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THE EFFECT OF FREE SCHOOL MEALS ON HOUSEHOLD FOOD PURCHASES: EVIDENCE FROM THE COMMUNITY ELIGIBILITY PROVISION

Michelle M. Marcus
Katherine G. Yewell

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The Effect of Free School Meals on Household Food Purchases: Evidence from the Community Eligibility Provision
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ABSTRACT

We find evidence that exposure to universal free school meals through the Community Eligibility Provision (CEP) had a meaningful impact on grocery spending for households with children, with monthly food purchases declining by about $11, or 5 percent. For households in zip codes with higher exposure, the decline is as high as $39 per month, or 19 percent. We also show evidence that the composition of food purchases changes, with low income households experiencing an increase in the dietary quality of their food purchases by about 3 percent after CEP. Finally, we show CEP exposure is associated with an 11 percent decline in the percent of households that ran short of money or tried to make their food money go further, and an almost 5 percent decline in households classified as food insecure. Our results on the heterogeneous effects of CEP exposure by prior free/reduced price lunch eligibility reveal large benefits in terms of both spending, dietary composition, and food insecurity for previously eligible low-income families, suggesting that the stigma of free school meals may be declining after universal access.

Michelle M. Marcus
Department of Economics
Vanderbilt University
310 Calhoun Hall
Nashville, TN 37240
and NBER
michelle.marcus@vanderbilt.edu

Katherine G. Yewell
Department of Health Management and Systems Sciences
School of Public Health and Information Sciences
University of Louisville
485 E. Gray Street
Louisville, KY 40202
katherine.yewell@louisville.edu

A data appendix is available at http://www.nber.org/data-appendix/w29395

1 Introduction

The national school lunch program (NSLP) is the second largest nutrition assistance program in the US, costing about $13.8 billion annually. Nearly 100,000 schools serve lunches to about 30 million students each day, with 22 million students served at free or reduced-prices (USDA, 2019). The NSLP is a critical part of the social safety net and provides substantial resources to low-income families, for whom school lunches represent an important source of calories and nutrition. While other important safety net programs, such as the Supplemental Nutrition Assistance Program (SNAP), have been shown to have important impacts on household budgets (Shapiro, 2005; Hamrick and Andrews, 2016; Kuhn, 2018; Carr and Packham, 2019; Laurito and Schwartz, 2019), we know much less about the impact of access to free school lunches on household spending and diet composition.

Measuring the impact of access to free school lunches on household budgets is challenging because eligibility has traditionally been based on family income, and households decide when to participate, making it likely that NSLP take-up is correlated with other important determinants of household spending, such as income, family size, and martial status. We overcome this identification challenge by exploiting variation from the introduction of universal free school meals through the Community Eligibility Provision (CEP).

Despite the nutritional importance of school meals for low-income students, an estimated 20-55 percent of students eligible for free lunch do not participate.[1] Prior to the introduction of the CEP, stigma and application costs represented significant barriers to participation in the NSLP. Bhatia et al. (2011), for example, found that the availability of unsubsidized foods competing with the NSLP made NSLP participation itself an easily visible marker of income status, stigmatizing students and discouraging participation. To reduce these barriers to school meal participation, the Community Eligibility Provision eliminates applications for free and reduced-price school meals and allows schools with students that meet a certain poverty threshold[2] to provide free meals for all students, regardless of their family income.

[1]The estimates vary by school level and by year. In general, there are higher participation rates for elementary school students, and the participation rates are increasing slightly over time (School Nutrition Association, 2014).

[2]This threshold is defined as schools with an Identified Student Percentage (ISP) of at least 40 percent. That is, schools with at least 40 percent of students identified as being previously eligible for free school meals based on participation in federal means tested programs are eligible and may elect to participate in

As of 2019, the take-up rate for eligible schools was about 65 percent, making CEP available to over 13.6 million students in more than 28,000 schools and over 4,600 districts across the US (Maurice et al., 2019).

By reducing the price of school meals to zero for families with children in eligible schools, CEP is likely to have a significant impact on household budgets and food spending for both newly eligible households and households previously eligible but who did not participate. Through its impact on the household budget, CEP may also alter the composition of household food purchases and affect the dietary quality of at-home food consumption. Not only could this have important implications for household nutrition and obesity in the short-run, but research has also shown policy-driven increases in access to food during childhood can improve later life health and economic outcomes (Hoynes et al., 2016; Bütikofer et al., 2018). Thus, the impact of CEP on household budgets and dietary quality have important implications for long run outcomes and improved intergenerational mobility.

This paper studies the impact of providing universal free school meals through the Community Eligibility Provision on household food spending, diet composition, and food security. Our identification strategy exploits plausibly exogenous variation in the availability of CEP over time, which is independent of individual household take-up decisions. Using the Nielsen household panel data from 2004-2016 and the Current Population Survey from 2001-2017, we estimate the effect of CEP exposure on grocery store purchases, dietary quality, and food security for households with school-aged children compared to those without school-aged children.

