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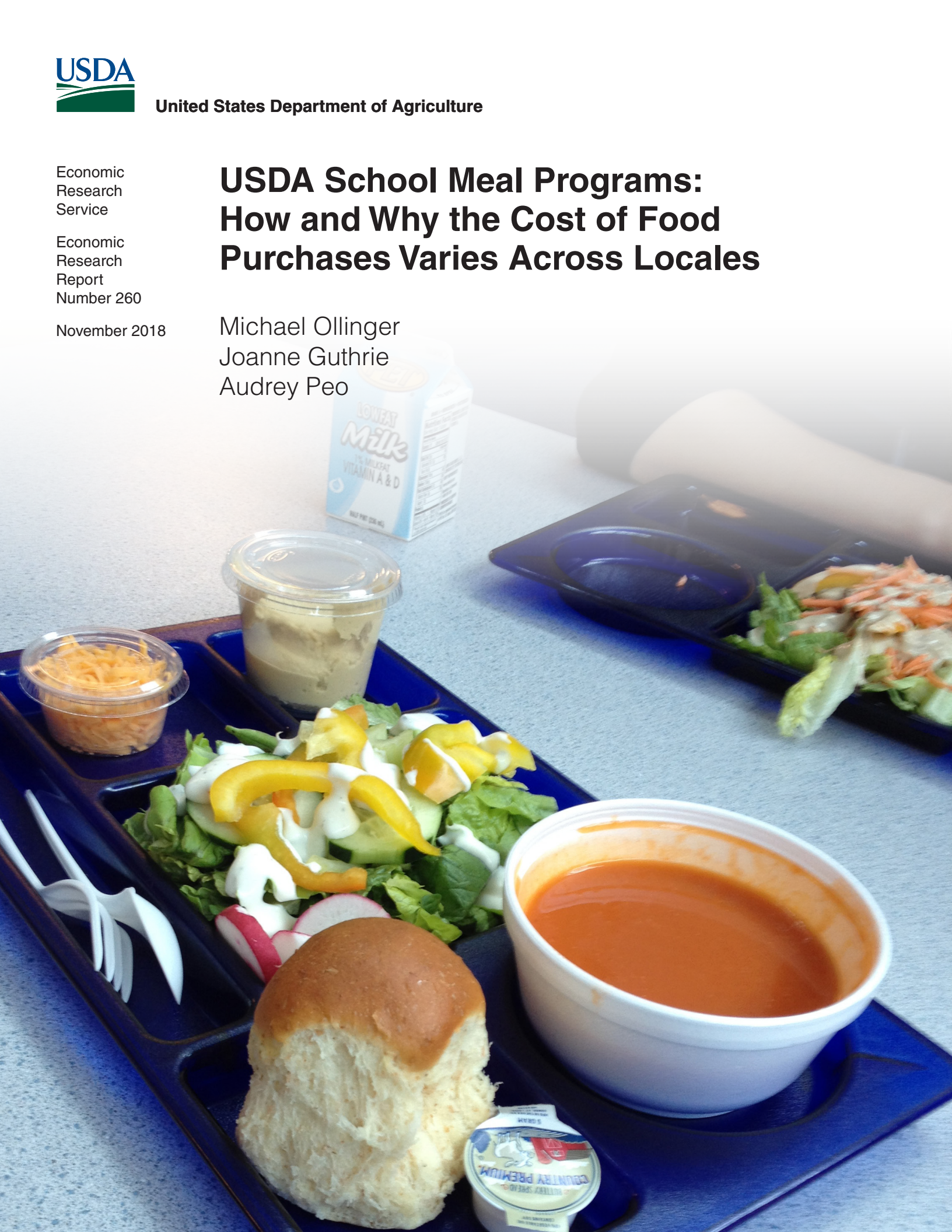

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Abstract

The United States Department of Agriculture's (USDA) National School Lunch and School Breakfast Programs are operated locally by school food authorities (SFAs), usually a part of the local school district. SFAs are reimbursed at nationally set rates for the cost of meals served to participating students. Previous USDA, Economic Research Service (ERS) analysis found substantial variation in total costs across SFAs but did not identify the sources of those cost differences. This report examines food cost differences, using a large national sample of SFAs to examine how food purchase costs vary by SFA location, characteristics, and purchasing practices. Results show that food costs dropped with the volume of products purchased. Food costs also varied considerably across location—SFAs in the Northern Plains and Mountain regions had higher average food costs, and SFAs in the Southeast regions had the lowest food costs for major food groups. SFA purchasing practices also affected costs. Purchasing cooperatives, a popular strategy among SFAs, had mixed associations with food costs, possibly because SFAs may use them not only to reduce costs, but also for aims such as obtaining wider access to desired food products.

Keywords: National School Lunch Program, School Breakfast Program, school meals, school food authorities, food costs.

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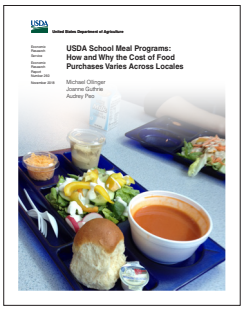


USDA School Meal Programs: How and Why the Cost of Food Purchases Varies Across Locales

Michael Ollinger, Joanne Guthrie, and Audrey Peo

What Is the Issue?

Food costs make up almost half of overall meal costs in the National School Lunch Program (NSLP) and School Breakfast Programs (SBP). These programs serve millions of children healthy meals every school day, with most meals provided to low-income children free or at a reduced price. A better understanding of factors that affect food costs and how they vary at the local level could inform strategies to improve the economic efficiency of these programs. Local school food authorities (SFAs), usually a unit of the school district, are responsible for food purchasing, preparation, and service and are reimbursed by the USDA at rates set for the 48 contiguous States and the District of Columbia. However, local costs may vary, making it more difficult for SFAs with higher costs to serve appealing meals that meet USDA nutrition standards within their budget constraints. This study examines how food costs (defined as cost per ounce for foods in eight major categories) vary by volume of purchases and SFA characteristics such as location and purchasing practices. We consider how SFA purchasing practices and other decisions can mitigate effects of factors outside SFA control, such as cost differences associated with the volume of purchases and location.

What Did the Study Find?

Analyses of a nationally representative sample of public SFAs participating in the NSLP in 2009-10 provided the following insights of SFA-level variation in costs of foods purchased for the program:

- Per unit cost of a food product dropped with volume purchased. The cost of a low-volume purchase of fruits and vegetables (one-fourth the sample mean) was about 17 percent higher than the cost of a high-volume purchase (four times the sample mean). The smallest change (about 8 percent) was for milk and dairy.
- Food costs varied by region. SFAs in the Northern Plains and Mountain regions had higher average food costs for most major food categories (fruits and vegetables, staples, milk and dairy, meat and poultry, and fully processed foods). SFAs in the Southeast region had lower costs in all categories.

- Some purchasing practices, such as fixed-price contracts, were consistently associated with lower food costs. Use of cooperative buying had mixed results, sometimes associated with lower costs but not always. Cooperative buying may serve other purposes, such as accessing foods that would otherwise be unavailable to the SFA.

An important caveat is that this study is limited to an investigation of food costs only and does not consider other expenses of meal production, most notably labor costs, which on a national basis are roughly equal to food costs. However, like food costs, labor costs may vary across locations; for some SFAs, comparatively high food costs may be offset by lower labor costs, enabling those SFAs to produce meals that are still within the constraints of Federal lunch and breakfast reimbursement rates. Future research with datasets that include labor and other nonfood costs of meal production is needed to better understand cost differences across SFAs.

How Was the Study Conducted?

Data were obtained from the USDA School Food Purchases Study III, conducted in school year (SY) 2009-10. The study is the most recent available source of national estimates of the quantity, value, and unit prices of food acquisitions by public unified school districts participating in the NSLP and SBP, obtained from a nationally representative sample of 420 SFAs spread across 48 contiguous States and the District of Columbia. Information also was collected on SFA characteristics, procurement practices, and food service operations. Foods are sorted into eight groups representing major SFA purchasing categories (fruits and vegetables; staples such as cereal, bread products, flour, and rice; milk and dairy; meat and poultry; desserts; snacks; prepared foods; and nondairy drinks). For each group, food cost per ounce was estimated as a function of the quantity purchased, SFA location and other SFA characteristics and SFA purchasing practices, and product characteristics. We account for survey design by using survey strata and survey weights and report nationally representative results.

USDA School Meal Programs: How and Why the Cost of Food Purchases Varies Across Locales

Introduction

In 2016, the average daily participation in the National School Lunch Program (NSLP) and School Breakfast Program (SBP) was 30.4 million students for lunches and 14.6 million for breakfasts (USDA FNS, 2017). School food authorities (SFAs), usually a unit within the school district, operate programs in their district and are reimbursed by USDA for meals they serve to participating students. Low-income children receive the meals for free or at a reduced price, and USDA provides higher reimbursements for those meals. Otherwise, reimbursements are set at a uniform national rate for the 48 contiguous States and the District of Columbia.[1] However, Ollinger, Ralston, and Guthrie (2011) indicated that there are substantial differences in the cost of producing NSLP meals across SFAs and that variations in food costs were a major contributor to those cost differences.

Food and labor are the two major costs of school meals, each accounting for approximately 44 percent of total costs (Ollinger and Guthrie, 2015). The extent to which food costs vary across SFAs is of interest because it may impact the ability of some SFAs to serve appealing meals that meet USDA nutrition standards. Changes in school meal nutrition standards, established under the Healthy, Hunger-Free Kids Act of 2010 (HHFKA) and implemented in schools beginning in 2012, heightened concerns about the ability of some SFAs to afford the increased servings of fruit, whole grains, and healthier mix of vegetables required. An expert committee convened by the Institute of Medicine, National Academy of Sciences (IOM, 2009), concluded that, on average, changes in nutrition standards for meals by the HHFKA could increase lunch food costs between 4 and 9 percent, while breakfast costs could increase between 20 and 25 percent. To address this increase, the HHFKA provided an additional 6 cents per lunch reimbursement to SFAs certified to be in compliance with the new meal patterns. Yet, as reported by the School Nutrition Association (SNA), school nutrition program operators continued to express concern about the cost of meeting updated standards (SNA, 2015). Some SFAs may struggle more than others, but the extent to which cost differences across SFAs play a role is not well established. A report from the U.S. Government Accountability Office (USGAO, 2014) concluded that more information on school meal cost differences and the factors that drive them was needed.

The purpose of this report is to address some of the information needs outlined by the USGAO (2014) by examining food cost differences across a variety of foods and a range of SFAs. We use food input price data from the USDA's School Food Purchase Study III (SFPS-III), which is the most recent available data and the third of a series of nationally representative studies supported by USDA's Food and Nutrition Service. The SFPS-III provided national estimates of the quantity, value,

[1]SFAs receive an extra 2 cents per lunch served if at least 60 percent of lunches were served at the free or reduced-price rates in the second preceding school year. SFAs also received an additional 28 cents for free and reduced-price breakfasts in the 2009/10 school year for each school in which at least 40 percent of lunches were served free or at reduced price in the second preceding school year.

and unit prices of food acquisitions by public school districts participating in the NSLP and SBP during the 2009-10 school year (Young et al., 2012). It also found that formal bidding practices and cooperative buying practices were associated with lower costs per unit for about one-half the items they examined, and that the use of food service management companies was associated with higher food costs per unit.[2]

Young et al. (2012) provide important information, but all results are based on simple statistics with no controls for other factors that might affect costs, such as SFA size or location. This report extends that research by conducting detailed econometric analyses of factors associated with food cost variation, including economies of scale in food purchase voloume; SFA size, region, and urbanicity; and SFA purchasing practices and other characteristics. We consider cost per unit for 8 food groups in 10 regions across the contiguous 48 States and 4 urbanicities. The food groups are: fruits and vegetables; staples, such as cereal, flour, and rice; milk and dairy; meat and poultry; desserts; snacks; prepared foods; and nondairy drinks. The regions are the 10 farm production regions defined by USDA and to which the SFPS-III assigned the SFAs in its survey; urbanicities, include urban, suburban, and town areas, and rural areas. The data are 8 years old and therefore represent food purchases before implementation of the new school meal nutrition standards, but they still allow us to gain a better understanding of the variation in food purchasing prices across the multiple dimensions we explore.

Food costs account for about 44 percent of the cost of a school meal served in the NSLP (Ollinger and Guthrie, 2015). In 2004, average meal cost differences amounted to $0.38 per meal across 21 locations spanning the United States (Ollinger et al., 2011)[3]. Thus, although food prices are a large share of the costs of school meals, other costs are also important. Labor costs, which are roughly equal to food costs at the national level, may vary locally. SFAs with low labor costs may be choosing to make meals from basic ingredients, for example, having kitchen employees make pizzas from scratch on site, while SFAs with high labor costs may be choosing to purchase more expensive ready-to-cook items like frozen pizzas. Yet, the cost of prepare-from-basic-ingredients and ready-to-cook approaches may be similar because of labor cost differences.

