lb	$0.68	$1.83	Banana	$0.68	lb	$0.68	$1.83
Apple Juice	1.6698	$4.21	gal	$0.48	$0.80	Apple Juice	$4.21	gal	$0.48	$0.80
Apple Sauce	0.9654	$0.88	lb	$0.88	$0.85	Apple Sauce	$0.88	lb	$0.88	$0.85
Orange Juice, 100%	0.5090	$4.53	gal	$0.52	$0.26	Orange Juice, 100%	$4.53	gal	$0.52	$0.26
Spinach, Bunch	0.8560	$2.59	lb	$2.59	$2.22	**Bagged Spinach**	$3.32	lb	$3.32	$2.84
Carrot, Loose or Bagged	0.8560	$0.77	lb	$0.77	$0.66	Carrot, Loose or Bagged	$0.77	lb	$0.77	$0.66
Broccoli, Head or Stalks	0.8560	$1.77	lb	$1.77	$1.51	Broccoli, Head or Stalks	$1.77	lb	$1.77	$1.51
Green String Beans	0.8560	$2.16	lb	$2.16	$1.85	Green String Beans	$2.16	lb	$2.16	$1.85
White Potato	1.1644	$0.62	lb	$0.62	$0.72	White Potato	$0.62	lb	$0.62	$0.72
Tomato	1.1372	$2.18	lb	$2.18	$2.48	Tomato	$2.18	lb	$2.18	$2.48
Canned Tomatoes	0.5372	$0.71	lb	$0.71	$0.38	Canned Tomatoes	$0.71	lb	$0.71	$0.38
Canned Green Beans	0.5372	$0.80	lb	$0.80	$0.43	Canned Green Beans	$0.80	lb	$0.80	$0.43
Canned Refried Beans	0.5372	$1.22	lb	$1.22	$0.66	Canned Refried Beans	$1.22	lb	$1.22	$0.66
White Potatoes, Frozen	0.4299	$0.97	lb	$0.97	$0.42	White Potatoes, Frozen	$0.97	lb	$0.97	$0.42
Broccoli, Frozen	0.4299	$1.42	lb	$1.42	$0.61	Broccoli, Frozen	$1.42	lb	$1.42	$0.61
Carrots, Frozen	0.4299	$1.50	lb	$1.50	$0.64	Carrots, Frozen	$1.50	lb	$1.50	$0.64
Candy, Gumdrop	2.6784	$1.63	lb	$1.63	$4.37	Candy, Gumdrop	$1.63	lb	$1.63	$4.37
Fruit Jam/Jelly/Preserve	0.8287	$1.23	lb	$1.23	$1.02	Fruit Jam/Jelly/Preserve	$1.23	lb	$1.23	$1.02
Margarine, Tub	1.3399	$1.37	lb	$1.37	$1.83	Margarine, Tub	$1.37	lb	$1.37	$1.83
Salad Dressing	0.9259	$16.67	gal	$2.01	$1.86	Salad Dressing	$16.67	gal	$2.01	$1.86
Soy Milk	0.5527	$6.67	gal	$0.78	$0.43	Soy Milk	$6.67	gal	$0.78	$0.43
Potato Chips	18.4585	$3.64	lb	$3.64	$67.23	Potato Chips	$3.64	lb	$3.64	$67.23
Cola, Regular	5.3477	$1.77	gal	$0.20	$1.09	Cola, Regular	$1.77	gal	$0.20	$1.09
Bottled Water	3.9446	$0.90	gal	$0.11	$0.42	Bottled Water	$0.90	gal	$0.11	$0.42

CHAPTER 7: DISCUSSION AND CONCLUSION

Household food choices are subject to a budget constraint and a time constraint. To achieve an adequate diet that supports a healthy, active life, households must have sufficient purchasing power and time resources. Household purchasing power is directly influenced by the price of food at retailers while household time resources are affected both by household characteristics and by the time costs related to food. The contributions of this dissertation inform discussions about both of these household constraints. First, this dissertation improves on prior efforts at collecting rich, detailed information on the availability and price of foods at the local or community level. In particular, methods developed in this dissertation aimed to increase the representativeness of price information and provide new ways of accounting for variability in food item availability when making price comparisons. The second aim of this dissertation was to investigate the implications of time costs and convenience attributes in foods on household food choices.

This concluding chapter reviews the key findings from the three articles presented in this dissertation. This is followed by a discussion of the implications of the findings and recommendations for future research.

Review of Findings and Contributions to the Literature

Household Spending and Time Constraints

Our findings suggest that the key issue for time-constrained households may be the presence of other adult household members with whom to share and delegate food-related tasks. We found that household structure was the most consistent, and in several

cases the most practically significant, predictor of the food shopping patterns examined. Compared to married couple households, single-adult households shopped on fewer days, suggesting that these households may seek to reduce travel time to and from food retail by consolidating shopping trips into fewer days. Single-adult households allocated their food budget differently from married couple households, favoring more convenient food choices. This increased allocation on more convenient forms of food was robust to the method of food aggregation and held true for broad, intermediate, and narrow food group definitions.

The effect of household size indicated a nuanced relationship with food spending patterns. Larger households shopped on more days, perhaps due to increased flexibility afforded by additional household members. However, household size had a diminishing marginal effect, suggesting that at some point the added complexity of schedules and logistics for large households may become a time-constraining factor. Larger households allocated a greater share of their overall food budget to more convenient forms of food.

All else equal, a household with more children shopped less frequently and spent more of its food dollars on prepared food and less on vegetables. The effect of full-time work and vehicle ownership was only significant in a handful of models predicting shopping days and food spending shares. Full-time work status was negatively associated with shopping days and positively associated with a greater share of the food budget being allocated to food away from home and on processed vegetables. Vehicle ownership was positively associated with shopping days and with increased spending on prepared food.

Our findings reinforce the conclusions reached by the IOM and NRC in their report on the adequacy of the SNAP benefit. They concluded that the time requirements for food acquisition and preparation assumed by the TFP are inconsistent with the time resources of most households at all income levels, but the time gap may be particularly salient for single working heads of household (Institute of Medicine [IOM] and National Research Council [NRC], 2013).

While there is a well-developed literature on the socio-demographic covariates of food expenditures, this study advances the literature by focusing specifically on household characteristics closely tied to the time resources of households and on food at home spending outcomes that are most likely to be affected by increased demand for convenience. Other studies that have used the CEX to address these issues have focused primarily on spending on food away from home as an indicator of household demand for convenience in food (Stewart, Blisard, Bhuyan, and Nayga, 2004; Ziol-Guest, DeLeire, and Kalil, 2006). This study disaggregated food at home expenditures into sub-categories based on convenience attributes. To our knowledge, this study is among the first to use CEX information on the date of purchase for food items to calculate the number of shopping days for food at home and examine correlations with proxies for household time resources.

Finally, the analysis of CEX data in this chapter served as an important stepping-stone to the development of the community food price survey methods used in subsequent chapters. The food group definitions and hierarchy used in this analysis served as the basis for identifying representative food items to be priced during the

primary data collection effort, while the food spending shares were applied as expenditure weights when aggregating food prices by store size in later chapters.

Food Retailer Size and Prices

We found that availability of representative food items was not an issue at large food stores in our sample. Almost all large stores carried the majority of the representative food items. Availability was significantly lower for most items at small stores, however. Food items available at small stores were predominantly shelf stable rather than perishable. Certain food items were nearly ubiquitous at small stores, such as potato chips and regular cola (100 percent availability), bottled water (99 percent), and gumdrop candy (98 percent). Fresh meats and produce were not widely available at small stores.

The average price of the lowest priced product and the product with the most shelf space was consistently higher at small stores. The price premium of shopping at small stores was greatest for reduced fat yogurt and regular ice cream. A few food items sold at small stores were priced competitively with large stores. We found that the price difference ratio was lowest for low fat milk, fresh 100% orange juice, and fresh eggs.

Small stores rarely stocked fresh meats or produce, with most shelf space dedicated to shelf-stable, and usually more processed, food items. Small stores were not completely lacking in healthful foods, however, with a majority of small stores stocking food items such as low fat milk, fresh 100% orange juice, and canned vegetables. Large stores, while typically well stocked with fresh fruits and vegetables, also sell many

calorie-dense food items that are significantly cheaper on a per unit basis compared to small stores.

