The persistence of healthy behaviors in food purchasing

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Abstract

When some healthy foods are temporarily subsidized, how does that affect diet and how long does the impact last? I study the U.S. Special Supplemental Nutrition Program for Women, Infants, and Children, which gives vouchers for healthy foods. Using household-level scanner data and exploiting a reform of the program, first, I find that the subsidies make diet healthier. The effect is driven by increased purchases of subsidized products without sizable externalities on other product categories. Second, there is little evidence of a long-term impact on food purchases—when households become ineligible, the effect of the program diminishes. Third, demand model estimates show that in the first years after the end of eligibility, households are still more likely to prefer the previously subsidized products. The estimates imply that price differences between healthy and unhealthy foods play a large role in the decrease in the program's impact.

JEL codes: D12, I12, L66, I38

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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.

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1 Introduction

Obesity is a public health problem that leads to higher medical care costs and imposes negative externalities (Cawley, 2015). One of the causes of obesity is an unhealthy diet. While a diet might be an individual's optimal choice given budget and other constraints, the negative externalities of obesity provide a rationale for government intervention. Indeed, governments use various policies to improve diets, like fat and sugar taxes and regulation of nutrition labeling and advertising. To reduce costs, policies, such as vouchers and subsidies on healthy foods, often target specific products and give only temporary incentives. When designing and evaluating such policies, it is important to take into account all their short- and long-term impacts.

This paper studies three questions. First, when a policy subsidizes some healthy foods, what is the impact on the subsidized foods and on the overall healthiness of diet? Second, how long does the impact last after the subsidies end? Third, what role do prices have in affecting the persistence of the policy impact? I study the effect of the policy on both the observed behavior and underlying preferences. Why is it important to understand the impact on preferences? Often the healthy product is more expensive than its unhealthy substitute. A price-sensitive person, even when she otherwise prefers a healthy option, might not buy it because of the price difference. Hence, temporary incentives might not change the long-run behavior even if these did change preferences.

Specifically, I study a U.S. federal program, the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), which gives vouchers for healthy foods. The program is important in itself. In 2016, eight million people participated in WIC per month. Moreover, WIC provides a good setting for the study. Participation eligibility is restricted to children up to their fifth birthday and pregnant, postpartum, and breastfeeding women. WIC food vouchers are restricted to specific foods. In particular, since the 2009 policy reform, in some food categories, the vouchers are restricted only to healthier products: fruits and vegetables, whole-wheat bread, low-fat milk. By providing free healthy products, the program gives incentives to eat more healthily. The incentives are temporary, lasting until the child's fifth birthday. Furthermore, the 2009 reform provides an exogenous change in the policy.

In the analysis, I use Nielsen household-level scanner data of grocery purchases. The dataset includes information on households' WIC status, composition, and income. The dataset covers eleven years, 2006–2016. I focus on the product categories included in the WIC food vouchers, but I also analyze the overall healthiness of diet by calculating the Healthy Eating Index. Data on product prices are obtained from the Nielsen Retail Scanner Data.

My analysis starts by estimating the impact of healthy food subsidies on the overall healthiness of diet and the subsidized products. Identification is based on the WIC program reform that changed the composition of food vouchers. The main analysis uses a difference-in-differences estimator that compares the changes in purchases when households start to receive the vouchers of the two groups of WIC households—ones exposed to the old and others exposed to the new WIC program. Both groups of households start to receive the vouchers, but the foods included in the vouchers are different. My estimates confirm that with the new WIC program, households' grocery purchases indeed became healthier, as was intended by the program. Specifically, regarding the product categories included in the vouchers, I find evidence that the new WIC program increased the share of whole wheat bread purchases, decreased the average percentage of milk fat purchased and increased fruit and vegetable purchases. I find that the new WIC program increased the overall healthiness of diet as measured by the Healthy Eating Index. The effect is driven by increased purchases of subsidized healthy products without sizable positive or negative externalities on other product categories. This emphasizes the importance of the decision of which products to include in the program.

Second, I study the long-term impact of healthy food subsidies by analyzing the changes in purchases when the households become ineligible for the program. Again, the main analysis uses a difference-in-differences estimator that compares the changes in purchases when households become ineligible of the two groups of WIC households—ones that were exposed to the old and others exposed to the new WIC program. I find evidence that after the end of program eligibility, bread and milk purchases became unhealthier so that the positive effect of the program disappears. The results are robust to alternative specifications, including propensity score matching, synthetic control method, and Arellano-Bond estimator. There is also some evidence of the overall diet becoming unhealthier, but the results are imprecise. Then I look at the reduced form evidence on the role of prices in affecting the persistence of the policy impact. I use the exogenous regional differences in the pricing of milk, wherein in some states, milk prices increase with fat percentage and in others, prices are flat. I find that in states where healthy products are relatively cheaper, the policy impact is more persistent. Overall, the results show that healthy food subsidies don't have a long-term impact on purchases. However, the results raise a question of whether no impact on purchases is due to the limited impact on preferences or relatively high healthy food prices?

To examine the long-term impact of healthy food subsidies on preferences and separate it from the role of prices, I estimate a demand model. I model demand using a discrete choice

random coefficient multinomial logit model, allowing household heterogeneity in preferences. To address price endogeneity, I use the control function approach and production input prices as instruments. To estimate the persistence of the impact of the WIC policy on purchases after households' eligibility has ended, again, I use the change in the policy. The change in the policy generated a large increase in the share of healthy purchases during the WIC program. I find that in the first years after the end of eligibility, households are still more likely to prefer the previously subsidized products.

The demand model estimates allow performing the counterfactual analysis that studies two questions. First, how much does the change in tastes induced by the program decrease a subsequent subsidy needed for a given change in purchases? The demand model estimates showed that the post-reform WIC program has a long-term impact on preferences, but the reduced form evidence showed that the change in preferences is not reflected in behavior. The question is whether the change in preferences would have long-term benefits if healthy food prices were lower? In practice, policies often don't happen in isolation, and there is a rising trend in public health initiatives, such as taxes on unhealthy foods or subsidies on healthy foods. Does the WIC-induced change in preferences matter for the impact of subsequent public health policy? In particular, I simulate the impact of a ten-cent subsidy on a healthy product. The results show that the change in tastes induced by post-reform WIC magnifies the impact of subsequent policies; it doubles the effect of the subsidy.

The second counterfactual asks whether it is profitable for a firm to (partly) subsidize a policy that subsidizes healthy food products? The incentive for the firm would be to generate long-term changes in tastes and increase demand. The analysis shows that it is not profitable for a firm to subsidize the program in a sizable way. The subsidies are too costly compared to the long-term increases in profits. However, the results also show that the government-subsidized programs that promote healthy behaviors increase the market share of healthy products and allow the producers to raise prices. In this way, these programs are profitable for the producers of healthy products.

The paper builds on the literature in economics that studies nutritional choices. The literature has shown that prices matter, but also that nutritional choices are persistent and difficult to change.[1] For example, Dubois et al. (2014), using scanner data from different

[1]Other topics this literature has studied include the role of restaurants (Anderson and Matsa, 2011; Currie et al., 2010), nutritional information (Bollinger et al., 2011; Moorman et al., 2012; Puranam et al., 2017), bans on advertising (Dhar and Baylis, 2011; Dubois et al., 2018), food availability and food deserts (Allcott et al., 2019), and weight loss programs (Uetake and Yang, 2018). For an overview of the literature on the economics of nutrition and obesity, see Cawley (2015).

countries, showed that price differences explain a large share of the difference in calories consumed between France and the U.S. In the case of milk, which is one of the products studied in this paper, Khan et al. (2016) showed that even small price differences lead to large differences in fat consumption. Atkin (2013, 2016), using data of migration, has provided evidence of habit formation and quantified the costs of the persistence of nutritional choices. Ma et al. (2013) and Oster (2018), using scanner data, showed that individuals are reluctant to make all the required changes to their diets even when diagnosed with diet-related disease. To my knowledge, the current paper is the first to analyze the role of prices and the persistence of nutritional choices together when studying the impact of public policy.

More broadly, the paper belongs to the literature on the long-term effects of temporary interventions. More closely related to the current paper are those on the long-term effects on health behaviors. For example, Kueng and Yakovlev (2018) find evidence of a temporary regulation having long-lasting effects on alcohol consumption. Charness and Gneezy (2009) provide evidence of persistent effects from an experimental treatment that gave temporary incentives to exercise. Experimental studies on commitment contracts also find evidence of effects long-after incentives have ended, examples include exercising (Royer et al., 2015) and smoking cessation (Giné et al., 2010). There is also a growing experimental literature analyzing long-term impacts of temporary incentives on nutritional choices (including List and Samek, 2015; Belot et al., 2016; Loewenstein et al., 2016; Belot et al., 2018).

The paper contributes to the literature on the impact of the WIC program. Literature in economics studying the program has concentrated mostly on birth outcomes (Figlio et al., 2009; Hoynes et al., 2011), participation (Rossin-Slater, 2013), and the impact of WIC on market outcomes (Meckel, 2016).[2] Literature in nutrition science has shown that the 2009 change in WIC food packages increased the healthiness of WIC participants' food consumption.[3,4] The closest previous works to this paper are Khan et al. (2018) and Frisvold et al. (2019), which both analyze the persistent impact of WIC vouchers on food purchases after eligibility has ended using household-level scanner data. Khan et al. (2018) focus on the cereal category and use detailed data on brand inclusion to the program to estimate WIC contemporaneous and long-term impact on brand persistence as well as on the consumption of sugar and fiber in the cereal products. To separate the short term state dependence and long-term persistence, they also estimate a demand model. My paper extends the analysis by studying the impact

[2]Hoynes and Schanzenbach (2015) provide a recent overview of the literature on WIC.

[3]For an overview, see Schultz et al. (2015) and a report by the National Academies of Sciences, Engineering, and Medicine (NASEM, 2017).

[4]Griffith et al. (2018) provide evidence based on a similar program in the UK.

on all products included in the WIC vouchers as well as the overall healthiness of diet. In contrast to their analysis, I use the change in the policy to identify the effects. Frisvold et al. (2019) also use the change in the WIC policy and difference-in-differences regressions to estimate the impact of the WIC vouchers on purchases of WIC products during and after program eligibility. My analysis differs from both of the papers in two major ways. First, I estimate the impact of the policy on the overall healthiness of diet. I find that the program makes diets healthier by increased purchases of subsidized healthy products without sizable positive nor negative externalities on other product categories. This has implications for designing the program. It indicates that it is important which product categories to include in the program because it improves diets mainly through the direct effect on the included categories. Second, I provide evidence that the persistence of the program impact depends on prices. This means that when a planner designs a public health policy or a firm chooses a product line, the trade-off between short-term and long-term effects should be compared. I provide two counterfactual exercises to study these effects.

The rest of the paper is organized as follows. Section 2 describes the WIC program and data. Section 3 estimates the impact of healthy food subsidies and its persistence. Section 4 analyzes the role of prices. It first provides estimates from a demand model and then uses these estimates in the counterfactual analysis. Section 5 concludes.

2 Background on WIC and data

2.1 Background on WIC

WIC is a U.S. in-kind food and nutrition assistance program targeted at women and children 0–4 years old. In 2016, eight million people participated in WIC per month, and it accounted for six percent of U.S. food and nutrition assistance expenditures (Oliveira, 2017). The average monthly WIC program cost for food per participant was 43 dollars.

The following categories of people are eligible to participate in WIC: pregnant, breast-feeding (up to child's first birthday), and postpartum women (up to six months after birth), and children up to their fifth birthday.[5] The income eligibility requirement to participate in WIC is income not exceeding 185 percent of the federal poverty guidelines.[6] Income eligibility

[5]USDA. Food and Nutrition Service. "WIC Eligibility Requirements." Last published: August 3, 2016. https://www.fns.usda.gov/wic/wic-eligibility-requirements.

[6]States are allowed to decrease the eligible income cutoff, but in practice in all states, it equals the 185 percent of the federal poverty guidelines (Oliveira and Frazao, 2015).

requirement is automatically satisfied if the individual or a family member is eligible for SNAP, Medicaid, or Temporary Assistance for Needy Families benefits (for more see Oliveira, 2017). A large share of families with small children participates in WIC. According to the USDA report (Oliveira and Frazao, 2015), in 2012, 51 percent of infants (up to their first birthday) and almost 30 percent of pregnant and postpartum women and children aged 1–4 participated in WIC. Not everyone eligible participates in WIC. According to the USDA report (Johnson et al., 2014), in 2011, the rate at which eligible individuals participated in WIC was highest among infants (83%) and postpartum non-breastfeeding women (81%), and lowest among children aged 1–4 (54%). Those who participate tend to have lower income.[7]

WIC benefits are in the form of quantity vouchers for specific food items (except for fruits and vegetables, which is a cash voucher). The set of foods in the WIC food package is rather small. Children aged 1–4 and women receive regular food items, which until 2009 included mainly milk, juice, cereal, eggs, legumes, and peanut butter. Infants until their first birthday receive infant formula, infant cereal, and infant juice.

In 2009, there was a major change in the types of foods provided by WIC. The goal of the change was to make WIC food packages consistent with new dietary guidelines. While WIC was established to fight malnutrition in low-income families, over time, obesity became a problem, and concerns were raised whether WIC contributes to child obesity (Oliveira and Frazao, 2009). The change added new foods: whole grain products, fruits, and vegetables. Specifically, it added whole wheat bread. The change also introduced restrictions on the fat percentage of milk. Specifically, whole milk is no longer allowed, except for one-year-old children. Altogether, the 2009 reform was cost neutral as it reduced the quantities of some foods, in particular, milk, juice, and eggs.[8] An example of a WIC food package is shown in table A1 in appendix A.

The most controversial of the 2009 changes to the WIC food package was probably the restriction on the fat percentage of milk. For the past several decades, dietary guidelines have recommended decreasing dietary fat. But there is still no consensus in the medical and nutritional science literature whether that is beneficial (for examples of recent overviews of

[7]More than two-thirds of WIC participants have income below the federal poverty level (Oliveira and Frazao, 2015). Less than three percent of the participants have income above the upper limit. The fact that income can be above the limit is explained by automatic eligibility through other programs, which have higher income limits in some states.

[8]In 2014, there were additional small modifications to the food package. These changes reduced milk fat percentage even further, allowing only low-fat (1%) or non-fat milk for children 2-4 years of age and women, and increased the cash voucher for fruits and vegetables. It also allowed states to authorize whole wheat macaroni (pasta) products as substitutes for whole wheat bread and allowed partial substitution of milk with yogurt.

the debate see Wang and Hu (2017); Ludwig et al. (2018)). However, the change in the WIC vouchers was made based on the report commissioned from the Institute of Medicine.[9] The change was consistent with the recommendations by the American Academy of Pediatrics: whole milk for one-year-old children and 1% or non-fat for older children (Gidding et al., 2006). Therefore, despite the above-mentioned controversy, in this paper, to be consistent with the goal of the WIC reform, I call the restrictions to the milk fat percentage healthy.

2.2 Data

In the paper, the main data source is the Nielsen Homescan Consumer Panel. Data on product prices is obtained from the Nielsen Retail Scanner Data.[10] The consumer panel is representative of the U.S. population. The participating households in the panel are asked to scan all their grocery purchases bought for personal at-home consumption. The dataset includes UPC level information of the purchased quantities. Reliability of the data has been analyzed by Einav et al. (2010). In addition to purchases, Nielsen collects information on household demographic characteristics using annual surveys. The demographic characteristics include household income and composition, employment status and education of household heads, and the age of each child. Starting from 2006 the dataset provides information on household WIC status. In the analysis, I use the Nielsen data that covers eleven years, 2006–2016. Nutritional information is obtained from the databases from the U.S. Department of Agriculture (USDA, 2018a,b).

When analyzing purchases in specific product categories, I focus attention on categories that are included in the standard WIC food package for both mothers and children. These are milk, bread, fruits and vegetables, juice, eggs, and cereals.[11] The 2009 policy reform affected all these categories except cereals.[12] Specifically, the new WIC food packages added bread and fruits and vegetables and decreased the quantity of milk, juice, and eggs. Therefore, I will analyze the impact on the aggregate quantity of purchases in these categories (aggregating

[9]The report was published by Committee to Review the WIC Food Packages and Food and Nutrition Board (2005).

[10]Both datasets are 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. Information on availability and access to the data is available at http://research.chicagobooth.edu/nielsen.

[11]I don't analyze the impact on dry beans and peanut butter, which are also included in the food vouchers, but where a substitution is allowed between the products either by the household or in the state-level regulation.

[12]The 2009 policy reform included a minor change for cereals, which changed the choice set of available products. Specifically, it required that at least half of the cereals brands available to WIC households must be whole grain. However, the reform did not require WIC households to purchase whole grain cereals.

across brands, package sizes, and other product characteristics). Additionally, the reform restricted milk to be low-fat (except for one-year-old children) and bread to be whole wheat. Therefore, in the case of bread and milk, I also study the impact on the type of product purchased (fat percentage for milk and grain characteristics for bread). Specifically, the analysis focuses on white dairy milk, loaves of bread, fruits and vegetables (including fresh, frozen, and canned), and juice (including concentrate and frozen). Milk is measured in gallons, bread in pounds, cereals in ounces, and eggs by count. To aggregate together the more heterogeneous products, different fruits and vegetables and different types of juice (including concentrated), I measure the quantities of these categories in calories.

To measure the overall healthiness of diet, I calculate the Healthy Eating Index. The index is a standard measure of diet quality in the U.S. The U.S. Department of Agriculture uses the index to monitor diet quality of the U.S. population and evaluate federal nutrition programs such as SNAP and the National School Lunch program. The index measures compliance with the U.S. Dietary Guidelines. Specifically, the index measures the healthiness of diet per calories consumed. It adds points for consuming healthy products (for example, fruits and vegetables and whole grains) and deletes points for consuming unhealthy products (for example, refined grains and saturated fats). It scores the diet on a scale from 0–100.

In the analysis, I include only products with UPCs (barcodes). The products without UPCs are non-packaged items from categories such as fruit, vegetables, meat, and baked goods. In the Nielsen dataset, only a small subset of households is asked to record products without UPCs. To use a bigger sample of households and make purchases of all households comparable, I exclude products without UPCs. This affects the quantity of fruits and vegetables and the Healthy Eating Index. In particular, the measured quantity of fruits and vegetables is a lower bound on all fruit and vegetable purchases.

The analysis will focus on households for which I can infer that they receive WIC assistance and the timing of their WIC eligibility. To do that, I combine survey data of household self-reporting receiving the assistance with WIC age eligibility requirements, and the data about the age of each child. I assume that a household is receiving WIC assistance if it self-reported receiving WIC assistance and if it has a WIC age-eligible child (or expecting mother). Combining the two requirements gives some validity to the survey data. In the following part of the paper, when as a short-hand, I say that a household is receiving WIC assistance then I mean the above assumption. I assume that the household becomes ineligible when they don't have an age-eligible child anymore (that is when the child becomes five years old).

Next, I outline the choices made in the construction of the datasets used in the estimation. Further details of dataset construction are provided in appendix B.

Dataset for reduced form analysis: construction and descriptive statistics. In section 3, the reduced form analysis focuses on households that report receiving WIC assistance. Remaining households are included in alternative control groups. Table 1 presents demographic characteristics of the households. It compares the treatment group, that is, those that receive WIC assistance after the policy change (column 1), to those receiving it earlier (columns 2 and 4), to households with children or lower income (column 3), and to the remaining households (column 5). Households receiving WIC assistance on average have a lower income, larger household size, and are more likely to be racial minorities. Table A2 in appendix A presents summary statistics of purchases.