We find that CEP exposure reduces spending on food by about \$11 per month, or about 5 percent from the mean, among households with children relative to households without children. We also focus on a set of food groups we categorize as typically lunch or breakfast foods and find a \$5.50, or about 9 percent decrease in spending on these foods. Next, we explore the effect of CEP on the dietary quality of household grocery purchases and find that a composite health score of grocery store purchases improves for lower-income households with children by about 3 percent after they gain access to free school meals. This suggests that lower-income households substitute toward more healthy food consumed at home while

CEP.

also saving money. In addition to these differing effects across household income levels, we also examine heterogeneity by school levels and find the largest reductions in grocery spending among households in areas with large takeup of CEP at the primary school level. Finally, we find that CEP leads to large improvements in household food security. These results support the hypothesis that previously-eligible low-income households experience significant benefits from the adoption of CEP.

Previous literature has documented the benefits of free school meals along other important dimensions. Access to free school meals improves test scores and cognitive achievement (Ruffini, 2021; Gordanier et al., 2020; Schwartz and Rothbart, 2017; Frisvold, 2015) and reduces school suspensions (Gordon and Ruffini, 2018).[3] Yet, there is little evidence of the impact of access to and take-up of free school meals on household food spending and diet composition.[4]

In the context of low-income families who are eligible for the Supplemental Nutrition Assistance Program (SNAP), a body of research indicates that these households are especially likely to face resource constraints towards the end of the SNAP benefit cycle when the benefits are running out. For instance, studies have shown that food consumption declines and grocery store theft increases toward the end of the benefit cycle (Shapiro, 2005; Hamrick and Andrews, 2016; Carr and Packham, 2019). Kuhn (2018) also shows evidence that diet quality worsens over the benefit month, but that children may be protected from some cyclical food insecurity by school meal programs. Similarly, Laurito and Schwartz (2019) find that school lunch participation rates are linked to the timing of SNAP payments and conclude that school lunches may fill the "SNAP gap". However, less is known about the causal impact in the reverse direction, so we seek to discover how access to free school meals

[3]Evidence on the effect of free school meals through the CEP on obesity has shown mixed findings across different settings (Davis and Musaddiq, 2019; Davis, 2020).

[4]In contemporaneous work, Handbury and Moshary (2021) study the retail response to free school meals through CEP. Measuring exposure to CEP at the grocery chain level across all local stores, they find evidence that chains with the most chain exposure to CEP make chain-level price reductions across all stores due to decreased revenue. When CEP is measured at a local level, there is no evidence that prices respond to local CEP exposure. These findings show that uniform pricing dampens price responses in areas where chain exposure is low, but local adoption is high (and vice versa). Using a model of grocery demand, they find reduced grocery costs result in significant indirect benefits for the median household. As our estimates rely on local comparisons of households with and without children, any impact on purchases through a price channel should be captured by our control group.

impacts household budget constraints. The roll out of CEP across schools allows us to examine not only the effect of free school meals on previously eligible households, but also the effect on households that did not already qualify for free meals and do not face such tight resource constraints.

This paper expands upon existing work and makes several important contributions to the literature. First, we show the impact of an increase in access to free school meals on household food purchases. CEP is a costly program aimed to eliminate food insecurity and improve nutrition and academic outcomes for the nation's poorest students, but the impact of CEP extends beyond education and schools and also affects households directly by relaxing budget constraints. Resulting changes in household grocery purchases can have a direct impact on students, as well as spillover effects on other family members. Understanding the impact of CEP on household budgets can provide insight as to the amount households save and the way in which they might reallocate their purchases between different types of food or redistribute their budget across household members.

This paper also provides new evidence documenting the impact of access to free school meals on the healthiness of household food purchases. Existing work has shown that the nutritional content of school lunches can impact child health (Schanzenbach, 2009; Bhattacharya et al., 2006) and improving the dietary quality of school meals can impact test scores (Anderson et al., 2018; Belot and James, 2011; Figlio and Winicki, 2005). However, no paper has considered that free school meals may change the health quality of at-home food purchases as well. The dietary quality of food consumed at both home and school matters, but it is unclear how access to free school lunch changes the dietary quality of household grocery purchases and food consumed outside of school. Researchers have estimated that eating a healthy diet costs about $1.50 more per day (Rao et al., 2013), so relaxing the household budget constraint could allow households to afford healthier food such as fruits and vegetables. On the other hand, if households substitute toward less healthy food consumed at home, this may diminish the benefits of CEP. Again, these changes in household diet quality may also have spillover effects to other family members which have been previously unexplored.

Third, with information on household income, this paper explores whether CEP benefited households that were previously eligible for free lunch. We find that these low income households experience grocery savings, are able to purchase a healthier bundle of food, and experience declines in food insecurity. In this way, we document the degree to which the non-monetary stigma and application costs prevented these households from participating in free school meals prior to universal availability. Our results suggest that if there are low participation rates in the targeted group for a specific policy with the presence of stigma and application costs, expanding access and reducing application costs can increase participation among the targeted group.

Finally, this paper contributes to a literature documenting the impact of eligibility for free school meals on food insecurity among low income households (Fletcher and Frisvold, 2017; Arteaga and Heflin, 2014). Our work expands upon this literature to show that universal free school meals through CEP also have an important impact on reducing food insecurity. Our findings complement recent work by Ozturk et al. (2021) documenting a decrease in food bank use with higher CEP exposure.

