Does School Lunch Fill the "SNAP Gap" at the End of the Month?

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Abstract
This paper examines the relationship between the timing of SNAP benefit payments and participation in school lunch and breakfast using the National Household Survey of Food Acquisitions and Purchases (FoodAPS). An event study approach examines participation over the five-day window before and after the SNAP payment. We find that school lunch participation decreases 17 to 23 percentage points immediately after the SNAP payment among 11-18 year olds while breakfast drops 19 percentage points to 36 percentage points. The decline begins the day prior to payment. We find no effects for 5-10 year olds. Models examining participation over the full SNAP month using individual random effects yield similar findings. Among teenagers, participation in school lunch and breakfast decline in the first two weeks of the SNAP month, increasing afterwards. Non-school meals show the opposite pattern. Overall, results indicate SNAP households rely more on school lunch and breakfast toward the end of the SNAP month. Older children substitute away from school meals to non-subsidized meal options earlier in the SNAP benefit cycle.

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1. Introduction

In 2016, approximately 12.3% of households in the US were food insecure. This means that a significant number of Americans, at some point, were unable to cover their food and nutrition needs (Coleman-Jensen et al., 2017). Children are not exempt from experiencing food insecurity. In 2016, children were food insecure in roughly 8% of households with children (Coleman-Jensen et al., 2017). There are several programs in the country to help families and their children meet their nutrition and food needs. Two of the largest are the Supplemental Nutrition Assistance Program (SNAP) and the National School Lunch Program (NSLP). There is evidence that these programs contribute to ameliorate food insecurity (i.e. Hoynes & Schanzenbach, 2015), however, much remains to be learned about their effectiveness, and how households use them. Further, while many families with children are likely to use both SNAP and school lunch, little research documents the relationship between them.

According to a recent report from the White House Council of Economic Advisers (2015), monthly SNAP payments are insufficient to cover a family's food needs for the entire month. Persuasive empirical evidence shows that, indeed, food consumption, purchases and nutrition intake decrease toward the end of the SNAP benefit cycle, especially during the last week of the SNAP month (Shapiro, 2005; Hoynes & Schanzenbach, 2015). That is, there is a "SNAP gap" at the end of the month. Is there a countervailing increase in school lunch participation? To what extent does the NSLP ameliorate this exhaustion of benefits, that is "close the SNAP gap"?

This paper answers these questions using newly available data from the National Household Food Acquisitions and Purchase Survey (FoodAPS), a nationally representative survey that tracks food acquisitions for all members of a household – including children – for seven days. We take advantage of the longitudinal nature of FoodAPS, and construct a child by day dataset with measures of SNAP participation, days since SNAP payment and measures of school and non-school meal participation.[2] We use two distinct empirical approaches. First, we use an event study approach leveraging the subset of FoodAPS households that received their SNAP payment during data collection week. For this analysis, we compare school meal participation for children in these households in the five weekdays before SNAP payment to participation in the five weekdays after the SNAP payment. This strategy yields an estimate of the short-run effect of SNAP on school meal participation. Second, we examine the evolution of participation in school meals over the full SNAP month exploiting the panel nature of our data to estimate models with individual random effects.

To preview our findings, short-run models show a decline in both school lunch and breakfast right after SNAP payment among 11-18 year olds. Specifically, lunch participation drops by 17 percentage points and breakfast participation declines by 20 percentage points for this age group. We find some evidence of an "anticipation effect" – school meal participation decreases 18 percentage points the day before SNAP pay, and continues to drop following benefit receipt (23 percentage points). Breakfast also declines – 25 percentage points the day before SNAP pay rising to 36 percentage points in the days after payment. Finally, among 11-18 year olds, non-school breakfast increases substantially after SNAP benefits. Younger children seem less responsive. There is no significant change in school meal participation for 5-10 year olds around the SNAP payment date, although non-school breakfast acquisitions decrease after SNAP payments.

Our full month models yield similar results. We find that 11-18 year olds drop school

[2] We will refer to our main outcome variables as measuring participation in school or non-school meals, but because FoodAPS only records food acquisitions we do not know if children actually ate the meal they acquired.

meal participation for the first two weeks of the SNAP benefit cycle reaching the lowest point – 23 percentage points for lunch and 21 percentage points for breakfast – on days 11 to 15 of the SNAP month. For all school meals, participation increases after that. We observe the opposite trend for non-school meals. As before, results for 5-10 year olds are generally not significant.

In sum, this paper provides evidence that school meals might offset declines in food benefits at the end of the SNAP month, especially for teenagers who are less likely to participate in school meal programs. This group, however, substitutes away from school meals when SNAP benefits are high. We also explore differences by gender and race/ethnicity. Event study results show a larger drop in school lunch participation after SNAP for females than males, but smaller differences in breakfast participation. As for race/ethnicity, school lunch declines are driven by non-white children 11 to 18 years old. There are no large differences by race/ethnicity for school breakfast participation, but increases in non-school breakfast are driven by whites.

The rest of the paper is organized as follows. Section 2 reviews the literature and develops a theoretical framework. Section 3 describes the FoodAPS data, our measures, and sample. Section 4 outlines the empirical strategy. We discuss results and robustness tests in section 5, and conclude in the last section.

2. Literature Review and Theory

Supplemental Nutrition Assistance Program (SNAP)

In 2008, SNAP became the new name of the Food Stamp Program to reflect the increased emphasis on nutrition as well as higher benefit amounts and it is the largest food assistance program in the US. In 2016, close to 23 million households participated in the program. To qualify for SNAP, households need to meet either categorical eligibility or certain income, resource, and employment requirements[3]. SNAP recipients redeem their benefits electronically using an Electronic Benefit Transfer (EBT) card to purchase eligible food items. In 2016, there were 260,115 stores authorized to accept SNAP. Program benefits are fully funded by the federal government, and funds are authorized by Congress. The costs of administering the program, however, are shared by the federal, state, and local governments. In 2015, the SNAP participation rate for all eligible individuals was 83%, while the participation rate of employed poor persons was lower at 72% (Farson Grey & Cunnyngham, 2017). Overall, households below the poverty line participate more than those above but still eligible, as do households with children (Farson Grey & Cunnyngham, 2017).

In 2015, over 40% of SNAP participants were 18 years old or younger and the vast majority reside in urban areas. That same year, the average income of SNAP participants was $786, and SNAP benefits averaged $254. Participation in the Temporary Assistance for Needy Families (TANF) program among SNAP households is low – less than 6% of SNAP households received benefits as of 2015 (Farson Gray, Fisher, & Lauffer, 2016).

SNAP and food consumption

A large and rich body of work documents the relationship between SNAP and various outcomes including spending and consumption (Hoynes & Schanzenbach, 2009; Gundersen & Ziliak, 2003), food security and nutrition (Castellary et al., 2016; Hoynes & Schanzenbach, 2015) and health (Gibson, 2003; Seligman et al., 2014). A subset of this literature focuses on children, and, among these, many study the effects on BMI and obesity (Gibson, 2004;

[3] For additional details see: http://www.fns.usda.gov/snap/eligibility#Employment%20Requirements

Schmeiser, 2012). More recently, attention has shifted to investigating how the timing of SNAP benefits influences behavior and consumption. This is an important issue, especially for households with children because of the consequences for food security. Indeed, in 2009, most households with children had exhausted at least half of their SNAP benefits within two weeks, and nearly 50% had used almost all of their benefits (Castner & Henke, 2011). This exhaustion in benefits has consequences for a household’s food consumption. In an earlier study, Wilde and Ranney (2000) find that consumption decreases during the SNAP month, suggesting this drop is the result of households making larger shopping trips at the beginning of the month, possibly due to transportation constraints. Shapiro (2005) uses survey data, and also finds a decline in consumption and caloric intake at the end of the SNAP month. Contrary to Wilde and Ranney (2000), he finds no difference for households that make frequent trips. Todd (2014) finds similar results, including decreases in the consumption of certain products such as milk, vegetables and meat especially in the period before the benefit increase of the American Recovery and Reinvestment Act (ARRA) of 2009. Data collected from SNAP recipients support this evidence. SNAP recipients report purchasing and eating a greater variety of foods at the beginning of the month (Darko, Eggett & Richards, 2013; Seefeldt & Castelli, 2009).

While consumption decreases at the end of the SNAP benefit payment cycle, other behaviors are affected as well. For example, SNAP recipients are more likely to shop at grocery stores and “big box” stores and more likely to eat at home earlier in the SNAP month, than later, when they are more likely to shop at convenience stores (Damon, King & Leibtag, 2013). Castellari and colleagues (2016) use the Nielsen Homescan Consumer Panel Dataset (NHCPD) to examine consumption patterns of bread, milk, beer, soft drinks, and tobacco throughout the SNAP month. They find that purchases are higher on benefit receipt dates, and that total consumption is also affected by whether benefit payments happen on a weekend. Purchases of beer are especially sensitive to weekend benefit receipt. One limitation of this study is that they do not know when households actually receive the benefit, or whether they receive it on a weekend. Their treatment variables are, then, the probability that a household receives benefits on a particular date, and the likelihood that benefits are received on a weekend estimated from the share of treatment days that fall on a weekend. While current research shows that household food purchases and consumption of certain goods decrease at the end of the SNAP month, evidence of the effects of SNAP benefit exhaustion on child food consumption is limited. Most research focused on children examines the effect of the timing of SNAP payments on health and school outcomes. Two recent studies estimate the relationship between the timing of SNAP payments and academic outcomes. Gassman-Pines and Bellows (2015) find a curvilinear relationship between the timing of SNAP payments and test scores. Test scores peak around day 17 and start decreasing after that. Cotti, Gordanier and Oztuk (2017) show that math test scores decrease toward the end of the SNAP month, and especially in the four days after receipt of SNAP payments.

