WIC Participation and Relative Quality of Household Food Purchases

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Outline

- Overview of US Food and Nutrition Assistance Programs
- WIC Program
- Our study
- Arkansas panel data on school children's body mass index (BMI)
- Other current research projects using these data

US Nutrition & Food Assistance Programs (~$100B/year)

- About 25% of Americans participate in 1 or more of domestic food and nutrition assistance programs that provide children and needy families better access to food and a more healthful diet. These programs also represent a significant Federal investment, accounting for over two-thirds of USDA's budget.

- Supplemental Nutrition Assistance Program (SNAP) (Food Stamps Program)
  - provides nutrition assistance to eligible, low income individuals and households via a monthly benefit on a debit like card that is used at authorized retailer stores to purchase food. Largest program in the domestic hunger safety net.

- Child Nutrition Programs
  - NSLP, NSBP, FFVP

- WIC

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

- US food assistance program that focuses on pregnant, postpartum or breastfeeding women, infants, and children up to 5 years old

- As the 3rd largest food and nutrition assistance program, WIC served about 7.3 million participants per month in fiscal year 2017,

- Started in 1974; serves half of US infants and close to 30% of children, pregnant women and postpartum women

- Provides federal grants to states for:
  1. Supplemental foods
  2. Health care referrals
  3. Nutritional education

WIC Eligibility

- Categorical
  - Women who are pregnant, postpartum (up to 6 months), or breastfeeding (up to one year)
  - Infants up to one year old
  - children up to the 5th birthday

- Residential
  - Must live in the state where benefits are received
  - Income - set by the state, but no more than 185% of the federal poverty guideline.

2016 Poverty Thresholds

$12,486 for a single individual under age 65

$14,507 a household of two people with a householder 65 years or older with no children

$24,339 for a family of four with two children under age 18

Past Studies

- A lot of focus on birth outcomes (Sonchak 2016; Currie and Rajani 2014; Gai and Feng 2012; Hoynes et al. 2011; Figlio et al 2009)

- WIC associated with improvements in birth outcomes

Selection Bias Issue

Effect can be overestimated - if participation is more attractive to those who are concerned about health (Gordon and Nelson 1995; Besharov and Germanis 2001).

Effect can be underestimated - if participants more likely to have characteristics associated with poor health (Bitler and Currie 2005).

Selection Bias and Birth Outcomes

- WIC effects on birth outcomes found robust to selection bias (Currie and Rosin-Slater 2015). Some strategies include:
  - maternal fixed effects (Sonchak 2016; Currie and Rajani 2014);
  - exploiting staggered deployment of WIC across counties early in the program history (Hoynes, Page and Stevens 2011);
  - comparing outcomes from mothers transitioning into and out of the program over multiple births (Figlio, Hamersma, and Roth 2009).

Selection Bias and Nutritional Outcomes

- WIC participation associated with improvements in dietary quality, nutrient intakes, and/or biochemical indicators of nutritional adequacy (see Fox et al. 2004; Black et al. 2012).

- Less direct attention on role of selection bias

- Evidence whether WIC foods matter is important to understanding the mechanisms by which the program leads to better health

Our Research Question:

Does WIC participation meaningfully alter food choices in a way that would be conducive to improvements in diet?

Why is this question especially important now?

- WIC is targeted for cuts in the White House's budget proposal (Aisch and Parlapiano 2017).
- WIC foods account for 70% of program cost (Oliveira and Frazão 2015)
- Supplemental nature led some to question whether WIC is sufficiently meaningful
- Others think that it is other program features (education, nutrition referrals) that could be responsible for mitigating the likelihood of poor outcomes
- Thus, evidence on whether WIC foods matter is important to understanding the mechanisms by which the program leads to better health!

Secondary Aim

Understand whether geographic barriers impact WIC participation

Two questions:

1) Whether inadequate access to WIC clinics limits participation

   Binary variable taking the value of one if the household was within one (ten) miles of a clinic and located in an urban (rural) tract.

2) Whether quality of household food purchases differs meaningfully for participants without access to supermarkets

   Based on food desert status as indicated by USDA tract measures.

   A tract is considered low access if at least 100 households are more than ½ mile from the nearest supermarket and have no access to a vehicle; or at least 500 people or 33 percent of the population live more than 20 miles from the nearest supermarket, regardless of vehicle access.

