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Cost Implications of Participant Product Selection in USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

Tina L. Saitone, Xuemei Li, Patrick W. McLaughlin, and Richard J. Sexton

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Abstract

USDA's Special Supplemental Nutrition Program for Women, Infants and Children (WIC) is the third-largest food assistance program in the United States. WIC participants are required to select fixed quantities of WIC-approved foods except for fruits and vegetables, for which they receive a cash-value voucher. Participants may lack an explicit economic incentive to minimize food costs by shopping at low-cost WIC-authorized vendors or selecting less expensive products, brands, or packages of foods. Thus, each WIC State agency faces the challenge of simultaneously controlling program costs and supporting participants' satisfaction by providing options when they shop for WIC foods.

WIC State agencies seek to strike this balance in a multitude of ways. One of the most common cost-containment tools is to require participants to purchase the least expensive brand (LEB) of a WIC-authorized product in some food categories. However, the WIC food packages were last revised in 2009, and little is known about the current cost implications of WIC participants choosing expensive brands, products, and package sizes. This study is the first to estimate the potential cost savings from limiting participant choice through LEB policies. We use administrative data on WIC transactions from California and IRI retail scanner data to estimate these potential cost savings for the most frequently redeemed food instruments and extrapolate the information to the State level for a period of over 2 years. The estimated savings associated with LEB policy implementation in California range from $16.1 million to $30.5 million annually.

Keywords: Special Supplemental Nutrition Program for Women, Infants, and Children; WIC; cost-containment; food costs.

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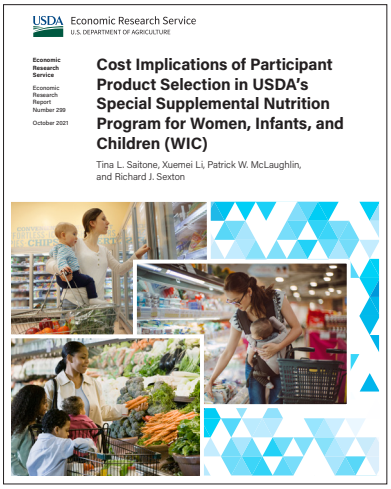


What Is the Issue?

USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is the third-largest food and nutrition program in the United States, with total Federal program spending in fiscal year (FY) 2019 of $5.3 billion. In addition to nutrition education, healthcare referrals, and breastfeeding support, WIC provides food packages targeted to the dietary needs of nutritionally at-risk and low-income pregnant, postpartum, and breastfeeding women, infants, and children. Regulations direct WIC State agencies to provide participants with a variety of foods to choose from, in prescribed food categories, to accommodate participant preferences.

WIC is a discretionary grant program, and thus cost-containment is an important priority for ensuring efficient use of Federal funds. Given that WIC participants receive WIC foods free of charge, they may lack an explicit economic incentive to minimize costs by shopping at low-cost WIC-authorized vendors or selecting less expensive products, brands, or packages at a given vendor. Thus, each WIC State agency faces the challenge of finding ways to control program costs while maintaining participant satisfaction and encouraging program participation.

One of the most common cost-containment strategies of WIC State agencies is to limit selection within a food category by requiring participants to purchase the least expensive brand (LEB) of a product. Although 19 States were using some type of LEB policy to contain costs as of 2015, the rest, including California, allow participants to choose among multiple options with potentially differing prices in a food category. No published studies have investigated cost savings from implementing LEB policies since the WIC food package was revised in 2009. Because LEB policies may also incur administrative costs and reduce choices for WIC participants, quantifying potential food-cost savings is necessary for weighing the net benefits of these policies. Although this study uses data from California, the results will be helpful for other WIC State agencies that are considering implementing LEB policies.

What Did the Study Find?

The analysis focuses on the three most frequently redeemed WIC food instruments (FIs, or paper vouchers that each allow fixed quantities of a combination of WIC foods) in California. These FIs account for over 30 percent of total WIC food costs in the State and together cover combinations of many of the most common food items provided to participants nationally (specifically, low-fat milk, cheese, eggs, 100-percent fruit juice, ready-to-eat breakfast cereals, and whole grains). Results of the analysis showed that:

- Restricting participant product selection to the LEBs of low-fat milk, cheese, eggs, 100-percent fruit juice, and whole grains leads to food-cost savings for the three most frequently redeemed FIs ranging between 4.6 percent and 18.2 percent compared to a baseline of random shopping among eligible products and brands (with WIC customers having no preferences and viewing all brands as effectively identical);
- Estimated cost savings from LEB policy implementation are more substantial if the simulated baseline for comparison is of WIC participants selecting the most expensive WIC product in each food category. In this scenario, food-cost savings range from 9.3 to 31.6 percent, depending upon the FI being redeemed; and
- Estimated food-cost savings at large (seven or more cash registers) WIC-authorized food retailers in California ranged from $16.1 million to $30.5 million annually from implementing LEB requirements.

How Was the Study Conducted?

For the foods comprising the three most frequently redeemed food instruments in California, the costs of participants' WIC purchases were simulated under three scenarios of shopping behavior: (1) random shopping within a food category, (2) shopping for the most expensive brand(s) within a food category, and (3) shopping for the least expensive brand(s) in a food category. The simulated cost of the resulting bundles was compared to the actual costs of each FI by analyzing transactions from eight supermarkets with a relatively high volume of WIC sales, available from administrative data on WIC transactions in California. Prices for each WIC-authorized food item (i.e., milk, cheese, eggs, 100-percent fruit juice, ready-to-eat breakfast cereals, and whole grains) were obtained from Information Resources, Inc. (IRI) InfoScan store-level sales data for selected supermarket chains. To estimate potential savings from implementing LEB policies across a variety of WIC food categories, the authors compared simulated food costs from restricting choice to the LEB of selected product categories to actual food costs—in other words, to a participant selecting from among a wide variety of authorized brands and packages without WIC guidelines.

Cost Implications of Participant Product Selection in USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

Introduction

USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is the third-largest food and nutrition assistance program in the United States. In fiscal year (FY) 2019, WIC accounted for 5.7 percent of total USDA expenditures ($5.3 billion out of $92.4 billion) on food assistance (Tiehen, 2020).[1] The purpose of WIC is to provide food assistance to nutritionally at-risk low-income pregnant, breastfeeding, and postpartum women, infants, and children less than 5 years of age by providing free supplemental foods, nutrition education, healthcare referrals, and breastfeeding support.

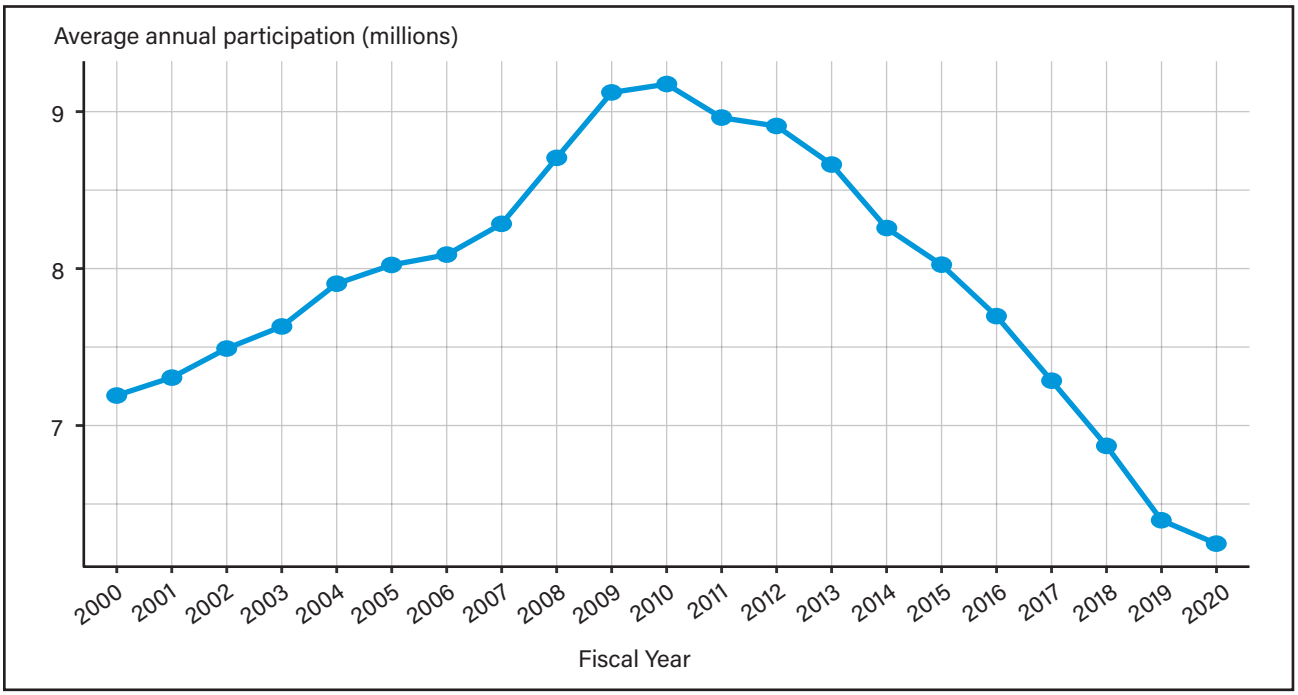
Participant eligibility is determined by income (applicants' income must be at or below 185 percent of the Federal poverty line) or participation in other Federal assistance programs, such as the USDA, Supplemental Nutrition Assistance Program (SNAP), Medicaid, or Temporary Assistance for Needy Families. In addition, the participant must be determined to be at nutritional risk. Average monthly WIC participation in the United States grew substantially from FY 2000 to FY 2010 (figure 1); since then, average monthly participation has declined by nearly 16 percent. FY 2020 marked the lowest participation level in 18 years, with an average of nearly 6.2 million people participating each month. In FY 2019, 51 percent of participants were children, 24 percent were women, and the rest were infants (Tiehen, 2020).

The USDA, Food and Nutrition Service (FNS) provides oversight and assistance to 89 WIC State agencies responsible for local administration of the program, which covers the 50 States, the District of Columbia, 33 Indian Tribal Organizations, and 5 U.S. territories. Since WIC is a discretionary grant program, the number of participants who can be served each fiscal year is dependent on congressional appropriations and operating costs; cost containment thus helps to make efficient use of Federal funds.[2] Given food costs constitute the majority of total WIC costs (roughly 70 percent, on average, from FY 2000 to FY 2018), they are often the focus of cost-containment policies implemented by WIC State agencies.

[1]The largest food and nutrition program in the United States is the USDA, Supplemental Nutrition Assistance Program ($60.4 billion in FY 2019), followed by the USDA, National School Lunch Program ($14.1 billion in FY 2019).

[2]Cost containment in this report broadly refers to vendor cost containment: a given State agency's "vendor peer group system, competitive price criteria, and allowable reimbursement levels" (7 CFR 246.4(a)(14)(xvi)).

Figure 1
Total WIC participation in the United States, fiscal years 2000–2020



Source: USDA, Food and Nutrition Service's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) data.

WIC State agencies provide food benefits to participants through seven broad food packages specified by FNS regulations (7 Code of Federal Regulation (CFR) 246.10). Food packages vary by participant category (e.g., pregnant woman, child, infant), are intended to be supplemental to all other food purchases and acquisitions, and consist of foods deemed to address the nutritional needs of the participant category. Foods provided by WIC benefits have an estimated value of 5.8 percent of total food expenditures by WIC households (National Academies of Sciences, Engineering, and Medicine, 2017). Depending on the participant's category, food packages consist of some combination of milk, eggs, legumes, canned fish, whole grains, cereals, juice, infant food, infant cereals, fruits, vegetables, and infant formula.

Participants obtain their food benefits using food instruments (FIs), which are distributed either via paper vouchers or electronic benefit transfer (EBT) cards. All WIC State agencies were required to transition to an EBT system by October 1, 2020. Under the paper FI system, participants must redeem all food items issued on the FI in the same transaction or lose the unredeemed benefits.

FNS regulations allow WIC State agencies to provide food benefits via one or more food delivery systems, including retail, home delivery, or direct distribution (with participants picking up supplemental food from storage facilities operated by the State or local agency) (7 CFR 246.12). The vast majority of benefits are distributed via WIC-authorized commercial food retailers, with less than 2 percent of total food redemption value in FY 2012 distributed directly or through home food delivery contractors (Tiehen and Frazão, 2016).

Based on recommendations from the National Academies of Sciences, Engineering, and Medicine, in late 2007, USDA implemented a comprehensive revision to WIC food packages via an interim rule (72 (Federal Register (FR) 68966). WIC State agencies were required to implement these changes by October 2009. The goals of the new food package regulation included "…provid[ing] WIC participants with a wider variety of food, providing WIC State agencies with greater flexibility in prescribing food packages to accommodate participants with cultural food preferences" (79 FR 12273). Within the confines of these FNS regulations (7 CFR 246), WIC State agencies are responsible for identifying food products consistent with program require-

ments and are afforded latitude on the options made available to participants within approved food categories, provided the foods meet the requirements in the Federal regulation (i.e., are WIC-eligible). The food package regulations stipulate that it is ultimately the responsibility of the WIC State agencies to determine the specific brands and types of foods to authorize. For example, WIC State agencies have the option to offer organic forms of WIC-eligible foods but are not required to do so.[3]

Given that WIC participants receive WIC foods free of charge, they may not have an explicit economic incentive to minimize food costs by selecting less expensive products, brands, or packages at a given vendor. Thus, each WIC State agency faces the challenge of controlling program costs while simultaneously maintaining participant satisfaction and encouraging program participation by providing options to participants shopping for WIC foods.[4] WIC State agencies seek to strike this balance in a multitude of ways.[5] Thorn et al. (2015) surveyed the strategies employed by WIC State agencies throughout the United States and found it was very common for the agencies to limit purchases to specific brands within a given food category.[6]

Another strategy for containing program costs is to require participants to select the least expensive brand (LEB) of a particular product. State agencies implement LEB policies in a variety of ways. For example, Texas WIC requires that vendors declare to the State agency their "traditionally" LEB product in each WIC-approved food category. The Texas agency requires that 85 percent of a vendor's monthly WIC redemptions be for the declared LEB products. Further, the vendor's declared LEB products must be labeled on the store's shelves. Other State agencies have more flexible guidelines. Arkansas WIC does not require vendors to submit a formal LEB product declaration, but it does require them to label the LEB items on the store shelves. WIC vendors in Arkansas are not required to re-tag LEB WIC items if there is a periodic sale (less than 15 days) when similar items become cheaper, but they must sell the LEB items to WIC participants if the items have LEB status at the time of purchase.[7]

[3]The one exception in this regard is WIC State agencies are required to allow participants to purchase organic fruits and vegetables with cash-value vouchers. However, because participants face a budget constraint when using cash-value vouchers, purchasing organic fruits and vegetables has no implications for food cost containment.

[4]In addition to food costs, States might exclude some brands in a category if the administration costs associated with approval are high. For example, Thorn et al. (2015) documents that the majority of WIC State agencies allowed national brand whole-grain flakes but not the store brand equivalent, which was allowed by only 4 percent. Despite the store brand whole-grain flakes likely being a cheaper option than the national brand, if such brands are substantially less prominent, State agencies may either deem approval not worthwhile or be unaware of the brand altogether.

[5]Infant formula is the only WIC food item for which Federal regulations require cost containment. Typically, States award single-supplier contracts to infant formula manufacturers, who bid competitively by offering the highest rebate (i.e., lowest net price). These rebates are substantial, for example, averaging 92 percent of the wholesale price of infant formula in FY 2013 (Oliveira et al., 2013). In total, rebates reduced the cost of providing infant formula to WIC participants by nearly $1.8 billion in FY 2014: the pre-rebate cost of infant formula was $2.27 billion (40.3 percent, the largest pre-rebate share), and the post-rebate cost was $478.3 million (12.4 percent, the third-largest post-rebate share) (Kline et al., 2018).

[6]All WIC agencies limit the brands of cereal available for WIC redemption. This is also a common practice for infant cereal (94 percent of WIC agencies), soy-based beverages (98 percent), and infant fruits and vegetables and infant cereals (94 percent) (Thorn et al., 2015).

[7]Unlike California prior to July 2020, the Texas and Arkansas WIC State agencies have statewide EBT systems for the distribution of WIC food benefits, which may make implementing LEB policies easier compared to the paper voucher system. On the one hand, monitoring adherence to LEB policies is substantially simplified as the UPC of purchase is recorded in the EBT system. On the other hand, EBT systems will allow for the purchase of more expensive but otherwise WIC-approved brands for legitimate reasons (e.g., if the LEB is out of stock). Thus, the task for both vendors and participants of correctly identifying the LEB remains the same under the EBT system.

Regardless of the State agency-level rules governing implementation, LEB policies are relatively common. As of FY 2015, 19 WIC State agencies required participants to purchase the LEB in at least one product category. Table 1 identifies these State agencies, as well as the specific product categories that each designated as LEB in FY 2015. For example, 19 WIC State agencies required participants to select the LEB of milk (Thorn et al., 2015). Further, many States engage in form-type restrictions. For example, 67 percent of State agencies did not allow the purchase of organic WIC-eligible foods (aside from fruits and vegetables), and 71 percent prohibited the redemption of cage-free eggs using WIC FIs (Thorn et al., 2015).

Table 2 summarizes the average monthly food benefit cost on a per participant basis for the 5 most recent fiscal years for WIC State agencies with some type of LEB policy in place in FY 2015. Table 3 provides the same information for WIC State agencies that did not use LEB policies at the time to control program food costs. While average food benefit costs differ substantially across State agencies, comparing group LEB versus non-LEB averages does not reveal systematic or economically important differences.