National School Lunch Program (NSLP) and National Breakfast Program (SBP)

The NSLP is a federal program that provides low-cost or free lunches to eligible children in schools and other child care institutions. Created in 1946 through the National School Lunch Act, it is the second largest food assistance program in the country. In its first year of operation it provided meals for over 7 million children. The number of children served has increased substantially since then, and by 2016 more than 31 million children received school lunches at a cost of $13.6 billion.

The school lunch program defines students as eligible for free lunch if their family income is at or below 130 percent of the poverty threshold and eligible for a reduced price lunch if family income is between 130 and 185 percent of the poverty threshold. The price of lunch for all other students is established by local food authorities (USDA, FNS, 2017).[4]

Additionally, some schools participate in the School Breakfast Program (SBP), founded in 1966 by the Child and Nutrition Act and administered by the USDA. Unlike the NSLP, not all schools participate in the SBP. USDA (2017) reports that in 2016 over 100,000 schools and other child care institutions participated in the NSLP, while only about 87,000 schools participated in the SBP. Accordingly, while more than 31 million students participated in the NSLP, less than half as many (14.6 million) participated in the breakfast program in 2016. We focus on the larger program – NSLP – but we also examine school breakfast.

School meal participation and child outcomes

While federal guidelines establish eligibility, not all eligible children participate in school lunch or breakfast programs and utilization varies within the population that participates. First, schools need to take part in the program, that is, the program needs to be available in children's schools. Second, some children may not participate in school meal programs due to the stigma associated with these subsidized meals. Using data from the Panel Study of Income Dynamics Mitcherva and Powell (2009) find that an increase in the share of students eligible for free lunch is positively correlated with increased school meal participation. According to Marples and

[4] Lunches served under this program must meet certain federal nutrition requirements such as the availability of fruits and vegetables, and whole grains. Attention to the nutritional value of school meals increased with the Healthy Hunger Free Kids Act of 2010. There are also specific calorie limits based on age, as well as reductions in the sodium content of meals. The decision of what food items are served remains with local food authorities, and schools and districts that participate in this program get reimbursed for each lunch served.

Spillman (1995) high school students are more likely to eat school lunch if their friends do. Finally, even if children are eligible for school meal programs, and those are available in their school, they may still not eat school meals for a number of other reasons. For example, schools may offer competing options through "a la carte" menu items that are preferred (Gundersen, 2015).[5]

The literature has examined the impact of the NSLP on child nutrition reaching mixed conclusions. Gleason & Suitor (2003), for example, report a link between NSLP and improvements in child nutrition, increased intake of vitamins and minerals, and higher consumption of saturated fats. Battacharya et al (2004) use the National Health and Nutritional Examination Survey (NHANES) III to estimate the impact of NSLP/SBP on various outcomes, finding more persuasive evidence that the SBP improves child nutrition but little evidence that the NSLP improves children's diet (although the wide availability of the NSLP constrains the difference in difference analysis considerably). In a more recent study, Campbell et al. (2011) find no effects of the NSLP on diet, but an increase in the quantity consumed compared to eligible children that do not participate, and to children in schools that do not offer the program. The NSLP has also been linked with higher child obesity (Schanzenbach 2009; Millimet et al. 2010). In contrast, Gundersen et al. (2012) find that the NSLP improves general child health and obesity. Finally, Nord and Romig (2006) suggest the NSLP can improve food insecurity. Few of these studies, however, are recent enough to reflect the changes in the NSLP as a result of the

[5] Recent studies have focused on the effect of Universal Free Meals (lunch and breakfast) on participation, which may also reduce the stigma associated with these programs. Schwartz and Rothbart (2016) study the effect of universal free lunch in New York City (NYC). They find increases in school lunch participation for both poor and non-poor students ranging from 5.4 to 11pp, respectively. UFM has no effect on school breakfast. Regarding breakfast, Leos-Urbel et al. (2013) find that free school breakfast in NYC increases participation for children eligible for free meals, those eligible for reduced price meals (20 percent) and full price students (35 percent). Finally, studies on breakfast in the classroom (BIC) initiatives also find increases in participation. Corcoran, Elbel and Schwartz (2016) find that breakfast participation in NYC increases by roughly 30pp when BIC is offered schoolwide.

Healthy Hunger Free Kids Act of 2010.

Several studies have focused on the SBP. Battacharya et al (2006) find positive impacts of participation in this program on dietary quality, and Millimet et al (2010) find improvements in child obesity. Corcoran and colleagues (2016) conclude that BIC does not impact academic performance or child obesity in NYC. Similarly, Schanzenbach and Zaki (2014) analyze experimental data and find little evidence that BIC improves health or academic achievement, as well as little improvements on nutrition. In contrast, Imberman and Kugler (2014) found positive impacts on test scores.

So far, research on school meal programs is mixed. Further, as it was the case with studies on SNAP, research that examines the school lunch program tend to consider it independently of the overall food safety net. Indeed, there is little evidence of how school meal participation, nutrition, and consumption of school meals vary with a family's resources throughout the month, in particular for SNAP participants. This paper adds to the current literature by focusing on the relationship between SNAP and school meals. We improve on current studies by using a detailed dataset that allows us to track children in SNAP households' food acquisitions over time (for seven days) at different points of the SNAP benefit cycle. In doing so, we are able to provide insights into how families use SNAP and school lunch and breakfast, that is, into whether there is substitution (or not) between SNAP and the NSLP and the SBP.

Why might school meal participation change after SNAP payments?

If there is complete consumption smoothing for SNAP families in anticipation of regular benefit receipt, there may be no change in school meal participation over the SNAP month, as families balance out of school purchases and in school consumption. That is, the timing of SNAP benefits may not affect school meal participation if families do not increase school lunch to compensate for low balances toward the end of the SNAP month. However, existing evidence indicates consumption smoothing is not complete. Stephens (2003), for example, shows the timing of payments often affects consumption and expenditures. Further, Castner & Henke (2011) show that SNAP benefits run out toward the end of the month and many families with children use up their benefits in the first two weeks. Families employ different strategies to compensate for this exhaustion in benefits. Schenck-Fontaine, Gassman-Pines & Hill (2017) surveyed African-American families in Durham, North Carolina, finding that SNAP households are more likely to borrow money from social networks starting in the third week of the SNAP month. Use of food banks comes after borrowing and not until the last week of the cycle.

While these papers do not explore school meals, they do suggest it may have a role in supporting food consumption when SNAP benefits run low. Families may increase reliance on school lunch at the end of the SNAP month as benefits are exhausted and then reduce reliance after the SNAP payment (the beginning of the SNAP month) opting to bring lunch from home, or purchase from other vendors. That is, school lunch participation may decline at the start of the SNAP month compared to later in the benefit cycle. Notice, however, that the precise timing of this change is ambiguous. Studies on behaviors in and around payday for individuals receiving social security (also a regular income that can be predicted) show sharp increases in consumption on the day of benefit receipt and days after pay. In some cases, those increases begin two days before peaking on payday (Stephens, 2003). These suggest the changes in school meal participation might begin the day before the SNAP payment day, in an "anticipation effect".[6]

[6] It is possible that the existence of "anticipation effects" or not depend on characteristics of SNAP recipients such as the benefit amount as well as the place of residence. In future versions of this paper we will explore whether and

Further, the relationship between SNAP and school lunch may vary by age. Students in middle and high school have lower rates of school meal participation than elementary school students (Mirtcheva & Powell, 2009) which may be due to greater sensitivity to stigma or greater access to competing options (including open campuses). For example, recent qualitative evidence shows that middle school students report buying breakfast in convenience stores on the way to school rather than eating breakfast at school and that other students often make fun of children eating school breakfast (Bailey-Davis et al., 2012). We take into account these differences and stratify all our models by age.

3. Data and Measures

The main source of data for this paper is FoodAPS, a nationally representative survey of 4,826 households co- sponsored by the USDA’s Economic Research Service (ERS) and the Food and Nutrition Service (FNS). FoodAPS is a rich and detailed dataset with information on food acquisitions during seven days for the primary respondent, and for the other members of the household, including school-age children. In addition, FoodAPS includes information about participation in other nutrition programs, in particular for children who participate in school lunch (breakfast), as well as detailed information on what items were acquired as part of a meal, where the acquisition took place (such as home or school), and the meal’s nutritional information.[7] The survey was administered between April 2012 and January 2013. Data collection was a multi-step process that consisted of an initial interview with the primary

to what extent our results depend on other income, SNAP benefit amount, and place of residence. FoodAPS offers some insight into whether households use other food sources such as food banks, to the extent that is possible due to the number of respondents using these sources we will also explore them.

[7] For more details on the structure and different datasets that are part of FoodAPS see ERS, FoodAPS User Guide, November, 2016.

respondent.[8] This interview took place prior to the first day of data collection. During the week of data collection, all members of a household aged 11 or older recorded food acquisitions in a food book, while the primary respondent recorded meal acquisitions for those aged 10 or younger and completed the Meals and & Snack Forms (M&SF). The M&SF indicate for all survey participants in the household whether they acquired breakfast, lunch, dinner or snacks on a given day of the data collection week. In addition to the initial interview, there were three follow-up phone interviews and a final interview with the primary respondent after the last day of data collection (day seven).

Building a child-day dataset

We begin by identifying children in FoodAPS individual dataset (FI). There are a total of 3,338 school-age children (5 to 18 years old). We match these data with the FoodAPS household dataset (FH) to select children that are poor (in household with incomes less than 185% of poverty threshold) and distinguish between those that are in households currently receiving SNAP (1,445) and those that are not (742).