Using FoodAPS Data to Answer the Question

- Focus on dietary quality of food purchases.
- We can distinguish between WIC participating households who used WIC for purchases and those who did not.
- Sample was not stratified by time of month or date of delivery of WIC benefits – so the samples of WIC households using or not using WIC benefits should be nearly random
- We match both groups to eligible non-participants
- Use PSM and Supervised Machine Learning

General Findings

- WIC households have higher quality of food purchases than eligible non-WIC households (5.5% improvement)
- Driven by WIC households who redeemed WIC foods during interview week
- No significant difference between WIC participants who did not redeem WIC foods and eligible non-participants
- Geographic barriers - WIC clinic access not adversely affecting participation and quality of food purchases not dependent on supermarket access

Data: FoodAPS

- From US Department of Agriculture
- First nationally representative survey of American households to collect unique and comprehensive data about household food purchases and acquisitions.
- Detailed information was collected about foods purchased or acquired for consumption at home and away from home, including foods acquired through food and nutrition assistance programs.

FoodAPS

The survey was fielded between April 2012 and January 2013 and collected information about:

- Quantities and expenditures for all at-home and away-from-home foods and beverages purchased and acquired from all sources by all household members over a seven-day period;
- Eating occasions by all household members;
- Household characteristics, including income, program participation, non-food expenditures, food security, health status, and diet and nutrition knowledge; and
- Household access to food, including location of purchase and distance to food stores and restaurants.

Data

- FoodAPS collected food purchases over the course of 7 days
- USDA constructed the “household HEI” - we call Healthy Purchase Index (HPI)
- Standardized by SAE (standard adult equivalents) - takes into consideration differing nutrient needs by gender and age and thus accounts for different household compositions

Data

- Assembled two geographic barriers: supermarket access and WIC clinic access

  Supermarket access measure using USDA's tract-level measure indicating limited access to supermarkets

  We assembled Clinic data.
  - We used 2012-2013 locations if available otherwise 2015-2016 locations.
  - USDA-ERS personnel took our clinic data and provided radial distances from each household to the nearest WIC clinic.

Healthy Purchase Index (HPI)

- Measures a household's ability to meet US dietary guidelines from its food purchases

- 12 Dietary Components
  - Total fruit
  - Whole fruit
  - Total vegetables
  - Greens and beans
  - Whole grains
  - Dairy
  - Protein foods
  - Seafood and plant proteins
  - Fatty acids
  - Refined grains
  - Sodium
  - Empty calories

- Based on the HEI-2010, but differs primarily in that
  - it is computed over food purchases as opposed to food intake and
  - it is measured at the household as opposed to the individual level.

Descriptive Statistics for the Sample

Variable	Eligible Non-Participants	WIC Participants		
		All	Redeemed WIC	Did Not Redeem WIC
	N = 505	N = 423	N=152	N=271
Healthy Purch. Index	50.388	50.259	55.958	47.062
Rural	0.236	0.234	0.257	0.221
Marital Status	0.626	0.539	0.579	0.517
Hispanic	0.247	0.392	0.351	0.415
African American	0.156	0.172	0.112	0.205
Less High School	0.081	0.163	0.164	0.162
High School	0.196	0.324	0.309	0.332
Some College	0.384	0.369	0.355	0.376
College or Higher	0.339	0.144	0.171	0.129
Monthly Income ($1000)	5.144	2.834	3.071	2.702
WIC Eligible Children	0.853	0.749	0.822	0.708
WIC Eligible Infants	0.129	0.286	0.342	0.255
WIC Eligible Woman	0.158	0.296	0.283	0.303
WIC Clinic Access	0.358	0.404	0.362	0.428
Supermarket Access	0.145	0.220	0.191	0.236
Self-reported Healthy Diet	0.382	0.409	0.375	0.428