Table 1
WIC State agencies with LEB policies in fiscal year 2015

WIC State agency	Product category									
	Milk	Cheese	Eggs	DB	CB	PB	CF	BJ	FJ	WG
Alabama	✓	✓								
Alaska	✓	✓	✓			✓				
Arkansas	✓	✓	✓		✓				✓	
Florida	✓	✓	✓						✓	
Georgia	✓	✓	✓				✓		✓	
Hawaii	✓		✓							
Illinois	✓	✓	✓			✓				
Indiana	✓		✓							
Kansas	✓	✓	✓	✓						
Kentucky	✓	✓								
Louisiana	✓	✓	✓							✓
Massachusetts	✓		✓							
Nevada	✓		✓							
New Hampshire	✓		✓							
North Carolina	✓	✓	✓							
Oklahoma	✓	✓	✓							
South Carolina	✓									
Texas	✓	✓		✓				✓	✓	✓
West Virginia	✓									

Notes: LEB = Least expensive brand. Food product legend: DB = dried beans, CB = canned beans, PB = peanut butter, CF = canned fish, BJ = bottled juice, FJ = frozen juice, WG = whole grain.

Source: USDA, Economic Research Service and University of California, Davis compilation based on a review of Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) State Agency Shopping Guides.

Despite the multitude of different strategies employed by WIC State agencies throughout the country, little is known about the food-package cost implications of WIC participants choosing expensive brands, products, and package sizes. Further, to date, only limited research has quantified the potential cost savings associated with limiting participant choice. Kirlin et al. (2003) compared different cost-containment policies across six State agencies and found alternative cost-containment regimes would reduce WIC food package costs between 0.2 and 21.4 percent. Davis and Leibtag (2005) used scanner data across 17 different States to determine the factors that influence interstate variation in average monthly WIC food costs and estimated the degree to which different cost-containment policies would save program food costs. These authors found the effectiveness of LEB policies or other restrictions at producing food cost savings depend on both what participants would purchase in the absence of restrictions and the relative prices of alternatives. Therefore, to best estimate food cost savings from LEB policies requires an understanding of choices participants make when using their benefits and how that relates to prices charged by WIC-authorized vendors.

This study evaluates the effectiveness of LEB cost-containment policies in California by using actual WIC redemptions and simulations conducted with retail scanner data. The study seeks to answer two related questions: (1) what are the product categories for which WIC participants tend to prefer the most expensive brands, and (2) what are the food cost implications of limiting participant product choices for WIC-eligible foods?[8]

In order to answer these questions, we used transaction-level WIC FI redemption data from California WIC and matched store-level scanner data from eight WIC-authorized supermarkets to compare actual FI redemption costs to various simulated scenarios where (1) participant choice was limited by LEB policies or (2) the most expensive WIC-approved products were selected. Comparison of these simulated scenarios provides information to policymakers and program operators of the cost implications of limiting participant choice within specific WIC-eligible food categories. Given that all WIC State agencies are confronted with identifying and implementing cost-containment policies while simultaneously maintaining participant satisfaction, our results are relevant for programs throughout the country.

[8]There may be implications beyond cost savings to limiting participant choices such as reduced program participation, reduced participant satisfaction from WIC-authorized food choices being limited, fewer FIs being redeemed, or participants augmenting their shopping patterns or choosing to shop at different stores. Yet, our dataset does not enable these issues to be analyzed as part of this study.

Table 2

Average monthly food costs per participant (dollars): WIC State agencies with LEB policies in fiscal year (FY) 2015

WIC State agency	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	5-year avg.
Alabama	46.59	45.19	48.34	45.52	45.43	46.21
Alaska	50.48	54.53	52.51	52.82	56.77	53.43
Arkansas	46.51	43.90	43.81	43.09	43.46	44.16
Florida	44.62	43.80	42.17	42.03	42.41	43.00
Georgia	45.47	40.82	40.03	39.62	38.19	40.82
Hawaii	51.97	53.10	51.38	53.08	54.10	52.73
Illinois	48.16	47.81	48.44	52.16	48.83	49.08
Indiana	37.26	38.09	38.47	36.17	32.72	36.54
Kansas	37.78	39.59	36.41	37.92	37.11	37.77
Kentucky	39.42	40.86	42.72	40.15	35.42	39.71
Louisiana	50.18	48.91	48.04	47.14	45.47	47.95
Massachusetts	39.99	39.20	38.25	38.95	37.43	38.76
Nevada	37.62	37.26	37.03	36.05	36.54	32.33
New Hampshire	32.89	32.45	33.05	33.15	30.09	43.70
North Carolina	43.28	46.63	42.84	42.73	42.93	37.27
Oklahoma	40.30	40.02	38.67	35.97	34.62	45.68
South Carolina	46.26	46.71	45.94	44.96	44.51	28.30
Texas	26.46	29.27	28.89	29.81	27.08	40.13
West Virginia	42.33	39.28	39.22	41.15	38.66	42.09
LEB States average	**42.50**	**42.50**	**41.91**	**41.71**	**40.62**	**46.21**

Notes: LEB = Least expensive brand. avg. = Average.

Source: USDA, Food and Nutrition Service's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) data.

Table 3

Average monthly food costs per participant (dollars): WIC State agencies with no LEB policies in fiscal year (FY) 2015

WIC State agency	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	5-year avg.
Arizona	42.88	44.09	45.55	44.94	42.80	44.30
California	46.05	47.21	47.80	46.09	45.33	46.49
Colorado	40.61	40.99	41.36	41.03	36.94	40.16
Connecticut	42.25	46.22	48.04	43.65	43.59	44.75
Delaware	37.85	40.07	40.55	40.07	38.33	39.37
Idaho	36.83	36.19	35.28	34.59	35.15	35.61
Iowa	33.44	36.48	36.86	30.51	32.61	33.98
Maine	41.06	44.41	45.71	39.69	41.76	43.13
Maryland	43.05	41.38	45.14	44.39	41.71	39.19
Michigan	40.46	41.23	38.62	38.60	37.05	44.61
Minnesota	46.00	43.79	44.07	43.98	44.66	36.91
Mississippi	54.05	53.03	53.35	53.89	50.99	41.38
Missouri	37.60	38.20	38.22	35.87	34.36	42.55
Montana	42.68	38.95	41.40	42.23	41.66	53.46
Nebraska	44.72	45.96	43.65	41.36	39.50	35.60
New Jersey	53.48	53.31	53.48	53.48	53.56	53.61
New Mexico	36.03	37.54	37.00	36.06	36.68	46.41
New York	54.71	55.29	53.97	53.09	50.94	33.70
North Dakota	48.92	47.30	47.02	47.21	46.29	38.35
Ohio	35.78	35.93	34.76	31.67	30.37	43.81
Oregon	39.93	38.83	40.52	37.48	35.00	44.49
Pennsylvania	43.94	41.79	45.93	44.19	43.21	45.42
Rhode Island	46.38	44.27	44.23	44.56	43.00	41.02
South Dakota	47.47	48.70	48.42	46.37	42.39	37.18
Tennessee	41.98	44.05	38.23	41.63	39.19	49.87
Utah	36.10	36.40	36.87	37.89	38.66	33.18
Vermont	49.91	52.90	53.20	48.30	45.02	41.55
Virginia	31.21	37.92	30.68	35.36	30.72	42.39
Washington	41.29	41.96	43.26	42.30	38.93	30.95
Wisconsin	43.33	44.50	44.73	41.23	38.15	41.50
Wyoming	31.69	33.16	30.88	32.34	33.18	44.30
Non-LEB average	**42.33**	**42.97**	**42.86**	**41.74**	**40.38**	**46.49**

Notes: LEB = Least expensive brand. avg. = Average.

Source: USDA, Food and Nutrition Service's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) data.

California WIC

California has the largest WIC State agency in the country, with average monthly participation of nearly 1.1 million women, infants, and children in FY 2017, or about 15 percent of all WIC participants. The average monthly food benefit cost in California in FY 2017 was $45.33 per person (table 3), with statewide program food expenditures totaling nearly $558 million in the same year.[9]

Like most WIC State agencies, California WIC facilitates food benefit distribution by authorizing retail establishments to redeem WIC food instruments. More than 5,500 vendors were authorized in California in 2012, including most stores of leading retail food chains (Saitone et al., 2014). FNS requires WIC State agencies choosing to use commercial vendors for the redemption of FIs to establish maximum allowable reimbursement levels (MARLs).[10] MARLs act as price ceilings and are established for each FI issued by the agency. Given various store- and market-level factors that may influence food prices, FNS requires MARLs to be set according to vendor peer-group structures. Peer groups are made up of vendors sharing characteristics such as similar size or format, geographic location, or the number of WIC sales so that stores in a given peer group likely have similar business models and purchasing power. MARLs are one form of cost containment implemented by all WIC State agencies.[11]

While California WIC uses MARLs to contain vendor pricing, it does not employ LEB policies and allows participants broad choices in product types, brands, and package sizes within Federal WIC food regulations. Participants have access to a shopper's guide, which advises them on what products are approved and disallowed for purchase with WIC vouchers.[12] Given the relative absence of product-specific restrictions in California, the State is an ideal testing ground for determining the possible cost savings that WIC State agencies may obtain through implementing various product-specific cost-containment policies (e.g., LEB). In order to simulate these possible outcomes, we relied on two specific datasets: actual FI transaction-level redemption data for California WIC participants and Information Resources, Inc. (IRI) InfoScan®, which includes store-level scanner data for California grocery retailers.

California WIC Redemption Data and Food Instruments

The California WIC redemption data consist of FI redemptions made under the program from October 2009 through March 2012.[13] The variables in the redemption data can generally be divided into three categories: (1) FI identification and information, (2) vendor identification, and (3) redemption and MARL information.

Each observation in the dataset is an FI transaction that contains the individual serial number of the food instrument and the food item code, which describes the food items available for purchase with that particular FI. During this time, the California WIC agency had 239 active FIs and Cash Value Vouchers (CVVs) issued for purchasing fresh fruits and vegetables. The 36 most frequently redeemed FIs accounted for roughly 90 percent of the value of all FIs redeemed, while the less frequently redeemed FIs often included products

[9]WIC data on food costs and participation can be found on the FNS website.

[10]Under the EBT system, MARLs are set for each individual eligible food item.

[11]The California WIC Agency, during the period of this study, established MARLs for 16 different vendor peer groups. Using the number of cash registers as a proxy for store size, California WIC established five vendor size groupings: 1-2, 3-4, 5-6, 7-9, and 10 registers and above. In addition, the State was divided into three geographic regions, creating 15 (5 x 3) peer groups. The final peer group consisted of Above-50 (A-50) vendors, who derive 50 percent or more of their annual food sales revenue from WIC redemptions. See Saitone et al. (2014) for a detailed discussion of how peer groups influence program costs.

[12]The current California WIC Shoppers Guide can be viewed on the WIC homepage of the California Department of Public Health.

[13]These data are the same as those described and utilized in Saitone et al. (2014).

that are specialty items for participants with specific nutritional needs or dietary restrictions. Thus, only a few food instruments collectively accounted for the majority of program food expenditures. In this study, we focus on the three most frequently redeemed FIs in California during the study period: FIs 6003, 6011, and 6012. Table 4 provides a breakdown of the food items contained in each of these FIs. In addition to accounting for 31 percent of total California WIC redemptions by value during the study period, these FIs contain the food items commonly targeted for LEB policies (see table 1).

Vendor information available in the WIC redemption dataset consists of vendor name, vendor identification number, address and zip code, vendor peer group, and the county where the vendor is located. Vendors that are part of a chain also have a contract identification number to link them to other vendors who are members of the same chain. We used the vendor information in the redemption data to link actual WIC FI redemptions in California to stores in the IRI scanner data.

Table 4
Food items contained in the most frequently redeemed combination food instruments

				Choose either:				Choose either:	
Food item	Low/non-fat milk	Whole grains	Breakfast cereal	Bottled juice	Concentrated juice	Eggs	Cheese	Dry beans	Peanut butter
6003	1 gal	16 oz	36 oz	N	N	N	N	N	N
6011	1 gal	16 oz	N	64 oz	11.5/12 oz	N	N	N	N
6012	1 gal 1 qt	N	N	N	N	1 doz	16 oz	16 oz	16-18 oz

Note: Food items not included in a food instrument are indicated by "N." oz = ounces, gal = gallon, qt = quart, doz = dozen.

Source: California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) transaction data.

Also included in these data are the value that the vendor requested for the redemption of the FI and the relevant FI MARL for the vendor during that period. The amount requested for redemption is the sum of the prices for all products the participant purchases with a given FI. However, we do not know what specific products (e.g., brand, type, package size, etc.) were purchased to fulfill the food instrument, including whether or not the FI was fully or partially redeemed.

IRI Scanner Data

The second dataset utilized in this study is IRI InfoScan® retail scanner data. These data include weekly food retail sales at the level of universal product code (UPC) from over 40,000 food retail establishments across the United States. For each participating food retail establishment, the data include UPC code, product description, volume sold, and product price (derived as sales revenue divided by the volume of sales) for most items sold in the store in a given week. The sales variables include in aggregate both WIC and non-WIC sales combined.

A store dictionary dataset accompanies the retailer scanner data, containing store name, address, retail chain, and retail marketing area (RMA). Included in the IRI data are participating food retailers classified as grocery stores, drug stores, convenience stores, mass merchandisers, club stores, and dollar stores.[14] Using store name and address information, we were able to identify which food retailers in the IRI dataset are WIC-authorized vendors where California WIC participants redeemed their FIs.

Using both UPC codes and the product dictionary file, we were able to code products as WIC-eligible following the guidelines for California WIC participants in the California WIC Shoppers Guide. This process had to be conducted on a store-by-store basis, as different retailers carry different sets of products that may or may not be WIC-approved.

[14]Most of the A-50 and small non-A-50 (1-4 registers) authorized-WIC vendors in California do not supply scanner data to IRI and therefore cannot be analyzed as part of this study.

Store Selection and Simulation

We specified several criteria for the selection of WIC-authorized vendors in California for the simulation analysis. First, the store must have been both California WIC-authorized and supplying scanner data to IRI for January 2011 through March 2012. This reduced the number of WIC-authorized food retailers available for potential inclusion in the study to 733 (from a total of nearly 5,500).[15]

Second, given that the simulations were conducted at the store level, each store selected needed to have a significant number of WIC FI redemptions in each month. Across all matched stores, the average total number of FIs transacted per store in 2012 was 6,483. There was substantial store-level variation; for example, one WIC-authorized retailer redeemed 42,458 FIs during a single year while another only redeemed 10. In order to have enough observed WIC transactions in the simulation, we restricted our sample of WIC-authorized stores to those with more than 10,000 WIC FIs redeemed in 2012 and more than 1,000 FIs redeemed in each month of that year. Given that our simulated shopping behavior occurs at the FI level, we also required each WIC-authorized store to have transacted at least 100 of each of the three food instruments considered—FIs 6003, 6011, and 6012 (table 4)—in March 2012.

Finally, we checked that there was both geographic and chain-level variation in the sample of stores chosen. This was to ensure we could investigate how prices differed across stores, chains, and the State and, in turn, how these differences impacted savings from LEB policies. Table 5 includes information on the eight stores analyzed, including their location (county), the number of cash registers, the total FIs redeemed in that store in 2012, and the number of the three most frequently redeemed FIs (6003, 6011, and 6012) transacted in March 2012. Data-sharing agreements with IRI prohibit identifying specific chains or stores. Thus, throughout the analysis, we referred to chains as 1 to 4 and stores within each chain as stores 1 and 2.

We focused the simulation analysis on WIC redemptions and store-level scanner prices in March 2012 because it was the most recent month for which transaction-level redemption data were available. We constrained the analysis to a single month (March 2012) to eliminate possible time variation in the retail prices. Conducting the analysis during only 1 month is unlikely to speciously drive our findings; we provide evidence for this claim in appendix A.

Given the necessity to match WIC-transaction data and IRI data at the store level and to have substantial WIC traffic at each store, neither small WIC-authorized vendors nor vendors located in remote rural areas could be included in the study. Results should thus be interpreted to apply to large supermarkets in urban settings. Exclusion of rural areas is not a major limitation because most WIC participants live in urban areas; for example, about half of all California participants live in the greater Los Angeles area (Ma et al., 2019). Small non-A-50 retailers (those with 1–4 cash registers) comprise a disproportionately small share of FI redemptions in California (15.4 percent of revenue but 22.9 to 29 percent of all authorized vendors from October 2009 to February 2012), making their exclusion from the analysis of minor importance (Sexton and Saitone, 2012).[16]

[15]Note that roughly one-quarter of all grocery stores in the United States, as measured by the 2012 Economic Census, appear in the IRI retail scanner data (Muth et al., 2016). Furthermore, store-level data do not exist for several prominent chains. However, the studied stores are frequently patronized by WIC participants compared to other large supermarkets in California.

[16]A-50 vendors are also excluded from this study despite their prominence in California's WIC. A-50 vendors comprised 16 percent of all authorized vendors but redeemed 37 percent of the value of all benefits from October 2009 to February 2012 (Saitone and Sexton, 2012). These vendors do not provide scanner data to IRI. In addition, A-50 vendor prices are constrained by FNS regulations to not exceed the statewide average redemption value. California WIC imposes this constraint by setting the A-50 MARL for each FI at the statewide average redemption value in preceding time periods. McLaughlin et al. (2019) show that California A-50 vendors set prices for each FI very near its MARL.

