The Effect of SNAP on the Composition of Purchased Foods: Evidence and Implications

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Online Appendix

Contents

*Hastings and Shapiro: Brown University and NBER (e-mail: justine_hastings@brown.edu, jesse_shapiro_1@brown.edu). Kessler: Brown University (e-mail: ryan_kessler@brown.edu). Section 3 in this online Appendix uses data from The Nielsen Company (US), LLC. Researcher(s) own analyses calculated (or derived) based in part on data from The Nielsen Company (US), LLC and marketing databases provided through the Nielsen Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the Nielsen data are those of the researcher(s) and do not reflect the views of Nielsen. Nielsen is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

1 Data Appendix

Linking Retailer Food Products to TFP categories

UPC Food Products

We assign UPC food products to TFP product categories in two steps. First, we join UPC food products to product categories in the Quarterly Food-at-Home Price Database (QFAHPD) (Todd et al. 2010) using a crosswalk between UPCs and QFAHPD product categories established by the USDA (Todd et al. 2010; USDA 2016c). Second, we join QFAHPD product categories to TFP product categories using the crosswalk between QFAHPD and TFP product categories established in Volpe and Okrent (2012).

The crosswalk between UPCs and QFAHPD product categories established by the USDA is based on version 2 of the QFAHPD, while the crosswalk between QFAHPD product categories and TFP product categories established in Volpe and Okrent (2012) is based on version 1 of the QFAHPD. Relative to version 1, version 2 has two additional product categories: "non-alcoholic diet carbonated beverages" and "unsweetened coffee and tea." We assign these version-2 product categories to the "soft drinks, sodas, fruit drinks, and ades (including rice beverages)" and "coffee and tea" TFP categories, respectively.

Due to imperfections inherent to the UPC-to-QFAHPD-to-TFP mapping, we make two changes to the TFP product categories. First, because the "all potato products" TFP category contains both potato products and other starchy vegetable products, we rename the category "all starchy vegetable products." Second, because the "soups" TFP category contains canned soups, sauces, and prepared foods we combine the "soups" and "fats and condiments" TFP categories into a single category which we denote as "soups, fats, and condiments."

Random-Weight Food Products

We assign random-weight food products directly to TFP product categories using retailer and TFP product category descriptors. The assignment was performed by hand by a coauthor and then refined following a review by a research assistant.

Classifying the Healthfulness of TFP Categories

We identify TFP product categories that are recommended by the 2010 Dietary Guidelines for Americans (DGAs) (HHS and USDA 2010) for increased consumption using the healthful classification of QFAHPD product categories established in Volpe, Okrent, and Leibtag (2013).

In aggregating the QFAHPD-level healthful classification we encounter two issues. First, there are three TFP product categories that contain both healthful and unhealthful QFAHPD product categories: “all cheese (including cheese soup and sauce),” “beef, pork, veal, lamb, and game,” and “fats and condiments.” We follow Handbury, Rahkovsky, and Schnell (2016) and mark all three categories as unhealthful. Second, since the healthful classification in Volpe, Okrent, and Leibtag (2013) is based on version 1 of the QFAHPD, it does not suggest a classification for “coffee and tea.” We mark this category as healthful.

Linking Retailer Food Products to the USDA SR28 and FNDDS

Here we outline our procedure for linking retailer products to food items in release 28 of the USDA National Nutrient Database for Standard Reference (SR28) (USDA 2016a) and the 2011-2012 version of the USDA Food and Nutrient Database for Dietary Studies (FNDDS) (USDA 2014).

We proceed in two rounds. In the first round, we link a subset of retailer products to the SR28. In the second round, we link the remaining products to the union of the SR28 and FNDDS.

Round 1: Linking Select Products to the USDA SR28

We link retailer food products in product categories for which the UPC-level nutrition data cover less than half of category food spending to the SR28 by hand in two steps.

First, we use retailer product category and SR28 food item descriptors to link retailer product categories to SR28 food items. Since some retailer product categories can reasonably be linked to multiple SR28 food items, we allow the mapping between product categories and food items to be one-to-many. For each link established between a retailer product category and an SR28 food item, we record the weight associated with a typical unit of the food item (e.g., the weight of a medium-sized banana).[1] We also flag product categories that contain nutritionally distinct products.

Second, for retailer product categories flagged in step one as containing nutritionally distinct products, we repeat step one at the product level, using retailer product and SR28 food item descriptors to link retailer products to SR28 food items, again allowing for the mapping to be one-to-many. We limit the scope of this second step to a subset of top-selling products, chosen to account for 95 percent of spending among the product categories flagged as containing nutritionally distinct products.

To help ensure a high degree of accuracy in our hand-coding, we complete steps one and two twice and reconcile any discrepancies. Given the product-category and product-level links, we assign to each retailer

[1] The weight of a typical unit is often identified by weight descriptors (`msre_desc`) containing “medium,” “fruit,” or the name of the item (e.g., “avocado,” “melon,” “potato”).

product the median nutritional content and weight across the SR28 food items to which it was linked, with priority given to the product-level links.

Round 2: Linking Remaining Products to the USDA SR28 and FNDDS

In round 1, we linked select retailer products to the SR28. In this round, we link the remaining products to the union of the SR28 and FNDDS.

We link retailer products to food items in the union of the SR28 and FNDDS by hand, mirroring our approach in step one of round one above. Unlike in round one, we do not capture information regarding weight, and we do not establish links at the product level.

To help ensure a high degree of accuracy in our hand-coding, all product categories are linked twice and discrepancies are reconciled. Given the product category level links, we assign to each retailer product the median nutritional content across the SR28 and/or FNDDS food items to which it was linked.

Obtaining Information on USDA Food Patterns

We obtain USDA Food Pattern information from the 2011-2012 version of the USDA Food Pattern Equivalents Ingredients Database (FPID) and the USDA Food Pattern Equivalents Database (FPED, Bowman et al. 2014). The FPID contains the amount of each of the thirty-seven USDA Food Patterns per 100 edible grams of food items in the SR28. The FPED contains the same information but for food items in the FNDDS—a derivative of the SR28 containing more mixed-ingredient food items.

We join retailer products to food items in the FPID and FPED, using product category level links with the SR28 and FNDDS as crosswalks. We assign to each retailer product the median food pattern content across the FPID and/or FPED food items to which it was linked.

Rhode Island Administrative Data

We use Rhode Island state administrative records housed in a secure facility. Personally identifiable information has been removed from the data and replaced with anonymous identifiers that make it possible for researchers with approved access to join and analyze records associated with the same individual while preserving anonymity (Hastings et al. 2019).

The data include anonymized state SNAP records from April 2006 through December 2012, which indicate the months of benefit receipt and the collection of individuals associated with each household on SNAP in each month. We define a SNAP spell to be a contiguous period of benefit receipt. We assume that an individual belongs to the household of her most recent spell, does not change households between the end of any given spell and the start of the next spell, and belongs to the household of her first spell as of the start of the sample period. We determine each individual's age in each month, and we exclude from our sample any household whose adult (over 18) composition changes during the sample period. We also exclude from our sample any household whose membership we cannot uniquely identify in every month, which can occur either because we lack a unique identifier for an individual in the household or because a given individual is associated with multiple households in the same month.

The data also include anonymized administrative records of the state's unemployment insurance system joined via anonymized identifiers to the individuals in the SNAP records over the same period. We compute, for each household and quarter, the sum of total unemployment insurance benefits received by and total earnings reported for all individuals who are in the household as of the quarter's end. We exclude from our sample any household-quarter in which the household is not observed for all three months of the quarter. We also exclude from our sample any household-quarter in which the household's total quarterly earnings exceed the 99.9999th percentile or in which unemployment insurance benefits in any month of the quarter exceed three times the four-week equivalent of the 2016 maximum individual weekly benefit of $707 (Rhode Island Department of Labor and Training 2016).

2 Inference for the TS2SLS Estimator

Let $\hat{\theta}_1$ denote the estimated coefficients on the excluded instruments in the first stage, with estimated variance $\hat{\mathbf{V}}_1$. Let $\hat{\theta}_2$ denote the estimated structural parameters in the second stage, with unadjusted estimated variance $\hat{\mathbf{V}}_2$. Let ∇_{21} denote the gradient of $\hat{\theta}_2$ with respect to $\hat{\theta}_1$ at the estimated value of the parameters. We compute the adjusted estimated variance $\hat{\mathbf{V}}_2^*$ of $\hat{\theta}_2$ as

$$\hat{\mathbf{V}}_2^* = \hat{\mathbf{V}}_2 + \nabla_{21}\hat{\mathbf{V}}_1\nabla_{21}'.$$

This follows Newey and McFadden (1994, equation 6.12) under the assumption of independent samples. Except where otherwise stated, we use asymptotic standard errors clustered at the household level for the inputs $\hat{\mathbf{V}}_1$ and $\hat{\mathbf{V}}_2$.

3 Association Between SNAP Participation and the Composition of Purchased Foods in the Nielsen Homescan Consumer Panel

This section investigates the longitudinal association between SNAP participation and the composition and nutrient content of foods purchased for at-home consumption in data from the Nielsen Homescan Consumer Panel.

3.1 Data and Definitions

Our discussion of the Nielsen Homescan Consumer Panel (NHCP) draws heavily on Bronnenberg et al. (2015) and Hastings and Shapiro (2018), and we sometimes quote these studies without specific attribution.

3.1.1 Purchases and SNAP Participation

We obtained data from the NHCP from the Nielsen Company (US), LLC and marketing databases provided by the Kilts Center for Marketing Data Center at the University of Chicago Booth School of Business.[2] Panelist households are given an optical scanner and are asked to scan the barcode of every consumer packaged good they purchase, regardless of the store where it was purchased.[3]

Nielsen recruits its panelists by direct mail and through internet advertising, and provides incentives to recruit and retain panelists. Muth et al. (2007) and Kilts Center for Marketing (2016) describe the recruitment process in more detail.

We observe 663 million purchases made on 119 million purchase occasions by 158,830 households from January 2004 through September 2015. For each product purchased on each shopping trip, we observe the date, the transaction price, the quantity of items purchased, and the total expenditure on the item.

We obtained from the Nielsen Company a quarterly supplement from the Homescan Panel Omnibus Survey. Grummon and Taillie (2017) use this supplement to study the cross-sectional association between SNAP participation and the nutritional content of household grocery purchases. The supplement is available to us for the fourth quarter of 2010 and for every other quarter from the fourth quarter of 2011 through the second quarter of 2015. It contains panelists' answers to the following question:

> *Are you or anyone in your household currently using or have you ever used food stamps, which includes food stamp card or voucher or cash grant from the state for food (also known as Supplemental Nutritional Assistance Program (SNAP), Electronic Debit Card (EBT card))?*

[2] Information on the data is available at `http://research.chicagobooth.edu/nielsen/`.

[3] Beginning in 2007, a subset of panelists are asked to itemize purchases of products (e.g., produce) that do not have a barcode.

Please read all response options then select the one that best describes you.

1) Currently using food stamps

2) Have used food stamps, but not currently using them.

3) Have never used food stamps.

We define a *SNAP quarter* as any household-quarter in which the household's answer is "currently using food stamps." Of the household-quarters in our panel for which this question is asked, 7.3 percent are SNAP quarters.

3.1.2 Product Classification and Nutritional Information

The NCHP data include characteristics of each product purchased, including the Universal Product Code (UPC) if it has one, a text description of the product, the product's size, and the product's location within a taxonomy. We refer to locations within the taxonomy as *product categories*. Across all products observed in the data there are 1304 unique product categories. We exclude all products without a UPC from our calculations.

We classify UPC products as SNAP-eligible or SNAP-ineligible based on the product taxonomy and the guidelines for eligibility published on the USDA website (FNS 2017). Across all SNAP-eligible UPC products there are 608 unique product categories. We exclude all SNAP-ineligible UPC products from our calculations.

We classify SNAP-eligible UPC products according to the product categories underlying the USDA's Thrifty Food Plan (TFP) (USDA 2007) using the procedure described in Section IB of the paper.

We obtain nutritional information for SNAP-eligible food products following the sources and procedures described in Section IC of the paper. The UPC-level data sources and imputations provide nutritional information for SNAP-eligible UPC products that account for 74.9 and 23.2 percent of SNAP-eligible UPC spending, respectively. We exclude from our analysis the products that account for the remaining 1.9 percent of SNAP-eligible UPC spending.

3.1.3 Food Spending, Food Attributes, and Food Healthfulness

For each household in our panel, we calculate the quarterly average of monthly total UPC spending, monthly kilocalories, and monthly micronutrients purchased in each calendar quarter. We exclude from our analysis the 10 households who spend more than $5,000 on UPC products in a single month.

We also compute several measures of the healthfulness of purchased foods. We calculate the share of kilocalories purchased going to each of the TFP product categories, as described in Section ID1 of the paper. We calculate a nutrient density index for each of the nutrients that are generally required to appear on the Nutrition Facts label and for which the FDA recommends either increased or limited consumption, as described in Section ID2 of the paper. We calculate a nutrient density score (NDS) to summarize the nutrient density indexes, as described in Section ID2 of the paper. We exclude from our analysis values of the NDS above the 99.9th percentile.

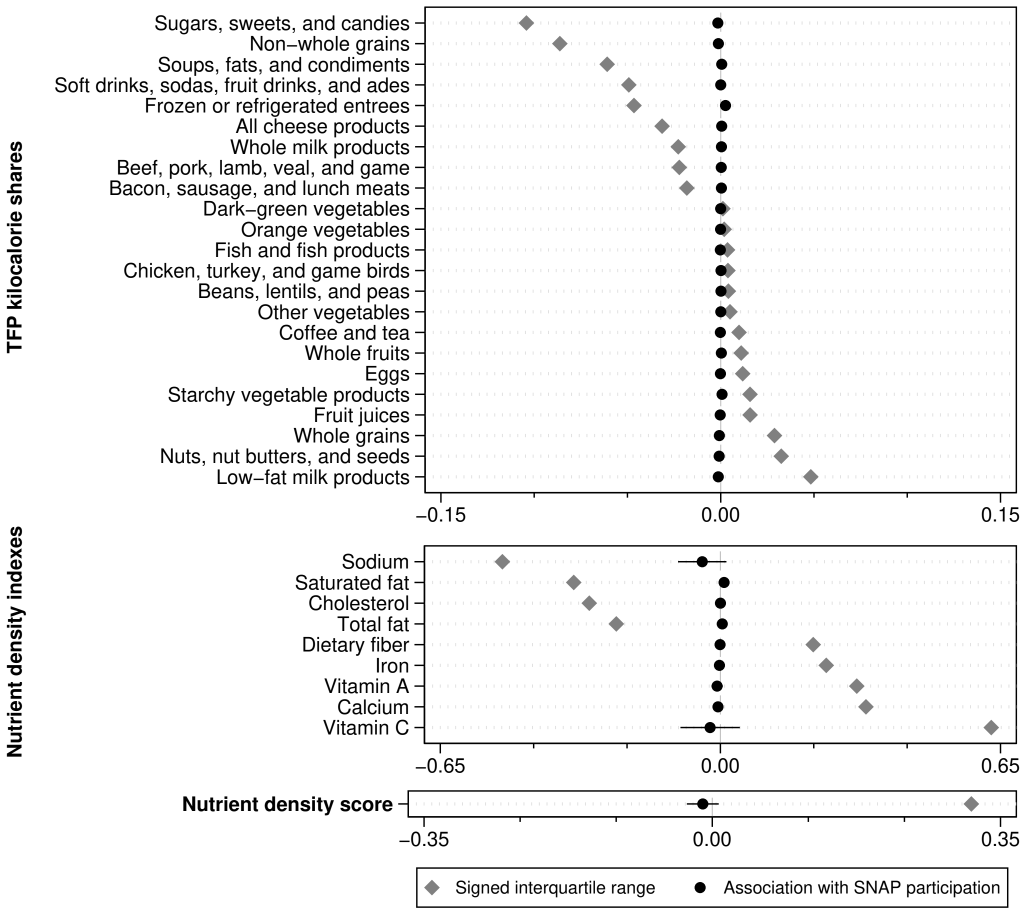
3.2 Methods and Estimates

Our unit of analysis is the household-quarter. We estimate a two-way fixed effects regression of each measure of healthfulness on an indicator for whether the current quarter is a SNAP quarter, including both a household fixed effect and a calendar quarter fixed effect. The estimated coefficient on the SNAP quarter indicator is our summary of the longitudinal association between SNAP participation and healthfulness.

Online Appendix Figure 1 presents the estimated coefficients for the full set of TFP kilocalorie shares, the full set of nutrient density indexes, and the NDS. For each outcome variable, we report the estimated coefficient, its confidence interval, and the cross-sectional interquartile range (IQR) of the average of the outcome variable, signed so that a positive IQR indicates that higher values of this outcome are associated with greater healthfulness.

Online Appendix Figure 1 shows that, in most cases, the association between SNAP participation and healthfulness is small relative to the cross-sectional variation in measured healthfulness. For example, in the case of the NDS, the confidence interval on the estimated coefficient ranges from -0.0309 to 0.0079, or from -0.0982 to 0.0251 of an IQR. Online Appendix Figure 1 also shows that, in most cases, the coefficient estimates are less precise than the corresponding estimate of the causal effect of SNAP reported in Figure 4 of the paper. For example, for the NDS, the standard error on the estimated coefficient is 0.0099, which is larger than the standard error of 0.0039 on the estimated effect reported in Figure 4 of the paper.

Online Appendix Figure 1: Association Between SNAP Participation and Food Healthfulness

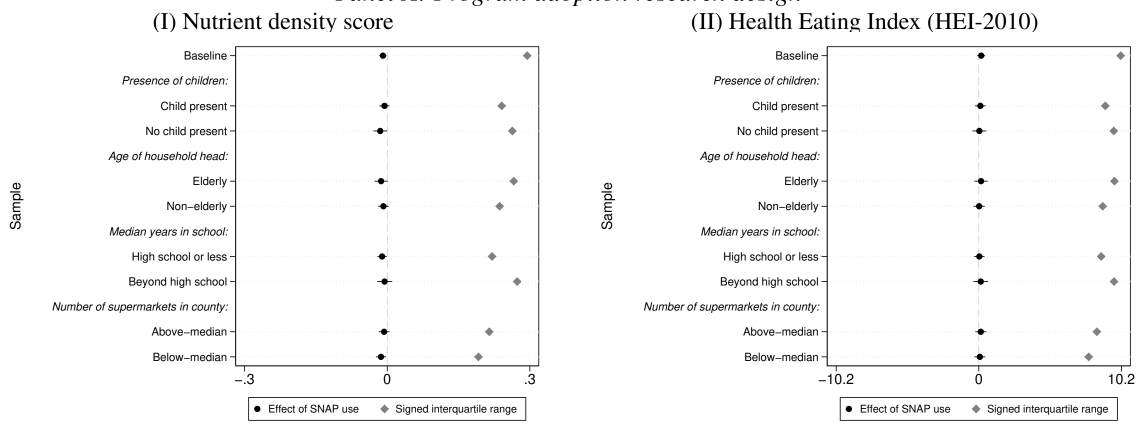


Notes: Data come from the Nielsen Homescan Consumer Panel and the Homescan Panel Omnibus Survey. Each box presents the signed IQR of and the estimated association with SNAP participation on the given outcome(s). For the signed IQR, the sample is all households and the unit of observation is the household. For the estimated association with SNAP participation, the sample is the set of households that report being on SNAP in at least one survey response and report not being on SNAP in at least one survey response, and the unit of observation is the household-quarter. For each outcome, the signed IQR is the IQR of the average of the outcome across calendar months for each household, signed to reflect a one IQR increase in food healthfulness. For each outcome, the association with SNAP participation is estimated via a regression of the outcome on an indicator for whether the current quarter is a SNAP quarter, including fixed effects for household and calendar quarter. In the first box, the outcomes are the shares of kilocalories going to each of the product categories that underlie the Thrifty Food Plan (TFP), and the IQR is signed according to the TFP healthfulness classification described in Section 1 of this online Appendix. In the second box, the outcomes are nutrient density indexes, and the IQR is signed according to whether the corresponding Daily Value bound represents a lower or upper bound. In the third box, the outcome is the nutrient density score (NDS), and the IQR is signed to reflect the fact that the NDS is increasing in food healthfulness by construction. Error bars represent 95 percent confidence intervals based on asymptotic standard errors clustered by household.