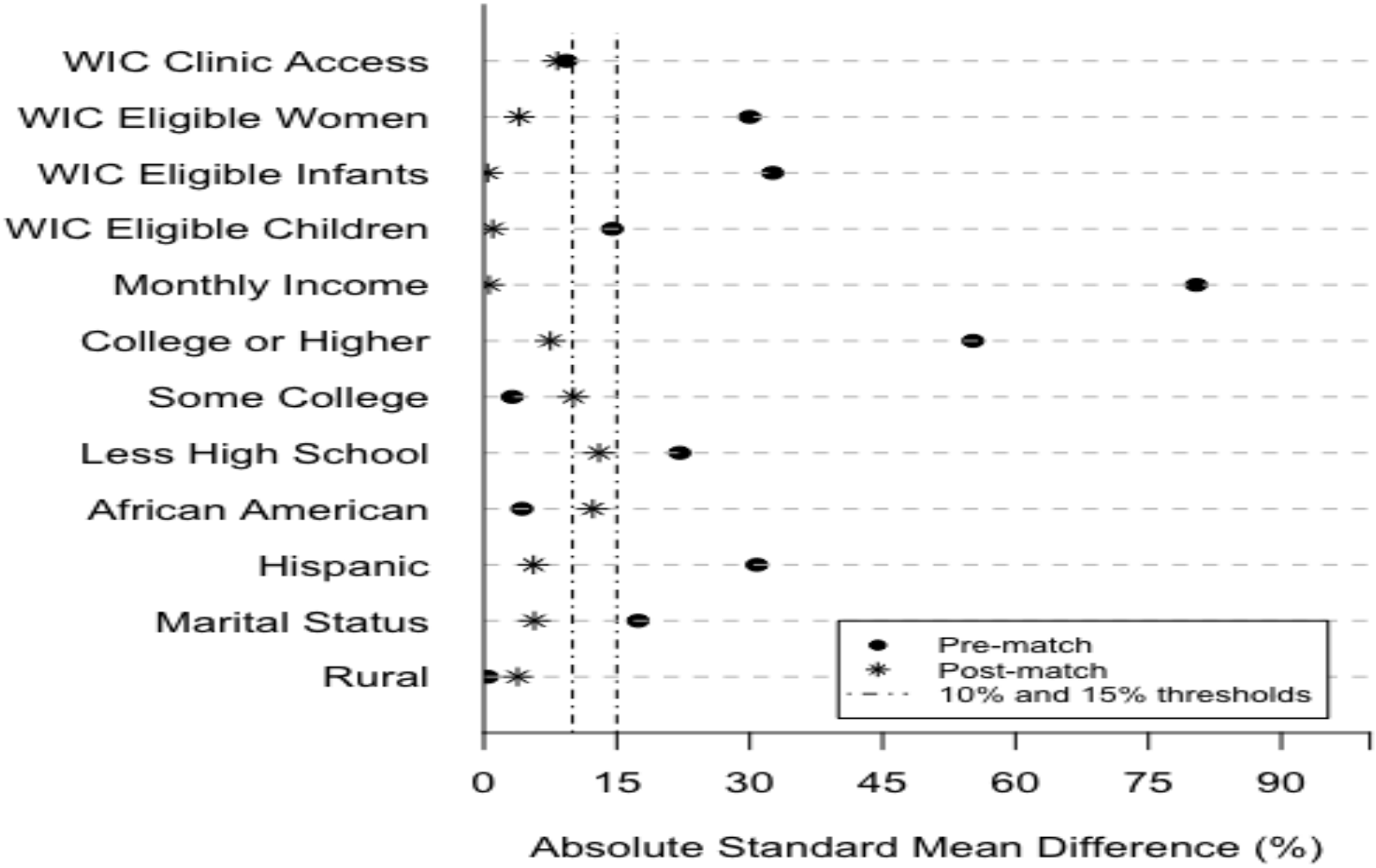
Matching WIC Households to Eligible Non-WIC Households

- Given lack of data for valid instrument, matching methods provide a way to reduce selection bias among observational data (Rosenbaum 2002; DiPrete and Gangl 2004).
  - The goal is to find a group of non-treated individuals who are similar to the treated individuals in all baseline characteristics.
  - Matching mimics a randomized experiment conditional on observed characteristics
- We use propensity score matching (with logistic regression to estimate the propensity score) (Rosenbaum and Rubin 1983; 1985).