Table 5
Store-level FI redemption information

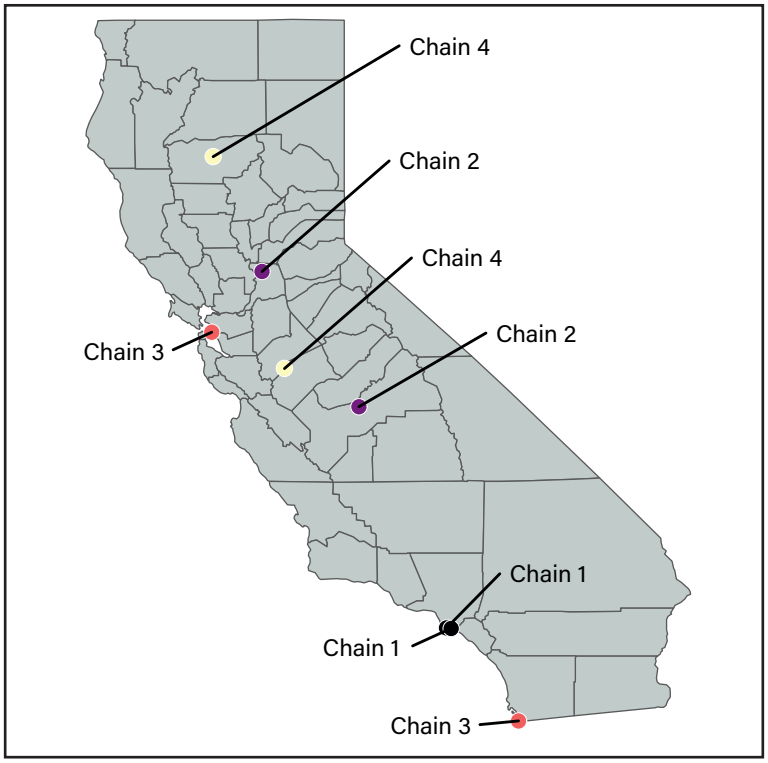
Chain code	Store code	County	Number of registers	Total FIs redeemed (2012)	Number of FIs redeemed in March 2012		
					FI 6012	FI 6011	FI 6003
Chain 1	1	Los Angeles	15	19,477	189	112	129
	2	Los Angeles	18	11,550	94	94	108
Chain 2	1	Sacramento	15	17,699	244	172	181
	2	Fresno	8	15,184	232	150	138
Chain 3	1	San Diego	10	35,721	472	297	341
	2	Alameda	14	21,209	255	167	189
Chain 4	1	Stanislaus	8	24,774	315	194	208
	2	Tehama	17	19,947	277	192	213

Note: FI = Food Instrument.

Source: USDA, Economic Research Service and University of California, Davis calculations using California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) transactions data.

Prior research on California WIC cost containment (Saitone et al., 2014) shows that small WIC vendors charged substantially higher prices for WIC FIs, regardless of geographic location. These findings, combined with our inability to analyze the product-level prices at these vendors, caution against generalizing the potential cost savings from implementing LEB restrictions at small WIC vendors in California or elsewhere.

Figure 2
Geographic location of stores in the simulation analysis



Source: California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) transaction data.

Simulation Methodology and Implementation

Given the California WIC transaction data do not include a detailed breakdown of the specific products purchased with combination FIs and that the IRI data do not single out WIC sales, it was necessary to design a simulation methodology to make inferences about the product-category shopping patterns of WIC participants.[17] We simulated WIC participants' shopping behavior and the resultant FI redemption costs under three different scenarios: (1) random shopping within a food category, (2) shopping for the most expensive brand(s), and (3) shopping for the least expensive brand(s) in one or more food categories. Each of these simulations was then compared to actual California WIC participant shopping patterns and FI redemption costs for each store in the study.

Simulations were conducted at the store level using the available WIC-approved products and computed monthly average prices in the IRI scanner data.[18] Simulation of the random-shopping scenario was conducted by using a computer-generated algorithm to randomly select a single product from a given food category for the three most frequently redeemed FIs (6003, 6011, 6012). For example, when simulating random shopping for FI 6003, the computer program randomly selected individual products corresponding to a gallon of nonfat/low-fat milk, 16 ounces of whole grains, and up to 36 ounces of ready-to-eat breakfast cereal. The total redeemed value for this purchase was the sum of the prices for the three product selections. This procedure was then repeated 1,000 times per store for each FI.

The most-expensive brand (MEB) scenario was designed for comparison purposes. FI redemption values simulated in the MEB scenario can then be compared, on a store-by-store basis, to actual redemption values to determine the degree to which price-insensitive WIC participants' shopping resembles MEB shopping.

Finally, the LEB simulations were designed to quantify the potential cost savings associated with implementing various LEB policies. For all possible combinations of product categories available through WIC (table 1), we simulated the redemption values from imposing LEBs in the respective product categories with the three most frequently redeemed FIs in California. Each of the results from the store-level LEB policy combinations was then compared to the actual redemptions during the same month to determine the potential cost savings of each policy.

We applied a decision-tree approach in the simulation for each product category by store for simulating the MEB and LEB shopping scenarios. The mechanics for selecting a brand are similar for both scenarios, which is why we describe their selection procedures together. The first step for each store and product category was to identify by UPC code the specific products that were approved for purchase through WIC.[19] The methodologies implemented in each product category follow.

[17]Similar simulation methodologies have been successfully employed by Saitone et al. (2014) and McLaughlin et al. (2019). In each of these studies, the economic impact of hypothetical scenarios where FI transactions taking place at a subset were "re-shopped" at all other authorized vendors to simulate the absence of the former subset of vendors.

[18]The IRI scanner data include a comprehensive offering of private label products, also known as store brands, for only a limited number of food retail chains. While private label products are included among the WIC-approved foods studied here, it may be possible that some private label sales are not reported. However, roughly 43 percent of the identified WIC-approved items are private label, suggesting the implications of failing to capture any private label brands are minimal.

[19]There was variation across product categories in the number of observed WIC-approved items. For quarts of milk of each fat content, each store had only one approved item but two or more approved gallons. Most cheese types had five or more approved items. Stores were observed to carry 10 or more approved items in breakfast cereal, peanut butter, whole grains, juice, and dried beans. Most study stores carried two or three WIC-approved items for eggs, except for one store that had one approved item.

Low-Fat Milk

For each WIC-approved volume (e.g., gallon, quart), we first found the LEB and MEB for each approved butterfat content—nonfat, 1 percent, and 2 percent. From among this set of LEBs and MEBs, a single product was selected at random at uniform probability for both the LEB and MEB, chosen in the simulation iteration.

Cheese

For each WIC-approved cheese type, we found the LEB and MEB among approved package sizes and designs (i.e., 16-ounce block, round, or string). Then we selected a product at random at uniform probability among the set of LEBs for the least-cost simulation and among the set of MEBs for the most-expensive brand simulation.[20]

Whole Grains

California WIC participants can fulfill the whole-grain product category in their FIs from six different product forms: whole wheat bread, tortillas, brown rice, barley, oatmeal, and bulgur.[21] For the random shopping simulation, we randomly selected one 16-ounce item from the six product forms. For the LEB and MEB simulations, the least and most expensive brands within each product form were selected, and from among those products, a single product type was chosen at random with uniform probability.

Bottled and Concentrated Fruit Juice

WIC participants have the option to select bottled or concentrated fruit juice. We did not have information on WIC participant preferences across juice types, and in simulations, we weighted the selections by the availability of the juice types in each store.[22] After this weighting process, the simulation allowed for random selection among approved juice flavors.

Ready-to-Eat Breakfast Cereals

Ready-to-eat (RTE) breakfast cereals are available in a wide range of sizes, and WIC participants are allowed to redeem FIs with multiple boxes that total up to 36 ounces of cereal. Given that no WIC State agencies currently employ LEB policies for breakfast cereals, LEB simulations were not run for this product category.[23] We also did not run an MEB simulation due to the computational difficulty of the task. To facilitate the selection of multiple types and sizes of cereal, the following process was used for each run of the simulation in each store:

[20]Participants are allowed to choose the cheese type they prefer. For example, the LEB of Colby cheese can be selected, even if the LEB of another cheese type, say cheddar, is less expensive. The only allowed string cheese in California during the study period was mozzarella, so mozzarella string cheese was treated as a separate product from mozzarella blocks or rounds.

[21]As of March 2016, California WIC approved the purchase of whole-grain pasta as another product form for whole grains. The cost-containment implications of this addition are unclear.

[22]Bottled fruit juice comprises 63 to 77 percent of available juice options across the study stores.

[23]In choosing whether to restrict participant choice to LEBs, State agencies are faced with striking a balance between obtaining food cost savings and potentially decreasing participant satisfaction with food benefits or increasing administrative costs. On the one hand, the extent of price variability in breakfast cereal implies significant savings could be obtained by imposing LEB restrictions. The fact that no State employs LEBs in this product category implies that costs in participant satisfaction and increased administrative burden unequivocally outweigh any potential savings. This is consistent with evidence that California WIC participants highly value access to a variety of national brands of breakfast cereal, with cereal availability influencing their choice of vendors for their WIC shopping (McLaughlin, 2015). Excluding breakfast cereal from hypothetical LEB restrictions, therefore, focuses on providing the most realistic and relevant estimates of food cost savings.

1. We made a random selection at uniform probability of WIC-approved cereal, and if that box was larger than 24 ounces, the simulation was stopped. This was because program rules require cereal to be purchased in boxes of at least 12 ounces, and thus any further selection would exceed the 36 ounces allocated by the FI.

2. If the box selected was 24 ounces or less, we continued the simulation with a random selection of another cereal box greater than or equal to 12 ounces but low enough in volume that the combined purchases for the FI did not exceed 36 ounces.

3. Finally, we summed the prices of the cereals purchased in the simulation to determine the total cost in that run.

Eggs, Peanut Butter, and Dried Beans

Among WIC-approved products, we selected the LEB and MEB for each product category and then selected a particular product type at random with uniform probability from the LEB and MEB product sets to conduct the LEB and MEB simulations.

LEB policies can impose challenges for program participants and WIC-authorized vendors in terms of identifying the LEB and ensuring the correct product is purchased (Kirlin et al., 2003). States implementing LEB policies impose regulations on vendors as to how the LEB is determined and marketed to participants, including training cashiers to ensure the correct brand is purchased. This challenge may be especially pronounced when prices for WIC-eligible products vary over time. For instance, while this study identifies a category's LEB based on monthly average prices for analytical simplicity, this LEB may not always have the lowest price if computed on a weekly basis. In fact, an examination of weekly average prices indicates the brand with the lowest price changed once in March 2012 for most cheese types, juice, and peanut butter for the majority of the study stores. However, the LEB generally remained the item with the lowest weekly average price for dried beans, eggs, milk of all sizes, and whole grains.

State agencies operating with limited budgets also face challenges in ensuring compliance with LEB policies if it makes upholding program integrity more cumbersome. Given that the designation of LEB can vary by administrative definitions or due to price changes over time, monitoring all vendors for compliance may be a complex, resource-intensive task. Addressing these issues, however, is beyond the scope of this study—the simulation analysis assumes an LEB policy can be implemented to ensure that the least-cost eligible product is correctly marketed by vendors as the WIC-approved product and identified and purchased by all participants.

Price Variation in WIC-Authorized Food Categories

Before describing the results of the simulation analysis, we show the price variability of products available in the studied stores in the food product categories that comprise the three most frequently redeemed FIs in California. Product price variability across brands and packages, stores, and locations is the key consideration in seeing savings from implementing least-cost policies. These summary statistics are necessary for a perspective on the simulation results that follow, as price variability differs by State (McLaughlin et al. 2018).

Table 6 summarizes the store-level price variability in the IRI scanner data in each product category included in the three most-frequently-redeemed FIs. For example, eggs, although rather homogenous in types that are WIC-approved (specialty products like cage-free eggs are not approved), exhibit substantial within-store price variation. Store 2 in Chain 1 had the highest average price for a dozen eggs ($3.52), while Store 1 in Chain 3 had the lowest average egg prices ($1.94/dozen). Many stores have a standard deviation in excess of 75 cents per dozen in the egg category, meaning that the average difference in prices across different brands of WIC-approved eggs in a given store is typically in excess of 75 cents.

RTE breakfast cereal, whole grains, and cheese—which also show substantial in-store price variation— are product categories where California WIC provides participants with wide latitude in redemption options (table 6). These are also product categories that were shown by Saitone et al. (2014) to have the potential to increase program costs substantially through product selection. We provide a more in-depth look at the brand-level, store-level, and chain-level price variation exhibited in the IRI data in these product categories in box plots in figures 3 through 6.

Table 6

Store-level product price variability among available WIC-approved foods (dollars)

Store	Statistic	Milk (quart)	Cheese (16 oz)	Eggs (oz)	Peanut butter (16 oz)	Beans (16 oz)	Bottled juice (64 oz)	Frozen juice (12 oz)	RTE cereal (oz)	Whole grains (16 oz)
Ch1, St1	Mean	1.07	6.47	3.22	3.23	1.88	3.83	2.25	0.27	2.48
	SD	0.40	0.64	1.28	0.90	0.93	0.66	0.54	0.08	0.94
	CV	0.37	0.10	0.40	0.28	0.49	0.17	0.24	0.30	0.38
Ch1, St2	Mean	1.12	6.33	3.52	3.24	1.92	3.85	2.31	0.26	2.61
	SD	0.33	0.67	0.74	0.84	0.89	0.62	0.05	0.06	0.92
	CV	0.29	0.11	0.21	0.26	0.46	0.16	0.02	0.23	0.35
Ch2, St1	Mean	1.12	4.69	3.06	2.99	1.55	3.42	2.15	0.27	2.78
	SD	0.25	0.72	0.74	0.65	0.62	0.66	0.28	0.06	1.00
	CV	0.22	0.15	0.24	0.22	0.40	0.19	0.13	0.22	0.36
Ch2, St2	Mean	1.07	4.60	2.66	2.96	1.56	3.58	2.07	0.26	2.88
	SD	0.25	0.63	1.06	0.47	0.58	0.59	0.40	0.07	1.08
	CV	0.23	0.14	0.40	0.16	0.37	0.16	0.19	0.27	0.38
Ch3, St1	Mean	1.00	5.92	1.94	2.93	1.36	3.55	1.99	0.27	2.64
	SD	0.32	1.66	0.36	0.71	0.3	0.94	0.40	0.08	0.90
	CV	0.32	0.28	0.19	0.24	0.22	0.26	0.20	0.30	0.34
Ch3, St2	Mean	1.37	4.71	2.86	3.38	1.79	3.77	2.11	0.27	3.14
	SD	0.40	0.68	0.82	0.56	0.87	0.55	0.42	0.07	0.95
	CV	0.29	0.14	0.29	0.17	0.49	0.15	0.20	0.26	0.30
Ch4, St1	Mean	1.03	5.18	2.41	3.46	1.48	3.39	2.02	0.25	3.12
	SD	0.32	0.57	0.95	0.60	0.29	0.64	0.36	0.06	0.88
	CV	0.31	0.11	0.39	0.17	0.20	0.19	0.18	0.24	0.28
Ch4, St2	Mean	1.10	4.71	2.66	3.56	1.47	3.47	2.22	0.27	3.22
	SD	0.30	0.68	0.80	0.68	0.32	0.53	0.65	0.07	0.80
	CV	0.27	0.14	0.30	0.19	0.22	0.15	0.29	0.26	0.25

Notes: CV stands for the coefficient of variation, which is defined as the standard deviation (SD) divided by the mean. California WIC includes 1 gallon and 1 quart of milk in FI 6012. Thus, in this table, we convert the gallon price to the per quart price in the table by dividing by 4. Ready-To-Eat (RTE) breakfast cereal is authorized in box sizes between 12 ounces (oz) and 36 ounces. Prices for RTE cereal in the table are calculated by dividing the total box price by the number of ounces in each box to arrive at a price per ounce.

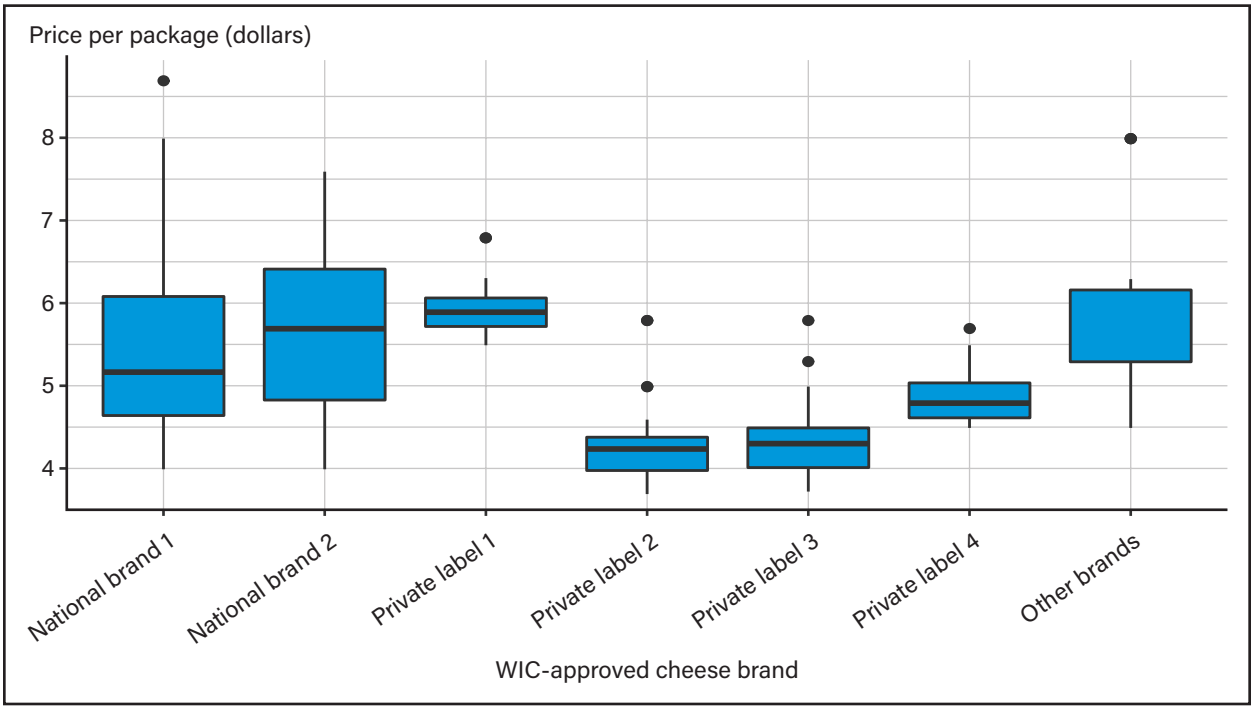
Ch = chain; St = Store. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service and University of California, Davis calculations using California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) transactions data.