Not only do our findings have important implications for household spending, nutrition, and food security in the short run, but improvements to early childhood nutrition and food security driven by CEP can have important impacts on later life health, earnings, and education (Hoynes et al., 2016; Bütikofer et al., 2018). As the effect on earnings can be transmitted across generations (Bütikofer et al., 2018), our findings may translate into increased intergenerational mobility and reductions in existing disparities.

2 Background

2.1 Policy Environment

In late 2010, Congress passed and signed into law The Healthy, Hunger Free Kids Act (HHFKA, Pub Law 111-296) as part of the Obama administration's agenda to improve access to healthy food for children in schools. This followed former First Lady Michelle Obama's highly publicized health campaign, "Let's Move!", aimed at reducing childhood obesity through improved nutrition and physical activity. HHFKA amended several existing laws, including the Richard B. Russell National School Lunch Act of 1946, the Elementary and Secondary Education Act of 1965, and the Child Nutrition Act of 1966. HHFKA added new funding for child nutrition programs, provided incentives to meet updated nutritional standards, and introduced changes to increase access to school meals for low-income and at-risk children.

A major part of the Act's role in expanding access to school meals was through the Community Eligibility Provision (CEP), which offers universal free meals in high poverty areas. This "community eligibility" is based on the number of students directly eligible for free school meals according to administrative data. As such, individual households no longer have to fill out applications for free or reduced school meals at the start of each school year, eliminating the non-monetary time and effort costs that they faced prior to CEP. Additionally, CEP reduces school-level administrative burden and improves efficiency of the NSLP, since schools no longer need to collect these individual applications to determine eligibility for free or reduced school meals.[5] If an eligible school or district adopts CEP, all students receive free lunch and breakfast at no charge, regardless of their individual economic status.

Eligibility for universal meal service under CEP is determined based on the "Identified Student Percentage" (ISP), which is the percent of students within a school or district that are directly eligible for free school meals based on their household participation in federal means-tested public assistance programs.[6,7] A school or district is eligible and may choose to participate in CEP if it has an ISP of at least forty percent.

[5]Under CEP, schools or districts must renew their direct certification numbers only once every four years to maintain eligibility; however they can also update the numbers annually to capture more current information.

[6]These programs include the Supplemental Nutrition Assistance Program (SNAP), Temporary Assistance for Needy Families (TANF), or the Food Distribution Program on Indian Reservations (FDPIR). Other eligible categories include homeless, runaway, migrant, foster, or Head Start children.

[7]Prior to CEP, local education agencies often used National School Lunch Program (NSLP) data to carry out Title I requirements under the Elementary and Secondary Education Act of 1965. This meant students eligible for free and reduced-price lunch were designated as economically disadvantaged, and the percentage of economically disadvantaged students in a school was used by local education agencies to rank schools and to allocate Title I funds to selected schools. With the elimination of free and reduced-price lunch applications, schools now conduct direct certification, which involves obtaining lists of participating families from other state agencies that keep track of these programs. This allows them to calculate the school-level and district-level ISP for determining CEP eligibility.

2.2 CEP Roll Out and School Adoption

CEP became available at the state-level over three years starting in school year (SY) 2011-2012, and was implemented nationally in SY 2014-2015. Illinois, Kentucky, and Michigan were the first three states to implement CEP in SY 2011-2012, followed by New York, Ohio, West Virginia, and the District of Columbia in SY 2012-2013, and Florida, Georgia, Maryland, and Massachusetts in SY 2013-2014. The remaining states followed with national implementation occurring in SY 2014-2015. Figure A1 in the appendix shows the roll out of CEP availability in states over time.

Despite the state-level roll out in CEP availability, schools and school districts had to decide to participate. Not all schools that were eligible for CEP chose to participate in the first year that CEP was available at the state-level. Figure 1 shows the timing of school-level CEP adoption relative to when states first allow CEP, with observations at the state-year level. The grey bars show the distribution across all states in the cumulative fraction of schools within the state that have CEP in each year since the state first allowed CEP. Red Xs show the average across all states in each year since the state first allowed CEP. It is evident that not all schools eligible for CEP adopted CEP in the first year it was available. In our sample, the average fraction of schools with CEP grows over time from about 11 percent in the first year of state access to CEP to about 29 percent 4 years after a state first has access to CEP.

This delay in adoption among eligible schools may be due in part to lack of information about the new program, administrative delays, or financial considerations. After a school or district elects to participate in CEP, this alters the federal reimbursement scheme for school lunches.[8] In addition to changing the reimbursement scheme, CEP also changes the expected number of meals served at a school. The opportunity cost of meals decreases for students, because (1) meals are now cheaper (free) if students were previously ineligible for free school meals, (2) students' families do not have to incur the time and effort costs of applying for

[8] Under traditional school meal schemes, school districts are reimbursed with federal funds at different rates for the number free, reduced, and paid lunches and breakfasts served. The federal free reimbursement rate is highest, followed by the reduced price rate, and the federal paid rate. After adopting CEP, these meal price categories no longer apply, since all meals served must be provided for free, regardless of an individual student's economic status. The revised reimbursement scheme for CEP schools is that $(1.6 \times ISP)$ percent of meals are reimbursed at the federal free rate, and the remaining are reimbursed at the paid rate.

free meals, and (3) receiving free meals can no longer single out a student's financial status, causing stigma. Therefore, CEP participating schools can expect to serve more meals. These schools may also incur economies of scale and be able to source inputs more cheaply due to bulk discounts. For all of these reasons, the decision to participate in CEP is potentially endogenous at the school level, but is plausibly exogenous at the household level. However, it is still possible that changes in demographic composition or economic conditions that impact household purchase decisions may coincide with CEP adoption. In section 5.1 we test for this and find no evidence of systematic changes in household characteristics correlated with CEP adoption.