[2]Formal bids in which schools solicit competitive bids are generally for larger purchases and extend over a period of time and include fixed-price and fixed-price plus escalator contracts. Informal methods include over-the-phone quotes or quotes received directly from a salesperson.

[3]The 21 locations include three urbanicities for each of seven FNS regions. The urbanicities are rural, suburban, and urban areas.

Background

Nationwide, SFAs face a common challenge: they must serve participating schoolchildren meals that are healthful— that is, that meet USDA nutrition standards—and that are sufficiently appealing to encourage participation and consumption, within a budget constraint largely determined by USDA meal reimbursements (Newman et al., 2008; Ralston, et al., 2008). Children from households with incomes at or below 130 percent of the Federal poverty threshold are eligible to receive meals for free; those with household incomes between 130 and 185 percent of the threshold are eligible to receive meals for a reduced price of no more than $0.40 for lunch and $0.30 for breakfast; and other students pay a price set by the local SFA. USDA reimburses free, reduced-price, and paid meals on a sliding scale that is adjusted annually for inflation. Since 2012, SFAs that meet the updated nutrition standards have also received an additional 6 cents per lunch (FNS, 2017). With some adjustment for high-poverty schools, SFAs in the 48 contiguous States receive the same reimbursement rates (Alaska, Hawaii, and Puerto Rico receive separate rates).

USDA reimbursements are the single largest revenue stream that SFAs use to cover food, labor, and other costs of producing USDA school meals (Bartlett et al., 2008). Besides the per meal cash reimbursements, USDA also provides SFAs with USDA Foods entitlement funds that can be used to purchase products from the USDA, Agricultural Marketing Service (known as USDA Foods, they are also often referred to as "USDA commodities" or "commodity foods").[4] Products are also obtained by the Commodity Credit Corporation under USDA's price support. The amount of USDA Foods entitlement available to an SFA is calculated using a formula that multiplies the number of NSLP lunches served in the prior year by a per meal rate established in the Federal Register and updated for inflation. In the 2017-18 school year, the per-meal rate was 23.25 cents per lunch served (USDA-FNS, 2017). However, due to a regulation that requires 12 percent of total funding for school meals to come in the form of USDA Foods, States received about 33.5 cents of entitlement funding per lunch served in school year 2017-18.

States have three different options for spending USDA Foods entitlement funds: USDA Foods direct delivery items, USDA Foods bulk items diverted for processing, and USDA-Department of Defense (USDA DoD) Fresh produce. With input from SFAs, States select direct delivery USDA Foods from the USDA Foods Available List, published annually by USDA. Foods include a wide variety of domestically grown and processed items from the major food groups. In recent years, USDA has worked to make more nutritious items, such as whole grains, lower fat cheeses, and lower sodium canned vegetables, available through USDA Foods. Through the USDA Foods processing program, SFAs have the option to divert bulk USDA Foods ingredients to processors to be made into items that suit their menus—for example, bulk chicken may be used to make chicken burritos. SFAs also have the option to order fresh produce using the USDA Foods DoD Fresh Program.

Decisions about the use of USDA Foods may influence overall SFA food costs. USDA Foods account for about 15-20 percent of foods on a meal tray in a given year, according to FNS (Food and Nutrition Service, 2016). The remaining food is bought through commercial market channels, where SFA characteristics such as location and size—both the region of the country and urbanicity, as defined by being located in a rural, suburban, or urban area—may influence food costs.

[4]USDA Foods include domestically grown and processed protein, dairy, grains, fruits and vegetables, and other food items purchased by USDA for use in schools.

Other sources of revenue include meal payments made by students not receiving free meals. Some SFAs also receive funding from State or local school meal programs and most SFAs obtain revenues from the sale to students of non-USDA snacks and other foods (often referred to as á la carte or competitive foods); many also provide other services with feeding programs that may or may not be funded by USDA, such as catering meals for co-located Head Start classrooms or other groups. The funds provided by these non-School Meal Program sources vary considerably across SFAs and are smaller than School Meal Program reimbursements (Bartlett et al., 2008).

Economic Framework

As described above, SFAs generate revenues primarily from Federal reimbursements received for the meals served to students through the NSLP and SBP augmented by other revenue streams. Meals are costly (Bartlett et al., 2008) to prepare and must be within SFA food and school labor budgets, giving budget-constrained SFAs an incentive to minimize costs. At the same time, meals must meet USDA nutrition standards and be appealing to students, encouraging participation and consumption (Newman et al., 2008).

Meal Costs

There have been several studies of the cost of producing a NSLP meal. The most recent, by Bartlett et al. (2008), estimated the full SFA cost, defined as including both reported and unreported costs, of producing a school meal using data collected in school year 2005-06. Reported costs are those costs charged to the SFA budget and from the SFA's perspective represent the costs that they are expected to cover in running the NSLP and SBP. The full SFA cost of producing a school meal also includes any unreported costs defined as costs incurred by the school district in support of the food-service operation but not charged to the SFA budget. Unreported costs vary across SFAs but may include such items as administrative or support functions performed by school district personnel, (such as accounting, data processing, payroll, purchasing, storage, and transportation) and use of school facilities, equipment, and services (such as energy, communications, and transportation) provided or purchased by the school district.

Bartlett et al. estimated the mean reported and full cost of producing a reimbursable school meal. For the average SFA, the national reported cost of producing a reimbursable lunch in SY 2005-06 was less than the Federal subsidy for a free lunch. The mean reported cost of a SBP breakfast for the average SFA was greater than the Federal subsidy for a regular or severe need breakfast. Full costs for both meals were greater than the Federal subsidy for a free meal. Both reported and unreported costs were collected through survey data.

Ollinger and Guthrie (2015) considered the direct cost of producing a school meal from cafeteria labor, food, and food preparation and service materials. That report showed that food and labor costs each accounted for about 44 percent of the total cost and varied across regions and urbanicities.

Neither Bartlett et al. (2008) nor any other study has considered the full economic cost of producing a school meal. The economic cost includes not only the cost of producing a school meal but also the opportunity costs and benefits of devoting resources to producing the meals rather than using resources for other educational needs.

Food Costs

A core belief in economics is that individuals and organizations have an incentive to pay the lowest possible price for goods and incur the lowest labor cost for services. In that sense, economic theory suggests that a cost-minimizing SFA would choose a mix of food and labor inputs that meet nutrition guidelines at the lowest costs. For example, if labor costs are relatively low, then a SFA may buy more unprocessed foods and prepare foods at a school or central facility.

Economists and school food experts have identified a number of strategies that food buyers have employed to lower their food costs. These include volume discounts and certain purchasing practices. There are also other factors, such as location, that can affect food supply prices. For example, SFAs located in vegetable-growing areas may have access to low-cost fresh vegetables, while SFAs in remote, rural areas may have high food-shipping costs.

High-volume buyers can use bargaining power to get volume discounts (Chipty and Snyder, 1999; Inderst and Wey, 2006).[5] Suppliers may grant volume discounts because (1) their shipping, handling, and transaction costs may be lower since they can combine many orders into one and (2) large orders may require longer production runs, enabling them to lower costs of production. MacDonald et al. (2000) and Ollinger et al. (2000) demonstrated that economies of scale in meat and poultry production yield lower costs. Empirically, Griffith et al. (2009) examined a series of models that provided estimates of savings to consumers on food purchases at typical food stores after controlling for time, location, and bar-code-specific information. They found that consumers saved money by buying in bulk, purchasing store brands, and selecting discounted products, and by choosing lower cost outlets. Finally, Ralston et al. (2008) reported that some large-volume school food buyers reduce their food costs by negotiating price discounts.

There are limits to how large a volume an SFA may purchase. Food costs include refrigeration and storage and spoilage costs. At some point, storage and refrigeration costs exceed the cost savings due to purchasing in bulk, making smaller, multiple purchases a lower cost option. Alternatively, storage and refrigeration may not be available, making frequent purchases a necessity.

Shrewd buyers may employ purchasing practices that result in lower prices for food. Matthewson and Winter (1996) report that buyer groups (e.g., purchasing cooperatives) form to enhance buyer power. Pannell-Martin and Boettger (2014) identify several purchasing strategies that affect prices. They remind us that suppliers have no incentive to control costs under a cost-plus fixed-fee pricing scheme and may demand a higher upfront price if they bear the risk of rising costs under fixed-price contracts. They also point out that centralized purchasing, such as by cooperatives, can lead to lower food purchase costs because there is greater buying power.

Pannell-Martin and Boettger also assert that purchasing managers may pay a higher price for branded foods, such as national brands of pizza that may be popular with students and encourage participation. Other important product characteristics, for example, are whether the product is canned (versus fresh or frozen) or sold as single-serve units. In addition, SFAs lacking essential management skills may choose to use food service management companies that handle many operational tasks, including food purchasing.

Other empirical research shows that NSLP meal costs vary across regions and urbanicities (Ollinger and Guthrie, 2015). The precise mechanisms driving those cost differences were not explored, but small and remote SFAs in sparsely populated regions could face high transportation costs, resulting in higher purchasing costs. More densely populated areas, on the other hand, may benefit from lower transportation costs.

[5]Bargaining power may be implicit or explicit. Implicit bargaining occurs if a vendor sells greater volumes for lower per unit costs without any direct negotiation. For example, listed prices may be lower per unit for higher volume purchases. Explicit bargaining power exists when a buyer (an SFA) negotiates directly with a supplier and wins a lower price due to its size. Better terms offered by suppliers may include lower prices per unit (i.e., volume discounts, or other cost lowering measures, such as better service, etc.).

In summary, we expect food costs to depend on the volume of product purchased, purchasing practices, product characteristics, and SFA characteristics including size and location. We create an econometric model that allows us to test the degree to which these factors affect food costs, but first we describe the detailed data needed to examine questions of food costs.

Data

The data come from the USDA's School Food Purchase Study (SFPS-III) SY 2009-10. The SFPS-III data were collected over the 2009-10 school year via a nationally representative survey of 420 public SFAs spread across 48 contiguous States and the District of Columbia and stratified across 10 farm production regions, as defined by USDA. Agralytica, a research firm contracted by USDA, conducted the study and used a survey instrument in which each SFA was expected to provide descriptive information on its school district, food service operations, and procurement procedures.

There were 390 SFAs who provided some information on their characteristics, as well as purchased food product information; of these, 366 supplied complete data (87 percent response rate). The SFPS-III includes questions on food acquisitions, SFA characteristics, procurement practices, and food service operations. The food acquisition data include detailed information about food purchased through market channels and obtained via the USDA Foods program during a 3-month period.[6] Information about purchased food includes product type, e.g., canned beans, product code, unit size, number of cases, unit price, total cost, other charges, and rebates/discounts or credits. Information was provided through vendor summaries, copies of invoices, tally sheets, and/or bid specifications.

The SFA characteristics data include information on student enrollment, SFA geographic locations, number of school meals, and other factors. It also includes the price of full-price meals,[7] the number and types (breakfasts and lunches) of meals served, whether the SFA offers a la carte foods, and other aspects of foodservice operations. The procurement practices data include the use of cooperative buying arrangements, contract types (e.g., fixed-cost or reimbursable (cost-plus)), the use of promotions, and other purchasing strategies.

The original dataset furnished to USDA by its survey contractor (Young et al., 2012) contained 129,297 observations of 995 food products, such as turkey hotdogs, identified by food code. These observations included some products with multiple entries by the same SFA over the study period; we combined those observations into a revised dataset with 80,569 observations. In addition, we deleted observations of condiments like mustard and catsup because we are interested in common foods used as a major component of the meal. We also dropped data for products with fewer than four observations because these products were purchased by less than 1 percent of SFAs and had insufficient data for analyses. Our final dataset had 71,477 observations and 817 food products.

The food products included in the final dataset were categorized into 8 food groups with similar characteristics. The SFPS-III survey and the Quarterly Food at Home Price Database 2 (QFAHPD2) of ERS guided categorization. The eight categories include fruits/vegetables, staples, milk and dairy, meat and poultry, desserts, snacks, fully processed foods, and nondairy drinks. Staples included

[6]The 3-month period was to reduce the reporting burden on the SFAs. To ensure that the data collected reflected annual purchases, sample districts were assigned evenly to all four quarters of the school year.

[7]SFAs set their own price for full-price meals charged to students not receiving free or reduced-price meals. USDA reimbursement rates for free and reduced-price meals in the year of data collection are shown in the box.

products often used as ingredients, such as flour. Milk products are nondessert foods such as milk and cheese, but not ice cream. Desserts included baked goods, cookies, and frozen novelties (ice cream, etc.). Snacks included potato and tortilla chips and crackers.