Box plots are an easy way to summarize the underlying variability of data by providing many relevant statistics in one graph. They can be interpreted as follows: The line within the box is the median value (50th percentile); the bottom side (top side) of the shaded box area is the 25th (75th) percentile of the data (i.e., the area of the box contains 50 percent of the observations); and the vertical line extending to the bottom (top) of the box is the 10th (90th) percentile. The dots outside of these "whiskers" are outlier or extreme observations.[24] All the box plots have prices along the vertical axis (left-hand side of each figure) and summarize data for the simulated period (March 2012).

Figures 3-6 use box plots to show the price variability of WIC-authorized cheeses in the stores included in the simulation analysis. WIC-authorized cheeses in California can only be purchased in a single 16-ounce package size (block, round, or mozzarella string), which eliminates the need for multiple panels in a graphic. Figure 3 shows price variation across brands of cheese is substantial. For example, National Brand 1 cheeses have nearly a $4 range between the 10th and 90th percentiles of the pricing distribution in a single month. For the most part, across all stores, private-label cheeses are more affordable and have less inherent variability in price. This is likely due, in part, to this product being offered in only two of the eight stores included in the simulation, eliminating any cross-chain pricing variability.

Figure 3
Available WIC-authorized cheese: Brand-level price variability

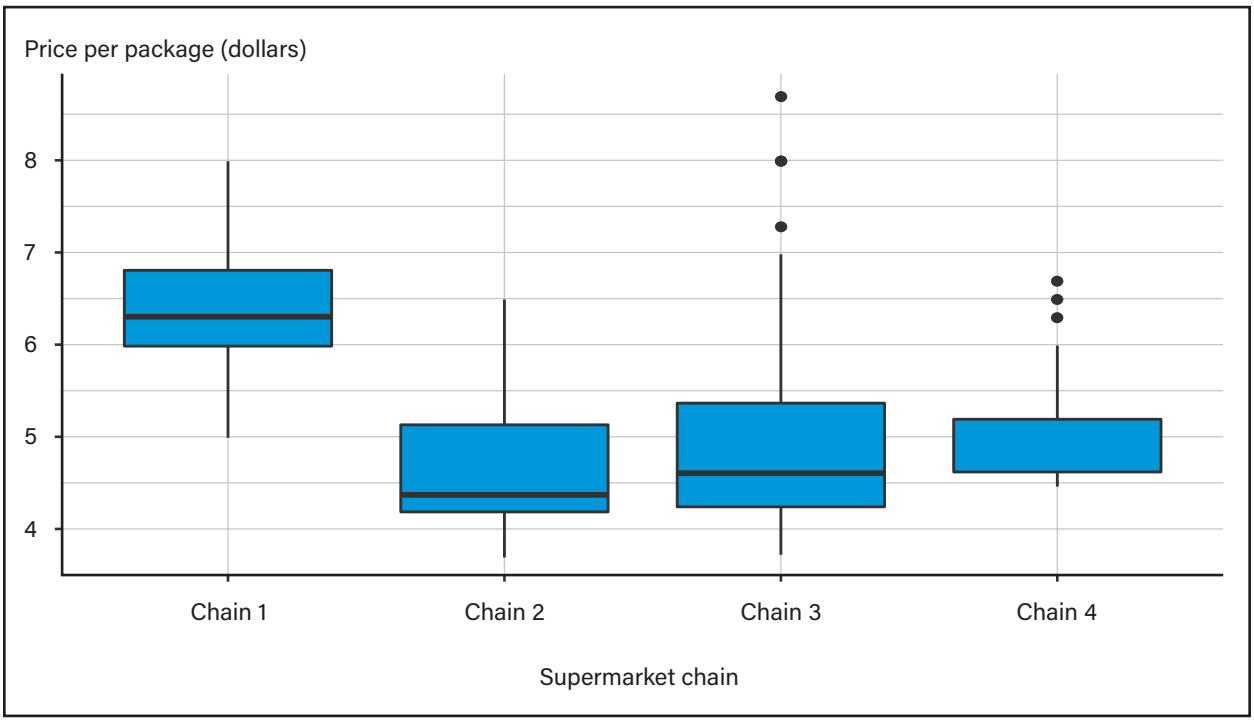


Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan.

[24]Outliers are those observations whose absolute value exceeds 1.58 multiplied by the interquartile range (i.e., the 75th percentile minus the 25th percentile).

Figure 4
Available WIC-authorized cheese: Chain-level price variability



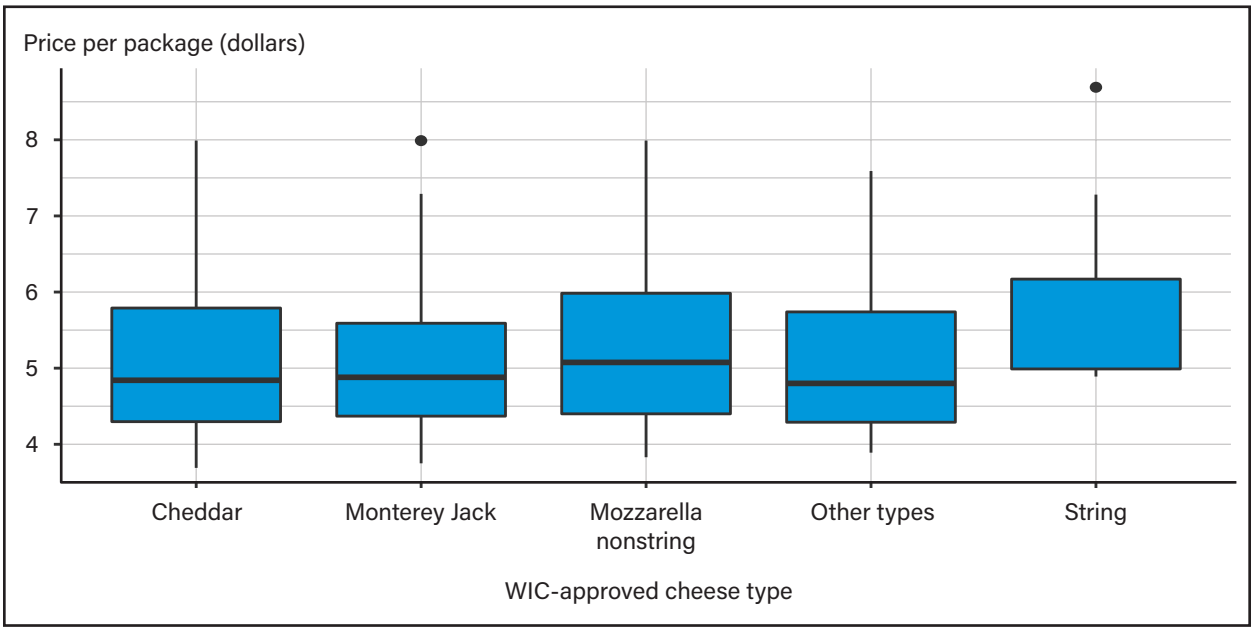
Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan.

Figure 4 considers chain-level price variation for the WIC-authorized cheese category. Overall, Chain 1 charges substantially higher prices for cheeses compared to the other three chains in the study. The median value for Chain 1 ($6.40/16 ounces) is roughly the same as Chain 2's 90th percentile price and exceeds the vast majority of prices charged by Chain 4. Thus, the savings associated with LEB pricing policies that include cheese would have a relatively larger impact for participants who shop in Chain 1 stores.

Figure 5 considers whether price variation is driven by cheese type (e.g., cheddar, jack, etc.). The figure shows that price distributions are very similar for all approved cheese types except mozzarella string. However, mozzarella string is considerably more expensive, costing between 55 and 61 cents more per package on average than any other product type in the cheese category after controlling for factors such as vendor peer group and brand type.

Figure 5
Available WIC-authorized cheese: Price variability by approved type

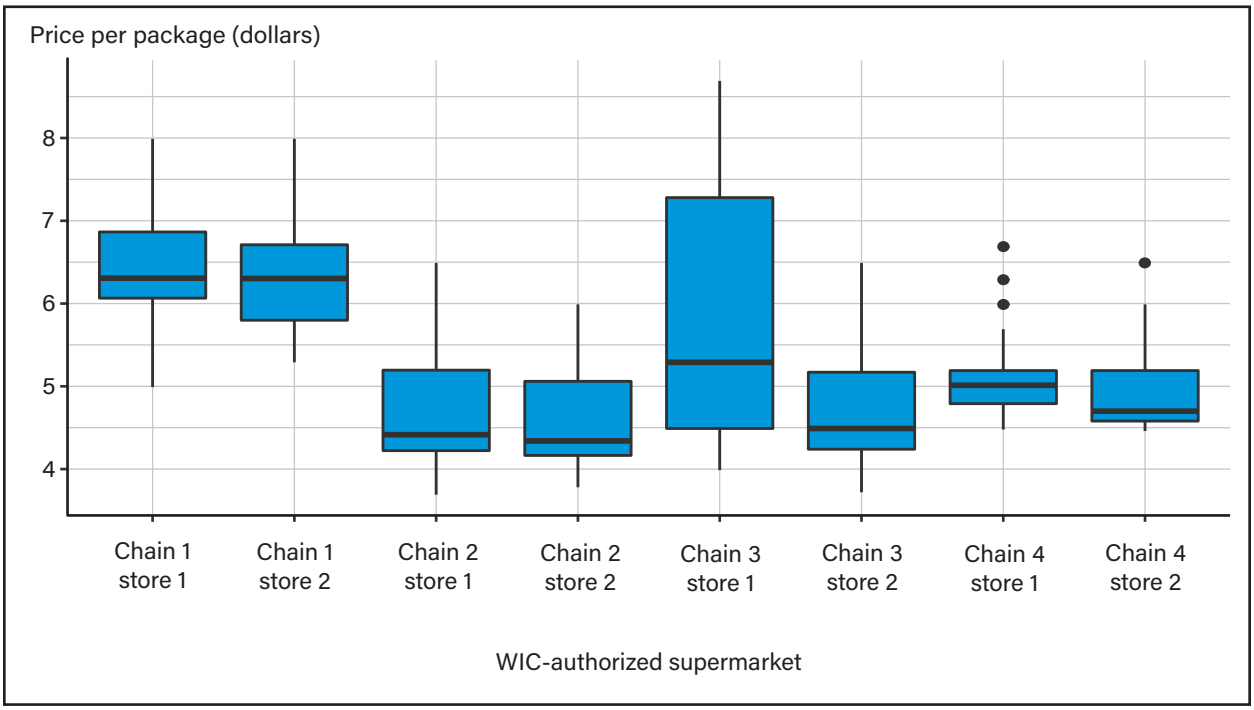


Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan.

Finally, figure 6 shows the store-level price variability in the WIC-authorized cheese category. Prices in Chain 1 stores are higher than other retailers included in the simulation. Notably, Store 1 in Chain 3 has the most price variability in this product category, with the 10th to 90th percentiles of the price distribution spanning nearly $5 for 16 ounces of cheese.

Figure 6
Available WIC-authorized cheese: Store-level price variability



Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan.

The inherent variability in prices for WIC-approved cheeses among WIC-authorized retailers is an example of how price variability, and thus potential food cost savings, can differ. While some of this variation is due to chain-level and store-level pricing policies beyond the scope of this study,[25] the following section shows how restricting the product choices available to participants can influence food costs.

[25]Tools available to WIC agencies to address high-cost WIC vendors include setting maximum allowable redemption values and determining store eligibility to participate in WIC. Stores are authorized or not on an individual store basis.

Simulation Results

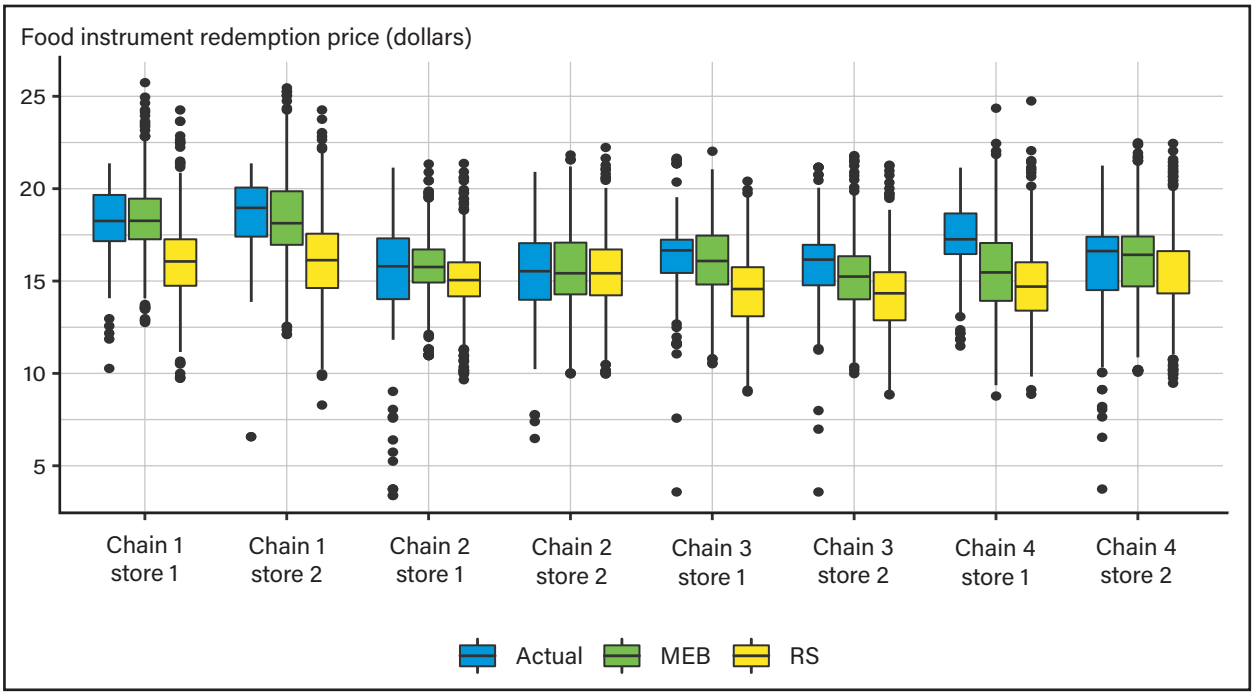
Results from the random-shopping (RS), LEB, and MEB simulation analyses for the eight WIC-authorized grocery retail stores selected for examination are summarized in this section. Beyond comparing store-level average FI prices, we also investigated how the actual and simulated pricing distributions compared to one another to offer insight into how WIC participants are making product-selection decisions. Finally, we offered a rough calculation of the possible cost savings associated with implementing LEB cost-containment policies in California.

We first conducted RS and MEB simulations to establish the plausibility of various baselines for comparison to different cost-containment policies. The transaction-level data from California WIC provide the cost associated with each FI redemption, but they do not include the specific products purchased or the cost of each product. Thus, comparing either the RS or MEB simulations to the distribution of actual FI prices provides possible baselines for estimating the reduction in program costs from alternative LEB policies. Given the available transaction-level data do not identify partial redemptions, the actual redemption prices may be biased downward in some cases.[26] Thus, the simulated baselines provide FI price comparisons representative of FIs that are fully redeemed. In addition, this exercise offers insight into the product categories within which WIC participants may prefer the most expensive brands.

Comparing the distribution by store of actual FI prices to simulated values revealed participants tended to purchase the most expensive brands in some product categories but not all (figures 7–9). We used three distinct metrics to determine how the in-store pricing distributions differ. The first one compared the mean of the actual shopping pricing distribution within stores for each FI to the RS- and MEB-simulated mean prices. We use a t statistic to determine if the means are statistically different (at the 0.05 significance level).

[26]As noted, the California WIC transaction data do not provide information on the products or prices for the individual products that comprise each FI. Further, since we don't know the products purchased with each FI, we are not able to eliminate transactions that are partial redemptions (i.e., a situation where only a subset of the authorized products is redeemed). Observations to the extreme bottom of the actual pricing distributions shown in figures 7-9 likely represent partial redemptions.

Figure 7
Pricing distributions by store for actual and simulated shopping, food instrument (FI) 6003



Notes: Most expensive brand (MEB) refers to the scenario where participants are assumed to choose the most expensive WIC-approved brand. Random shopping (RS) refers to the scenario where participants randomly choose among approved brands.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan and California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) administrative data on benefit transactions.