3 Data & Methods

3.1 School-Level CEP Participation

Information on CEP participation for all US schools after the nation-wide roll out in SY 2014-2015 was obtained from the Food Research and Action Center (FRAC)[9] and the Center on Budget and Policy Priorities (CBPP).[10,11] We focus on the 48 contiguous US states. For schools adopting CEP prior to the national adoption, we obtained school adoption data from individual state agencies, including Georgia, Indiana, Kentucky, Michigan, New York, and Ohio. We were unable to obtain complete information on schools adopting CEP in several states prior to the national availability in 2014, including Illinois, West Virginia, Maryland, and Florida; households in these states are excluded from the main analysis. We also exclude states where school identifiers could not be merged with school attendance boundaries, including New Hampshire, Rhode Island, and Vermont. In robustness checks discussed in section 5.3, we show that the results are robust to including states with incomplete information on CEP adoption timing.

[9]See: http://frac.org/research/resource-library/community-eligibility-cep-database. Last Accessed: March 13, 2020

[10]See: https://www.cbpp.org/research/community-eligibility-database-take-up-of-community-eligibility-this-school-year. Last Accessed: March 13, 2020

[11]CEP participation data is underreported in the National Center for Education Statistics (NCES) data. Using NCES data, Handbury and Moshary (2021) find participation is 30% lower than the more comprehensive CBPP data we use for this study.

3.2 First Stage School Meal Data

To present evidence that CEP affected the number of free meals received at school, we use data on paid, free, and reduced-price breakfasts and lunches served from the US Department of Agriculture Food and Nutrition Service (USDA FNS) office. The USDA FNS tracks state-level participation rates and the number of meals served for the National School Lunch Program (NSLP) and School Breakfast Program (SBP) going back to 1980. For our analysis, we focus on the annual number of NSLP free/reduced-price and paid meals served per student, using NCES data on the total number of public school students in the state. We look at all meals as well as breakfast and lunch meals separately. Results are consistent across all measures.

3.3 Household Purchase Data

To measure the effect of CEP on household food spending and diet composition, we use the Nielsen Consumer Panel Dataset (2004-2016), which contains a longitudinal panel of 40,000 to 60,000 households from across the U.S. each year. We have detailed information about household member demographics and the purchases they make. Demographic variables in the Nielsen Panel include household size, income categories, age and presence of children, race, education, employment, occupation, and marital status. As CEP should only impact families with children in school, we use information on the presence of children to define our treated families.[12] We also use the zip code of household residence along with geographic school attendance boundaries to assign households to schools, discussed in detail in section 3.5. In our main analysis, we exclude any households that move zip codes in order to eliminate possible selection into CEP participating schools.[13]

Households participating in the Nielsen Panel use scanners at home to record the purchases they make, including the specific items (by UPC code), date, store of purchase, and how much they spent. We link household trips to the UPC codes and add up spending in

[12] To be consistent across data sources, we broadly define treated households as those with a child under age 18. We also confirm in appendix table A6 that our results are robust to a more restricted definition of school-aged children who are between 6 and 17 years old.

[13] We also show that the results are robust to including these households that move in appendix table A6.

certain categories for each trip over a month, so that each observation is a household-year-month unit.

Our main outcomes of interest are household food purchases and diet composition. We focus on the following categories of household purchases: total food, breakfast food, and lunch food. The appendix describes additional details on the construction of these product groups and Tables A1 and A2 list the product groups defined as breakfast and lunch foods.

For measures of diet composition, we first classify food items as either healthy or unhealthy based on USDA dietary guidelines. See the appendix for a detailed description of this classification. For instance, healthy foods include fruits and vegetables, whole-grain products, low-fat meats and dairy, fish, and nuts. Unhealthy foods include regular fat meats and dairy, fats and oils, carbonated sodas, and commercially prepared pre-packaged foods.[14] In addition to looking at monthly spending on healthy and unhealthy foods, we also consider spending on purchases of specific categories of food that are unambiguously healthy (vegetables), and unhealthy (commercially prepared pre-packaged food). While these categorizations are clear and based on USDA definitions and recommendations, one limitation of these measures is that we cannot categorize all foods and provide an overall measure of diet quality. Therefore, we create a measure to examine the overall diet quality of at-home food purchases, as detailed below.

Composite Health Score

We construct a continuous measure that allows us to compare the aggregate health of the entire bundle of goods that households purchase each month, following Hut and Oster (2019). This method combines information on the healthiness of individual food items with the share of spending on each item. With this approach, we are less concerned with the individual food items purchased but instead focus on the composition of the overall bundle.