We obtain data on meal acquisitions from FoodAPS' Food Away From Home dataset (FAFH). These include all food acquisitions recorded by children in their own food books or reported by the primary respondent. They include the type (e.g. lunch), date, and place of the acquisition (e.g. school) among other information. Because these data keep a record of acquisitions that happened away from home, and some meals may occur in the home or are prepared at home to eat at school, we supplement the FAFH data with the M&SF. Recall that these data only indicate whether a child had a lunch, breakfast, dinner, or snack on a given day of

[8] The primary respondent is the household's main food shopper or meal planner (ERS, FoodAPS User Guide, 2016)

data collection and it is filled out by the primary respondent. Our final data set includes child-day observations that have lunch (breakfast) information from one of these two data sources. That is, we drop child-day observations with no lunch (breakfast) information on either dataset.[9] Further, we restrict our sample to children interviewed when school was in session, excluding children interviewed during summer and other breaks.[10] Overall, these sample restrictions result in a total of 1,173[11] children amounting to 7,532 child-day observations and 5,529 child-day *weekday* observations with lunch.[12]

Table 1 shows demographic characteristics of the resulting sample by their SNAP status. There are a total of 794 children in SNAP households and 379 poor children in non-SNAP households. As shown, SNAP children differ from the non-SNAP. Specifically, SNAP children are more likely to be non-white, live in public housing, attend a traditional public school, and less likely to live in a rural area, and in a household with a car than poor children in non-SNAP households. Further, SNAP children are more likely to participate in school lunch and breakfast than the non-SNAP. Specifically, SNAP children are 13 to 15 percentage points more likely to get a school lunch and correspondingly 14 to 18percentage points less likely to have a non-school lunch than non-SNAP kids, but we see no differences in school and non-school breakfast choices.[13]

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[9] For example, in the case of lunch of a total of 6,314 weekday child-day observations when school was in session we were unable to identify lunch data in the FAFH or M&SF for 785 observations. In the case of breakfast we were unable to identify a breakfast in either dataset for 1,072 observations.

[10] We exclude 2,613 observations.

[11] We observe 80.39% of children in our sample during all seven days of data collection. Table A in appendix provides more details about the number of observations per child in the sample.

[12] There are of 5,242 child-day weekday observations when school was in session for breakfast.

[13] These results come from regressing school and non-school meal participation indicators on a dummy equal 1 if child *i* is in a SNAP household and 0 if she is not. These models include demographic controls and day of the week and interview month fixed effects. Results reported in table B in the appendix.

Measures

Our key measures capture daily participation in school lunch and breakfast as well as non-school lunch and breakfast. "School lunch" equals one if the child or primary respondent reported acquiring lunch on a given day at school in the FAFH dataset or if lunch was classified as a *school lunch* based on the items acquired (FAFH-item) dataset[14], and if lunch was free or part of a reimbursable meal. It is zero if the student did not acquire a school lunch or report having lunch. Similarly, our non-school lunch measure equals one if the child or primary respondent reported getting lunch on a given day of data collection, and lunch was not coded as a school lunch. We create school and non-school breakfast measures similarly.

Overall, lunch participation is high. On an average day, 92% of children have a lunch and 82% a breakfast. There are some differences by age. Roughly 93% of 5-10 year olds have lunch and 90% breakfast. In contrast, 92% of 11-18 year olds have lunch and 75% breakfast.

4. Empirical Strategy

We exploit two plausibly exogenous sources of variation. One is the timing of SNAP benefit receipt, and the other is the timing of FoodAPS data collection. We take advantage of the fact that in most states the date of SNAP benefit receipt is assigned based on the social security number, case number, or first letter of recipients' last name[15], and so the precise timing is credibly random. Second, we use the timing of FoodAPS data collection relative to the SNAP benefit cycle, which is also random. The implication is that we have variation in the time of

[14] According to the FAFH Item data, food items were identified as part of reimbursable school meals using the School Nutrition Dietary Assessment Study (SNDA-IV) collected during 2009-2011. Thus, the FAFH-item dataset provides information of whether items in a meal were part of a reimbursable meal or not, which we use in creating our school meal participation variable.

[15] States sometimes use a combination of these indicators, as well as birthdate. For additional details:http://www.fns.usda.gov/snap/snap-monthly-benefit-issuance-schedule

SNAP payments that we think is uncorrelated with relevant household characteristics in the survey data.

We use two distinct empirical approaches. The first estimates a short-run effect of SNAP on school lunch and breakfast participation. The second explores patterns of participation over the entire SNAP month. Our first analyses focus on the households that received a SNAP payment during data collection week (days one to seven).[16] There are a total of 170 school aged children in these households amounting to 1,008 kid-day weekday observations and 806 kid-day observations when school was in session. We observe most children in this sample before and after SNAP pay, however, for those in households that received payments on the first day (last day) of data collection we only have data for their post (pre) SNAP pay period.[17]

We estimate the following baseline specification:

$$meal_{idm} = \alpha + \beta PostSNAPpay_{idm} + X'_{idm}\theta + \delta_d + \mu_m + \varepsilon_{idm}$$

In this model meal equals 1if *i* had a "school lunch" (breakfast), or a "non-school lunch" (breakfast) on day *d* interview month *m.* "Post SNAP pay" equals 1 on the day of SNAP pay and every day after SNAP, and it is zero for all days before SNAP pay. X is a vector of individual and demographic controls such as gender, race, whether *i* attends a traditional public school, and whether the household lives in a rural area, in public housing, and has a car. δ and μ are day of the week and interview month fixed effects. β is the coefficient of interest and it captures the short-run effect of SNAP payments on meal participation within a five-day window around the SNAP payment.[18] It provides a causal estimate of the effect of SNAP payment on school (and

[16] Note that we use ERS cleaned variable of days since SNAP payment, which assumes for current SNAP households a 30 day benefit cycle.
[17] Of the 806 kid-day observations there are a total of 305 observations before SNAP pay and 501 after SNAP pay.
[18] While we observe most children for five days that is not the case for all of them. To be exact we observe 84.4% of kids for all seven days of data collection, and over 90% for at least four days. Also note that because we include children that receive SNAP pay from day one to seven of the data collection week we may observe some children for five days after SNAP pay and for no days before, while we may observe others for five days pre SNAP pay and

non-school) meal participation if the timing of SNAP payments within data collection window is random.

To test this condition, we performed a balance test comparing the demographic composition of children before and after SNAP pay. To do so, we regress the "Post SNAP pay" indicator on the set of individual and household level demographic characteristics. The model also includes day of the week and interview month fixed effects. We then test for the joint significance of demographic controls. Result from this test (see table C in appendix) show that demographic controls do not predict SNAP payment and that the two samples are comparable.

We estimate an extended specification of this model in which we break the "Post SNAP pay" dummy into a series of dummy variables indicating: two days pre SNAP pay, one day pre SNAP pay, day of SNAP pay and post SNAP pay for all days after benefit receipt. In this model the reference group are days 3 to 5 prior to SNAP payments. This extended specification will shed light on the existence of pre-trends in participation, and especially on the possibility of an "anticipation effect". All models are weighted using household sampling weights.[19]

The second analyses examine participation over the full SNAP month in a model linking participation to a set of indicator variables capturing the number of days since the household received the SNAP payment in five day intervals. These models use all 1,173 children in the sample.[20] Individual random effects ν_i control for unobserved time-invariant individual heterogeneity that is uncorrelated with the SNAP payment dummies under the assumption that the timing of SNAP payments relative to data collection is random. The rest of this model is as

no days after. The rest will have at least one day pre SNAP pay and at most four days post SNAP pay.

[19] Standard errors are computed using Taylor series linearization that account for the complex structure of the survey. We also computed standard errors using the household replicate weights and jackknife repeated replication technique and we also tested the sensitivity of our estimates using the household weights and clustering the standard errors at the household level. In all cases standard errors were similar.

[20] Recall that we observe 98% of children for at least two days, and 80.39% for five weekdays (and seven days overall).

before. Specifically, we estimate:

$$meal_{idm} = \alpha + \beta_1 SNAPpayday_{idm} + \beta_2 Days1to5_{idm} + \beta_3 Days6to10_{idm} + \beta_4 Days11to15_{idm} + \beta_5 Days16to20_{id} + \beta_6 Days21to25_{id} + \delta_d + \mu_m + X'_{idm}\theta + \nu_i + \varepsilon_{idm}$$

Days1to5 is an indicator variable taking a value of one for observations in the first five days following the SNAP payment, and zero otherwise. *Days6to10* identifies observations in the following five days, and *Days11to15*, *Days16to20* and *Days21to25* are defined accordingly. The reference period is the last five days in the SNAP month, *Days26to30.* Again, regressions are weighted using the household sampling weights, and standard errors are clustered at the household level.

5. Results

Short-run effect of SNAP on meal participation

We begin by showing demographic characteristics of the different analysis samples in table 1. Overall, the event study and the full sample look fairly similar along most characteristics. However, children in the even study sample are more likely to live in public housing (17.1% compared to 13.3%) and in a rural area (27.1% versus 20.5%) than the non-event study sample. They are also less likely to attend a traditional public school and live in a household that has a car. As for other demographic characteristics, the samples are similar in age, but the event study sample has a higher share of non-whites and lower share of females than the non-event study sample. Table 3 shows mean participation for SNAP children by sample. Lunch and breakfast participation rates are similar across samples. In general, roughly 48% of children participate in school lunch compared to 43% that acquire non-school lunches. School breakfast participation rates are much lower – 22 to 24%.

First, we show results from our baseline model estimating the effect of SNAP pay on school lunch and breakfast participation. We show both unadjusted and adjusted models with individual and household level controls for completeness, but adjusted models are our preferred specification and so we focus our discussion of the results on those. As table 4 shows, we find large decreases in both school lunch (17 percentage points) and breakfast (20 percentage points) participation for children aged 11 to 18 after SNAP pay (columns 2 and 4 in panel B). In contrast, lunch participation does not change for children aged 5 to 10. Coefficients suggest school breakfast might decline by roughly 8 percentage points for this group (column 4 in panel A), but this coefficient is only significant at the 10% level.