In recognizing the distributions may not be normal, the second and third tests utilized the entire distribution instead of a measure of central tendency. The Kolmogrov-Smirnov (KS) test uses the distance between the actual and simulated distributions to assess if they are statistically equivalent. Finally, the Wilcoxon rank-sum test (W test) uses the sum of the rank of the actual redemption values relative to the simulated values to determine if the distributions are statistically equivalent. Appendix B provides additional detail about how these tests were conducted and all the FI-specific within-store tests.

The t-test of means for FI 6003 shows the mean of the actual redemption distribution was not statistically different from the mean of the MEB simulated distribution for five of the eight stores (at the 0.05 significance level). When comparing actual redemption distributions to the RS distributions, only two stores (Chain 2, Stores 1 and 2) appeared to have the same means (failure to reject the null hypothesis at the 0.05 significance level). For five of the eight stores, we rejected the null hypothesis that the distributions are equal (at the 0.05 significance level) using the KT test (appendix table B1). Stated alternatively, the actual shopping behavior of California WIC participants redeeming FI 6003 differed statistically from the MEB-simulated shopping behavior (figure 7) in five of the eight stores considered. In the other three cases (Chain 1, Store 1; Chain 2, Store 2; and Chain 3, Store 2), the distribution of prices resulting from actual California WIC participant shopping patterns was not statistically different from the distribution created by the MEB simulation. Finally, using the W test, we found that in three of the eight stores (Chain 1, Store 2; Chain 3, Store 2; and Chain 4, Store 1), the actual shopping distribution cannot be statistically differentiated from the MEB-simulated distribution.

Using the same testing procedures, we also compared the distributions generated from the random shopping simulation with the actual shopping behavior of California WIC participants redeeming FI 6003 (figure 7). This suite of tests indicates that in only one of the eight stores sampled (Chain 2, Store 2) was the random shopping simulation distribution not statistically different from the actual shopping patterns of California WIC participants (at the 0.05 significance level using the KT test) for this food instrument.

FIs 6011 and 6012 are more complex than FI 6003 for the RS and MEB simulation analysis. This is because the first two FIs require participants to make selections within a given food category, i.e., bottled or concentrated juice (FI 6011) and dry beans or peanut butter (FI 6012) (table 4). Given that the California WIC transaction data do not include the products selected when a participant redeems a FI, we have no data about the choices participants made within these product categories.

The cost difference associated with participant choice within a food category (e.g., dried beans versus peanut butter) is often substantial. This creates a situation where the MEB simulations for FIs 6011 and 6012 will tend to be biased upward, with choice within a food category driving the increases in the price distributions. For an approved amount of either juice type authorized by FI 6011, the average price of the MEB of bottled juice exceeded the average price of the MEB of concentrated juice by $1.40 across the eight stores. Within the FI 6011 MEB simulation, participant choice (bottled versus concentrated juice) was weighted based on product availability. For approved quantities authorized by FI 6012, the average MEB peanut butter price exceeded the average MEB dry bean price by $2.99 across the stores in the study.[27] When the California WIC Agency was considering breaking FI 6012 into two FIs, one for participants wanting peanut butter and one for participants wanting dried beans, it estimated that 60 percent of participants would choose the peanut butter option. Based on this information, the MEB simulation assumed that 60 percent of participants redeemed the MEB peanut butter, and the remaining 40 percent redeemed the MEB dried beans. These underlying assumptions in the MEB simulations, particularly for FI 6012, created a situation where the MEB simulations are likely to overstate the simulated price for any participants who selected the lower priced item within the food category.

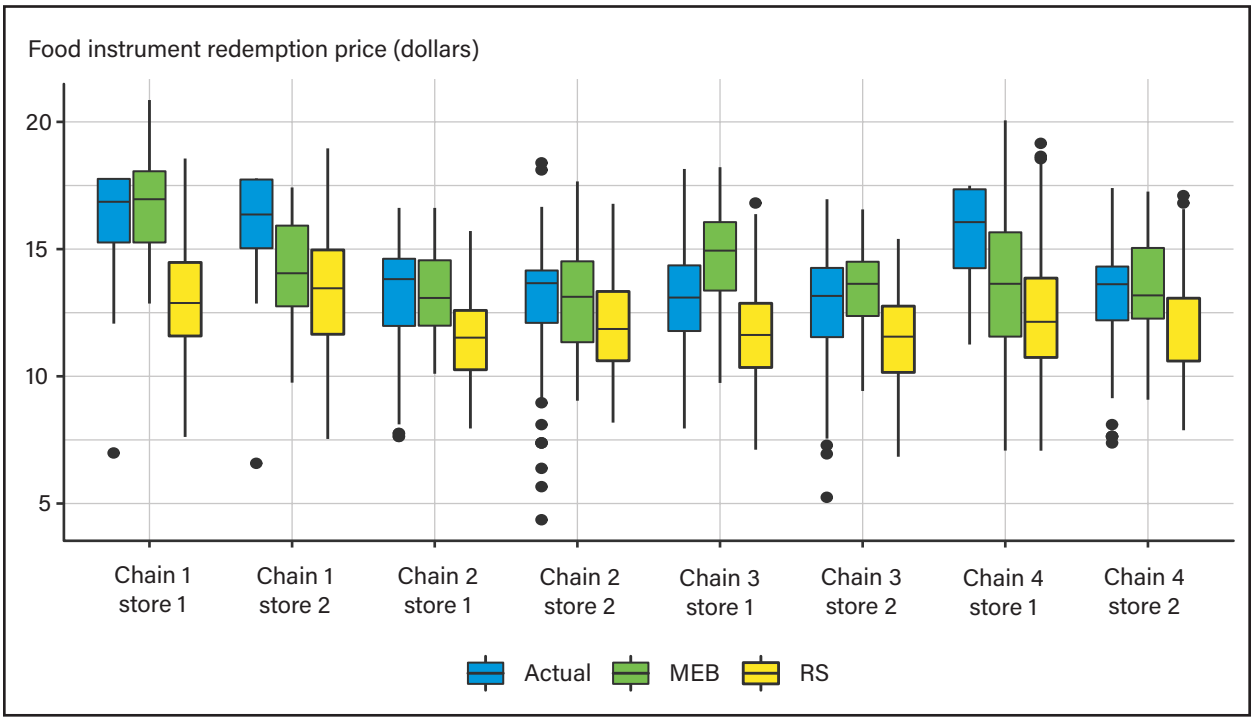
For FI 6011, the t test of means and the W test confirmed that for three stores (Chain 2, Stores 1 and 2; Chain 4, Store 2), the MEB-simulated distribution was not statistically distinguishable from the actual shopping patterns of participants (figure 8). The RS-simulated distribution produced pricing distributions that are statistically different from actual participant shopping patterns under all three statistical testing procedures. This suggests the MEB simulation produced results that are a closer approximation to actual California WIC participant shopping patterns compared to the random shopping simulation.

Finally, considering FI 6012 (figure 9), the three statistical tests we employed suggested that the actual and MEB distributions were all statistically different from one another across all stores. This may be driven by a number of factors, including participant choice within food categories. In figure 9, the MEB pricing distributions are generally shifted up, suggesting the MEB is overestimating the cost associated with products redeemed via this FI. This is likely driven by partial redemptions of FI 6012; National Academies of Science, Engineering, and Medicine (2017) documents that the redemption rate for peanut butter and dried beans is only roughly 50 percent, making this food category one of the most under-redeemed. When comparing actual shopping and the RS distributions for four stores (Chain 2, Stores 1 and 2; Chain 3, Stores 1 and 2), the W test indicated no statistical difference between them. Given that some pricing distributions are more closely approximated by the MEB simulation (FIs 6003 and 6011) and others appear to be more closely

[27]Given that multiple types of dry beans are WIC-authorized, there are multiple MEB product-price combinations available in the simulation. For this illustration, we used the average across the available MEB product types.

related to the RS simulation (FI 6012), we used both the MEB and RS simulations as baselines for comparison to various LEB scenarios explored in the next section.

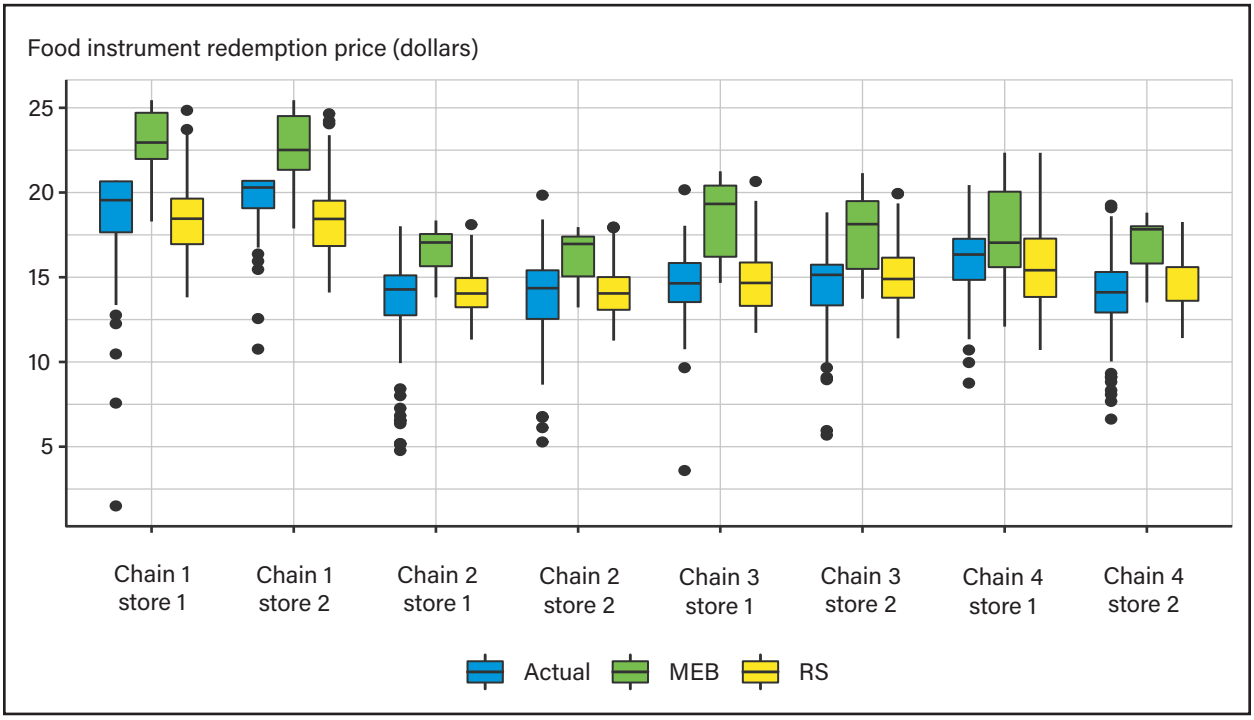
Figure 8
Actual and simulated shopping pricing distributions by store, food instrument (FI) 6011



Notes: Most expensive brand (MEB) refers to the scenario where participants are assumed to choose the most expensive WIC-approved brand. Random shopping (RS) refers to the scenario where participants randomly choose among approved brands.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan and California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) administrative data on benefit transactions.

Figure 9
Actual and simulated shopping pricing distributions by store, food instrument (FI) 6012



Notes: Most expensive brand (MEB) refers to the scenario where participants are assumed to choose the most expensive WIC-approved brand. Random shopping (RS) refers to the scenario where participants randomly choose among approved brands.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan and California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) administrative data on benefit transactions.

Comparisons for the FIs 6003 and 6011 provide some statistical support for the hypothesis that, on average, California WIC shoppers tend to select the more expensive product options than in a scenario where shopping is done at random. The idea that consumers may use price as a proxy for quality is not new (e.g., Gabor and Granger, 1966). More recent work suggests the price-quality correlation in consumers' minds persists due to the increasing amount of information available to consumers about any given product and the "cognitively daunting" nature of making optimal product selections (Rao and Monroe, 1988; Rao and Sieben, 1992). Thus, it is not surprising to observe this tendency to purchase the more expensive products among WIC participants, especially given that the products issued as part of each FI have specific characteristics that allow participants to purchase them (e.g., meet the Federal nutritional eligibility criteria) and are provided free of charge. An important component to the price as a proxy for quality theory as it relates to WIC is that many WIC-approved food products such as fluid milk, eggs, basic cheeses, and dry beans have little product differentiation, even though retailers often carry multiple brands and, as shown in this study, considerable price dispersion may exist for these products. For example, both the Federal Government through the USDA and State governments set uniform standards for fluid milk regarding purity, butterfat content, pasteurization, and vitamin fortification, leaving little scope for products to be differentiated.

Although it may be rational for WIC participants to use price as a proxy for quality, in such regulated settings, it is unlikely that the more expensive brands are providing them with better value, making it reasonable for WIC officials to consider least-cost policies for product categories where brands are fundamentally homogeneous. However, undertaking such a policy is not without tradeoffs. In fact, California WIC required purchases of the LEB of milk from 1999 to 2000 but discontinued the practice when it became confusing for participants and store cashiers (Kirlin et al., 2003).

To quantify possible cost savings associated with various LEB policies, the authors used two benchmarks of comparison. Given the similarity between the actual redemption distributions and the MEB-simulation results for FIs 6003 and 6011, we chose the MEB simulation as a benchmark in order to calculate the cost savings from incorporating various LEB policies. We refer to cost savings relative to MEB shopping as an upper bound. Since the pricing distributions associated with FI 6012 more closely approximate the RS simulated outcomes, we used the RS simulation results as a second benchmark that may be more representative of the true cost savings. Another advantage of constructing these benchmark simulations was to mitigate the influence that partial redemptions might have on our results if we were to use actual shopping patterns. Ultimately, when quantifying the impacts of possible LEB policies, we were comparing mean (i.e., a measure of central tendency) values, mitigating the skewness of the distributions.

Tables 7-9 summarize simulation analyses for FI 6012, FI 6011, and FI 6003, respectively. The top segment of each table provides costs of average simulated redemption value per FI under RS, MEB shopping, and multiple LEB shopping scenarios (e.g., restricting participants to purchasing the LEB in one or more specified product categories). The second portion of the tables provides two measures of potential savings: (1) RS relative to the various LEB cost-containment policies, and (2) MEB simulation results compared to alternative LEB cost-containment policies. These two benchmarks provide an upper (MEB–LEB) and lower (RS–LEB) bound for our potential cost-saving estimates.

The first row in each table provides the average cost of the FI derived from the RS simulation. For example, the average redemption value of FI 6012 in Chain 1, Store 1, when the computer shopped at random for each of the products in the FI (milk, cheese, eggs, and peanut butter/dry beans), is $18.41. The second row of each table summarizes the average FI cost derived from the MEB simulation. For example, the average redemption value for FI 6012 in Chain 1, Store 1 when participants are assumed to purchase the most expensive eligible products is $23.12 per FI.

The subsequent lines in each table under the LEB heading provide the simulated redemption value when specific products are subject to a LEB cost-containment policy. This allows State agencies considering LEB policy implementation to discern the products that are likely to produce the largest cost savings.

For Chain 1, Store 1, the average redemption value of FI 6012 with a LEB policy for milk only is $17.68 per FI. The associated average savings from this policy are listed in the panes below ($0.73 per FI when compared to RS shopping and $2.43 per FI when compared to MEB). For the same store, if all products in FI 6012 were subject to an LEB policy, the average redemption value per FI would be $14.80, a $3.61 per FI cost savings relative to the RS baseline (roughly 20 percent) and an $8.32 per FI savings compared to the MEB baseline (about 36 percent).

Unsurprisingly, the more products subject to an LEB policy, the larger the potential cost savings. On average, across all eight stores, the LEB policy for all products contained in FI 6012 reduces costs between 18.2 percent ($2.88 per FI; compared to the RS baseline) and 31.6 percent ($6.01 per FI; compared to the MEB baseline). When considering specific products, the largest potential cost savings were achieved from implementing LEB policies for peanut butter ($1.48 per FI average saving across eight stores; compared to the RS simulation) and cheese ($0.83 per FI average savings across eight stores, compared to the RS simulation).

The cost savings associated with LEB policies for FIs 6011 (table 8) and 6003 (table 9) are more modest than those for FI 6012 (table 7) for a few reasons. First, FI 6012 contains more products from which participants can make selections. Second, the products commonly subject to LEB policies for FIs 6011 and 6003 have less variability in terms of price and authorized product types and forms. The average cost savings from implementing an LEB policy for all products in FI 6011 across all eight stores is between 9.5 percent (compared to

the RS baseline) and 21.4 percent (compared to the MEB baseline). For all products in FI 6003, the average savings are between 4.6 (compared to the RS baseline) and 9.3 percent (compared to the MEB baseline).