Table 1: Household demographic characteristics

	Treatment group	Control groups			
	WIC post-reform	WIC pre-reform	Children, low-income	WIC in the past	Other
	(1)	(2)	(3)	(4)	(5)
Household income	47114.2	47141.2	52218.4	53436.4	80312.2
Household size	4.1	4.1	2.6	3.4	1.9
College	0.464	0.366	0.460	0.398	0.625
Race: white non-Hispanic	0.701	0.705	0.796	0.705	0.822
Households	714	372	97702	9960	56860
Household-years	3665	2245	405289	38496	234974

Note: The table presents sample average demographic characteristics. An observation is a household-year pair. Sample consists of household-years in the panel data fixed effects regressions. Column 1 includes households who received WIC assistance after the 2009 policy change. Column 2 includes households who received WIC assistance only before the 2009 policy change. Column 3 includes households who have children or lower income (income below 200 percent of the federal poverty guidelines). Column 4 includes households who received WIC assistance in the past (before the survey) and at least during one year of the survey still had children under the age 18 in the household, but don't have younger than eight-year-old children. Column 5 includes the remaining households. Income is deflated to 2015 dollars using the consumer price index for urban consumers.

Dataset to estimate the demand model: construction and descriptive statistics. In section 4, to keep the demand model estimation manageable, I restrict attention to a smaller sample of households who have all reported receiving WIC assistance. Specifically, in the estimation, I use the households in columns 1–2 and 4 of table 1. The demand model

is estimated using only the time periods when WIC eligibility has ended.[13] To ensure a sufficient number of observations per household, I exclude households with less than twenty purchases. Table A3 in appendix A describes demographic characteristics of households used in the demand model estimation.

The demand model is estimated using data only on the bread category (for reasons that will be discussed in section 4). I aggregate all types of bread into four products. *White bread* is a non-whole-grain bread made from white refined flour. I differentiate between two types of whole grain bread. First, following WIC regulation, I classify bread as *whole wheat bread* if it contains 100% whole wheat flour. Second, I call bread that is only partially made with whole wheat flour or contains any other type of whole grain flour or rye flour *whole grain bread*. Finally, *other bread* aggregates together all other non-whole grain bread types (like Cinnamon Raisin, Cinnamon Swirl, etc.).

To obtain prices of available products, I use the Nielsen store dataset. Because the store dataset does not cover all stores, I'm not able to obtain prices from the same exact store the household visited. Instead, I calculate weighted average prices at the state level. For robustness analysis, for a smaller sample of purchases that can be mapped to a specific store, I also calculate store level prices. To alleviate the concern that more price sensitive households are more likely to buy private label products, I use the same weight for private label versus brand across products in a given state in a given year.[14] Prices are deflated to 2015 dollars using the consumer price index for urban consumers. For details of the calculation of prices, see appendix B.

Table A3 presents summary statistics of prices of each product. The cheapest product is white bread with a median price of about $1.5 per pound. All other types of bread are about 40 cents more expensive than white bread.

[13]Periods when households received WIC vouchers (and thus the products for free) are excluded to be able to estimate how prices affect purchases. While households receive WIC vouchers, I don't have information about whether on a given shopping trip they are paying with the voucher or cash. Hence, I wouldn't know the price they faced on a given shopping trip: whether the regular price or price zero because of the voucher. Periods before WIC are excluded because the number of households that are in the sample both before and after WIC is small.

[14]To explain the concern, let's consider a simplified example. Suppose generic bread has the same price across all products (white, whole wheat, etc) and suppose that branded bread has a higher price but also constant across products. Suppose households who buy white bread buy private label. Then, the simple volume-weighted aggregate prices would imply that white bread is cheaper, even though no one can save money by switching to white bread.

3 The impact of healthy food subsidies

3.1 The impact of subsidies during program eligibility

Main empirical strategy. The empirical strategy exploits the 2009 reform of the WIC program that changed the content of food vouchers. In the main analysis, I estimate a difference-in-differences regression[15] that compares changes in purchases associated with starting to receive WIC vouchers in the two groups of households—those receiving the vouchers from the old policy and those from the new policy. These two groups of households should be otherwise similar, both start to receive the vouchers when their child is born, but the vouchers are different. The new policy introduced healthy food subsidies— vouchers for fruits and vegetables, whole wheat bread, and low-fat milk. It reduced the subsidized quantity of milk, juice, and eggs while keeping the subsidized quantity of cereals unchanged.

Using household-level quarterly data, I estimate the following difference-in-differences regression:

$$\begin{aligned} Y_{it} = \alpha_1 \cdot WIC_{it} + \alpha_2 \cdot PostReform_{it} + \beta_1 \cdot WICPostReform_{it} \\ + \gamma \cdot X_{it} + HouseholdFE_i + \delta \cdot D_t + \varepsilon_{it} \end{aligned} \tag{1}$$

The outcome variable (Y) is a measure of purchases. Variable WIC is an indicator for receiving WIC vouchers and $PostReform$ is an indicator for time periods after the WIC policy reform has taken place (the exact time period depends on the state). The coefficient of interest is β_1, which measures the impact of receiving WIC vouchers after the policy reform ($WICPostReform$). The regressions include time-varying household characteristics (X), household fixed effects ($HouseholdFE$), and either a time trend or fixed effects for each time period (D). The time-varying household characteristics include logarithm of income, household size, and indicator variables for the period before the child is born, and children aged 0, 1, ..., 5, 6-12, and 13-17. For milk, the regression also includes an interaction term for WIC and one-year-old child to take into account that for one-year-old children, WIC food vouchers provide whole milk.

The regressions are estimated using a sample that includes WIC households in the time periods before they receive WIC vouchers or while they receive the vouchers. In the main analysis, I estimate the regressions using two alternative samples (additional samples are

[15]Robustness analysis uses alternative estimators such as propensity score matching and synthetic control method.

considered in the robustness analysis). The first sample includes only WIC households (columns 1–2 in table 1). The second sample includes a larger control group (columns 1–3 in table 1). The drawback of the second sample is that now the control group includes households that don't receive WIC vouchers. The benefit is to be able to better control for the changes in consumption over time.

Identification. Identification of the impact of healthy food subsidies exploits the 2009 change in the food vouchers. It changed the composition of vouchers and introduced subsidies on healthy foods. The impact of the subsidies is identified by comparing the changes associated with starting to receive the vouchers of the two groups of WIC households—pre-reform and post-reform. Comparison of the changes in purchases of the two groups of WIC households should alleviate the concern that there are unobservable changes coinciding with WIC participation, which households' observed characteristics don't account for. It should also alleviate the concern that the treatment group is a selected sample because the treatment and control groups are both WIC households and thus selected in a similar way.

Main results. Table 2 presents the main results of the impact of the post-reform WIC program on purchases of subsidized products. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1).

The results in table 2 show that the new WIC program increases the healthy bread purchases (as a share from all bread purchases), decreases milk fat percentage, and increases fruit and vegetable purchases. These changes are expected based on the changes in the food vouchers. However, there is no evidence that the new WIC program affects the quantity of bread, milk, juice, eggs, or cereals. Again, it is expected that the cereals quantity did not change, because cereals were included in the analysis as a placebo as the reform did not change the quantity of cereals in the food vouchers. Even though the reform did decrease the quantity of milk, juice, and eggs and added bread to the vouchers, I find no significant effect on purchases.

Table 3 presents the estimates of the impact of the new WIC program on the overall healthiness of purchases measured by the Healthy Eating Index. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1).

The results in table 3 show that the new WIC program increases the Healthy Eating Index (columns 1–2). However, when calculating the Healthy Eating Index while excluding

Table 2: The impact of post-reform WIC on subsidized products

	Bread		Bread		Milk		Milk	
	Healthy %		Log. quantity		Fat %		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WIC post reform	4.281***	6.605***	0.033	0.012	-0.102**	-0.197***	0.060	0.055
	(1.495)	(1.399)	(0.051)	(0.044)	(0.049)	(0.050)	(0.055)	(0.055)
WIC	-1.831	-0.626	-0.024	0.003	-0.049	-0.069*	-0.077	-0.038
	(1.316)	(1.041)	(0.043)	(0.039)	(0.043)	(0.040)	(0.050)	(0.045)
Post reform	0.492	0.270	-0.121**	0.000	-0.087*	-0.014**	-0.096*	0.006
	(1.743)	(0.260)	(0.051)	(0.009)	(0.048)	(0.007)	(0.056)	(0.008)
Year-quarter FE	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	514	514	515	515	511	511	512	512
Households	514	96563	515	96564	511	94232	512	94233
Household-quarters	6000	1365973	6765	1613424	5998	1331699	6718	1585847
	Fruits & veg.		Juice		Eggs		Cereals	
	Log. quantity		Log. quantity		Log. quantity		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WIC post reform	0.285***	0.193*	0.050	0.304	0.105	0.027	0.092	0.092
	(0.106)	(0.100)	(0.196)	(0.185)	(0.093)	(0.083)	(0.094)	(0.083)
WIC	-0.144	-0.126	0.164	0.315*	-0.172**	-0.079	0.065	0.096
	(0.095)	(0.088)	(0.179)	(0.166)	(0.084)	(0.076)	(0.080)	(0.072)
Post reform	-0.099	0.002	0.130	0.119***	-0.155*	0.020	-0.186*	-0.036**
	(0.085)	(0.018)	(0.192)	(0.037)	(0.093)	(0.015)	(0.097)	(0.017)
Year-quarter FE	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	517	517	515	515	513	513	515	515
Households	517	97829	515	94029	513	95449	515	96870
Household-quarters	6782	1623263	6754	1596280	6733	1601167	6757	1615696

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. Bread healthy % and milk fat % are in the range of 0–100, quantity is measured in pounds for bread, gallons for milk, kilocalories for fruits and vegetables and juice, counted for eggs, and ounces for cereals. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In columns 5–6 in the top panel, regressions include an interaction term for WIC and 1-year-old child. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1). In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

the product categories with subsidies on healthy options, the positive effect largely disappears (columns 3–4). This suggests that the reform did not generate sizable positive or negative

Table 3: The impact of post-reform WIC on the Healthy Eating Index

	All products		Excluding products affected by reform	
	(1)	(2)	(3)	(4)
WIC post reform	0.939**	1.033***	0.410	0.348
	(0.467)	(0.398)	(0.443)	(0.380)
WIC	0.093	-0.512	0.413	-0.214
	(0.382)	(0.337)	(0.366)	(0.323)
Post reform	0.289	0.137	0.085	0.083
	(0.463)	(0.094)	(0.451)	(0.090)
Year-quarter FE	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes
WIC households	517	517	517	517
Households	517	98219	517	98216
Household-quarters	6782	1625600	6781	1625402

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. Dependent variable is the Healthy Eating Index calculated using either all products (columns 1–2) or excluding fruits and vegetables, bread, and milk (columns 3–4). All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1). In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

externalities on other product categories. For example, one could have expected that households might start to purchase healthier products even in the product categories excluded from vouchers. Or the opposite, that households might compensate by purchasing unhealthy products in the excluded categories. But overall, the effects in other product categories are insignificant and small in magnitude.

Tables A4–A5 in the appendix shed further light on what drives the increase in the Healthy Eating Index. The Healthy Eating Index can be increased in two ways, either by increasing consumption of healthy components or by decreasing consumption of unhealthy components. The estimates in table A4 show that the increase in the index comes mainly from the increased consumption of healthy components. More specifically, table A5 shows that the increase comes mostly from whole grains and fruits and vegetables.

The estimates regarding the impact on subsidized products are consistent with the previous literature. The literature has found that the change in the food vouchers increased whole wheat bread consumption, lowered milk fat percentage, and increased fruit and vegetable

consumption, although, in the case of fruits and vegetables, the impact was very small (for overviews of the studies see Schultz et al. (2015); NASEM (2017)). Previous evidence regarding the impact on the overall healthiness of diet is somewhat mixed (Kong et al., 2014; Tester et al., 2016). My estimates show that the post-reform WIC increased the overall healthiness of diet. Furthermore, my analysis provides a novel finding regarding the externalities of the WIC reform on the product categories not included in the vouchers.

Robustness and heterogeneity. Robustness and heterogeneity of these results is analyzed in tables A6–A16 and figure A1 in appendix A. The robustness analysis includes: parallel trends, alternative samples, and alternative estimators such as propensity score matching and synthetic control method. I also study heterogeneity of the effects across demographic characteristics. Overall the conclusion remains that in the new WIC program, households' share of healthy bread purchases increases, milk fat percentage decreases, and the overall diet healthiness measured by the Healthy Eating Index increases. The effect on fruit and vegetable purchases is not fully robust to alternative specifications.

Tables A6–A8 present results from regressions that are otherwise the same as in tables 2–3 but include separate pre-treatment time trends for the treatment and control groups. In a few regressions, there is evidence that the pre-treatment time trends are indeed significantly different for the treatment and control groups. However, in the small sample (in odd-numbered columns) for most of the variables (including the share of healthy bread, milk fat percentage, fruits and vegetables, and the Healthy Eating Index) there is no evidence of the treatment group having a significantly different pre-treatment time trend. The estimates regarding the impact of the new WIC program remain similar to those in tables 2–3.

Tables A9–A10 present results estimated using the same regressions as in tables 2–3 but alternative samples. In odd-numbered columns, the control group includes households who reported having received WIC vouchers in the past. In the even-numbered columns, the control group includes all households. The estimates are otherwise very similar to those in tables 2–3, except that with the alternative samples, the new WIC program is also associated with an increase in juice purchases.

Next, I use propensity score matching as an alternative estimation method. I collapse the data to a cross-section by calculating the differences in purchases before receiving and while receiving the WIC vouchers. For the share of healthy bread, percentage of low-fat milk, and the Healthy Eating Index, it is a simple difference in the averages. For the quantities, it is the difference between the logarithms of averages ($\log(y_t/y_{t-1})$, where y_t is the average

quantity purchased while receiving WIC vouchers and y_{t-1} is the average quantity before receiving WIC vouchers. I use the larger sample (the sample in the even-numbered columns in tables 2–3), which includes households who did not receive WIC benefits. For each of these non-WIC households, I draw a random time period when they started to receive WIC vouchers. Table A11 presents the estimates of propensity score from a logit model that uses household demographic characteristics to predict WIC participation after the policy reform. Then I use these predicted probabilities to estimate the average treatment effect on the treated using propensity-score matching. I estimate the average treatment effect on the treated instead of the average treatment effect for two reasons. First, because in the current case, I believe it to be what the difference-and-difference estimator measures, and second, it requires weaker assumptions.

Tables A12–A13, in the even-numbered columns, present the propensity score matching estimates. For comparison, the odd-numbered columns present estimates from a simple cross-sectional OLS regression. Overall the results are similar to those in the main analysis. The exception is fruits and vegetables, for which the propensity score estimator is statistically insignificant. For the fat percentage of milk and the Healthy Eating Index the propensity score matching estimates are slightly lower in magnitude.

Next, I use synthetic control method to evaluate the impact of the new WIC policy. I generate a synthetic control group for each of the treated units, that is, for each of the households exposed to the new WIC. The sample of WIC households does not allow to generate a long enough panel before and after the start of receiving the vouchers, especially for the control group (households exposed to the old program). Therefore, I use the larger sample (the sample in the even-numbered columns in tables 2–3) to obtain the synthetic control method estimates. In the same way as for the propensity score matching above, for the non-WIC households, I draw a random time period when they started to receive WIC vouchers. Figure A1 presents the results for the impact of the post-reform WIC on the share of healthy bread, milk fat percentage, logarithm of the quantity of fruits and vegetables, and the Healthy Eating Index. The results show a large positive effect on the share of healthy bread and a large negative effect on milk fat percentage. There is some evidence of a small positive effect on the Healthy Eating Index and mixed results regarding fruits and vegetables.

Finally, tables A14–A16 address heterogeneity of the effects across demographic characteristics. These re-estimate the regressions in tables 2–3 while including interactions of the WIC effects with income and household size. Specifically, WIC effects are interacted either with normalized household size and logarithm of income (odd-numbered columns) or

indicator variables for income or household size below the 25th percentile or above the 75 percentile (even-numbered columns). In the case of healthy bread share (table A14 column 2), there is evidence that for the households with larger income, the new WIC program effect is smaller. Limited evidence of heterogeneity could be due to the fact that the significant treatment effects are estimated mainly for person-level outcomes (like the fat percentage and the Healthy Eating Index). We would expect more heterogeneity in the household-level quantities.

3.2 How long do the changes last after program eligibility ends?

Empirical strategy. In the main analysis, I estimate a difference-in-differences regression[16] to measure the long-term impact of healthy food subsidies. Again, the empirical strategy exploits the 2009 reform of the WIC program that changed the content of food vouchers. I compare two groups of households—those that participated in the program before the policy reform and those who participated after the policy reform. I compare the changes in their purchases when they become ineligible for the program. These two groups of households should be otherwise similar, both become ineligible when their child becomes five years old, but the vouchers were different.

Using household-level quarterly data I estimate the following difference-in-differences regression:

$$\begin{aligned} Y_{it} = {} & \alpha_1 \cdot IneligibleYear1_{it} + \alpha_2 \cdot IneligibleYear2_{it} + \alpha_3 \cdot IneligibleYear3+_{it} \\ & + \alpha_4 \cdot PostReform_{it} + \beta_1 \cdot PostReformWIC_{it} \times IneligibleYear1_{it} \\ & + \beta_2 \cdot PostReformWIC_{it} \times IneligibleYear2_{it} \\ & + \beta_3 \cdot PostReformWIC_{it} \times IneligibleYear3+_{it} \\ & + \alpha_5 \cdot StillElig_{it} + \alpha_6 \cdot PostReformWIC_{it} \times StillElig_{it} \\ & + \gamma \cdot X_{it} + HouseholdFE_i + \delta \cdot D_t + \varepsilon_{it} \end{aligned} \tag{2}$$

The outcome variable (Y) is a measure of purchases. Variable $IneligibleYear1$ is an indicator that equals one during the first year when a household has become ineligible for WIC, similarly for years 2 and 3+ (which means the 3rd year or later). Variable $PostReform$ is an indicator for time periods after the WIC policy reform has taken place. The coefficients

[16] Robustness analysis uses alternative estimators such as propensity score matching, synthetic control method, and Arellano-Bond estimator.

of interest, $\beta_1, \beta_2, \beta_3$, measure the change in purchases when a household that was receiving WIC vouchers post reform becomes ineligible for these. Thus, these coefficients measure the long-term impact of the healthy food subsidies provided by the post-reform WIC vouchers. The regressions include time-varying household characteristics (X), household fixed effects ($HouseholdFE$), and either a time trend or fixed effects for each time period (D). The time-varying household characteristics include logarithm of income, household size, and indicator variables for the period before the child is born, and children aged 0, 1, ..., 5, 6-12, and 13-17. For milk, the regression also includes an interaction term for WIC and 1-year-old child to take into account that for one-year-old children, WIC food vouchers give whole milk.

The regressions are estimated using a sample that includes WIC households in the time periods when they receive WIC vouchers or after they became ineligible for the vouchers. In the main analysis, I estimate the regressions using two alternative samples (additional samples are considered in the robustness analysis). The first sample includes only WIC households (columns 1–2 in table 1). The second sample includes a larger control group (columns 1–3 in table 1).

Identification: Identification of the long-term impact of healthy food subsidies exploits the 2009 change in the food vouchers that introduced subsidies on healthy foods. The long-term impact of the subsidies is identified by comparing the changes associated with becoming ineligible for vouchers of the two groups of WIC households—pre-reform and post-reform. The comparison of the two groups of WIC households should alleviate the concern that there are unobservable changes coinciding with the end of program eligibility, which households' observed characteristics don't account for. As discussed in 3.1, it should also alleviate the concern that the treatment group is a selected sample, because the treatment and control groups are both WIC households.