The price differential between small stores and large stores may be attributed in part to differences in package size options. Large stores offer a wider range of package size options, including family or bulk size packaging that may be cheaper on a per unit basis. The average package size was statistically significantly larger at large stores for 20 of the 29 items with enough observations to conduct an analysis of variance.

Based on the price of the product with the lowest unit price, the cost of the small store basket was 39 percent higher than the cost of the large store basket. This reflected the price difference for comparable items but also captured differences in item availability across store type. More specifically, the weighted average price of food at large stores was overstated in this comparison because it included the price of food items not typically available at small stores, such as fresh meats, fish, and produce, which tend to have relatively higher unit prices. To compare prices, conditional on availability, this study calculated a pure price difference based on the mix of food items that were most comparable across retailer type, modeled after the Paasche price index. The weighted average cost of a pound of food was 59 percent higher at small stores compared to large stores, using the price of the lowest priced product. This is significantly higher than the first estimate, demonstrating the impact of item availability on price comparisons.

Using the price of the product of the most shelf space resulted in higher average weighted costs for the market baskets, but smaller differences between small and large stores. The pure price difference dropped to 33 percent when based on the product with

the most shelf space, illustrating the role of package size and brand on estimated price differences.

Chapter 5 is one of the few studies to provide detailed, granular empirical data on variations in food availability and price by retailer size in the Boston metropolitan area. This study improved on existing methods of community food price survey research in two ways.

First, it implemented a systematic research design to ensure representativeness of sampled geographic areas, food retailers, and food items. Sampled areas were representative of the areas where people lived. Sampled stores were selected using a balanced approach that matched two small stores to a large store from each survey cluster. This was designed to ensure that the sample of small stores and large stores came from comparable competitive environments. The selected food items, based on a combination of food expenditure data from the CEX and food consumption data from the NHANES, were representative of food spending and consumption patterns among U.S. households.

Second, this study employed novel methods for handling variability in food item availability across retailer types and missing price information. When aggregating food prices, careful attention was paid to food item comparability and distinguishing between differences in food item availability and differences in food prices. Food items were given relatively narrow definitions but with flexibility on brand and package size attributes. This decision improved comparability between small and large stores by reducing missing values, but still limited the range of acceptable items to avoid unlike comparisons (Kaufman and Handy, 1989). To further account for variability in the

availability of food items in small stores, expenditure weights generated from the analysis in Chapter 4 were adjusted to reflect lower food item availability at small stores. Incorporating information on availability into the weights avoided the need to impute price information or discard observations based on missing values. We adapted the Paasche price index approach and used the availability-adjusted weights to calculate the overall aggregated price difference between small and large stores, controlling for lower food item availability in small stores.

Price Premium for Food Attributes

Data from Boston area food retailers indicate that most MyPlate substitute items were more readily available than their standard counterparts. Availability of whole grain products was extremely limited at small food retailers. A few MyPlate substitutes, namely olive oil, reduced fat yogurt, and 100% apple juice, were significantly easier to find than their standard counterparts. Applying MyPlate guidance and making nutritional upgrades within MyPlate food groups typically involved a significant increase in the unit price for substituted items. Ten of the fifteen MyPlate substitute items were significantly more expensive than their standard counterparts, after controlling for store size and neighborhood socioeconomic characteristics. There were some exceptions. Low fat milk, reduced fat yogurt, and unsalted nuts were significantly less expensive than their standard counterparts.

Convenience substitute items were more widely available than their standard counterparts. Perishability may play a role in this disparity, as more convenient forms of food items are often more highly processed and packaged for better shelf stability. The

sign of the price difference for convenience substitutions was not as consistent as with the MyPlate substitutions. Four of the nine convenience substitute items were significantly more expensive than their standard counterparts while three of the nine were significantly less expensive, after controlling for store size and neighborhood socioeconomic characteristics. With the exception of potatoes and carrots, which are relatively less perishable fresh vegetables, the frozen or canned form of vegetables were less expensive than their fresh form.

When put in the context of the overall food budget, we found that the estimated impact of both types of substitutions was substantially tempered but that the net effect was a small increase in the overall cost of the basket of goods. Taken together, the MyPlate substitutions raised the cost of the market basket of food by 5.3 percent. The convenience substitutions raised the cost of the market basket by 1.7 percent. While relatively small in magnitude, these cost increases are nontrivial, especially for low-income households that are faced with tight budget constraints.

This study advances the literature on price differentials for nutrition and convenience attributes in food while improving on existing community food price survey methods in three ways. A basket of standard food items was systematically chosen using data on food expenditures from the CEX and food consumption from the NHANES that was representative of the food spending patterns of American households. Using a simple substitution principle, the standard basket was augmented with a set of substitute food items that allowed for detailed pairwise comparisons between similar food items that differed primarily on nutritional or convenience attributes. Few studies based on community food price surveys control for store size and store environment

characteristics. This study improved upon the literature by conducting pairwise comparisons using hedonic regression analysis to control for these factors. Finally, expenditure weights estimated in Chapter 4 were attached to substitute food items to estimate the weighted average effect of food substitutions and assess the overall economic significance of food price differences.

Implication of Findings

Increasing access to healthful food, particularly fresh produce, has been a focal point of federal and local initiatives like the First Lady Michelle Obama's Let's Move! campaign, the federal HFFI, New York City's Healthy Bodegas program, Boston's Healthy on the Block initiative, Baltimore's Healthy Stores program, and Philadelphia's Healthy Corner Store initiative. HFFI supports projects that increase access to healthful, affordable food in communities with low access to these foods. One way HFFI does this is by providing incentives to supermarkets to locate in underserved communities. However, the level of consumer demand required to support a large store precludes having a supermarket in every neighborhood. Other policy efforts are aimed at building the capacity of small stores already located in these communities to offer fresh produce and a healthier mix of foods and stimulating community awareness and demand for these foods. We found that the majority of small stores in the study sample stocked some shelf stable forms of vegetables. These findings underscore the potential of promoting shelf stable vegetables as an early or stand-alone goal in small store interventions.

In their review of 16 recent small store interventions aimed at improving the availability of healthy food options, Gittelsohn, Rowan, and Gadhoke (2012) found that

about a third of the interventions focused exclusively on promoting fresh produce. A key concern among small store owners and operators in stocking fresh produce are revenue losses due to spoilage. According to federal dietary guidance, consumption of fresh, frozen, canned, or dried/dehydrated vegetables count towards meeting dietary recommendations on vegetable consumption (USDA, 2013). Canned and frozen vegetables have low perishability, and increasing their availability in small stores may be a more realistic goal for some of these interventions. Increasing the availability of other shelf-stable MyPlate substitutes, such as whole grain products, could be another area of emphasis in these interventions.

Findings from this dissertation also highlight the tradeoffs between the time costs involved in acquiring and preparing food at home and the monetary cost of the food items themselves. Certain households have characteristics that strongly impact the time resources available for food-related activities, such as household composition and full-time work status. Findings from Chapter 4 suggest that meeting recommendations on vegetable consumption may be a challenge not only from a taste perspective, but also from a time perspective, if the households believe that they do not have the time, motivation or energy to prepare vegetables and integrate them into their meals.

Estimates of the cost of acquiring and preparing a low cost but healthful meal would benefit from more explicit assessments of the time costs assumed or implied. One of the criticisms of the TFP is that it does not adequately reflect the time cost involved in purchasing and preparing low cost meals from scratch for time-pressed households (Jabs and Devine, 2006; Mancino and Newman, 2007; Rose, 2007). Although it allows for some convenience options, the TFP assumes that meals are mostly made from scratch.

In their 2013 report on the adequacy of the SNAP benefit, the IOM and NRC suggested increasing SNAP benefit to provide time-constrained families additional resources to purchase more convenient and easy-to-prepare foods. Our findings indicate that certain households, specifically single adult households, may be relatively more time constrained than others. We also found that some food item substitutions intended to save time on food preparation at home resulted in price increases. Future research should examine the cost implications of updating the TFP to include greater representation of nutritious but convenient forms of food, such as frozen fruits and vegetables or canned fruits and vegetables with no sugar or salt added (Mancino and Newman, 2007). Investigating the cost and nutrition implications of such changes to the composition of the TFP should be high on the research agenda.