Food products are identified by the five-digit food code given in the appendix of the SFPS-III. Each observation includes a price per unit, units per container, volume of purchases, total costs, and other information on product characteristics such as fresh versus canned or frozen. Food is differentiated by type of main ingredient or product type, but not by container size. For example, chicken nuggets and fish nuggets are two separate products, but cereal in 12- ounce boxes and the same type of cereal in 18-ounce boxes is the same product. The quantity of food is given in ounces because this is the largest common unit of weight.

Table 1 shows the number of SFAs available for analysis: 10 regions and 4 urbanicities in each food group. Table 2 reports the total numbers of products and SFAs included in each food group. It also indicates the mean number of products per SFA and the number of SFAs per food product. It shows that each SFA purchased about 54 types of fruits and vegetables and 44 types of staples, but only 10 types of desserts and 12 types of snacks.[8] Table 2 also shows that there was an average of 50-126 SFAs purchasing any given food product. Note that these data do not include condiments and other excluded products.

Table 3 illustrates how food costs vary with the volume of purchases for various food groups using a cost index in which cost estimates are given as percentages of mean costs. Data in the table show that the cost of fruits and vegetables for SFAs in the 90th percentile for volume purchased were about 19 percent lower than the cost of those SFAs in the 10th percentile. SFAs in the 90th percentile in all food groups had lower costs than SFAs in smaller percentiles. The smallest change in costs was for milk and dairy—SFAs in the 90th percentile paid about 9 percent less than SFAs in the 10th percentile. These differences suggest volume of purchases affects food costs, but location and many other factors may also affect food costs. In our empirical strategy, we describe these factors and our approach to examination of their effects on food costs per ounce.

[8]All products are identified in the School Food Purchase Study-III: Statistical Appendixes. Products and the food codes by which they are listed are quite specific. For example, peaches in heavy syrup, dried peaches, and peaches in light syrup are three different products.

Table 1
Number of SFAs by urbanicity and 10 regions

	Region										
Urbanicity	Appa-lachia	Delta	Great Lakes	Mid-west	Moun-tain	North-east	Northern Plains	Pacific	South-east	Southern Plains	Total
	Number of SFAs										
City	9	6	6	10	10	11	3	10	9	16	90
Rural	22	4	5	11	9	13	1	9	22	16	112
Suburb	7	0	5	17	2	28	2	15	14	7	97
Town	4	5	6	8	6	9	4	10	4	11	67
Total	42	15	22	46	27	61	10	44	49	50	366

SFA = School Food Authority.
Source: USDA, Economic Research Service calculations using data from the School Food Purchases Study III.

Table 2
Mean number of products per SFA and mean number of SFAs for each product by food group

Food group	Number of SFAs	Number of products purchased by all SFAs	Mean number of products purchased per SFA	Mean number of SFAs purchasing any single product
Fruit and vegetables	366	214	54.3	92.8
Staples	366	148	43.6	107.8
Milk and dairy	366	58	14.6	92.3
Meat and poultry	366	82	23.6	105.1
Desserts	366	51	9.5	68.3
Snacks	366	35	12.1	126.1
Fully processed foods	366	148	21.7	53.6
Nondairy drinks	366	81	16.0	72.3

SFA = School Food Authority.
Source: USDA, Economic Research Service calculations using data from the School Food Purchases Study III.

Table 3
Cost index values and volume of purchases

Food groups	Variable	Units	Percentile					
			10	30	50	Mean	70	90
			Index value per ounce					
Fruits/ vegetables	Delivered cost index	Index/ounce	1.11	1.03	0.98	1.00	0.97	0.92
	Total ounces	Thousands	1.10	3.82	9.60	38.40	25.00	162.4
Staples	Delivered cost index	Index/ounce	1.14	1.01	0.98	1.00	0.95	0.91
	Total ounces	Thousands	1.31	4.51	10.79	41.99	27.80	175.2
Milk/ dairy	Delivered cost index	Index/ounce	1.06	1.01	0.99	1.00	0.97	0.97
	Total ounces	Thousands	5.58	33.61	93.37	366.9	240.6	1550.
Meat/poultry	Delivered cost index	Index/ounce	1.10	1.02	1.00	1.00	0.96	0.92
	Total ounces	Thousands	1.19	4.79	12.42	53.1	33.3	226.7
Desserts	Delivered cost index	Index/ounce	1.12	1.03	1.01	1.00	0.94	0.88
	Total ounces	Thousands	0.49	2.03	4.90	22.3	13.18	96.2
Snacks	Delivered cost index	Index/ounce	1.10	1.02	0.98	1.00	0.98	0.92
	Total ounces	Thousands	0.39	1.53	3.99	17.34	10.82	73.8
Fully processed foods	Delivered cost index	Index/ounce	1.13	1.01	0.99	1.00	0.96	0.93
	Total ounces	Thousands	1.08	4.28	11.3	51.88	31.5	227.3
Nondairy drinks	Delivered cost index	Index/ounce	1.16	1.03	0.97	1.00	0.95	0.90
	Total ounces	Thousands	1.96	8.22	22.7	109.8	64.0	480.9

Source: USDA, Economic Research Service calculations using data from the School Food Purchases Study III.

Empirical Strategy

The central theme of this paper is an examination of food cost differences across SFAs. The unit of analysis is a food product identified by a unique food code and purchased by an SFA. To make statistically valid inferences, we must have comparable products with a sufficient number of observations. The key variable is food price paid, that is, food cost per unit. Fortunately, our data are quite detailed—the food code allows us, for example, to distinguish cheese pizzas from pepperoni pizzas and fresh apples from apple sauce. Nevertheless, there are limits to the product information available. Food codes, for example, do not account for differences in the types of fresh apples (e.g., Red Delicious versus Gala) or the degree of freshness.

Ideally, we would be able to examine single, homogeneous products with no differences in quality. However, we do not have sufficient observations; thus, we sort food products into similar groups and examine each group separately. The food groups include fruits and vegetables, staples, milk and dairy, meat and poultry, desserts, snacks, fully processed foods, and nondairy drinks. An advantage of examining separate food groups rather than all data together is that key parameters can vary across foods.

Our analysis follows Griffith et al. (2009), who examined food price discounts due to factors such as store promotions and bulk purchasing while controlling for location and other variables. We use SFA food code product cost per ounce instead of prices, and we control for SFA and product characteristics as we examine cost differences due to volume of purchases, buying practices, and location. We are not able to ascribe causality to righthand side (independent) variables, such as the volume of purchases because some variables are endogenous. For example, SFAs may increase food purchases to gain volume discounts and lower their purchasing costs. Nevertheless, we are able to examine correlations between food cost per unit and independent variables and use control variables to account for other factors that may affect costs.

Our variable of interest (average product cost per ounce, $PC_{i,f}$) is defined as the mean product cost for all purchases of product "f" by SFA "i" over the entire period. SFAs may make several purchases of the same product in different types of packaging, ranging from bulk to small multi-serving containers; thus, equation 1 is defined as the sum of all purchasing costs divided by the volume of all purchases.[9]

1) $$PC_{i,f} = \frac{\sum_{t=1}^{n} cost_{i,f,t} * PB_{f,t} * BX_{f,t}}{\sum_{t=1}^{n} oz_{f,t} * PB_{f,t} * BX_{f,t}},$$

where $cost_{i,f,t}$ is cost to SFA "i" of product "f" in package type "t"; $PB_{f,t}$ is the number of packages per box of food "f" of package type "t"; $BX_{f,t}$ is the number of boxes of product "f" that are packed in packaged type "t"; and $oz_{f,t}$ is ounces per package of package type "t" of food "f". We use cost per ounce averaged over all purchases rather than prices for each purchase because we want each SFA to account for no more than one observation per product to avoid giving greater weight to SFAs with many purchases. It also may be that volume discounts are given only after a minimum purchase

[9]Products in single-serve packages that are identical to multi-serve packages are treated as separate products because single-serve packaging reduced labor costs. Multi-serve packaging requires labor to prepare a single-serve selection for a meal.

is made, making it possible to have different prices for the same product and volumes for the same SFA. Note also that volume discounts may be reflected in the list price or the volumes. For example the price of one 14-ounce box of toasted oats may be different than the price of each 14-ounce box of toasted oats if purchased by the case. Cost per ounce also captures cost differences between different size packages, for example, 14- and 10-ounce boxes of toasted oats.

We want to be able to easily and clearly express product cost differences across SFAs. This means, to the extent possible, we need to control for differences in product quality. Here we define product quality as encompassing any of the many product attributes that might influence how purchasers value them, for example, nutrition or the convenience of a frozen versus fresh product. The price paid reflects the value of that quality and the subsequent price offered.

We account for quality in two ways. First, we use food product dummy variables. This is effective because food product codes contain specific, detailed information about products that contribute to quality distinctions—for example, bran flakes have different quality attributes than frosted oats. Dummy variables isolate these features.

Second, we express costs of foods as an index. Higher quality foods have been shown to have higher prices. However, we are interested in relative costs across SFAs and not absolute costs. Thus, we define all prices relative to a mean price for any food product. This technique means that product price is in the form of a cost index in which cost estimates are given as percentages of mean costs. By expressing costs this way, we can, for example, determine a vegetable's cost in the Great Lakes as a percentage of sample mean costs and compare it to a vegetable's cost in the southern plains. The food cost index ($FCI_{i,f}$) for SFA "i" and food "f" is:

2) $$FCI_{i,f} = \frac{PC_{i,f}}{MPC_f}$$

where $PC_{i,f}$ is the mean product cost per ounce for all purchases of product "f" by SFA "i" over the entire period and MPC_f is the mean cost per ounce of product "f" for all SFAs.

Another advantage of a cost index is that it enables us to make comparisons across products with very different product qualities. For example, the difference in costs for products priced at $11.00 and $10.00 is $1.00 and the difference in prices for SFAs that pay $1.10 and $1.00 for different products is $0.10. These are substantial price differences, but their relative costs are identical because ratios eliminate quality differences.

Factors other than quality also affect food cost per unit. We use equation (3) to examine the extent to which the food cost index $FCI_{i,f}$ is affected by product quality (Q), volume purchased (V), purchasing practices (**P**), product characteristics (**K**), SFA characteristics (C), location (**L**) and seasonality (**S**). We expect costs per ounce to drop as the volume purchased rises, i.e. $dFCI/dV < 0$. We discuss the variables in detail below

3) $$FCI_{i,f} = \alpha_0 + \beta Q_{f,i} + \gamma V_{f,i} + \sum_j \rho_j P_{j,f,i} + \sum_k \lambda_k K_{k,f,i} + \sum_l \omega_l C_{l,i} + \sum_m \tau_m L_{m,i} + \sum_q \theta_q S_{q,i} + \xi_{f,i},$$

Equation 3 expresses an econometric relationship between one food product "f" purchased by one SFA "i". In this paper, we are examining differences across all SFAs and all foods in a food. The numbers of usable observations are given in table 6, second last row and range from 3,483 for

desserts to 19,859 for fruits and vegetables; the number of associated food products varies from 35 snacks to 214 fruit and vegetables (third last row of table 6). There are 366 SFAs.

Equation 4 is an econometric model accounting for all SFAs and the foods they purchased in a food group. We replaced the variable product quality in equation 3 with a dummy variable "D" equal to one for a food "f" and zero otherwise; this variable captures all unique features of each product, enabling us to distinguish, for example, canned peaches in heavy syrup from canned peaches in light syrup.

4) $$\sum_f \sum_i FCI_{f,i} = \alpha_0 + \beta \sum_f D_f + \gamma \sum_f \sum_i V_{f,i} + \sum_j \rho_j \sum_f \sum_i P_{f,i} + \sum_k \lambda_k \sum_f \sum_i K_{f,i} + \sum_l \omega_l \sum_i C_i + \sum_m \tau_m \sum_i L_i + \sum_q \theta_q \sum_i S_i + \xi_{f,i}.$$

Discussion of Variables

The definitions for all variables and their sample means are given in table 4; table 5 gives the mean values of variables that differ across food groups. The food cost index and volume of product has been discussed above. Other variables are discussed in more detail below.

Purchasing Practices

Purchasing practices include vendor selection criteria—availability of promotions and discounts, vendor services, vendor location, and if the vendor distributes USDA Foods. These questions deal with general SFA purchasing practices and do not vary for different categories of foods. Other purchasing practices, by contrast, varied by food group categories. These other practices included whether the SFA (1) purchases through a cooperative, (2) decentralizes purchasing, (3) makes lump sum purchases, and (4) uses fixed price contracts. Share of food purchased locally was assessed for fruits and vegetables.