Main results. Tables 4 and 5 present main results of the long-term impact of the new WIC program. The outcomes included in these tables are the ones wherein the previous section evidence of short-term impact was found. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1).

The results in table 4 show that when households become ineligible for the new WIC program, their purchased share of healthy bread decreases and milk fat percentage increases. The effect is larger, the more time has passed from the end of WIC eligibility. I find no significant effect on fruit and vegetable purchases. This could be explained by the fact that

the short-term effect on fruits and vegetables (in table 2) was small, which makes it more difficult to detect any long-term effect.

Table 4: Long-term impact of post-reform WIC on subsidized products

	Bread		Milk		Fruits & Veg.	
	Healthy %		Fat %		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-reform WIC × Inelig. year 1	-9.763***	-9.433***	0.272***	0.248***	0.094	0.119
	(1.437)	(1.405)	(0.049)	(0.048)	(0.095)	(0.098)
Post-reform WIC × Inelig. year 2	-10.238***	-9.982***	0.287***	0.254***	0.013	0.060
	(1.867)	(1.694)	(0.059)	(0.055)	(0.121)	(0.114)
Post-reform WIC × Inelig. year 3+	-12.403***	-11.935***	0.363***	0.330***	0.017	0.093
	(2.064)	(1.858)	(0.070)	(0.066)	(0.130)	(0.121)
Inelig. year 1	4.347***	0.629	-0.186***	-0.063*	-0.090	-0.093
	(1.351)	(0.870)	(0.053)	(0.038)	(0.109)	(0.077)
Inelig. year 2	5.244***	0.621	-0.179***	-0.085**	0.027	-0.029
	(1.735)	(1.084)	(0.060)	(0.041)	(0.135)	(0.083)
Inelig. year 3+	6.341***	0.522	-0.173**	-0.117***	0.144	0.029
	(1.960)	(1.042)	(0.068)	(0.044)	(0.167)	(0.081)
Post reform	3.664***	0.238	-0.068*	-0.015**	-0.172**	0.002
	(0.999)	(0.260)	(0.036)	(0.007)	(0.084)	(0.018)
Year-quarter FE	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	808	808	807	807	813	813
Households	808	96857	807	94528	813	98125
Household-quarters	15188	1375161	14820	1340521	17096	1633577

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. Bread healthy % and milk fat % are in the range of 0–100, quantity of fruits and vegetables is measured kilocalories. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In columns 3–4, regressions include an interaction term for WIC and 1-year-old child. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1). In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Long-term impact of WIC on other products in the vouchers is presented in tables A17–A18 in appendix A. As there was no evidence of a short-term impact on these products, for most of the products, there is also no evidence of long-term impact, except for eggs, purchases of which slightly decrease.

The results in table 5 show that in the first year when households become ineligible for

the new WIC program, their overall diet becomes less healthy as measured by the Healthy Eating Index. The negative effect is statistically significant only in the first year, however, the magnitude of the negative effect remains similar in the following years (column 1).

Table A19 in appendix A presents the estimates of the long-term impact on the Healthy Eating Index components. It shows that the decrease in the index is driven by the decrease in the purchases of healthy components.

Table 5: Long-term impact of post-reform WIC on the Healthy Eating Index

	Healthy Eating Index	
	(1)	(2)
Post-reform WIC × Inelig. year 1	-1.012*	-0.804*
	(0.525)	(0.487)
Post-reform WIC × Inelig. year 2	-1.119	-0.643
	(0.683)	(0.618)
Post-reform WIC × Inelig. year 3+	-0.957	-0.486
	(0.713)	(0.657)
Inelig. year 1	0.427	0.126
	(0.552)	(0.380)
Inelig. year 2	1.105*	0.423
	(0.647)	(0.444)
Inelig. year 3+	0.997	0.119
	(0.741)	(0.442)
Post reform	0.669*	0.142
	(0.384)	(0.094)
Year-quarter FE	No	Yes
Household FE	Yes	Yes
WIC households	813	813
Households	813	98515
Household-quarters	17096	1635914

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. Dependent variable is the Healthy Eating Index. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In column 1, the sample is restricted to WIC households (columns 1–2 in table 1) and in column 2, the sample includes a larger control group (columns 1–3 in table 1). In column 1, regressions include a time trend. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Robustness and heterogeneity. Robustness and heterogeneity of these results is analyzed in tables A20–A27 and figure A2 in appendix A. The robustness analysis includes: parallel

trends, alternative samples, and alternative estimators such as propensity score matching, synthetic control method, and Arellano-Bond estimator. Overall the conclusion remains that when eligibility for the new WIC program ends households' share of healthy bread purchases decreases and milk fat percentage increases. The effect on the Healthy Eating Index is not fully robust to alternative specifications.

Tables A20–A21 present results from regressions that are otherwise the same as in tables 4–5, but include separate pre-treatment time trends for the treatment and control groups. In the large sample (even-numbered columns), there is no evidence of the treatment group having a significantly different pre-treatment time trend. The estimates regarding the persistence of the new WIC policy are similar to those in tables 4–5.

Tables A22–A23 present results estimated using alternative samples. In odd-numbered columns, the control group includes households who reported having received WIC vouchers in the past. In even-numbered columns, the control group includes all households. For the product categories (table A22), results remain very similar to the estimates in table 4. For the Healthy Eating Index (table A23), the estimates are insignificant and smaller in magnitude compared to the main results in table 5.

Next, I use propensity score matching as an alternative estimation method. I collapse the panel dataset into a cross-sectional dataset by calculating for each household the change in purchases when their WIC eligibility ends. For the share of healthy bread, percentage of low-fat milk, and the Healthy Eating Index it is simply the difference in the averages before and after WIC eligilibility has ended. For the fruit and vegetable purchases it is the difference between the logarithms of averages ($\log(y_t/y_{t-1})$, where y_t is the average quantity of fruits and vegetables purchased after WIC eligibility has ended and y_{t-1} is the average quantity before the WIC eligibility has ended. I use the larger sample (the sample in the even-numbered columns in table 4), which includes households who did not receive WIC benefits. For each of these non-WIC households, I draw a random time period when their WIC eligibility ended. Table A24 presents estimates of propensity score from a logit model that uses household demographic characteristics to predict WIC participation after the policy reform. Then I use these predicted probabilities to obtain the propensity score matching estimator.

Table A25, in the even-numbered columns, presents the propensity score matching estimates of the average treatment effect on treated households. For comparison, the odd-numbered columns present estimates from a simple cross-sectional OLS regression. The propensity score matching estimates for bread are similar in magnitude to those in table 4,

while for milk the magnitude is smaller. For the Healthy Eating Index the magnitude is also smaller and the estimates are statistically insignificant. This is not surprising considering that the estimates measure the averages across time periods, not distinguishing how long has passed since the WIC eligibility ended, and in table 5 column 2 the estimated decrease was concentrated in the first year after the eligibility had ended.

Next, I use synthetic control method to evaluate the impact of the new WIC policy. I generate a synthetic control group for each of the treated units, that is, for each of the households exposed to the new WIC. I obtain the synthetic control method estimates using the WIC sample (the sample in the odd-numbered columns in tables 4–5). Figure A2 presents the results for the long-term impact of the post-reform WIC on the share of healthy bread, milk fat percentage, logarithm of the quantity of fruits and vegetables, and the Healthy Eating Index. The results show a large decrease in the share of healthy bread and a large increase of milk fat percentage when WIC eligibility ended. The impact on fruits and vegetables and the Healthy Eating Index is mixed.

Table A26 presents alternative estimates of the persistence of purchases from regressions with a lagged dependent variable and household demographic characteristics. The odd-numbered columns present results from panel data fixed effects regressions and even-numbered columns present Arellano-Bond estimators where the end of WIC eligibility and the WIC policy change serve as additional instruments. In all the regressions, the lagged dependent variable is positively associated with current purchases. This provides additional evidence of the persistence in purchases. However, based on the main analysis we would expect that at the time when WIC eligibility ends, there is a sharp change in behavior. To take into account the change, table A27 presents estimates from regressions that include indicators for the end of WIC eligibility and where a lagged dependent variable is added as an additional regressor. Again, the odd-numbered columns present results from a panel data fixed effects regression and even-numbered columns present Arellano-Bond estimators where the end of WIC eligibility and the WIC policy change serve as additional instruments. In all the regressions, the coefficient on the lagged dependent variable is positive. In the regressions where the outcome is the share of healthy bread or the fat percentage of milk, the coefficient on the ineligibility for the new WIC program remains statistically significant, although, it is slightly smaller in magnitude compared to the estimates in table 4. Note that in table A27 the coefficient measures the immediate effect. The long-term effect can be calculated by combining the immediate effect (let me denote this by β) with the coefficient on the lagged dependent variable (denoted by ρ) using the following formula: $\beta/(1-\rho)$. According to the

formula, the long-term effect equals -5.45 for bread and 0.26 for milk.

Finally, tables A28–A29 address heterogeneity of the effects across demographic characteristics. These present estimates from regressions with indicators for the end of WIC eligibility interacted with income and household size. Specifically, WIC effects are interacted either with normalized household size and logarithm of income (odd-numbered columns) or indicator variables for income or household size below the 25th percentile or above the 75 percentile (even-numbered columns). Overall, there are no significant heterogeneous effects of the end of post-reform WIC eligibility, except for household size in the case of bread (column 2 table A28).

Prices and the persistence of the program's impact. How do prices affect the persistence of the program's impact? It's difficult to answer the question because prices are endogenous. In regions where consumers like healthy food, prices of healthy food could be higher which then could affect the persistence of the policy. However, in the case of milk, Khan et al. (2016) present evidence that there are exogenous regional differences in milk pricing: states where milk prices are increasing in fat percentage and others where milk prices are flat. I use these regional differences in prices to look at the heterogeneity in persistence. Specifically, I calculate state-level median milk price differences of different fat percentages (whole milk, 2%, 1%, and skim milk) across stores and time periods using data on private label one-gallon milk.[17] Based on these price differences, I categorize states to those with flat prices where the price of whole milk is not more expensive than others, those where whole milk is more expensive than others (at least 5 cents more expensive), and those with mixed price rankings. Figure A3 in appendix A present a map describing the regional differences in prices.

Table 6 presents estimates of the impact of the policy and policy's persistence which are estimated separately in states where prices are flat and in those where prices are increasing in the fat percentage. The first two columns show that the impact of the policy in these states is similar: the post-reform policy decreased milk fat percentage by about the same amount. Columns 3–4 show that the persistence of the policy impact differs in the first two years after program eligibility has ended. Where prices are flat, hence it's relatively cheaper (compared to other states) to buy whole milk, households are faster to increase the milk fat percentage.

[17]Private label accounts for about 80% of milk that is sold, and 1 gallon is the most popular package size.

Table 6: Long-term impact and prices. Dependent variable: milk fat percentage

	Policy impact		Policy persistence	
	Prices flat	Prices increasing	Prices flat	Prices increasing
	(1)	(2)	(3)	(4)
WIC post reform	-0.281***	-0.266***		
	(0.100)	(0.087)		
WIC	-0.032	-0.007		
	(0.084)	(0.063)		
Post-reform WIC × Inelig. year 1			0.416***	0.163
			(0.085)	(0.101)
Post-reform WIC × Inelig. year 2			0.475***	0.176*
			(0.105)	(0.098)
Post-reform WIC × Inelig. year 3+			0.355***	0.313**
			(0.118)	(0.132)
Inelig. year 1			-0.115**	-0.067
			(0.058)	(0.086)
Inelig. year 2			-0.130*	-0.104
			(0.069)	(0.080)
Inelig. year 3+			0.006	-0.163**
			(0.075)	(0.083)
Year-quarter FE	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes
WIC households	154	83	246	142
Households	51660	22579	51752	22638
Household-quarters	704171	334865	706480	336823

Note: Columns 1–2 re-estimate the regression in column 6 of table 2 and columns 3–4 re-estimate the regression in column 4 of table 4. In columns 1 and 3, the sample is restricted to households in states where milk prices are flat (do not differ by fat percentage). In columns 2 and 4, the sample is restricted to households in states where milk prices are increasing in fat percentage. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Discussion and limitations. The analysis in section 3 raises several questions and faces limitations. Is the impact of the new WIC program driven by income effect? The WIC vouchers increase income, which might lead the households to substitute to healthier foods. However, the change in WIC vouchers kept the value of the vouchers the same. Hence, in the above regressions, controlling for receiving WIC vouchers captures the effects related to WIC, including the income effect. Specifically, parameter α_1 in equation 1 and α_1–α_3 in equation 2 capture the effects related to WIC, including the income effect. These parameter estimates are insignificant in most of the regressions. Then the parameters of the WIC and

post-reform interaction terms (β_1 in equation 1 and β_1–β_3 in equation 2) separate the effect of the food vouchers being restricted to healthy foods. However, I cannot decompose that effect into a substitution effect (change in relative prices) and information effect (learning about recommended foods).

The analysis focuses on households who choose to participate in the WIC program and who report doing that. In the WIC sample (in the odd-numbered columns in tables 2–5), the issue is mainly about the generalizability of the results. Specifically, in the WIC sample, the comparison is between two groups of households who both report receiving WIC assistance. There is the same self-selection into treatment for both the treatment and control groups. The analysis of pre-treatment trends gives further support that the treatment and control groups are similar pre-treatment. Hence, the estimates measure the effect of the program on the treated but might not generalize to other groups. However, in the larger sample (the even-numbered columns in tables 2–5), the control group might include some households who received the WIC assistance but did not report it and households who chose not to participate in the WIC program. As long as self-selection into the program, conditional on controlling for the changes in income and birth of a child, relates to households' fixed characteristics, it is not a threat for the identification. But the underreporting of program participation could lead to underestimation of the effect of the program in the larger sample. However, in most cases, the estimates from both samples are similar. Furthermore, in most cases, the results from propensity score matching and synthetic control method are also similar to the estimates in tables 2–5.

Finally, as is always the case with scanner data, it includes information only on purchases, not consumption or food waste. If households were more likely to discard food that they received for free, then the impact of the program would be overestimated.

4 The role of prices

In this section, I estimate a demand model to examine the long-term impact of healthy food subsidies on preferences and separate it from the role of prices. I focus only on bread for two reasons. First, bread was the product category with the highest short-term impact of the subsidy. Second, it is a typical product category in terms of pricing of healthy and unhealthy products—the healthy version is more expensive than the unhealthy alternative. In this way, it provides a good example of typical choices between healthy and unhealthy foods.

I use the demand model estimates for counterfactual analysis. The counterfactual analysis

answers two questions. First, how much does the program decrease a tax or a subsidy needed to obtain a given change in the healthiness of purchases? Second, would it be profitable for firms to provide such temporary subsidies as provided by WIC?

4.1 Demand model

I model demand using a discrete choice multinomial logit model with random coefficients. Household i, in week t, chooses a product with the highest indirect utility, where the indirect utility from product j equals:

$$u_{ijt} = \alpha_{it} p_{jt} + \beta_{ijt} x_j + \gamma_{it} \cdot \mathbf{1}[ProductBought_{i,t-1} = j] + \varepsilon_{ijt} \tag{3}$$

where p_{jt} is price, x_j is a product dummy capturing time invariant characteristics of product j, $\mathbf{1}[ProductBought_{i,t-1} = j]$ is an indicator function that equals one if the household bought product j in the previous time period and zero otherwise. I assume that the taste shock ε_{ijt} is independent across households, products, and time, and distributed according to a type 1 extreme value distribution. Therefore, the probability that household i buys product j in period t equals:

$$Prob_{ijt} = \frac{\exp(u_{ijt})}{\sum_{k=1}^{J} \exp(u_{ikt})} \tag{4}$$

Aggregating the probabilities across households gives us demand for product j in the market.

The demand model is estimated using only the time periods post-WIC. The reason why I don't use any time periods while households receive WIC vouchers is that I don't have information about whether on a given shopping trip they are paying with the voucher or cash. Hence, I wouldn't know the price they faced on a given shopping trip: whether the regular price or price zero because of the voucher. Therefore, I restrict attention to post-WIC time periods. To analyze the persistence of the policy, I exploit the change in the policy again and compare households exposed to the policy before and after the policy reform.

The persistence of the policy impact. Motivated by results in section 3, the changes in purchases during the program driven by the change in the WIC policy are allowed to affect tastes in the post-WIC years. Specifically, taste for the healthy (whole wheat) bread depends (among other things which will be discussed below) linearly on the share of the healthy bread

purchases while on WIC interacted with the year dummies since WIC eligibility ended:

$$\begin{aligned}\theta_{it} \quad &= \theta_1 \cdot WholeWheatShareInWIC_i \times PostYear1_{it} \\ &+\theta_2 \cdot WholeWheatShareInWIC_i \times PostYear2_{it} \\ &+\theta_3 \cdot WholeWheatShareInWIC_i \times PostYear3+_{it} \end{aligned} \tag{5}$$

where $WholeWheatShareInWIC$ measures the average share of whole wheat bread purchases from all bread purchases during the time period while receiving the WIC vouchers, $PostYear1$ is an indicator variable that equals one in the first year when WIC eligibility has ended, analogously for $PostYear2$ and $PostYear3+$ (3 or more years since WIC eligibility has ended).

Identification of the persistence parameters, θ-s, is based on the exogenous change in the policy that generated a sharp increase in the whole wheat bread share during WIC, $WholeWheatShareInWIC$. As pointed out in the literature (Dube et al., 2010), the difficulty lies in separating the inertia in choices from consumer heterogeneity. Here, the assumption is that the unobservable taste parameters of the WIC households come from the same distribution (specification of which is described further below) no matter whether they participated in the WIC program before or after the policy reform. The policy reform generates an exogenous shock to whole wheat bread share during the program. The decay of the policy impact is identified by the exogenous WIC eligibility cut-off and the time that has passed since the eligibility ended.

While in the main model, the identification of inertia is based on the functional form, in appendix A, I model it more flexibly. Specifically, in appendix A, I present results from an alternative model where the preferences for the healthy (whole wheat) bread are interacted with WIC policy group (before or after the policy change) and year dummies (number of years since the end of program eligibility). The model essentially allows group-specific tastes for healthy bread. These group-specific taste parameters are identified by the same argument as in section 3 and above. That is, these two groups of households differ by whether they were exposed to the WIC program before or after the policy change. The time since their eligibility ended is determined by when their child became five years old.

Household heterogeneity. The model allows household heterogeneity in preferences in the marginal utility of income (α_{it}), taste for products (β_{ijt}), and state dependence (γ_{it}). I model heterogeneity as a linear combination of households' observed characteristics

and unobserved characteristics, except for state dependence (γ_{it}), in which case I allow only observed characteristics. The unobserved characteristics are captured by a household-specific time-invariant random term which is independent across households distributed according to a normal distribution, the parameters of which will be estimated. The observed characteristics include logarithm of household income, household size, and age. For example, household i's marginal utility of income equals $\alpha_{it} = \mathbf{v}'_{it}\boldsymbol{\alpha}_1 + \mu_i$, where $\mathbf{v}_{it}$ is a vector of the household's observed characteristics, $\boldsymbol{\alpha}_1$ is a vector of parameters to be estimated, and μ_i captures unobserved characteristics (normally distributed). I assume household observed characteristics affect the taste for whole grain and whole wheat in the same way. That is, I assume that household i's taste for whole grain bread, $j = WholeGrain$, equals:

$$\beta_{ijt} = \mathbf{v}'_{it}\boldsymbol{\beta}_{1k} + \eta_{ij} \tag{6}$$

where $\mathbf{v}_{it}$ is the vector of the household's observed characteristics, η_{ij} captures the household's unobserved taste for whole grain bread (normally distributed), and $\boldsymbol{\beta}_{1k}$ is the vector of estimated parameters, which is restricted to be the same as for whole wheat bread. Then the taste for whole wheat bread equals $\beta_{ijt} = \theta_{it} + \mathbf{v}'_{it}\boldsymbol{\beta}_{1k} + \eta_{ij}$, where θ_{it} captures the persistence of the policy impact from equation (5). In the main specification, I assume the unobservables μ_i and η_{ij}, where $j = WholeGrain, WholeWheat, White$, are independent. In the robustness checks, I allow these four unobservables to be correlated.