Data on the healthiness of individual food items was created and generously provided by Hut and Oster (2019) based on a survey of primary care doctors. The doctors were asked to score these individual food items as healthy (score of 1), unhealthy (score of -1), or neither (score of 0).[15] They then aggregated these scores across doctors to get an average healthiness

[14] Table A3 in the appendix lists the USDA food group categories and their designation as healthy or unhealthy.

[15] Where "healthy" or "unhealthy" specifically means the food category was considered by the doctor to

score for each Nielsen food module that is a continuous measure $h_j \in [-1, 1]$, where $h_j = 1$ means all doctors considered the module to be healthy, $h_j = -1$ means all doctors considered the module to be unhealthy, and $h_j = 0$ is neutral.

For the bundle of food purchased by a household each month, we calculate a weighted average of the health score h_j of individual food modules and the share of spending on that module. Specifically, for household i in month t we have:

$$score_{it} = \sum_j share_{ijt} h_j \tag{1}$$

where $share_{ijt}$ is the expenditure share of household i's basket made up of food item j in month t. The overall health score is a continuous measure between -1 and 1, where a household that purchases only food which all doctors agree are unhealthy has a score of -1, and a household that purchases only food which all doctors agree are healthy has a score of 1.[16] The average household in our panel has a diet score of -0.27, indicating that they consume a larger share of unhealthy items.[17]

Two different bundles of goods may have the same degree of healthiness, so it is possible for households to change the bundles of goods they purchase without affecting the overall diet health score. For example, consider apples and bananas which are both unanimously healthy food items ($h_{apples} = h_{bananas} = 1$). Suppose that apples cost twice as much as bananas, and a household changes their consumption bundle by substituting one apple for two bananas. The overall health score will not change in this case. Note that this also does not change our previous outcome: monthly spending on food categorized as healthy.

On the other hand, households can also reallocate spending in a way that does affect the overall health score through changing the relative amount of spending, or through purchasing individual food items with different health scores (or both). Items classified as healthy (or unhealthy) based on our USDA definition may differ in their degree of healthiness. For

be a "good" or "bad" source of calories, respectively.

[16] Hut and Oster (2019) show that this measure of diet quality is closely related to other diet measures such as nutrition data, while also capturing broader information about household budget allocations to diet quality. This approach also overcomes difficulties other researchers have faced using nutritional data since it can be hard to match enough UPC codes to capture the full diet.

[17] This is similar to the estimate from Hut and Oster (2019), which they calculated to be about -0.296 on average for Nielsen purchases in 2004-2015.

instance, the degree of unhealthiness of a gallon of ice cream could be different from the degree of unhealthiness of a gallon of frozen yogurt ($h_{IceCream} \neq h_{FrozenYogurt}$). Suppose a household substitutes a gallon of frozen yogurt for a gallon of ice cream and the prices of these two goods are the same. The share of spending remains unchanged, but the different health scores h_j would cause a change in the overall diet score. While these are highly stylized examples, they demonstrate the complexities that the composite health score variable captures.

3.4 Food Insecurity Data

To measure the effect of CEP on household food insecurity, we utilize the Food Security Supplement to the Current Population Survey (CPS), which is sponsored by the USDA and conducted each December (2001-2017). The survey covers around 37,000 households per year and asks the household member questions about topics such as hunger, the availability of food, and ability to afford balanced meals. There are ten core questions used to assess the food security of households, with an additional eight asked if the household includes children.[18] The CPS also has detailed information about household demographics, including state of residence, number of household members, presence of children, and the sex, race, ethnicity, age, education level, and income level of the respondent.

We consider four outcomes of interest. First, whether the household indicates that they ran short of money and tried to make their food or food money go further. Second, we use the raw number of the designated food insecurity questions that they answered affirmatively. Third, we use the USDA's definition of food insecurity, which is a binary classification equal to one if a household answered affirmatively to at least three food insecurity questions. Finally, we consider the Rasch Scale Score, which is a standard index of food insecurity provided in the CPS supplement. The Rasch Scale Score is a continuous number between 1.43 and 13.03, where higher numbers indicate more food insecure households. The intuition for this index is to consider not only the number of affirmative answers to the food insecurity questions, but also the severity of the particular questions and frequency that is indicated

[18] See Coleman-Jensen et al. (2019) for a full list of food security questions in the CPS food security supplement.

in the responses.[19] All of these outcomes reference the household's behavior and experiences over the past 12 months, so we lag the treatment variable in our regressions by a year. In our sample, about 24 percent of households indicate that they ran short of money and tried to make their food or food money go further in the last 12 months, and about 13 percent of households are designated as food insecure.

3.5 Defining Treatment

Ideally, we would be able to perfectly observe when households have children attending a CEP participating school. However this remains unknown to the researcher. We proxy for CEP availability by defining the probability that a household has a child attending a CEP school. We refer to this as "CEP exposure."

We calculate the probability that a household is exposed to CEP using information on household residential zip code from the Nielsen data and the school attendance boundaries for the 2013-14 school year from the National Center for Education Statistics (NCES). A school attendance boundary, or catchment area, is a geographic area from which the students are eligible to attend a local school. Typically, a local school district determines the school attendance boundaries for schools within its district. We use separate school attendance boundaries for all primary, middle, and high schools in keeping with the NCES format.