Table 5 shows how four purchasing practices varied across food groups. It shows that only about one-fourth of SFAs use cooperatives and that more than one-half of SFAs make lump sum payments and use fixed-price contracts.

Product Characteristics

As described previously, in addition to cash meal reimbursements, USDA provides SFAs with entitlement funding for the purchase of USDA Foods.[10] Food is distributed through State distribution channels. USDA Foods used directly by SFAs are similar to products purchased by SFAs in the commercial market and include a variety of products, such as fresh pears and oranges, canned green beans, french fries, ground beef, and cheese. Entitlement funding can also be used to purchase fresh fruits and vegetables through the USDA and Department of Defense (DoD) Fresh Fruit and Vegetable Program (DoD Fresh). SFPS-III indicates that SFAs purchased 61 different fruits and vegetables under this program in the 2009-10 school year.[11]

Prices for DoD Fresh are set by contracted fruit and vegetable distributors and approved by DoD. USDA Foods are competitively procured, ensuring that USDA pays a fair market price for the products and that SFAs receive the most value from their USDA Foods entitlement. As pointed out by a reviewer of the report, not all USDA Foods are the same price; they can vary by location and transportation costs to get the product to the SFAs. Table 5 shows that USDA Foods account for more than 5 and less than 15 percent of SFA fruits and vegetables, staples, milk and dairy, and meat and poultry products.

[10]In 2009-10 (the year of data collection), SFAs were provided with a commodity value of 19.5 cents per meal.

[11]According to SFPS-III, 56 percent of respondents to the survey said the prices for DoD Fresh produce were comparable to commercial prices, 21 percent thought prices were higher, and 23 percent thought prices were lower. Buyers thought that DoD Fresh produce was of better quality. SFA buyers lower the costs of DoD Fresh produce by applying USDA entitlement dollars for their purchase.

Table 4
Variable definitions and means

Variable	Mean	Definition
Dependent variable (CU)		
Food cost index	1.000	$FCI_{if} = \frac{PC_{if}}{MPC_f}$, where PC_{if} is average product cost per ounce of product "f" for SFA "i" and MPC_f is mean product costs of all SFAs for product "f" over entire year. Product cost "f" per ounce for SFA "i" is defined as: $PC_{if} = \frac{\sum_{t=1}^{n} cost_{ift} * PB_{ft} * BX_{ft}}{\sum_{t=1}^{n} oz_{ft} * PB_{ft} * BX_{ft}}$, where $cost_{ift}$ is cost to SFA "i" of product "f" in package type "t"; PB_{ft} is the number of packages per box of food "f" of package type "t"; BX_{ft} is the number of boxes of product "f" that are packed in packaged type "t"; oz_{ft} is ounces per package of package type "t" of food "f".
Purchased volume	Q	
Log (ounces)	8.620	Log of ounces purchased. Ounces = $\sum_{t=1}^{n} oz_{ft} * PB_{ft} * BX_{ft}$, where oz_{ft} is ounces per package of package type "t" of food "f"; PB_{ft} is the number of packages per box of food "f" of package type "t"; BX_{fm} is the number of boxes of food "f" that are packed in packaged type "t".
Purchasing practices (P)		
Vendor selection: promotions	0.218	Indicator variable equal to one if SFA considers available promotions; zero otherwise.
Vendor selection: service	0.720	Indicator variable equal to one if SFA considers vendor services; zero otherwise.
Vendor selection: location	0.353	Indicator variable equal to one if SFA considers vendor location; zero otherwise.
Vendor selection: has USDA foods	0.467	Indicator variable equal to one if SFA considers whether vendor offers USDA foods; zero otherwise.
Percent purchased locally	0.0267	Share of food costs for locally grown produce.
Food purchased by a cooperative	0.308	Indicator variable equal to one if SFA uses a cooperative to make purchases in food group; zero otherwise.
Decentralized purchase	0.387	Indicator variable equal to one if purchasing decision made at the school level; zero otherwise.
Lump sum purchase	0.728	Indicator variable equal to one if purchasing decision made in one lump sum for all or a group of foods; else zero.
Fixed-price contracts	0.758	Indicator variable equal to one if SFA uses a strictly fixed price contract for purchases; zero otherwise.
Product characteristics (K)		
Log number products	5.294	Log of number of products purchased by the SFA in the food group.
Processed from USDA food	0.051	Indicator variable equal to one if purchased processed product was given a rebate or discount by the supplier because the product contained USDA Foods using USDA entitlement dollars; zero otherwise.
DOD food	0.013	Indicator variable equal to one if some fruits or vegetables were purchased from DOD with USDA entitlement dollars; else zero.
USDA food	0.077	Indicator variable equal to one if some products were USDA Foods purchased using USDA entitlement dollars; else zero .
SFA characteristics (C)		
Log (Total meals served)	14.08	Log of total number of lunches and breakfasts served by the SFA.
Onsite kitchen	0.588	Indicator variable equal to one if 75 percent or more of SFA schools have an onsite kitchen; zero otherwise.
Share elementary	0.626	Lunches and breakfasts served to elementary school children as share of all meals served.
Share reduced	0.628	Lunches and breakfasts served as reduced-price or free meals as share of all meals.
Share lunches	0.680	Lunches served as a share of all meals served.

Table 4
Variable definitions and means—continued

Variable	Mean	Definition
Other programs_25	0.092	Indicator variable equal to one if revenue from Head Start and other nontraditional school meal programs was more than 25 percent of total revenue and zero otherwise. Total revenues includes all revenue from reimbursable and non-reimbursable meals but does not include subsidies from States. Data from the *School Food Authority Characteristics Survey, 2002-03* indicates that State subsidies for school meals were less than one percent of revenue.
A la carte foods	0.922	Indicator variable equal to one if SFA served a la carte foods; zero otherwise.
Food service management	0.197	Indicator variable equal to one if SFA uses a food service management company; zero otherwise.
Location (L)		
Region		
Appalachia	0.120	Indicator variable equal to one if State of SFA is Kentucky, North Carolina, Tennessee, Virginia, or West Virginia; otherwise zero.
Delta	0.036	Indicator variable equal to one if State of SFA is Arkansas, Louisiana, or Mississippi; otherwise zero.
Great Lakes	0.060	Indicator variable equal to one if State of SFA is Michigan, Minnesota, or Wisconsin; otherwise zero.
Midwest	0.129	Indicator variable equal to one if State of SFA is Iowa, Illinois, Indiana, Missouri, or Ohio; otherwise zero.
Mountain	0.069	Indicator variable equal to one if State of SFA is Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, or Utah; otherwise zero.
Northeast	0.168	Indicator variable equal to one if State of SFA is Connecticut, District of Columbia, Delaware, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, or Vermont; otherwise zero.
Northern Plains	0.032	Indicator variable equal to one if State of SFA is Kansas, North Dakota, Nebraska, or South Dakota; otherwise zero.
Pacific	0.115	Indicator variable equal to one if State of SFA is California, Oregon, or Washington; otherwise zero.
Southeast	0.146	Indicator variable equal to one if State of SFA is Alabama, Florida, Georgia, or South Carolina; otherwise zero.
Southern Plains	0.125	Indicator variable equal to one if State of SFA is Oklahoma or Texas; otherwise zero.
Urbanicity		
City	0.270	Indicator variable equal to one if SFA located in city; otherwise zero.
Town	0.166	Indicator variable equal to one if SFA located in town; otherwise zero.
Rural	0.280	Indicator variable equal to one if SFA located in rural fringe of city or at a farther distance from a city; otherwise zero.
Suburb	0.284	Indicator variable equal to one if SFA located in suburb; otherwise zero.
Seasonality (S)		
Quarter_2	0.267	Indicator variable equal to one if food purchased in second (October-December, 2009) quarter; zero otherwise.
Quarter_3	0.252	Indicator variable equal to one if food purchased in third (January-March, 2010) quarter; zero otherwise.
Quarter_4	0.252	Indicator variable equal to one if food purchased in fourth (April-June, 2010) quarter; zero otherwise.

SFA = School Food Authority. NSLP = National School Lunch Program.
Source: USDA, Economic Research Service calculations and definitions based on information from the School Food Purchases Study III.

Table 5
Mean values of all variables that vary by food group[1]

	Food groups							
	Fruit and vegetables	Staples	Milk and dairy	Meat and poultry	Desserts	Snacks	Fully processed foods	Non-dairy drinks
Volume purchased (Q)								
Log ounces	8.53	8.39	9.053	8.960	8.098	7.96	8.82	9.201
Ounces (thousands)	38.5	42.3	365.7	53.0	22.2	17.3	51.8	109.5
Purchasing (N) practices (P)	Share of all SFAs							
Food purchased by cooperative	0.240	0.240	0.247	0.409	0.303	0.371	0.454	0.318
Decentralized purchasing	0.420	0.407	0.423	0.312	0.389	0.375	0.334	0.395
Lump sum	0.655	0.839	0.807	0.667	0.658	0.696	0.804	0.750
Fixed price	0.693	0.882	0.846	0.643	0.748	0.731	0.792	0.799
Product characteristics (K)								
Log number of products	4.04	3.810	2.728	3.207	2.370	2.55	3.156	2.86
Number of products	59.12	47.06	15.95	25.84	11.62	13.44	25.29	18.75
Processed from USDA commodity	0.006	0.030	0.047	0.175	0.016	0.009	0.154	0.005
DOD food	0.043	0.000	0.000	0.00	0.00	0.00	0.00	0.00
USDA commodity	0.130	0.058	0.117	0.134	0.003	0.000	0.010	0.012

[1]Data are either common across SFAs or vary by food group. These variables were identified in the variable list and change according to the food group. Other variables identified in the variable list, such as the indicator variables for the Southwest region, do not change by food group and are not included here. Their mean values are given in table 4. DOD = Department of Defense.

Source: USDA, Economic Research Service calculations using information from the School Food Purchases Study III.

SFAs can also send USDA Foods to a food processor who works under contract with the SFA to use the USDA Foods item in a processed product. For example, cheese may be sent to a processor to use in the production of pizzas. The pizzas then are sold to the SFA at a discount that reflects the value of the donated USDA Foods.[12] Products processed from USDA Foods are similar to other products purchased by SFAs and may include items such as chicken nuggets and hamburger patties. These products account for more than 15 percent of all meat and poultry and further-processed products but very little of other products (table 5).

Other product characteristics also vary considerably across items within a given food group. For example, about two-thirds of fruits and vegetables and half of drinks are fresh; other items may be canned or frozen. These characteristics are captured in the food codes that describe and distinguish food products, making it possible to control for such product quality differences by using food code dummy variables. In contrast, characteristics, such as USDA Foods, must be included in the regression because foods distributed in the USDA Foods program may also be sold commercially—for example, apples are a USDA Foods item, but they can also be purchased commercially.

[12]As noted by a reviewer, some processed foods containing USDA Foods have cost rebates. Another reviewer observes that the market price paid by the SFA for the final product plus the entitlement dollars used by the SFA may or may not exceed the price of the same product procured in the commercial market. We measure only the cost to the SFA and do not include the value of the entitlement dollars.

SFA Characteristics and Location Variables

Eight SFA characteristics variables are included in the analysis (table 4). The variable log *Total meals served* is an indicator of SFA size. Having an onsite kitchen (versus having meals prepared offsite and delivered) may impact types of foods that can be purchased. Because serving sizes for USDA meals vary by student age grouping, the share of elementary schools in the SFA may affect purchasing. Share of meals served free or at a reduced price could affect purchasing as could share of total meals (lunches and breakfasts) that are lunches. The variable *Other programs_25* accounts for cost variation due to purchases of food products for meals prepared by SFAs and served for the Elderly Nutrition Program, after-school snacks program, Head Start, Summer Food Service Program, and other SFA-sponsored food programs. *Food service management* accounts for SFAs that hire a food management company to provide any service, such as purchasing or administrative tasks.

The remaining variables are location variables identifying the region in which the SFA is located and SFA urbanicity and seasonality. States included in each region are given in the table; Midwest is the reference region. There are four urbanicities: city, town, suburb, and rural; suburb is the reference urbanicity. Finally, seasonality is defined as a quarter of the school year. The first quarter is the reference quarter and covers the July-September period.

Econometric Methods

As previously described, the data are panel data collected in a nationally representative survey in which observations are identified by unique SFAs and unique food codes. There is one observation for each food product purchased by each SFA, and each SFA has a number of observations equal to the number of foods it purchased. Each observation is assigned to a food group containing common foods.