Table 5 shows the same model for non-school meals. In this case, we find that the coefficients for older students are positive, but they are not statistically significant. Interestingly, non-school breakfast participation decreases substantially (13 percentage points) for 5-10 year olds immediately after SNAP pay.

Examining this short-run effect is important, however, these analyses shed little light on the behavior of SNAP children immediately before SNAP pay as well as on the day of SNAP payments. That is, it is important to examine the existence of any trends in participation that might emerge before families receive their SNAP benefit. Table 6 shows results from the extended specification for school meals. School lunch and breakfast participation starts decreasing the day before or two days before SNAP pay and this negative effect is larger after SNAP payment. Specifically, 11-18 year olds are 18 percentage points less likely to acquire a school lunch the day before SNAP pay and 23 percentage points less likely to do so after SNAP receipt (column 2, panel B). School breakfast drops 19 percentage points two days before SNAP and continues to decline after that. In the days after SNAP receipt 11-18 year olds are 36 percentage points less likely to acquire a school breakfast compared to the days before SNAP benefit receipt (column 4, panel B).

Is there an opposite trend in non-school meal participation? Non-school meal acquisitions increase for 11-18 year olds and it begins the day before SNAP pay. Results are positive for both non-school lunch and non-school breakfast, but only statistically significant for the latter. Column 8 shows that non-school breakfast acquisitions substantially go up the day before SNAP pay (26 percentage points) and continue to do so after SNAP pay (24 percentage points). Taken together, these analyses suggest that 11-18 year olds substitute school meals for non-school options, and especially non-school breakfast when they can. We find no effects for 5-10 year olds, but we do see a large decrease in non-school breakfast participation after SNAP pay of 30 percentage points (column 8, panel A).

Overall, findings from these extended specifications provide some evidence of "anticipation effects", that is, households know they are going to receive the SNAP payment and may use their resources to substitute away from school meals, for example, by providing lunch from home or allowing children to acquire competing alternatives to subsidized school lunches.[21]

Subgroup results

The effect of SNAP payment may differ by subgroup. Indeed, students of different gender or race/ethnicity may have different preferences for non-school meal options, or they may experience stigma and other barriers to participation differently. We investigate these differences

[21] As we noted earlier, in future versions of this paper we are going to further test the existence of these anticipation effects by examining whether the effect depends on households SNAP benefit amount, other income, as well as the use of other food assistance resources such as food banks.

in tables 7 and 8. Table 7 summarizes results from the baseline specification by gender. There is a large drop in school lunch participation for females aged 11 to 18 years old of 25 percentage points (column 5), while there are smaller gender differences in school breakfast participation (column 6). Males aged 5 to 10 years old decrease their school breakfast participation by 14 percentage points (column 2), and there is no effect for females. In contrast, females aged 5 to 10 years old are 21 percentage points less likely to have a non-school breakfast (significant at the 10% level) (column 4).

As for differences between white and non-white children (table 8), baseline regressions suggest that decreases in school lunch after SNAP pay for 11-18 year olds are driven by non-whites. Indeed, the probability that they will acquire a school lunch drops by 20 percentage points after SNAP pay (column 5). Interestingly, we also observe a decline in school lunch for non-white 5-10 year olds (16 percentage points only significant at the 10% level). School breakfast drops similarly for both white and non-white 11-18 year olds (column 6), while the increase in non-school breakfast acquisitions is driven by whites (28 percentage points – column 8). In contrast, declines in non-school breakfast for 5-10 year olds are driven by non-whites.

In sum, subgroup analyses suggest girls and non-white 11-18 year olds are more likely to decrease school meals after SNAP pay, but there are smaller differences by gender and race/ethnicity for school breakfast. Whites substitute school meals for non-school breakfast, while non-whites do not.

Changes in school and non-school meal participation over the SNAP month

Results discussed so far focused on the short-term impact of the SNAP payment on school and non-school meal participation. While they provide evidence that 11-18 year olds substitute away from school meals at the start of the SNAP benefit cycle, they provide limited insights into how children use school meals throughout the entire month. That is, if school meals help ameliorate declines in food consumption at the end of the SNAP month as our event study results suggest, at which point in the SNAP benefit cycle families rely more on school meals? Figure 1 shows results from the full month specification with random effects by age for school lunch and non-school lunch participation and figure 2 shows similar results for breakfast.[22] As shown, among 11-18 year olds, school lunch participation drops in the first two weeks of the SNAP month reaching the lowest point on days 11 to 15 (23 percentage point decline), and increasing afterwards. Non-school lunches increase correspondingly in the first two weeks of the SNAP month for this age group, peaking on days 11 to 15 with a 22 percentage point increase. Results for 5-10 year olds are generally not significant and do not have a consistent direction. Figure 2 shows similar conclusions for breakfast. School breakfast acquisitions drop in the first two weeks of the SNAP benefit cycle for 11-18 year olds reaching the lowest point in the second week with a decline of 21 percentage points and increasing after that. Non-school breakfast acquisitions increase up to days 11 to 15 (19 percentage points increase) and decline later in the SNAP month. As for lunch, results for 5-10 year olds are generally not significant but we see increases in school breakfast in the first 10 days of the SNAP month and declines afterwards. On days 20 to 25 of the SNAP month there is a large drop in school breakfast and a corresponding increase in non-school breakfast. While these results warrant further investigation, they suggest school breakfast may play a different role in younger children's food acquisitions (and perhaps consumption) than school lunch. Further, they also highlight differences in how older and

[22] For these results in tabular form see tables D and E in appendix. These tables also include for completeness unadjusted models, models with only demographic controls, as well as our preferred specification with random effects.

younger kids use school meals that need to be further probed and understood.

Robustness tests

We tested the robustness of results in this paper in a number of ways. First, we re-estimated our baseline specifications adding a control for whether the SNAP payment was received on a weekend, following the Castellari et al (2016) finding that weekend payments differ for households' consumption and purchasing behavior. Table 9 includes results from this robustness test for the baseline specification, and table 10 shows results for the extended specification. Overall, our findings remain largely unchanged with the addition of a weekend pay dummy.[23]

Second, we stratified models by school level instead of age. Indeed, if there are differences in children's ability to procure non-school meals they may vary by grade level (K-elementary school vs middle and high school) rather than by age. Tables 11 and 12 show results for the baseline and the extended specifications. Overall, results are robust to this stratification. Baseline results in table 11 show a drop in school lunch participation only for children in middle and high school of 19 percentage points. School breakfast acquisitions decline for both children in K-elementary school and middle and high school after SNAP pay by 15 percentage points and 19 percentage points, respectively (column 4). The extended specification reported in table 12 also confirms results reported above. Declines in school lunch acquisitions begin the day before SNAP pay for children in middle and high school with a 21 percentage point drop (column 2). This decline continues after SNAP pay and it is roughly 25 percentage points. School breakfast also decreases for children in K-elementary school immediately after SNAP pay (panel A,

[23] In the next version of this paper we will also include this test for the full month.

column 4). This decline begins two days before SNAP payments for children in middle school and high school and magnitudes are similar as those reported in models stratified by age. Column 8 confirms increases in non-school breakfast acquisitions for students in middle and high school.

Full month models stratified by grade also yield similar conclusions.[24] That is, they show declines in school lunch and breakfast for children in middle and high school, and increases in non-school meal acquisitions. Results for children in K-elementary school are similar to those reported in the paper for 5-10 year olds.[25]

6. Discussion

In this paper, we examine the relationship between the timing of SNAP benefit payments and school lunch and breakfast participation. We use two empirical strategies that allow us to estimate effects in the short-run (over a five-day window) as well as over the full SNAP month. Results using the two strategies yield similar conclusions. Teenagers 11 to 18 years old substantially decrease their school meal participation immediately after SNAP payments and for the first two weeks of the benefit cycle. In contrast, they seem to increase their non-school meal acquisitions during this time. Specifically, we find decreases between 17 percentage points and 36 percentage points for school meals and increases between 13 percentage points and 26 percentage points for non-school breakfast. These are not small changes and comparable to findings in other studies that examine school meal participation. For example, recent evidence on UFM found increases in lunch participation ranging from 5 to 11 percentage points for poor and non-poor students, respectively (Schwartz & Rothbart, 2016), and estimates on the effect of the

[24] Tables available from authors.

[25] To further test the robustness of our conclusions in the next version of this paper we will conduct a placebo test randomly assigning SNAP benefit receipt dates to the sample of non-SNAP children. We should find no effect of SNAP payments on lunch and breakfast participation.

BIC program in NYC found it increases breakfast participation by 30 percentage points when offered school-wide (Corcoran, Elbel & Schwartz, 2016). Interestingly, we do not find similar decreases in lunch participation post SNAP pay for 5-10 year olds. This is an important finding because middle and high school students are less likely to participate in school meals (Mirtcheva & Powell, 2009). These students may have more attractive competing options or the stigma associated with subsidized lunches is higher for them. FoodAPS, unfortunately, does not provide information about the school food environment facing children, whether they have access to an open campus, or whether schools serve "a la carte" menu items. Thus, we are limited in our ability to explore how these characteristics of the meal options available to children affect their choices. As for where teenagers acquire non-school meals, our examination of the FAFH data suggest 11-18 year olds do use outside options such as restaurants and other fast food places, groceries and convenience stores, as well as family and friends when they can, which aligns with qualitative evidence (Bailey-Davis et al, 2013). Interestingly, we observe that most non-subsidized meals happen at school. Future research could use the FAFH items dataset to try to uncover differences in the items acquired between meals at school coded as subsidized options and those that are not on days before and after SNAP benefit receipt to determine the role that competing options play in children's meal choices. It is important to note that any analyses that explore non-school options are limited by the inability to use FoodAPS to distinguish meals (and the items of those meals) that were brought to school but prepared in the home, which could be another important source of substitution for children.