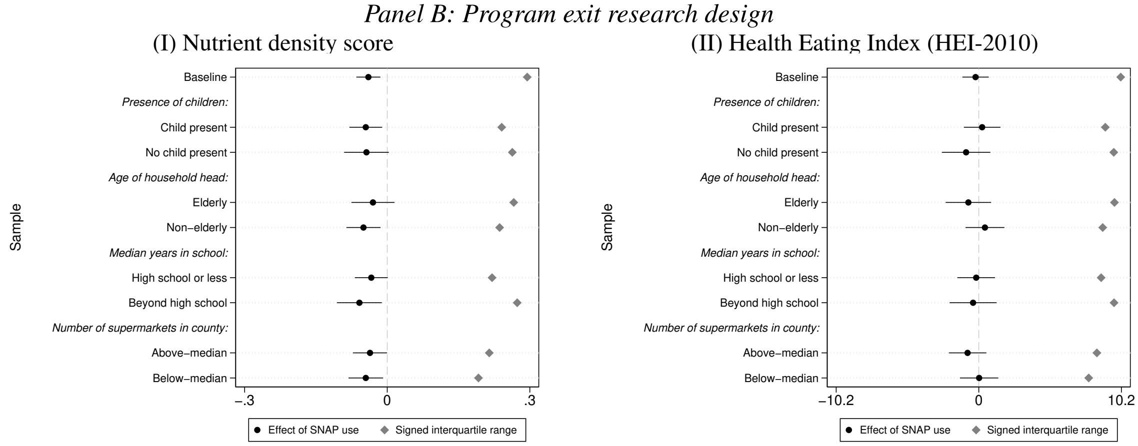
4 Supplemental Figures and Tables

Online Appendix Figure 2: Effect of SNAP Use on Food Healthfulness by Household Characteristics

Panel A: Program adoption research design



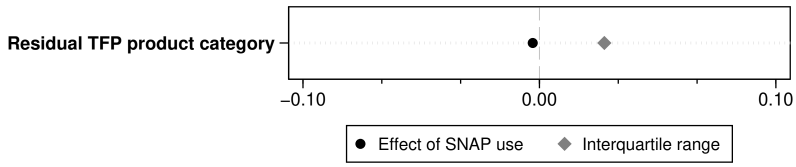
Panel B: Program exit research design



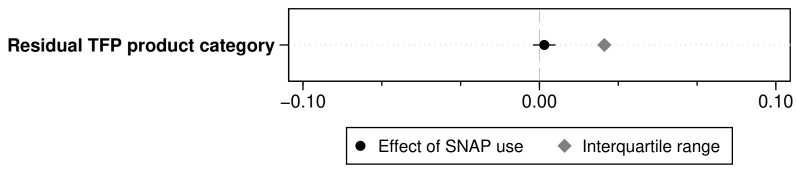
Notes: Each panel presents the estimated effect of SNAP use on and the signed interquartile range (IQR) of the given outcome for different samples of households. For the estimated effect of SNAP use series, the sample is the set of SNAP adopters that fall within the category given on the y-axis, and the unit of observation is the household-time period. For the signed IQR series, the sample is all retailer households that fall within the category given on the y-axis, and the unit of observation is the household. "Child present" indicates the presence of one or more children aged 0-18 years of age in the household. "Elderly" indicates whether the head of household is 55 years old or older. "High school or less" indicates whether the median number of years of schooling for individuals 25 years old or older in the household is less or equal than 12. The number of supermarkets in county ¨above-median¨ indicates whether the household resides in a county where the number of supermarkets is above the median number of supermarkets among our sample of SNAP adopters. Information on these characteristics is provided by the retailer as described in Hastings and Shapiro (2018) and Hastings and Shapiro (2018b). For each outcome and sample, the signed IQR is the IQR of the average of the outcome across calendar months for each household in the given sample, signed to reflect a one IQR increase in food healthfuless. In panel A, the time period is a calendar quarter and the causal effect of SNAP use is estimated in two samples using the TS2SLS estimator defined in Inoue and Solon (2010) in a model that includes calendar quarter fixed effects. Standard errors are calculated as outlined in Section 2 of this online Appendix. The endogenous variables are the change in an indicator for whether the current quarter is a SNAP quarter and change in average monthly in-state earnings. The excluded instruments are an indicator for whether the current quarter is a SNAP adoption quarter and its first lead. The first stage for the change in in-state earnings is estimated on the sample of SNAP adopters in the Rhode Island administrative data described in Section IG of the paper, not restricting to households in the given category. The first stage for the change in an indicator for whether the current quarter is a SNAP quarter and the second stage are estimated in the retail panel, limiting to households in the given category. In panel B, the time period is a calendar month and the causal effect of SNAP use is estimated via a two-stage least squares regression of the change in the outcome on the change in an indicator for whether the current month is a SNAP month, with an indicator equal to one in the first month of a six-month clock that begins in the most recent adoption month as the excluded instrument and calendar month fixed effects as exogenous controls. This regression is estimated on data from the retail panel, limiting to households in the given category. The clock indicator is set to zero in the first six months (inclusive of the adoption month) following the most recent adoption, in any month after the first 24 months (inclusive of the adoption month) following the recent adoption, and in any month for which there is no preceding adoption. In both panels, error bars represent 95 percent confidence intervals based on asymptotic standard errors clustered by household. In the left column, the outcome is the nutrient density score (NDS). In the right column, the outcome is the Healthy Eating Index (HEI-2010). In both columns, the IQR is signed to reflect that both the NDS and the HEI-2010 are increasing in food healthfulness by construction.

Online Appendix Figure 3: Effect of SNAP Use on Kilocalorie Share of Food Products not Assigned to Thrifty Food Plan Product Category

Panel A: Program adoption research design

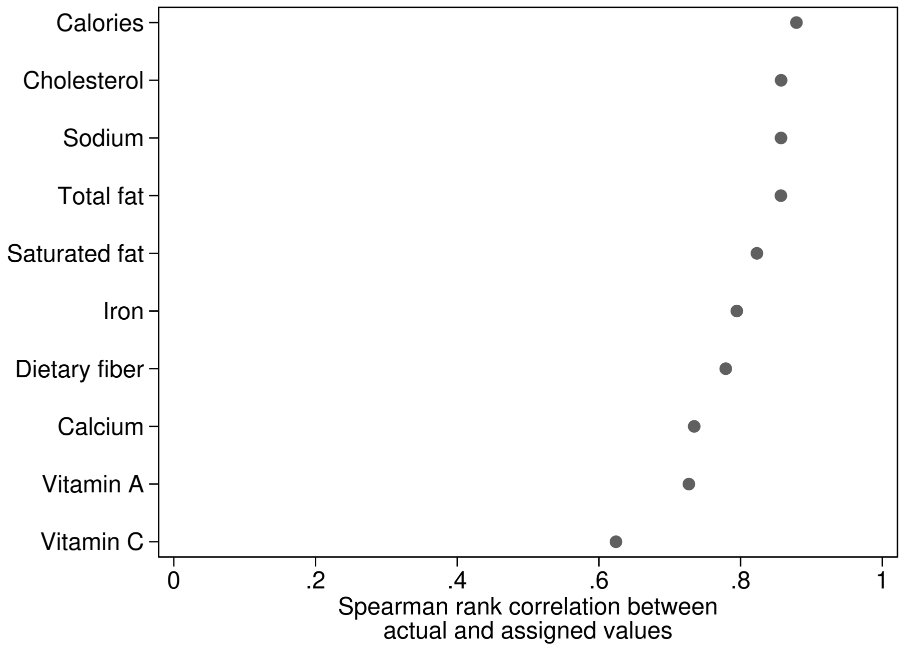


Panel B: Program exit research design



Notes: The plot presents the interquartile range (IQR) of and the estimated effect of SNAP use on the share of kilocalorie purchases going to food products not assigned to a Thrifty Food Plan product category (i.e., the residual TFP product category). For the IQR series, the sample is all retailer households and the unit of observation is the household. The IQR is the IQR of the average of the outcome across calendar months for each household. For the estimated effect of SNAP use, the sample is the set of SNAP adopters and the unit of observation is the household-time period. In panel A, the time period is a calendar quarter. The effect of SNAP use is estimated via a two-sample two-stage least squares regression (Inoue and Solon 2010) of the change in the outcome on the change in an indicator for whether the current quarter is a SNAP quarter and the change in average monthly in-state earnings, with an indicator for whether the current quarter is a SNAP adoption quarter and its first lead as excluded instruments and calendar quarter fixed effects as exogenous controls. The first stage for the change in in-state earnings is estimated on the sample of SNAP adopters in the Rhode Island administrative data described in Section IG of the paper. The first stage for the change in an indicator for whether the current quarter is a SNAP quarter and the second stage are estimated in the retail panel. Standard errors are calculated as outlined in Section 2 of this online Appendix. In panel B, the time period is a calendar month. The effect of SNAP use is estimated via a two-stage least squares regression of the change in the outcome on the change in an indicator for whether the current month is a SNAP month, with an indicator equal to one in the first month of a six-month clock that begins in the most recent adoption month as the excluded instrument and calendar month fixed effects as exogenous controls. The clock indicator is set to zero in the first six months (inclusive of the adoption month) following the most recent adoption, in any month after the first 24 months (inclusive of the adoption month) following the recent adoption, and in any month for which there is no preceding adoption. Error bars represent 95 percent confidence intervals based on asymptotic standard errors clustered by household.

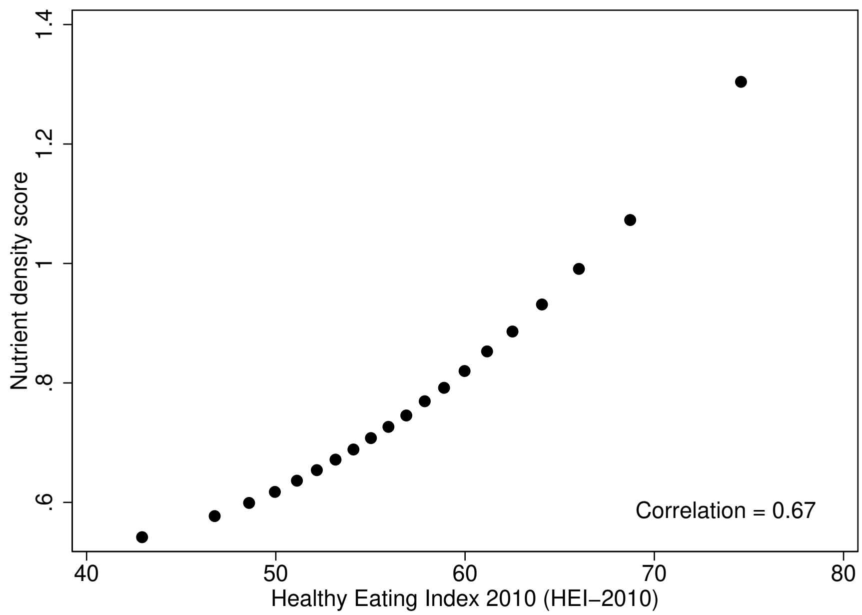
Online Appendix Figure 4: Product-level Assessment of Nutrient Data Assignment Scheme



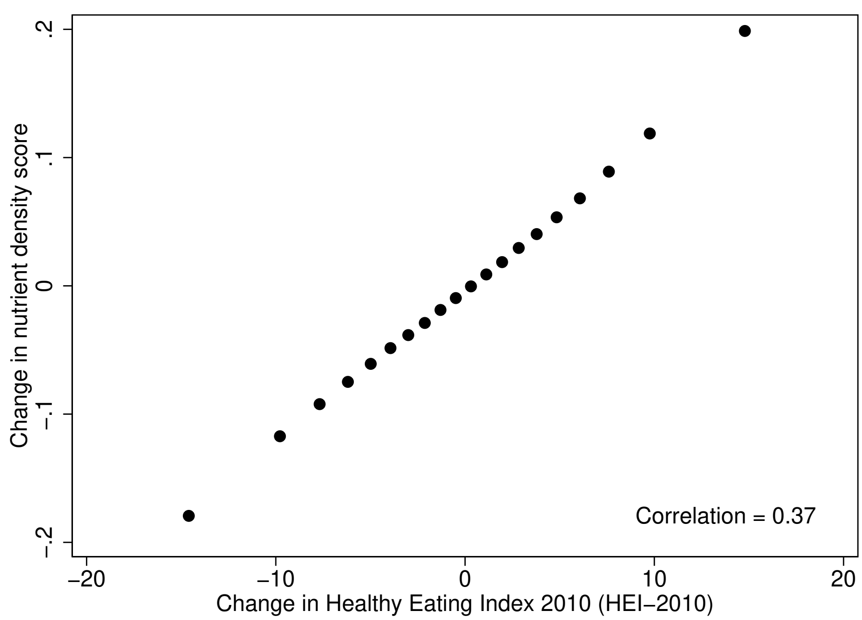
Notes: The figure presents Spearman rank correlations between actual and assigned nutrient values. The unit of observation is a product. The sample is a randomly-chosen subset of UPC food products for which UPC-level nutrition data are available that together account for 10 percent of UPC food spending. For each UPC food product, the actual nutrient values come from the UPC-level data sources outlined in Section IC of the paper. The assigned values come from the assignment method defined in Section IC of the paper, conducted as if nutrient values for the given product were not present in the UPC-level data sources.

Online Appendix Figure 5: Relationship Between Summary Measures of Food Healthfulness

Panel A: Cross-sectional relationship

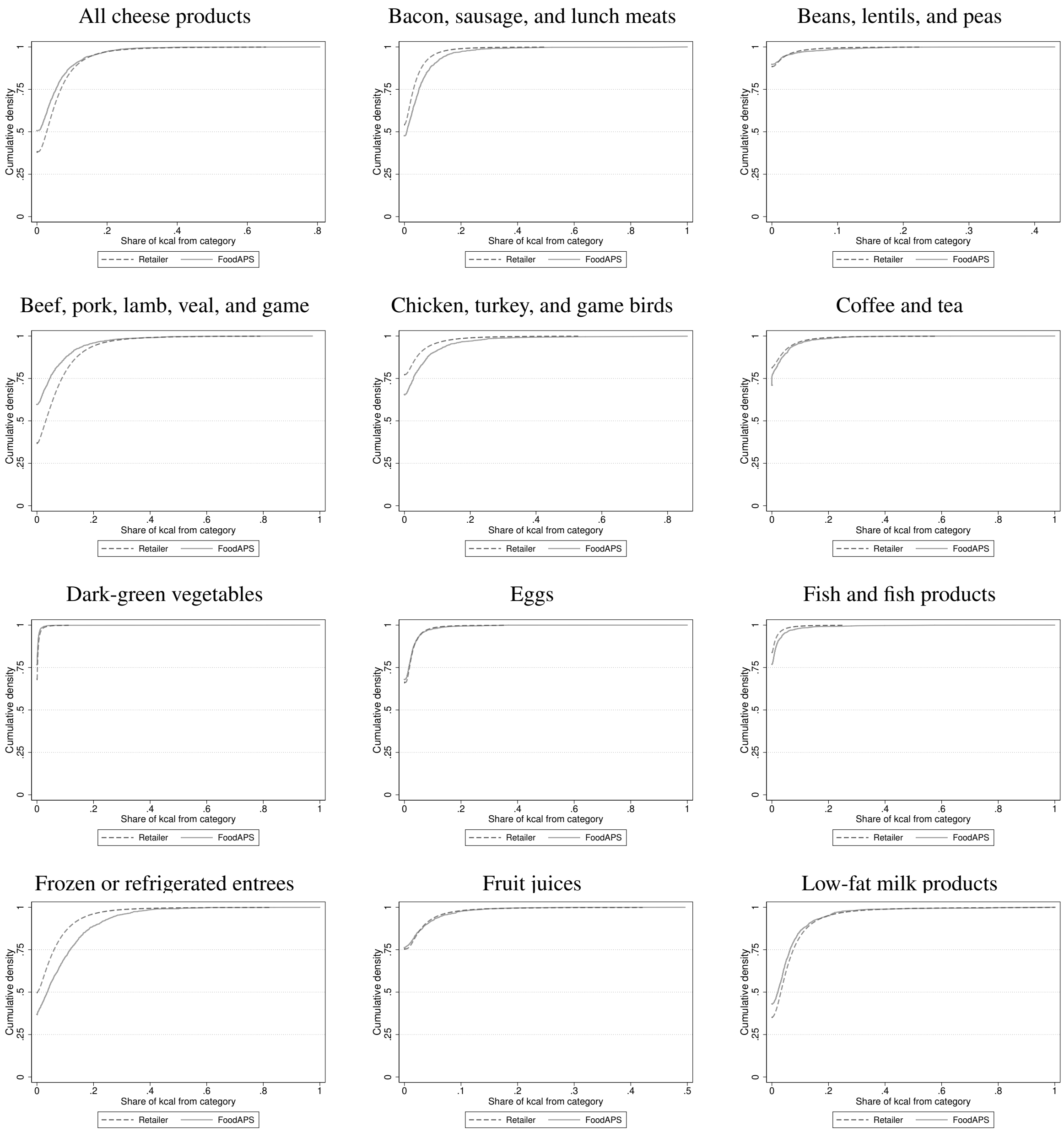


Panel B: Within-household relationship

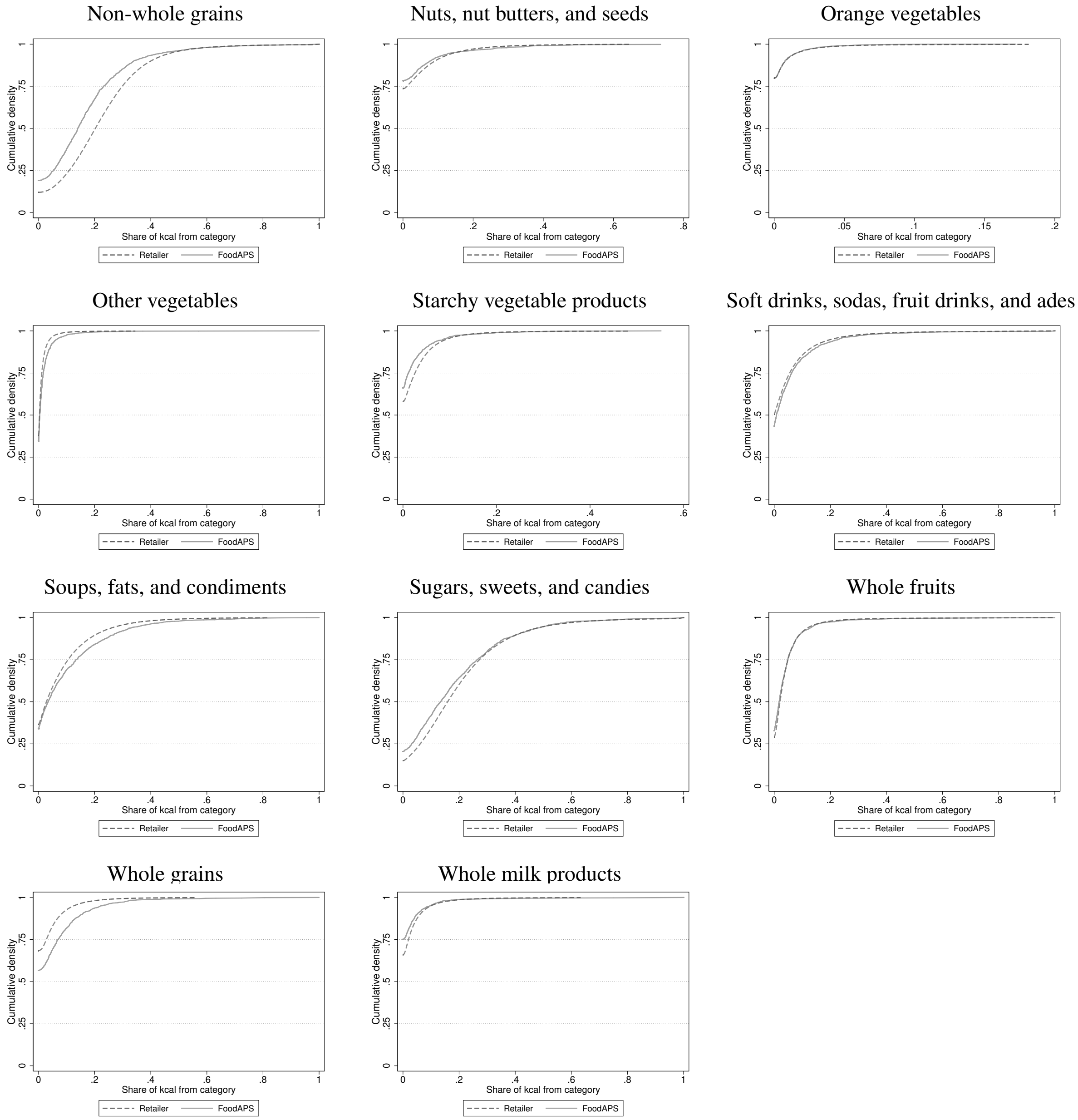


Notes: Panel A presents a binned scatter plot of the relationship between the nutrient density score (NDS) and the Healthy Eating Index 2010 (HEI-2010). The unit of observation is a household. Panel B presents a binned scatter plot of the relationship between the change in the NDS and the change in the HEI-2010. The unit of observation is a household-quarter. In both panels, the sample is all households in the retail panel. The binned scatter plots are constructed as follows. We divide observations into twenty equally-sized bins according to the x-axis variable. We then plot the average of the y-axis variable and the x-axis variable within each bin.