The regression results in Chapter 6 showed that the food environment plays a key role in determining the magnitude of the price difference for MyPlate and convenience substitutes. Consumers living in areas with a relatively high concentration of smaller stores and low concentration of large stores may be faced with significantly higher unit prices for food. Individual consumers and households must consider the tradeoff between higher food costs at nearby stores and the monetary and time costs of traveling further away in search of lower prices. As the share of the area without access to a vehicle increased, the unit prices of food items increased, all else equal. This suggests that lower mobility among residents may result in lower price competition among neighborhood stores and higher prices. Policies could be designed to assist those without access to vehicles living in areas with a low concentration of large retailers. This could take the form of a voucher or adjustments to the SNAP benefits to help subsidize transportation to

large retailers located further away (Andrews, Bhatta, and Ver Ploeg, 2013). By allowing a number of different deductions, the SNAP benefit formula already adjusts for a variety of other costs that low-income households commonly incur, such as costs for housing, medical care, dependent care.

Recommendations for Future Research

The existing literature connecting the food retail environment to nutrition and health outcomes has mostly relied on store format, type, or size to proxy for the contents within stores, such as food item availability and pricing (Franco et al., 2009; Rose et al., 2010). A common assumption is that the presence of supermarkets corresponds to the availability of a wide range of food items, including fresh fruits and vegetables, at relatively low cost. This has contributed to a predominance of studies focusing on the proximity or density of supermarkets, rather than the availability and price of food items within stores. Other food price data sources, including scanner data from Nielsen, are not typically representative at the geographic scale of the neighborhood or city. This dissertation improves on methods of collecting and analyzing data on food item availability and price conditions within stores.

Studies focused on improving assessments of food availability and pricing within stores, including this dissertation, generally lack corresponding household data on food spending, consumption or health outcomes. Connecting detailed, localized information about in-store characteristics, such as food item availability and pricing, to household-level data on nutrition or health outcomes among households residing in the community is an important area for future research. Future studies could connect data on food item

availability and price collected using methods similar to those developed in this dissertation with household outcomes to explore the causal mechanisms between food environment factors and nutrition and health outcomes.

An important area for future work drawing causal connections between food retail conditions and household outcomes involves the psychosocial context of food prices and how consumers perceive and interpret differences in availability and prices within the same store and across different stores or store formats. There is evidence that consumer perception of availability and price differences between regular and healthier food options mattered more than actual availability and price differences (Giskes, Van Lenthe, Brug, Mackenbach, and Turrell, 2007). Research on food prices collected using community food price surveys could be complemented by household surveys that assess how households perceive and respond to differences in availability and price within stores and across stores. Even if fresh fruits and vegetables are made available at small stores but at a high cost, consumers may opt not to purchase any or will choose to make their purchases at large stores located further away, leaving small store operators to absorb the cost of spoiled produce.

More research on the impact of interventions designed to change the food retail environment is needed. Although this study collected and analyzed data for only one point in time, methods developed in this dissertation could be used to collect information on food item availability and price for multiple points in time. These measures could be used as part of a pre- and post-intervention study design to assess the impact of changes to the types, pricing, and display of foods available at existing neighborhood retailers. Forthcoming work in this area include the Pittsburgh Hill/Homewood Research on

Eating, Shopping & Health (PHRESH), a pre-post study looking at the effect of building a new grocery store on the health and nutrition status of residents of the intervention community. The literature is still lacking in rigorous evaluations of small store interventions aimed at improving the availability of healthy food options in urban neighborhoods.

In Chapters 4 and 6, this dissertation looked at convenience foods that are shelf-stable (canned), refrigerated or frozen. These convenience foods were classified as food at home. The role of freshly prepared food sold at food retailers that can be consumed at or away from home has grown in importance and warrants further investigation. Food retailers have been devoting more square footage and staffing to expand their freshly made prepared food offerings as they respond to consumers' growing demand for convenience, freshness, and healthfulness, while providing the retailer with a profit margin much higher than the rest of the store (Park and Capps, 1997).

This is partly a response to intense competition from nontraditional food retailers like supercenters, dollar stores, and mass merchandisers that have expanded their food offerings and cut into the market share of traditional retailers like supermarkets (Leibtag, 2006). Drugstore chains like Walgreens and CVS have expanded their freshly prepared food sections, with many stores offering ready-to-eat sandwiches and salads. There is a need for data on food prices and food expenditures that provide greater detail and distinction between different classes of convenience foods: food away from home purchased at restaurants, freshly prepared foods purchased at food retailers, and more shelf-stable convenience foods.

Future research efforts should examine the implications of using nutritious, but convenient, forms of food on food costs, dietary quality, and household time use. One of the criticisms of the TFP is that it does not adequately reflect the time cost involved in purchasing and preparing low cost meals from scratch for time-pressed households (Jabs and Devine, 2006; Mancino and Newman, 2007; Rose, 2007). Our findings suggest that households may have a preference for more convenient forms of food when pressed by time constraints and that these choices have cost implications. Additional research is needed to estimate the impact that using nutritious but more convenient forms of food (at home) has on time use, food costs, and dietary quality for different types of households. An important first step would be to estimate the impact of increasing the proportion of more convenient, but still healthful, food items in future revisions of the Thrifty Food Plan on food costs and nutritional quality

The methods developed for this study can be applied to a number of other areas of empirical inquiry related to food prices. Methods from the second article can easily be adapted to measure differences in food item availability and price across different geographic areas or communities. Similarly, methods featured in the third article could be modified to investigate the price implications of other food item substitutions, such as substituting animal-based products with vegetarian options or conventional products with organic substitutes.

Conclusion

This study contributes novel methods and data to advance the food environment literature on community level food pricing and the role of time costs and convenience in

food prices and food choices. Data from the CEX were used to show that certain households, such as those headed by a single adult and those with children, may be more time-constrained than others and make food purchasing choices that economize on time. These households tended to shop for food at home less frequently and allocate a greater share of their food budget to more convenient forms of food. Data collected with a community food price survey were used to describe differences in food availability and price between small food retailers and large retailers. Findings from this study indicate that fresh produce and meats are difficult to find at small stores and that food prices tended to be higher at small stores. Adjusting for food item variability had a significant impact on estimates of aggregated price levels. The estimated price premium at small stores ranged from 25 percent for the total price difference based on the product with the most shelf space to 59 percent for the pure price difference based on the product with the lowest unit price. Adjusting for food item availability resulted in larger estimated price differences. Finally, comparisons of food item prices based on nutrition and convenience attributes showed that most substitutions based on nutrition recommendations entailed higher prices, but more convenient food items were not consistently more or less expensive than the standard reference items. When put in the context of the overall food budget, the estimated impact of both types of substitutions was substantially tempered but that the net effect was a small increase in the overall cost of the basket of goods.

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APPENDIX 1: SURVEY INSTRUMENT

Community Food Availability and Pricing Survey

Complete Before Price Survey

Store ID: ☐☐☐

Rater ID: ☐☐

Date: ☐☐ ☐☐ ☐☐
Month Day Year

Start Time: ☐☐ : ☐☐ ☐ AM ☐ PM

Complete After Price Survey

End Time: ☐☐ : ☐☐ ☐ AM ☐ PM

Private Label(s): _____
_____

Comments
_____
_____
_____
_____
_____
_____
_____

Observation Status
- ☐ Completed
- ☐ Denied
- ☐ New store name: _____
- ☐ Out of business
- ☐ Store not found
- ☐ Replacement Store

Store Characteristics

Store Type
- ☐ Supermarket (SM)
- ☐ Grocery Store (GS)
- ☐ Convenience Store (CS)
- ☐ Combination Grocery/Other (CO)
- ☐ Mass Merchandiser (MM)
- ☐ Super Center (SC)
- ☐ Dollar Store (DS)
- ☐ Specialty Store (SP)