Overall, findings in this paper suggest that school lunch may ameliorate declines in food consumption at the end of the SNAP month. As such, it provides additional insights into the different coping strategies of SNAP households to maintain food consumption throughout the

SNAP month. Specifically, our findings suggest that SNAP households do not fully smooth consumption. Older children increase reliance on school meals toward the end of the SNAP cycle, but choose non-subsidized options earlier in the SNAP month. This information may prove useful for the managers of school food facilities and future work might fruitfully be aimed at understanding variations in participation in school lunch and potential implications for policy and practice. As for policy implications unrelated to the school food environment, we need to further understand possible consequences of the substitution between school and non-school meals for children's health and diet. The quality of school meals has improved with the adoption of the Healthy Hunger Free Kids Act in 2010 and our own estimates using FoodAPS suggest that participation in school meals is positively correlated with the Healthy Eating Index (HEI). Specifically, we estimate that acquiring school lunch on a day increases the HEI by 5 to 10 points for 11-18 year olds and 5-10 year olds, respectively. Thus, it would be important to understand whether the decrease in non-school meals we find in this paper negatively impacts the quality of teenagers' diet. We hope to address this question in a future version of this paper.

There are some limitations worth noting. First, while we are able to provide results by age, gender, and race, we have not explored how findings vary with benefit amounts, household size, or overall household resources such as income from other programs. These analyses will not only help explain which specific behaviors and program characteristics matter for the use of school meals, but also, they will help us test and better understand the existence of anticipatory effects. Exploring these differences is also a task for future work. Finally, we restricted our analyses to periods when school was in session, but it would be useful to know how food acquisitions and meal quality changes during the summer months when children have less access to school meals.

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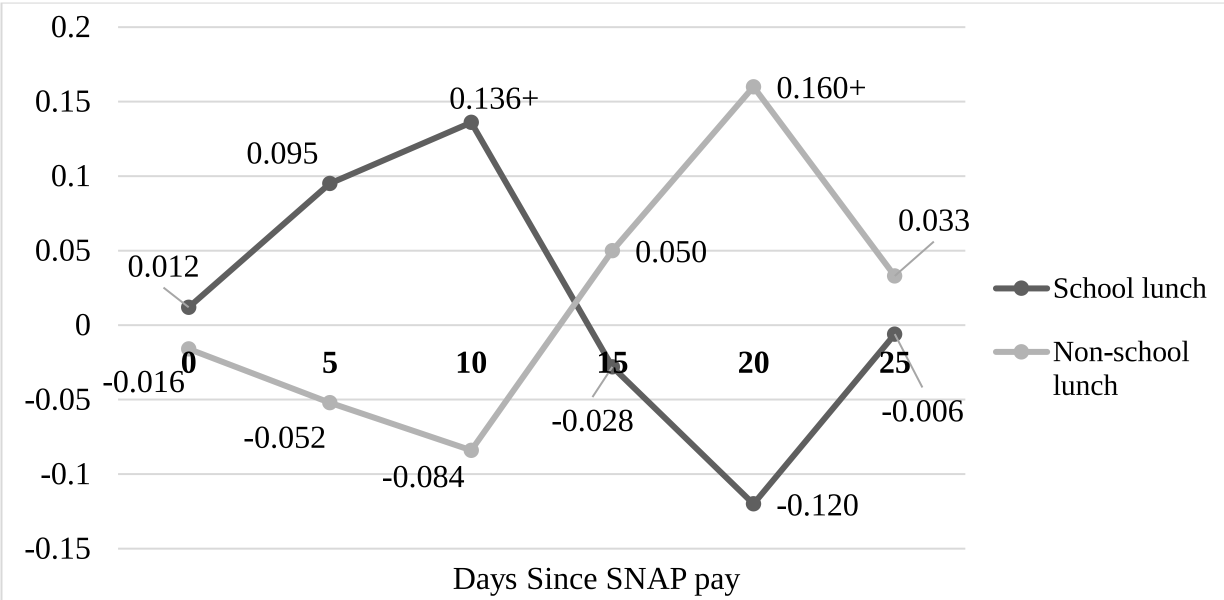
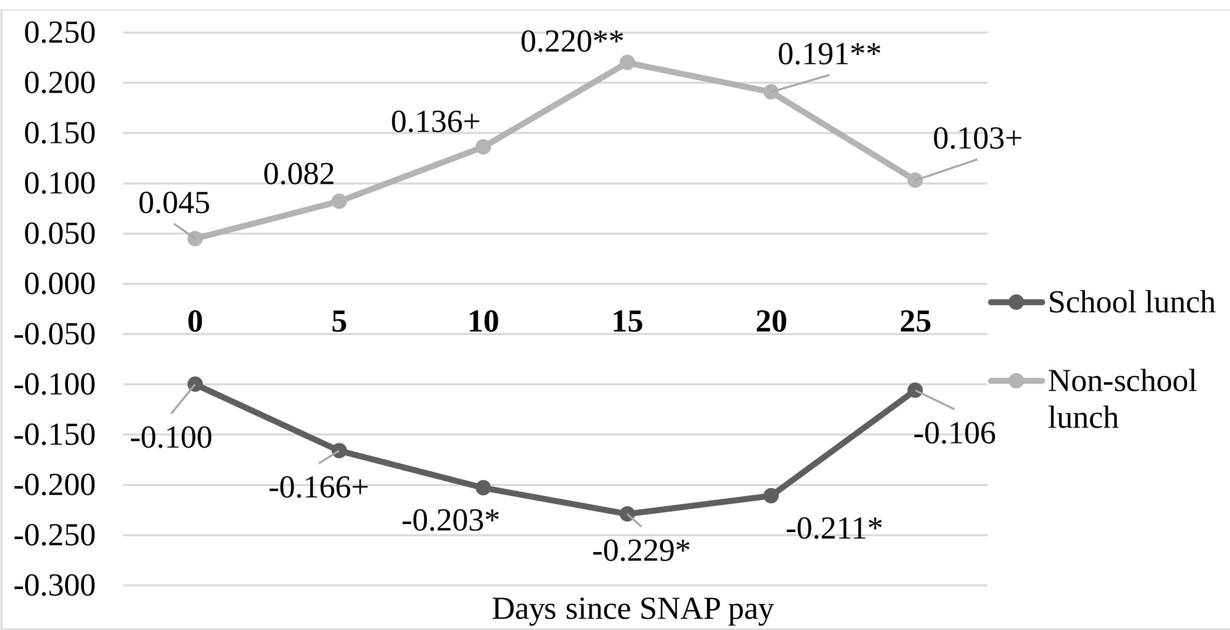
Figures

Figure 1: SNAP and lunch participation, full SNAP month models with random effects,