Table 7
Random shopping (RS), least expensive brand (LEB), and most expensive brand (MEB) simulation results, FI 6012

Chain and store	Ch1, St1	Ch1, St2	Ch2, St1	Ch2, St2	Ch3, St1	Ch3, St2	Ch4, St1	Ch4, St2
FI 6012								
	Food cost (dollars per FI)							
RS simulation	18.41	18.35	14.15	14.09	15.52	14.62	14.69	14.93
MEB simulation	23.12	22.69	16.60	16.60	17.52	17.05	18.42	17.80
LEB								
(1) Milk	17.68	17.67	14.11	14.03	15.19	14.48	14.27	14.64
(2) Cheese	17.51	17.55	13.30	13.40	13.89	13.70	14.28	14.51
(3) Dry beans	18.34	18.20	14.14	14.06	15.51	14.61	14.73	14.93
(4) Eggs	17.76	17.63	13.79	13.64	15.34	14.21	14.31	13.90
(5) Peanut butter	17.17	16.28	13.44	13.35	14.82	13.71	13.29	13.52
(6) All	14.80	13.92	12.18	12.11	12.63	12.22	12.11	11.78
	Incremental savings (dollars per FI)– RS simulation compared to LEB							
Savings (1)	0.73	0.68	0.04	0.06	0.33	0.14	0.42	0.29
Savings (2)	0.90	0.80	0.85	0.69	1.63	0.92	0.41	0.42
Savings (3)	0.07	0.15	0.01	0.03	0.01	0.01	0.04	0.00
Savings (4)	0.65	0.72	0.36	0.45	0.18	0.41	0.38	1.03
Savings (5)	1.24	2.07	0.71	0.74	0.70	0.91	1.40	1.41
Savings (6)	3.61	4.43	1.97	1.98	2.89	2.40	2.58	3.15
	Incremental savings (dollars per FI) – MEB simulation compared to LEB							
Savings (1)	2.43	2.37	0.07	0.17	1.48	0.28	1.10	0.38
Savings (2)	1.98	1.50	1.76	1.67	1.69	1.81	0.84	0.87
Savings (3)	0.19	0.28	0.08	0.07	0.09	0.02	0.01	0.06
Savings (4)	1.94	2.04	1.08	1.08	0.3	0.99	1.53	2.09
Savings (5)	1.76	2.58	1.45	1.47	1.33	1.74	2.83	2.63
Savings (6)	8.32	8.77	4.42	4.49	4.89	4.83	6.31	6.02

Notes: FI = Food Instrument. Ch = Chain. St = Store.

Source: Simulations using California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) transaction data and Information Resources, Inc. (IRI) InfoScan retail scanner data.

FIs 6011 and 6003 contain some different WIC-approved products than FI 6012, namely whole grains and fruit juice. For FI 6011 (table 8), the largest individual product cost savings are associated with implementing an LEB policy for juice. Across all eight stores, the average savings associated with juice is $0.42 per FI compared to the RS baseline. As expected, the savings associated with making whole grains subject to an LEB policy are consistent across FIs 6011 and 6003, averaging $0.37 per FI compared to the RS baseline.

Table 8

Random shopping (RS), least expensive brand (LEB), and most expensive brant (MEB) simulation results, FI 6011

Chain and store	Ch1, St1	Ch1, St2	Ch2, St1	Ch2, St2	Ch3, St1	Ch3, St2	Ch4, St1	Ch4, St2
				FI6011				
	Cost (dollars per FI)							
RS simulation	12.97	13.33	11.50	12.02	12.31	11.84	11.61	11.42
MEB simulation	16.78	14.11	13.20	13.09	13.89	13.39	14.70	13.41
LEB								
(1) Milk	12.10	12.47	11.44	11.96	11.93	11.71	11.19	11.40
(2) Juice	12.29	12.71	11.32	11.73	11.70	11.64	11.26	11.02
(3) Whole grains	12.54	12.52	10.86	11.84	11.83	11.79	11.58	11.11
(4) All	10.99	11.04	10.62	11.49	10.84	11.46	10.81	10.69
	Savings (dollars per FI)							
Savings (4) (RS versus LEB)	1.98	2.29	0.88	0.53	1.47	0.38	0.80	0.73
Savings (4) (MEB versus LEB)	5.79	3.07	2.58	1.60	3.05	1.93	3.89	2.72

Notes: FI = Food Instrument. Ch = Chain. St = Store.

Source: USDA, Economic Research Service and University of California, Davis calculations from simulations using California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) transactions data and Information Resources, Inc. (IRI) InfoScan retail scanner data.

Table 9

Random shopping (RS), least expensive brand (LEB), and most expensive brand (MEB) simulation results, FI 6003

Chain and store	Ch1, St1	Ch1, St2	Ch2, St1	Ch2, St2	Ch3, St1	Ch3, St2	Ch4, St1	Ch4, St2
				FI 6003				
	Food cost (dollars per FI)							
RS simulation	16.04	16.09	15.04	15.40	14.72	15.45	14.44	14.19
MEB simulation	18.30	15.30	15.86	15.54	15.49	16.09	16.05	15.15
LEB								
(1) Milk	15.17	15.23	14.98	15.34	14.34	15.32	14.02	14.17
(2) Whole grains	15.61	15.28	14.4	15.22	14.24	15.4	14.41	13.88
(3) All	14.74	14.43	14.34	15.16	13.85	15.27	13.99	13.86
	Savings (dollars per FI)							
(RS versus LEB)	1.30	1.66	0.70	0.24	0.87	0.18	0.45	0.33
(MEB versus LEB)	3.56	0.87	1.52	0.38	1.64	0.82	2.06	1.29

Notes: FI = Food Instrument. Ch = Chain. St = Store.

Source: USDA, Economic Research Service and University of California, Davis calculations from simulations using California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) transactions data and Information Resources, Inc. (IRI) InfoScan retail scanner data.

We used the results from the previous section coupled with the California WIC transaction-level data to estimate the overall savings potential from implementing LEB policies. We confined this analysis to supermarkets (defined for our purposes as stores in California that have seven or more cash registers), given that the stores in the simulation were all chain supermarkets located in urban areas. We note that our estimated LEB cost savings for supermarkets are unlikely to be representative of LEB cost savings for A-50 or small non-A-50 WIC-authorized retailers, given their smaller store formats and less-comprehensive product offerings compared to supermarkets.[28]

We based our calculations on the 29-month period from October 2009 to February 2012. During this period, FI 6012 was redeemed by WIC participants more than 23 million times and accounted for nearly 13 percent of the State's total program costs (Sexton and Saitone, 2012). FIs 6003 and 6011 were redeemed a total of 16.1 million and 14.9 million times, respectively. Overall, these three FIs accounted for 31.2 percent of total program redemption costs during this period.

Table 10 summarizes the upper bound (MEB baseline) and lower bound (RS baseline) average percentage savings by FI across all stores included in the simulation, assuming all products eligible for purchase under each FI are subject to an LEB policy. These percentage savings were then used to estimate the actual food cost reduction associated with applying LEB policies to California WIC-participant purchases. In general, the co-movement of observed prices and redemption values documented in appendix A supports applying the percentage value associated with savings from the LEB policy to FI redemption values observed in the previous months. However, given the WIC food package revisions implemented in October 2009 included food items that may not have been standard, the actual relative savings may have been different in the earliest months of the 29-month period.[29]

Table 10
Estimated food cost savings from least expensive brand (LEB) policy implementation by FI

	Upper bound MEB benchmark		Lower bound RS benchmark	
FI Code	Percentage of actual FI cost saved	U.S. dollars	Percentage of actual FI cost saved	U.S. dollars
6003	9.3	9,801,855	4.6	4,848,229
6011	21.4	17,669,655	9.1	7,513,732
6012	31.6	46,264,200	18.2	26,631,699
Combined	**22.05**	**73,735,710**	**11.66**	**38,993,660**

Notes: FI = Food Instrument. MEB = Most Expensive Brand. RS = Random Shopping.

Source: USDA, Economic Research Service and University of California, Davis calculations from simulations using California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) transactions data and Information Resources, Inc. (IRI) InfoScan retail scanner data.

[28]In particular, very little cost saving would likely be achieved for A-50 vendors, given their redemption rates are tightly constrained by FNS regulations to not exceed the statewide average redemption rate on a per FI basis. A-50 prices would decline indirectly, however, under an LEB policy because the reduced redemption rates for non-A-50 vendors would cause the statewide average redemption rate to decline for those FIs containing foods subject to LEB.

[29]The whole-grains food category, especially 100-percent whole wheat bread, is particularly relevant in this regard. The 2009 food package revisions required participants to purchase 16-ounce packages of whole grain, which was not initially a common size of loaves of this bread category. Unsurprisingly, 16-ounce loaves of 100-percent whole wheat bread were found to be the most expensive size on a per ounce basis (Stewart et al., 2019). However, the price per loaf was virtually unchanged as of 2012, while the prices and redemption values of the studied FIs containing a whole-grain benefit increased.

Table 11 details the total number of FIs redeemed and their actual costs for the same period at large WIC-authorized vendors in California. These retailers accounted for between 44.5 percent (FI 6011) and 46.9 percent (FI 6012) of FIs redeemed in California during this time. FI 6012 was redeemed nearly 10.9 million times in large WIC-authorized vendors during the 29-month period for a total cost to the program of $146.5 million.

If California WIC had imposed an LEB policy for all eligible products contained in FI 6012, we estimate the lower bound of program cost savings would have been 18.2 percent, or $26.6 million (table 10), for FIs redeemed at large vendors. Similarly, for FI 6003, imposing the LEB policy where all items are subject to the policy is estimated to reduce food costs by at least 4.6 percent, an estimated cost reduction of $4.85 million on sales at large retailers during this period. A LEB policy for FI 6011 would reduce food costs by an estimated 9.1 percent, providing an estimated savings of $7.51 million. The lower bound of total estimated program savings from these three combination food instruments in large retailers is $38.9 million for the 29-month period (an average of nearly $1.34 million per month).

Table 11
FIs redeemed by number and value at large vendors, October 2009–February 2012

FI Code	No. of FIs redeemed	Percent of total redeemed	Actual cost (dollars) FIs redeemed	Cost (dollars) under LEB policy	Cost (dollars) under LEB policy
				Lower bound	Upper bound
6003	7,226,926	45.0	105,396,299	100,548,070	95,594,444
6011	6,619,921	44.5	82,568,478	75,054,746	64,898,823
6012	10,867,919	46.9	146,505,305	119,873,606	100,241,105

Notes: FI = Food Instrument. LEB = Least Expensive Brand.

Source: USDA, Economic Research Service and University of California, Davis calculations from simulations using California Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) transactions data and Information Resources, Inc. (IRI) InfoScan retail scanner data.

These cost savings represent a conservative lower bound in that they are based on the RS baseline, ignore potential cost savings from applying the policy to smaller WIC vendors, and are restricted to only FIs 6003, 6011, and 6012, although many other food instruments contain foods that would be subject to an LEB policy. For example, the estimated savings for large-vendor sales of FIs 6003, 6011, and 6012 are $9.8 million, $17.7 million, and $26.6 million, respectively, for the MEB baseline. The total savings estimated for these three FIs during the 29-month study period is in excess of $73.7 million (roughly $2.54 million per month). Given the earlier discussion and the numbers in figures 10 and 11, the estimates based on the MEB simulation baseline are likely more representative of the actual savings that would be realized if an LEB cost-containment policy were implemented in California than the lower-bound estimates based on the RS comparison.

A sense of the further savings available from including additional food instruments in the analysis is implied by considering FIs 6000, 6001, and 6002. These FIs are identical to 6003, 6011, and 6012, except that low-fat milk is replaced with whole milk. They accounted for about 10 percent of the total FI redemption value during our study period, compared to 31 percent for FIs 6003, 6011, and 6012. Thus, including FIs 6000, 6001, and 6002 in our calculations would expand savings under either the RS or MEB baselines by about one-third.[30]

[30]This calculation assumes supermarket price dispersion for whole milk is similar to the price dispersion observed in this study for low-fat milk.

Discussion and Conclusions

WIC gives State agencies considerable autonomy in the administration of their programs. Many States have chosen to implement least-cost brand policies for selected WIC food items (table 1). Following the implementation of the 2009 food packages, however, there has been little analysis of the program cost savings that accrue due to least-cost policies by analyzing the actual benefit redemption behavior of WIC participants.

This study has addressed the question of savings from least-cost policies by combining administrative data from California WIC with retail scanner data from IRI. California, the Nation's largest WIC in both participants and program expenditure, grants WIC participants considerable latitude to choose among products, brands, and package sizes for approved foods within each food category. This makes California an ideal laboratory for examining the fiscal impact of least-cost policies.

Our analysis—based on actual WIC sales for a 29-month period in eight urban California supermarkets from four different supermarket chains across the largest urban population areas of California (figure 2)—found cost savings from implementing a least-cost policy that ranged from 4.6 percent to 31.6 percent (table 10) for the three most-redeemed FIs. The specific savings estimate depended on the FI under analysis and the baseline (RS versus MEB shopping) used for comparison to the least-cost policy. While this analysis was based on WIC transactions and average monthly prices from only eight supermarkets serving California WIC in March 2012, the food prices of these stores are representative of prices of other supermarkets with a relatively large volume of WIC business not included in the study.

The goal of the study has been to provide WIC State agency officials with information on the food cost savings associated with alternative LEB policies. WIC officials in other States will need to consider how well the California results extend to their program settings. For example, California offers participants comparatively broad choices, and during the study period, its maximum redemption rates for FIs had little impact on retailers' price setting (Sexton and Saitone, 2012). Even among States that do not implement least-cost brand policies, there is considerable heterogeneity in products and brands that are eligible. In general, States that are less expansive in the choices they afford WIC participants will achieve lower percentages of cost savings from adopting a least-cost policy. Similarly, States that have more restrictive maximum redemption rates than were invoked in California during the study period can expect to achieve less in savings than those found for California.

In addition, the potential savings from least-cost policies analyzed in this report may be realized differently or similarly in other States depending on how prices and product selection of WIC items vary. For instance, McLaughlin et al. (2018) examined price variability in WIC food items across four States and found considerable price variation for peanut butter, as in the present study. However, McLaughlin's study also found virtually zero price variation in eggs, unlike the significant difference in prices within and across retailers observed for California. Nevertheless, the results presented here are broadly informative given that the studied vendors represent large chain supermarkets located in an urban food environment, much like most vendors serving the program nationwide.

The data constraints faced in this study may limit the interpretation of some of the findings. While the items sold and prices charged by the eight study stores were largely representative of the supermarkets in the IRI retail scanner data, the potential food savings of LEB policies applied to smaller stores and other less traditional WIC vendors remain unknown. However, most WIC benefits are redeemed at supermarkets and other large food retailers in nearly all States (Tiehen and Frazão, 2016), which are thus the most important vendors for cost-containment considerations. Further, the lack of item-level purchases in the WIC transaction data makes it difficult to account for the effect of partial redemptions on savings. The increasing availability of

WIC EBT data, which contain item-level purchases for all WIC transactions at all WIC vendors, may help future research overcome these two broad limitations. In addition, neither the IRI data nor the WIC transaction data can account for in-store factors that may influence purchasing, such as on-shelf availability of WIC-approved food items and labels indicating which food items are WIC-approved. However, the collection of such data would limit the scope of any study dramatically, both in the number of stores studied and the time of sales observed.

Finally, this study has addressed only part of the equation local WIC officials must solve in deciding whether implementing least-cost policies is right for their States. We have addressed the potential cost savings from implementing least-cost policies, savings that could stretch State agencies' budgets or provide more services to participants (for example, increased support for the nutrition education and breastfeeding components of the program).

The other considerations State agency officials must address are participant satisfaction and administrative complexity associated with LEB policies; other cost-containment policies that may not produce such substantial savings may be preferable. For example, LEB policies implemented for milk in California were sufficiently confusing for participants and vendors that they were ultimately abandoned (Kirlin et al., 2003). Recent work documents participants in several States experiencing decision fatigue when trying to adhere to food item restrictions (Chauvenet et al., 2019). LEB restrictions may also make it difficult for participants to locate eligible products in the store. Limiting food item choices may dissuade participants from fully redeeming their benefits or enrolling in WIC altogether. Low participation is a policy concern because numerous studies have documented health benefits associated with WIC participation, including increased birth weight, improved maternal and infant health, and increased probability of breastfeeding.[31] To our knowledge, there has been no research to ascertain whether the extent of product choice afforded WIC participants is associated with their program participation rate. Such knowledge is needed to fully evaluate the efficacy of State WIC programs adopting least-cost food policies.

LEB policies also impose burdens on retailers in terms of identifying, labeling, and reporting the LEB products, and State agencies face challenges and costs in implementing and ensuring compliance with LEB policies. For instance, ascertaining that individual WIC-authorized vendors are selling their declared LEBs adds an additional, potentially costly layer of monitoring, which States that do not require LEB purchases do not face. These administrative costs must also be considered in a decision calculus regarding the imposition of LEB policies.

The effect of the COVID-19 pandemic and resulting economic and policy responses may have had a significant but difficult-to-discern impact on the LEB decision calculus. First, disruptions to supply chains, potential lack of availability of specific products, and price increases all have consequences for feasible food cost savings, participants' ability to successfully acquire WIC foods, retailers' ability to adhere to LEB policies, and State agencies' ability to monitor this adherence. Second, the pandemic may have significantly affected a variety of key WIC participant attributes and behaviors that affect food costs, such as a State's composition of WIC participants (David and Leibtag, 2005), the types of stores where WIC participants shop (Ma et al., 2019; McLaughlin et al., 2018; McLaughlin et al., 2019), and the incidence of partially redeeming benefits (Li et al., 2021). Analysis of changes in partial redemption of WIC benefits concurrent to the pandemic may also provide an indicator of participants' ability to successfully acquire their food benefits. Finally, documenting the policy response of States, including changes in LEB restrictions and approved waivers dictating compliance with Federal regulations, may help researchers understand how States navigate LEB implementation in a highly complex, fast-evolving economic and policy situation.

[31]See McLaughlin et al. (2019) for a summary of studies documenting health benefits from WIC participation.

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Appendix A: Statistical Properties of the Studied Stores' Food Prices

This appendix assesses the feasibility of using the chosen subset of USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)-authorized retail sales data to make inferences about WIC benefit redemption patterns across the State of California. We considered WIC benefit redemptions taking place at eight large WIC-authorized vendors in California from October 2009 to March 2012, using Information Resources, Inc. (IRI) InfoScan retail scanner data and actual WIC redemptions at these stores during March 2012.