Store Operating Hours

	Open	Mid-Day Break	Close
Mo			
Tu			
We			
Th			
Fr			
Sa			
Su			

Number of Cash Registers

☐☐

Express Checkout Lane Available?
- ☐ Yes
- ☐ No

Self-Checkout Stations Available?
- ☐ Yes
- ☐ No

Store Features
- ☐ Fresh produce (fruits and/or vegetables)
- ☐ Refrigerator/Freezer cases
- ☐ Unpackaged meat case
- ☐ Unpackaged seafood case
- ☐ Prepared food section

Store ID: _____ Page 2

CEREAL AND BAKERY PRODUCTS

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
1. Corn Flakes Cereal						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2. Toasted Oats Cereal						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
3. Spaghetti						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
4. Spaghetti, Whole Wheat or Whole Grain						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
5. White Rice						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
6. Brown Rice						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

Store ID: _____ Page 3

CEREAL AND BAKERY PRODUCTS

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
7. Instant Rice						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
8. Loaf of Bread, White						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
9. Loaf of Bread, 100% Whole Grain or Whole Wheat						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
10. Bread Buns/Rolls						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
11. Bread Buns/Rolls, 100% Whole Grain or Whole Wheat						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

Store ID: _____ Page **4**

PROCESSED FRUITS

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
12. Apple Juice						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
13. 100% Apple Juice, Unsweetened						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
14. Apple Sauce						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
15. Apple Sauce, Unsweetened						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

PROCESSED VEGETABLES

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
16. Canned Tomatoes: Crushed, Diced, Petite Cut, Stewed, or Whole Peeled						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

Store ID: _____ Page 5

PROCESSED VEGETABLES

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
17. Canned Green String Beans						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
18. Canned Refried Beans						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
19. Dried Beans, Pinto or Black						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

OTHER FOOD AT HOME

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
20. Olive Oil						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
21. Salad Dressing						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /Qt	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /Qt	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /Qt	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

Store ID: _____ Page 6

OTHER FOOD AT HOME

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
22. Fruit Jam, Jelly or Preserve						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
23. Candy, Gumdrop						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
24. Potato Chips						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
25. Nuts, Unsalted						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
26. Cola, Regular						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
27. Cola, Diet						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

Store ID: _____ Page 7

OTHER FOOD AT HOME

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
28. Bottled Water, Unsweetened and Uncarbonated						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	

FROZEN FOODS

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
29. Fish Sticks or Fillet, Frozen						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
30. Vanilla Ice Cream						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	Qt	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	Qt	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	Qt	$ /gal	❑No ❑Yes	
31. Vanilla Ice Cream, Reduced Fat or Light						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	Qt	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	Qt	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	Qt	$ /gal	❑No ❑Yes	
32. White Potatoes, Frozen						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

Store ID: _____ Page 8

FROZEN FOOD

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
33. Broccoli, Frozen						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
34. Carrots, Frozen						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

REFRIGERATED FOODS

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
35. Margarine or Margarine-like Spread, Tub						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
36. 100% Orange Juice						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
37. Soy Milk						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

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DAIRY

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
38. Whole Milk, Fluid						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
39. Low Fat Milk, Fluid (Skim, 1%, 2%)						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /gal	❑No ❑Yes	
40. Cheddar Cheese, Chunk						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
41. Cheddar Cheese, Reduced Fat, Chunk						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
42. Cheddar Cheese, Shredded						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
43. Yogurt						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

Store ID: _____ Page **10**

DAIRY

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
44. Yogurt, Reduced Fat						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

MEAT, POULTRY, FISH, AND EGGS

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
45. Fresh Eggs						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	egg	$ /100ct	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	egg	$ /100ct	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	egg	$ /100ct	❑No ❑Yes	
46. Chicken Breast, Boneless and Skinless						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
47. Whole Chicken						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
48. Ground Turkey						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

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MEAT, POULTRY, FISH, AND EGGS

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
49. Ground Beef						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
50. Ground Beef, Extra Lean (90% or more)						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
51. Ground Beef, Patties						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
52. Beef, Steak						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
53. Beef, Roast						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
54. Pork, Chop						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

Store ID: _____ Page 12

MEAT, POULTRY, FISH, AND EGGS

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
55. Pork, Ham						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
56. Pork, Sausage						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
57. Pork, Bacon						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
58. Frankfurter, Wiener, or Hot Dog						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
59. Bologna						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
60. Salmon Fillet or Steak, Fresh						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	lb	$ /lb	❑No ❑Yes	

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

Store ID: _____ Page 13

FRESH PRODUCE

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
61. Apple						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
62. Banana						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
63. White Potato						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
64. Tomato						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
65. Spinach, Bunch						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
66. Carrot, Loose or Bagged						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No

1 pound (lb) = 16 ounces (oz) 1 gallon (gal) = 128 fluid ounces (oz)

Store ID: _____ Page **14**

FRESH PRODUCE

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
67. Broccoli, Head or Stalks						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
68. Green String Beans						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
69. Spinach, Pre-washed and Bagged						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	Organic ❑Yes ❑No

FIELD NOTES:

APPENDIX 2: SURVEY FIELD MANUAL

Community Food Availability and Pricing Survey

Instruction Manual for Data Collection

Before Leaving for the Store

Identify and Locate Store

The survey store list has the name, address, and Store ID of every store included in the study. Identify the next store scheduled for a site visit. On a new survey instrument, fill out the three-digit Store ID on the Cover Page and on the top of every page of the survey. Print out a map and directions to the store. If using a GPS device, program the address of the store into the GPS device.

Checklist of Materials and Supplies

Before leaving for the store, make sure you have the following with you:

- ☐ This instruction manual (19 pages including appendices)
- ☐ Name and address of the store
- ☐ Map and directions to the store
- ☐ Watch (or cell phone with clock function)
- ☐ Cover letter (see Appendix A)
- ☐ Survey instrument (15 pages including cover page)
- ☐ Clipboard
- ☐ Pens
- ☐ Calculator (with random number generator function)
- ☐ Measuring tape
- ☐ Several sheets of scratch paper

Scheduling Site Visits

Complete data collection between 9am and 4pm. This helps ensure that items have been stocked for the day and have not sold out. This also facilitates efficient data collection by avoiding busier times of the day (4-7pm). Consider taking your own lunch break between 12pm and 1pm, which is another busy time for stores.

Upon Arrival at Store

Verify Store Name and ID

Verify that the name of the store matches the name on the survey store list. If the store name is different but the store still sells food items, note the name change on the survey store list by writing the new name in the comment space provided. Under **Observation Status** on the Survey Cover Page, check the box for "New store name" and write in the new store name in the space provided.

If the store has closed and gone out of business or cannot be found, check the relevant box under **Observation Status**. Note this information on the survey store list in the comment space provided. Put away the survey form for this store but do not discard.

Refer to the substitute store list and randomly select a replacement store. The replacement store should be of the same store type (supermarket or non-supermarket) and comparable distance to the census tract centroid. For instance, if the original store is within a 1-mile radius of the census tract centroid, the replacement store should also be within a 1-mile radius of the centroid. If there are no other stores within the 1-mile radius, randomly select the replacement store from stores within a 2-mile radius. Prepare a new survey instrument. Check the box for "Replacement Store." Start from the beginning of this instruction manual.

Interacting with Store Staff
Enter the store and find the store manager or owner. Briefly explain the purpose of the research project and the type of data being collected. Reassure the store manager/owner that 1) the store name, location and policies will remain confidential and not be published or associated with the data collected; 2) data collection will not interrupt customers, store employees or the normal flow of business; and 3) no data will be collected from customers or store staff. If the manager/owner agrees to allow data collection, offer to leave a copy of the cover letter explaining the purpose of the project with the store manager/owner.

If the store manager/owner refuses data collection, thank him or her and then refer to the substitute store list and randomly select a replacement store. The replacement store should be of the same store type (supermarket or non-supermarket) and comparable distance to the census tract centroid. Under **Observation Status** on the Survey Cover Page, check the box for "Denied." Include any comments about the interaction with store staff in the space for comments on the Survey Cover Page.

Survey Cover Page: Complete Before Conducting Price Survey

Store ID
The three-digit Store ID should have been filled out before arriving at the store. If not, refer to the survey store list and find the Store ID corresponding to the store name and location. Record this in the boxes provided. If the store is a replacement store, fill in the Store ID of the original store.

Rater ID
Record your two-digit Rater ID in the boxes provided.