Online Appendix Figure 6: Comparisons of Distributions of TFP Kilocalorie Shares in the Retail Panel and FoodAPS Data

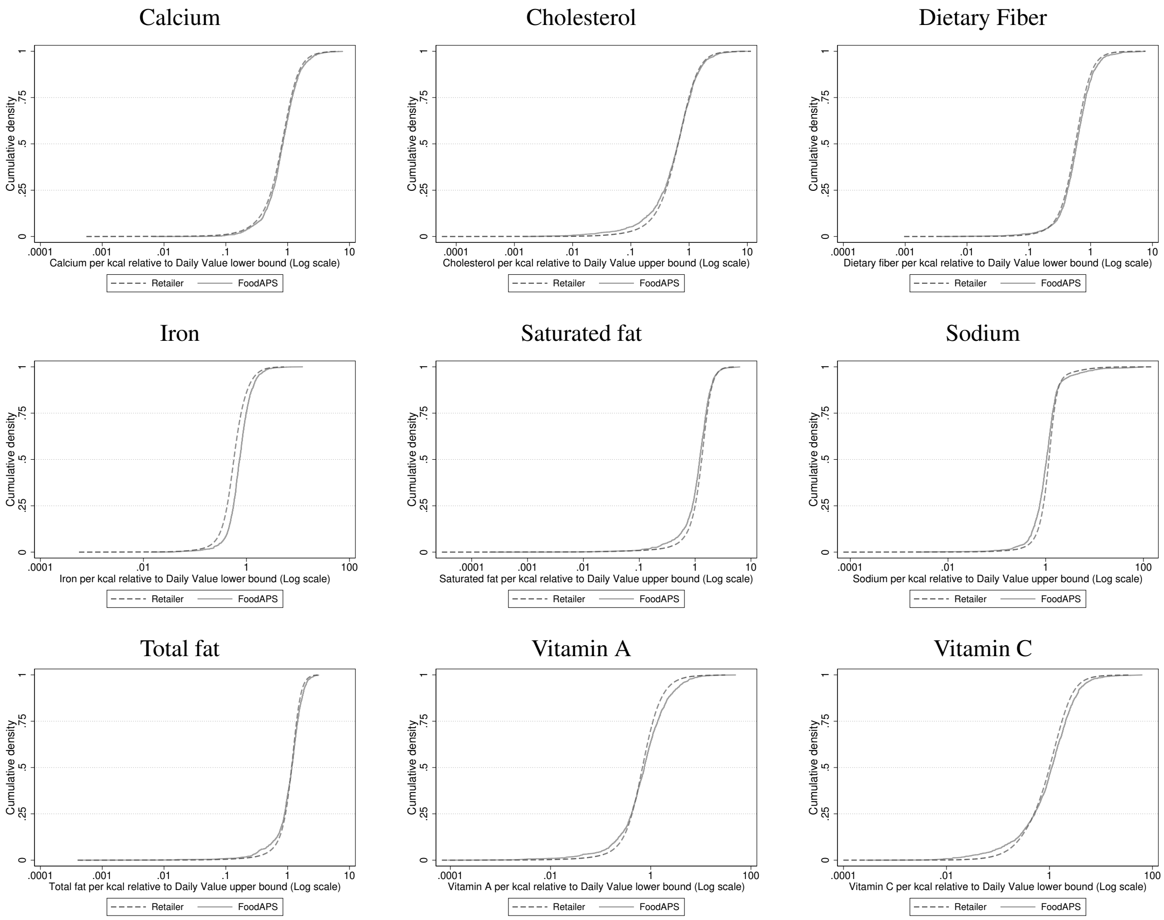


Online Appendix Figure 6: Comparisons of Distributions of TFP Kilocalorie Shares in the Retail Panel and FoodAPS Data (Continued)



Notes: Each panel plots the cumulative distribution function of a measure of food healthfulness across households in two different samples. For the line labeled "FoodAPS," the sample is the set of households surveyed in the FoodAPS data, described in Section IE of the paper. Each FoodAPS household is weighted according to the FoodAPS household weights such that the overall sample is nationally representative. For each household, the measure of food healthfulness is calculated from all observed food-at-home acquisitions during the survey week. For the line labeled "Retailer," the sample is all households in the retail panel during a randomly-assigned pseudo-survey week. Pseudo-survey weeks are randomly assigned to retailer households such that the distribution of pseudo-survey weeks in the retail panel equals the distribution of actual survey weeks in the FoodAPS data. For each household, the measure of food healthfulness is calculated from all food purchases at the retailer during their given pseudo-survey week. Each outcome is the share of kilocalories from a given product category underlying the Thrifty Food Plan, as described in Section ID1 of the paper. The horizontal dotted lines intersect the 25th, 50th, and 75th percentiles of the distributions.

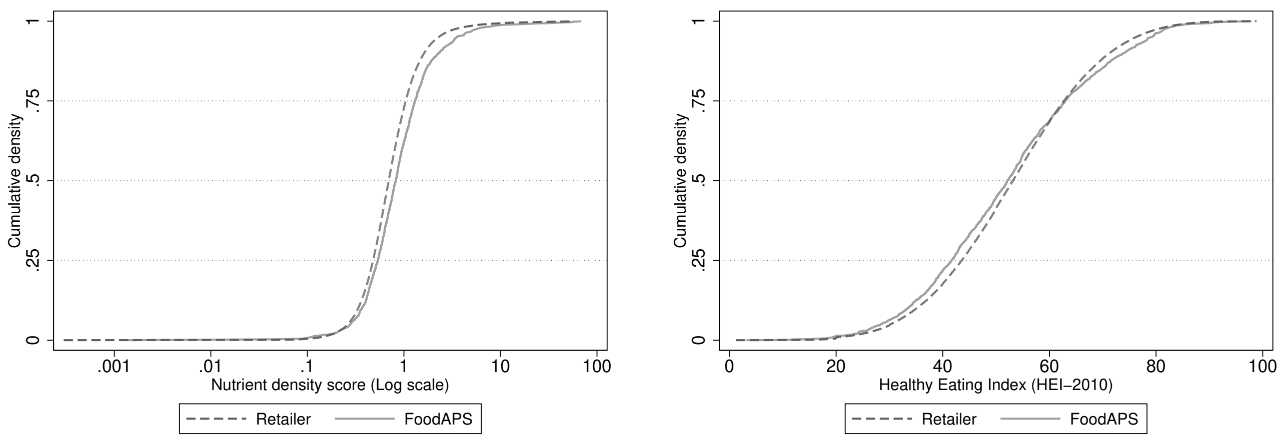
Online Appendix Figure 7: Comparisons of Distributions of Nutrient Density Indexes in the Retail Panel and FoodAPS Data



Notes: Each panel plots the cumulative distribution function of a measure of food healthfulness across households in two different samples. For the line labeled "FoodAPS," the sample is the set of households surveyed in the FoodAPS data, described in Section IE of the paper. Each FoodAPS household is weighted according to the FoodAPS household weights such that the overall sample is nationally representative. For each household, the measure of food healthfulness is calculated from all observed food-at-home acquisitions during the survey week. For the line labeled "Retailer," the sample is all households in the retail panel during a randomly-assigned pseudo-survey week. Pseudo-survey weeks are randomly assigned to retailer households such that the distribution of pseudo-survey weeks in the retail panel equals the distribution of actual survey weeks in the FoodAPS data. For each household, the measure of food healthfulness is calculated from all food purchases at the retailer during their given pseudo-survey week. Each outcome is a nutrient density index defined as the amount of a given nutrient purchased per kilocalorie divided by the corresponding nutrient density implied by the Food and Drug Administration (FDA) Daily Value (DV) bounds, as described in Section ID2 of the paper. All measures are shown on a log scale. The horizontal dotted lines intersect the 25th, 50th, and 75th percentiles of the distributions.

Online Appendix Figure 8: Comparisons of Distributions of Summary Measures of Food Healthfulness in the Retail Panel and FoodAPS Data

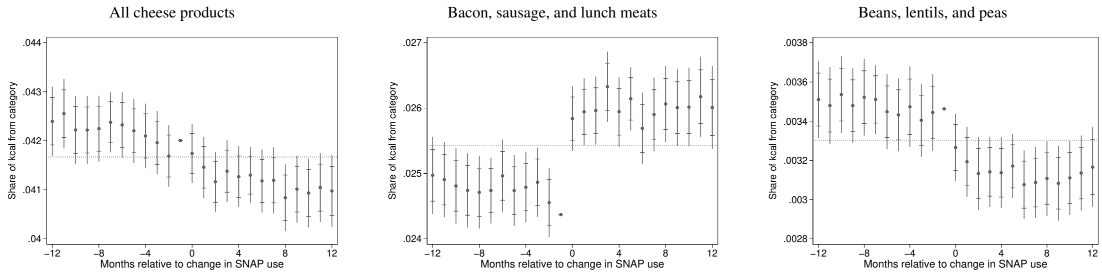
Panel A: Nutrient density score | *Panel B: Healthy Eating Index (HEI-2010)*



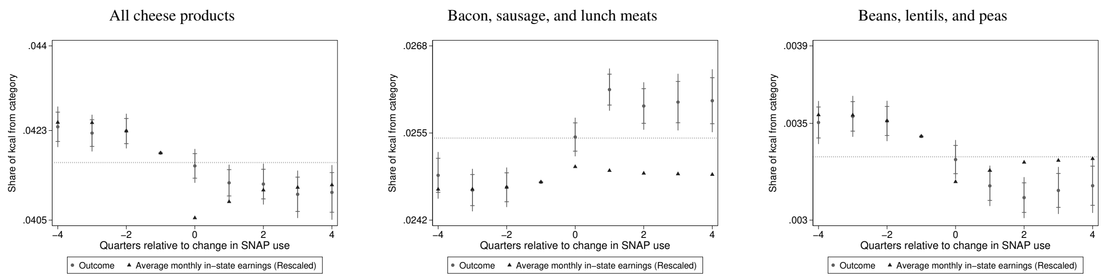
Notes: Each panel plots the cumulative distribution function of a measure of food healthfulness across households in two different samples. For the line labeled “FoodAPS,” the sample is the set of households surveyed in the FoodAPS data, described in Section IE of the paper. Each FoodAPS household is weighted according to the FoodAPS household weights such that the overall sample is nationally representative. For each household, the measure of food healthfulness is calculated from all observed food-at-home acquisitions during the survey week. For the line labeled “Retailer,” the sample is all households in the retail panel during a randomly-assigned pseudo-survey week. Pseudo-survey weeks are randomly assigned to retailer households such that the distribution of pseudo-survey weeks in the retail panel equals the distribution of actual survey weeks in the FoodAPS data. For each household, the measure of food healthfulness is calculated from all food purchases at the retailer during their given pseudo-survey week. In panel A, the measure of healthfulness is the nutrient density score, described in Section ID2 of the paper. The nutrient density score is shown on a log scale. In panel B, the measure of healthfulness is the Healthy Eating Index (HEI-2010), described in Section ID3 of the paper. The horizontal dotted lines intersect the 25th, 50th, and 75th percentiles of the distributions.

Online Appendix Figure 9: Dynamics of TFP Kilocalorie Shares Before and After Entry Into SNAP

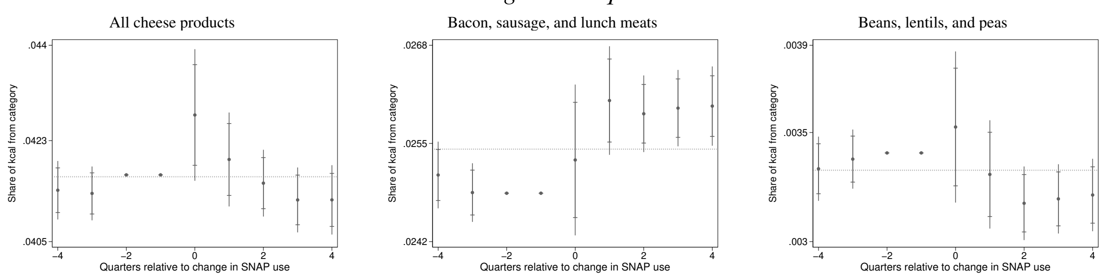
Panel A: Monthly frequency



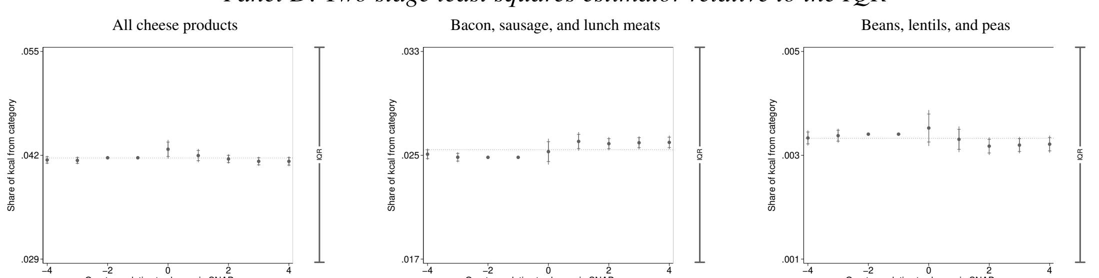
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator

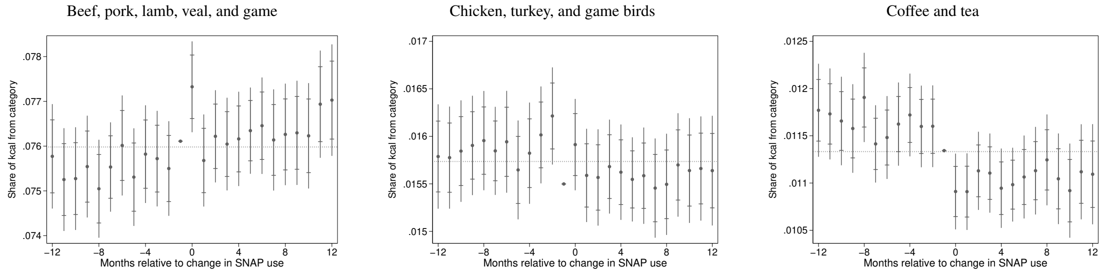


Panel D: Two stage least squares estimator relative to the IQR

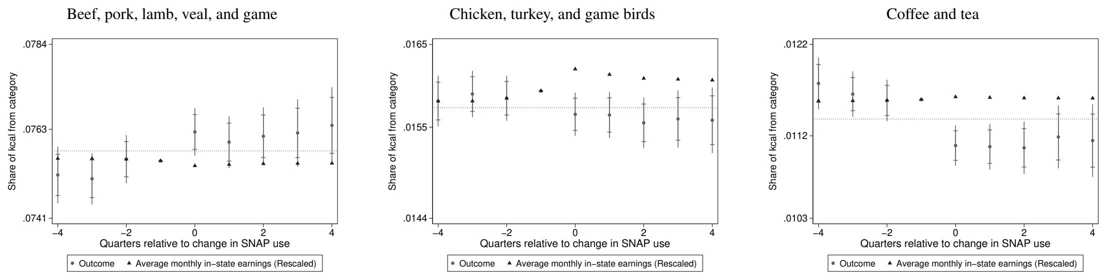


Online Appendix Figure 9: Dynamics of TFP Kilocalorie Shares Before and After Entry Into SNAP (Continued)

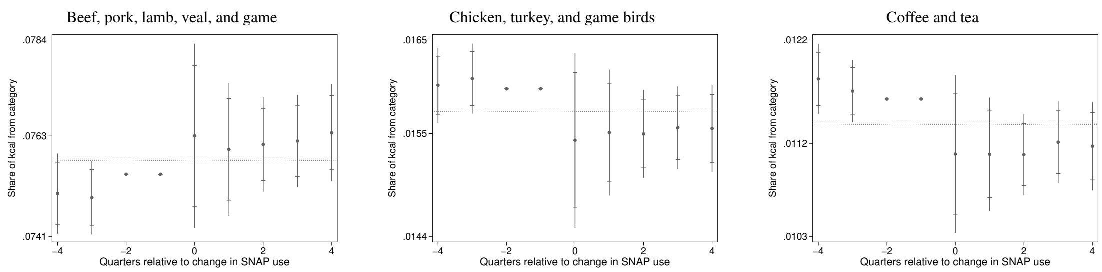
Panel A: Monthly frequency



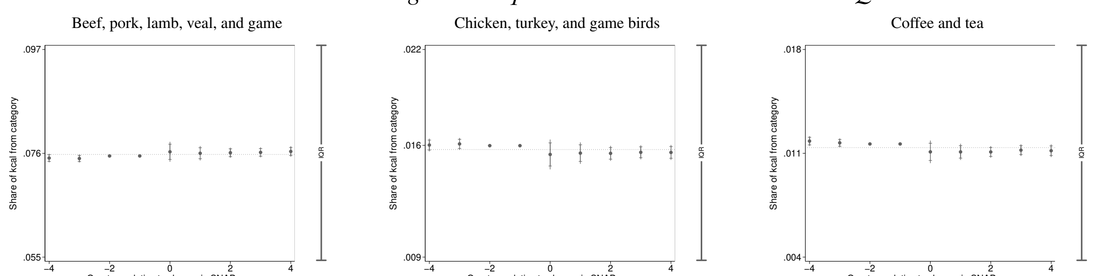
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator

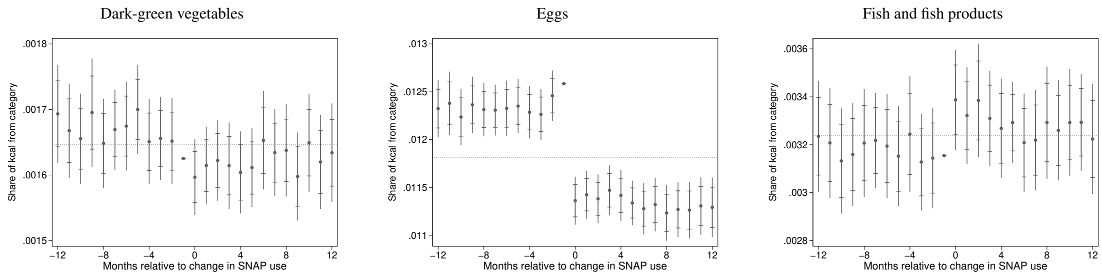


Panel D: Two stage least squares estimator relative to the IQR

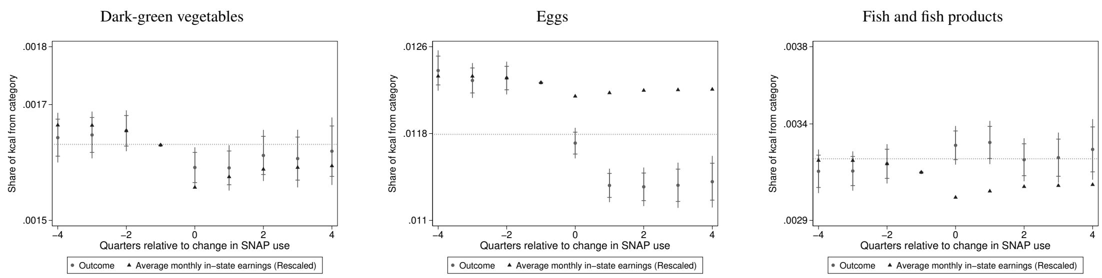


Online Appendix Figure 9: Dynamics of TFP Kilocalorie Shares Before and After Entry Into SNAP (Continued)

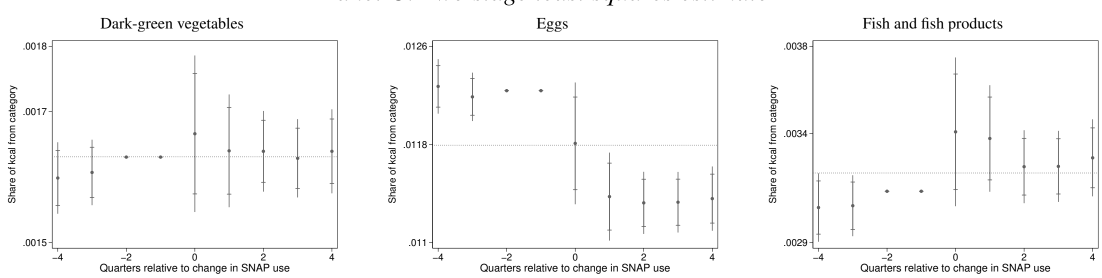
Panel A: Monthly frequency



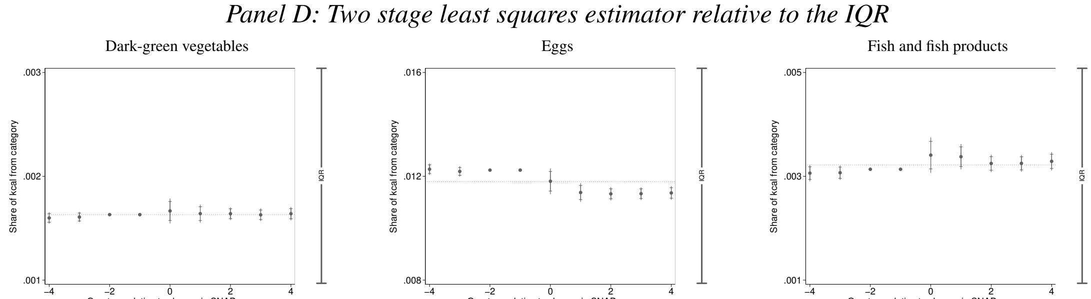
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator

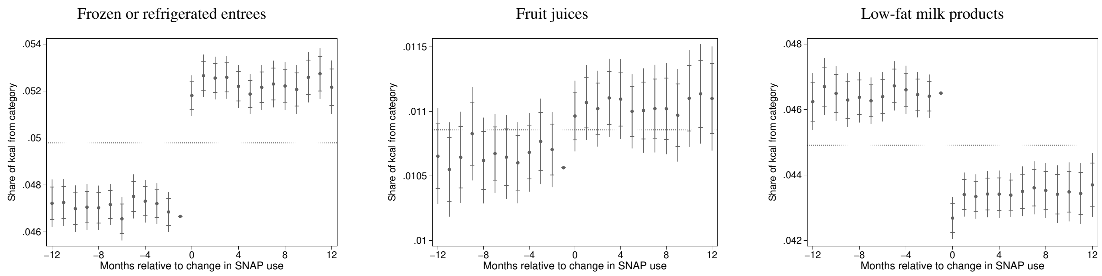


Panel D: Two stage least squares estimator relative to the IQR

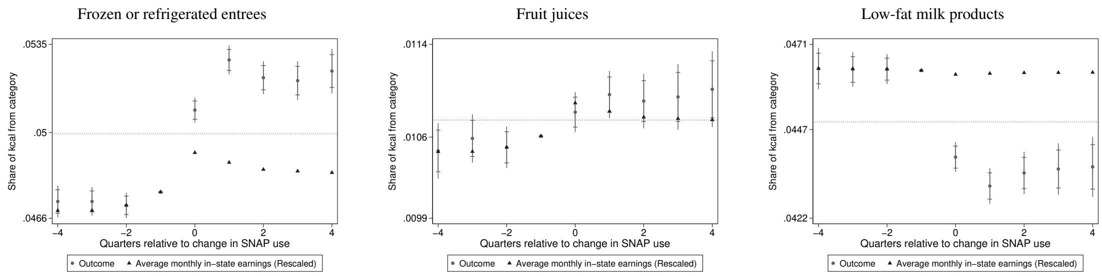


Online Appendix Figure 9: Dynamics of TFP Kilocalorie Shares Before and After Entry Into SNAP (Continued)

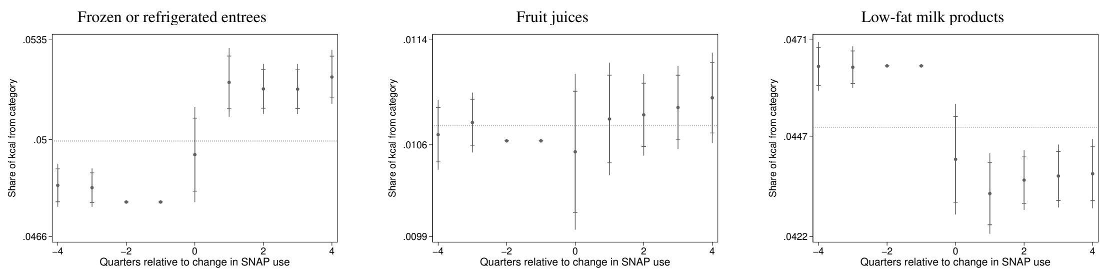
Panel A: Monthly frequency



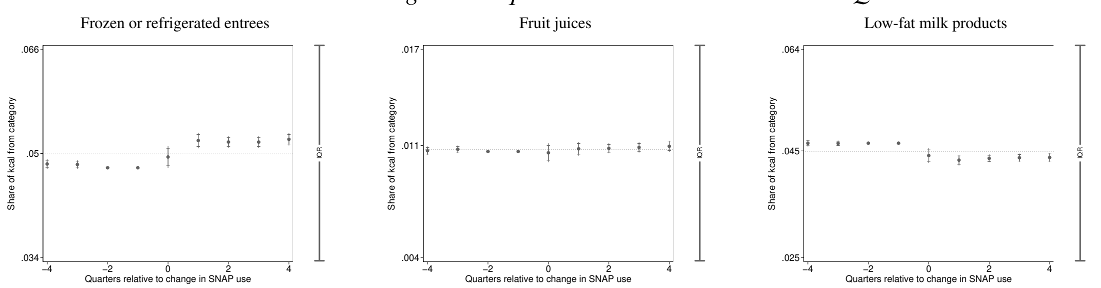
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator

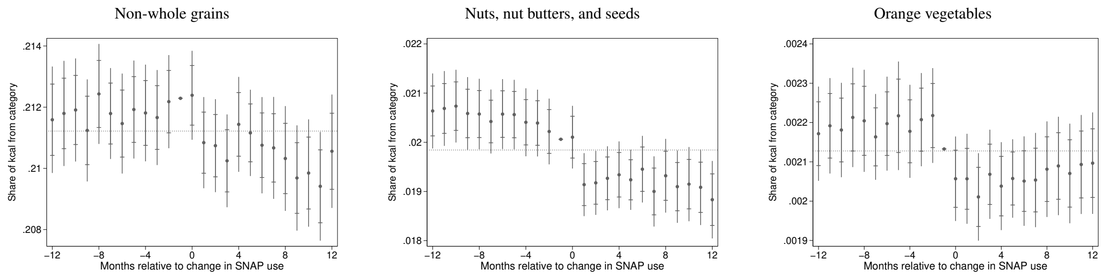


Panel D: Two stage least squares estimator relative to the IQR

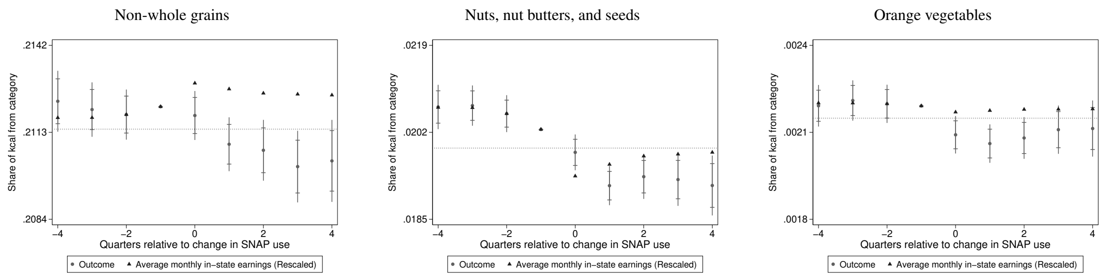


Online Appendix Figure 9: Dynamics of TFP Kilocalorie Shares Before and After Entry Into SNAP (Continued)

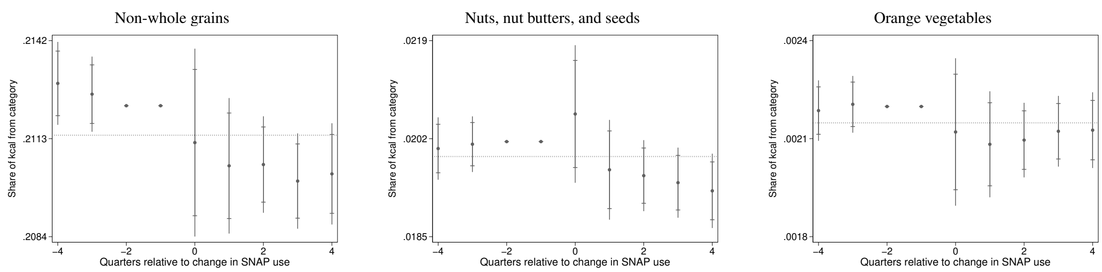
Panel A: Monthly frequency



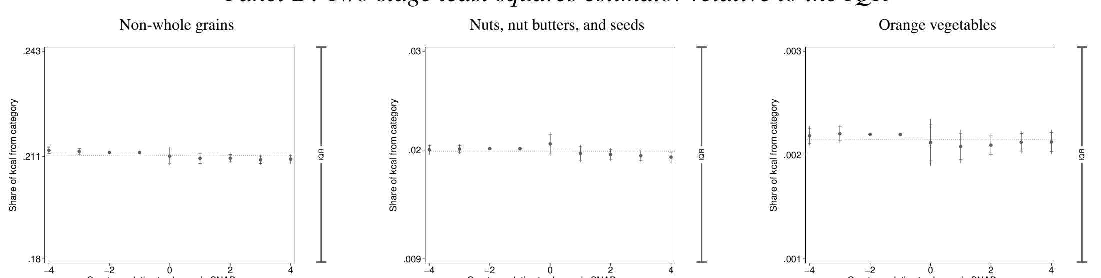
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator

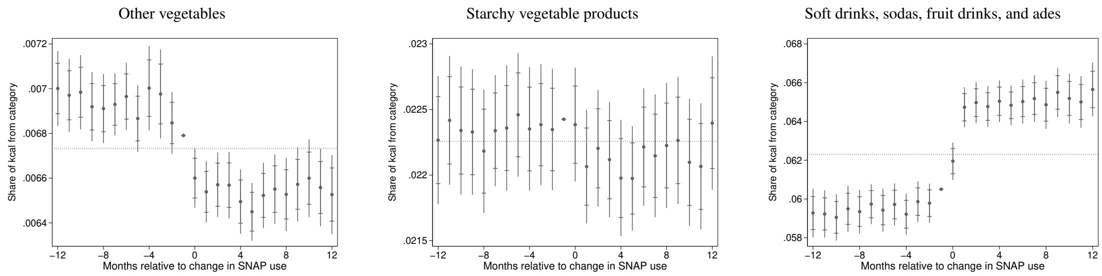


Panel D: Two stage least squares estimator relative to the IQR

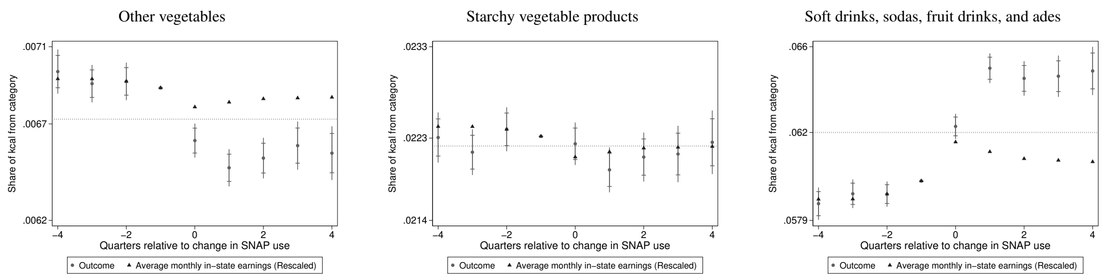


Online Appendix Figure 9: Dynamics of TFP Kilocalorie Shares Before and After Entry Into SNAP (Continued)

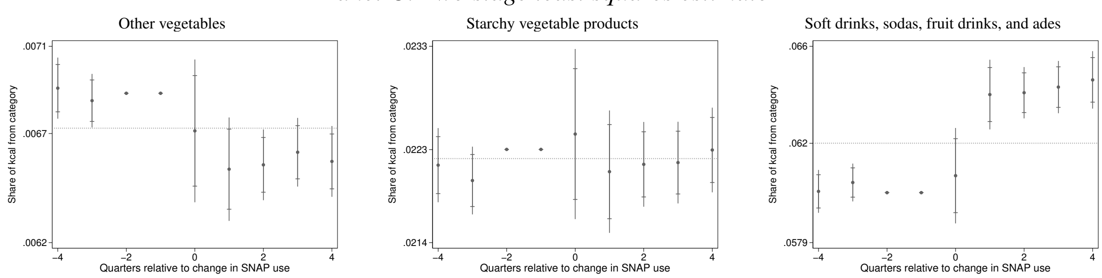
Panel A: Monthly frequency



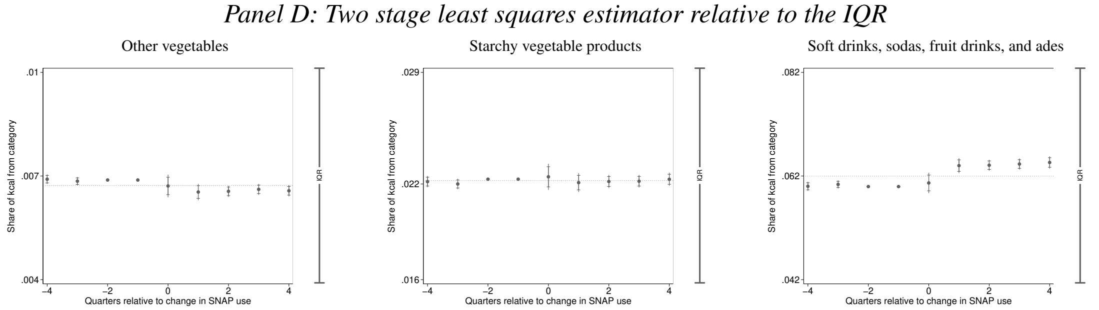
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator

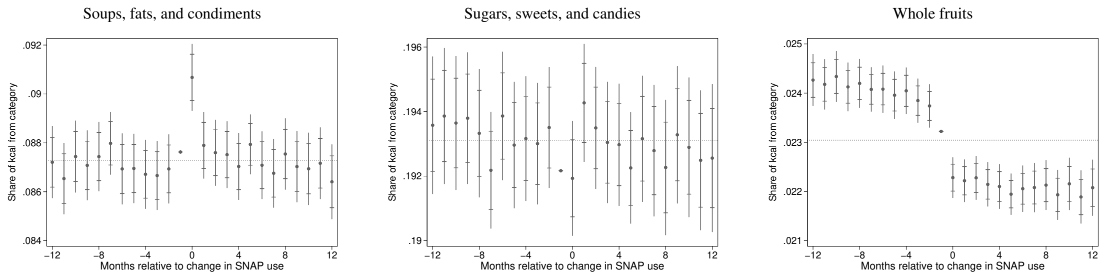


Panel D: Two stage least squares estimator relative to the IQR

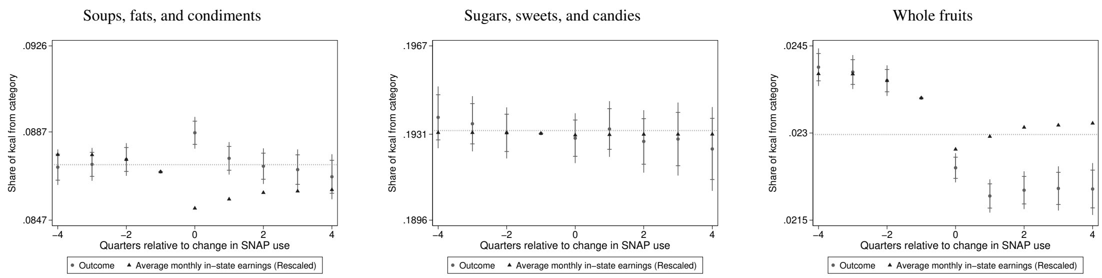


Online Appendix Figure 9: Dynamics of TFP Kilocalorie Shares Before and After Entry Into SNAP (Continued)