To create a proxy for household exposure to CEP, we intersect household zip codes with each school attendance boundary to calculate the percent of the zip code area served by each school. Assuming a uniform distribution of households within the zip code, this provides a measure of the probability that a child attends each school.[20] When schools adopt CEP, we use this as a measure of probability of exposure to CEP for households. Because the school attendance boundaries are divided into primary, middle, and high schools, this gives us a separate measure of CEP exposure at each level.

In addition to these three measures, we create a summary measure of "overall" CEP exposure that combines information about school-level exposure. The overall CEP exposure

[19] For more on the Rasch Scale Score, see Nord and Bickel (2002).

[20] To the extent that school attendance boundaries change over time, this will introduce additional measurement error and may attenuate our results towards zero.

measure for each zip code is calculated as follows:

$$CEP_{Overall} = \frac{1}{N} \sum_{j} [n_j \times p_j] \tag{2}$$

where j indexes school levels ($j \in \{\text{primary, middle, high}\}$), n_j is the number of schools in each level, p_j is the percent of a zip code area intersecting school attendance boundaries with CEP in each school level, and N is the total schools in the zip code. This gives us a weighted average of the percent of a zip code area exposed to CEP based on school attendance boundary overlap, where the weights are the number of schools in each level: primary, middle, and high school.

Figure 2 shows the geographic variation in overall CEP exposure at the zip code level by the end of the sample period. Dark blue, medium-dark blue, medium-light blue, and light blue zip codes have overall CEP exposure above 75 percent, 50-75 percent, 25-50 percent, and 0-25 percent, respectively. Gray zip codes do not have any exposure to CEP schools and white areas are zip codes with missing information. Figure 3 shows the geographic variation in overall CEP exposure over time for school years 2011-2012 in Panel A to 2016-2017 in Panel F.[21] We exploit variation in exposure to CEP at the zip code level which varies over time as schools adopt CEP.

4 Empirical Strategy

In theory, CEP expands the household budget set by increasing access to free meals at school, both for newly eligible households and for previously eligible households who now face lower application and stigma costs after the program. However, the overall effects of CEP on household grocery store purchases are ambiguous depending on whether the substitution or income effects dominate the household consumption decision as school meals become relatively cheaper. Thus, it is an empirical question whether CEP affected the purchasing decisions of households.

[21]We were unable to obtain complete school-level CEP adoption data from several states that allowed CEP before the national roll-out. These states are excluded in our main analysis, but the results are robust to their inclusion.

To identify the effect of CEP on grocery store purchases, we estimate difference-in-differences models that rely on plausibly exogenous variation in the timing and level of CEP exposure across households in different zip codes for school-aged children versus those without. Specifically, we estimate:

$$Y_{izt} = \beta_0 + \beta_1(CEP_{tz} \times Kid_{it}) + \beta_2 CEP_{tz} + \beta_3 Kid_{it} + \beta_4 X_{izt} + \tau_t + \gamma_i + \varepsilon_{izt} \tag{3}$$

where Y_{izt} are the food purchase outcomes from Nielsen for household i in zip code z in year-month t. CEP_{tz} is either a binary measure of any exposure to CEP, the percent of the household's zip code exposed to CEP for school level $j \in \{\text{primary, middle, high}\}$, or the overall measure of CEP exposure: $CEP_{Overall}$ as defined in equation 2. Kid_{it} is an indicator variable equal to one if the household has children.[22] The specification includes year-month fixed effects, τ_t, household fixed effects, γ_i, and a vector of household controls, X_{izt}, including marital status, race and ethnicity, the number of children, household size, household income bins, WIC participation, type of residence, and education. Standard errors are clustered at the household level.[23]

The coefficient of interest, β_1, shows the effect of increasing the probability of exposure to CEP for school level j from 0 to 100 percent for households with school-aged kids relative to other households. Since households without such children should be unaffected by CEP, they act as a control group. In order for our estimate to identify the causal effect of CEP, the variation in when households are exposed to different levels of CEP must be plausibly unrelated to unobserved determinants of household grocery store purchases. We show there is no evidence of changing household demographic characteristics that coincide with CEP exposure. We also estimate dynamic event study models in order to examine changes in the effects over time as well as rule out any pre-trends. In our event studies, we calculate event-time relative to the first year that a zip code experienced any positive CEP exposure. Finally, we address concern that the presence of dynamic treatment effects in settings with variation

[22] To be consistent across data sets, we define Kid as equal to 1 if the household has any children less than 18 years old. In appendix table A6 we confirm that results are robust to a more specific rage of ages for school-aged children of 6-17 years old.

[23] We also show that results are robust to clustering at the zip-code level in appendix table A6.

in treatment timing may lead to bias in our main estimates (Callaway and SantAnna, 2020; Goodman-Bacon, 2018; Borusyak and Jaravel, 2017; De Chaisemartin and d'Haultfoeuille, 2020). We show in the appendix that our results are consistent across treatment-timing groups and we find similar results using methodology from Callaway and SantAnna (2020). As the majority of CEP adoption occurs with national roll-out, this is not surprising.