Date
Record the month, date and year of the current site visit in the boxes provided.

Start Time
After you have received permission to collect data from the store manager/owner, record the current time in the boxes provided. Use the 12-hour convention for recording the time, checking the corresponding box to indicate whether the time is in the AM or PM.

Survey Cover Page: Store Characteristics

After receiving permission to collect data from the store manager/owner, take a few moments to familiarize yourself with the store layout and characteristics. Knowing the store layout in advance will facilitate efficient data collection by minimizing time spent searching for store sections and aisles, allowing you to focus on identifying specific food items and collecting data. If the store is relatively large, you may need to do a quick walk-through of the store before you begin data collection.

Store Type

- **Supermarket (SM):** A large, corporate-owned store primarily engaged in retailing a general line of food, such as canned and frozen foods; fresh fruits and vegetables; and fresh and prepared meats, fish, and poultry. They usually have 5 or more cash registers.

- **Grocery Store (GS):** A smaller non-corporate-owned store, or a "neighborhood" or "mom and pop" store, primarily engaged in retailing a general line of food, such as canned and frozen foods; fresh fruits and vegetables; and fresh and prepared meats, fish, and poultry. They usually have fewer than 5 cash registers.
- **Convenience Store (CS):** A small store, also known as a food mart, primarily engaged in retailing a limited line of goods that generally includes milk, bread, soda, and snacks.
- **Combination Grocery/Other (CO):** A store engaged in retailing food items in combination with other goods or services. These include drugstores or pharmacies selling food items or a gasoline stations selling food items.

Nontraditional Food Retailers

- **Mass Merchandiser (MM):** A large store that primarily sells household items, electronic goods, sporting goods, and apparel, but also offers packaged food products, typically at discount prices.
- **Super Center (SC):** A large combination supermarket and discount general merchandise store averaging 170,000 square feet of floor space, with grocery products account for up to 40 percent of floor space. This type of store also includes warehouse clubs or superstores. This survey EXCLUDES warehouse clubs requiring a paid membership to shop.
- **Dollar Store (DS):** A small variety store that sells general merchandise and food products. These stores offer a wide assortment of basic household goods at very low prices.
- **Specialty Store (SP):** A meat/poultry specialty store or a fruit/vegetable specialty store.

Store Operating Hours

The store's operating hours are usually posted near the entrance. If you cannot locate this information quickly, ask store staff for assistance. For each day of the week, record the time that the store opens at the start of the day, any mid-day break when the store is closed (e.g. for lunch or restocking), and the time the store closes at the end of the day,

using the 12-hour convention for recording time. Be sure to designate whether the time is in the AM or PM. Draw a horizontal line through any empty cells. For example, if a store is open from 9 AM to 5 PM from Monday through Friday, but is closed for lunch between 12 PM and 1 PM on those days, this information should be recorded in the table as follows:

	Open	Mid-Day Break	Close
Mo	9 AM	12 PM - 1 PM	5 PM
Tu	9 AM	12 PM - 1 PM	5 PM
We	9 AM	12 PM - 1 PM	5 PM
Th	9 AM	12 PM - 1 PM	5 PM
Fr	9 AM	12 PM - 1 PM	5 PM
Sa	----------	----------	---------
Su	----------	----------	---------

If the store is open 24 hours a day every day of the week, record Monday's opening time as 12 AM, Sunday's closing time as 12 AM, and draw a horizontal line through all other cells. This information should be recorded as follows:

	Open	Mid-Day Break	Close
Mo	12 AM	----------	---------
Tu	----------	----------	---------
We	----------	----------	---------
Th	----------	----------	---------
Fr	----------	----------	---------
Sa	----------	----------	---------
Su	----------	----------	12 AM

In some cases, a store may be open for 24 hours a day, but only on some days of the week. For example, suppose a store is open 24 hours a day each day of the week, with the exception of Monday morning from 9 AM to 12:30 PM. This information should be recorded in the table as follows:

	Open	Mid-Day Break	Close
Mo	12 AM	9 AM - 12:30 PM	---------
Tu	----------	----------	---------
We	----------	----------	---------
Th	----------	----------	---------
Fr	----------	----------	---------
Sa	----------	----------	---------
Su	----------	----------	12 AM

Number of Cash Registers
Count and record the number of cash registers. This includes cash registers at self-checkout lanes. Do not count registers at a customer service counter, or at the pharmacy counter, or at a photo developing counter.

Express Checkout
Indicate whether or not the store offers express checkout lanes and cash registers. Include self-checkout lanes also designated as express checkout lanes.

Self-Checkout
Indicate whether or not the store offers self-checkout lanes and cash registers.

Store Features

- **Fresh produce:** Check this box if the store sells fresh fruits or vegetables.
- **Refrigerator/freezer cases:** Check this box if the store has refrigerator or freezer cases to store perishable food and beverage items. Do not include refrigerator cases for unpackaged meat and seafood.
- **Unpackaged meat case:** Check this box if the store sells fresh, unpackaged meat in a refrigerated case, with the assistance of store staff.
- **Unpackaged seafood case:** Check this box if the store sells fresh, unpackaged seafood in a refrigerated case, with the assistance of store staff.
- **Prepared food section:** Check this box if the store offers unpackaged, random-weight, ready-to-eat prepared food for dine-in or carry-out.

Collecting Food Availability and Pricing Information

Overview of Data Collection
You will be collecting information on the availability and price of 69 different food items. The food items included in this survey are some of the most commonly purchased and consumed foods among U.S. consumers. A food item may be sold in one or more forms, or products. A product is a unique combination of a brand, product line extension and package size or weight. A product line extension is a variation on a brand based on flavor, nutritional attributes, or other attributes such as organic production. For example, store brand apple-flavored toasted oats cereal is an example of a product line extension of store brand toasted oats cereal. Store brand cola sold in 6-packs of 8-oz cans and store brand cola sold in 1-liter bottles represent two different products belonging to the same food item, “Cola, Regular.” For meat products, products may vary based on the type of cut and or fat content. For instance, sirloin steak and porterhouse steak are distinct products belonging to the ”Beef Steak” food item. For fresh fruits and vegetables, products may vary based on the variety of fruit or vegetable. For instance, Red Delicious apples and Fuji apples are distinct products belonging to the “Apple” food item.

For each food item, you will collect information on 1) the product with the lowest unit price; 2) the product occupying the most shelf space; and 3) the product occupying the second most shelf space. By collecting up to three prices for each food item instead of

just one, this survey is designed to provide detailed information on the variability in availability and price for a given food item not just across different stores, but also within a given store.

Lowest Price Product

You will compare unit prices to identify the product with the lowest price. The unit price of a food item is the price in dollars of a unit of the food item. Depending on the food item, the relevant unit price may be expressed by count, weight, or fluid volume.

When collecting information on food items, look for products that match the food item listed on the survey instrument. Refer to this instruction manual for guidance on the range of products encompassed by a given food item. Consider each unique product when calculating unit prices. Some food items may be sold in several sections of the store, such as ready-to-eat corn flake cereal sold both in regular aisles and in the natural/organic section or candy sold both in the regular aisles and near the check-out lanes. If a food item is sold in more than one area of the store, **consider only products stocked in the main section or aisle for that food item**. The main section or aisle for a given food item is the one that has the most shelf space dedicated to that food item. In supermarkets, aisle signs may help determine where the main section for a food item is located.

If the food item is not sold by the store, check the box for "No" in the first column and the row for "Lowest $" and leave the rest of the row blank.

If a store sells only one product for a given food item and it is in stock, check the box for "Yes" in the first column and the row for "Lowest $" and then record the information for this product.

If a store sells only one product for a given food item but that product is out of stock, check the box for "Out of Stock" in the first column and the row for "Lowest $" and then record the information for this product, if possible. You can tell that the product is out of stock if there is an empty space for the product on the shelves and signs or stickers indicating that the product is usually stocked and sold. If there is price information on the product provided on the shelf or on nearby signs, record this information. If there is no price information, write "No Price Available" in the "Comments" space.

Some stores may post the unit price on the display shelf. Use these to help you quickly identify the lowest price item. Otherwise, use scratch paper and your calculator to calculate the unit price yourself. Refer to the bottom of each survey page or Appendix C for help converting between different units. Write the date and the Store ID in upper right corner of any scratch paper used.