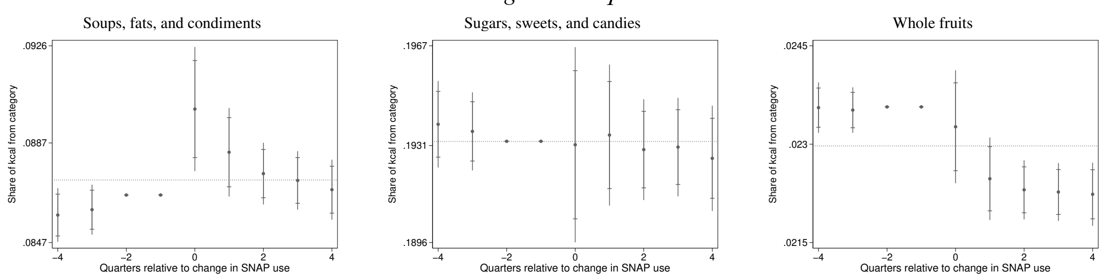
Panel A: Monthly frequency



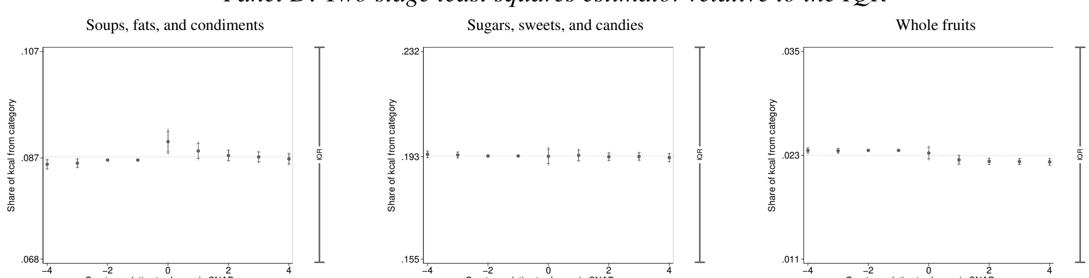
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator

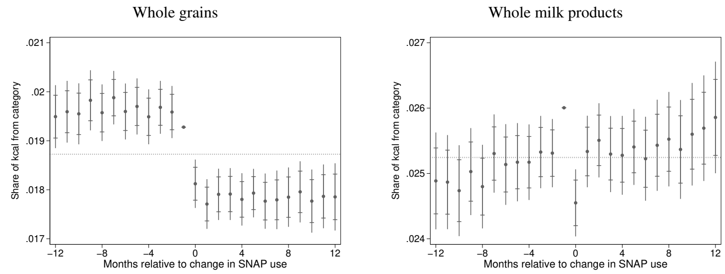


Panel D: Two stage least squares estimator relative to the IQR

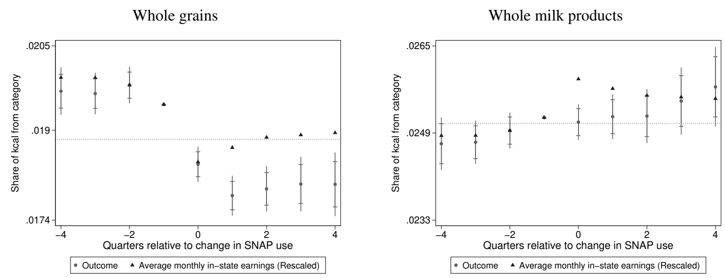


Online Appendix Figure 9: Dynamics of TFP Kilocalorie Shares Before and After Entry Into SNAP (Continued)

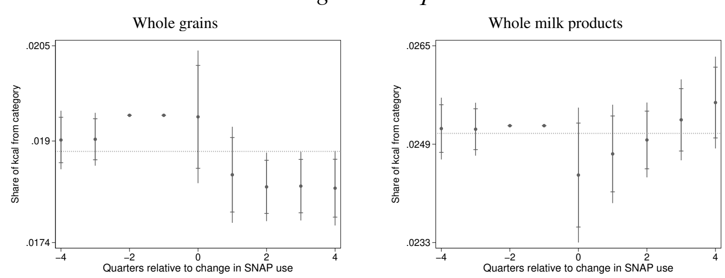
Panel A: Monthly frequency



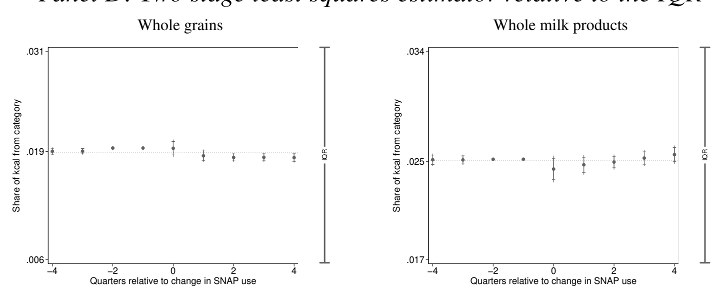
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator



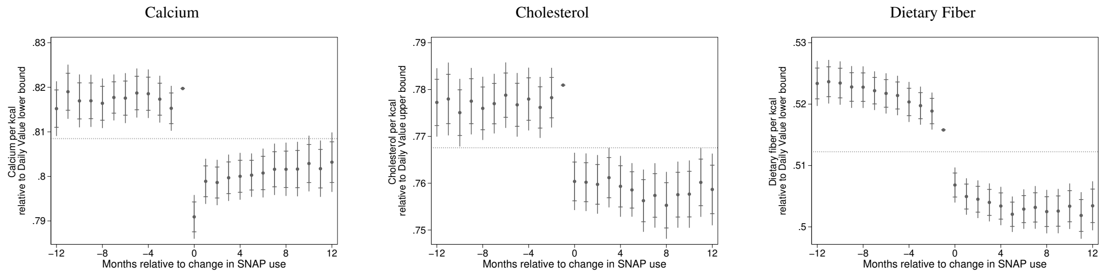
Panel D: Two stage least squares estimator relative to the IQR



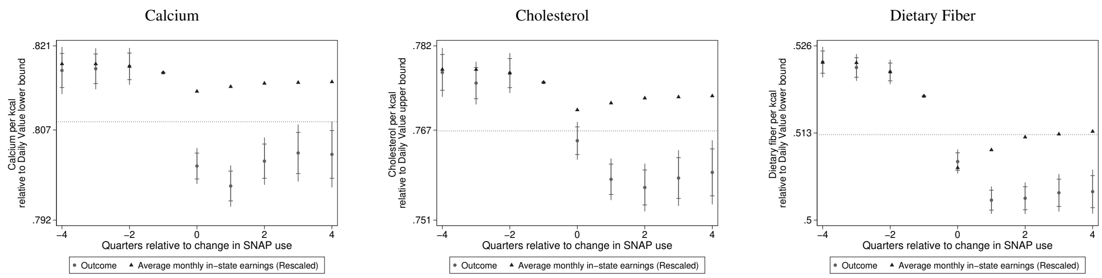
Notes: Each figure plots coefficient estimates from a two-stage least squares regression of a measure of healthfulness on a vector of leads and lags of the contemporaneous change in SNAP use. The sample is the set of SNAP adopters. The unit of observation is the household-time period. Each regression includes controls for the sum of the change in SNAP use before the start of the plot window and after the end of the plot window, with the number of SNAP adoption periods before the start of the plot window and after the end of the plot window as excluded instruments. The change in SNAP use and the SNAP adoption indicator are treated as zero outside of the sample period. Each regression includes household and time period fixed effects. The coefficient estimates are shifted by a constant such that the mean of the coefficient estimates is equal to the mean of the outcome in the estimation sample. This mean is marked by a dotted line within each plot. The inner error bars represent 95 percent pointwise confidence intervals based on asymptotic standard errors clustered by household. The outer error bars represent 95 percent uniform sup-t confidence intervals computed as outlined in Montiel Olea and Plagborg-Møller (2019) based on an asymptotic variance-covariance matrix clustered by household. In panel A, the time period is a calendar month. In panels B through D, the time period is a calendar quarter. In panel A and panel B, the endogenous variables are a vector of leads and lags of the contemporaneous change in SNAP use, with leads and lags of a contemporaneous indicator for whether the current time period (i.e., month or quarter) is a SNAP adoption period as excluded instruments. The coefficient on the first lead of the contemporaneous change in SNAP use is normalized to zero. In panel B, in addition to the dynamics of the outcomes, the plots show the dynamics of in-state earnings (from Figure 2 of the paper) rescaled such that the change in in-state earnings matches the change in the outcome between two and one periods prior to the change in SNAP use. In panel C and panel D, the estimates are based on the research design described in Section IIA of the paper. The model is estimated in two samples using the TS2SLS estimator defined in Inoue and Solon (2010). Standard errors are calculated as outlined in Section 2 of this online Appendix. The endogenous variables are a vector of leads and lags of the contemporaneous change in SNAP use and average monthly in-state earnings, with leads and lags of a contemporaneous indicator for whether the current quarter is a SNAP adoption quarter as excluded instruments. The first stage for in-state earnings is estimated on the sample of SNAP adopters in the Rhode Island administrative data described in Section IG of the paper. The first stage for the leads and lags of the contemporaneous change in SNAP use and the second stage are estimated in the retail panel. The coefficients on the first and second leads of the contemporaneous change in SNAP use are normalized to zero. In panel D, we repeat the plots in panel C, setting the y-axis range to be the interquartile range of the average of the outcome across all retailer households. Each outcome is the share of kilocalories from a given product category underlying the Thrifty Food Plan, as described in Section ID1 of the paper.

Online Appendix Figure 10: Dynamics of Nutrient Density Indexes Before and After Entry Into SNAP

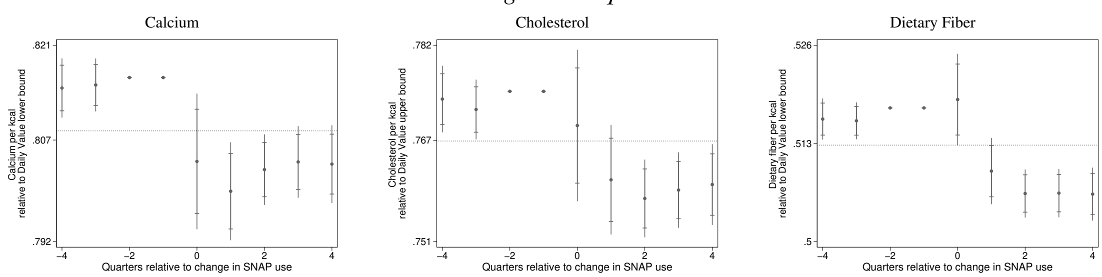
Panel A: Monthly frequency



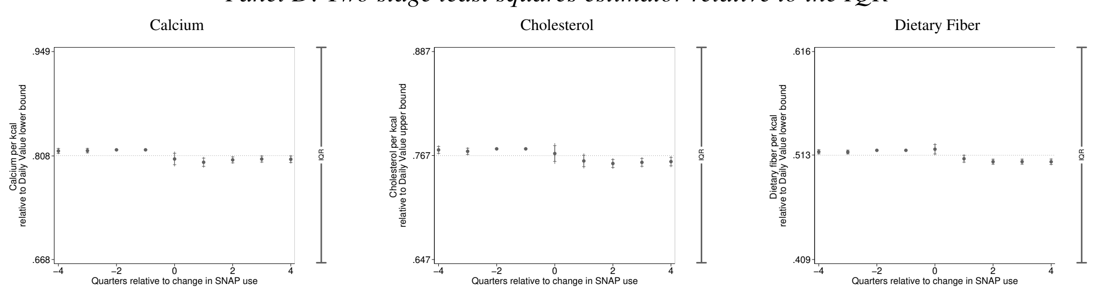
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator

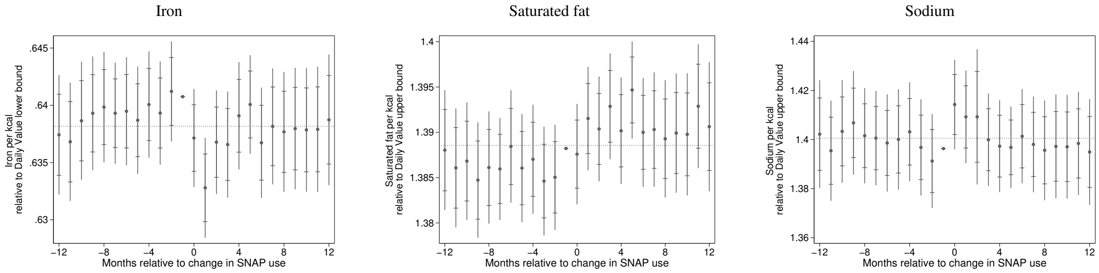


Panel D: Two stage least squares estimator relative to the IQR

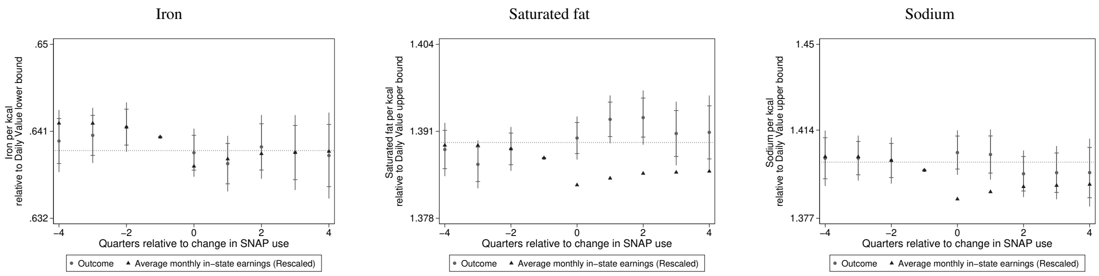


Online Appendix 10: Dynamics of Nutrient Density Indexes Before and After Entry Into SNAP (continued)

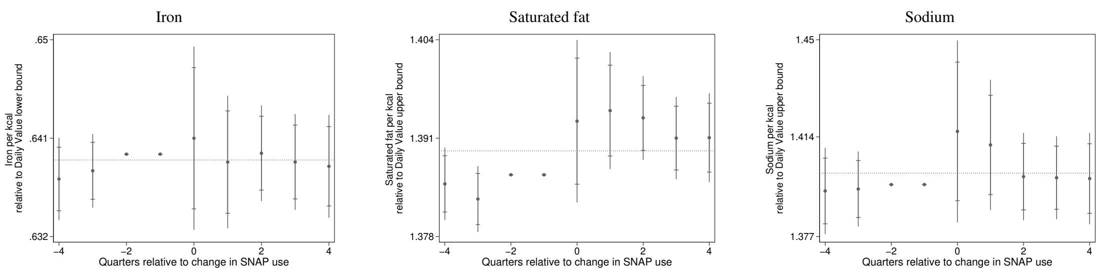
Panel A: Monthly frequency



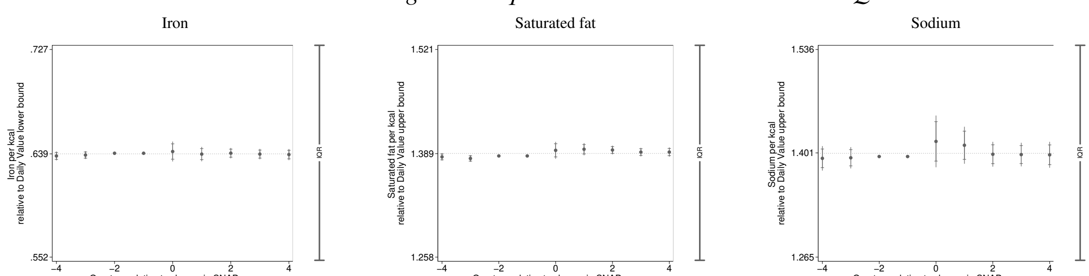
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator

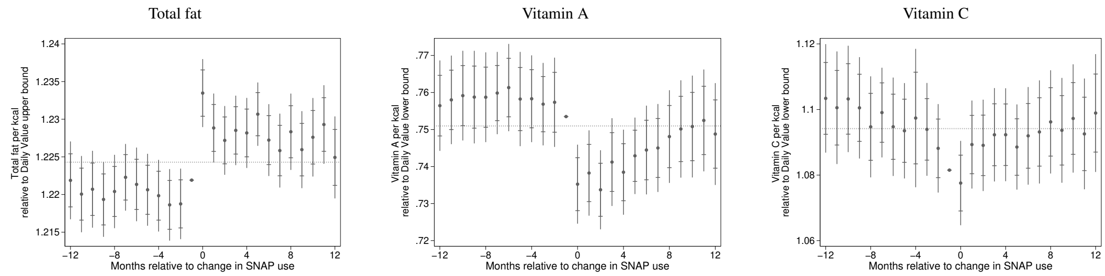


Panel D: Two stage least squares estimator relative to the IQR

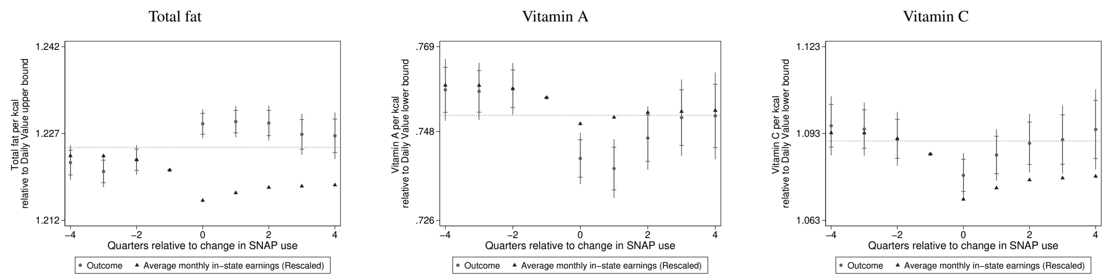


Online Appendix 10: Dynamics of Nutrient Density Indexes Before and After Entry Into SNAP (continued)

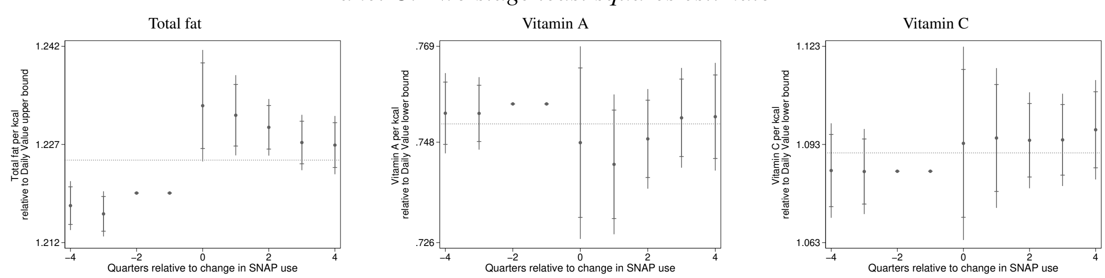
Panel A: Monthly frequency



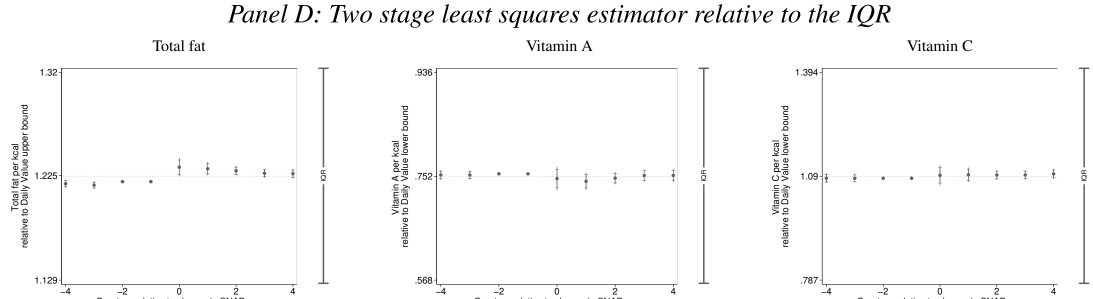
Panel B: Quarterly frequency with in-state earning dynamics



Panel C: Two stage least squares estimator



Panel D: Two stage least squares estimator relative to the IQR

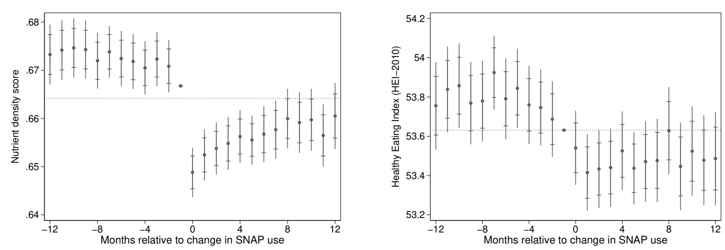


Notes: Each figure plots coefficient estimates from a two-stage least squares regression of a measure of healthfulness on a vector of leads and lags of the contemporaneous change in SNAP use. The sample is the set of SNAP adopters. The unit of observation is the household-time period. Each regression includes controls for the sum of the change in SNAP use before the start of the plot window and after the end of the plot window, with the number of SNAP adoption periods before the start of the plot window and after the end of the plot window as excluded instruments. The change in SNAP use and the SNAP adoption indicator are treated as zero outside of the sample period. Each regression includes household and time period fixed effects. The coefficient estimates are shifted by a constant such that the mean of the coefficient estimates is equal to the mean of the outcome in the estimation sample. This mean is marked by a dotted line within each plot. The inner error bars represent 95 percent pointwise confidence intervals based on asymptotic standard errors clustered by household. The outer error bars represent 95 percent uniform sup-t confidence intervals computed as outlined in Montiel Olea and Plagborg-Møller (2019) based on an asymptotic variance-covariance matrix clustered by household. In panel A, the time period is a calendar month. In panels B through D, the time period is a calendar quarter. In panel A and panel B, the endogenous variables are a vector of leads and lags of the contemporaneous change in SNAP use, with leads and lags of a contemporaneous indicator for whether the current time period (i.e., month or quarter) is a SNAP adoption period as excluded instruments. The coefficient on the first lead of the contemporaneous change in SNAP use is normalized to zero. In panel B, in addition to the dynamics of the outcomes, the plots show the dynamics of in-state earnings (from Figure 2 of the paper) rescaled such that the change in in-state earnings matches the change in the outcome between two and one periods prior to the change in SNAP use. In panel C and panel D, the estimates are based on the research design described in Section IIA of the paper. The model is estimated in two samples using the TS2SLS estimator defined in Inoue and Solon (2010). Standard errors are calculated as outlined in Section 2 of this online Appendix. The endogenous variables are a vector of leads and lags of the contemporaneous change in SNAP use and average monthly in-state earnings, with leads and lags of a contemporaneous indicator for whether the current quarter is a SNAP adoption quarter as excluded instruments. The first stage for in-state earnings is estimated on the sample of SNAP adopters in the Rhode Island administrative data described in Section IG of the paper. The first stage for the leads and lags of the contemporaneous change in SNAP use and the second stage are estimated in the retail panel. The coefficients on the first and second leads of the contemporaneous change in SNAP use are normalized to zero. In panel D, we repeat the plots in panel C, setting the y-axis range to be the interquartile range of the average of the outcome across all retailer households. Each outcome is the amount of a given nutrient purchased per kilocalorie divided by the corresponding nutrient density implied by the Food and Drug Administration (FDA) Daily Value (DV) bounds, as described in Section ID2 of the paper.