We also estimate the first-stage effect of CEP on the number of school lunches served, using variation in the percent of schools within the state that have adopted CEP over time. The following equation shows the first-stage difference-in-differences specification used to study the effect of CEP on meals served in schools:

$$L_{sy} = \theta_0 + \theta_1(\%CEP_{sy}) + \theta_2\Gamma_{sy} + \tau_y + \sigma_s + \varepsilon_{sy} \tag{4}$$

where s indexes states and y indexes years. The specification includes time-varying state controls Γ_{sy} such as unemployment rates and demographic characteristics including the fraction of the population that is Black, Hispanic, or other races, the fraction of individuals with a high school degree and with some college or more, and the fraction below the federal poverty level.[24] We also include state and year fixed effects, σ_s and τ_y, respectively, and standard errors are clustered at the state level. Outcomes of interest, L_{sy}, are the number of meals served per student at the state-by-year level, for both paid and free or reduced-price lunches. The main treatment variable of interest, $\%CEP_{sy}$, is a continuous measure of the percent of schools that have adopted CEP within the state. The coefficient of interest, θ_1, shows the effect of increasing the percent of schools that have adopted CEP from 0 to 100 percent. As with our main analysis, we also estimate dynamic event study models to examine changes in the effects over time, relative to the first period of any positive CEP exposure within the state.

Finally, we estimate the effect of CEP on measures of food insecurity using the CPS December Supplement. Since we have more detailed household information, including whether they had school-aged children, but only state-level geographic information, our estimation

[24] Results are robust to excluding these state controls.

strategy combines the approaches of equations 3 and 4. Specifically, we estimate:

$$
\begin{aligned}
F_{isy} = \gamma_0 + \gamma_1(\%CEP_{sy} \times Kid_{iy}) + \gamma_2(\%CEP_{sy}) + \gamma_3 Kid_{iy} \\
+\gamma_4 X_{isy} + \gamma_5 \Gamma_{sy} + \tau_y + \sigma_s + \varepsilon_{isy}
\end{aligned} \tag{5}
$$

where F_{ist} are food insecurity outcomes from the CPS for household i in state s in year y. The main treatment variable $\%CEP_{sy}$ is the same as used in equation 4. Kid_{iy} is an indicator variable equal to one if the household has children less than 18 years old. The specification includes a vector of household controls, X_{isy}, including marital status, race and ethnicity, household size, household income categories, WIC participation, maximum household education level, and maximum hours of work for the head of household. We also include the same time-varying state controls as before, Γ_{sy}, year fixed effects, τ_y, state fixed effects, σ_s, and cluster standard errors at the state level. The coefficient of interest, γ_1, shows the effect of increasing the number of schools that have adopted CEP from 0 to 100 percent after CEP becomes available within the state for households with school-aged children. As before, since households without school-aged children should be unaffected by CEP, they act as an additional control group. We also estimate dynamic event study models as before.

5 Results

5.1 Descriptive Statistics

Table 1 shows summary statistics for household characteristics for the whole sample, as well as separately for zip codes without any CEP exposure and those that eventually experience some amount of CEP exposure. The table shows that households in zip codes with any CEP exposure are less likely to be married, more likely to be white, less likely to have higher incomes, and more likely to have a less educated head of household. This is unsurprising, since only high-poverty schools with an ISP over 40 percent are eligible for CEP. Any cross-sectional comparison of household purchases across zip codes exposed and unexposed to CEP would likely be biased, since these characteristics, such as income and education, are related to household purchases directly.

Instead, we leverage timing of CEP exposure at the zip code level. We show that the timing of CEP exposure is unrelated to changing demographic characteristics in Table 2 and Figure 4. We regress various household characteristics on our measures of CEP exposure and year-by-month and zip code fixed effects. Standard errors are clustered at the zip code level. Using either a binary indicator for any CEP exposure in Panel A or the percent of exposure in Panel B, there is no significant relationship with a variety of demographic controls, including martial status, household size, income, education, and employment. Column 1 summarizes these demographics into one index, by predicting total food spending based on demographic characteristics. This measure of predicted food spending captures changes in demographics and is unrelated to CEP exposure. Figure 4 shows the associated event study with predicted food spending as the outcome. Similarly, there is no evidence of any change in predicted spending based on demographic characteristics after CEP.

5.2 First Stage Effect of CEP Adoption on School Meals Served

We begin by showing the first stage impact of CEP exposure on the number of paid meals and free and reduced-price meals served in schools. The data available to us is a measure of the total number of meals served in each state per year in each category (free and reduced-price versus paid). We note that the lack of nationwide data reporting meals served at the school level limits the precision of our estimates. We aggregate school level CEP adoption to the state level to take advantage of the variation in adoption timing at the school level. We use the percentage of all schools in a state that have adopted CEP, which changes over time.

Figure 5 shows the event study graphs for the first stage results. Outcomes are the number of free and reduced price lunches served per student in panel (a) and the number of paid lunches per student in panel (b). Panels (c) and (d) show the results for free and reduced price breakfasts per student and paid breakfasts per student, respectively. Coefficients are shown for years before and after CEP adoption, where time 0 is the first year a state experienced any CEP adopting schools. As expected, the number of free and reduced-price lunches and breakfasts served per student increase after CEP starts, while the number of paid lunches and breakfasts per student decline.