We examine food prices within each food group with separate regressions and account for survey design by using survey weights for data that are stratified across the 10 regions described in table 4. We use separate regressions in order to allow parameter values to differ across food groups. Using a system of equations in which all regressions are examined as a unit may appear appropriate because the foods are linked. However, this is not necessary because we use the same model to examine each food group, and Edgerton et al. (1996, p. 77) reminds us that results for systems of equations and regressions run separately yield identical results when the model does not vary.

Food groups have up to 214 products, which vary in unchanging ways. For example, flour and rice are staples, yet they are used in different ways and have different characteristics. As explained, we use product food code dummy variables to account for the unchanging characteristics of each food product. A test from Hausman (1978) supports this approach, significantly rejecting the hypothesis that there are no food product effects.[13]

Allison (2009) reminds us that for each food product (1) there must be at least two observations and (2) the dependent variable must change at least once. If these criteria are not met, all observations associated with the food are dropped. Cameron and Miller (2015) demonstrated that analyses can understate standard errors and overstate t-statistics if there is little variation within each group (i.e., of SFAs within each food product). SFAs, however, have widely varying characteristics, making data clustering unlikely.

[13]We tested our models without food product dummy variables. R^2 in those models ranged from about 0.074 for nondairy drinks to 0.168 for milk and dairy and poultry and meat. Scale parameters on volume purchased varied from 100 percent to 12 percent higher with the inclusion of food product dummies in the model; other variables had modest differences. We report the model that accounts for food products because the dummy for food products accounts for food quality. This is reflected in the significant Hausman statistic and higher R^2 for the model with product dummy variables.

Model Results and Simulated Effects

We examine results for our model and present simulations that illustrate the model's implications. One focus is to evaluate economies of scale in purchasing, as reflected in the significance and sign of the coefficient for the volume of purchases. We recognize that the volume of purchases is likely endogenous with price, since a supplier could induce greater purchases by lowering prices. This means that we may show an association between cost per unit and volume but not causation. This association becomes stronger as we control for other factors that may affect costs.

Another interest is to better understand the impact of reported purchasing practices. To interpret our results, it is important to consider key aspects of the data. SFAs reported vendor selection criteria—promotions, service, location, and availability of USDA foods—as broadly applied to all of their food purchasing decisions, rather than distinguishing the importance of the criteria for each group. For example, SFAs saying they based purchase decisions on promotions are assumed to follow this practice for fruits and vegetables, milk and dairy, desserts, and all foods. Therefore, we expect results to be consistent across all food groups. For other purchasing practices, such as buying from a cooperative, SFAs gave responses for each food group; therefore, coefficients on these terms may vary across food groups.

Our final interest is to better understand the role of location in food costs. Ollinger and Guthrie (2015) have shown that costs per meal vary across SFAs located in different regions of the country and can also vary depending on urbanicity (i.e., urban or suburban or rural). We want to see if those differences are reflected in food costs.

Discussion of Model Estimates

Model results for all food groups are reported in table 6. The R^2 values range from 0.112 for staples to 0.216 for meat and poultry and indicate the amount of cost variation across food groups explained by model variables. The values are not unusual for a study using cross-sectional data and suggest that most cost variation is due to factors that are unique to the SFA or food product.[14]

The estimated regression coefficients show that a greater volume of purchases of a given product (log ounces) is associated with lower unit costs. The cost reduction ranges from 2.4 percent for milk and dairy to 6.4 percent for desserts at mean values of ounces purchased. However, only larger SFAs may be able to take advantage of discounts because larger purchase volumes must be stored if not immediately consumed, suggesting high storage costs for smaller SFAs. It is interesting to note that after accounting for volume of purchases and other factors, purchase costs increase with SFA size (total meals), implying higher purchase transaction costs with size. Taken together, these findings suggest that smaller SFAs may have the lower costs of volume purchases offset by storage costs, whereas large SFAs may have lower costs of volume purchases offset by higher transaction costs.

[14]We also tested our model with a dataset in which we dropped products with fewer than 20 observations and observations in which the SFA product cost exceeded 500 percent of the mean cost. Results were consistent.

Table 6

Results of impact of purchasing volume and practices on the cost per ounce of selected foods paid by SFAs participating in the National School Lunch Program

Variables	Fruit / vege-tables	Staples	Milk and dairy	Meat and poultry	Desserts	Snacks	Fully processed foods	Nondairy drinks
Constant	-0.073 * (0.039)	0.206*** (0.045)	-0.108*** (0.068)	-0.021 (0.052)	0.073 (0.054)	-0.594*** (0.048)	-0.254*** (0.042)	-0.035 (0.049)
Log ounces	-0.054*** (0.001)	-0.050*** (0.001)	-0.024*** (0.001)	-0.033*** (0.001)	-0.064*** (0.002)	-0.056*** (0.002)	-0.040*** (0.001)	-0.047*** (0.002)
Purchasing practices								
	Practices used across all food groups							
Vendor selection: Promotions	0.008** (0.004)	0.007 (0.004)	0.002 (0.006)	0.001 (0.005)	0.050*** (0.007)	-0.013** (0.006)	-0.003 (0.004)	0.007 (0.006)
Vendor selection: Service	0.008*** (0.003)	0.016*** (0.003)	-0.0005 (0.004)	-0.0008 (0.003)	-0.023*** (0.006)	-0.010 (0.005)	0.003 (0.004)	0.006 (0.005)
Vendor selection: Location	-0.005 (0.003)	0.006** (0.003)	0.008 (0.005)	0.012*** (0.004)	-0.057*** (0.005)	0.028** (0.005)	-0.005 (0.004)	-0.011** (0.005)
Vendor selection: has USDA foods	0.004 (0.003)	-0.012*** (0.003)	-0.012*** (0.004)	-0.017*** (0.004	0.014** (0.005)	-0.007* (0.004)	-0.008** (0.004)	-0.032*** (0.005)
	Practices that vary by food group							
Percent purchased locally	-0.0002 (0.0002)	-	-	-	-	-	-	-
Purchased by cooperative	0.050*** (0.005)	0.032*** (0.007)	0.009 (0.008)	-0.004 (0.007)	0.030*** (0.009)	0.032*** (0.007)	-0.019*** (0.006)	0.002 (0.008)
Purchased by cooperative *rural	-0.080*** (0.007)	-0.067*** (0.009)	-0.010 (0.011)	-0.025*** (0.008)	-0.105*** (0.013)	-0.074*** (0.009)	-0.006 (0.007)	-0.076*** (0.010)
Purchased by co-operative *city	-0.097*** (0.008)	-0.038*** (0.009)	0.040*** (0.011)	0.050*** (0.009)	0.018* (0.014)	-0.034*** (0.010)	0.0023 (0.009)	0.045*** (0.014)
Purchased by cooperative *town	-0.034*** (0.010)	-0.011 (0.009)	-0.026** (0.012)	0.015* (0.009)	-0.035** (0.014)	-0.040*** (0.011)	0.018** (0.009)	-0.044*** (0.012)
Decentralized purchasing	0.009*** (0.003)	-0.002 (0.003)	-0.019*** (0.004)	0.006 (0.003)	0.011** (0.005)	-0.024*** (0.004)	0.018*** (0.004)	0.003 (0.005)
Lump sum purchasing	0.010*** (0.003)	-0.009** (0.004)	-0.073*** (0.006)	0.009*** (0.003)	-0.052*** (0.006)	-0.017*** (0.005)	-0.004 (0.005)	-0.024*** (0.005)
Fixed price contracts	-0.023*** (0.003)	-0.033*** (0.004)	-0.010** (0.004)	-0.020*** (0.003)	0.011* (0.006)	0.006** (0.004)	-0.036*** (0.005)	-0.010 (0.007)
Product characteristics								
Log number of products	0.056*** (0.005)	0.035*** (0.005)	0.042*** (0.007)	0.061*** (0.006)	-0.007* (0.007)	0.065*** (0.007)	0.049*** (0.006)	0.049*** (0.008)
Processed from USDA commodity	-0.390*** (0.014)	-0.219*** (0.011)	-0.400*** (0.011)	-0.333*** (0.006)	-0.266*** (0.009)	-0.177*** (0.020)	-0.205*** (0.005)	-
DOD food	-0.023*** (0.006)	-	-	-	-	-	-	-
USDA commodity	0.052*** (0.003)	0.027** (0.004)	0.184*** (0.008)	0.040*** (0.004)	-	-	-	-
SFA characteristics								
Log total meals served	0.011*** (0.001)	0.011*** (0.0015)	0.003** (0.002)	0.002 (0.002)	0.046*** (0.003)	0.042*** (0.002)	0.002 (0.002)	0.018*** (0.003)
Onsite kitchen	-0.009** (0.004)	-0.003 (0.003)	0.004 (0.005)	-0.010*** (0.003)	-0.011** (0.005)	0.008** (0.004)	0.000 (0.001)	-0.002 (0.005)

Table 6

Results of impact of purchasing volume and practices on the cost per ounce of selected foods paid by SFAs participating in the National School Lunch Program—continued

Variables	Fruit / vege-tables	Staples	Milk and dairy	Meat and poultry	Desserts	Snacks	Fully processed foods	Nondairy drinks
	Practices that vary by food group							
Share elementary schools	0.002 (0.011)	-0.035*** (0.009)	0.077*** (0.016)	0.002 (0.020)	0.049** (0.021)	0.008 (0.017)	-0.0009 (0.013)	0.112*** (0.019)
Share reduced-price meal	0.047*** (0.013)	0.013 (0.013)	0.001*** (0.022)	0.015 (0.015)	-0.232** (0.021)	0.064*** (0.017)	-0.022 (0.015)	-0.032 (0.020)
Share lunches	0.102*** (0.017)	0.050*** (0.022)	0.001 (0.022)	0.063*** (0.021)	-0.023 (0.031)	0.265*** (0.027)	0.013 (0.022)	0.080** (0.031)
Other programs_25	-0.038*** (0.004)	0.022*** (0.007)	-0.012 * (0.006)	0.008* (0.005)	0.022** (0.009)	-0.037*** (0.007)	0.023* (0.006)	0.020*** (0.007)
A la carte foods	0.003 (0.004)	-0.026*** (0.004)	0.034*** (0.007)	-0.028*** (0.005)	0.044*** (0.009)	0.026*** (0.006)	0.004 (0.006)	-0.099*** (0.010)
Food service management	0.047 *** (0.004)	0.036*** (0.004)	0.032*** (0.005)	-0.002 (0.004)	-0.017** (0.007)	0.014** (0.006)	-0.014*** (0.005)	0.066*** (0.006)
Location								
Midwest[1]	-	-	-	-	-	-	-	-
Northeast	0.021*** (0.006)	0.012** (0.006)	-0.101*** (0.008)	0.027*** (0.006)	-0.028*** (0.008)	-0.085*** (0.007)	0.052*** (0.008)	-0.019*** (0.007)
Great Lakes	-0.034*** (0.006)	0.016* (0.007)	0.002 (0.009)	-0.011** (0.007)	-0.023* (0.010)	0.006 (0.009)	-0.005 (0.007)	0.007 (0.010)
Northern Plains	0.158*** (0.011)	0.084*** (0.007)	0.071*** (0.017)	0.044*** (0.008)	0.061** (0.016)	-0.032* (0.012)	0.112*** (0.007)	-0.055*** (0.015)
Appalachia	0.011*** (0.004)	-0.017*** (0.004)	-0.063*** (0.004)	0.020*** (0.004)	-0.006 (0.007)	-0.029*** (0.006)	-0.004 (0.004)	0.037*** (0.007)
Delta	0.048*** (0.004)	-0.068*** (0.004)	0.031** (0.007)	0.005 (0.006)	-0.245*** (0.025)	-0.121*** (0.016)	0.010*** (0.005)	-0.060** (0.008)
Southeast	-0.020*** (0.005)	-0.050*** (0.004)	-0.013*** (0.005)	-0.029*** (0.005)	-0.112*** (0.009)	-0.145*** (0.007)	-0.025*** (0.005)	-0.047*** (0.009)
Southern Plains	0.024*** (0.005)	-0.013*** (0.004)	0.014*** (0.005)	0.038*** (0.005)	-0.013 (0.011)	0.013** (0.006)	0.080*** (0.005)	0.149*** (0.008)
Mountain	0.050*** (0.006)	0.066*** (0.006)	0.006 (0.007)	0.068*** (0.005)	-0.035** (0.009)	0.061*** (0.007)	0.100*** (0.006)	0.014 (0.013)
Pacific	0.010 (0.004)	0.060*** (0.005)	-0.079*** (0.006)	0.002 (0.005)	-0.003 (0.008)	-0.004 (0.007)	0.052*** (0.006)	0.056*** (0.008)
Suburb[1]	-	-	-	-	-	-	-	-
City	0.041*** (0.005)	-0.003 (0.003)	-0.031*** (0.009)	-0.028*** (0.007)	0.013 (0.010)	0.038*** (0.009)	0.026*** (0.007)	0.028*** (0.007)
Town	-0.011** (0.005)	-0.033*** (0.004)	-0.002 (0.007)	-0.028*** (0.006)	0.052*** (0.009)	0.050*** (0.009)	-0.027*** (0.006)	0.045*** (0.009)
Rural	0.047*** (0.005)	0.003 (0.004)	0.005 (0.008)	-0.014*** (0.005)	0.081*** (0.009)	0.141*** (0.008)	-0.001 (0.007)	0.060*** (0.008)
Seasonality								
Quarter_11 (July-September	-	-	-	-	-	-	-	-
Quarter_2 (October-December)	0.049*** (0.004)	0.003 (0.003)	0.044*** (0.005)	-0.018*** (0.004)	0.012*** (0.006)	0.034*** (0.006)	-0.005* (0.004)	0.025*** (0.007)