Online Appendix Figure 11: Dynamics of Summary Measures of Food Healthfulness Before and After Entry Into SNAP

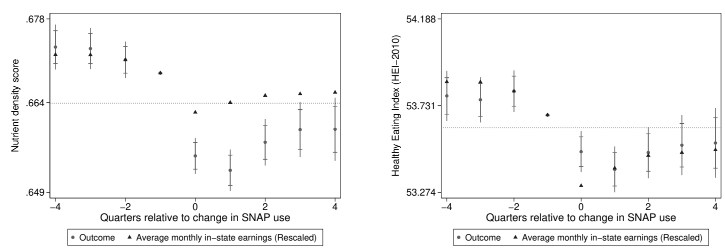
Panel A: Monthly frequency

(I) Nutrient density score (II) Healthy Eating Index (HEI-2010)



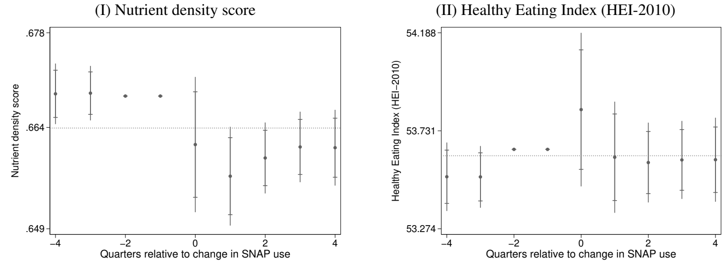
Panel B: Quarterly frequency with in-state earning dynamics

(I) Nutrient density score (II) Healthy Eating Index (HEI-2010)



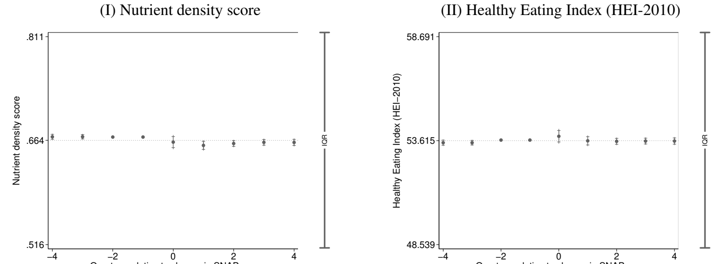
Panel C: Two stage least squares estimator

(I) Nutrient density score (II) Healthy Eating Index (HEI-2010)



Panel D: Two stage least squares estimator relative to the IQR

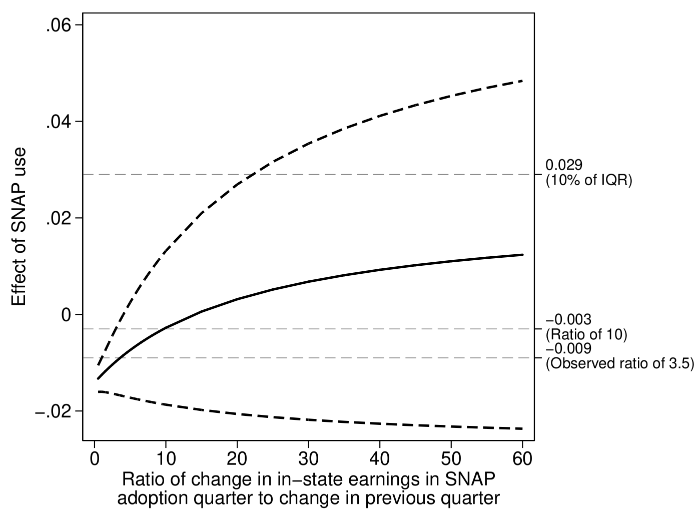
(I) Nutrient density score (II) Healthy Eating Index (HEI-2010)



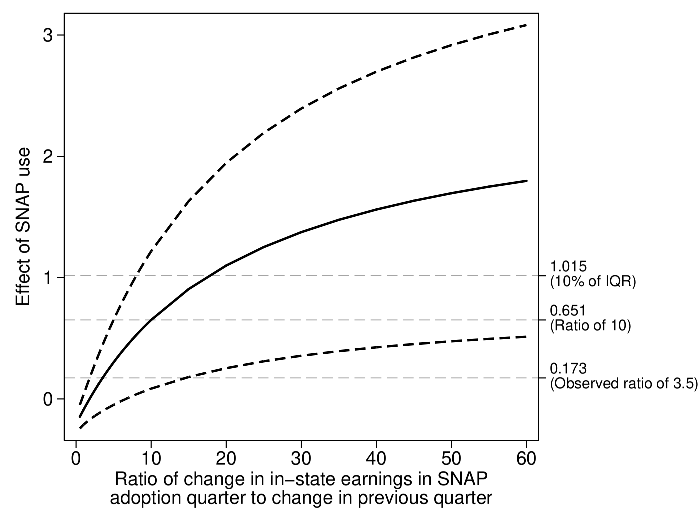
Notes: Each figure plots coefficient estimates from a two-stage least squares regression of a measure of healthfulness on a vector of leads and lags of the contemporaneous change in SNAP use. The sample is the set of SNAP adopters. The unit of observation is the household-time period. Each regression includes controls for the sum of the change in SNAP use before the start of the plot window and after the end of the plot window, with the number of SNAP adoption periods before the start of the plot window and after the end of the plot window as excluded instruments. The change in SNAP use and the SNAP adoption indicator are treated as zero outside of the sample period. Each regression includes household and time period fixed effects. The coefficient estimates are shifted by a constant such that the mean of the coefficient estimates is equal to the mean of the outcome in the estimation sample. This mean is marked by a dotted line within each plot. The inner error bars represent 95 percent pointwise confidence intervals based on asymptotic standard errors clustered by household. The outer error bars represent 95 percent uniform sup-t confidence intervals computed as outlined in Montiel Olea and Plagborg-Møller (2019) based on an asymptotic variance-covariance matrix clustered by household. In panel A, the time period is a calendar month. In panels B through D, the time period is a calendar quarter. In panel A and panel B, the endogenous variables are a vector of leads and lags of the contemporaneous change in SNAP use, with leads and lags of a contemporaneous indicator for whether the current time period (i.e., month or quarter) is a SNAP adoption period as excluded instruments. The coefficient on the first lead of the contemporaneous change in SNAP use is normalized to zero. In panel B, in addition to the dynamics of the outcomes, the plots show the dynamics of in-state earnings (from Figure 2 of the paper) rescaled such that the change in in-state earnings matches the change in the outcome between two and one periods prior to the change in SNAP use. In panel C and panel D, the estimates are based on the research design described in Section IIA of the paper. The model is estimated in two samples using the TS2SLS estimator defined in Inoue and Solon (2010). Standard errors are calculated as outlined in Section 2 of this online Appendix. The endogenous variables are a vector of leads and lags of the contemporaneous change in SNAP use and average monthly in-state earnings, with leads and lags of a contemporaneous indicator for whether the current quarter is a SNAP adoption quarter as excluded instruments. The first stage for in-state earnings is estimated on the sample of SNAP adopters in the Rhode Island administrative data described in Section IG of the paper. The first stage for the leads and lags of the contemporaneous change in SNAP use and the second stage are estimated in the retail panel. The coefficients on the first and second leads of the contemporaneous change in SNAP use are normalized to zero. In panel D, we repeat the plots in panel C, setting the y-axis range to be the interquartile range of the average of the outcome across all retailer households. In the first column, the measure of healthfulness is the nutrient density score, described in Section ID2 of the paper. In the second column, the measure of healthfulness is the Healthy Eating Index (HEI-2010), described in Section ID3 of the paper.

Online Appendix Figure 12: Sensitivity of Program Adoption Research Design to Alternative Income Dynamics

Panel A: Nutrient density score



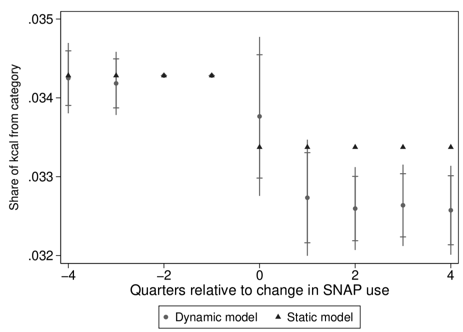
Panel B: Healthy Eating Index (HEI-2010)



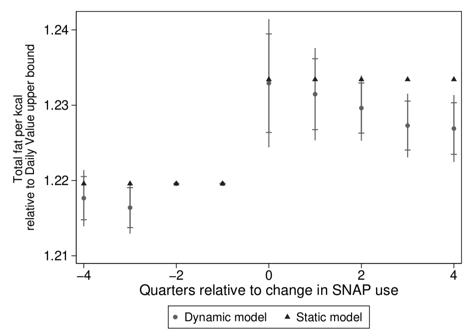
Notes: The figures show the estimated effect of SNAP use on the given outcome as a function of the ratio α of the change in in-state earnings in the quarter of SNAP adoption to the change in the quarter before. The sample is the set of SNAP adopters. The unit of observation is the household-quarter. For each α, the estimated effect of SNAP use is obtained via a 2SLS regression of the change in the given measure of healthfulness Δh_{it} on the change in an indicator for whether the current quarter is a SNAP quarter Δs_{it}, with an indicator for whether the current quarter is a SNAP adoption quarter z_{it} as the excluded instrument and the change in counterfactual in-state earnings Δx_{it}^{α} and calendar quarter fixed effects ψ_t as exogenous controls. Counterfactual in-state earnings are defined in the retail panel as $\Delta x_{it}^{\alpha} = -\alpha z_{it} - 1 \cdot z_{it+1} + \hat{\phi}_t$, with the calendar quarter fixed effects $\hat{\phi}_t$ coming from the first stage underlying Figure 4 of the paper and estimated using the Rhode Island administrative data described in Section IG of the paper. The solid black line represents estimates of the effect of SNAP use on the given outcome. The dashed black lines represent 95 percent confidence intervals based on asymptotic standard errors clustered by household. In panel A, the outcome is the nutrient density score (NDS), described in Section ID2 of the paper. In panel B, the outcome is the Healthy Eating Index (HEI-2010), described in Section ID3 of the paper. The dashed horizontal lines mark 10 percent of the interquartile range (IQR) of the average of the outcome across all retail households, the estimated effect of SNAP at $\alpha = 10$, and the estimated effect of SNAP at the observed α. The observed α corresponds to the ratio of the coefficient on the lead of SNAP adoption to the coefficient on SNAP adoption in the first stage underlying Figure 4 of the paper and is estimated using the Rhode Island administrative data described in Section IG of the paper.

Online Appendix Figure 13: Dynamics of Select Outcomes Before and After Entry Into SNAP, with Predictions of Static Model

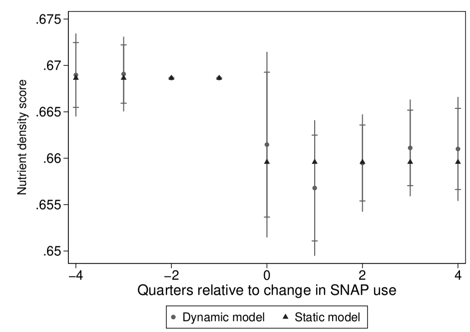
(I) Share of kcal from fruits and non-starchy vegetables



(II) Share of kcal from total fat relative to the Daily Value upper bound



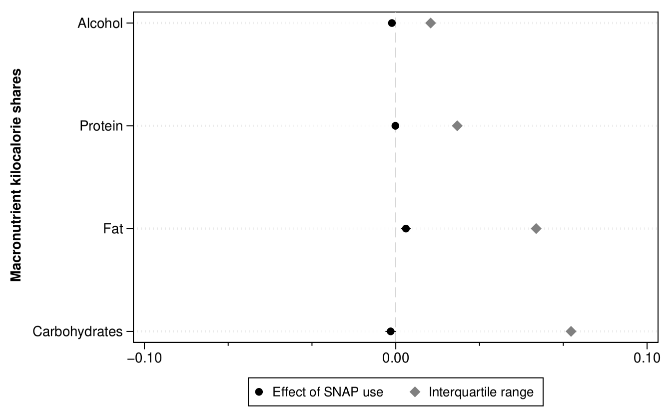
(III) Nutrient density score



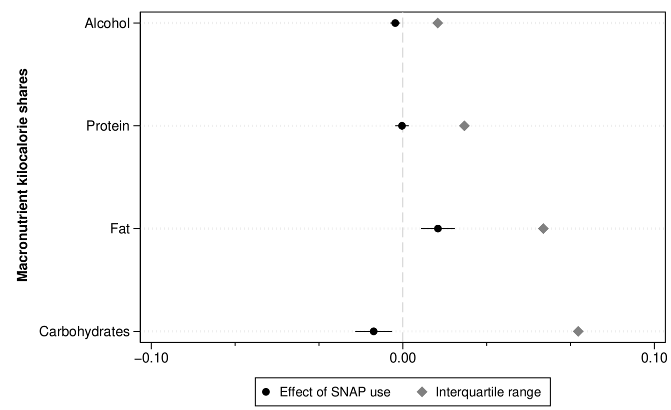
Notes: Each panel plots coefficients estimated using the models underlying Figure 3 and Figure 4 in the paper. The sample is the set of SNAP adopters. The unit of observation is the household-quarter. The "Dynamic model" series plots coefficient estimates from a two-stage least squares regression of a measure of healthfulness on a vector of leads and lags of the contemporaneous change in SNAP use. The model is estimated in two samples using the TS2SLS estimator defined in Inoue and Solon (2010). Standard errors are calculated as outlined in Section 2 of this online Appendix. The endogenous variables are a vector of leads and lags of the contemporaneous change in SNAP use and average monthly in-state earnings, with leads and lags of a contemporaneous indicator for whether the current quarter is a SNAP adoption quarter as excluded instruments. The first stage for in-state earnings is estimated on the sample of SNAP adopters in the Rhode Island administrative data described in Section IG of the paper. The first stage for the leads and lags of the contemporaneous change in SNAP use and the second stage are estimated in the retail panel. The coefficients on the first and second leads of the contemporaneous change in SNAP use are normalized to zero. Each regression includes controls for the sum of the change in SNAP use before the start of the plot window and after the end of the plot window, with the number of SNAP adoption quarters before the start of the plot window and after the end of the plot window as excluded instruments. The change in SNAP use and the SNAP adoption indicator are treated as zero outside of the sample period. Each regression includes household and calendar quarter fixed effects. The "Static model" series is set to zero in all quarters prior to change in SNAP use and the estimated causal effect of SNAP use (depicted in Figure 4 of the paper) in all quarters following change in SNAP use. For the dynamic model series, the coefficient estimates are shifted by a constant such that the mean of the coefficient estimates is equal to the mean of the outcome in the estimation sample. For the static model series, the coefficients are shifted by a constant such that the static mdoel series coincides with the dynamic model series in the two periods immediately preceding the change in SNAP use. The inner error bars represent 95 percent pointwise confidence intervals based on asymptotic standard errors clustered by household. The outer error bars represent 95 percent uniform sup-t confidence intervals computed as outlined in Montiel Olea and Plagborg-Møller (2019) based on an asymptotic variance-covariance matrix clustered by household. In the first column, the measure of healthfulness is the share of kilocalories from fruits and non-starchy vegetables, described in Section ID1 of the paper. In the second column, the measure of healthfulness is the share of kilocalories from total fat relative to the Daily Value upper bound, described in Section ID2 of the paper. In the third column, the measure of healthfulness is the nutrient density score, described in Section ID2 of the paper.

Online Appendix Figure 14: Effect of SNAP Use on Macronutrient Kilocalorie Shares

Panel A: Program adoption research design



Panel B: Program exit research design

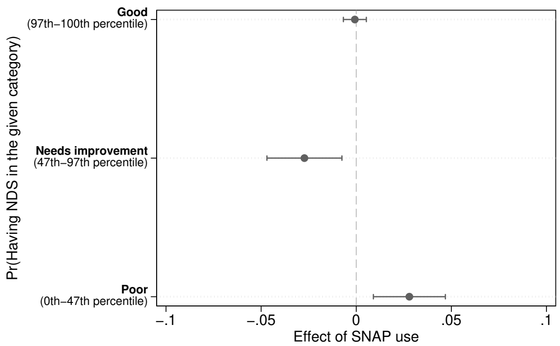


Notes: The plot presents the IQR of and the estimated effect of SNAP use on the given outcomes. For the IQR series, the sample is all retailer households and the unit of observation is the household. For the estimated effect of SNAP use, the sample is the set of SNAP adopters and the unit of observation is the household-time period. In panel A, the time period is a calendar quarter. For each outcome, the effect of SNAP use is estimated via a two-sample two-stage least squares regression (Inoue and Solon 2010) of the change in the outcome on the change in an indicator for whether the current quarter is a SNAP quarter and the change in average monthly in-state earnings, with an indicator for whether the current quarter is a SNAP adoption quarter and its first lead as excluded instruments and calendar quarter fixed effects as exogenous controls. The first stage for the change in in-state earnings is estimated on the sample of SNAP adopters in the Rhode Island administrative data described in Section IG of the paper. The first stage for the change in an indicator for whether the current quarter is a SNAP quarter and the second stage are estimated in the retail panel. Standard errors are calculated as outlined in Section 2 of this online Appendix. In panel B, the time period is a calendar month. For each outcome, the effect of SNAP use is estimated via a two-stage least squares regression of the change in the outcome on the change in an indicator for whether the current month is a SNAP month, with an indicator equal to one in the first month of a six-month clock that begins in the most recent adoption month as the excluded instrument and calendar month fixed effects as exogenous controls. The clock indicator is set to zero in the first six months (inclusive of the adoption month) following the most recent adoption, in any month after the first 24 months (inclusive of the adoption month) following the recent adoption, and in any month for which there is no preceding adoption. Error bars represent 95 percent confidence intervals based on asymptotic standard errors clustered by household. Each outcome is the share of kilocalories from the given macronutrient.