Following most of the discrete choice demand literature, I don't model the purchase quantity decision nor purchasing more than one product on a given trip (for the details of the dataset construction, see appendix B). I also don't include measures of advertising, because advertising typically varies by brand and not by product characteristics (by the type of bread).

Control function. To address the concern of price endogeneity, I estimate the model using a control function. Following Petrin and Train (2010), I assume the pricing function takes the following form where the price of product j in week t in market m equals

$$p_{jtm} = \mathbf{z}'_{jtm}\boldsymbol{\delta} + \xi_{jtm} \tag{7}$$

where $\mathbf{z}_{jtm}$ is the vector of exogenous instruments and ξ_{jtm} is the unobserved price shock. The pricing function is estimated at the market (state) level, because price variables are constructed so that these vary only by market, not by consumer. Typically, when estimating

a demand model, we are concerned that prices might depend on the unobserved factors that directly affect demand. In the control function approach, the identifying assumption is that prices and taste shocks, ε, are independent conditional on the unobserved factors, ξ, affecting prices.

For instruments I use the input prices interacted with product fixed effects (following Villas-Boas, 2007), and I also include state fixed effects. Interacting input prices with product fixed effects allows the cost of input to affect each product's price to a different extent. Specifically, the instrument is the world price of wheat, which varies across time.

I estimate the model in two steps. First, I estimate the reduced form pricing regression (equation 7) with ordinary least squares to recover the residuals ξ_{jtm}. Then I include these residuals as an additional regressor (control function) in the indirect utility (equation 3), and estimate the demand model.

4.2 Estimation results

The estimates of the demand model are presented in table 7. Column 1 and 2 present estimates without and with a control function, respectively. The estimates are otherwise mostly similar, but, as expected, the coefficient on price is larger in absolute value with a control function. Furthermore, including the control function decreases the taste for the bread that costs the least (white bread). The first stage control function estimates are presented in table A30 in appendix A.

On the one hand, the demand model estimates confirm the results from the reduced form analysis in the previous section, showing that after the end of the program eligibility, the impact of the program decreases over time. Specifically, the taste for whole wheat interacted with the product share while in the program decreases over the years post-program. On the other hand, the estimates show that in the first years after the end of eligibility, the program still increases tastes for whole wheat bread. The estimates also highlight the importance of household heterogeneity. The impact of prices varies substantially by observable household characteristics. Larger households tend to be more price-sensitive. High-income and smaller households tend to prefer whole grain/wheat bread.

Since consumers care about prices, it causes preferences for product characteristics and actual purchases to differ. Table A31 in appendix A presents the actual market shares, predicted market shares, and predicted market shares if prices were equal (using estimates with a control function in table 7). In columns 1 and 2, actual and predicted market shares with actual prices show that the model fit is good. Column 3 presents predicted market

Table 7: Bread demand model estimates

	No control function (1)		Control function (2)	
	Estim.	SE	Estim.	SE
Mean				
Price	−1.447	(0.588)	−2.753∗	(0.883)
Price × Log. income	0.086	(0.047)	0.086	(0.046)
Price × Household size	−0.086∗	(0.021)	−0.085∗	(0.020)
Price × Age	0.010	(0.008)	0.010	(0.008)
Previous product	1.291∗	(0.159)	1.290∗	(0.158)
Previous product × Log. income	−0.016	(0.014)	−0.016	(0.014)
Previous product × Household size	−0.031∗	(0.007)	−0.031∗	(0.007)
Previous product × Age	−0.004∗	(0.001)	−0.004∗	(0.001)
White bread	−0.624∗	(0.069)	−1.236∗	(0.313)
Whole grain bread	−2.446∗	(0.332)	−2.436∗	(0.331)
Whole wheat bread	−3.321∗	(0.336)	−3.426∗	(0.342)
Whole grain/wheat × Log. income	0.167∗	(0.025)	0.167∗	(0.025)
Whole grain/wheat × Household size	−0.061∗	(0.012)	−0.061∗	(0.012)
Whole grain/wheat × Age	−0.003	(0.004)	−0.003	(0.004)
Whole wheat × WW share in WIC × Post year 1	2.665∗	(0.243)	2.661∗	(0.241)
Whole wheat × WW share in WIC × Post year 2	2.004∗	(0.277)	2.001∗	(0.275)
Whole wheat × WW share in WIC × Post year 3	1.294∗	(0.262)	1.293∗	(0.262)
Residual			1.297	(0.647)
Standard Deviation				
Price	0.044	(0.050)	0.043	(0.050)
White bread	1.789∗	(0.036)	1.789∗	(0.036)
Whole grain bread	1.281∗	(0.028)	1.281∗	(0.028)
Whole wheat bread	1.591∗	(0.037)	1.592∗	(0.037)
Log-likelihood	-469224.3		-469218.3	
Number of choices	2328792		2328792	
Number of WIC households	422		422	
Number of households	7129		7129	

Note: The table presents estimates from 2 random coefficient logit models. For each model, the first column presents parameter estimates and the second column standard errors. The lower part of the table presents standard deviations of the distributions of random coefficients. The base type of bread is *other* bread. Standard errors are clustered at the household level. * Indicates significance at the 1 percent level.

shares if prices for all products in all time periods were equal. Column 4 calculates the percentage change in the market shares if prices were equal compared to the actual prices. With equal prices, the market share of white bread (which was the cheapest) would decrease, while the shares of other types of bread would increase. Note that the largest increase would be for the *other* bread category, which consists of non-whole-grain breads including bread like cinnamon raisin.

Robustness and heterogeneity. In appendix A, I explore the robustness of the demand model estimates in the following dimensions: (1) distribution of the random coefficients, (2) construction of prices, (3) state dependence, (4) household heterogeneity, and (5) persistence of the policy impact. Importantly, the results from the alternative specification of persistence highlight that in the first years after eligibility ends, households still like healthy bread more. Overall the conclusion remains that the impact of the program decreases over time.

First, in table 7, random coefficients were allowed to be correlated only through observable demographic characteristics while unobservables are assumed to be independent. Table A32 in appendix A relaxes the independence assumption presenting the estimates from the same model as in column 2 of table 7 but where the random coefficients are allowed to be correlated. The estimates show strong positive correlation between whole grain and whole wheat bread and negative between whole wheat and white bread. Regarding the program's persistence, the estimates are very similar to those in table 7. Furthermore, while in table 7, random coefficients are allowed to vary in mean only across demographic groups, in appendix A, the variance is also allowed to depend on demographic characteristics. Specifically, table A33 presents estimates where the variance of price is allowed to vary by income, household size, and age. Similarly, in table A34, the variance for the taste of whole wheat bread varies by these characteristics. Overall, the results remain similar to those in table 7.

Combining state-level price data and household-level purchases to estimate the demand model potentially introduces errors. While price data is not available for each store these households visit, about 30 percent of the purchases can be matched to the stores in the dataset. Table A35 presents estimates where the prices are from the specific store and time period which the household visited. Overall the results are similar to those in table 7. To address another potential concern about the construction of prices, table A36 presents estimates using the same sample as in table 7 but state level prices which are weighted by volume where the weights are bread type specific. These prices have larger price differences between products because of the lower share of private label purchases in the case of more expensive bread

types (whole grain, whole wheat, and other bread). Correspondingly, estimates in table A36 show lower price sensitivity, but in other ways, in particular, regarding the persistence of the program, the estimates are similar.

Using state-level prices and monthly varying instruments could raise concerns whether there is enough price variation to identify the state dependence coefficient on previous period purchase. Table A37 presents estimates from the model without the indicator for product purchased previous time. The estimates are similar to those in table 7.

Table A38 presents estimates from a model which is otherwise the same as in table 7 but where the persistence of the policy impact on the preference for healthy bread is captured by indicators whether the household was in the program before or after the policy reform and indicators for the years since the end of their program eligibility. The specification essentially estimates a group-specific taste for healthy (whole wheat) bread for each of the six groups: households exposed to WIC either before or after the policy change and capturing their tastes either in the 1st, 2nd or 3rd plus years post-WIC eligibility. The estimates show that in the years after WIC eligibility has ended, households exposed to the WIC program after the policy change like the healthy bread more but the effect decreases over the years. Note that there is no reason to expect that households exposed to the WIC program before the policy change like the healthy bread more than the control group, however the indicators for these groups are included to allow for these differences. According to the estimates, households exposed to WIC before the policy change have similar tastes for the healthy bread compared to the control group.

Finally, to take into account the household heterogeneity, A39 re-estimates the model in column 2 of table 7 but adds the interaction of the share of whole wheat bread during WIC and indicator variables for different household sizes. The goal is to take into account a different number of decision makers. The estimated coefficients on the interaction terms are not statistically significant at ten percent level. Table A40 re-estimates the model in table A38 but now interacts the post-reform dummies with the share of household members that were eligible for WIC. The number of eligible household members determines the value of the voucher and hence is the main driver of how much the household substituted to the healthy bread while they received the vouchers. Similar to the results in table A38, the estimates show that households exposed to the WIC program after the policy change like the healthy bread more but the effect decreases over the years.

4.3 Analysis of subsidies

I use the demand model estimates to simulate the impact of subsidies. The demand model estimates imply that past purchases affect current tastes. This has implications on policy. Suppose the policy maker would like to use subsidies for healthy or taxes on unhealthy products to change consumption. After WIC the size of a tax or a subsidy required to obtain a given change is smaller than before.

Table 8 describes the impact of tastes and subsidies in the years after WIC eligibility has ended. Columns 1 and 3 present the predicted market shares calculated with old (old WIC policy) tastes, and columns 2 and 4 with new (new WIC policy) tastes. In columns 3 and 4, the market shares are simulated with a 10 cent subsidy on the healthy product (whole wheat bread). Note that the counterfactuals are calculated under the assumption that the estimated control function on prices does not change.

Table 8: The impact of whole wheat bread subsidy

	Predicted market shares				Percentage change in market shares		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tastes	Old	New	Old	New	Δ Tastes	-	Δ Tastes
Subsidy	No	No	Yes	Yes	-	Δ Subsidy	Δ Subsidy
Other bread	36.0	35.4	35.6	34.9	-1.8	-1.1	-3.0
Whole grain bread	15.0	14.7	14.8	14.5	-2.1	-1.3	-3.6
Whole wheat bread	7.0	8.2	7.8	9.2	18.3	11.7	31.7
White bread	42.0	41.7	41.8	41.4	-0.8	-0.5	-1.4

Note: The impact of a 10 cent subsidy on whole wheat bread after WIC eligibility has ended. Market shares sum up to 100. Predicted market shares are calculated using estimates with control function (model 2) in table 7.

Columns 5-7 measure the relative contribution of tastes and subsidies on the change in market shares. They show that the change in tastes magnifies the impact of the subsidy. It more than doubles the impact of the 10 cent subsidy on the market share of whole wheat bread. In other words, after WIC the subsidy needed to obtain a given level of increase in the whole wheat bread market share is less than half of that without the WIC program.

4.4 Would it be profitable for firms to subsidize healthy foods?

The demand model estimates show that the post-reform WIC program has an impact on tastes even years after households have become ineligible. This raises the question of whether it would be profitable for the producers of healthy products to subsidize a program like WIC?

Or more generally, to provide temporary subsidies for healthy products, hoping to increase demand in the long-run. I'll answer the question using the following back-of-the-envelope calculations that make simplifying assumptions about the market structure. The results are summarized in table 9, where columns 1 and 2 present the results for pre-reform and post-reform, and column 3 presents the difference. Note that the counterfactuals are calculated under the assumption that the estimated control function on prices does not change.

I start by calculating the cost of the WIC bread vouchers for the firm that producers healthy bread. I calculate the marginal cost of the whole wheat bread by assuming that whole wheat bread is produced by a single firm that competes à la Bertrand with the producers of other types of bread. Using these assumptions, I find that the marginal cost of whole wheat bread equals \$1.01. Then I calculate the total cost of WIC bread vouchers assuming the maximum allowed WIC subsidies for a mother for one year (1 pound of bread per month) and for a child for four years (2 pounds of bread per month). These calculations imply that the total cost of bread vouchers equals about \$109 per household. Note that the calculations include only the direct cost of providing the product for free and not the effect of a potential decrease in demand.

Table 9: The cost of the subsidy versus profits for a healthy food producer

	Pre-reform (1)	Post-reform (2)	Change (3)
	Panel A: Costs		
Total costs of subsidy per household	0	109.1	109.1
	Panel B: Profits with current prices		
Market shares	7.0	8.2	1.3
Profits per household	10.8	12.8	2.0
Profits as % of cost of subsidy	.	.	1.8
	Panel C: Profits with optimal prices		
Own price elasticities	-2.17	-2.08	0.09
Optimal prices	1.87	1.94	0.07
Market shares	7.4	8.1	0.7
Profits per household	11.5	13.6	2.1
Profits as % of cost of subsidy	.	.	1.9

Note: Calculated using estimates with control function (model 2) in table 7. Total cost calculated assuming the maximum allowed WIC subsidies for a mother for one year and a child for 4 years. Total profits calculated for 5 years, assuming a household purchases 3 pounds of bread per month.

How much does a firm gain from the increases in the preferences for the healthy product? As we saw already in the previous subsection, the change in the tastes generated by the

WIC reform increases whole wheat bread's market share. Via a larger market share, it also increases the profits of the whole wheat bread's producer. Panel B of table 9 presents profits per household calculated over five years, assuming the household purchases 3 pounds of bread per month (which was the average according to summary statistics in table A2). The table shows that the increase in profits generated by the change in tastes is small, it's only about 2% compared to the costs of the program.

Note that when households' tastes change, then it would be optimal for the firm to change the prices. Panel C of table 9 presents the price elasticities of the households exposed to the WIC program pre- or post-reform. It also presents the corresponding optimal prices, resulting market shares, and profits. The resulting increase in profits is slightly larger but still only about 2% of the costs of the program. Moreover, there is a caveat. Higher prices are likely to make the program's impact less persistent, which imply that the profits calculated in panel C are an upper bound.

These calculations imply that it is not profitable for firms to subsidize a program like WIC in a sizable way. The temporary subsidies are too costly and won't be enough to generate substantial long-term changes in tastes. However, the results also show that the government-subsidized programs that promote healthy behaviors increase the market share of healthy products and allow the producers to raise prices. In this way, these programs are profitable for the producers of healthy products. Moreover, in situations where the same firm is producing both healthy and unhealthy products, government health initiatives may give additional opportunities for price discrimination.

5 Conclusion

In this paper, I study the short- and long-term impact of healthy food subsidies on the healthiness of food purchases. I find that the subsidies make diet healthier and increase the purchases of subsidized products. The positive effect on the diet is driven by subsidized products. That is, there are no sizable positive nor negative externalities on other product categories. Similarly, there is little evidence of the subsidies having any long-term impact. When households become ineligible, the effect of the subsidies diminishes. However, demand model estimates show that the program has some long-term impact on preferences. In the first years, after the end of eligibility, households are still more likely to prefer the previously subsidized products. The estimates imply that price differences between healthy and unhealthy products play a role in the decrease in the program's impact. Even if the

program's impact on purchases is not long-lasting, it induces a change in tastes which is relevant for subsequent policies.

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A Online Appendix: Additional tables and figures

Table A1: WIC food package, per month, 2009 - 2014

	Children	Women		
	1–4 years	Pregnant, partially breastfeeding	Postpartum	Breastfeeding
Milk (gallons)	4	5.5	4	6
Whole wheat/grain bread (lb)	2	1	-	1
Juice (gallons)	1	1.125	0.75	1.125
Breakfast cereal (oz)	36	36	36	36
Cheese (lb)	-	-	-	1
Eggs	12	12	12	24
Fresh fruits and vegetables ($)	6	8	8	10
Canned fish (oz)	-	-	-	30
Legumes (lb)	1	1	1	1
And/or peanut butter (oz)	Or 18	And 18	Or 18	And 18

Note: Whole milk is the standard milk for 1-year-old children. Reduced fat (2%) milk is the standard milk for children 2-4 years of age and women. Milk is allowed to be partially substituted by cheese. As substitutes to bread, states are allowed to authorize brown rice, bulgur, oatmeal, whole-grain barley, or soft corn or whole wheat tortillas on an equal weight basis.
Source: Federal Register, 2007, Vol. 72, No. 234, pp. 68989–68990.

Table A2: Summary statistics of purchases (per household/quarter)

	Treatment group	Control groups			
	WIC post-reform	WIC pre-reform	Children, low-income	WIC in the past	Other
	(1)	(2)	(3)	(4)	(5)
Bread (lb)	9.52	10.34	7.59	9.09	5.83
Bread healthy %	14.95	8.55	10.81	8.20	12.54
Milk (gallons)	9.10	8.98	6.09	7.35	4.24
Milk fat %	1.92	1.95	1.76	1.93	1.52
Fruits & vegetables (kcal)	8465.42	8252.82	7559.35	7767.06	7493.87
Juice (kcal)	5155.33	4818.57	3357.62	3409.29	2816.71
Eggs (count)	62.57	61.47	50.83	59.17	43.77
Cereals (oz)	177.33	168.80	119.79	147.35	93.30

Note: The table presents sample averages of purchases. Purchases do not include Nielsen random weight products.

Table A3: Summary statistics of the demand model dataset

	Mean	SD	Perc. 25	Median	Perc. 75	N
Panel A: Demographic characteristics						
Household income	52.98	30.17	30.27	47.50	71.56	39800
Household size	3.43	1.36	2.00	3.00	4.00	39800
Age	45.98	8.03	40.50	45.50	51.00	39800
Panel B: Prices						
Other bread	2.04	0.28	1.84	1.98	2.19	27573
Whole grain bread	2.05	0.26	1.87	2.02	2.21	27573
Whole wheat bread	1.96	0.21	1.82	1.97	2.11	27573
White bread	1.57	0.20	1.44	1.56	1.68	27573

Note: In panel A, a unit of observation is a household-year pair, and in panel B, a state-week pair. *Household income* is annual, measured in thousands of dollars. *Age* is the average age of household heads measured at the baseline. Price of bread is measured in dollars per pound. Both prices and incomes are deflated to 2015 dollars using the consumer price index for urban consumers.