A. Age 5-10



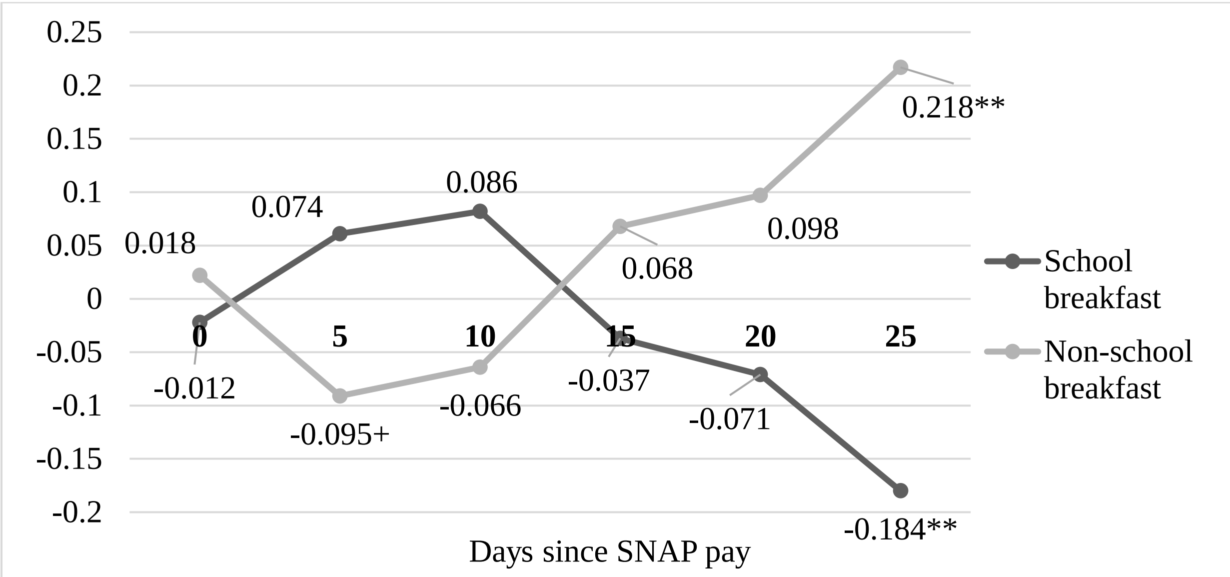
B. Age 11-18



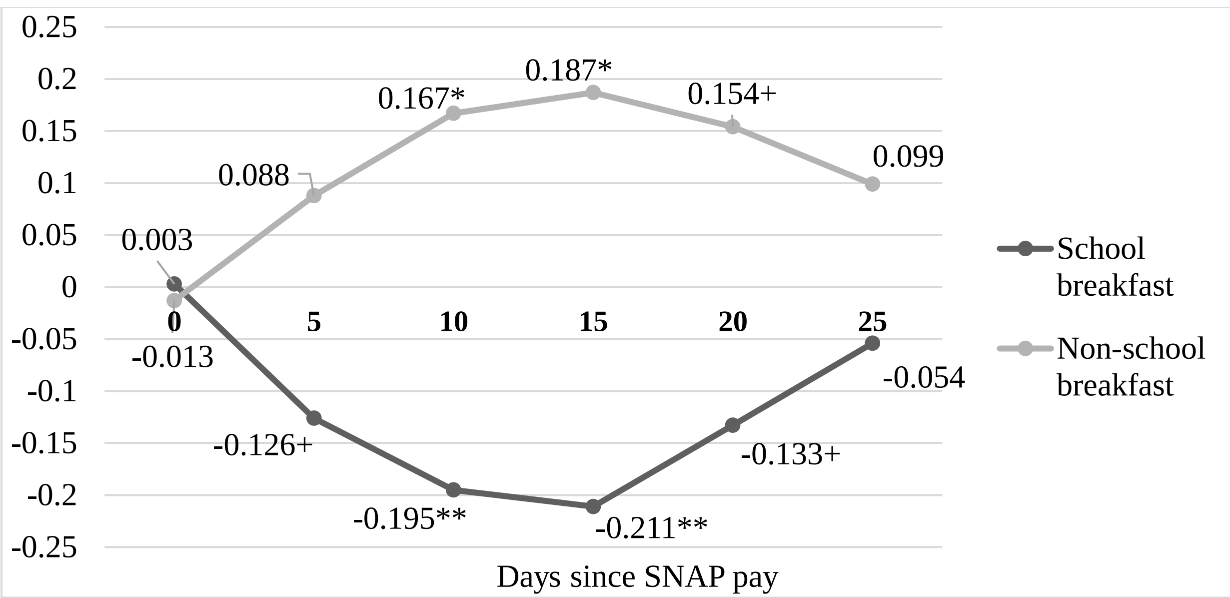
Notes: Graphs show coefficients from full cycle random effects models stratified by age. All models include demographic controls: female, non-white, public housing, public school, rural area, household has car, day of the week and interview week dummies and individual random effects. Sample restricted to SNAP children interviewed when school was in session. All models are weighted using the sample household weights and standard errors are clustered at the household level.

Figure 2: SNAP and breakfast participation, full SNAP month models with random effects

A. Age 5-10



B. Age 11-18



Notes: Graphs show coefficients from full cycle random effects models stratified by age. All models include demographic controls: female, non-white, public housing, public school, rural area, household has car, day of the week and interview week dummies and individual random effects. Sample restricted to SNAP children interviewed when school was in session. All models are weighted using the sample household weights and standard errors are clustered at the household level.

Tables

Table 1: Demographic characteristics, SNAP and non-SNAP children

	SNAP	Non-SNAP
Non-white	65.74	54.35
Female	46.85	49.34
Age	10.65	11.50
Public housing	14.11	7.39
Public school	93.45	89.71
Rural area	21.91	28.50
Household has car	78.84	91.29
Number of children = 1,173	794	379

Notes: Sample restricted to children interviewed when school Was in session. Sample includes children in SNAP household and those in households with income less than 185% of the poverty threshold.

Table 2: Mean characteristics, RD and full sample, school in session

	Event study sample	Non-event study sample	Full sample
Non-white	69.4	64.7	65.7
Female	41.2	48.4	46.9
Age	10.9	10.6	10.7
Public housing	17.1	13.3	14.1
Rural	27.1	20.5	21.9
Public school	91.2	94.1	93.5
Has car	75.9	79.6	78.8
Observations	170	624	794

Notes: Event study sample includes children in K-12 receiving SNAP payments during data collection week. All samples restricted to children interviewed when school was in session.

Table 3: Mean lunch and breakfast participation by sample type

	Event study sample	Obs.	Non-event study sample	Obs.	Full sample	Obs.
All students						
Lunch						
School	47.1	806	48.4	2,936	48.1	3,742
Non-school	42.8	806	43.8	2,762	43.6	3,742
Breakfast						
School	24.1	784	22.7	2,762	23.0	3,546
Non-school	51.5	784	60.5	2,762	58.5	3,546

Notes: Event study sample includes children in K-12 receiving SNAP payment during data collection week. All samples restricted to children interviewed when school was in session.

Table 4: Regression results, SNAP and school meal, baseline models

	School lunch		School breakfast	
DV:	(1)	(2)	(3)	(4)
A. Age 5-10				
Post SNAP pay	0.042	-0.008	-0.079	-0.075+
	(0.077)	(0.064)	(0.065)	(0.044)
Observations	367	367	354	354
R-squared	0.175	0.373	0.191	0.282
B. Age 11-18				
Post SNAP pay	-0.146+	-0.169*	-0.184*	-0.195*
	(0.077)	(0.074)	(0.087)	(0.084)
Demographic controls	N	N	N	Y
Day of the week FX	Y	N	Y	Y
Interview month FX	Y	N	Y	Y
Observations	439	439	430	430
R-squared	0.365	0.415	0.230	0.263

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes: Demographic controls include: female, non-white, public housing, rural area, public school, household has car. All models are weighted using household sampling weights. Standard errors are calculated using Taylor series linearization. Post SNAP pay equals 1 on the day of SNAP pay and all days after. Sample restricted to children in households receiving SNAP pay during data collection and interviewed when school was in session.

Table 5: Regression results, SNAP and non-school meal participation, baseline model

	Non school lunch		Non-school breakfast	
DV:	(1)	(2)	(3)	(4)
A. Age 5-10				
Post SNAP pay	-0.102	-0.085	-0.093	-0.129*
	(0.063)	(0.068)	(0.067)	(0.052)
Observations	367	367	354	354
R-squared	0.125	0.178	0.221	0.285
B. Age 11-18				
Post SNAP pay	0.039	0.046	0.089	0.074
	(0.063)	(0.061)	(0.083)	(0.089)
Demographic controls	N	N	N	Y
Day of the week FX	Y	N	Y	Y
Interview month FX	Y	N	Y	Y
Observations	439	439	430	430
R-squared	0.300	0.374	0.363	0.408

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes: Demographic controls include: female, non-white, public housing, rural area, public school, household has car. All models are weighted using household sampling weights. Standard errors are calculated using Taylor series linearization. Post SNAP pay equals 1 on the day of SNAP pay and all days after. Sample restricted to children in households receiving SNAP pay during data collection and interviewed when school was in session.

Table 6: Regression results, SNAP and school meal participation by age

	School lunch		School breakfast		Non-school lunch		Non-school breakfast	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Age 5-10								
Two days before SNAP pay	0.181	0.065	0.030	0.028	-0.012	0.071	-0.143	-0.162
	(0.114)	(0.121)	(0.115)	(0.081)	(0.144)	(0.132)	(0.121)	(0.104)
One day before SNAP pay	-0.012	-0.029	0.011	0.028	-0.014	0.025	-0.150	-0.170
	(0.170)	(0.143)	(0.147)	(0.122)	(0.132)	(0.134)	(0.109)	(0.111)
Day of SNAP pay	0.067	-0.060	-0.151	-0.158	-0.025	0.017	0.048	-0.012
	(0.126)	(0.121)	(0.124)	(0.095)	(0.109)	(0.121)	(0.076)	(0.089)
Post SNAP pay	0.087	0.010	-0.051	-0.033	-0.127	-0.071	-0.238*	-0.295**
	(0.129)	(0.128)	(0.128)	(0.086)	(0.120)	(0.129)	(0.109)	(0.084)
Observations	367	367	354	354	367	367	354	354
R-squared	0.183	0.376	0.196	0.289	0.130	0.182	0.256	0.318
B. Age 11-18								
Two days before SNAP pay	0.075	0.022	-0.216+	-0.190*	-0.045	0.025	0.139	0.197
	(0.122)	(0.082)	(0.106)	(0.080)	(0.118)	(0.088)	(0.132)	(0.120)
One day before SNAP pay	-0.155	-0.182+	-0.251*	-0.246**	0.176	0.182+	0.268**	0.255**
	(0.122)	(0.093)	(0.106)	(0.086)	(0.119)	(0.094)	(0.087)	(0.049)
Day of SNAP pay	-0.195	-0.218*	-0.270+	-0.250*	0.116	0.129	0.116	0.131
	(0.131)	(0.105)	(0.142)	(0.117)	(0.118)	(0.096)	(0.125)	(0.106)
Post SNAP pay	-0.172	-0.228*	-0.344**	-0.355**	0.077	0.113	0.242*	0.240**
	(0.128)	(0.106)	(0.116)	(0.102)	(0.112)	(0.088)	(0.094)	(0.084)
Observations	439	439	430	430	439	439	430	430
R-squared	0.377	0.425	0.258	0.290	0.311	0.382	0.385	0.427

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes: Demographic controls include: female, non-White, age less than 10 years old, public school, public housing, rural area, household has car. All models have day of the week and interview month fixed effects. Sample is restricted to children in households receiving SNAP payments during data collection week (including first and last day of data collection). All models are weighted using household sampling weights, and standard errors are computed using Taylor series linearization.

Table 7: Regression results, SNAP and lunch participation, baseline specification by gender

	Age 5-10				Age 11-18			
	School lunch	School breakfast	Non-school lunch	Non-school breakfast	School lunch	School breakfast	Non-school lunch	Non-school breakfast
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post SNAP pay*Female	-0.008	0.011	-0.199	-0.208+	-0.253*	-0.227	0.127	0.143
	(0.090)	(0.061)	(0.120)	(0.110)	(0.101)	(0.136)	(0.091)	(0.133)
Post SNAP pay*Male	-0.007	-0.138*	-0.006	-0.071	-0.098	-0.167	-0.022	0.015
	(0.071)	(0.069)	(0.073)	(0.068)	(0.069)	(0.066)	(0.055)	(0.075)
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y
Day of the week FX	Y	Y	Y	Y	Y	Y	Y	Y
Interview month FX	Y	Y	Y	Y	Y	Y	Y	Y
Observations	367	354	367	354	439	430	439	430
R-squared	0.373	0.287	0.186	0.288	0.402	0.264	0.379	0.412

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes: Demographic controls include: female, non-white, public housing, rural area, public school, household has car. All models include day of the week fixed effects and interview month fixed effects. All models are weighted using household sampling weights. Standard errors are computed using Taylor series linearization. Models include interactions of the post SNAP pay dummy with gender dummies (female and male). Sample restricted to children in households receiving SNAP pay during data collection week and interviewed when school was in session. Female dummy included in all regressions.