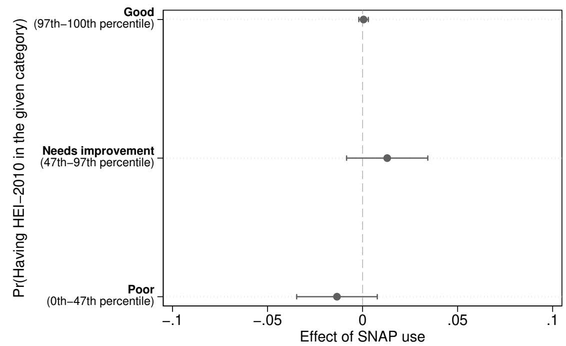
Online Appendix Figure 15: Effect of SNAP Use on the Distribution of Food Healthfulness

Panel A: Program adoption research design

(I) Nutrient density score (NDS)

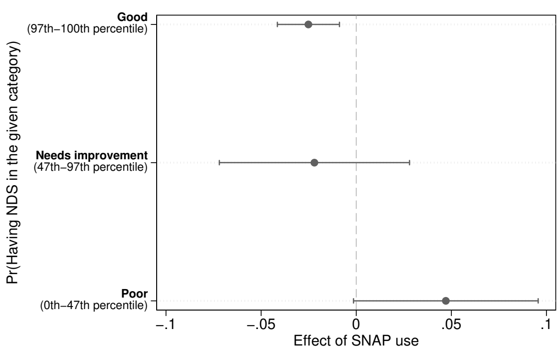


(II) Healthy Eating Index (HEI-2010)

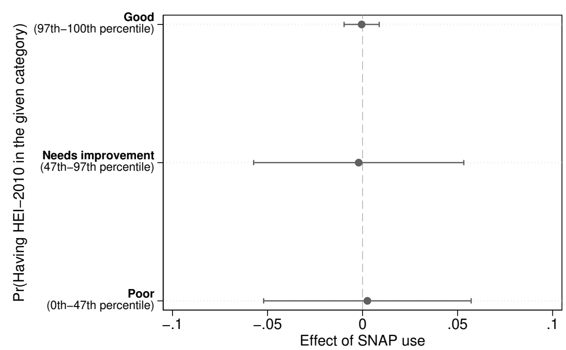


Panel B: Program exit research design

(I) Nutrient density score (NDS)

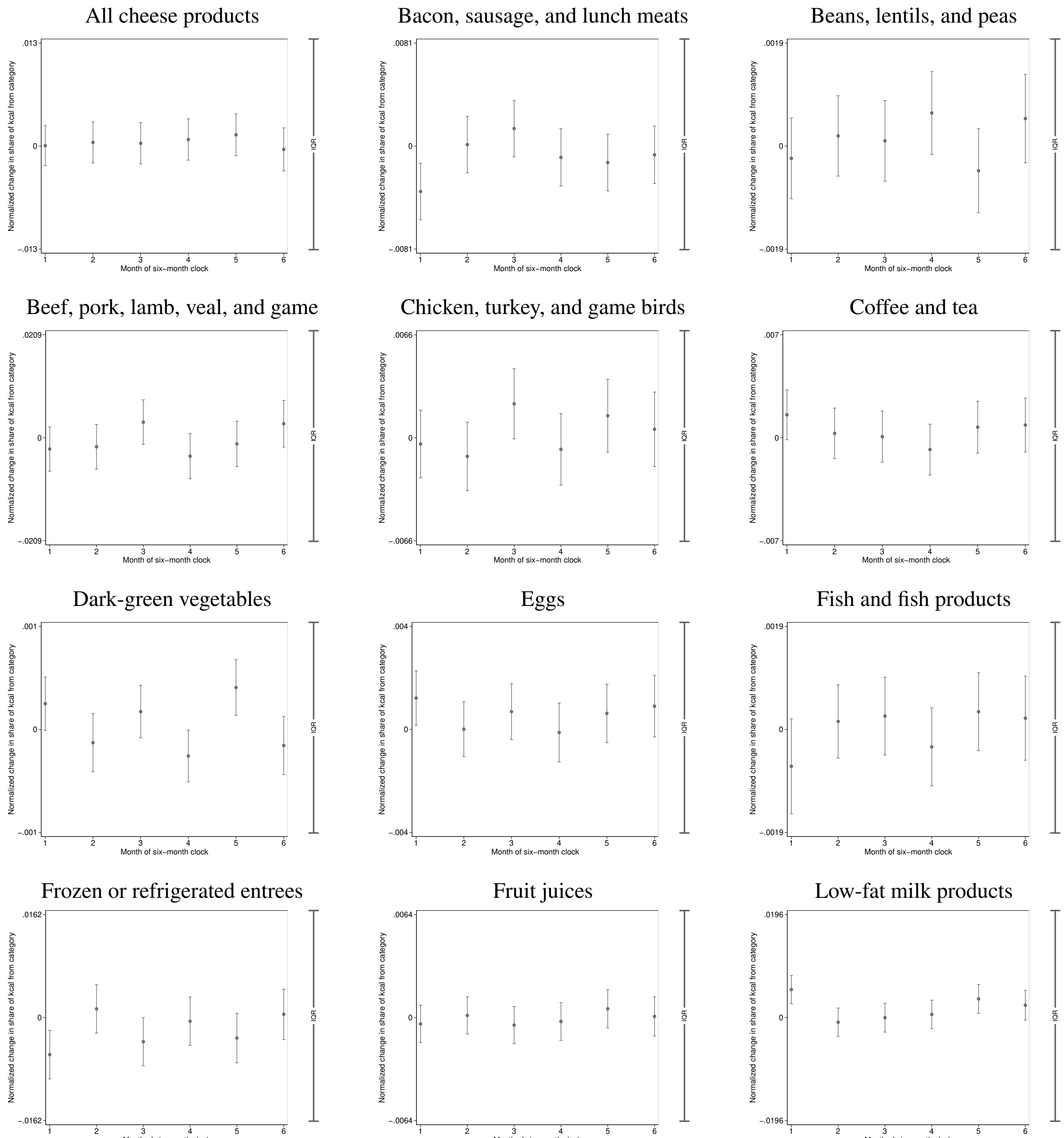


(II) Healthy Eating Index (HEI-2010)

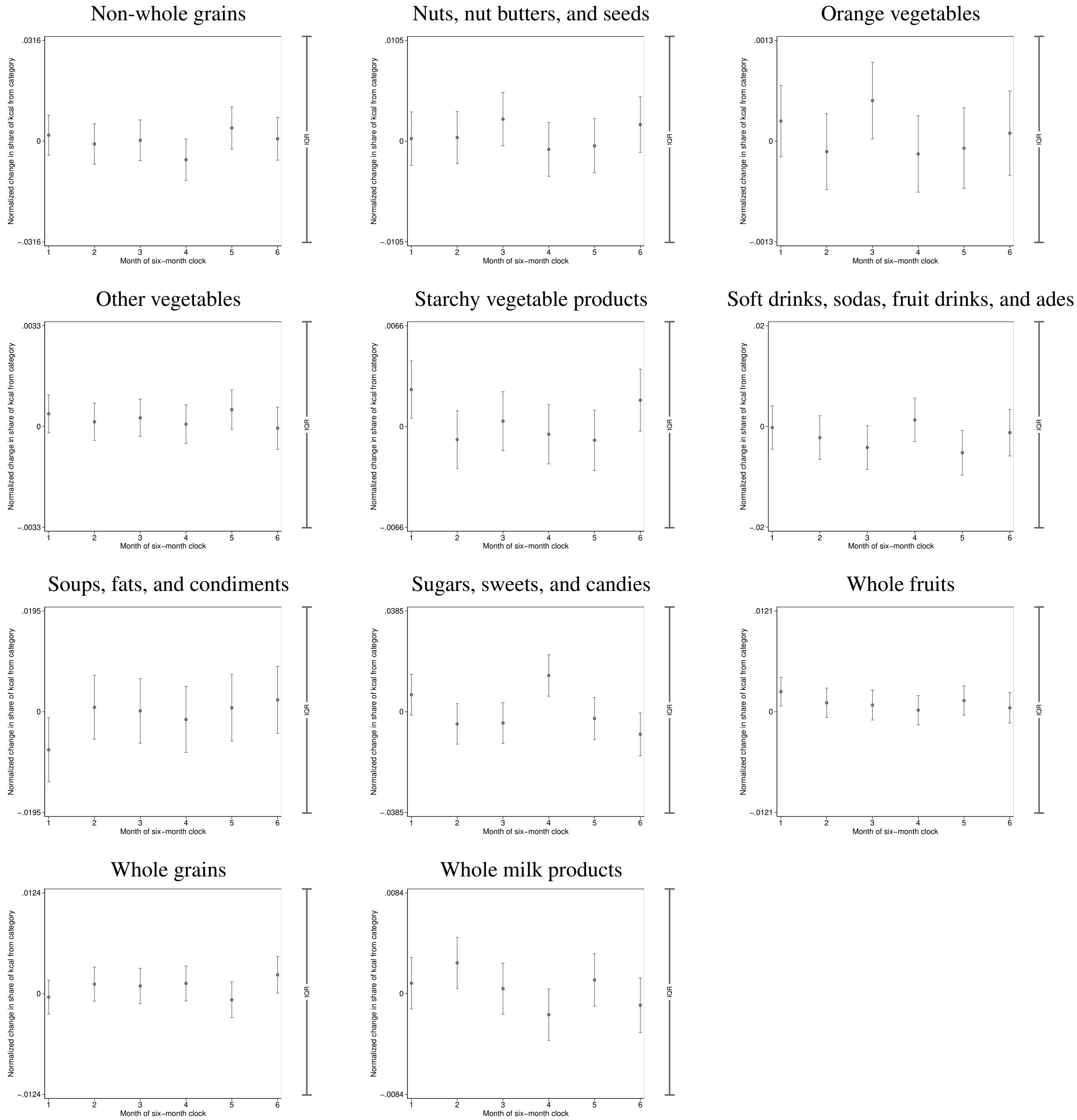


Notes: Each figure plots estimates of the effect of SNAP use on the probability of having a "good," "needs improvement," or "poor" level of healthfulness. In the left column, the outcome is the nutrient density score (NDS), described in Section ID2 of the paper. In the right column, the outcome is the Healthy Eating Index (HEI-2010), described in Section ID3 of the paper. For the HEI-2010, "good," "needs improvement," and "poor" levels of healthfulness are defined by score cutoffs established by the USDA for "good," "needs improvement," and "poor" levels of the original Healthy Eating Index (HEI) (USDA 1995). See Drenowatz et al. (2014), Gubur and Demir (2017), and Yosaee et al. (2017) for examples of prior work applying the original HEI cutoffs to the HEI-2010. For the NDS, "good," "needs improvement," and "poor" score cutoffs are computed as follows. First, we compute the percentiles of the original HEI score cutoffs in the distribution of the HEI-2010 using the FoodAPS data. Each FoodAPS household is weighted according to the FoodAPS household weights such that the overall sample is nationally representative. These are the percentiles reported in parentheses in the plots. Second, we compute the value of the NDS at each of the estimated percentiles in the sample of all retailer households, where the NDS of each household is the average NDS across all household-months. In panel A, the sample is the set of SNAP adopters and the unit of observation is a household-quarter. For each outcome, the effect of SNAP use is estimated via a two-sample two-stage least squares regression (Inoue and Solon 2010) of the change in the outcome on the change in an indicator for whether the current quarter is a SNAP quarter and the change in average monthly in-state earnings, with an indicator for whether the current quarter is a SNAP adoption quarter and its first lead as excluded instruments and calendar quarter fixed effects as exogenous controls. The first stage for the change in in-state earnings is estimated on the sample of SNAP adopters in the Rhode Island administrative data described in Section IG of the paper. The first stage for the change in an indicator for whether the current quarter is a SNAP quarter and the second stage are estimated in the retail panel. Standard errors are calculated as outlined in Section 2 of this online Appendix. In panel B, the sample is the set of SNAP adopters and the unit of observation is a household-month. For each outcome, the effect of SNAP use is estimated via a two-stage least squares regression of the change in the outcome on the change in an indicator for whether the current month is a SNAP month, with an indicator equal to one in the first month of a six-month clock that begins in the most recent adoption month as the excluded instrument and calendar month fixed effects as exogenous controls. The clock indicator is set to zero in the first six months (inclusive of the adoption month) following the most recent adoption, in any month after the first 24 months (inclusive of the adoption month) following the recent adoption, and in any month for which there is no preceding adoption. Error bars represent 95 percent confidence intervals based on asymptotic standard errors clustered by household.

Online Appendix Figure 16: Dynamics of TFP Kilocalorie Shares Over the Six-month SNAP Clock

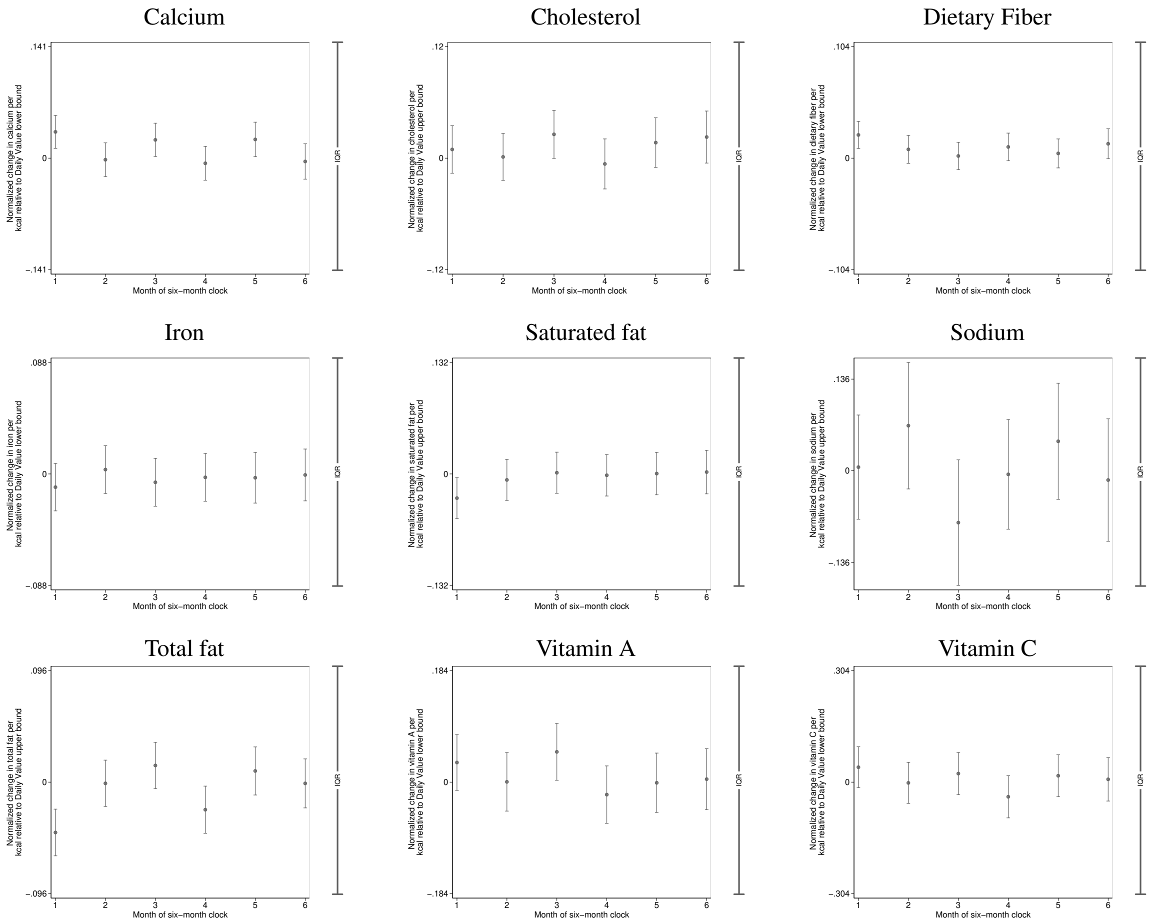


Online Appendix Figure 16: Dynamics of TFP Kilocalorie Shares Over the Six-month SNAP Clock (Continued)



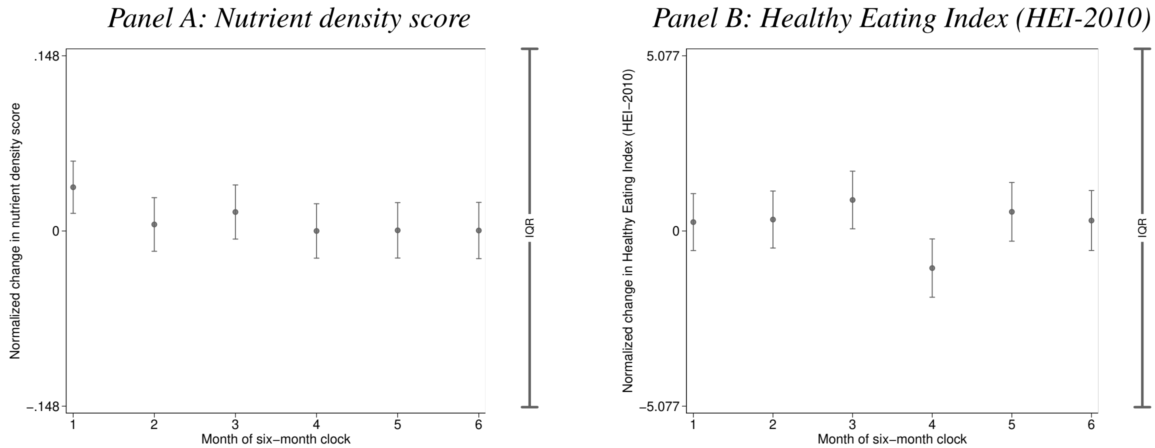
Notes: Each figure plots coefficients from a regression of a normalized measure of food healthfulness on a vector of indicators for the position of the current month in a monthly clock that begins in the most recent adoption month and resets every six months or at the next SNAP adoption, whichever comes first. So, for example, the first month of the clock corresponds to months 7, 13, 19, etc. following SNAP adoption. The sample is the set of SNAP adopters. The unit of observation for each regression is the household-month. Each regression includes calendar month fixed effects. The omitted category consists of the first six months (inclusive of the adoption month) after the household's most recent SNAP adoption, all months after the first 24 months (inclusive of the adoption month) following the household's most recent adoption, and all months for which there is no preceding adoption. Error bars represent 95 percent confidence intervals based on asymptotic standard errors clustered by household. For each outcome, we first divide the change in the outcome by the absolute value of the coefficient on clock month 1 in the regression from panel A of Figure 5 of the paper. We then use this normalized change as the dependent variable. Each outcome is the share of kilocalories from a given product category underlying the Thrifty Food Plan, as described in Section ID1 of the paper. In all plots, the range of the y-axis is the interquartile range of the average of the outcome across all retailer households.