First, we compared prices over time at the eight grocery stores included in the study and the remaining California grocery stores in IRI InfoScan data for food baskets that represented the types of foods provided by the WIC Food Instruments (FIs; a voucher for a bundle of WIC foods that participants redeem at vendors) selected for the study. Food baskets were constructed for FIs 6003, 6011, and 6012 individually, as well as a composite food basket that included all the food items offered by any of the three FIs. An individual food item (i.e., at the universal product code (UPC) level) was a candidate for inclusion in a food basket if it belonged to the same category, per the IRI product dictionary, as one of the food items identified as WIC-eligible at the study stores in March 2012. While this likely included many food items that were not WIC-approved, broad price trends affecting both non-WIC and WIC items were captured.

As study and non-study stores did not have identical offerings, and any given stores were likely to change the products they carry over time, individual food items were aggregated into groups to make comparisons. In particular, two levels of aggregation were separately examined: subcategory (i.e., the "product" column in the IRI product dictionary) and brand. For example, aggregating bottled juice items to the subcategory level meant comparing prices for subcategories such as apple, grape, and orange juice across stores and over time. Brand-level aggregation was one level lower, where all the brands of each subcategory form each grouping (e.g., all brands of apple juice). While brand-level aggregation was the closest grouping to actual consumer choice, study stores may not carry the same brands as non-study stores (and vice versa) and may not carry the same brands over time. Comparisons could not be made in these cases, which is why subcategory-level aggregation was also examined, as all California grocery stores tend to carry the same product categories over time.[32]

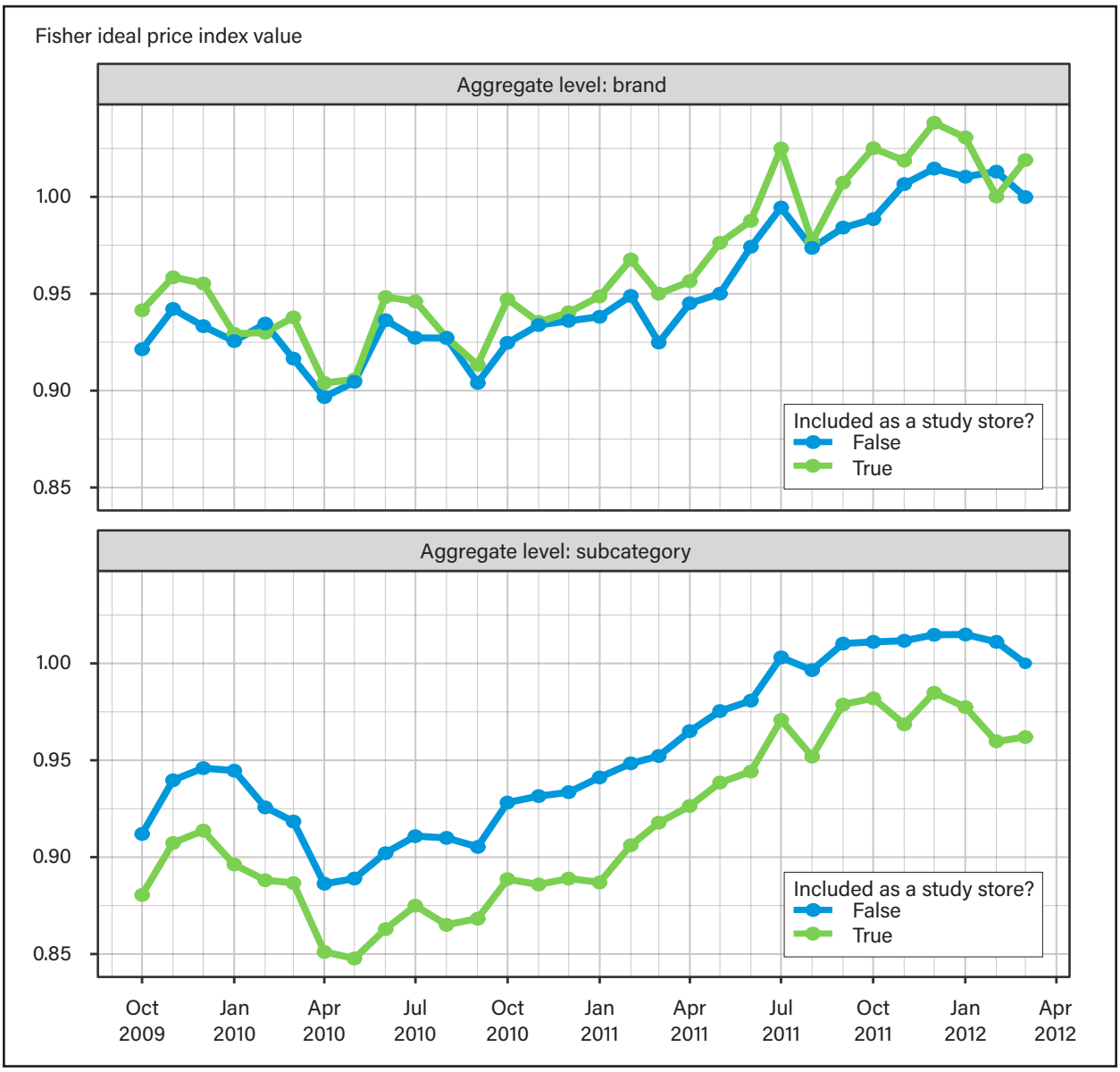
Price indices for study and non-study stores were calculated for each month spanning October 2009 to March 2012. In particular, Fisher ideal price indices were computed; they are commonly applied to retail scanner data and closely approximate more precise and computationally intensive indices (Zhen et al., 2019).[33] For comparison, the base group (e.g., where the index was normalized to be equal to 1) was non-study group stores in March 2012.

[32]There were 2,998 unique brands belonging to the product categories observed in California grocery stores at any time from October 2009 to March 2012. However, only 464 brands were common to both study and non-study stores over the period. In contrast, all but 9 of the 78 total observed number of subcategories were sold at both study and non-study stores over the full study period.

[33]The Fisher ideal price index is the geometric sum of the Laspeyres and Paasche indices, which respectively tend to under- and overestimate a "true" cost index that represents the cost function derived from a food basket demand system.

Figure A1

Fisher Ideal Price Index comparison for FI 6003 food basket for study stores versus non-study stores, October 2009 to March 2012

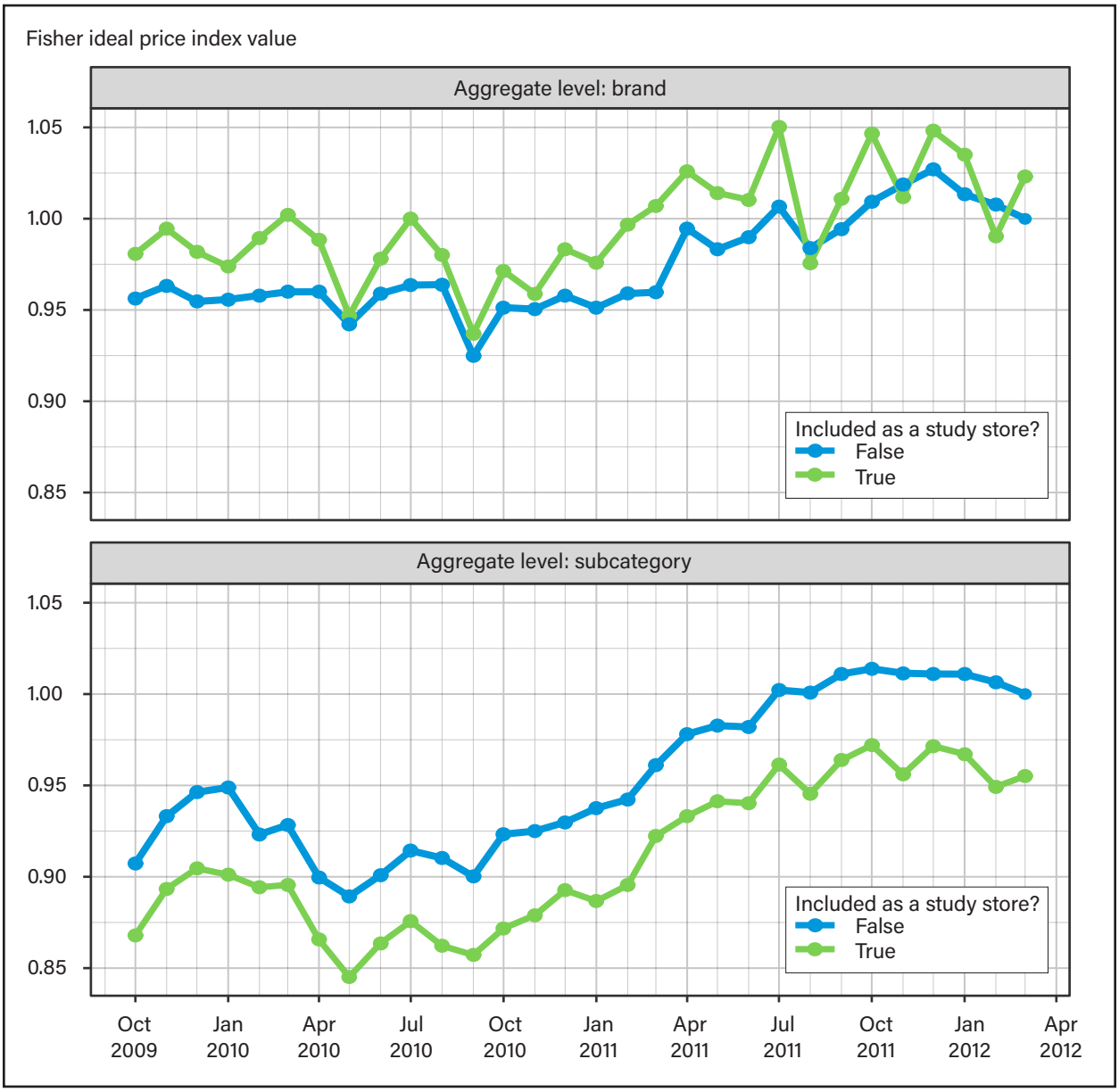


Note: FI = Food Instrument.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan data.

Figure A2

Fisher Ideal Price Index comparison for FI 6011 food basket for study stores versus non-study stores, October 2009 to March 2012

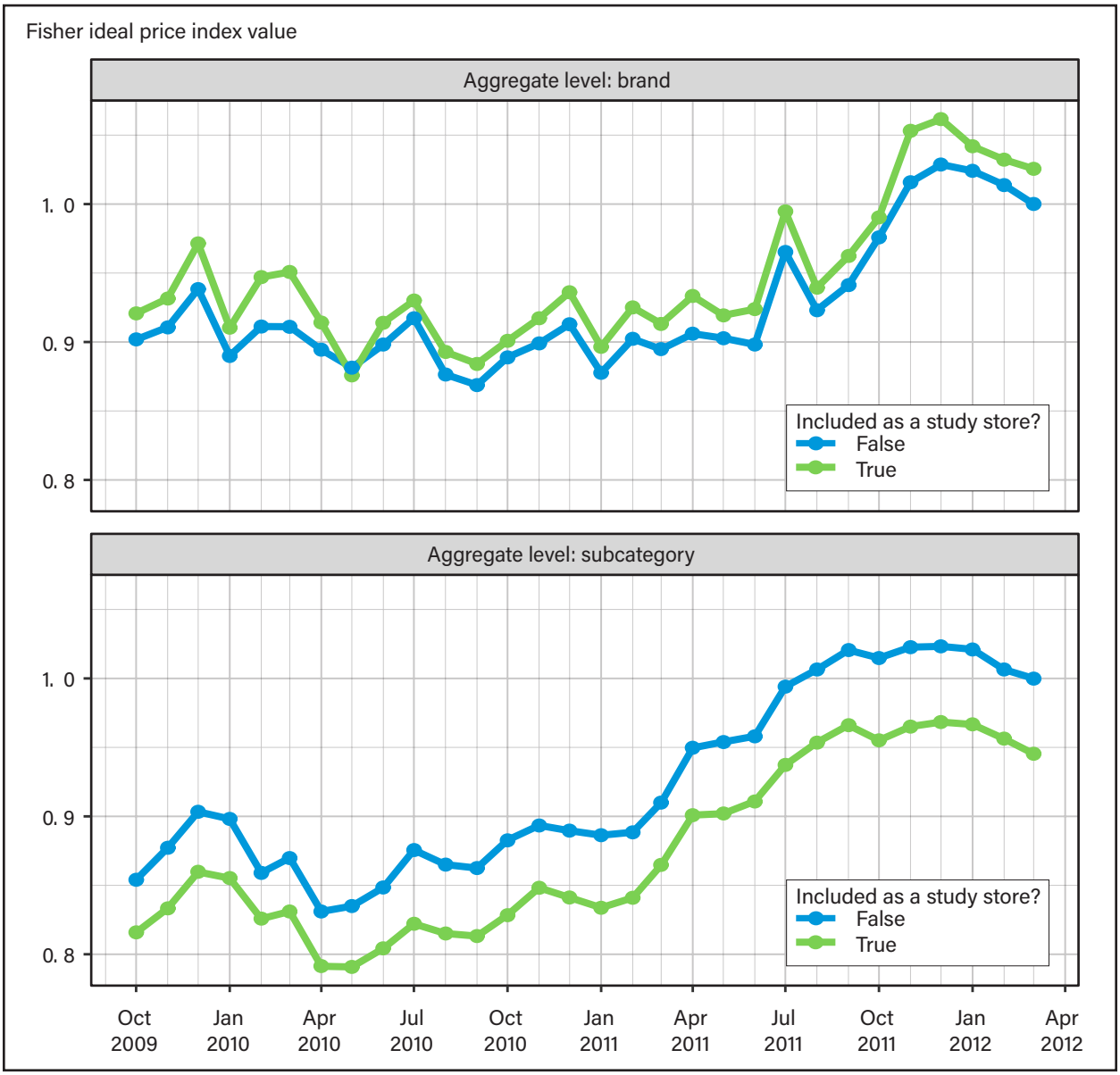


Note: FI = Food Instrument.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan data.

Figure A3

Fisher Ideal Price Index comparison for FI 6012 food basket for study stores versus non-study stores, October 2009 to March 2012

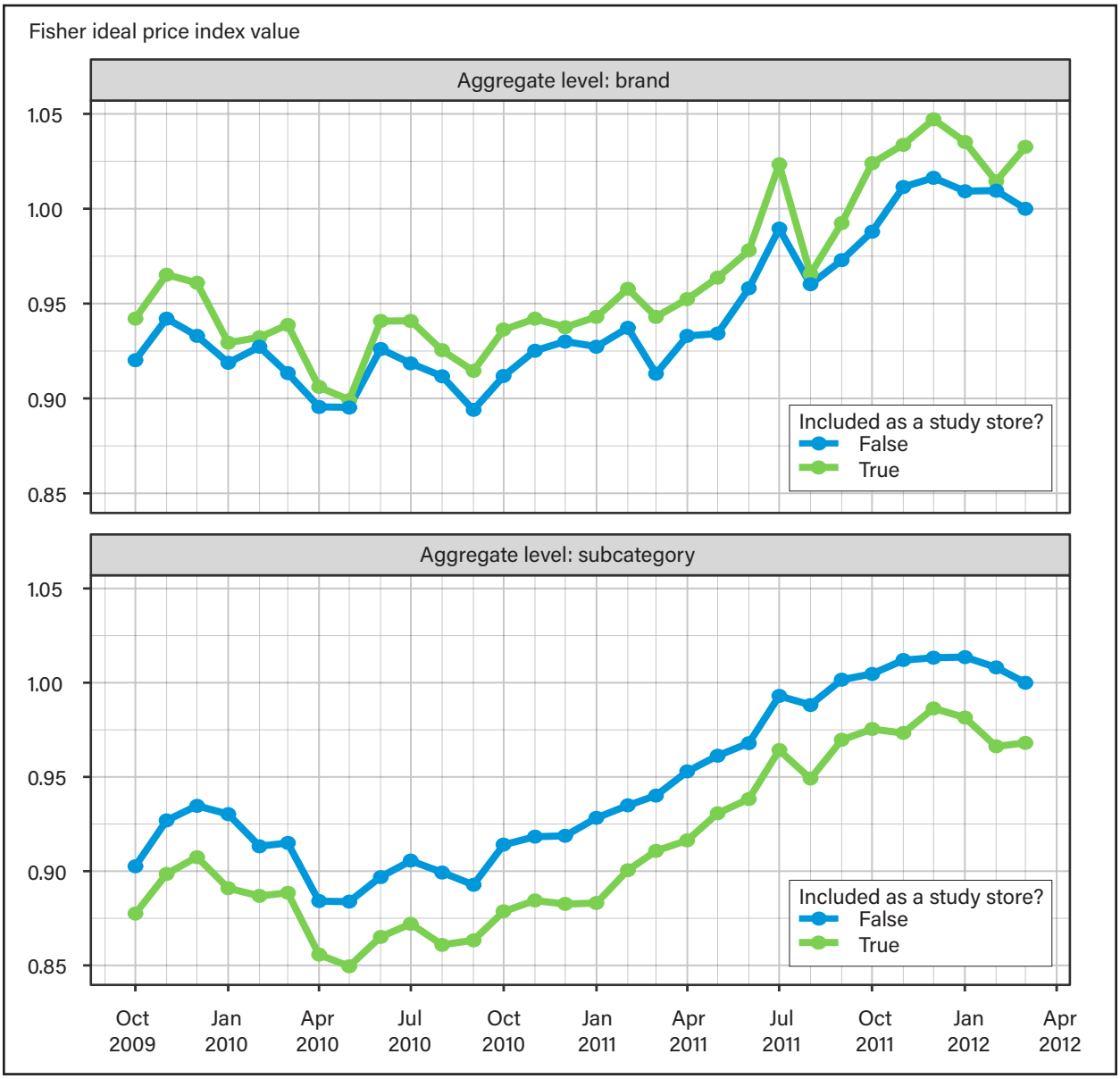


Note: FI = Food Instrument.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan data.