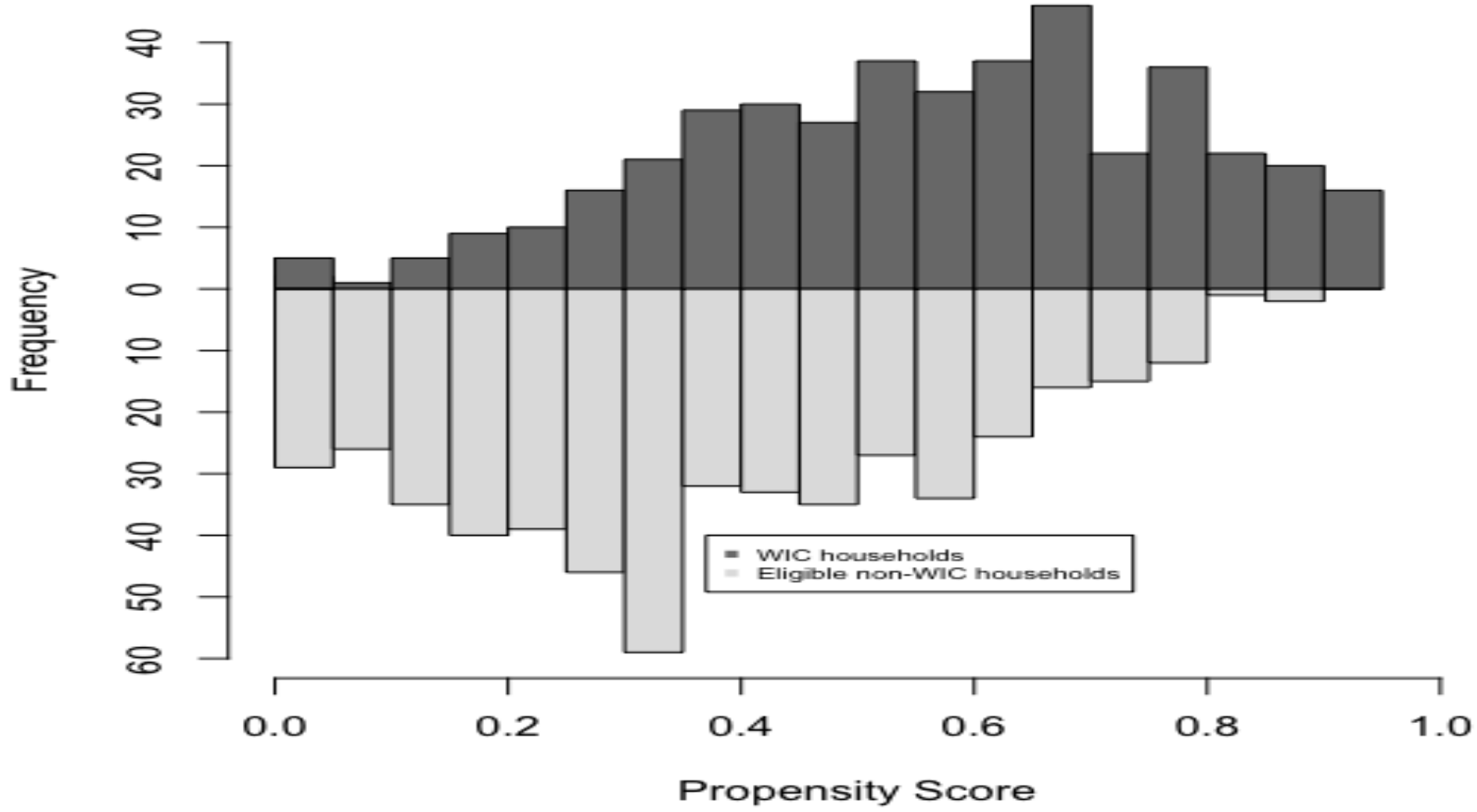
Logit Model used to Match WIC Participants to Eligible Non-Participants (marginal effects, including state fixed effects)

	Estimate
Rural	0.063
	(0.044)
Marital Status	0.026
	(0.033)
Hispanic	**0.161*** **
	(0.044)
African American	0.076
	(0.048)
Less High School	0.024
	(0.052)
Some College	-0.050
	(0.037)
College or Higher	**-0.193*** **
	(0.046)
Monthly Income	**-0.039*** **
	(0.007)
WIC Eligible Children	-0.022
	(0.024)
WIC Eligible Infants	**0.157*** **
	(0.038)
WIC Eligible Woman	**0.172*** **
	(0.037)
WIC Clinic Access	-0.025
	(0.035)
Number of Observations	928

Assessing the Quality of Matched Samples



Distribution of propensity scores among WIC and eligible non-WIC households before the imposition of common support



Standard mean differences between WIC and eligible non-WIC households (0.05 level)

Variable	Pre-match	Post-match
Rural	-0.378	3.802
Marital Status	-17.38*	5.732
Hispanic	30.783*	5.618
African American	4.325	-12.272
Less High School	22.149*	-12.995
Some College	-3.181	10.065
College or Higher	-55.273*	7.483
Monthly Income	-80.368*	0.642
WIC Eligible Children	-14.496*	-1.043
WIC Eligible Infants	32.585*	0.392
WIC Eligible Woman	30.011*	4.037
WIC Clinic Access	9.33	8.292

Effect of WIC Participation (ATT) on Healthy Purchasing Index Score from Matched WIC Subsamples.