Table A4: The impact of post-reform WIC on the Healthy Eating Index adequacy and moderation components

	Adequacy (healthy) components		Moderation (unhealthy) components	
	(1)	(2)	(3)	(4)
WIC post reform	1.251***	1.169***	-0.312	-0.136
	(0.355)	(0.320)	(0.315)	(0.273)
WIC	-0.364	-0.598**	0.457*	0.086
	(0.307)	(0.277)	(0.273)	(0.235)
Post reform	0.473	0.159**	-0.184	-0.022
	(0.350)	(0.068)	(0.301)	(0.057)
Year-quarter FE	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes
WIC households	517	517	517	517
Households	517	98219	517	98219
Household-quarters	6782	1625600	6782	1625600

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In odd-numbered columns, the sample is restricted to WIC households. In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A5: The impact of post-reform WIC on the Healthy Eating Index components

	(1)	(2)
Panel A: Moderation (unhealthy) components		
Refined grains	-0.093*	-0.061
	(0.055)	(0.048)
Sodium	0.136	0.102
	(0.102)	(0.093)
Added sugar	0.604	0.453
	(0.536)	(0.488)
Saturated fat	0.111	-0.174
	(0.167)	(0.143)
Panel B: Adequacy (healthy) components		
Total fruits	0.022	0.026**
	(0.014)	(0.012)
Whole fruits	0.014	0.012
	(0.010)	(0.008)
Total vegetables	0.116**	0.088
	(0.054)	(0.054)
Greens and beans	0.031	0.024
	(0.023)	(0.023)
Whole grains	0.037*	0.055***
	(0.021)	(0.019)
Dairy	0.011	0.023
	(0.028)	(0.023)
Total protein	0.099**	0.042
	(0.046)	(0.040)
Sea and plant protein	0.014	-0.001
	(0.023)	(0.021)
Year-quarter FE	No	Yes
Household FE	Yes	Yes
WIC households	517	517
Households	517	98219
Household-quarters	6782	1625600

Note: Each cell presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In column 1, the sample is restricted to WIC households. In column 1, regressions include a time trend, while in column 2, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A6: Robustness of the impact of post-reform WIC on bread and milk purchases, parallel pre-treatment trends

	Bread		Bread		Milk		Milk	
	Healthy %		Log. quantity		Fat %		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WIC post reform	4.559***	5.701***	0.041	-0.002	-0.086*	-0.191***	0.009	0.033
	(1.556)	(1.413)	(0.055)	(0.047)	(0.051)	(0.048)	(0.059)	(0.053)
WIC	-1.825	-1.315	-0.021	-0.007	-0.047	-0.064	-0.028	-0.053
	(1.256)	(1.083)	(0.046)	(0.038)	(0.043)	(0.040)	(0.052)	(0.045)
Post reform	0.200	0.272	-0.132***	0.000	-0.105**	-0.014**	-0.099*	0.006
	(1.752)	(0.260)	(0.050)	(0.009)	(0.050)	(0.007)	(0.057)	(0.008)
Pre-treatment trend	0.083	0.291**	0.005	0.004	0.006	-0.002	0.056**	0.007
× Treatment group	(0.498)	(0.135)	(0.019)	(0.005)	(0.020)	(0.004)	(0.025)	(0.005)
Pre-treatment trend	0.112	0.011	0.002	0.001***	0.006	-0.000	-0.054**	0.002***
	(0.624)	(0.011)	(0.022)	(0.000)	(0.023)	(0.000)	(0.027)	(0.000)
Year-quarter FE	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	514	514	515	515	511	511	512	512
Households	514	96563	515	96564	511	94232	512	94233
Household-quarters	6000	1365973	6765	1613424	5998	1331699	6718	1585847

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In columns 5–6, regressions include an interaction term for WIC and 1-year-old child. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1). In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A7: Robustness of the impact of post-reform WIC on subsidized products, parallel pre-treatment trends

	Fruits & veg.		Juice		Eggs		Cereals	
	Log. quantity		Log. quantity		Log. quantity		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WIC post reform	0.272**	0.192*	0.162	0.098	0.096	0.013	0.027	0.071
	(0.113)	(0.100)	(0.207)	(0.185)	(0.098)	(0.083)	(0.097)	(0.083)
WIC	-0.128	-0.125	0.127	0.164	-0.166*	-0.089	0.122	0.081
	(0.102)	(0.091)	(0.181)	(0.167)	(0.089)	(0.077)	(0.082)	(0.072)
Post reform	-0.104	0.002	0.053	0.119***	-0.154*	0.019	-0.181*	-0.036**
	(0.086)	(0.018)	(0.199)	(0.037)	(0.092)	(0.015)	(0.095)	(0.017)
Pre-treatment trend	0.019	-0.001	-0.024	0.064***	0.007	0.004	0.063*	0.006
× Treatment group	(0.041)	(0.009)	(0.087)	(0.017)	(0.042)	(0.007)	(0.035)	(0.008)
Pre-treatment trend	-0.016	0.005***	0.074	0.005***	-0.008	0.004***	-0.066*	0.004***
	(0.043)	(0.001)	(0.096)	(0.001)	(0.044)	(0.001)	(0.039)	(0.001)
Year-quarter FE	No	Yes	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	517	517	515	515	513	513	515	515
Households	517	97829	515	94029	513	95449	515	96870
Household-quarters	6782	1623263	6754	1596280	6733	1601167	6757	1615696

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, 5$, 6-12, and 13-17. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1). In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A8: Robustness of the impact of post-reform WIC on the Healthy Eating Index, parallel pre-treatment trends

	All products		Excluding products affected by reform	
	(1)	(2)	(3)	(4)
WIC post reform	1.148**	1.169***	0.626	0.558
	(0.506)	(0.407)	(0.476)	(0.386)
WIC	-0.135	-0.413	0.163	-0.061
	(0.409)	(0.345)	(0.385)	(0.330)
Post reform	0.323	0.136	0.135	0.082
	(0.465)	(0.094)	(0.448)	(0.090)
Pre-treatment trend × Treatment group	-0.262	-0.044	-0.290*	-0.066*
	(0.164)	(0.041)	(0.151)	(0.039)
Pre-treatment trend	0.237	0.005	0.254	0.000
	(0.180)	(0.004)	(0.168)	(0.003)
Year-quarter FE	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes
WIC households	517	517	517	517
Households	517	98219	517	98216
Household-quarters	6782	1625600	6781	1625402

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. Dependent variable is the Healthy Eating Index calculated using either all products (columns 1–2) or excluding fruits and vegetables, bread, and milk (columns 3–4). All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1). In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A9: Robustness of the impact of post-reform WIC on subsidized products, alternative samples

	Bread		Bread		Milk		Milk	
	Healthy %		Log. quantity		Fat %		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WIC post reform	5.843***	6.609***	0.017	0.012	-0.160***	-0.202***	0.051	0.051
	(1.359)	(1.400)	(0.046)	(0.044)	(0.049)	(0.050)	(0.054)	(0.055)
WIC	-1.525	-0.486	0.033	-0.006	-0.018	-0.074*	-0.020	-0.047
	(1.085)	(1.041)	(0.040)	(0.039)	(0.040)	(0.040)	(0.045)	(0.045)
Post reform	-0.026	0.342	0.001	-0.007	-0.005	-0.007	-0.032	0.009
	(0.632)	(0.216)	(0.029)	(0.007)	(0.021)	(0.006)	(0.025)	(0.006)
Year-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	514	514	515	515	511	511	512	512
Households	10389	151536	10413	151537	10273	147264	10314	147265
Household-quarters	141300	2101937	160173	2538063	140489	2054502	159141	2489320
	Fruits & veg.		Juice		Eggs		Cereals	
	Log. quantity		Log. quantity		Log. quantity		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WIC post reform	0.180*	0.193*	0.311*	0.309*	0.056	0.020	0.086	0.094
	(0.102)	(0.100)	(0.185)	(0.185)	(0.083)	(0.083)	(0.083)	(0.083)
WIC	-0.079	-0.145*	0.314*	0.290*	-0.065	-0.095	0.110	0.084
	(0.088)	(0.088)	(0.167)	(0.166)	(0.077)	(0.076)	(0.072)	(0.072)
Post reform	-0.046	-0.014	-0.041	0.087***	-0.065	0.019	-0.110**	-0.023*
	(0.051)	(0.014)	(0.113)	(0.030)	(0.050)	(0.012)	(0.049)	(0.014)
Year-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	517	517	515	515	513	513	515	515
Households	10461	154406	10211	147557	10331	150227	10432	152192
Household-quarters	160465	2560016	159028	2513008	159491	2520303	160315	2543348

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In columns 5–6 in the top panel, regressions include an interaction term for WIC and 1-year-old child. In odd-numbered columns, the sample is restricted to past and present WIC households (columns 1–2 and 4 in table 1). In even-numbered columns, the sample includes all households. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A10: Robustness of the impact of post-reform WIC on the Healthy Eating Index, alternative samples

	All products		Excluding products affected by reform	
	(1)	(2)	(3)	(4)
WIC post reform	0.993**	1.084***	0.422	0.383
	(0.405)	(0.397)	(0.388)	(0.380)
WIC	-0.936***	-0.519	-0.582*	-0.206
	(0.348)	(0.337)	(0.333)	(0.323)
Post reform	0.174	0.150*	0.331	0.133*
	(0.266)	(0.077)	(0.258)	(0.073)
Year-quarter FE	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes
WIC households	517	517	517	517
Households	10477	155079	10477	155076
Household-quarters	160540	2564003	160522	2563680

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. Dependent variable is the Healthy Eating Index calculated using either all products (columns 1–2) or excluding fruits and vegetables, bread, and milk (columns 3–4). All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In odd-numbered columns, the sample is restricted to past and present WIC households (columns 1–2 and 4 in table 1). In even-numbered columns, the sample includes all households. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A11: Predicting WIC participation after the policy reform, logit

	(1)
Household size	0.133***
	(0.041)
Log. income	-0.798***
	(0.075)
College	-0.609***
	(0.119)
Non-white	0.241**
	(0.117)
Indicators for children up to age 4	Yes
N	98219

Note: A unit of observation is a household. The sample includes households in columns 1–3 in table 1. Standard errors are in parentheses. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A12: Robustness of the impact of post-reform WIC on subsidized products, propensity score matching

	Bread		Bread		Milk		Milk	
	Healthy %		Log. quantity		Fat %		Log. quantity	
	OLS	PSM	OLS	PSM	OLS	PSM	OLS	PSM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WIC post reform	5.492***	6.022***	0.021	0.021	-0.088***	-0.135***	0.053*	0.034
	(0.919)	(1.100)	(0.032)	(0.032)	(0.023)	(0.037)	(0.027)	(0.036)
N	87554	87554	96385	96385	84466	84466	94056	94056
	Fruits & veg.		Juice		Eggs		Cereals	
	Log. quantity		Log. quantity		Log. quantity		Log. quantity	
	OLS	PSM	OLS	PSM	OLS	PSM	OLS	PSM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WIC post reform	0.067	-0.001	0.120	0.104	-0.050	-0.058	0.096	0.040
	(0.068)	(0.052)	(0.152)	(0.094)	(0.057)	(0.055)	(0.062)	(0.047)
N	97645	97645	93850	93850	95270	95270	96686	96686

Note: A unit of observation is a household. Odd-numbered columns present estimates from OLS regressions, even-numbered columns present propensity score matching estimates of the average treatment effect on the treated. Dependent variable is the difference before and while receiving WIC vouchers in the share of healthy bread, fat percentage of milk or the difference between the logarithms of quantities ($\log(y_t/y_{t-1})$). The sample includes households in columns 1–3 in table 1. Standard errors (in parentheses) are adjusted to take into account that the propensity score is estimated. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A13: Robustness of the impact of post-reform WIC on the Healthy Eating Index, propensity score matching

	All products		Excluding products affected by reform	
	OLS	PSM	OLS	PSM
	(1)	(2)	(3)	(4)
WIC post reform	1.055***	0.685**	0.520*	0.313
	(0.330)	(0.317)	(0.313)	(0.289)
N	98011	98011	98004	98004

Note: A unit of observation is a household. Odd-numbered columns present estimates from OLS regressions, even-numbered columns present propensity score matching estimates of the average treatment effect on the treated. Dependent variable is the difference before and while receiving WIC vouchers in the Healthy Eating Index. In columns 1–2, the Healthy Eating Index includes all product, and in columns 3–4, it excludes fruits and vegetables, bread, and milk. The sample includes households in columns 1–3 in table 1. Standard errors (in parentheses) are adjusted to take into account that the propensity score is estimated. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A14: Heterogeneous impact of post-reform WIC on bread and milk purchases

	Bread		Bread		Milk		Milk	
	Healthy %		Log. quantity		Fat %		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WIC post reform	6.336***	9.109***	0.008	-0.026	-0.192***	-0.232***	0.042	-0.019
	(1.435)	(2.176)	(0.044)	(0.069)	(0.053)	(0.080)	(0.053)	(0.077)
WIC	-0.476	-0.713	0.004	0.017	-0.073*	-0.144**	-0.034	-0.076
	(1.083)	(1.752)	(0.039)	(0.066)	(0.042)	(0.061)	(0.044)	(0.069)
WIC post reform	-1.884		-0.004		0.033		0.006	
× norm. log(Income)	(2.609)		(0.076)		(0.079)		(0.100)	
WIC post reform	0.091		-0.000		-0.011		-0.047	
× norm. household size	(0.862)		(0.035)		(0.031)		(0.046)	
WIC × norm.	0.157		-0.020		0.019		0.002	
log(income)	(2.114)		(0.064)		(0.061)		(0.088)	
WIC × norm.	-0.668		-0.009		0.011		-0.042	
household size	(0.618)		(0.029)		(0.026)		(0.038)	
WIC post reform		-7.155*		0.058		0.122		0.176
× income>75th perc.		(3.765)		(0.105)		(0.130)		(0.135)
WIC post reform		-2.112		0.045		0.012		0.101
× income<25th perc.		(3.034)		(0.114)		(0.103)		(0.139)
WIC post reform		-0.706		-0.046		-0.017		-0.091
× household size>75th perc.		(3.334)		(0.109)		(0.104)		(0.140)
WIC post reform		-0.753		0.101		0.037		0.044
× household size<25th perc.		(3.836)		(0.128)		(0.156)		(0.148)
WIC ×		1.879		-0.093		0.015		-0.036
income>75th perc.		(2.790)		(0.088)		(0.096)		(0.111)
WIC ×		1.808		0.007		0.049		0.011
income<25th perc.		(2.094)		(0.100)		(0.088)		(0.113)
WIC ×		-2.212		0.031		0.119		0.018
household size>75th perc.		(2.296)		(0.089)		(0.075)		(0.112)
WIC ×		-0.588		0.003		0.121		0.234*
household size<25th perc.		(3.025)		(0.112)		(0.143)		(0.127)
Post reform	0.270	0.270	0.000	0.000	-0.014**	-0.014**	0.006	0.006
	(0.260)	(0.260)	(0.009)	(0.009)	(0.007)	(0.007)	(0.008)	(0.008)
Year-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	514	514	515	515	511	511	512	512
Households	96563	96563	96564	96564	94232	94232	94233	94233
Household-quarters	1365973	1365973	1613424	1613424	1331699	1331699	1585847	1585847

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In columns 5–6, regressions include an interaction term for WIC and 1-year-old child. The sample includes households in columns 1–3 in table 1. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A15: Heterogeneous impact of post-reform WIC on subsidized products

	Fruits & veg.		Juice		Eggs		Cereals	
	Log. quantity		Log. quantity		Log. quantity		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WIC post reform	0.175*	0.219	0.255	0.363	0.028	0.078	0.083	0.212
	(0.100)	(0.144)	(0.185)	(0.280)	(0.085)	(0.142)	(0.085)	(0.129)
WIC	-0.113	-0.218*	0.348**	0.030	-0.084	-0.204	0.090	-0.093
	(0.087)	(0.126)	(0.165)	(0.252)	(0.077)	(0.135)	(0.075)	(0.118)
WIC post reform	-0.207		-0.212		-0.209		-0.084	
× norm. log(Income)	(0.176)		(0.341)		(0.140)		(0.152)	
WIC post reform	0.051		0.106		-0.038		-0.109*	
× norm. household size	(0.085)		(0.123)		(0.057)		(0.066)	
WIC × norm.	0.314*		0.488		0.099		0.072	
log(income)	(0.160)		(0.315)		(0.130)		(0.140)	
WIC × norm.	-0.094		-0.247**		0.018		-0.012	
household size	(0.081)		(0.115)		(0.048)		(0.060)	
WIC post reform		-0.327		0.147		-0.245		-0.171
× income>75th perc.		(0.204)		(0.414)		(0.200)		(0.195)
WIC post reform		0.045		0.037		0.290		-0.190
× income<25th perc.		(0.281)		(0.498)		(0.197)		(0.212)
WIC post reform		0.066		-0.116		-0.232		-0.192
× household size>75th perc.		(0.218)		(0.405)		(0.199)		(0.167)
WIC post reform		0.127		-0.698		-0.027		0.005
× household size<25th perc.		(0.361)		(0.555)		(0.215)		(0.280)
WIC ×		0.400**		0.417		0.185		0.186
income>75th perc.		(0.168)		(0.359)		(0.170)		(0.154)
WIC ×		-0.158		0.074		-0.096		0.116
income<25th perc.		(0.259)		(0.445)		(0.187)		(0.192)
WIC ×		-0.059		-0.145		0.184		0.125
household size>75th perc.		(0.193)		(0.355)		(0.170)		(0.140)
WIC ×		0.170		1.151**		0.260		0.419
household size<25th perc.		(0.316)		(0.506)		(0.208)		(0.256)
Post reform	0.002	0.002	0.119***	0.119***	0.020	0.020	-0.036**	-0.036**
	(0.018)	(0.018)	(0.037)	(0.037)	(0.015)	(0.015)	(0.017)	(0.017)
Year-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	517	517	515	515	513	513	515	515
Households	97829	97829	94029	94029	95449	95449	96870	96870
Household-quarters	1623263	1623263	1596280	1596280	1601167	1601167	1615696	1615696

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. The sample includes households in columns 1–3 in table 1. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A16: Heterogeneous impact of post-reform WIC on the Healthy Eating Index

	All products		Excluding products affected by reform	
	(1)	(2)	(3)	(4)
WIC post reform	0.990**	1.108	0.341	0.488
	(0.397)	(0.682)	(0.378)	(0.638)
WIC	-0.518	-0.778	-0.258	-0.398
	(0.337)	(0.604)	(0.322)	(0.563)
WIC post reform × norm. log(Income)	-0.726		-0.989	
	(0.677)		(0.690)	
WIC post reform × norm. household size	-0.241		-0.397	
	(0.276)		(0.257)	
WIC × norm. log(income)	0.407		0.768	
	(0.559)		(0.576)	
WIC × norm. household size	-0.082		0.057	
	(0.238)		(0.216)	
WIC post reform × income>75th perc.		-0.239		-0.285
		(0.991)		(0.949)
WIC post reform × income<25th perc.		0.891		0.823
		(0.921)		(0.891)
WIC post reform × household size>75th perc.		-1.227		-1.410
		(0.957)		(0.897)
WIC post reform × household size<25th perc.		0.419		0.563
		(0.955)		(0.942)
WIC × income>75th perc.		0.523		0.521
		(0.787)		(0.767)
WIC × income<25th perc.		-0.466		-0.669
		(0.812)		(0.784)
WIC × household size>75th perc.		0.550		0.572
		(0.775)		(0.727)
WIC × household size<25th perc.		0.286		-0.011
		(0.834)		(0.823)
Post reform	0.137	0.137	0.083	0.083
	(0.094)	(0.094)	(0.090)	(0.090)
Year-quarter FE	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes
WIC households	517	517	517	517
Households	98219	98219	98216	98216
Household-quarters	1625600	1625600	1625402	1625402

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. Dependent variable is the Healthy Eating Index calculated using either all products (columns 1–2) or excluding fruits and vegetables, bread, and milk (columns 3–4). All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. The sample includes households in columns 1–3 in table 1. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A17: Long-term impact of post-reform WIC on subsidized products. Dependent variables: logarithm of quantity of bread or milk