Sale prices

The prices recorded in the survey should reflect the price of food items before taxes but after all applicable sales or discounts. This includes daily or weekly special prices and discounts available through the use of a store loyalty card. **Do not include** discounts

available only with a coupon. **Do not include** manager's specials that are only applicable to a limited number of items for a given product (usually the older perishable items approaching the expiration date). If available, record the regular price, package size and units in the comment space.

In the case of multi-unit discounts, such as buy 1, get 1 offers, use the following as a guide for recording the sale and regular prices. In this example. a 14.5 oz can of green string beans usually sells for $0.80. The store is offering a buy 1, get 1 sale. Record $0.80 for the price of the product. Indicate that the price applies to two cans by writing "2x14.5" in the column for "Units." In the comment space, record the regular price.

Food Item	Brand	Price	Units	Unit Price	Sale?	Comments
17. Canned Green String Beans						
Lowest $: ❑Yes ❑No ❑Out of Stock	❑Private Label ❑National	$ 0.80	2x14.5 oz	$ 0.44 /lb	❑No ❑Yes	$0.80 for 14.5oz
1st Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	
2nd Space: ❑See Lowest ❑Out of Stock	❑Private Label ❑National	$	oz	$ /lb	❑No ❑Yes	

Products with the Most Shelf Space

If the store offers more than one product for a given food item, you will need to identify and collect information on the two products that occupy the most shelf space. Consider each unique product or combination of brand, product line extension, and package size when measuring shelf space. Remember to focus on food items sold in **the main section or aisle for that food item**. You should consider only products that can be assessed and compared without having to move between different aisles of a store. **Do not include end cap (end-of-aisle) in your assessment. Include island displays only if they are in the main section or aisle for that food item.**

The method for determining shelf space will vary by food item, but in general you will assess **the width** of the shelf space or display case occupied by the product. In many cases, **this will simply involve a visual inspection of the shelf space**. It may be possible to determine the products with the most shelf space by "eye-balling" the shelves and identifying the two products that occupy the largest share of total shelf space. Assume that products can potentially be stacked to fill the vertical space of its assigned shelf space. For products that occupying shelves of similar heights, you only need to consider the width of the shelf space occupied by a product. You will only need to consider the height of a product's shelf space if you need to compare products occupying shelves of different heights. Consider the area (width times height) of the assigned shelf space when identifying the product with the most shelf space.

If a product is usually sold but is out of stock at the time of the data collection, include the empty shelf space usually occupied by the out of stock product in your assessment, but only if the shelf space is clearly labeled and designated for the out of stock product. If

there is empty shelf space but no signs indicating which product typically occupies the space, do not include this shelf space in your assessment.

If the product with the most shelf space is also the lowest price product, check the box for "See Lowest" and leave the rest of the row blank to indicate that the information for the product with the most shelf space is the same as that for the lowest price product. Similarly, if the product with the second most shelf space is also the lowest price product, check the box for "See Lowest" and leave the rest of the row blank.

If either the product with the most shelf space or the product with the second most shelf space is usually sold by the store but is out of stock at the time of data collection, check the box for "Out of Stock" in the first column. This may happen if a popular item is put on sale. You can tell that the product is out of stock if there is an empty space for the product on the shelves and signs or stickers indicating that the product is usually stocked and sold. If there is price information on the product provided on the shelf or on nearby signs, record this information. If there is no price information, write "No Price Available" in the "Comments" space.

Leave the row for "2nd Space" blank if information for all applicable products have already been recorded in the row for "Lowest $" and "1st Space." This may be the case if there are only one or two products sold by the store for a given food item.

Where applicable, additional instructions for specific food items are provided in the sections that follow.

Breaking Ties

If it is not immediately apparent which product occupies the most shelf space, a measuring tape may be used to measure shelf space dimensions. While it is important to have a systematic method of determining which product occupies the most shelf space in situations where it is not immediately apparent, please keep in mind that the goal is to identify the products with the most shelf space, not to collect precise measurements of shelf space.

In situations where there is a tie for the most shelf space, assign each distinct product a number, starting at 1. Start numbering tied products from the upper left hand shelf space, going left to right and then down to the next shelf. For instance, if there are 3 different products of corn flake cereal tied for the most shelf space, and two are on the middle shelf and one is on the lowest shelf, assign the leftmost tied product on the middle shelf the number 1, the rightmost tied product on the middle shelf the number 2 and the third tied product on the lowest shelf the number 3. Then use the random number generator function on your calculator. The random number generator function will provide a random number of three digits or more. Look at the third digit. If that digit is a number from 1 to 3, designate the product assigned this as the product with the most shelf space. Fill in the information for this product in the row for "1st Space." If the digit does not correspond to one of the products, generate another random number and repeat the process until the last digit of the random number corresponds to one of the products.

Repeat this process to randomly select the product with the second most shelf space. Fill in the information for this product in the row for "2nd Space." If there are 10 or more tied items, use the second and third digits of the random number when breaking ties.

Filling Out the Survey

Column 1: Check the appropriate box to indicate the product's availability.

Column 2: Check the appropriate box to indicate whether the product is a private label brand or a national brand. Private label brands are typically cheaper than national brands and include the store brand carrying the store's name and non-store discount brands. For unpackaged products with no label, like fresh produce, leave this blank.

Column 3: Record the sticker price (not the unit price) after all applicable discounts and sales, excluding coupon discounts.

Column 4: Record the product package size or weight, including the applicable units. The default units are there for your convenience. You may cross them out and replace them with alternative units if necessary.

Column 5: Calculate and record the unit price. To save on time, you may record the unit price appearing on shelf labels and just double-check these after leaving the store. The default units are there for your convenience. You may cross them out and replace them with alternative units if necessary. If the store systematically uses a different convention for unit prices, (such as price per ounce instead of price per pound or price per gallon), you may leave this field blank and calculate it afterward.

Column 6: Indicate whether or not the recorded price is a discounted price or not.

Column 7: Record the regular price of items that are on sale, if available.
For fresh produce, check the appropriate box to indicate whether the product is conventional or organic.
Where applicable, indicate the food item type.

Organic Products

Include organic products when identifying the product with the lowest price, the most shelf space, or the second most shelf space. If the product with the lowest price, most shelf space, or second most shelf space is organic, write "organic" in the comment space. For fresh produce, indicate whether the product is conventional or organic by checking the appropriate box in the comment space.

Products Sold by Count

Some products may be priced by count or piece, such a head of broccoli. If so, select a product at random and use a weighing scale to determine the weight in pounds. Divide the price by the weight to calculate the price per weight. Note in the comment space that the product is sold by count. The only exception to this are eggs, which are typically priced per count (dozen or 100 count).

If a scale is not available (such as in smaller stores), record the price per item. Then use the latest USDA National Nutrient Database for Standard Reference (Release 24) to estimate the weight of the typical item. For instance, the weight for a raw, unpeeled

medium apple is 182g or 6.4 oz. The database is available at http://ndb.nal.usda.gov/ndb/foods/list.

Cereal and Bakery Products

To determine whether or not a product is a whole grain or whole wheat product, check the ingredients panel. Whole grain or whole wheat flour should be the first ingredient listed.

Cereal and Breakfast Food Section/Aisle

1. *Corn Flakes Cereal*:

Ready-to-eat corn flake cereal products, including sugar-frosted corn flakes. Corn flakes cereal is made primarily from milled corn.

2. *Toasted Oats Cereal*:

Ready-to-eat toasted oats cereal products, including apple cinnamon, honey nut, and other flavored toasted oats cereal products. Toasted oats cereal is made primarily from whole grain oats or whole oat flour.

Grains, Pasta and Side Dishes Section/Aisle

3. *Spaghetti*

Spaghetti pasta, including thin, thick, and regular products. Include multigrain products, but exclude whole grain or whole wheat products.

4. *Spaghetti, Whole Grain or Whole Wheat*

Whole grain or whole wheat spaghetti pasta, including thin, thick, and regular products. Exclude multigrain products.

5. *White Rice*

Uncooked white rice, including short grain, long grain, and enriched products. Exclude brown rice, wild rice, rice pilaf or converted, cooked, instant, parboiled, ready-to-eat, ready-to-serve, or reconstituted products. Exclude flavored or mixed products.