Table 8: Regression results, SNAP and lunch participation, baseline specification by race/ethnicity

	Age 5-10				Age 11-18			
	School lunch	School breakfast	Non-school lunch	Non-school breakfast	School lunch	School breakfast	Non-school lunch	Non-school breakfast
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post SNAP pay*Non-white	0.012	-0.047	-0.159+	-0.221**	-0.195*	-0.184+	0.006	0.015
	(0.069)	(0.053)	(0.087)	(0.056)	(0.091)	(0.102)	(0.069)	(0.107)
Post SNAP pay*White	-0.056	-0.139	0.112	0.088	-0.108	-0.220*	0.142	0.282*
	(0.122)	(0.097)	(0.119)	(0.093)	(0.097)	(0.117)	(0.096)	(0.136)
Demographic controls	Y	Y	Y	Y	N	Y	N	Y
Day of the week FX	Y	Y	Y	Y	Y	Y	Y	Y
Interview month FX	Y	Y	Y	Y	Y	Y	Y	Y
Observations	367	354	367	354	439	430	439	430
R-squared	0.374	0.283	0.192	0.299	0.416	0.263	0.377	0.421

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes: Demographic controls include: female, non-white, public housing, rural area, public school, household has car. All models include day of the week fixed effects and interview month fixed effects. All models are weighted using household sampling weights. Standard errors are computed Taylor series linearization. Models include interactions of the post SNAP pay dummy with race dummies (non-white and white). Sample restricted to children in households receiving SNAP pay during data collection week and interviewed when school was in session. Non-white dummy included in all regressions.

Table 9: Robustness test, SNAP and meal participation, baseline specification, weekend SNAP pay

DV:	School lunch (1)	School breakfast (2)	Non-school lunch (3)	Non-school breakfast (4)
A. Age 5-10				
Post SNAP pay	-0.012	-0.068	-0.096	-0.152**
	(0.064)	(0.043)	(0.067)	(0.048)
Weekend SNAP pay	-0.035	0.084	-0.084	-0.296+
	(0.111)	(0.128)	(0.113)	(0.162)
Observations	367	354	367	354
R-squared	0.374	0.286	0.183	0.332
B. Age 11-18				
Post SNAP pay	-0.161*	-0.184*	0.036	0.067
	(0.068)	(0.077)	(0.053)	(0.083)
Weekend SNAP pay	0.090	0.127	-0.110	-0.076
	(0.113)	(0.099)	(0.120)	(0.138)
Observations	439	430	439	430
R-squared	0.418	0.272	0.379	0.410

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes: All models include demographic controls: female, non-white, public housing, rural area, public school, household has car. All models have day of the week fixed effects and interview month fixed effects. All models are weighted using household sampling weights. Standard errors are computed using Taylor series linearization and account for the complex structure of the survey. Sample restricted to children in households receiving SNAP pay during data collection week and interviewed when school was in session.

Table 10: Robustness test, SNAP and meal participation, extended specification, weekend SNAP pay

	School lunch	School breakfast	Non-school lunch	Non-school breakfast
DV:	(1)	(2)	(3)	(4)
A. Age 5-10				
Two days pre SNAP pay	0.068	0.025	0.075	-0.149
	(0.117)	(0.081)	(0.136)	(0.107)
One day pre SNAP pay	-0.029	0.025	0.026	-0.160
	(0.141)	(0.124)	(0.136)	(0.115)
Day of SNAP pay	-0.078	-0.141	-0.008	-0.083
	(0.122)	(0.084)	(0.110)	(0.079)
Post SNAP pay	0.007	-0.033	-0.075	-0.294**
	(0.128)	(0.086)	(0.130)	(0.077)
Weekend SNAP pay	-0.051	0.065	-0.074	-0.257
	(0.109)	(0.131)	(0.112)	(0.164)
Observations	367	354	367	354
R-squared	0.377	0.291	0.186	0.352
A. 10-18				
Two days pre SNAP pay	0.030	-0.175*	0.015	0.189
	(0.075)	(0.074)	(0.076)	(0.119)
One day pre SNAP pay	-0.163+	-0.214**	0.160+	0.238**
	(0.087)	(0.076)	(0.085)	(0.054)
Day of SNAP pay	-0.189+	-0.201+	0.094	0.104
	(0.094)	(0.099)	(0.077)	(0.104)
Post SNAP pay	-0.216*	-0.335**	0.099	0.229**
	(0.095)	(0.091)	(0.073)	(0.078)
Weekend SNAP pay	0.073	0.124	-0.089	-0.068
	(0.118)	(0.090)	(0.121)	(0.132)
Observations	439	430	439	430
R-squared	0.427	0.299	0.385	0.429

Standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1
Notes: All models include demographic controls: female, non-white, public housing, rural area, public school, household has car. All models have day of the week fixed effects and interview month fixed effects. All models are weighted using household sampling weights. Standard errors are computed using Taylor series linearization. Sample restricted to children in households receiving SNAP pay during data collection week and interviewed when school was in session.

Table 11: Robustness test, SNAP and meal participation, baseline specification by grade level

	School lunch		School breakfast		Non-school lunch		Non-school breakfast	
DV:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. K-Elementary School								
Post SNAP pay	0.020	-0.028	-0.153*	-0.147**	-0.087	-0.073	-0.044	-0.063
	(0.061)	(0.066)	(0.072)	(0.049)	(0.060)	(0.072)	(0.074)	(0.080)
Observations	439	439	426	426	439	439	426	426
R-squared	0.172	0.342	0.305	0.385	0.123	0.154	0.208	0.252
B. Middle and High School								
Post SNAP pay	-0.178+	-0.192*	-0.178+	-0.187+	0.062	0.066	0.089	0.070
	(0.093)	(0.087)	(0.095)	(0.092)	(0.081)	(0.074)	(0.094)	(0.098)
Demographic controls	N	Y	N	Y	N	Y	N	Y
Day of the week FX	Y	Y	Y	Y	Y	Y	Y	Y
Interview month FX	Y	Y	Y	Y	Y	Y	Y	Y
Observations	367	367	358	358	367	367	358	358
R-squared	0.305	0.385	0.227	0.272	0.259	0.379	0.308	0.373

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes: Demographic controls include: female, non-white, public housing, rural area, public school, household has car. All models are weighted using household sampling weights. Standard errors are calculated using Taylor series linearization. Sample restricted to children in households receiving SNAP pay during data collection week and interviewed when school was in session.

Table 6: Robustness test, SNAP and meal participation, extended specification by grade level

	School lunch		School breakfast		Non-school lunch		Non-school breakfast	
DV:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. K-Elementary School								
Two days pre SNAP pay	0.135	0.041	-0.065	-0.033	0.031	0.103	-0.144	-0.146
	(0.122)	(0.112)	(0.163)	(0.113)	(0.162)	(0.160)	(0.107)	(0.086)
One day pre SNAP pay	-0.053	-0.077	-0.103	-0.086	0.002	0.063	-0.090	-0.066
	(0.166)	(0.149)	(0.156)	(0.113)	(0.124)	(0.135)	(0.091)	(0.098)
Day of SNAP pay	0.047	-0.056	-0.243	-0.223*	-0.023	0.007	0.046	0.003
	(0.107)	(0.122)	(0.151)	(0.102)	(0.107)	(0.123)	(0.091)	(0.102)
Post SNAP pay	0.031	-0.045	-0.202	-0.183+	-0.089	-0.025	-0.147	-0.155
	(0.110)	(0.129)	(0.149)	(0.097)	(0.110)	(0.131)	(0.107)	(0.108)
Observations	10,490	10,490	10,477	10,477	10,490	10,490	10,477	10,477
R-squared	0.178	0.345	0.142	0.257	0.125	0.157	0.226	0.264
B. Middle and High School								
Two days pre SNAP pay	0.086	0.036	-0.181+	-0.154+	-0.076	-0.006	0.198	0.246+
	(0.135)	(0.077)	(0.103)	(0.082)	(0.122)	(0.062)	(0.136)	(0.127)
One day pre SNAP pay	-0.209	-0.206+	-0.231*	-0.196*	0.220	0.198+	0.298**	0.258**
	(0.146)	(0.102)	(0.104)	(0.076)	(0.139)	(0.105)	(0.093)	(0.057)
Day of SNAP pay	-0.273+	-0.264*	-0.260+	-0.214+	0.181	0.170	0.159	0.152
	(0.150)	(0.112)	(0.153)	(0.107)	(0.141)	(0.106)	(0.138)	(0.103)
Post SNAP pay	-0.216	-0.254*	-0.325*	-0.324**	0.101	0.125	0.275*	0.253**
	(0.151)	(0.115)	(0.120)	(0.098)	(0.136)	(0.096)	(0.102)	(0.084)
Demographic controls	N	Y	N	Y	N	Y	N	Y
Observations	10,415	10,415	10,406	10,406	10,415	10,415	10,406	10,406
R-squared	0.326	0.400	0.25	0.293	0.281	0.392	0.334	0.395

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes: Demographic controls include: female, non-white, public housing, rural area, public school, household has car. All models have day of the week fixed effects and interview month fixed effects. All models are weighted using household sampling weights. Standard errors are computed using Taylor series linearization. Sample restricted to children in households receiving SNAP pay during data collection week and interviewed when school was in session.