Table 6

Results of impact of purchasing volume and practices on the cost per ounce of selected foods paid by SFAs participating in the National School Lunch Program—continued

Variables	Fruit / vege-tables	Staples	Milk and dairy	Meat and poultry	Desserts	Snacks	Fully processed foods	Nondairy drinks
	Practices that vary by food group							
Quarter_3 (January-March)	0.073*** (0.004)	0.033*** (0.004)	0.087*** (0.006)	0.013*** (0.004)	0.10*** (0.008)	0.025*** (0.005)	-0.003 (0.004)	0.050*** (0.008)
Quarter_4 (April-June)	0.089*** (0.004)	0.012*** (0.004)	0.057*** (0.006)	0.035*** (0.004)	0.074*** (0.007)	0.020*** (0.005)	0.037*** (0.005)	0.005 (0.007)
Number of food products	214	148	58	82	51	35	148	81
Observations	19,859	15,957	5,354	8,621	3,483	4413	7933	5,857
R-square	0.136	0.112	0.204	0.216	0.164	0.137	0.153	0.137

Notes: Standard errors are in parentheses.

*, **, *** Significant at the 90-, 95-, and 99-percent levels.

[1]Midwest, Suburb, and Quarter 1 are reference variables for region of the country, urbanicity, and seasonality. A reference variable is variable against which other variables of the same type are relative to. For example, the co-efficient 0.049 for Quarter 2 in fruits and vegetables means costs in Quarter 2 are 4.9 percent higher than in Quarter 1.

Source: USDA, Economic Research Service estimates using information from the School Food Purchases Study III.

Purchasing practices are of high interest because, unlike location or other SFA characteristics, they are under the control of SFA management. SFAs can choose purchasing practices that lower their food, handling and cooking, and/or administrative costs. Promotions, for example, may imply lower food costs, whereas service practices may be expected to reduce handing and administrative costs but raise food prices. Results are not consistent across food categories, suggesting that SFAs may not adhere strictly to these general practices.

Pannel-Martin and Boettger (2014) and Matthewson and Winter (1996) assert that buyer cooperatives could negotiate lower costs. SFAs also may use cooperatives to enable purchases that they could not otherwise make. The School Nutrition Association (SNA), the member association for school food-service managers, notes that cooperatives may make higher quality products affordable, make new products more available to SFAs, and increase access to items that are of special interest to SFAs but less available from broad line distributors (Fitzgerald, 2016). For example, Chu et al. (2012) found that cooperatives helped some SFAs to gain access to more whole-grain foods, a product category encouraged by USDA and required when USDA school meal standards were updated following HHFKA. The access to higher quality or specialty products that cooperatives can enable may justify higher prices. SNA also noted that cooperatives may reduce some administrative and labor costs.

There are four variables dealing with cooperative buying, the dummy variable for cooperatives and its interaction with urbanicities. Together, coefficients from these variables show how the effects of cooperatives vary across SFAs. The effect on suburban SFAs is the value of the coefficient for cooperatives alone. Results show that costs are higher for suburban SFAs using cooperatives for fruit/vegetables, staples, desserts, and snacks. Rural urbanicities have lower costs than other SFAs for all products except fruits and vegetables and milk and dairy. Rural SFAs using cooperatives for fruit and vegetable purchases have cost effects equal to 0.050 - 0.080, or minus 0.030, whereas city urbanicities using cooperatives for fruits and vegetables have costs effects of 0.050 - 0.097 or minus 0.047. SFAs in other urbanicities using cooperatives had higher costs than their counterparts not using cooperatives for all foods. These mixed results make sense if some SFAs use cooperatives to increase food variety or other nonprice attributes (Fitzgerald, 2016).

Results for the remaining purchasing practices varied by food group and practice. Decentralized purchasing was associated with higher costs in the majority of foods, whereas lump sum purchasing and fixed-price contracts were associated with lower costs in most foods. These results suggest that the value of purchasing practices may depend on the type of food or type of SFA.

Product characteristics also had some strong associations with variations in costs. Foods processed with USDA Foods had 18 to 40 percent lower costs, depending on the food group. However, this cost does not include the value of the USDA Foods that were used as inputs into the processed items by the food manufacturer. Thus, we are observing the final cost of the manufactured food and not the total costs to the SFA, which includes the value of the USDA Foods inputs.[15]

Location has a large impact on costs. For region and urbanicity, Midwest and Suburban SFAs are suppressed, meaning that values for other regions and urbanicities are relative to them. Across all food categories, the Southeast was associated with lower costs relative to Midwest SFAs, while Northern Plains and Mountain SFAs were associated with higher costs for most categories. Urbanicities appear to have little consistent effect on purchase costs with outcomes varying by type of food.

Larger SFA size, as measured by number of meals served, was associated with higher food costs after accounting for other factors, including volume purchased. Of the other SFA characteristics examined, use of a food service management company is of particular interest. It is associated with higher costs in five food groups and lower costs in three food groups. One possible explanation is that high-cost SFAs choose food service management companies to handle purchases. These companies may be able to lower costs, but unable to fully offset an SFA's inherently high costs. Future research is needed to explore the relationship of food service management company use to food costs and/or total meal costs.

Cost Estimates as Volume Purchased and Location Change

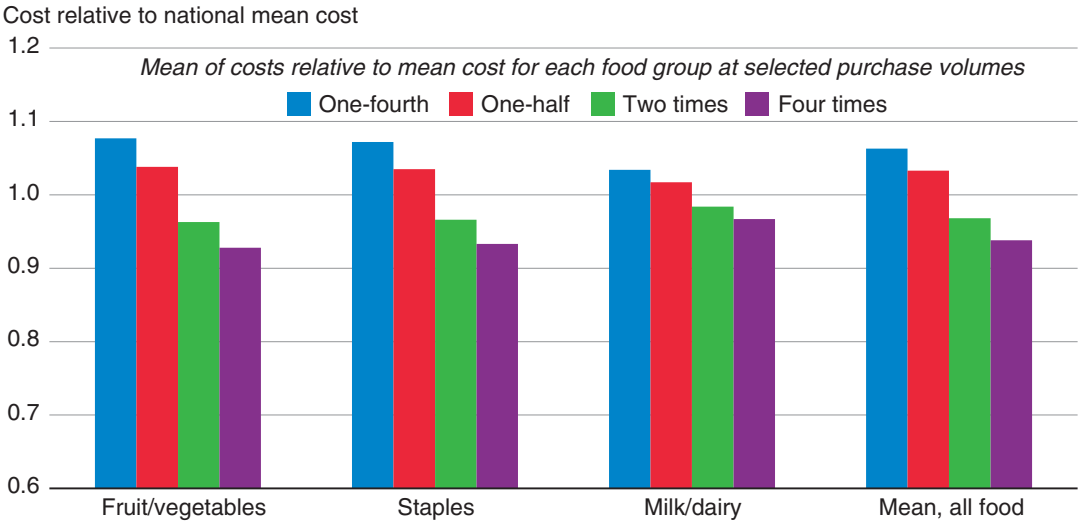
We use the model to show how costs vary across key attributes—volume of purchases, purchasing practices, and location. Previously, we considered variables that were significantly different from zero. Now, we want to estimate how costs vary as attributes such as the volume of purchases change while setting the value of all other variables at their mean levels.

Figure 1 illustrates how purchasing costs vary with the volume of purchases for selected food groups (data for all food groups are presented in table A.1). On average, SFAs with purchases equal to one-fourth the mean volume of SFA purchases had 13.3 percent higher costs than SFAs making four times the mean-volume purchases. These differences are based on mean values for all other variables, including SFA size. The cost of the smallest purchase (one-fourth the sample mean) was about 16.1 percent higher than the cost of purchases equal to four times the mean volume of SFA purchases for fruits and vegetables. The smallest change (about 6.9 percent) was for milk and dairy.

[15]Processed foods using USDA Foods are typically shipped to a State warehouse. Shipping fees are included in that price. However, there is a further shipping charge from the State warehouse to the SFA. This shipping cost is not included in our analysis. Thus, the savings due to a rebate are overstated. Using the SPS-III data, we estimated shipping cost to be about 5 percent of product value. If the shipping cost from the warehouse to the SFA is the same as to the warehouse, then the "adjusted" rebate would be about 13-35 percent.

Figure 1

Food costs for SFAs with one-fourth, one-half, twice, and four times the national mean volume of purchases, 2009-10



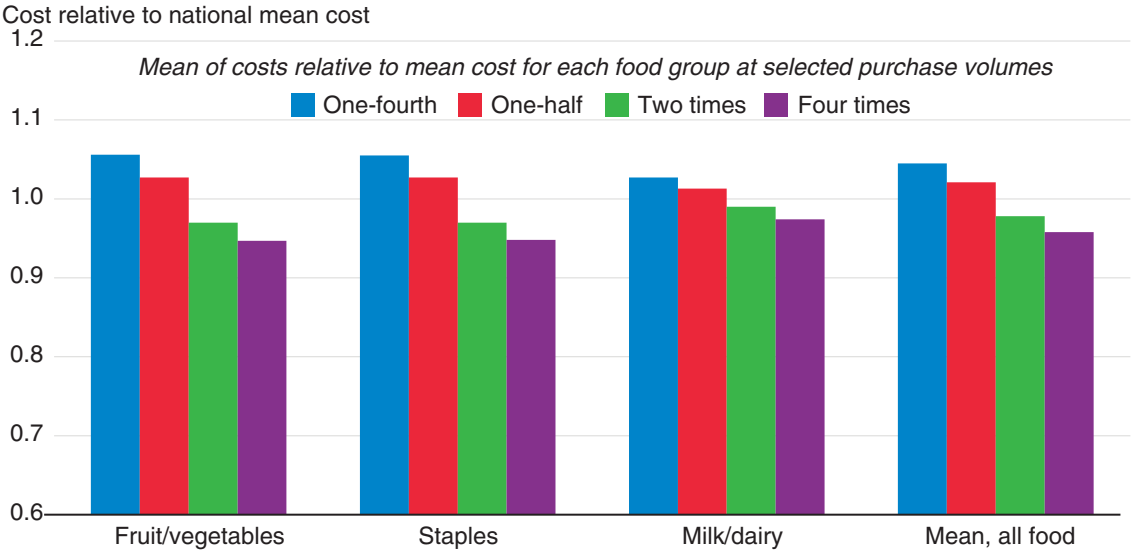
Source: U.S. Department of Agriculture, Economic Research Service estimates using information from USDA Food and Nutrition Service's School Food Purchases Study III.

Figure 2 (table A.2) adjusts volume of purchases by meals served, our measure of SFA size. SFAs with a purchasing volume of one-fourth the mean size were assumed to have one-fourth the mean number of meals served. We adjusted for size in a similar fashion for the one-half, twice, and four-times the mean categories. The adjusted values give more modest differences for different volume purchases, demonstrating how size may offset some of the savings associated with purchasing volume. On average, SFAs with purchases equal to one-fourth the mean purchase volume, adjusted for SFA meals served, had 9.1 percent higher costs than SFAs with four times the mean purchase volume and serving four times the mean number of meals.

Ollinger and Guthrie (2015) showed that meal costs vary considerably across regions. Results for food purchasing costs are consistent with those results. Figure 3 illustrates the two highest and two lowest cost regions for major food groups (table A.3 has costs for all food groups). The highest costs for major foods were in the Northern Plains and Mountain SFAs (9.2 and 5.3 percent above the mean), and the lowest costs were in Southeast and Appalachian SFAs (3.3 and 1.7 percent below the mean). Northern Plains SFAs paid 15.3, 7.9, and 11.4 percent more for fruits and vegetables, staples, and milk and dairy, respectively, while Southeast SFAs paid about 3.3 and 5.5 percent less for fruits and vegetables and staples, respectively, and 2.4 percent more for milk and dairy products. Urbanicity (fig. 4; table A.4) had smaller effects on food costs.