6. *Brown Rice*

Uncooked brown rice, including short grain and long grain products. Exclude white rice, wild rice, rice pilaf or converted, cooked, instant, parboiled, ready-to-eat, ready-to-serve, or reconstituted products. Exclude flavored or mixed products.

7. *Instant Rice*

Instant white or brown rice, including converted, cooked, parboiled, ready-to-eat, ready-to-serve, or reconstituted products. May be short grain, long grain, or enriched. Exclude wild rice or rice pilaf. Exclude flavored or mixed products.

Bread and Bakeshop

8. *Loaf of Bread, White*

Loaf of white bread. Exclude 100% whole grain or whole wheat products, including white whole wheat products.

9. *Loaf of Bread, 100% Whole Grain or Whole Wheat*
Loaf of 100% whole grain or whole wheat bread. Exclude multigrain products.

10. *Bread Buns/Rolls*
Bread buns or rolls, including products labeled as bulky, ciabatta, deli, dinner, finger, grinder, hamburger, hoagie, hotdog, Kaiser, onion, potato, sandwich, and sub. Include multigrain products, but not 100% whole grain or whole wheat products.

11. *Bread Buns/Rolls, 100% Whole Grain or Whole Wheat*
100% whole grain or whole wheat bread buns or rolls, including products labeled as bulky, ciabatta, deli, dinner, finger, grinder, hamburger, hoagie, hotdog, Kaiser, onion, potato, sandwich, and sub. Do not include multigrain products.

Processed Fruits

12. *Apple Juice*
Shelf stable apple juice, in bottle or juice box packaging. Include apple cider, but exclude light juice, juice concentrate, and mixed-fruit products.

13. *100% Apple Juice, Unsweetened*
Shelf stable unsweetened or no sugar added 100% apple juice, in bottle or juice box packaging. Include apple cider, but exclude light juice, juice concentrate, and mixed-fruit products.

14. *Apple Sauce*
Apple sauce, sold in bottles or in cups. Include cinnamon flavored products, but exclude apple sauce in mixture with other fruits.

15. *Apple Sauce, Unsweetened*
Unsweetened or no sugar added apple sauce, sold in bottles or in cups. Include cinnamon flavored products, but exclude apple sauce in mixture with other fruits.

Processed Vegetables

16. *Canned Tomatoes, Crushed, Diced, Petite Cut, Stewed or Whole Peeled*
Canned tomatoes, crushed, diced, petite cut, stewed or whole peeled. Include both regular and low sodium products. Include products with seasoning, such as garlic or basil. Exclude sundried tomatoes, tomato paste, tomato puree, or tomato sauce.

17. *Canned Green String Beans*
Canned green string beans. Include both regular and low sodium products. Include whole, cut and French style green beans.

18. *Canned Refried Beans*
Canned refried pinto or black beans, including traditional and fat free products.

19. *Dried Beans, Pinto or Black*

Dried pinto or black beans.

Other Food at Home

20. *Olive Oil*
Olive oil, regular or extra virgin.

21. *Salad Dressing*
Salad dressing, packaged in shelf-stable bottles. Include regular, light or fat free products.

22. *Fruit Jam, Jelly or Preserve*
Fruit jam, jelly or preserve. Include products in jars or squeezable containers. Include low sugar and sugar free products.

23. *Candy, Gumdrop*
Gum drop or spice drop bagged candy. Exclude hard candy and chocolate products.

24. *Potato Chips*
Potato chips of any flavor and cooking style. Include baked and kettle cooked products. Include reduced fat products. Exclude tortilla chips and vegetable chips.

25. *Nuts, Unsalted*
Unsalted nuts of any type. Include almonds, cashews, chestnuts, filberts/hazelnuts, macademia, peanuts, pecans, pistachios, walnuts, and nut mixtures.

26. *Cola, Regular*
Cola, sold in cans or bottles. Include any flavor, but exclude diet products.

27. *Cola, Diet*
Diet cola, sold in cans or bottles. Include any flavor.

28. *Bottled Water, Unsweetened and Uncarbonated*
Unsweetened and uncarbonated bottled water. Include artesian, distilled, drinking and spring water. Exclude club soda, seltzer, soda water, and sparkling water.

Frozen Foods

29. *Fish Sticks or Fillet, Frozen*
Frozen fish sticks or fillet. Include battered, breaded, or crispy products.

30. *Vanilla Ice Cream*
Vanilla ice cream. Exclude ice cream bars and sandwiches. Exclude reduced fat and frozen yogurt products. If vanilla flavor is not available, use chocolate ice cream and indicate this in the comment space. If chocolate is not available, select a flavor at random and indicate this in the comment space.

31. *Vanilla Ice Cream, Reduced Fat or Light*

Light or reduced fat vanilla ice cream. Exclude frozen yogurt products, ice cream bars or sandwiches. If vanilla flavor is not available, use chocolate ice cream and indicate this in the comment space. If chocolate is not available, select a flavor at random and indicate this in the comment space.

32. *White Potatoes, Frozen*
Frozen white potato products, including baked, french fries, hash browns, mashed, oven fries, roasted, shoestring fries, steak fries, and tater tots. Exclude potato skins or products in combination with meat or other vegetables. Indicate the product type in the comment space.

33. *Broccoli, Frozen*
Frozen broccoli products, including cuts, florets, and spears. Exclude products mixed with other vegetables, such as cauliflower, or in a sauce, such as cheese sauce. Indicate the product type in the comment space.

34. *Carrots, Frozen*
Frozen carrot products, including baby, crinkle cuts and slices. Exclude products mixed with other vegetables, such as peas, or in a sauce. Indicate the product type in the comment space.

Refrigerated Foods

35. *Margarine or Margarine-like Spread, Tub*
Margarine or margarine-like spread, in tub packaging. Include buttery and vegetable oil spreads.

36. *100% Orange Juice*
Refrigerated 100% orange juice, in bottle or juice box packaging. Include products with high pulp, some pulp, or no pulp. Include products with calcium or vitamin D. Exclude light juice, juice concentrate, and mixed-fruit products.

37. *Soy Milk*
Refrigerated ready-to-drink soy milk. Include plain, vanilla and light products. Exclude chocolate flavored products and non-dairy creamers.

Dairy

Fresh Milk and Cream

38. *Whole Milk, Fluid*
Fresh whole milk, in carton, plastic container, or glass bottle. Include products with or without vitamin D. Exclude flavored products.

39. *Low Fat Milk, Fluid (Skim, 1%, 2%)*
Fresh low fat milk, in carton, plastic container, or glass bottle. Include skim, 1%, and 2% products with or without vitamin D. Exclude flavored products.

Other Dairy Products

Do not include cheese products available at the deli/cheese counter.

40. *Cheddar Cheese, Chunk*
Cheddar cheese in chunk or bar form. Include mild, sharp and extra sharp products. Exclude reduced fat products.

41. *Cheddar Cheese, Reduced Fat, Chunk*
Reduced fat cheddar cheese in chunk or bar form. Include mild, sharp and extra sharp products.

42. *Cheddar Cheese, Shredded*
Cheddar cheese in shredded form. Include mild, sharp and extra sharp products. Include reduced fat products. Exclude cheddar blended with other types of cheeses.

43. *Yogurt*
Yogurt of any flavor, sold in multi-pack, single serve, or family size. Exclude frozen yogurt. Exclude nondairy or soy substitutes.

44. *Yogurt, Reduced Fat*
Reduce fat yogurt of any flavor, sold in multi-pack, single serve, or family size. Include fat-free and low-fat products, such as those made from skim, 1% or 2% milk. Exclude frozen yogurt. Exclude nondairy or soy substitutes.

Meat, Poultry, Fish, and Eggs

Meat and poultry products will vary based on the type of cut and amount of fat. If product is sold as a random weight item, leave the column for "Price" and "Unit" blank and just fill in the unit price in the column for "Unit Price."

Eggs
45. *Fresh Eggs*
Fresh eggs of any size, color or grade, sold by the dozen. Include organic, cage-free, vegetarian-fed products and products with health claims, such as omega-3 or DHA. Exclude egg substitutes.
Poultry
46. *Chicken Breast, Boneless and Skinless*
Boneless and skinless chicken breast. Include chicken breast tenders. Exclude bone-in split breast or breaded cutlets. Exclude frozen products.