Online Appendix Figure 17: Dynamics of Nutrient Density Indexes Over the Six-month SNAP Clock



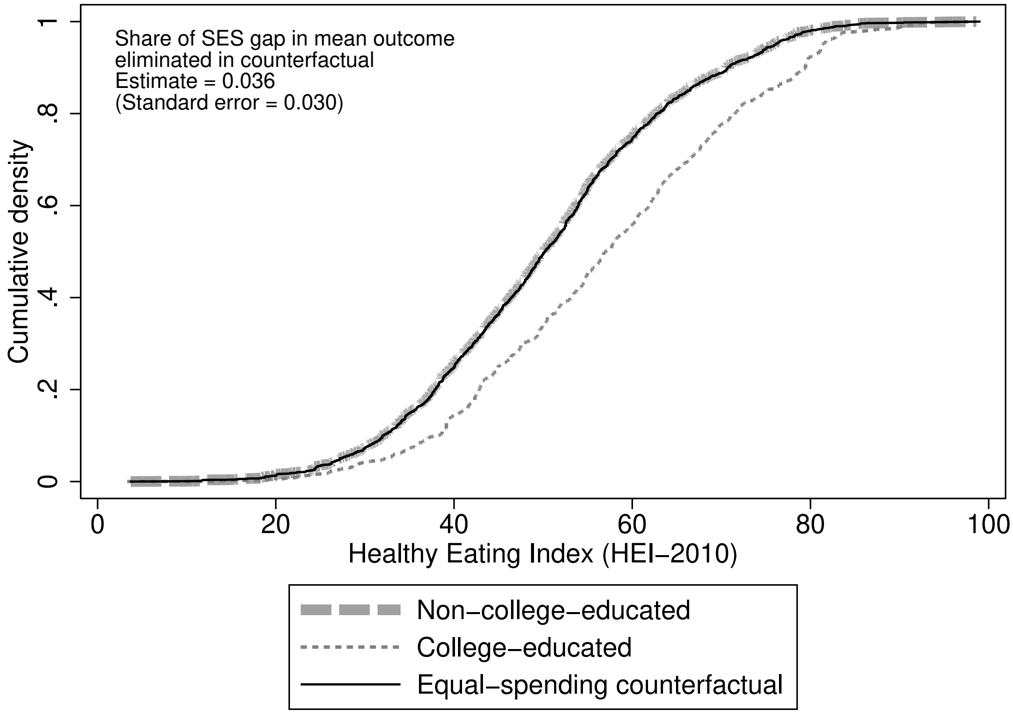
Notes: Each figure plots coefficients from a regression of a normalized measure of food healthfulness on a vector of indicators for the position of the current month in a monthly clock that begins in the most recent adoption month and resets every six months or at the next SNAP adoption, whichever comes first. So, for example, the first month of the clock corresponds to months 7, 13, 19, etc. following SNAP adoption. The sample is the set of SNAP adopters. The unit of observation for each regression is the household-month. Each regression includes calendar month fixed effects. The omitted category consists of the first six months (inclusive of the adoption month) after the household's most recent SNAP adoption, all months after the first 24 months (inclusive of the adoption month) following the household's most recent adoption, and all months for which there is no preceding adoption. Error bars represent 95 percent confidence intervals based on asymptotic standard errors clustered by household. For each outcome, we first divide the change in the outcome by the absolute value of the coefficient on clock month 1 in the regression from panel A of Figure 5 of the paper. We then use this normalized change as the dependent variable. Each outcome is a nutrient density index defined as the amount of a given nutrient purchased per kilocalorie divided by the corresponding nutrient density implied by the Food and Drug Administration (FDA) Daily Value (DV) bounds, as described in Section ID2 of the paper. In all plots, the range of the y-axis is the interquartile range of the average of the outcome across all retailer households.

Online Appendix Figure 18: Dynamics of Summary Measures of Food Healthfulness Over the Six-month SNAP Clock



Notes: Each figure plots coefficients from a regression of a normalized measure of food healthfulness on a vector of indicators for the position of the current month in a monthly clock that begins in the most recent adoption month and resets every six months or at the next SNAP adoption, whichever comes first. So, for example, the first month of the clock corresponds to months 7, 13, 19, etc. following SNAP adoption. The sample is the set of SNAP adopters. The unit of observation for each regression is the household-month. Each regression includes calendar month fixed effects. The omitted category consists of the first six months (inclusive of the adoption month) after the household's most recent SNAP adoption, all months after the first 24 months (inclusive of the adoption month) following the household's most recent adoption, and all months for which there is no preceding adoption. Error bars represent 95 percent confidence intervals based on asymptotic standard errors clustered by household. For each outcome, we first divide the change in the outcome by the absolute value of the coefficient on clock month 1 in the regression from panel A of Figure 5 of the paper. We then use this normalized change as the dependent variable. In panel A, the outcome is the nutrient density score (NDS), described in Section ID2 of the paper. In panel B, the outcome is the Healthy Eating Index (HEI-2010), described in Section ID3 of the paper. In both panels, the range of the y-axis is the interquartile range of the average of the outcome across all retailer households.

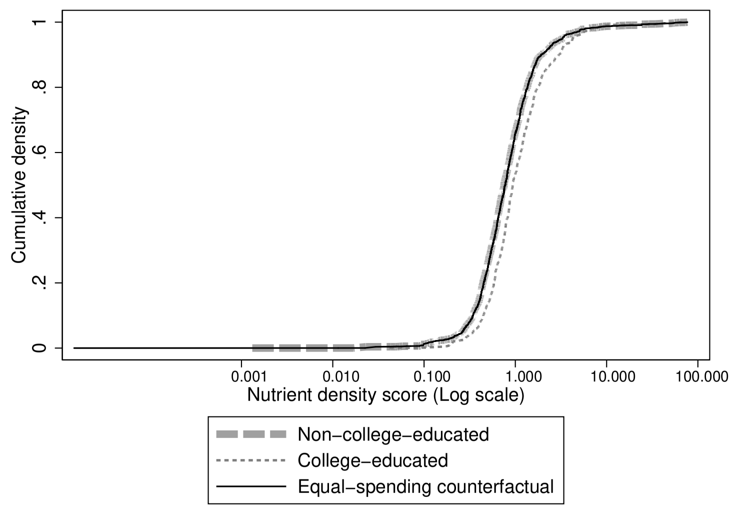
Online Appendix Figure 19: Role of Food-at-home Spending in Socioeconomic Disparities in the Healthy Eating Index (HEI-2010)



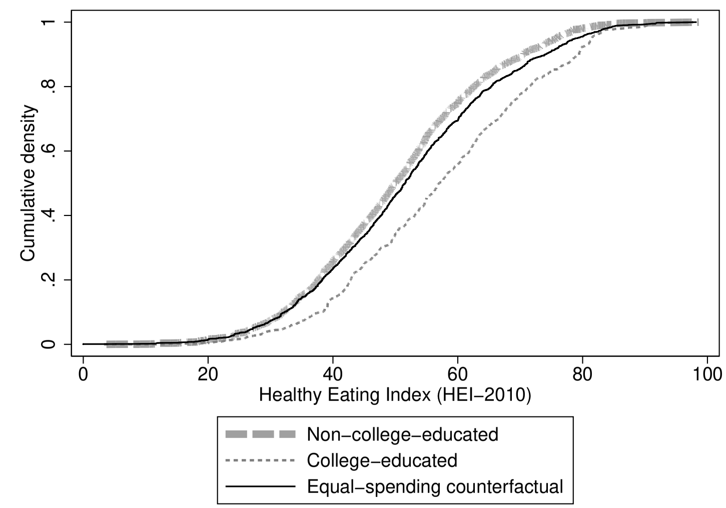
Notes: The figure plots cumulative distribution functions of the Healthy Eating Index (HEI-2010), described in Section ID3 of the paper, over a subset of households surveyed in the FoodAPS data, described in Section IE of the paper. The HEI-2010 is calculated from all food-at-home acquisitions during the survey week. Each FoodAPS household is weighted according to the FoodAPS household weights such that the overall sample is nationally representative. For the line labeled "Non-college-educated," the sample is the set of FoodAPS households whose main food shopper or meal planner does not report having a bachelor's degree or higher. For the line labeled "College-educated," the sample is the set of FoodAPS households whose main food shopper or meal planner reports having a bachelor's degree or higher. For the line labeled "Equal-spending counterfactual," the sample is the set of FoodAPS households whose main food shopper or meal planner does not report having a bachelor's degree or higher. The "Equal-spending counterfactual" series is constructed as follows. First, among non-college-educated and college-educated households, we compute percentiles of each household by total food spending. Second, we assign to each non-college educated household the food spending of the college-educated household at the closest percentile, breaking ties at random. We then use the estimates of the effect of food spending on the HEI-2010 from panel A of column (5) of Table 2 of the paper to compute counterfactual food healthfulness at the given counterfactual level of food spending. The "Share of SES gap in mean outcome eliminated in counterfactual" is the share of the difference in average HEI-2010 across college-educated and non-college-educated households that would be eliminated if college-educated and non-college-educated households had the same average food spending. The share is estimated as the effect of food spending on the HEI-2010 (from panel A of column (5) of Table 2 of the paper) times the difference in average food spending between college-educated and non-college-educated households divided by the difference in the average HEI-2010 between college-educated and non-college-educated households. The standard error associated with the estimated share is calculated via the delta method under the assumption that the estimate of the effect of food spending on the HEI-2010 is statistically independent from the estimated sample means.

Online Appendix Figure 20: Role of Food-at-home Spending in Socioeconomic Disparities in Summary Measures of Food Healthfulness, Allowing for Heterogeneity in the Effect of Food-at-home Spending

Panel A: Nutrient density score



Panel B: Healthy Eating Index (HEI-2010)



Notes: The figures plot cumulative distribution functions of a measure of food healthfulness over a subset of households surveyed in the FoodAPS data, described in Section IE of the paper. The measure of food healthfulness is calculated from all food-at-home (FAH) acquisitions during the survey week. Each FoodAPS household is weighted according to the FoodAPS household weights such that the overall sample is nationally representative. For the line labeled "Non-college-educated," the sample is the set of FoodAPS households whose main food shopper or meal planner does not report having a bachelor's degree or higher. For the line labeled "College-educated," the sample is the set of FoodAPS households whose main food shopper or meal planner reports having a bachelor's degree or higher. For the line labeled "Equal-spending counterfactual," the sample is the set of FoodAPS households whose main food shopper or meal planner does not report having a bachelor's degree or higher. The "Equal-spending counterfactual" series is constructed as follows. First, among non-college-educated and college-educated households, we compute percentiles of each household by total FAH spending. Second, we assign to each non-college-educated household the FAH spending of the college-educated household at the closest percentile, breaking ties at random. We then estimate the effect of FAH spending on diet healthfulness separately by quintile of food spending at the retailer in the six months prior to SNAP adoption. We then assign these estimates to non-college-educated households in the corresponding quintile of the FAH spending distribution and use them to compute counterfactual food healthfulness at the given counterfactual level of FAH spending. In panel A, the measure of food healthfulness is the nutrient density score, described in Section ID2 of the paper. The nutrient density score is shown on a log scale. In panel B, the measure of food healthfulness is the Healthy Eating Index (HEI-2010), described in Section ID3 of the paper.

Online Appendix Table 1: Tests of the Equality of the Distribution of Food Healthfulness in the Retail Panel and FoodAPS Data

Measure of food healthfulness	*p*-value
TFP kilocalorie shares:	
Share of kcal from sugars, sweets, and candies	0.000
Share of kcal from all cheese products	0.000
Share of kcal from coffee and tea	0.000
Share of kcal from soft drinks, sodas, fruit drinks, and ades	0.000
Share of kcal from eggs	0.733
Share of kcal from fruit juices	0.001
Share of kcal from whole fruits	0.000
Share of kcal from fruits and non-starchy veggies	0.000
Share of kcal from dark-green vegetables	0.000
Share of kcal from beans, lentils, and peas	0.584
Share of kcal from low-fat milk products	0.000
Share of kcal from nuts, nut butters, and seeds	0.000
Share of kcal from orange vegetables	0.008
Share of kcal from non-whole grains	0.000
Share of kcal from bacon, sausage, and lunch meats	0.000
Share of kcal from other vegetables	0.000
Share of kcal from chicken, turkey, and game birds	0.000
Share of kcal from frozen or refrigerated entrees	0.000
Share of kcal from beef, pork, lamb, veal, and game	0.000
Share of kcal from fish and fish products	0.000
Share of kcal from soups, fats, and condiments	0.000
Share of kcal from starchy vegetable products	0.000
Share of kcal from whole grains	0.000
Share of kcal from whole milk products	0.000
Nutrient density indexes:	
Calcium per kcal relative to Daily Value lower bound	0.004
Cholesterol per kcal relative to Daily Value upper bound	0.024
Dietary fiber per kcal relative to Daily Value lower bound	0.067
Iron per kcal relative to Daily Value lower bound	0.000
Saturated fat per kcal relative to Daily Value upper bound	0.000
Sodium per kcal relative to Daily Value upper bound	0.000
Total fat per kcal relative to Daily Value upper bound	0.000
Vitamin A per kcal relative to Daily Value lower bound	0.000
Vitamin C per kcal relative to Daily Value lower bound	0.000
Summary measures:	
Nutrient density score	0.000
Healthy Eating Index (HEI-2010)	0.000

Notes: This table presents results of tests of the equality of the distributions of measures of food healthfulness in the retail panel and the FoodAPS data. For each measure of food healthfulness, the table presents the *p*-value from an unweighted Kolmogorov-Smirnov test of the equality of the distributions across the two datasets. For the FoodAPS data, the sample is the set of surveyed households, as described in Section IE of the paper. For the retail panel, the sample is all households in the retail panel during a randomly-assigned pseudo-survey week. Pseudo-survey weeks are randomly assigned to retailer households such that the distribution of pseudo-survey weeks in the retail panel equals the distribution of actual survey weeks in the FoodAPS data. For each household, the measure of food healthfulness is calculated from all food purchases at the retailer during their given pseudo-survey week. Outcomes for which the CDF is depicted in log scale in online Appendix Figure 7 or online Appendix Figure 8 are tested in logs.

Online Appendix Table 2: Measure of Instrument Strength for Both Research Designs

	(1) Nutrient density score	(2) Healthy Eating Index (HEI-2010)
	Panel A: Program adoption research design	
Estimated coefficient on		
SNAP use	-0.0091	0.1734
	(0.0039)	(0.1400)
In-state earnings (in $100)	0.0036	0.2755
	(0.0025)	(0.0885)
Simulated size distortion cutoff (percent)	1.0	1.0
Number of household-quarters	611297	611363
Number of households	24456	24456
	Panel B: Program exit research design	
Estimated coefficient on		
SNAP use	-0.0396	-0.2320
	(0.0129)	(0.4814)
Size distortion cutoff (percent)	1.0	1.0
Number of household-months	2002182	2003811
Number of households	24456	24456

Notes: The sample is the set of SNAP adopters. The unit of observation is the household-time period. In panel A, the time period is a calendar quarter. In panel B, the time period is a calendar month. Each column within panels A and B reports coefficient estimates from an instrumental variables regression, with standard errors in parentheses clustered by household. All models include time period fixed effects. The estimates in panel A are based on the research design described in Section IIA of the paper. The model is estimated in two samples using the TS2SLS estimator defined in Inoue and Solon (2010). Standard errors are calculated as outlined in Section 2 of this online Appendix. In each column, the endogenous variables are the change in an indicator for whether the current quarter is a SNAP quarter and the change in average monthly in-state earnings (in hundreds of dollars). The excluded instruments are an indicator for whether the current quarter is a SNAP adoption quarter and its first lead. The first stage for the change in in-state earnings is estimated on the sample of SNAP adopters in the Rhode Island administrative data described in Section IG of the paper. The first stage for the change in the indicator for whether the current quarter is a SNAP quarter and the second stage are estimated in the retail panel. The "simulated size distortion cutoff (percent)" row presents estimates of the size distortion cutoff underlying the two-step, identification-robust confidence sets proposed by Andrews (2018). The estimated size distortion cutoff is a measure of identification strength, indicating the size distortion one must tolerate to conduct inference based on conventional confidence intervals. The size distortion cutoff is estimated using a simulated measure of the change in in-state earnings, a 100 point grid, and a minimum size distortion cutoff of 1 percent, following the implementation in Sun (2018). We use a simulated measure of the change in in-state earnings to accommodate the two-sample nature of our data. The simulated measure of the change in in-state earnings is constructed as the sum of the predicted change in in-state earnings (from the fist stage regression) and the change in a Gaussian AR(1) random variable drawn independently of the predicted change. We choose the parameters of the Gaussian AR(1) to minimize the Euclidean distance between the variance-covariance matrix of the first stage coefficients on the excluded instruments estimated using the simulated change in in-state earnings and the analogous variance-covariance matrix estimated using the actual change in in-state earnings. The estimates in panel B are based on the research design described in Section IIB of the paper. In each column, the endogenous variable is the change in an indicator for whether the current month is a SNAP month. The excluded instrument is an indicator equal to one in the first month of a six-month clock that begins in the most recent adoption month. The indicator is set to zero in the first six months (inclusive of the adoption month) following the most recent adoption, in any month after the first 24 months (inclusive of the adoption month) following the most recent adoption, and in any month for which there is no preceding adoption. So, the first month of the clock corresponds to months 7, 13, 19, etc. following SNAP adoption. The "size distortion cutoff (percent)" row presents estimates of the size distortion cutoff underlying the two-step, identification-robust confidence sets proposed by Andrews (2018). The size distortion cutoff is estimated using a 100 point grid and a minimum size distortion cutoff of 1 percent, following the implementation in Sun (2018). In column (1), the outcome is the change in the nutrient density score, described in Section ID2 of the paper. Missing values arise from the exclusion of extreme values as described in Section ID2 of the paper. In column (2), the outcome is the change in the Healthy Eating Index (HEI-2010), described in Section ID3 of the paper.

Online Appendix Table 3: Comparing Estimated Effect of Food-at-home Spending to Cross-sectional Association with Food Healthfulness

	(1) Nutrient density score	(2) Healthy Eating Index (HEI-2010)
Relationship with food-at-home spending (in $100s):		
Estimate of effect	-0.0167	0.3198
	(0.0072)	(0.2584)
Estimate of association	-0.1920	1.2038
	(0.0316)	(0.1188)
Difference between estimates	0.1753	-0.8840
	(0.0325)	(0.2843)

Notes: This table presents estimates of the effect of food-at-home (FAH) spending on summary measures of food healthfulness and the cross-sectional association between FAH spending and summary measures of food healthfulness. In column (1), the outcome is the nutrient density score described in Section ID2 of the paper. In column (2), the outcome is the Healthy Eating Index 2010 (HEI-2010) described in Section ID3 of the paper. Estimates of the effect of a $100 increase in FAH spending are obtained using the retail panel and the program adoption research design described in Section IIA of the paper, under the assumption that the retailer's share of FAH spending equals 1 (See columns (1) and (5) of panel A of Table 2 of the paper). The unit of observation is a household-quarter. Standard errors in parentheses are clustered by household. Estimates of the cross-sectional association are obtained using the FoodAPS data via regressions of the given outcome on FAH spending (in $100s) and household size fixed effects. The unit of observation is a household. Estimates and standard errors in parentheses incorporate the recommended sample weights. The "difference between estimates" is the estimate of the effect minus the estimate of the cross-sectional correlation. The standard error on the "difference between estimates," reported in parentheses, is computed under the assumption that the estimate of the effect and the estimate of the cross-sectional association are statistically independent.

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