	Bread		Milk	
	Log. quantity		Log. quantity	
	(1)	(2)	(3)	(4)
Post-reform WIC × Inelig. year 1	0.031	0.065	-0.060	-0.023
	(0.058)	(0.055)	(0.064)	(0.063)
Post-reform WIC × Inelig. year 2	-0.049	-0.005	-0.093	-0.053
	(0.070)	(0.066)	(0.082)	(0.075)
Post-reform WIC × Inelig. year 3+	-0.032	0.026	-0.098	-0.022
	(0.082)	(0.077)	(0.086)	(0.082)
Inelig. year 1	0.008	-0.025	0.003	0.014
	(0.066)	(0.043)	(0.069)	(0.046)
Inelig. year 2	-0.009	-0.029	0.008	-0.004
	(0.076)	(0.050)	(0.084)	(0.053)
Inelig. year 3+	-0.025	-0.048	0.038	-0.021
	(0.091)	(0.053)	(0.093)	(0.058)
Post reform	-0.053	-0.001	-0.009	0.006
	(0.042)	(0.009)	(0.049)	(0.008)
Year-quarter FE	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes
WIC households	809	809	811	811
Households	809	96858	811	94532
Household-quarters	17029	1623688	17052	1596181

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1). In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A18: Long-term impact of post-reform WIC on subsidized products. Dependent variables: logarithm of quantity of juice, eggs, or cereals

	Juice		Eggs		Cereals	
	Log. quantity		Log. quantity		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-reform WIC × Inelig. year 1	-0.245	-0.027	-0.172*	-0.191*	0.053	0.115
	(0.236)	(0.226)	(0.104)	(0.103)	(0.092)	(0.090)
Post-reform WIC × Inelig. year 2	-0.517*	-0.265	-0.077	-0.095	-0.021	0.043
	(0.286)	(0.260)	(0.122)	(0.118)	(0.112)	(0.104)
Post-reform WIC × Inelig. year 3+	-0.556*	-0.287	-0.056	-0.077	0.051	0.115
	(0.297)	(0.265)	(0.139)	(0.136)	(0.123)	(0.113)
Inelig. year 1	-0.576**	-0.646***	0.025	0.079	-0.133	-0.088
	(0.243)	(0.179)	(0.104)	(0.081)	(0.096)	(0.066)
Inelig. year 2	-0.236	-0.332*	0.005	0.068	-0.067	-0.025
	(0.287)	(0.198)	(0.119)	(0.089)	(0.119)	(0.076)
Inelig. year 3+	-0.385	-0.569***	-0.064	0.033	-0.092	-0.005
	(0.322)	(0.193)	(0.142)	(0.105)	(0.139)	(0.081)
Post reform	-0.416**	0.119***	-0.084	0.022	-0.076	-0.033*
	(0.166)	(0.037)	(0.072)	(0.015)	(0.070)	(0.017)
Year-quarter FE	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	808	808	807	807	811	811
Households	808	94322	807	95743	811	97166
Household-quarters	17040	1606566	17034	1611468	17080	1626019

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1). In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A19: Long-term impact of post-reform WIC on Health Eating Index components

	Adequacy (healthy) components		Moderation (unhealthy) components	
	(1)	(2)	(3)	(4)
Post-reform WIC × Inelig. year 1	-0.559	-0.698*	-0.453	-0.107
	(0.391)	(0.368)	(0.321)	(0.291)
Post-reform WIC × Inelig. year 2	-0.602	-0.618	-0.517	-0.025
	(0.495)	(0.441)	(0.404)	(0.359)
Post-reform WIC × Inelig. year 3+	-0.514	-0.637	-0.444	0.151
	(0.527)	(0.498)	(0.433)	(0.362)
Inelig. year 1	0.324	0.244	0.103	-0.118
	(0.411)	(0.281)	(0.335)	(0.234)
Inelig. year 2	0.745	0.639**	0.359	-0.216
	(0.488)	(0.311)	(0.390)	(0.268)
Inelig. year 3+	0.532	0.486	0.465	-0.368
	(0.556)	(0.328)	(0.446)	(0.265)
Post reform	0.782***	0.169**	-0.113	-0.026
	(0.292)	(0.068)	(0.251)	(0.057)
Year-quarter FE	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes
WIC households	813	813	813	813
Households	813	98515	813	98515
Household-quarters	17096	1635914	17096	1635914

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1). In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A20: Robustness of long-term impact of post-reform WIC on subsidized products, parallel pre-treatment trends

	Bread		Milk		Fruits & veg.	
	Healthy %		Fat %		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-reform WIC × Inelig. year 1	-7.525***	-7.961***	0.211***	0.251***	0.023	0.040
	(1.713)	(1.572)	(0.056)	(0.052)	(0.127)	(0.104)
Post-reform WIC × Inelig. year 2	-8.180***	-8.568***	0.233***	0.258***	-0.050	-0.018
	(2.017)	(1.880)	(0.062)	(0.057)	(0.150)	(0.118)
Post-reform WIC × Inelig. year 3+	-10.450***	-10.573***	0.332***	0.331***	-0.037	0.009
	(2.244)	(2.041)	(0.074)	(0.068)	(0.155)	(0.124)
Inelig. year 1	3.711***	0.728	-0.116**	-0.056	-0.048	-0.107
	(1.377)	(0.871)	(0.054)	(0.038)	(0.132)	(0.076)
Inelig. year 2	4.103**	0.552	-0.161***	-0.090**	0.055	-0.025
	(1.660)	(1.082)	(0.061)	(0.041)	(0.152)	(0.082)
Inelig. year 3+	5.024**	0.408	-0.213***	-0.118***	0.158	0.052
	(1.971)	(1.043)	(0.072)	(0.044)	(0.167)	(0.081)
Post reform	3.008***	0.236	-0.041	-0.015**	-0.147*	0.002
	(1.075)	(0.260)	(0.038)	(0.007)	(0.079)	(0.018)
Pre-treatment trend × Treatment group	-0.339*	-0.200	0.009	-0.001	0.010	0.010
	(0.193)	(0.152)	(0.006)	(0.004)	(0.014)	(0.007)
Pre-treatment trend	0.094	-0.011	-0.018***	0.001*	-0.008	0.004***
	(0.150)	(0.011)	(0.006)	(0.000)	(0.015)	(0.001)
Year-quarter FE	No	Yes	No	Yes	No	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	808	808	807	807	813	813
Households	808	96857	807	94528	813	98125
Household-quarters	15188	1375161	14820	1340521	17096	1633577

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In columns 3–4, regressions include an interaction term for WIC and 1-year-old child. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 in table 1). In even-numbered columns, the sample includes a larger control group (columns 1–3 in table 1). In odd-numbered columns, regressions include a time trend, while in even-numbered columns, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A21: Robustness of long-term impact of post-reform WIC on the Healthy Eating Index, parallel pre-treatment trends

	Healthy Eating Index	
	(1)	(2)
Post-reform WIC × Inelig. year 1	-0.493	-1.058*
	(0.620)	(0.547)
Post-reform WIC × Inelig. year 2	-0.637	-0.874
	(0.706)	(0.645)
Post-reform WIC × Inelig. year 3+	-0.499	-0.711
	(0.766)	(0.688)
Inelig. year 1	0.371	0.187
	(0.582)	(0.380)
Inelig. year 2	0.814	0.388
	(0.642)	(0.444)
Inelig. year 3+	0.632	0.084
	(0.749)	(0.442)
Post reform	0.519	0.142
	(0.412)	(0.094)
Pre-treatment trend × Treatment group	-0.079	0.034
	(0.063)	(0.042)
Pre-treatment trend	0.011	-0.001
	(0.056)	(0.004)
Year-quarter FE	No	Yes
Household FE	Yes	Yes
WIC households	813	813
Households	813	98515
Household-quarters	17096	1635914

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In column 1, the sample is restricted to WIC households (columns 1–2 in table 1). In column 2, the sample includes a larger control group (columns 1–3 in table 1). In column 1, regressions include a time trend, while column 2, time period fixed effects are included. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A22: Robustness of long-term impact of post-reform WIC on subsidized products, alternative samples

	Bread		Milk		Fruits & Veg.	
	Healthy %		Fat %		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-reform WIC × Inelig. year 1	-9.079***	-9.485***	0.224***	0.249***	0.078	0.130
	(1.395)	(1.404)	(0.048)	(0.048)	(0.098)	(0.098)
Post-reform WIC × Inelig. year 2	-9.698***	-10.029***	0.228***	0.255***	0.007	0.070
	(1.696)	(1.693)	(0.055)	(0.055)	(0.114)	(0.113)
Post-reform WIC × Inelig. year 3+	-11.401***	-12.010***	0.296***	0.332***	0.046	0.108
	(1.859)	(1.858)	(0.066)	(0.066)	(0.120)	(0.121)
Inelig. year 1	2.621**	0.689	-0.159***	-0.066*	-0.094	-0.106
	(1.232)	(0.869)	(0.049)	(0.038)	(0.099)	(0.077)
Inelig. year 2	2.390	0.698	-0.155***	-0.090**	0.005	-0.045
	(1.483)	(1.083)	(0.048)	(0.041)	(0.100)	(0.083)
Inelig. year 3+	1.753	0.686	-0.166***	-0.128***	0.041	0.003
	(1.399)	(1.041)	(0.050)	(0.044)	(0.100)	(0.081)
Post reform	-0.328	0.321	-0.010	-0.008	-0.050	-0.014
	(0.661)	(0.217)	(0.022)	(0.006)	(0.051)	(0.014)
Year-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	808	808	807	807	813	813
Households	10683	151830	10569	147560	10757	154702
Household-quarters	150488	2111125	149311	2063324	170779	2570330

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In columns 3–4, regressions include an interaction term for WIC and 1-year-old child. In odd-numbered columns, the sample is restricted to WIC households (columns 1–2 and 4 in table 1). Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A23: Robustness of long-term impact of post-reform WIC on the Healthy Eating Index, alternative samples

	Healthy Eating Index	
	(1)	(2)
Post-reform WIC × Inelig. year 1	-0.540	-0.761
	(0.488)	(0.488)
Post-reform WIC × Inelig. year 2	-0.401	-0.575
	(0.620)	(0.619)
Post-reform WIC × Inelig. year 3+	-0.091	-0.411
	(0.658)	(0.657)
Inelig. year 1	-0.198	0.093
	(0.507)	(0.380)
Inelig. year 2	0.113	0.387
	(0.563)	(0.445)
Inelig. year 3+	-0.443	0.112
	(0.575)	(0.442)
Post reform	0.225	0.153**
	(0.261)	(0.077)
Year-quarter FE	Yes	Yes
Household FE	Yes	Yes
WIC households	813	813
Households	10773	155375
Household-quarters	170854	2574317

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In column 1, the sample is restricted to past and present WIC households (columns 1–2 and 4 in table 1). Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A24: Robustness of long-run impact of WIC: propensity score matching, logit

	(1)
Household size	0.308***
	(0.032)
Log. income	-0.863***
	(0.057)
College	0.062
	(0.100)
Non-white	0.379***
	(0.098)
Indicators for children up to age 4	Yes
N	98515

Note: A unit of observation is a household. The sample includes households in columns 1–3 in table 1. Standard errors are in parentheses. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A25: Robustness of long-term impact of post-reform WIC, propensity score matching

	Bread Healthy %		Milk Fat %		Fruits & Veg. Log. quantity		Healthy Eating Index	
	OLS	PSM	OLS	PSM	OLS	PSM	OLS	PSM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-reform WIC	-11.772***	-11.373***	0.114***	0.136***	-0.004	0.042	-0.535*	-0.519
	(0.840)	(1.187)	(0.021)	(0.030)	(0.062)	(0.063)	(0.301)	(0.320)
N	87807	87807	84706	84706	97961	97961	98328	98328

Note: A unit of observation is a household. odd-numbered columns present estimates from OLS regressions, even-numbered columns present propensity score matching estimates of the average treatment effect on the treated. Dependent variable is the difference before and while receiving WIC vouchers in the share of healthy bread, fat percentage of milk, the Healthy Eating Index or the difference between the logarithms of quantities of fruits and vegetables ($\log(y_t/y_{t-1})$). The sample includes households in columns 1–3 in table 1. Standard errors (in parentheses) are adjusted to take into account that the propensity score is estimated. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A26: Arellano-Bond estimates

	Bread Healthy %		Milk Fat %		Fruits & Veg. Log. quantity		Healthy Eating Index	
	FE	AB	FE	AB	FE	AB	FE	AB
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged dependent variable	0.275***	0.155***	0.551***	0.366***	0.163***	0.117***	0.162***	0.072***
	(0.003)	(0.003)	(0.003)	(0.006)	(0.002)	(0.003)	(0.001)	(0.002)
WIC households	808	808	807	807	813	813	813	813
Households	92548	92548	89655	89655	98121	98121	98481	98481
Household-quarters	1180122	1180122	1173670	1173670	1521994	1521994	1523805	1523805

Note: A unit of observation is a household-quarter pair. Odd-numbered columns present panel data fixed effects estimates, even-numbered columns present Arellano-Bond estimates. The end of WIC eligibility and an indicator for periods after WIC policy change are used in addition to the standard Arellano-Bond instruments. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In columns 3–4, regressions include an interaction term for WIC and 1-year-old child. The sample includes households in columns 1–3 in table 1. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A27: Robustness of long-term impact of post-reform WIC: Arellano-Bond estimates

	Bread Healthy %		Milk Fat %		Fruits & Veg. Log. quantity		Healthy Eating Index	
	FE	AB	FE	AB	FE	AB	FE	AB
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-reform WIC × Ineligible	-7.417***	-4.605**	0.167***	0.166***	0.043	0.010	-0.633	-0.169
	(1.178)	(2.170)	(0.028)	(0.053)	(0.086)	(0.157)	(0.445)	(0.797)
Ineligible	0.233	1.213	-0.040*	0.023	-0.023	-0.093	0.273	-0.143
	(0.637)	(1.585)	(0.021)	(0.040)	(0.062)	(0.129)	(0.332)	(0.598)
Post reform	0.298	0.256	-0.006	0.000	-0.001	-0.059**	0.167*	0.243*
	(0.234)	(0.375)	(0.004)	(0.007)	(0.017)	(0.027)	(0.087)	(0.138)
Lagged dependent variable	0.275***	0.155***	0.550***	0.368***	0.163***	0.118***	0.162***	0.076***
	(0.003)	(0.003)	(0.003)	(0.006)	(0.002)	(0.003)	(0.001)	(0.002)
WIC households	808	808	807	807	813	813	813	813
Households	92548	92548	89655	89655	98121	98121	98481	98481
Household-quarters	1180122	1180122	1173670	1173670	1521994	1521994	1523805	1523805

Note: A unit of observation is a household-quarter pair. Odd-numbered columns present panel data fixed effects estimates, even-numbered columns present Arellano-Bond estimates. The end of WIC eligibility and an indicator for periods after WIC policy change are used in addition to the standard Arellano-Bond instruments. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In columns 3–4, regressions include an interaction term for WIC and 1-year-old child. The sample includes households in columns 1–3 in table 1. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A28: Heterogeneous long-term impact of post-reform WIC on subsidized products

	Bread		Milk		Fruits & Veg.	
	Healthy %		Fat %		Log. quantity	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-reform WIC	-10.437***	-15.110***	0.305***	0.328***	0.057	0.172
× Ineligible	(1.498)	(2.112)	(0.052)	(0.066)	(0.099)	(0.151)
Ineligible	0.338	1.723	-0.093**	-0.097*	-0.028	-0.046
	(0.847)	(1.246)	(0.041)	(0.052)	(0.074)	(0.125)
Post-reform WIC	0.275		0.031		-0.052	
× Inelig. × Norm. log(Income)	(2.338)		(0.080)		(0.165)	
Post-reform WIC	0.502		-0.015		0.036	
× Inelig. × Norm. household size	(0.824)		(0.032)		(0.053)	
Inelig. ×	1.649		-0.063		0.143	
Norm. log(income)	(1.691)		(0.066)		(0.122)	
Inelig. ×	0.284		0.010		-0.019	
Norm. household size	(0.504)		(0.024)		(0.043)	
Post-reform WIC		4.028		-0.041		-0.287
× Inelig. × Income>75th perc.		(3.151)		(0.110)		(0.224)
Post-reform WIC		2.336		-0.015		-0.237
× Inelig. × Income<25th perc.		(2.929)		(0.097)		(0.207)
Post-reform WIC		7.038***		-0.036		-0.047
× Inelig. × Household size>75th perc.		(2.704)		(0.109)		(0.188)
Post-reform WIC		6.310**		-0.008		0.123
× Inelig. × Household size<25th perc.		(3.205)		(0.107)		(0.207)
Inelig. ×		-0.312		-0.079		0.125
Income>75th perc.		(2.065)		(0.087)		(0.138)
Inelig. ×		-1.155		-0.047		-0.010
Income<25th perc.		(1.842)		(0.073)		(0.175)
Inelig. ×		-0.921		0.083		0.031
Household size>75th perc.		(1.800)		(0.077)		(0.133)
Inelig. ×		-2.744		0.073		-0.065
Household size<25th perc.		(1.859)		(0.085)		(0.163)
Post reform	0.237	0.236	-0.015**	-0.015**	0.002	0.002
	(0.260)	(0.260)	(0.007)	(0.007)	(0.018)	(0.018)
Year-quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
WIC households	808	808	807	807	813	813
Households	96857	96857	94528	94528	98125	98125
Household-quarters	1375161	1375161	1340521	1340521	1633577	1633577

Note: A unit of observation is a household-quarter pair. In odd-numbered columns, WIC ineligibility is interacted with normalized logarithm of income and normalized household size. In even-numbered columns, WIC ineligiblity is interacted with indicators for income and household size lower than the 25th percentile or higher than the 75th percentile. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. In columns 3–4, regressions include an interaction term for WIC and 1-year-old child. The sample includes households in columns 1–3 in table 1. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 % level, ** 5 % level, * 1 % level.

Table A29: Heterogeneous long-term impact of post-reform WIC on the Healthy Eating Index

	Healthy Eating Index	
	(1)	(2)
Post-reform WIC × Ineligible	-0.740	-1.567**
	(0.508)	(0.713)
Ineligible	0.191	0.736
	(0.378)	(0.561)
Post-reform WIC × Inelig. × Norm. log(Income)	-0.163	
	(0.758)	
Post-reform WIC × Inelig. × Norm. household size	-0.335	
	(0.303)	
Inelig. × Norm. log(income)	0.145	
	(0.567)	
Inelig. × Norm. household size	0.277	
	(0.229)	
Post-reform WIC × Inelig. × Income>75th perc.		1.002
		(1.122)
Post-reform WIC × Inelig. × Income<25th perc.		0.892
		(0.929)
Post-reform WIC × Inelig. × Household size>75th perc.		-0.301
		(1.014)
Post-reform WIC × Inelig. × Household size<25th perc.		1.298
		(1.057)
Inelig. × Income>75th perc.		-0.111
		(0.801)
Inelig. × Income<25th perc.		-0.385
		(0.696)
Inelig. × Household size>75th perc.		-0.168
		(0.725)
Inelig. × Household size<25th perc.		-1.230
		(0.794)
Post reform	0.143	0.142
	(0.094)	(0.094)
Year-quarter FE	Yes	Yes
Household FE	Yes	Yes
WIC households	813	813
Households	98515	98515
Household-quarters	1635914	1635914

Note: Each column presents estimates from a separate panel data fixed effects regression. A unit of observation is a household-quarter pair. In odd-numbered columns, WIC ineligibility is interacted with normalized logarithm of income and normalized household size. In even-numbered columns, WIC ineligiblity is interacted with indicators for income and household size lower than the 25th percentile or higher than the 75th percentile. All regressions include household size, logarithm of income, dummies for period before child is born, and children aged $0, 1, \ldots, , 5$, 6-12, and 13-17. The sample includes households in columns 1–3 in table 1. Standard errors (in parentheses) are clustered at the household level. *** Indicates significance at the 10 percent level, ** 5 percent level, * 1 percent level.