Appendix

Table A: Number of observations per child, 5-18 years old

Obs. per child	Freq.	Percent
One	23	1.96
Two	25	2.13
Three	28	2.39
Four	47	4.01
Five	56	4.77
Six	51	4.35
Seven	943	80.39
Total	1,173	100

Notes: Resulting number of observations per child after restricting sample to children interviewed when school was in session, and dropping child-day observations with missing lunch information.

Table B: Probability of school and non-school meal participation, SNAP and non-SNAP children by age

	School lunch		Non-school lunch		School breakfast		Non-school breakfast	
DV:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Age 5-10								
SNAP	0.112+	0.135*	-0.200**	-0.183**	0.056	0.048	-0.096	-0.058
	(0.059)	(0.051)	(0.051)	(0.046)	(0.042)	(0.040)	(0.060)	(0.063)
Observations	2,527	2,527	2,527	2,527	2,426	2,426	2,426	2,426
R-squared	0.050	0.089	0.072	0.124	0.032	0.046	0.024	0.064
B. Age 11-18								
SNAP	0.179**	0.158*	-0.180**	-0.144*	0.061	0.055	-0.057	-0.028
	(0.065)	(0.060)	(0.060)	(0.054)	(0.037)	(0.036)	(0.062)	(0.053)
Demographic controls	N	Y	N	Y	N	Y	N	Y
Day of the week FX	Y	Y	Y	Y	Y	Y	Y	Y
Interview month FX	Y	Y	Y	Y	Y	Y	Y	Y
Observations	3,002	3,002	3,002	3,002	2,816	2,816	2,816	2,816
R-squared	0.101	0.139	0.084	0.138	0.052	0.059	0.030	0.081

Standard errors in parentheses

** p<0.01, * p<0.05, + p<0.1

Notes: Demographic controls include: female, non-white, public housing, public school, rural area, household has car. Sample includes children in households that receive SNAP benefits and those in households with incomes less than 185 of the poverty threshold not on SNAP. Sample restricted to those interviewed when school was in session (excludes summer and other breaks).

Table C: Balance test, before and after SNAP pay, age 5-18 yrs. old

DV: Post SNAP pay	School in session (1)	Full Sample (2)
Non-white	0.100	0.001
	(0.116)	(0.100)
Female	0.012	0.017
	(0.042)	(0.035)
Public School	0.093	0.158
	(0.147)	(0.108)
Rural area	0.203+	0.188+
	(0.114)	(0.093)
Public housing	0.017	0.062
	(0.108)	(0.074)
Has car	0.033	-0.026
	(0.098)	(0.077)
Age less than 11 yrs. old	0.022	-0.023
	(0.039)	(0.031)
Includes Summer	N	Y
Day of the week FX	Y	Y
Interview month FX	Y	Y
F-stat	0.57	1.6
Prob>F	0.77	0.18
Observations	806	1,008
R-squared	0.164	0.172

Standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1
Notes: Sample restricted to children in households receiving payment during data collection week (including first and last day of data collection). Full sample includes children interviewed when school was in session and those interviewed during summer break.

Table D: Regression results, SNAP and lunch participation by age, full SNAP month specification

	School lunch			Non-school lunch		
DV:	(1)	(2)	(3)	(4)	(5)	(6)
A. Age 5-10						
Day of SNAP pay	0.096	0.106	0.012	-0.069	-0.086	-0.016
	(0.107)	(0.089)	(0.072)	(0.096)	(0.085)	(0.074)
Days 1-5 since SNAP	0.020	0.019	0.095	-0.052	-0.035	-0.052
	(0.081)	(0.075)	(0.063)	(0.078)	(0.075)	(0.078)
Days 6-10 since SNAP	0.074	0.058	0.136+	0.045	0.011	-0.084
	(0.093)	(0.085)	(0.079)	(0.089)	(0.083)	(0.086)
Days 11-15 since SNAP	-0.029	-0.046	-0.028	0.104	0.074	0.050
	(0.089)	(0.086)	(0.084)	(0.096)	(0.091)	(0.090)
Days 16-20 since SNAP	-0.159*	-0.145+	-0.120	0.245**	0.238**	0.160+
	(0.079)	(0.080)	(0.088)	(0.085)	(0.083)	(0.084)
Days 21-25 since SNAP	0.006	-0.008	-0.006	0.074	0.079	0.033
	(0.080)	(0.080)	(0.084)	(0.080)	(0.075)	(0.072)
Observations	1,846	1,846	1,846	1,846	1,846	1,846
R-squared	0.064	0.116		0.086	0.147	
Number of groups			388			388
B. Age 11-18						
Day of SNAP pay	-0.101	-0.105	-0.100	0.093	0.093	0.045
	(0.111)	(0.107)	(0.082)	(0.106)	(0.100)	(0.059)
Days 1-5 since SNAP	-0.021	-0.031	-0.166+	0.008	0.005	0.082
	(0.102)	(0.099)	(0.098)	(0.085)	(0.080)	(0.056)
Days 6-10 since SNAP	0.125	0.148	-0.203*	-0.132	-0.173*	0.136*
	(0.100)	(0.095)	(0.097)	(0.090)	(0.084)	(0.061)
Days 11-15 since SNAP	0.027	0.068	-0.229*	-0.046	-0.096	0.220**
	(0.100)	(0.094)	(0.092)	(0.091)	(0.084)	(0.066)
Days 16-20 since SNAP	-0.127	-0.102	-0.211*	0.087	0.037	0.191**
	(0.093)	(0.091)	(0.083)	(0.086)	(0.082)	(0.063)
Days 21-25 since SNAP	0.004	-0.004	-0.106	-0.060	-0.056	0.103+
	(0.098)	(0.099)	(0.075)	(0.096)	(0.097)	(0.059)
Observations	1,896	1,896	1,896	1,896	1,896	1,896
R-squared	0.092	0.132		0.075	0.128	
Number of groups			401			401
Demographic controls	N	Y	Y	N	Y	Y
Individual random effects	N	N	Y	N	N	Y

Standard errors in parentheses (clustered at the household level)
** p<0.01, * p<0.05, + p<0.1
Notes: Demographic controls include female, non-white, public school, rural area, public housing, household has car. All models include day of the week and interview month dummies. Sample restricted to children interviewed when school was in session. All models are weighted using the household sampling weights.

Table E: Regression results, SNAP and breakfast participation by age, full SNAP month specification

	School breakfast			Non school breakfast		
DV:	(1)	(2)	(3)	(4)	(5)	(6)
A. Age 5-10						
Day of SNAP pay	-0.103	-0.099	-0.012	0.059	0.043	0.018
	(0.093)	(0.088)	(0.064)	(0.123)	(0.112)	(0.081)
Days 1-5 since SNAP pay	-0.101+	-0.096	0.071	-0.077	-0.076	-0.095+
	(0.065)	(0.062)	(0.044)	(0.095)	(0.088)	(0.050)
Days 6-10 since SNAP pay	-0.077	-0.084	0.086	0.097	0.060	-0.066
	(0.087)	(0.082)	(0.061)	(0.120)	(0.112)	(0.065)
Days 11-15 since SNAP pay	-0.116	-0.126	-0.036	0.113	0.075	0.068
	(0.081)	(0.079)	(0.064)	(0.114)	(0.107)	(0.071)
Days 16-20 since SNAP pay	-0.076	-0.081	-0.071	0.163	0.157	0.098
	(0.090)	(0.090)	(0.081)	(0.110)	(0.104)	(0.086)
Days 21-25 since SNAP pay	-0.027	-0.029	-0.184**	0.142	0.134	0.218**
	(0.082)	(0.080)	(0.061)	(0.099)	(0.094)	(0.064)
Observations	1,774	1,774	1,774	1,774	1,774	1,774
R-squared	0.047	0.060		0.058	0.089	
Number of groups			373			373
B. Age 11-18						
Day of SNAP pay	-0.113	-0.114	0.003	-0.010	-0.006	-0.013
	(0.106)	(0.106)	(0.078)	(0.119)	(0.113)	(0.079)
Days 1-5 since SNAP pay	-0.140+	-0.142+	-0.126+	0.039	0.032	0.088
	(0.074)	(0.074)	(0.065)	(0.088)	(0.081)	(0.058)
Days 6-10 since SNAP pay	-0.088	-0.083	-0.195**	-0.036	-0.048	0.167*
	(0.079)	(0.079)	(0.073)	(0.102)	(0.092)	(0.069)
Days 11-15 since SNAP pay	-0.162*	-0.149	-0.211**	0.008	-0.004	0.187*
	(0.076)	(0.075)	(0.077)	(0.106)	(0.095)	(0.081)
Days 16-20 since SNAP pay	-0.151+	-0.147	-0.133+	0.096	0.076	0.154+
	(0.091)	(0.089)	(0.070)	(0.104)	(0.100)	(0.090)
Days 21-25 since SNAP pay	0.019	0.020	-0.054	0.055	0.077	0.099
	(0.081)	(0.080)	(0.064)	(0.108)	(0.103)	(0.080)
Observations	1,772	1,772	1,772	1,772	1,772	1,772
R-squared	0.106	0.104		0.054	0.104	
Number of groups			377			377
Demographic controls	N	Y	Y	N	Y	Y
Individual random effects	N	N	Y	N	N	Y

Standard errors in parentheses (clustered at the household level)
** p<0.01, * p<0.05, + p<0.1
Notes: Demographic controls include: non-white, female, public school, rural area, public housing, household has car. All models include day of the week and interview month dummies. Sample restricted to children interviewed when school was in session. All models are weighted using the housing sample weights.