	All Participants	Redeemed WIC	Did Not Redeem WIC
ATT estimate	2.742	9.443	-0.843
Standard error	1.351	1.573	1.421
p-value	0.042	<0.001	0.553
N (post-match)	534	178	337
Critical value	Sensitivity to Hidden Bias (Gamma)[a]		
0.05	1.13	2.82	-
0.10	1.17	3.05	-

Hidden Bias: Gamma

- The amount of change needed in the odds of being treated due to unobservables to change our inference.

- As the Rosenbaum test reveals, our ATT from the sample of all WIC participants switches from being statistically significant to insignificant at a gamma value of 1.13 and 1.17 at the 5 and 10 percent levels, respectively. This indicates that the odds of being treated must change 1.17 times due to unobservables to change inference (3.05 times for those who redeemed WIC at 0.10 level)

Average Treatment Effect on the Treated (ATT) Estimates from Matched Subsample of Households who Redeemed WIC by Component of the Healthy Purchasing Index (HPI).

HPI Component	ATT Estimate	Standard Error	p-value	Hidden Bias (Gamma)[a]	
				0.05	0.10
Adequacy components					
Total vegetables	-0.101	0.189	0.594	-	-
Greens and beans	0.237	0.254	0.350	-	-
Total fruit	0.798	0.202	<0.001	1.89	2.02
Whole fruit	0.534	0.247	0.031	1.30	1.39
Whole grains	1.829	0.338	<0.001	2.25	2.43
Total dairy	1.001	0.415	0.016	1.28	1.36
Total protein	0.076	0.179	0.673	-	-
Seafood and plant protein	0.901	0.261	<0.001	1.49	1.59
Fatty acids	0.398	0.473	0.400	-	-
Moderation components				-	-
Sodium	0.816	0.466	0.080	-	-
Refined grains	1.173	0.516	0.023	1.22	1.30
Empty calories	1.782	0.737	0.016	1.53	1.63

Cash Value Voucher (CVV) issue

Food packages are redeemed for specific quantities of food - but in October 2009, USDA introduced cash-value vouchers (CVV) earmarked just for fruits and vegetables.

Makes up approximately 10% of the total WIC food costs, and ranks third after the cost of infant formula and the cost of milk (Oliveira and Frazao 2015).

FoodAPS does not separately identify CVV so the relatively small value recorded for FV expenditures may reflect misreporting when using CVV (National Academies of Sciences, Engineering, and Medicine 2017)

So our estimates of WIC effects for FV may be lower bound

Robustness Checks on the Importance of WIC Foods

One potential issue:

WIC approved retailers have to stock healthier foods, which can account for some improvement in HPI.

So differences in shopping venue could account for WIC effects

To address the this issue:

We restricted the sample to include only households who shopped at a WIC-approved retailer during the interview period.

Outcome: Similar Results!

Effect of WIC Participation (Average Treatment Effect on the Treated (ATT)) on Healthy Purchasing Index Score from Matched WIC Subsamples: Excludes Households not Shopping at a WIC-approved Store.

	All Participants	Redeemed WIC	Did Not Redeem WIC
ATT estimate	2.671	9.385	-0.963
Standard error	1.353	1.579	1.425
p-value	0.048	<0.001	0.499
N (post-match)	527	178	330
Critical value	Sensitivity to Hidden Bias (Gamma)[a]		
0.05	1.13	2.80	-
0.10	1.17	3.02	-

Robustness Checks on the Importance of WIC Foods

- Another potential issue:

  A secondary selection problem may exist if some WIC participants systematically more likely to only partially redeem benefits - if shopping venues only stock partial WIC foods or if some households deem some WIC foods to be undesirable.

- To address the this issue:

  We re-estimated the ATT using an HPI that excludes items from shopping events where WIC redemptions accounted for majority of the total expenditures.

  Outcome: No longer a significant WIC effect once WIC foods are effectively removed from HPI

Effect of WIC Participation (Average Treatment Effect on the Treated (ATT)) on Healthy Purchasing Index Score from Matched WIC Subsamples: Healthy Purchasing Index Excludes Primary WIC Purchase Events.

	All Participants	Redeemed WIC	Did Not Redeem WIC
ATT estimate	-0.087	1.420	-0.843
Standard error	1.277	1.520	1.421
p-value	0.946	0.351	0.553
N (post-match)	534	178	337

Additional Findings

- We explore the heterogeneity among households with and without access to supermarkets.
  - There is no compelling evidence that nutritional improvements from WIC are adversely affected by supermarket access.