Table A30: Control function estimation. Dependent variable: price of bread

	Estimate	SE
Wheat price	0.629***	(0.022)
Wheat price: white bread	-0.080***	(0.028)
Wheat price: whole grain bread	0.009	(0.032)
Wheat price: whole wheat bread	0.151***	(0.035)
White bread	-0.352***	(0.007)
Whole-grain bread	0.030***	(0.008)
Whole-wheat bread	-0.041***	(0.009)
Constant	1.713***	(0.008)
State FE	Yes	
R-squared	0.682	
Number of observations	97264	

Note: A unit of observation is a bread type (white, whole grain, whole wheat, or other), state, and week triplet. Price of bread is measured as dollars per pound. Price of wheat is measured as dollars per kg. Robust standard errors are included in parenthesis. *** Indicates significance at the 1 percent level, ** at 5 percent level, * at 10 percent level.

Table A31: Actual and predicted market shares

	Market shares by product type			Difference
	Actual data	Predicted with actual prices	Predicted with equal prices	in market shares
Other bread	36.34	36.56	43.11	6.5
Whole grain bread	15.61	15.43	18.19	2.8
Whole wheat bread	7.53	7.30	7.50	0.2
White bread	40.52	40.71	31.20	-9.5

Note: Market shares sum up to 100. Predicted market shares are calculated using estimates with control function (model 2) in table 7. Market shares are calculated only based on the sample used in the demand model estimation. Because the sample includes only households who received WIC assistance, the market shares don't necessarily represent overall market shares.

Table A32: Bread demand model estimates: correlated random coefficients

	(1)	
	Estim.	SE
Mean		
Price	−2.753	(1.137)
Price × Log. income	0.076	(0.051)
Price × Household size	−0.100∗	(0.032)
Price × Age	0.013	(0.012)
Previous product	1.208∗	(0.163)
Previous product × Log. income	−0.013	(0.014)
Previous product × Household size	−0.031∗	(0.007)
Previous product × Age	−0.004∗	(0.001)
White bread	−1.195∗	(0.311)
Whole grain bread	−1.895∗	(0.389)
Whole wheat bread	−3.073∗	(0.398)
Whole grain/wheat × Log. income	0.088	(0.035)
Whole grain/wheat × Household size	−0.070∗	(0.018)
Whole grain/wheat × Age	0.006	(0.004)
Whole wheat × WW share in WIC × Post year 1	2.856∗	(0.315)
Whole wheat × WW share in WIC × Post year 2	2.214∗	(0.322)
Whole wheat × WW share in WIC × Post year 3	1.399∗	(0.355)
Residual	1.271	(0.652)
Standard deviation		
Price	0.080	(0.114)
Whole grain bread	1.532∗	(0.032)
Whole wheat bread	1.737∗	(0.038)
White bread	1.897∗	(0.037)
Covariance		
Price, whole grain bread	−0.002	(0.004)
Price, whole wheat bread	−0.003	(0.006)
Price, white bread	0.006	(0.013)
Whole grain bread, whole wheat bread	1.296∗	(0.079)
Whole grain bread, white bread	0.470∗	(0.073)
Whole wheat bread, white bread	−0.359∗	(0.086)
Log-likelihood	-463638.4	
Number of choices	2328792	
Number of WIC households	422	
Number of households	7129	

Note: The table presents estimates from a random coefficient logit model. The first column presents parameter estimates and the second column standard errors. The lower part of the table presents elements of the covariance matrix of the distribution of random coefficients. The base type of bread is *other* bread. Standard errors are clustered at the household level. * Indicates significance at the 1 percent level.

Table A33: Bread demand model estimates: allowing standard deviation of price variable differ by household characteristics

	Income		Household size		Age	
	(1)		(2)		(3)	
	Estim.	SE	Estim.	SE	Estim.	SE
Mean						
Price	−3.009∗	(0.868)	−3.031∗	(0.922)	−3.049∗	(0.857)
Price × Log. income	0.118∗	(0.042)	0.116	(0.045)	0.115∗	(0.042)
Price × Household size	−0.107∗	(0.022)	−0.104∗	(0.025)	−0.109∗	(0.021)
Price × Age	0.012	(0.006)	0.013	(0.006)	0.014∗	(0.005)
Previous product	1.249∗	(0.158)	1.249∗	(0.158)	1.250∗	(0.158)
Previous product × Log. income	−0.013	(0.014)	−0.013	(0.014)	−0.013	(0.014)
Previous product × Household size	−0.030∗	(0.007)	−0.030∗	(0.007)	−0.030∗	(0.007)
Previous product × Age	−0.005∗	(0.001)	−0.005∗	(0.001)	−0.005∗	(0.001)
White bread	−1.139∗	(0.307)	−1.137∗	(0.310)	−1.133∗	(0.306)
Whole grain bread	−2.347∗	(0.259)	−2.330∗	(0.275)	−2.338∗	(0.257)
Whole wheat bread	−3.349∗	(0.259)	−3.334∗	(0.271)	−3.344∗	(0.258)
Whole grain/wheat × Log. income	0.139∗	(0.022)	0.138∗	(0.022)	0.138∗	(0.022)
Whole grain/wheat × Household size	−0.083∗	(0.010)	−0.083∗	(0.010)	−0.084∗	(0.010)
Whole grain/wheat × Age	0.004	(0.002)	0.004	(0.003)	0.004	(0.002)
Whole wheat × WW share in WIC × Post year 1	2.365∗	(0.335)	2.393∗	(0.350)	2.361∗	(0.347)
Whole wheat × WW share in WIC × Post year 2	1.685∗	(0.348)	1.713∗	(0.365)	1.679∗	(0.359)
Whole wheat × WW share in WIC × Post year 3	1.054∗	(0.362)	1.074∗	(0.383)	1.052∗	(0.364)
Residual	1.178	(0.635)	1.186	(0.637)	1.180	(0.635)
Standard Deviation						
Price (household characteristic below median)	0.032	(0.069)	0.056	(0.050)	0.048	(0.077)
Price (household characteristics above median)	−0.035	(0.088)	−0.031	(0.138)	−0.070	(0.064)
White bread	1.869∗	(0.039)	1.875∗	(0.041)	1.872∗	(0.036)
Whole grain bread	1.335∗	(0.026)	1.335∗	(0.026)	1.337∗	(0.026)
Whole wheat bread	1.542∗	(0.032)	1.545∗	(0.033)	1.545∗	(0.031)
Log-likelihood	-468150.7		-468147.8		-468144.8	
Number of choices	2328792		2328792		2328792	
Number of WIC households	422		422		422	
Number of households	7129		7129		7129	

Note: The table presents estimates from three random coefficient logit models. For each model, the first column presents parameter estimates and the second column standard errors. The lower part of the table presents standard deviations of the distributions of random coefficients. The base type of bread is *other* bread. Standard errors are clustered at the household level. * Indicates significance at the 1 percent level.

Table A34: Bread demand model estimates: allowing standard deviation of whole wheat bread preference differ by household characteristics

	Income		Household size		Age	
	(1)		(2)		(3)	
	Estim.	SE	Estim.	SE	Estim.	SE
Mean						
Price	−3.305∗	(0.837)	−2.530	(1.037)	−2.210	(0.945)
Price × Log. income	0.105∗	(0.040)	0.068	(0.061)	0.068	(0.082)
Price × Household size	−0.090∗	(0.027)	−0.098∗	(0.025)	−0.087∗	(0.021)
Price × Age	0.019∗	(0.007)	0.013	(0.008)	0.002	(0.012)
Previous product	1.200∗	(0.158)	1.232∗	(0.159)	1.212∗	(0.160)
Previous product × Log. income	−0.010	(0.014)	−0.015	(0.014)	−0.013	(0.014)
Previous product × Household size	−0.031∗	(0.007)	−0.028∗	(0.007)	−0.030∗	(0.007)
Previous product × Age	−0.004∗	(0.001)	−0.004∗	(0.001)	−0.004∗	(0.001)
White bread	−1.237∗	(0.303)	−1.133∗	(0.303)	−1.164∗	(0.311)
Whole grain bread	−2.170∗	(0.285)	−1.701∗	(0.293)	−1.759∗	(0.547)
Whole wheat bread	−3.245∗	(0.287)	−2.815∗	(0.289)	−2.876∗	(0.588)
Whole grain/wheat × Log. income	0.109∗	(0.026)	0.101∗	(0.027)	0.117∗	(0.026)
Whole grain/wheat × Household size	−0.074∗	(0.014)	−0.096∗	(0.012)	−0.084∗	(0.012)
Whole grain/wheat × Age	0.007∗	(0.002)	0.000	(0.003)	−0.003	(0.012)
Whole wheat × WW share in WIC × Post year 1	1.661∗	(0.338)	2.104∗	(0.428)	3.183∗	(0.316)
Whole wheat × WW share in WIC × Post year 2	0.918∗	(0.348)	1.410∗	(0.456)	2.567∗	(0.349)
Whole wheat × WW share in WIC × Post year 3	0.104	(0.318)	0.581	(0.360)	1.858∗	(0.455)
Residual	1.241	(0.643)	1.181	(0.642)	1.314	(0.658)
Standard Deviation						
Price	−0.009	(0.072)	−0.029	(0.060)	−0.034	(0.077)
White bread	1.794∗	(0.031)	1.851∗	(0.041)	1.860∗	(0.040)
Whole grain bread	1.373∗	(0.031)	1.395∗	(0.026)	1.368∗	(0.075)
Whole wheat bread (below median)	1.753∗	(0.090)	1.656∗	(0.103)	1.592∗	(0.055)
Whole wheat bread (above median)	1.565∗	(0.086)	1.546∗	(0.036)	1.512∗	(0.065)
Log-likelihood	-468322.6		-467861.9		-468095.9	
Number of choices	2328792		2328792		2328792	
Number of WIC households	422		422		422	
Number of households	7129		7129		7129	

Note: The table presents estimates from three random coefficient logit models. For each model, the first column presents parameter estimates and the second column standard errors. The lower part of the table presents standard deviations of the distributions of random coefficients. The base type of bread is *other* bread. Standard errors are clustered at the household level. * Indicates significance at the 1 percent level.

Table A35: Bread demand model estimates: prices from the store of the shopping trip

	(1)	
	Estim.	SE
Mean		
Price	−4.041∗	(1.154)
Price × Log. income	0.052	(0.063)
Price × Household size	−0.079∗	(0.029)
Price × Age	0.002	(0.007)
Previous product	1.402∗	(0.243)
Previous product × Log. income	−0.029	(0.022)
Previous product × Household size	−0.045∗	(0.010)
Previous product × Age	−0.004	(0.002)
White bread	−1.997∗	(0.409)
Whole grain bread	−1.668∗	(0.445)
Whole wheat bread	−2.894∗	(0.453)
Whole grain/wheat × Log. income	0.127∗	(0.046)
Whole grain/wheat × Household size	−0.071∗	(0.018)
Whole grain/wheat × Age	−0.002	(0.005)
Whole wheat × WW share in WIC × Post year 1	3.506∗	(0.468)
Whole wheat × WW share in WIC × Post year 2	1.785∗	(0.510)
Whole wheat × WW share in WIC × Post year 3	0.642	(0.405)
Residual	2.811∗	(0.944)
Standard Deviation		
Price	−0.442∗	(0.111)
White bread	1.788∗	(0.050)
Whole grain bread	1.434∗	(0.040)
Whole wheat bread	1.677∗	(0.048)
Log-likelihood	-151060.9	
Number of choices	725720	
Number of WIC households	250	
Number of households	4024	

Note: The table presents estimates from a random coefficient logit model. The first column presents parameter estimates and the second column standard errors. The lower part of the table presents standard deviations of the distributions of random coefficients. The base type of bread is *other* bread. Standard errors are clustered at the household level. * Indicates significance at the 1 percent level.

Table A36: Bread demand model estimates: prices weighted by volume

	(1) Estim.	SE
Mean		
Price	−1.391	(0.638)
Price × Log. income	0.074	(0.042)
Price × Household size	−0.090∗	(0.021)
Price × Age	0.009	(0.008)
Previous product	1.297∗	(0.159)
Previous product × Log. income	−0.016	(0.014)
Previous product × Household size	−0.031∗	(0.007)
Previous product × Age	−0.004∗	(0.001)
White bread	−0.674∗	(0.120)
Whole grain bread	−2.108∗	(0.345)
Whole wheat bread	−2.956∗	(0.352)
Whole grain/wheat × Log. income	0.152∗	(0.026)
Whole grain/wheat × Household size	−0.046∗	(0.013)
Whole grain/wheat × Age	−0.006	(0.004)
Whole wheat × WW share in WIC × Post year 1	2.653∗	(0.266)
Whole wheat × WW share in WIC × Post year 2	1.990∗	(0.298)
Whole wheat × WW share in WIC × Post year 3	1.272∗	(0.267)
Residuals	0.184	(0.207)
Standard Deviation		
Price	0.018	(0.043)
White bread	1.783∗	(0.035)
Whole grain bread	1.286∗	(0.029)
Whole wheat bread	1.593∗	(0.036)
Log-likelihood	-469250.4	
Number of choices	2328792	
Number of WIC households	422	
Number of households	7129	

Note: The table presents estimates from a random coefficient logit model. The first column presents parameter estimates and the second column standard errors. The lower part of the table presents standard deviations of the distributions of random coefficients. The base type of bread is *other* bread. Standard errors are clustered at the household level. *** Indicates significance at the 1 percent level, ** at 5 percent level, * at 10 percent level.

Table A37: Bread demand model estimates: without previous purchase indicator

	(1)	
	Estim.	SE
Mean		
Price	−3.217∗	(1.106)
Price × Log. income	0.092	(0.069)
Price × Household size	−0.111∗	(0.026)
Price × Age	0.010	(0.009)
White bread	−1.565∗	(0.397)
Whole grain bread	−2.547∗	(0.483)
Whole wheat bread	−3.668∗	(0.495)
Whole grain/wheat × Log. income	0.173∗	(0.034)
Whole grain/wheat × Household size	−0.066∗	(0.014)
Whole grain/wheat × Age	−0.006	(0.006)
Whole wheat × WW share in WIC × Post year 1	3.097∗	(0.310)
Whole wheat × WW share in WIC × Post year 2	2.281∗	(0.367)
Whole wheat × WW share in WIC × Post year 3	1.420∗	(0.343)
Residual	1.749	(0.825)
Standard Deviation		
Price	0.043	(0.072)
White bread	2.187∗	(0.047)
Whole grain bread	1.598∗	(0.046)
Whole wheat bread	1.895∗	(0.049)
Log-likelihood	-496197.8	
Number of choices	2328792	
Number of WIC households	422	
Number of households	7129	

Note: The table presents estimates from a random coefficient logit model. The first column presents parameter estimates and the second column standard errors. The lower part of the table presents standard deviations of the distributions of random coefficients. The base type of bread is *other* bread. Standard errors are clustered at the household level. * Indicates significance at the 1 percent level.

Table A38: Bread demand model estimates: group and time period specific preference for whole-wheat

	(1)	
	Estim.	SE
Mean		
Price	−2.809∗	(0.942)
Price × Log. income	0.087	(0.048)
Price × Household size	−0.085∗	(0.020)
Price × Age	0.011	(0.011)
Previous product	1.282∗	(0.158)
Previous product × Log. income	−0.016	(0.014)
Previous product × Household size	−0.031∗	(0.007)
Previous product × Age	−0.004∗	(0.001)
White bread	−1.239∗	(0.318)
Whole grain bread	−2.468∗	(0.342)
Whole wheat bread	−3.454∗	(0.352)
Whole grain/wheat × Log. income	0.167∗	(0.025)
Whole grain/wheat × Household size	−0.061∗	(0.012)
Whole grain/wheat × Age	−0.002	(0.004)
Whole wheat × WIC before 2009	0.224	(0.177)
Whole wheat × WIC before 2009 × Post year 2	−0.083	(0.117)
Whole wheat × WIC before 2009 × Post year 3	−0.053	(0.173)
Whole wheat × WIC post 2009	0.457∗	(0.150)
Whole wheat × WIC post 2009 × Post year 2	−0.344∗	(0.101)
Whole wheat × WIC post 2009 × Post year 3	−0.569∗	(0.158)
Residual	1.306	(0.649)
Standard Deviation		
Price	0.044	(0.050)
White bread	1.785∗	(0.038)
Whole grain bread	1.280∗	(0.028)
Whole wheat bread	1.597∗	(0.038)
Log-likelihood	-469282.3	
Number of choices	2328792	
Number of WIC households	422	
Number of households	7129	

Note: The table presents estimates from a random coefficient logit model. The first column presents parameter estimates and the second column standard errors. The lower part of the table presents standard deviations of the distributions of random coefficients. The base type of bread is *other* bread. Standard errors are clustered at the household level. * Indicates significance at the 1 percent level.