Figure 2

Meal adjusted food costs for SFAs at one-fourth, one-half, twice, and four times the mean volume of purchases, 2009-10[1]

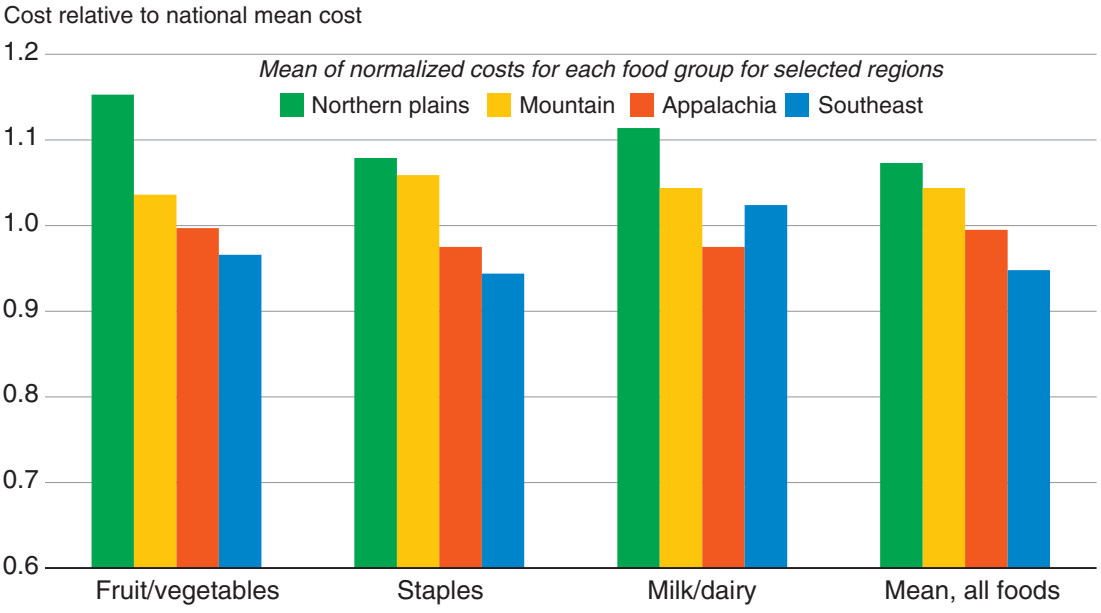


[1]Adjusted as follows: one-fourth mean purchases and one-fourth mean meals served, one-half mean purchases and one half-mean meals served, etc.

Source: U.S. Department of Agriculture, Economic Research Service estimates using information from USDA Food and Nutrition Service's School Food Purchases Study III.

Figure 3

Differences in regional purchasing costs relative to national mean, 2009-10: selected regions and food groups



Source: U.S. Department of Agriculture, Economic Research Service estimates using information from USDA Food and Nutrition Service's School Food Purchases Study III.

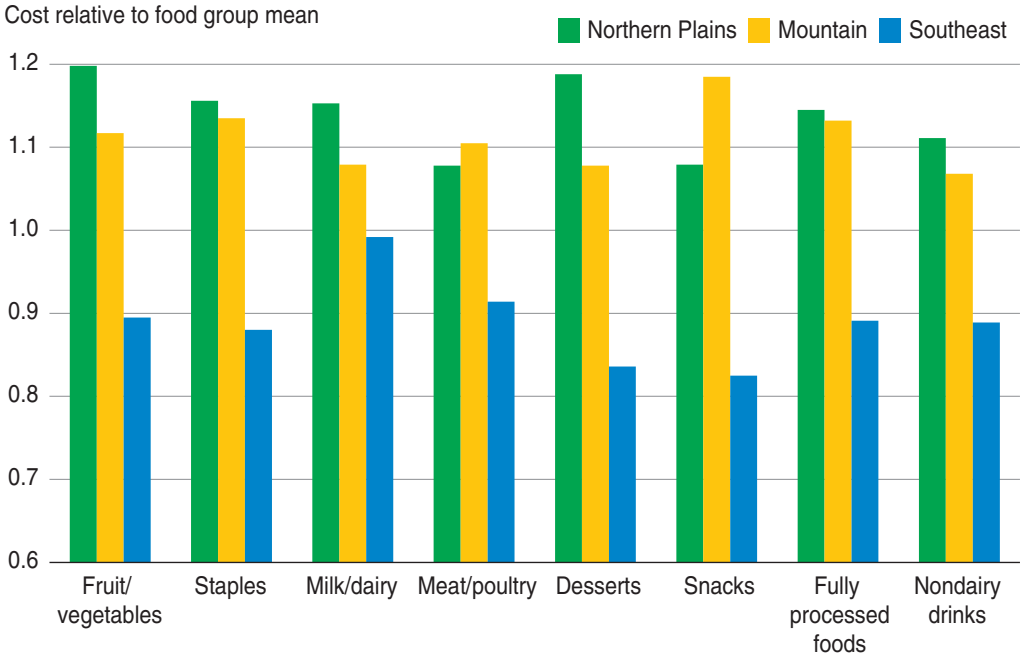
Figure 4
Purchasing costs by urbanicity relative to the national mean: selected food groups

Source: U.S. Department of Agriculture, Economic Research Service estimates using information from USDA Food and Nutrition Service's School Food Purchases Study III.

Next, we consider volume purchased and SFA location. Figure 5 shows the relative purchasing costs of the highest cost regions (Mountain and Northern Plains SFAs that are one-fourth the sample mean purchase volume) compared to the lowest cost SFAs (Southeast SFAs that are four times the sample mean purchase volume). Using information from tables A.5, A.6, A.7, mean costs for **all food groups** for SFAs in the Mountain and Northern Plains States at one-fourth the mean purchase volume are 25.1 and 28.7 percent higher than the costs in Southeast SFAs at four times the mean purchase volume. Purchasing costs for fruits and vegetables were about 39.0 percent higher for SFAs in the Northern Plains with one-fourth the mean volume of purchases than for Southeastern SFAs with four times the mean volume of purchases.

Figure 5

The most extreme purchasing cost comparison by size and region: Northern Plains and Mountain SFAs at one-fourth the mean size relative to Southeast SFAs at four times the mean size, 2009-2010



Source: U.S. Department of Agriculture, Economic Research Service estimates using information from USDA Food and Nutrition Service's School Food Purchases Study III.

The Effects of Cooperative Buying and Various Purchasing Practices as Purchase Volumes Change

Best purchasing practices vary considerably for different foods; a lower cost approach for one type of food may be a higher cost method for another. Cooperative purchasing has attracted considerable attention for benefits of lower costs and giving greater access to some foods (Pannel-Martin and Boettger, 2014; Matthewson and Winter, 1996; Fitzgerald, 2016). Meanwhile, Pannel-Martin and Boettger have discussed other purchasing practices at length.

Table 7 shows the purchase costs relative to the mean purchase costs for SFAs at one-quarter, once, and four times the mean purchase volume and use of cooperative purchasing arrangement. The data show that costs were about 1 percent lower for cooperatives at the mean purchase volume for all foods. There were differences across SFAs, however. The sum of the coefficients on the variables "Purchased by cooperative" and "Purchased by cooperative" times "rural" (table 6) indicate that the use of cooperatives by rural urbanicities is associated with lower costs. In contrast, use of cooperatives by suburban, city, and town SFAs are associated with higher costs in most product categories.[16] These higher costs do not mean that cooperatives fail as a useful purchasing tool because SFAs may use cooperatives to purchase foods that they otherwise may not be able to acquire.

[16]The coefficient on "Purchased by cooperative" is the value of cooperatives to suburban SFAs. Values of cooperatives for cities and towns are computed in the same manner as for rural SFAs.

Table 7
Estimated purchase costs for SFAs using and not using a cooperative to purchase food by food group at selected purchase volumes

Food group	One-fourth mean volume		Mean volume		Four-times mean volume	
	Cooperative used for purchases	Cooperative not used for purchases	Cooperative used for purchases	Cooperative not used for purchases	Cooperative used for purchases	Cooperative not used for purchases
	Purchase costs relative mean purchase cost					
Major foods						
Fruits and vegetables	1.076	1.079	0.997	1.001	0.926	0.929
Staples	1.070	1.073	0.998	1.001	0.931	0.934
Milk and dairy	1.037	1.033	1.003	0.999	0.970	0.966
Meat and poultry	1.044	1.050	0.996	1.003	0.951	0.958
Fully processed foods	1.049	1.068	0.991	1.009	0.937	0.953
Mean, major foods	1.055	1.061	0.997	1.003	0.943	0.948
Other foods						
Desserts	1.080	1.100	0.989	1.007	0.905	0.921
Snacks	1.074	1.087	0.991	1.006	0.919	0.929
Nondairy drinks	1.048	1.079	0.982	1.011	0.920	0.947
Mean, all foods	1.060	1.071	0.993	1.005	0.932	0.942

Source: USDA, Economic Research Service estimates using mean values by food group from the School Food Purchases Study III, the model given by equation 3, and estimated coefficients given in table 6.

We would like to examine the maximum contribution of "best" purchasing practices to purchase costs. We assume the best purchasing practice is the lowest cost option. Table 6 identifies coefficients for various purchasing practices. The lowest cost option would be to use the purchasing practice if the coefficient is negative and not use it if it is positive (we ignore significance because we are taking the extreme position and not the likely position). Conversely, the highest cost option is to use a purchasing practice if the coefficient is positive and not use it if it is negative.

Table 8 shows how costs vary by economies of scale and use of high- and low-cost purchasing practices at mean values for all other variables. The purchase practices included in this analysis are (1) vendor selection criteria, such as vendor provision of services and (2) the type of contract, including the use of decentralized purchasing, lump sum purchasing, and fixed contracts. High-cost purchasing practices are practices with positive coefficients for the given food category, as shown in table 6. We set variables for high-cost practices equal to zero if the coefficient is negative (does not use the purchasing practice) and one if the coefficient is positive (uses the purchasing practice and raises costs). Low-cost purchasing practices are practices with negative coefficients as shown in table 6. Variables for these coefficients equal one if the coefficient is negative (use the purchasing practice and reduces costs) and zero if the coefficient is positive (do not use the purchasing practice).

The impacts of purchasing practices vary by food group. If an SFA managed to follow the lowest cost methods in all cases (those methods with negative coefficients in table 6), it could reduce its food costs substantially, particularly if it currently uses the highest cost practices. The difference in costs between the

highest and lowest cost practices for the smallest volume of purchases (one-fourth the sample means) was 10.8 percent of costs for all foods, whereas for the difference for the largest volume of purchases (four times the sample mean), it was about 9.5 percent of costs (table 8).

Table 8
Estimated purchase costs when high- and low-cost purchasing practices are used at selected purchase volumes by food groups[a]

Food group	One-fourth mean volume		Mean volume		Four-times mean volume	
	High-cost purchase practices[b]	Low-cost purchase practices[c]	High-cost purchase practices	Low-cost purchase practices	High-cost purchase practices	Low-cost purchase practices
	Purchase costs relative to mean purchase cost					
Major foods						
Fruits and vegetables	1.119	1.046	1.039	0.970	0.964	0.901
Staples	1.134	1.040	1.058	0.970	0.987	0.905
Milk and dairy	1.108	0.997	1.071	0.964	1.036	0.933
Meat and poultry	1.086	1.018	1.038	0.972	0.990	0.928
Fully processed foods	1.105	1.031	1.044	0.974	0.987	0.921
Mean, major foods	1.110	1.026	1.050	0.970	0.993	0.918
Other foods						
Desserts	1.227	0.987	1.122	0.903	1.027	0.826
Snacks	1.143	1.027	1.057	0.949	0.977	0.878
Nondairy drinks	1.119	1.028	1.048	0.963	0.982	0.902
Mean, all foods	1.130	1.022	1.060	0.958	0.994	0.899

[a]Purchasing practices include selecting vendors based on promotions, selecting vendors based on services provided, selecting vendors based on location, selecting vendors because vendor has USDA foods, decentralized purchasing, lump sum purchasing, and fixed-price contracts.

[b]Costs are evaluated at sample mean values and model coefficients for all model variables except purchasing practices. High-cost purchasing practices are practices with positive coefficients, as shown in table 6. Variables for these coefficients equal zero if the coefficient is negative (do not use the purchasing practice) and one if the coefficient is positive (use the purchasing practice and raises costs).

[c]Costs are evaluated at sample mean values and model coefficients for all model variables except purchasing practices. Low cost purchasing practices are practices with negative coefficients, as shown in table 6. Variables for these coefficients equal one if the coefficient is negative (use the purchasing practice and reduces costs) and zero if the coefficient is positive (do not use the purchasing practice).