- We also explore the heterogeneity among households who reported having healthy diets and those who reported otherwise.
  - There is no significant difference in ATT estimates.

Robustness check using Machine Learning

- With PSM, we assumed a certain functional form
- In reality, this relationship could be complex
- Used generalized random forest developed by Athey, Tibshirani, and Wager (2017)
- Method relies on use of “honest trees” and a type of residual-on-residual regression in the leaves to eliminate the effect of confounding

Effect of WIC Participation on HPI from a Generalized Random Forest

	ATT Estimate	Standard Error
All Participants	2.267***	0.820
Subsample that Redeemed WIC	7.720***	1.161
Subsample that Redeemed WIC (HPI exc. WIC events)	-0.109	1.105
Subsample that did not Redeem WIC	-0.903	0.873
HPI Component (Subsample that Redeemed WIC)[A]		
Adequacy components		
Total vegetables	-0.264	0.135
Greens and beans	0.125	0.167
Total fruit	0.582***	0.143
Whole fruit	0.276	0.170
Whole grains	1.166***	0.258
Total dairy	0.978***	0.267
Total protein	-0.044	0.123
Seafood and plant protein	0.632***	0.182
Fatty acids	0.227	0.308
Moderation components		
Sodium	1.020***	0.332
Refined grains	0.496	0.337
Empty calories	2.445***	0.498

Conclusion

- Households participating in WIC have higher quality of food purchase compared to eligible non-participating households.
- This difference is driven entirely by households who redeemed WIC foods during the interview week.
- WIC foods, rather than self-selection of more nutrition-conscious households into the program, explain the improvement.
- Geographic barriers do not appear to be limiting WIC participation.

Arkansas Panel Data on Children's BMI

- Act 1220 - passed in 2003 by the Arkansas General Assembly in hope of reducing the high rates of childhood obesity within the state.
- With the passage of this act, first state to systematically assess children for bodyweight.
- Screening implemented by trained personnel in public schools across the state
- Our analysis of these confidential longitudinal data takes place on a secure computer in ACHI office in Little Rock, Arkansas.

Our research using Arkansas school children BMI panel data

- Effect of food retail environment (fast food restaurants, supermarkets, food desert)
- Effect of FFVP program
- Effect of recreational trails
- Effect of BMI report card
- Value of early childhood BMI screening if we can predict obesity by 4^{th} grade
- No child left behind policy
  - whether students attending schools that are close to school accountability cutoff are relatively overweight/obese compared to those attending schools that are further away from the cutoff.
- Merging of educational achievement scores and BMI data (near future initiative)

Other related projects

- Time use of SNAP recipients across benefit cycle (using ATUS)
- Double-up Food Bucks using a natural experiment involving supermarkets

Survey Questions Used by USDA to Assess Household Food Security

1. "We worried whether our food would run out before we got money to buy more." Was that often, sometimes, or never true for you in the last 12 months?

2. "The food that we bought just didn't last and we didn't have money to get more." Was that often, sometimes, or never true for you in the last 12 months?

3. "We couldn't afford to eat balanced meals." Was that often, sometimes, or never true for you in the last 12 months?

4. In the last 12 months, did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food? (Yes/No)

5. (If yes to question 4) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

6. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food? (Yes/No)

7. In the last 12 months, were you ever hungry, but didn't eat, because there wasn't enough money for food? (Yes/No)

8. In the last 12 months, did you lose weight because there wasn't enough money for food? (Yes/No)

9. In the last 12 months did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food? (Yes/No)

10. (If yes to question 9) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

(Questions 11-18 were asked only if the household included children age 0-17)

11. "We relied on only a few kinds of low-cost food to feed our children because we were running out of money to buy food." Was that often, sometimes, or never true for you in the last 12 months?

12. "We couldn't feed our children a balanced meal, because we couldn't afford that." Was that often, sometimes, or never true for you in the last 12 months?

13. "The children were not eating enough because we just couldn't afford enough food." Was that often, sometimes, or never true for you in the last 12 months?

14. In the last 12 months, did you ever cut the size of any of the children's meals because there wasn't enough money for food? (Yes/No)

15. In the last 12 months, were the children ever hungry but you just couldn't afford more food? (Yes/No)

16. In the last 12 months, did any of the children ever skip a meal because there wasn't enough money for food? (Yes/No)

17. (If yes to question 16) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

18. In the last 12 months did any of the children ever not eat for a whole day because there wasn't enough money for food? (Yes/No)