Figure A4

Fisher Ideal Price Index comparison for all studied items food basket for study stores versus non-study stores, October 2009 to March 2012



Note: FI = Food Instrument.

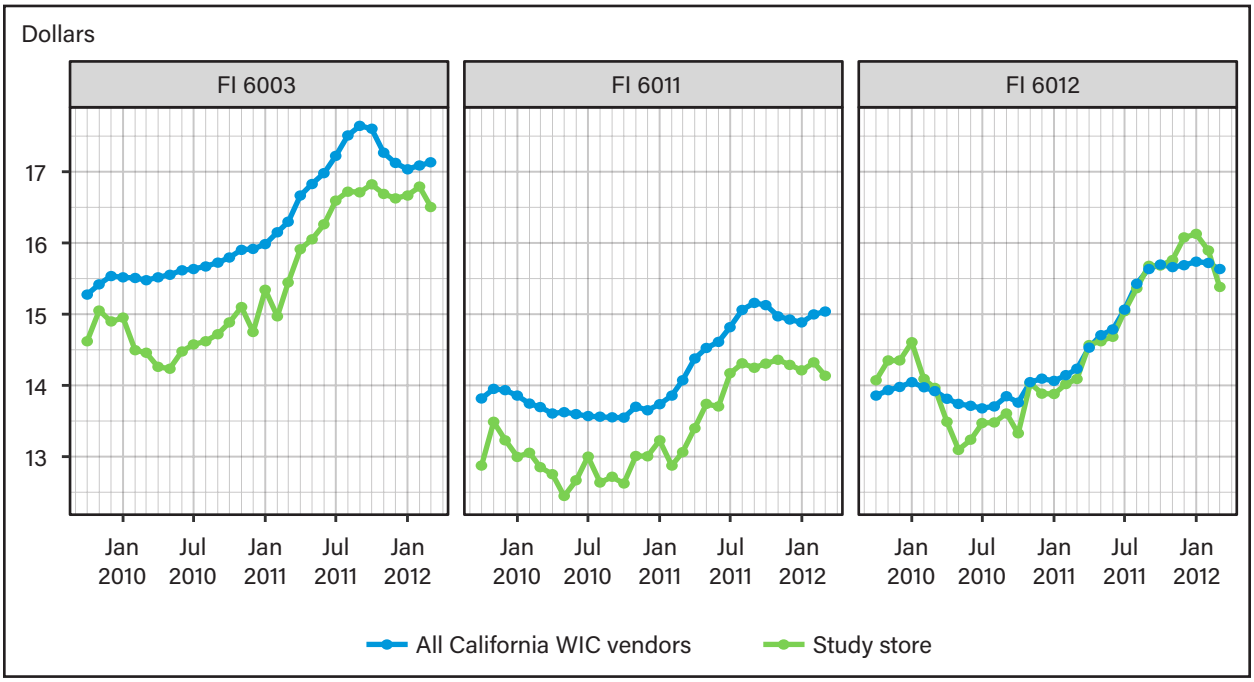
Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan data.

Figures A1-A4 present the computed price indices for the food baskets representing FIs 6003, 6011, 6012 and the aggregate of the studied food categories. In general, the study and non-study store prices were largely similar in a given month for all food baskets regardless of the level of aggregation. Depending on the food basket, study stores' brand-level prices tended to be on average 1.5 to 2.5 percent higher compared to non-study stores, but subcategory-level prices tended to average 3.3 to 4.9 percent lower. In other words, the study stores tended to charge, at most, slightly higher prices for common brands but modestly lower prices overall when we accounted for differences in brands across store group and time. This observation is consistent with recent evidence that there tends to be minimal variation of item-specific food prices for outlets within a chain

despite substantial variation in location and customer demographics (DellaVigna and Gentzkow, 2019), as many of the non-study stores belonged to the same chains as the study stores.

The prices for all food baskets varied substantially over the full study period. For example, subcategory prices for FI 6012 categories were roughly 15 percent lower in October 2009 compared to March 2012 for both study and non-study stores (figure A3). Monthly price changes tended to track closely between study and non-study stores; the Pearson's correlation coefficient, for instance, ranged from 96.1 to 99.7 percent for the study and non-study stores' price indices for each FI-aggregation level pair, except for brand-level prices of the FI 6012 basket, which had a coefficient of 84.8 percent.[34] Thus, while prices of the studied food items appear to vary significantly over time, the prices of study stores relative to non-study stores remained effectively constant, especially when examined at the subcategory level.

Figure A5
Average food instrument (FI) transaction values by FI, study stores versus all California WIC vendors



Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan data.

[34]All Pearson coefficients were statistically significant at a significance level of 5 percent.

Similarly, the average value of actual FI transactions of study stores tracked well with the value of all California WIC vendors (figure A5).[35] For instance, the Pearson's correlation coefficient of all vendors and study stores exceeded 95 percent for all FIs and was statistically significant at the 0.05 significance level. Thus, price trends in WIC-approved foods were the same, if not largely similar, as those observed throughout California WIC during this time. Further, the movement of the average value of FI transactions closely followed the subcategory-level aggregated price indices of figures A1-A3. For example, the Pearson's correlation coefficient of the average value of FI transactions and the subcategory-level aggregated price indices were roughly 95 percent or more for all FIs and were statistically significant at the 0.05 significance level. In short, the analysis in this appendix supports the use of IRI InfoScan retail scanner data from eight grocery stores with ample WIC sales in March 2012 to draw conclusions regarding all large California grocery retail stores from October 2009 to March 2012, using administrative data on FI transactions from this period. In particular, study and non-study stores charged similar prices over the full study period for commonly carried brands and subcategories of foods that aligned with food items provided by FIs 6003, 6011, and 6012. There may be some modest differences in prices, driven in part by differences in the brands that particular stores and/or chains choose to carry. Nevertheless, despite price variation over time, prices at study stores relative to non-study stores remained roughly constant. Further, prices of food items for the relevant subcategories tended to mirror movement in the average value of WIC transactions for all FIs from October 2009 to March 2012. Thus, a fixed percentage of savings estimated from study stores could be appropriately applied to the non-study stores.

[35]Roughly 50 percent of all California WIC vendors during this period were large vendors with five or more registers and accounted for 47.6 percent of the value of WIC redemptions (Saitone et al., 2014). A-50 vendors made up about 16 percent of vendors and 37 percent of sales and had faced maximum allowable reimbursement rates for benefits that limited their redemption values to the statewide average. The remaining vendors are small vendors with the highest prices of the three broad groups with a relatively small share of WIC sales.

Appendix B: Statistical Tests of Differences Between the Distributions of Actual and Simulated Redemption Values

The simulation exercise compared the distribution of actual food instrument (FI; a voucher for a bundle of WIC foods that participants redeem at vendors) redemption values to the distributions of redemption values under two scenarios of participant shopping behavior. Participants were assumed to either engage in random shopping (RS) by selecting randomly among WIC-approved items when using their FIs or choosing the most expensive brands (MEB). Examining how close the distribution of either RS- or MEB-simulated redemption values was to the distribution of actual redemption values for a given FI provided evidence as to which simulated shopping scenario was closest to the reality observed in transactions data.

In addition to presenting box plots of actual and simulated redemption values, we used several common statistical tests to examine whether two distributions (or a sufficient statistic for each case) were different from one another. In particular, we employed the following two-sided statistical tests:

- **T-test (test statistic *t*).** As a first pass, we examined whether the means of actual and simulated redemption values were statistically significantly different from one another. However, at least some of these distributions appeared to be non-normal, requiring the use of nonparametric tests.
- **Kolmogrov-Smirnov (KS) test (test statistic *D*).** This nonparametric test examined the distance between actual and simulated distributions. Specifically, the KS test rejects the null hypothesis that the two distributions were statistically the same if the maximum distance between the empirical cumulative distribution functions was sufficiently large. Outliers in one of the distributions (e.g., due to partial redemption of FIs) could result in rejecting the null, even if the distance between the distributions was otherwise small.
- **Wilcoxon rank-sum test (test statistic *W*).** Also known as the Mann-Whitney U-test, this examined the likelihood that the redemption value of an actual FI selected at random was greater or less than the redemption value of a simulated purchase, also chosen at random. The test statistic *W* is a function of the sum of the ranks of the simulated values relative to the actual redemption values.

The three tests were undertaken separately for each store and FI (tables B1-B3). Beginning with FI 6003, the null hypothesis that RS-simulated and actual redemption values take the same distribution was rejected using all three tests for all stores, except for Chain 2, Store 2. For this one store, the median value was essentially the same across all three cases, and the box component of the actual distribution spanned both the distributions of the simulated shopping scenario (figure 7). In addition, for Chain 2, Store 2, all three tests appeared to show that MEB-simulated and actual redemption values had the same distribution statistically. In other words, it appeared there was limited price variability for the goods comprising FI 6003 in Chain 2, Store 2, and thus there was no evidence of a statistical difference between MEB and RS shopping behavior at this store.

Table B1
Statistical tests comparing the distributions of actual and simulated redemption values for food instrument (FI) 6003

	Statistical test					
	t-test *t*=		Kolmogrov-Smirnov *D*=		Wilcoxon rank-sum *W*=	
Store	RS	MEB	RS	MEB	RS	MEB
Chain 1, Store 1	10.10***	-1.56	0.49***	0.11	99,822***	61,291
Chain 1, Store 2	9.51***	0.71	0.50***	0.15**	84,923***	59,720**
Chain 2, Store 1	0.44	-2.33**	0.25***	0.18***	106,091***	89,423
Chain 2, Store 2	0.03	-0.61	0.09	0.06	71,074	67,950
Chain 3, Store 1	11.25***	1.09	0.46***	0.14***	159,966***	110,550
Chain 3, Store 2	10.55***	4.34***	0.42***	0.24***	160,483***	133,987***
Chain 4, Store 1	22.40***	15.20***	0.62***	0.42***	289,712***	253,348***
Chain 4, Store 2	2.50**	-0.59	0.30***	0.09	115,736***	96,856

Notes: Food instrument (FI) 6003 comprises 1 gallon of low-fat milk, 16 ounces of whole grains, and 36 ounces of breakfast cereal. RS refers to the scenario in which participants are assumed to randomly shop among approved brands. MEB refers to the scenario in which participants are assumed to choose the most expensive brands. Statistical significance is indicated at the following levels: * = 10 percent, ** = 5 percent, and *** = 1 percent.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan data and California Special Supplemental Nutrition Program for Woman, Infants, and Children (WIC) transaction data.

For the remaining seven stores that are not Chain 2, Store 2, there appears to be statistical evidence that the distributions of actual redemption values most closely resemble the MEB-simulated distributions. All three tests failed to reject the null hypothesis in the case of MEB for Chain 1, Store 1 and Chain 4, Store 2. Among the remaining stores, the Wilcoxon rank-sum test failed to reject the null hypothesis for Chain 2, Store 1; Chain 3, Store 1; and Chain 4, Store 2. These three stores appear to have similar medians for actual and MEB-simulated redemption values but comparatively more low-valued outliers, which is consistent with partial redemptions existing in the actual distribution (figure 7). Hence, the null hypothesis was rejected for these three stores using KS but not the Wilcoxon rank-sum test. For remaining stores (i.e., Chain 1, Store 2; Chain 3, Store 2; and Chain 4, Store 1), the median actual redemption value was substantially higher than the median from the MEB scenario. However, for each of these three stores, the infimum (greatest lower bound) of the KS test corresponded to the MEB scenario (as it did for all eight stores for FI 6003).[36] Nevertheless, it is clear that MEB shopping as constructed in the simulation underestimates actual redemption values, which itself could be taken as evidence for the representativeness of MEB-style behavior. Therefore, it appears MEB is a better representation of actual shopping than RS for participants redeeming FI 6003.

[36]In other words, the distance between the MEB and actual redemption values was smaller than the distance between the RS and actual redemption values for all stores.

Table B2
Statistical tests comparing the distributions of actual and simulated redemption values for food instrument (FI) 6011

	Statistical test					
	t-test *t*=		Kolmogrov-Smirnov *D*=		Wilcoxon rank-sum *W*=	
Store	RS	MEB	RS	MEB	RS	MEB
Chain 1, Store 1	18.52***	-3.14***	0.63***	0.30***	100,062***	48,810**
Chain 1, Store 2	14.20***	10.36***	0.54***	0.43***	79,106***	74,465***
Chain 2, Store 1	10.85***	0.14	0.51***	0.19***	131,907***	90,230
Chain 2, Store 2	5.43***	-0.19	0.33***	0.15***	100,714***	79,139
Chain 3, Store 1	11.51***	-10.70***	0.38***	0.39***	142,392***	51,454***
Chain 3, Store 2	9.10***	-3.37***	0.36***	0.16***	136,249***	80,138***
Chain 4, Store 1	29.21***	15.96***	0.63***	0.41***	264,419***	217,188***
Chain 4, Store 2	9.21***	-0.28	0.39***	0.15***	121,628***	83,864

Notes: Food instrument (FI) 6011 comprises 1 gallon of low-fat milk, 16 ounces of whole grains, and either 64 ounces of bottled juice or 11.5 ounces of concentrated juice. RS refers to the scenario where participants are assumed to randomly shop among approved brands. MEB refers to the scenario where participants are assumed to choose the most expensive brands. Statistical significance is indicated at the following levels: * = 10 percent, ** = 5 percent, and *** = 1 percent.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan data and California Special Supplemental Nutrition Program for Woman, Infants, and Children (WIC) transaction data.

For FI 6011, the null hypothesis was rejected for RS using all three tests; however, this occurred for MEB as well in most cases (table B2). Nevertheless, the evidence appears to favor MEB-shopping more closely resembling actual shopping compared to RS for most stores. First, we failed to reject the null hypothesis under MEB for Chain 2, Store 1; Chain 2, Store 2; and Chain 4, Store 2 using the t-test and the Wilcoxon rank-sum test, but not the KS test. Rejection of the null for these three stores using the KS test appears to be driven by either differences in the medians or low-value outliers in actual redemption values. For the five remaining stores, the infimum (greatest lower bound) for all three tests corresponded to MEB, except the KS test for Chain 3, Store 1. The box and median for Chain 1, Store 1 appears to be highly similar, although there was a ceiling on actual redemption values that were below at least 25 percent of MEB-simulated redemption values (figure 8). For Chain 1, Store 2 and Chain 4, Store 1, the actual distribution well exceeded the MEB-simulated distribution. It was less clear, however, for both stores belonging to Chain 3. For each Chain 3 store, the median MEB-simulated redemption value exceeded the median actual value, which itself exceeded the median RS-simulated redemption value. The simulated distributions appear equidistant to the actual distribution of redemption value for Chain 3 Store 1 (e.g., W = 0.38 for RS and W = 0.39 for MEB). However, for Chain 3, Store 1, more of the distribution of MEB-simulated distribution overlapped with the actual distribution of redemption values compared to RS.

Table B3

Statistical tests comparing the distributions of actual and simulated redemption values for food instrument (FI) 6012

	Statistical test					
	t-test *t*=		Kolmogrov-Smirnov *D*=		Wilcoxon rank-sum *W*=	
Store	RS	MEB	RS	MEB	RS	MEB
Chain 1, Store 1	2.03**	-22.14***	0.27***	0.88***	114,906***	11,974***
Chain 1, Store 2	8.08***	-20.58***	0.44***	0.84***	99,641***	15,029***
Chain 2, Store 1	-3.12***	-19.28***	0.17***	0.65***	116,995	23,458***
Chain 2, Store 2	-0.81	-16.95***	0.14***	0.54***	119,642	37,064***
Chain 3, Store 1	-0.04	-32.19***	0.10**	0.62***	162,521	33,743***
Chain 3, Store 2	-2.86***	-25.04***	0.15***	0.63***	129,768	43,491***
Chain 4, Store 1	4.31***	-11.27***	0.19***	0.39***	271,888***	154,265***
Chain 4, Store 2	-4.64***	-22.48***	0.21***	0.62***	104,558***	27,902***

Notes: Food instrument (FI) 6012 comprises 1 gallon and 1 quart of low-fat milk, 1 dozen eggs, and either 16-18 ounces of peanut butter or 16 ounces of dried beans. RS refers to the scenario where participants are assumed to randomly shop among approved brands. MEB refers to the scenario where participants are assumed to choose the most expensive brands. Statistical significance is indicated at the following levels: * = 10 percent, ** = 5 percent, and *** = 1 percent.

Source: USDA, Economic Research Service and University of California, Davis calculations using Information Resources, Inc. (IRI) InfoScan data and California Special Supplemental Nutrition Program for Woman, Infants, and Children (WIC) transaction data.

In contrast to FIs 6003 and 6011, it appears the distribution of RS-simulated redemption values better resembles the distribution of actual simulated redemption. The distance between distributions was the smallest for RS-simulated and actual redemption values for all stores according to the conducted KS tests (table B3). In addition, the Wilcoxon rank-sum test failed to reject the null hypothesis for the stores belonging to Chain 2 and Chain 3. For the stores belonging to Chain 1, it was clear from visual inspection that the majority of MEB-simulated redemption values exceeded the maximum actual redemption values (figure 9). This characterization was similar for Chain 4 stores, although there was more distributional overlap between MEB and actual distributions. In all cases, however, the RS-simulated distributions were the closest to the actual distribution of redemption values.