Table A39: Bread demand model estimates: household heterogeneity

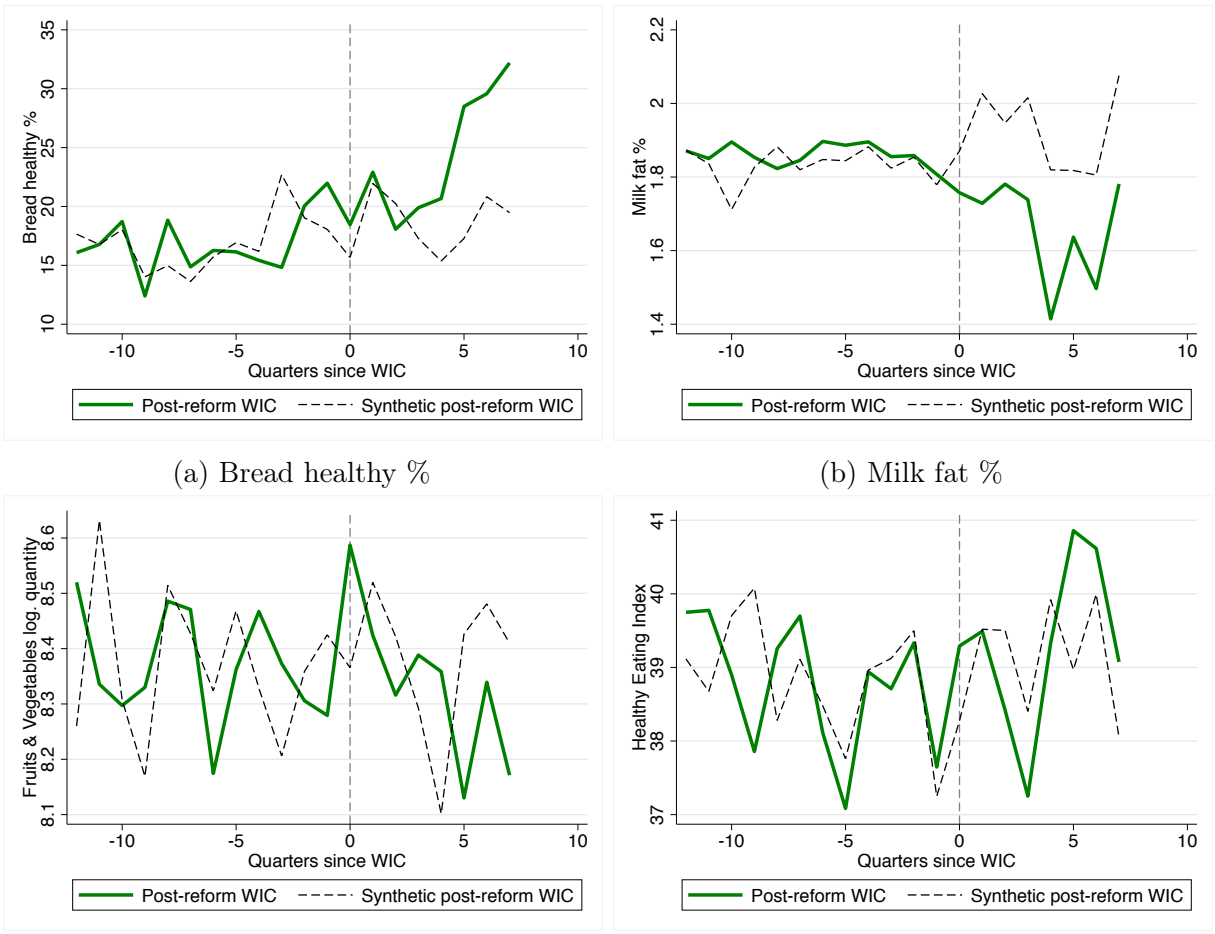
	(1)	
	Estim.	SE
Mean		
Price	−2.761∗	(0.906)
Price × Log. income	0.086	(0.048)
Price × Household size	−0.086∗	(0.021)
Price × Age	0.010	(0.007)
Previous product	1.291∗	(0.159)
Previous product × Log. income	−0.016	(0.014)
Previous product × Household size	−0.031∗	(0.007)
Previous product × Age	−0.004∗	(0.001)
White bread	−1.235∗	(0.313)
Whole grain bread	−2.437∗	(0.358)
Whole wheat bread	−3.425∗	(0.368)
Whole grain/wheat × Log. income	0.168∗	(0.026)
Whole grain/wheat × Household size	−0.060∗	(0.013)
Whole grain/wheat × Age	−0.003	(0.004)
Whole wheat × WW share in WIC × Post year 1	2.641∗	(0.438)
Whole wheat × WW share in WIC × Post year 2	1.945∗	(0.431)
Whole wheat × WW share in WIC × Post year 3	1.184∗	(0.396)
Whole wheat × WW share in WIC × Household size<3	0.981	(1.828)
Whole wheat × WW share in WIC × Household size=3	0.349	(0.786)
Whole wheat × WW share in WIC × Household size>4	0.018	(0.378)
Residual	1.294	(0.647)
Standard Deviation		
Price	0.046	(0.055)
White bread	1.790∗	(0.036)
Whole grain bread	1.280∗	(0.029)
Whole wheat bread	1.589∗	(0.038)
Log-likelihood	-469217.4	
Number of choices	2328792	
Number of WIC households	422	
Number of households	7129	

Note: The table presents estimates from a random coefficient logit model which is otherwise the same as in column 2 table 7, but adds the following interaction terms for the taste of whole wheat bread: whole wheat bread share during WIC interacted with dummies for household size 1-2, 3 or at least 5 (4-member household is the baseline category). The first column presents parameter estimates and the second column standard errors. The lower part of the table presents standard deviations of the distributions of random coefficients. The base type of bread is *other* bread. Standard errors are clustered at the household level. * Indicates significance at the 1 percent level.

Table A40: Bread demand model estimates: group and time period specific preference for whole-wheat, household heterogeneity

	(1)	
	Estim.	SE
Mean		
Price	−2.828∗	(0.992)
Price × Log. income	0.086	(0.048)
Price × Household size	−0.086∗	(0.020)
Price × Age	0.011	(0.012)
Previous product	1.281∗	(0.158)
Previous product × Log. income	−0.016	(0.014)
Previous product × Household size	−0.030∗	(0.007)
Previous product × Age	−0.004∗	(0.001)
White bread	−1.244∗	(0.319)
Whole grain bread	−2.469∗	(0.349)
Whole wheat bread	−3.453∗	(0.358)
Whole grain/wheat × Log. income	0.167∗	(0.025)
Whole grain/wheat × Household size	−0.060∗	(0.013)
Whole grain/wheat × Age	−0.002	(0.004)
Whole wheat × WIC before 2009	0.221	(0.177)
Whole wheat × WIC before 2009 × Post year 2	−0.083	(0.117)
Whole wheat × WIC before 2009 × Post year 3	−0.052	(0.173)
Whole wheat × WIC post 2009 × Share of WIC eligible	1.256∗	(0.461)
Whole wheat × WIC post 2009 × Post year 2 × Share of WIC eligible	−0.914∗	(0.331)
Whole wheat × WIC post 2009 × Post year 3 × Share of WIC eligible	−1.907∗	(0.479)
Residual	1.312	(0.650)
Standard Deviation		
Price	0.043	(0.051)
White bread	1.785∗	(0.038)
Whole grain bread	1.280∗	(0.028)
Whole wheat bread	1.597∗	(0.038)
Log-likelihood	-469278.5	
Number of choices	2328792	
Number of WIC households	422	
Number of households	7129	

Note: The table presents estimates from a random coefficient logit model. The first column presents parameter estimates and the second column standard errors. The lower part of the table presents standard deviations of the distributions of random coefficients. The base type of bread is *other* bread. Standard errors are clustered at the household level. * Indicates significance at the 1 percent level.



(a) Bread healthy %

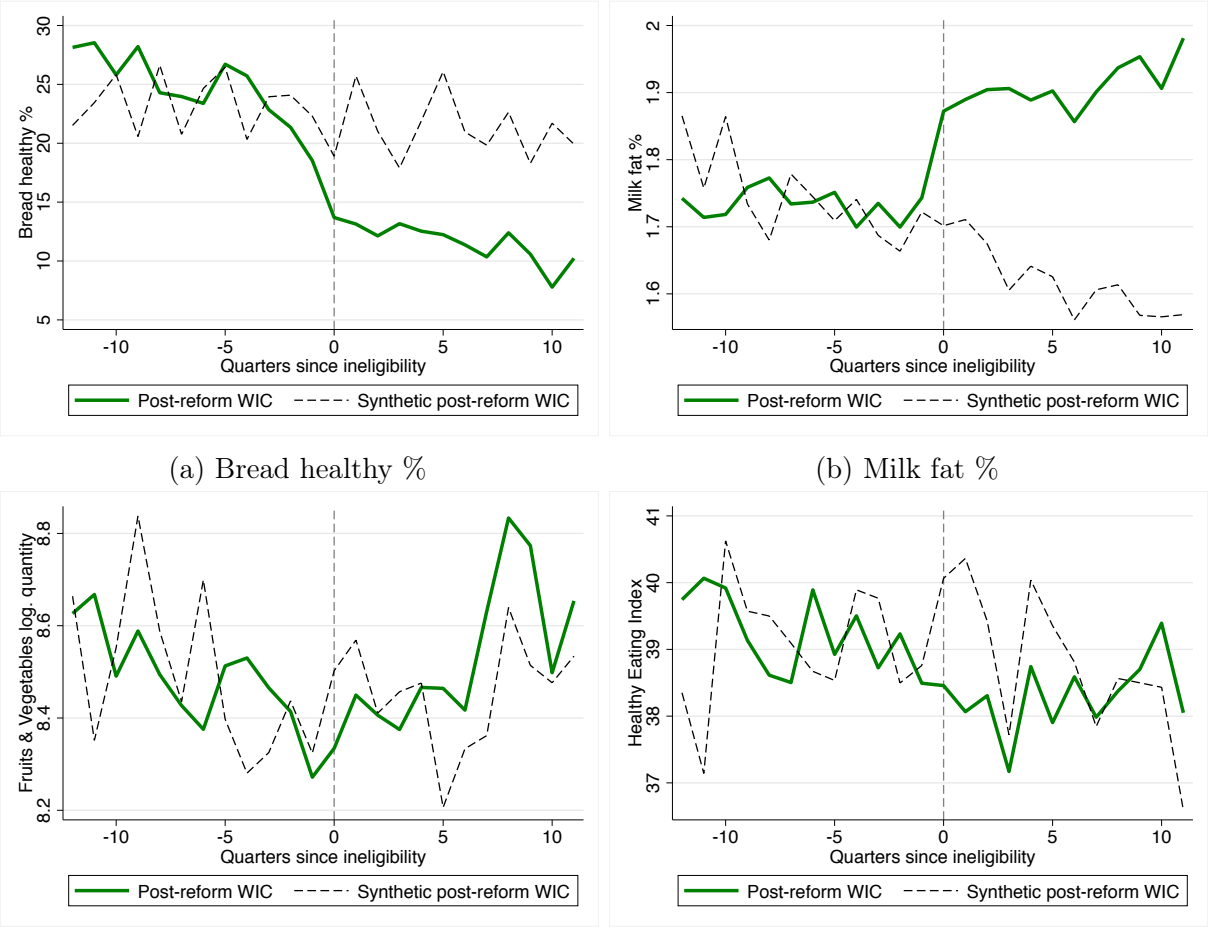
(b) Milk fat %

(c) Log. quantity of fruits and vegetables

(d) Healthy Eating Index

Figure A1: Synthetic control method estimates of the impact of post-reform WIC

Note: The figure describes the average treatment effect on treated by presenting averages of outcome variables of households exposed to post-reform WIC (treatment group) and their corresponding synthetic control groups 3 years before and after starting receiving WIC vouchers. The outcome variables are healthy bread share, milk fat percentage, logarithm of quantity of fruits and vegetables, and the Healthy Eating Index. The sample includes households in columns 1–3 in table 1. For the non-WIC households, a random time period is drawn when they started to receive WIC vouchers. For each of the treated units (households exposed to post-reform WIC) a synthetic control group is constructed. The control group is re-weighted to match the treated unit in the following characteristics: logarithm of income, household size, education, race, children, whether ever receives WIC assistance, and pre-treatment year averages of the outcome variable.



(a) Bread healthy %

(b) Milk fat %

(c) Log. quantity of fruits and vegetables

(d) Healthy Eating Index

Figure A2: Synthetic control method estimates of long-term impact of post-reform WIC

Note: The figure describes the average treatment effect on treated by presenting averages of outcome variables of households exposed to post-reform WIC (treatment group) and their corresponding synthetic control groups 3 years before and after WIC eligibility has ended. The outcome variables are healthy bread share, milk fat percentage, logarithm of quantity of fruits and vegetables, and the Healthy Eating Index. The sample includes households in columns 1–2 in table 1. For each of the treated units (households exposed to post-reform WIC) a synthetic control group is constructed. The control group is re-weighted to match the treated unit in the following characteristics: logarithm of income, household size, education, race, children, and pre-treatment year averages of the outcome variable.

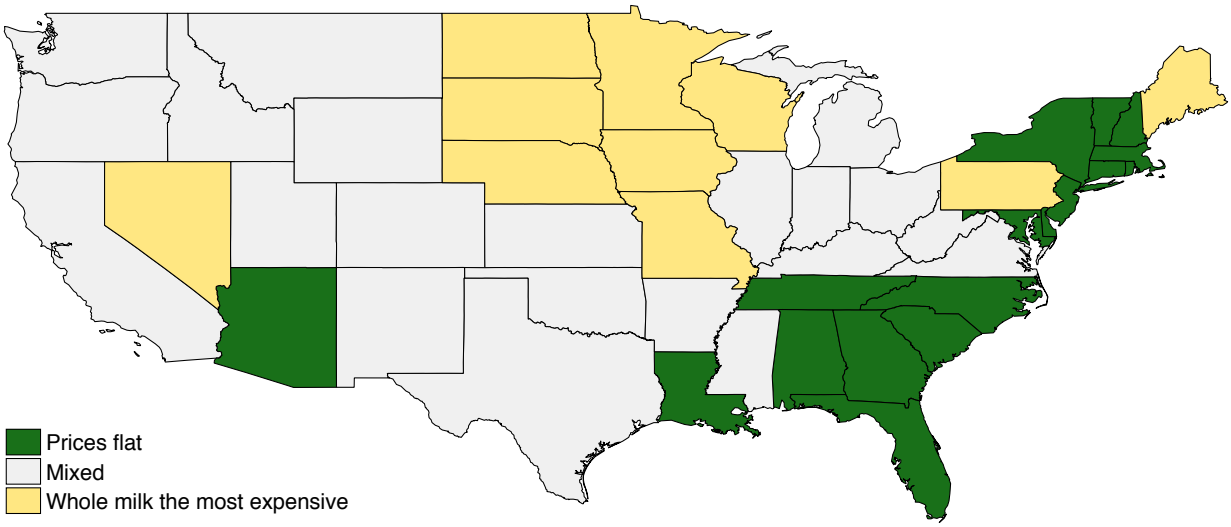


Figure A3: Milk prices

Note: States are categorized to those with flat prices where the price of whole milk is not higher than others, those where whole milk is more expensive than others (at least 5 cents more expensive), and those with mixed price rankings. States are categorized based on state-level median milk price differences of different fat percentages (whole milk, 2%, 1%, and skim milk) across stores and time periods using data on private label one-gallon milk.

B Online Appendix: Dataset construction

In this Appendix, I describe the construction of the dataset from the Nielsen Homescan consumer panel and Retail Scanner dataset from years 2006–2016. Retail Scanner dataset is used to construct price variables and Homescan consumer panel is used for purchases.

Purchases of subsidized products. In the case of bread, I concentrate on loaves of bread. I exclude organic products, multi-unit products, and unusual package sizes. That is, I restrict the sample to four most common package sizes: 16, 20, 22, and 24 oz. Note that in the majority of states, only 16 oz package bread is allowed as a WIC product, some states also allow 24 oz packages.

In the case of milk, I concentrate on dairy white fluid refridgerated milk. I exclude goat milk, lactose free milk, and organic milk. I also drop multi-unit products, and unusual package sizes. That is, the package sizes which I keep are: one gallon, half a gallon, and a quart (0.25 gallon). Note that in the majority of states, only one gallon package size is allowed as a WIC product, a few states also allow half a gallon and a quart. I keep only packages which are either plastic or carton, and drop glass bottles and other unusual packages.

Fruits and vegetables include fresh, frozen, and canned products. Fruits and vegetables include all products with barcodes (UPCs), except potatoes. Juice includes regular, frozen, and concentrated juice, but not fruit drinks. Cereals include breakfast cereals, hot cereals (including grits and cream of wheat), and granola.

Nutritional characteristics. Nutritional information of the products is obtained from the USDA databases. However, the databases do not include nutritional information for all the products in the Nielsen dataset. I use a sequential matching procedure similar to what is used by Dubois et al. (2014) and Oster (2018).

Product definition and aggregation of purchases in reduced form analysis (section 3). In section 3, purchases of each product are summed up to quarterly level. Following WIC regulations, I classify a bread as whole wheat bread if it is made using 100% whole wheat flour. A bread that only partially is made using whole wheat flour is classified as non-whole-wheat.

Product definition and aggregation of purchases in demand model estimation (section 4). In section 4, I group bread into four products: whole wheat, whole grain,

white, and other. Whole wheat bread is defined as before if bread is made with 100% whole wheat flour, whole grain contains whole wheat, whole grain, or rye flour (except 100% whole wheat), white bread is from white refined flour, and other bread aggregates together all other non-whole-grain bread types. Purchases of each product are aggregated to weekly level. When household purchased more than one product in a week, then I only include the largest (in terms of weight) purchase.

Underreporting of WIC status. In the survey data, household's WIC status seems to be underreported. The information on WIC status is collected via a survey question, which households are not required to answer. Therefore, as expected, in the dataset, the reported share of households receiving WIC assistance is lower than in the administrative data. Figure B4 shows the percentage of income eligible households who report receiving WIC assistance, by the age of the youngest child. The figure illustrates two aspects of the data. First, the magnitude of underreporting. Back-of-the-envelope calculations suggest that about forty percent of WIC participants report it in the survey.[18] Second, the households' reported WIC participation mirrors well the pattern in the administrative data. Namely, WIC participation is the highest during the calendar year when the child is born and decreases after that up to the child's fifth birthday. In the analysis, I focus on households who report receiving WIC assistance.

Construction of prices. For the main analysis, I use the same weight for private label versus brand across products in a given state in a given year. Specifcally, to aggregate UPC level prices to product prices, first I convert these to price per ounce. Then, for each of the products (white, whole wheat, whole grain, and other bread), I calculate the weighted average prices separately for private label and branded products for each state and week. The weight of the UPC is equal to its share of volume of that product in a state in a given year. Finally, for each product, state, and week triplet, I calculate the weighted average price combining the prices of private label and branded products. The weight of a private label product is equal to its share of volume across all bread in a given state in a given year.

For robustness analysis, I also calculate the weighted average prices, where UPC level prices are aggregated using weights that are equal to UPC's share of volume of that product in

[18] According to the USDA report (Johnson et al., 2014), around 80% of eligible infants (up to their first birthday) receive WIC. However, in this dataset, the reported WIC participation of the corresponding households is 35%. According to the administrative data, participation of children aged 1–4 is about 50%, but in this dataset, only around 20%.

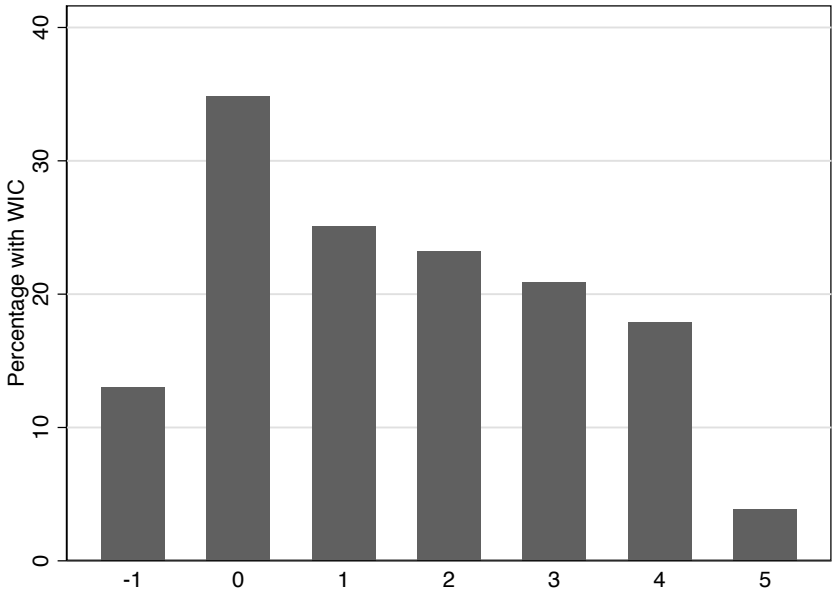


Figure B4: Percentage of households reporting receiving WIC assistance, by the years since the youngest child is born

Note: Sample is restricted to WIC income eligible households. Calculated as an average over household-years and weighted by Nielsen projection weights. Year 0 indicates that the youngest child is born during the current panel year. Income eligibility is calculated using the mid-point value of Nielsen reported household income interval.

a state in a given week. These prices have larger price differences between products compared to the prices used in the main analysis. This happens because, even though, for a given brand (or private label), price differences between the products are not that large, households that tend to buy cheaper products also tend to buy private label products.

Prices are deflated to 2015 dollars using the consumer price index for urban consumers.

Construction of demographic variables. I generate income variable as the mid-point of the reported income interval. Except for the highest income group, for which the mid-point cannot be calculated as no highest level is reported. For that group I assume that their household annual income equals 115,000 dollars, which is consistent with the current income distribution. Income is deflated to 2015 dollars using the consumer price index for urban consumers. In the demand model, *Age* is the average age of household heads at the baseline, that is, during the first year when they are in the sample. The variable is calculated at the baseline and kept constant for each household over time to capture the impact of age and

not the possible trend over time. To avoid that the impact of age is mainly driven by the upper tail, I cap the age at the 99th percentile.