Source: USDA, Economic Research Service estimates using mean values by food group from the School Food Purchases Study III, the model given by equation 3, and estimated coefficients given in table 6.

Conclusions

This study examined the extent to which school food costs are affected by economies of scale, the volume of purchased food, SFA location, and other characteristics, and purchasing practices. It extends previous analysis of the SFPS-III (Young et al., 2012) that provided detailed information about food product purchases and costs, SFA purchasing practices, and some descriptive cost information, but it did not provide a rigorous cost analysis showing how costs vary independent of other factors.

Large-volume purchases were consistently associated with lower costs, whereas higher costs were found to be associated with larger SFA size in terms of meals served (after controlling for volume purchased) and more products purchased. As with previous studies of overall meal costs (Ollinger and Guthrie, 2015), location was associated with food cost differences, with food costs highest for SFAs located in the Northern Plains and Mountain States.

Purchasing practices had mixed effects. Results indicate that fixed-price contracts and lump sum purchasing practices are associated with lower costs in most foods while decentralized purchasing is associated with higher costs in most foods. Other purchasing practices had less consistent effects across food categories. Findings on use of cooperatives were also mixed in that they were associated with lower costs for rural urbanicities and higher costs with other urbanicities. This may be because SFAs may use cooperatives for a range of reasons, not only to control food costs but also to access otherwise-unavailable products or to reduce administrative costs associated with food procurement. Finally, the use of Food Service Management Companies (FSMC) was associated with higher food costs for a number of food groups.

Future research is needed to understand the factors underlying some of these relationships, like the factors that lead to higher food costs associated with use of foodservice management companies. Although this analysis cannot address questions of causality, these results do offer some implications for understanding factors influencing food costs.

A key difference between our analysis and that of Young et al. (2012) is that we can use marginal analyses to show how changes in SFA location, volume purchased (and economies of scale), or use of selected purchasing practices affect costs independent of other factors. For example, we are able to explore how switching from food purchasing practices associated with higher costs to those associated with lower costs affects food costs and find that it can reduce them by between 8.1 and 11.0 percent at different volumes of purchasing.

Overall, the study illustrates sources of differences in costs for purchased products. Some sources of food cost variation, such as those due to location, cannot be controlled by SFAs. Although our analysis shows association, not causality, it suggests that volume purchasing and use of some purchasing practices could help lower food costs and reduce the cost disadvantages inherent to higher cost locations. However, since food costs are only one part of meal costs, it may be important to consider tradeoffs that could affect other aspects of meal costs, such as labor. Moreover, SFAs must consider whether use of a given strategy might reduce the appeal of the school meals to students—for example, if a small SFA buys larger volumes of more limited food products to achieve economies of scale, it may result in meals becoming more monotonous and less appealing.

Limitations and Issues for Future Research

It is important to keep in mind that our analyses explain, at most, 22 percent of the cost variation, suggesting that unexplained idiosyncratic (local) factors play a big role in explaining cost variation. More investigation is needed to identify these idiosyncratic factors. In addition, our findings raise several questions concerning SFA practices that require further research. What are the benefits of the use of cooperative buying arrangements? The role of purchasing cooperatives in improving food options for SFA directors within their cost constraints requires further investigation. Also of interest is a better understanding of the benefits that food management companies provide that justify their use.

Study data were collected before the updated USDA school meal nutrition standards were implemented (lunch standards were implemented in SY 2012-13 and breakfast standards in SY 2013-14). Newman (2012) found that higher food costs associated with meals that matched the new standards were primarily attributable to changes in vegetable requirements, increasing amounts served and requiring a more varied mix. Effects of such changes on food cost variation require further investigation with newer data when they become available.

Interpretation of findings must account for SFA purchasing goals. The aim of SFA administrators is to purchase food that children will eat and that meets USDA guidelines. Within that context, SFAs want to lower overall costs. Thus, for the sake of more palatable meals, an SFA may purchase more variety at lower volumes, raising its cost but also improving participation. Alternatively, an SFA may purchase a ready-to-eat food rather than ingredients for cooking because preparation costs (labor costs) outweigh the savings accruing to the purchase of the less costly ingredients.

The most important question remains whether variation in food cost affects the ability of some SFAs to serve appealing meals that meet USDA nutrition standards within their budget constraints. Purchased foods and labor each comprise about 44 percent of the cost of a school meal (Ollinger and Guthrie, 2015). The high labor share of costs suggests that low labor-cost SFAs with onsite kitchens and high food costs may be able to offset high food costs by buying less expensive food and using more labor. When Woodward-Lopez and colleagues (2014) investigated a sample of 10 SFAs in California, they found more cooking from basic ingredients resulted in lower food costs and increased labor costs but no significant increase in total costs, suggesting the trade-off may be feasible for some SFAs. Nationally, if labor costs are lower in higher food-cost locations such as the Northern Plains, then SFAs in those locations could possibly offset their relatively high food costs by purchasing basic ingredients and preparing food at school. More research, with future datasets that include information on food, labor, and other costs of meal production, may improve understanding of tradeoffs made by SFAs and improve our understanding of cost differences across SFAs.

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Appendix tables

Table A.1
Economies of scale in purchasing by food group

	Volume of purchases relative to mean				
Food group	One-fourth mean	One-half mean	Mean	Two-times mean	Four-times mean
	Cost index relative to mean cost index				
Major foods					
Fruits and vegetables	1.077	1.038	1.00	0.963	0.928
Staples	1.072	1.035	1.00	0.966	0.933
Milk and dairy	1.034	1.017	1.00	0.984	0.967
Meat and poultry	1.047	1.023	1.00	0.977	0.955
Fully processed foods	1.058	1.029	1.00	0.972	0.945
Mean, major foods	1.058	1.028	1.00	0.972	0.946
Other foods					
Desserts	1.093	1.046	1.00	0.956	0.915
Snacks	1.058	1.040	1.00	0.961	0.925
Nondairy drinks	1.068	1.033	1.00	0.968	0.937
Mean, all foods	1.063	1.033	1.00	0.968	0.938

Source: USDA, Economic Research Service estimates using information from the School Food Purchases Study III.

Table A.2
Economies of scale in purchasing by food group adjusted by meals served[1]

	Volume of purchases relative to mean				
Food group	One-fourth mean	One-half mean	Mean	Two-times mean	Four-times mean
	Cost index relative to mean cost index				
Major foods					
Fruits and vegetables	1.056	1.027	1.00	0.970	0.947
Staples	1.055	1.027	1.00	0.970	0.948
Milk and dairy	1.027	1.013	1.00	0.990	0.974
Meat and poultry	1.044	1.025	1.00	0.979	0.958
Fully processed foods	1.055	1.021	1.00	0.973	0.948
Mean, major foods	1.047	1.023	1.00	0.976	0.955
Other foods					
Desserts	1.025	1.012	1.00	0.988	0.976
Snacks	1.050	1.025	1.00	0.976	0.952
Nondairy drinks	1.040	1.020	1.00	0.981	0.962
Mean, all foods	1.045	1.021	1.00	0.978	0.958

[1]Adjusted as follows: one-fourth volume purchased and one-fourth meals served, one-half volume purchased and one-half meals served, etc.
Source: USDA, Economic Research Service estimates using information from the School Food Purchases Study III.

Table A.3
Purchase cost relative to mean costs by region and food group

	FNS region									
Food group	Appa-lachia	Delta	Lakes	Midwest	Mountain	North-east	Northern plains	Pacific	South-east	Southern plains
	Cost index relative to mean cost index									
Major foods										
Fruits and vegetables	0.997	1.034	0.955	0.985	1.036	1.007	1.153	0.995	0.966	1.010
Staples	0.975	0.927	1.008	0.992	1.059	1.004	1.079	1.053	0.944	0.978
Milk and dairy	0.975	1.071	1.041	1.038	1.044	0.938	1.114	0.959	1.024	1.055
Meat and poultry	1.006	0.991	0.971	0.984	1.055	1.012	1.030	0.988	0.957	1.023
Fully processed foods	0.963	0.977	0.962	0.967	1.071	1.019	1.083	1.020	0.944	1.049
Mean, major foods	0.983	1	0.987	0.993	1.053	0.996	1.092	1.003	0.967	1.023
Other foods										
Desserts	1.016	0.800	0.999	1.022	0.987	0.994	1.087	1.024	0.914	1.036
Snacks	1.001	0.913	1.038	1.031	1.096	0.948	0.999	1.028	0.893	1.045
Nondairy drinks	1.023	0.930	0.993	0.985	1.000	0.967	1.041	1.042	0.939	1.144
Mean, all foods	0.995	0.955	0.996	1.001	1.044	0.986	1.073	1.014	0.948	1.043

FNS = Food and Nutrition Service, USDA.
Source: USDA, Economic Research Service estimates using information from the School Food Purchases Study III.

Table A.4
Purchase costs relative to mean costs by urbanicity and food group

	Urbanicity			
Food group	Rural	Town	Suburban	City
	Cost index relative to mean cost index			
Major foods				
Fruits and vegetables	1.017	0.973	0.994	1.005
Staples	1.000	0.981	1.016	1.002
Milk and dairy	1.006	0.994	1.003	0.982
Meat and poultry	0.990	0.994	1.016	1.010
Fully processed foods	0.998	0.984	1.004	1.031
Mean, major foods	1.002	0.985	1.007	1.006
Other foods				
Desserts	1.015	1.012	0.973	0.993
Snacks	1.059	0.977	0.949	0.971
Nondairy drinks	1.009	1.005	0.978	1.021
Mean, all foods	1.012	0.988	0.992	1.002

Source: USDA, Economic Research Service estimates using information from the School Food Purchases Study III.

Table A.5

Economies of scale in purchasing for Mountain school food authorities by food group

	Volume of purchases relative to mean				
Food group	One-fourth mean	One-half mean	Mean	Two-times mean	Four-times mean
	Cost index relative to mean cost index				
Major foods					
Fruits and vegetables	1.117	1.076	1.036	0.998	0.962
Staples	1.135	1.097	1.059	1.023	0.988
Milk and dairy	1.079	1.061	1.0443	1.027	1.010
Meat and poultry	1.105	1.080	1.055	1.031	1.008
Fully processed foods	1.132	1.101	1.070	1.040	1.011
Mean, major foods	1.1136	1.083	1.05286	1.0238	0.9958
Other foods					
Desserts	1.078	1.078	0.987	0.944	0.903
Snacks	1.185	1.185	1.096	1.054	1.013
Nondairy drinks	1.068	1.033	1.000	0.968	0.937
Mean, all foods	1.112	1.089	1.043	1.011	0.979

Source: USDA, Economic Research Service estimates using information from the School Food Purchases Study III. .

Table A.6

Economies of scale in purchasing for Northern Plains school food authorities by food group

	Volume of purchases relative to mean				
Food group	One-fourth mean	One-half mean	Mean	Two-times mean	Four-times mean
	Cost index relative to mean cost index				
Major foods					
Fruits and vegetables	1.244	1.198	1.153	1.112	1.071
Staples	1.156	1.117	1.079	1.042	1.006
Milk and dairy	1.153	1.134	1.114	1.096	1.078
Meat and poultry	1.078	1.054	1.030	1.006	0.983
Fully processed foods	1.145	1.113	1.083	1.052	1.022
Mean, major foods	1.155	1.123	1.098	1.062	1.032
Other foods					
Desserts	1.188	1.136	1.087	1.040	0.994
Snacks	1.079	1.038	0.999	0.960	0.923
Nondairy drinks	1.111	1.076	1.041	1.008	0.975
Mean, all foods	1.144	1.108	1.073	1.040	1.007

Source: USDA, Economic Research Service estimates using information from the School Food Purchases Study III.

Table A.7

Economies of scale in purchasing for Southeast school food authorities by food group

	Volume of purchases relative to mean				
Food group	One-fourth mean	One-half mean	Mean	Two-times mean	Four-times mean
	Cost index relative to mean cost index				
Major foods					
Fruits and vegetables	1.041	1.003	0.966	0.930	0.895
Staples	1.011	0.977	0.944	0.912	0.880
Milk and dairy	1.060	1.042	1.025	1.008	0.992
Meat and poultry	1.002	0.979	0.957	0.935	0.914
Fully processed foods	0.998	0.970	0.943	0.915	0.891
Mean, major foods	1.022	0.994	0.967	0.940	0.914
Other foods					
Desserts	0.999	0.956	0.914	0.874	0.836
Snacks	0.964	0.927	0.893	0.857	0.825
Nondairy drinks	1.002	0.971	0.939	0.909	0.880
Mean, all foods	1.010	0.978	0.948	0.919	0.889

Source: USDA, Economic Research Service estimates using information from the School Food Purchases Study III.