47. *Whole Chicken*
Whole chicken. Include oven roasters. Exclude Cornish game hens and fully-cooked rotisserie chicken. Exclude frozen products.

48. *Ground Turkey*
Ground turkey meat of any fat content, either fresh or frozen. Exclude ground turkey preformed into patties. Exclude frozen products.

Beef

49. *Ground Beef*
Ground beef, except for extra lean (90%). Exclude frozen meat.

50. *Ground Beef, Extra Lean (90% or more)*
Ground beef, at least 90% lean. Exclude frozen meat.

51. *Ground Beef, Patties*
Fresh ground beef, preformed into patties. May be regular, lean or extra lean. May be random weight or packaged. Exclude frozen meat.

52. *Beef Steak*
A cut of beef that is two inches or less in thickness, with most steaks usually being one inch or so in thickness. Includes filet mignon, New York strip, porterhouse, rib eye, top/bottom round, sirloin, skirt plate, T-bone, and top blade. Exclude products cut up for stews, grilling or broiling.

53. *Beef Roast*
A cut of beef that has a thickness of two inches or more. Includes chuck, rib eye, rib roast small end, top/bottom round, and shoulder. Exclude products cut up for stews, grilling or broiling.

Pork

54. *Pork, Chop*
A cut of pork from the loin, including blade, loin, rib, shoulder, or sirloin chops. Exclude marinated products.

55. *Pork, Ham*
Leg of pork, either ready-to-eat or not. Ham may be fresh/uncured, cured, or cured-and-smoked. Exclude canned or shredded products. Exclude deli products or those from the deli counter.

56. *Pork, Sausage*
Ground pork combined with fat, flavorings, and preservatives that has been stuffed into a casing. Include andouille, breakfast, bratwurst, brown and serve, chorizo, Italian, kielbasa products made primarily from pork. Exclude frankfurters, wieners or hot dogs. Exclude canned products.

57. *Pork, Bacon*
Meat made from fatty underside of pig, either fresh/uncured, cured, or smoked. Include Canadian bacon, pancetta. Include fully-cooked and microwave-ready products.

Other Meats

58. *Frankfurter, Wiener, or Hot Dog*

Cooked and/or smoked sausages, usually skinless and traditionally served in a bun. Include products made from beef, chicken, pork, turkey or a mixture. Include reduced fat products. Do not include canned products.

59. *Bologna*
Soft, mild sausage, usually cooked and often smoked, that are traditionally served in a sandwich. Include products made from beef or pork. Include products made from beef, chicken, pork, turkey or a mixture. Include reduced fat products. Exclude canned products. Exclude products available at the deli counter.

Fish
60. *Salmon Fillet or Steak, Fresh*
Fresh salmon fillet or steak, either farmed or wild-caught. Exclude canned, cured, marinated or smoked salmon products.

Fresh Produce

If product is sold as a random weight item, leave the column for "Price" and "Unit" blank and just fill in the unit price in the column for "Unit Price." If fruit or vegetable is sold by count, pick one at random to weigh and price. Indicate conventional or organic production in the comment space.

Fresh Fruits
61. *Apple, Fresh*
Fresh apples of any variety, sold loose or bagged.

62. *Banana, Fresh*
Fresh bananas of any variety. Exclude plantains.

Fresh Vegetables
63. *White Potato*
Fresh white potato, sold loose or bagged. Include red, Russet, yellow, Yukon gold varieties, but exclude sweet potatoes.

64. *Tomato*
Fresh tomato, sold loose or on the vine. Exclude grape or cherry tomatoes. If heirloom variety, note this in the comment space.

65. *Spinach, Bunch*
Fresh spinach, sold by bunch. Include baby and regular spinach. Exclude bagged, canned or packaged products.

66. *Carrot, Loose or Bagged*
Fresh carrots, sold loose or bagged. Exclude baby carrots. Indicate whether or not carrots include tops.

67. *Broccoli, Head or Stalks*
Fresh broccoli, sold as head or stalks. Exclude florets, crowns or other precut products.

68. *Green String Beans*
Fresh green string beans.

69. *Spinach, Pre-washed and Bagged*
Fresh spinach, pre-washed and bagged/packaged. Include baby spinach. Exclude spinach mixed with other greens, such as a salad mix.

Survey Cover Page: Complete After Price Survey

End Time
After you have finished collecting data on food availability and price, record the current time in the boxes provided. Use the 12-hour convention for recording the time, checking the corresponding box to indicate whether the time is in the AM or PM.

Private Label(s)
List the name(s) of the private labels of the store, if available.

Comments
If a break was taken during data collection, please note this here and include the start and end times of the break. Add any comments or observations related to the process of data collection or store characteristics, such as causes of delays to data collection, interaction with store staff (especially denials) or unique convenience features of the store (e.g. portable price scanners).

Observation Status
Review the Survey Cover Page and each page of the Survey to make sure that data collection is complete. Check the box for "Completed." Thank the store manager/owner before leaving the store and moving on to the next store.

Appendix A: Sample Letter for Store Owner or Manager

Joseph Llobrera
91 Bradford Rd, Apt 1
Watertown, MA 02472

[STORE NAME]
[STREET ADDRESS]
[CITY, STATE, ZIP CODE]

[DATE]

Dear [STORE NAME] Owner/Manager,

My name is Joseph Llobrera and I am a student at the Friedman School of Nutrition Science and Policy of Tufts University in Boston. For my research project, I am visiting food stores all around the Boston metro area to create a profile of the availability and price of a wide range of food items at different types of food stores. I am not visiting to conduct an inspection or evaluation of your store and I am not connected with your competitors.

The information I gather will remain completely confidential. Each store has been assigned an identification number so that neither your store name nor its address will be identified on the survey form. **Your store's name, policies and prices will NOT be published or publicized.** The information collected will not be linked to your store. I will combine the information I collect at your store with information from other stores to create a broader picture of food availability and affordability in Boston area food stores. I am interested in the overall pattern for similar stores, not in the food selection and prices at any one store in particular.

I am using a survey to collect information on the availability and price of 69 different food items. The survey should take me no more than an hour and a half to complete. I will not speak to store staff or customers and will not interfere with the normal flow of business.

Thank you for your cooperation and for allowing me to spend some time in your store to collect this information. Your participation is voluntary and you may inform me at any time if you do not wish to participate further. If you have any questions, please do not hesitate to contact me at 413-687-9290.

Sincerely,

Joseph Llobrera

Joseph.Llobrera@tufts.edu
413-687-9290

Appendix B: Sample Script Explaining Project

Use the following script as a guide on how to introduce yourself and the research project to a food store owner or manager.

Hello. My name is Joseph Llobrera. I am a graduate student studying nutrition at Tufts University. For my PhD research project, I am interested in exploring the variations in food selection and price across different types of stores and the ways in which busy and time-pressed consumers can save on time without sacrificing a well-balanced and nutritious diet, both through their choice of stores and their choice of food items.

I am visiting randomly chosen food stores, including supermarkets, grocery stores and convenience stores, in neighborhoods around the Boston metro area.

[SHOW SURVEY WHILE YOU CONTINUE]

The survey gathers information on the availability of a wide range of foods and their prices. As you can see here on the cover page, I only record a store ID number, not the name or address, so the information is **confidential**.

I plan to combine this information with the other stores across the Boston metro area to get an overall picture of the availability and price of food items at Boston food stores. The information collected will not be linked to your store. I will NOT publish or publicize the name, policies or price information of any one store. Also, I won't be interacting with customers or store staff at all.

Would it be okay if I completed this survey in your store today?

[PAUSE for REPLY]

Thank you so much! Here is a letter that summarizes what I've just told you about the project with my contact information in case you have any questions. Thank you again!

Appendix C: Measurement Conversions

Weight

1 pound	=	16 ounces

Volume

1 pint	=	16 ounces
1 quart	=	32 ounces
½ gallon	=	64 ounces
1 gallon	=	128 ounces

Metric

1 kilogram	=	35.3 ounces
1 liter	=	33.8 fluid ounces