Table 3 shows regression results corresponding to Figure 5. Columns 1 and 2 show the effect of increasing the percent of schools that have adopted CEP on the number of free/reduced price lunches and paid lunches served per student annually, respectively. The estimates suggest that going from zero to 100 percent CEP schools increases free/reduced price lunches per student by about 18 meals per year, an increase of about 26 percent from the mean. Similarly, the number of paid lunches per student decreases by almost 14 per year, a change of over 37 percent from the mean. Columns 3 and 4 show a similar pattern for breakfasts served per student. Combining breakfast and lunch, we see in columns 5 and 6 that increasing the percent of schools that have adopted CEP to 100 percent would lead to an expected increase of about 28 free meals served per student per year and a decrease of about 20 paid meals. Overall, the results consistently show a statistically significant increase in free/reduced price meals served and a reduction in paid meals with increased CEP availability.[25]

5.3 Effect of CEP Exposure on Grocery Purchases

Total Food & Lunch Food Spending

Since CEP adoption increases the number of students receiving free and reduced-price meals, households essentially receive an income shock. Households with kids attending CEP schools no longer have to pay out-of-pocket for school meals or purchase groceries for breakfast and lunch. However, the overall impact on household grocery purchases is still ambiguous. Households may increases food purchases with the additional income or they may reduce food purchases since they no longer have to pack lunch to bring to school.

Figure 6 shows the event study graphs of grocery spending for households with children. Panels (a) and (b) show the results separately for all food purchases and for lunch and breakfast food purchases, respectively. The coefficients are estimated for each year relative to a zip code's first exposure to CEP. After CEP exposure begins, there is a reduction in both total food expenditure and lunch and breakfast food expenditures.

[25]Our first stage results also complement recent work by Ruffini (2021) who uses administrative school-level meal count data from 6 of the early CEP adopting states to show that these schools experienced an increase in annual breakfasts served per student of about 24 (46%), and an increase in annual lunches served per student of 12 (11%) after adopting CEP.

Table 4 shows the corresponding regression results from the estimation of equation 3, with a binary variable for post CEP exposure as the treatment variable in panel A and the weighted overall CEP exposure variable from equation 2 as the treatment variable in panel B. Column 1 panel A shows that CEP exposure decreased all food spending for households with kids by about \$11 per household per month, or about \$130 per year, as compared to households without kids. Relative to the mean spending of about \$206 per month, food purchases decreased by about 5 percent. Because all schools in a zip code did not necessarily participate in CEP, it is useful to consider the continuous measure of the percent of a zip code exposed to CEP in panel B. We can see that increasing CEP exposure from zero to 100 in a zip code leads to even larger decreases in food spending, about \$39 per month, or almost 19 percent from the mean. Columns 2 and 3 show the results for the categories of lunch and breakfast foods, respectively. In panel A, CEP exposure decreased lunch and breakfast food spending by about \$4 and \$1 per household per month, or about 8 and 14 percent from the mean lunch and breakfast food spending levels, respectively. Again, taking into account the probability of CEP exposure in panel B, these changes are even larger. Column 4 combines lunch and breakfast food spending and shows a decline of about \$5.50, or 9 percent from the mean (panel A). Increasing CEP exposure from zero to 100 percent could increase the magnitude of this decline to about \$21 per month, or 34 percent decline relative to the mean spending on lunch and breakfast foods (panel B).

These results are robust to a number of alternative specifications reported in Table A6, including an alternative definition of kids, excluding household controls, adding state by year and month fixed effects, clustering the standard errors at the zip code or state level, including states with missing information on school adoption timing, and including households that change residential location during the sample. We also show results by treatment timing group in Figure A3, where separate regressions are estimated for each treatment timing cohort relative to the never-treated group.[26] Each cohort is defined by the first year a household's zip code had any CEP exposure. Results are similar across treatment timing groups, suggesting that negative weighting due to dynamic treatment effects are not driving our main estimates. Our results are also robust to estimation based on Callaway and San-

[26]Table A7 shows the regression results from the associated difference-in-difference regressions.

tAnna (2020), as shown in Table A8 and Figure A4. As most of the variation is driven by the national roll-out, this is not surprising.

Diet Quality Results

While CEP exposure significantly decreases household spending on food purchases, it is unclear how the composition of household grocery purchases might change. In particular, we care about how households may allocate their food spending towards healthy or unhealthy foods. With the change in income that results from CEP, households may be able to afford more healthy purchases or they may substitute towards unhealthy purchases such as commercially prepared foods.

First, it is informative to consider the impact of CEP on broad categories of healthy and unhealthy purchases, as defined by the USDA (see section 3). Figure A2 shows how CEP exposure impacts purchases of healthy and unhealthy foods in panels (a) and (b), respectively. The figures show significant declines in purchases of both healthy and unhealthy foods following CEP availability, with no pre-trends prior to CEP adoption. Columns 1 and 2 in Table 5 display corresponding regression results for the effect of being exposed to any CEP (panel A), and of increasing overall access to CEP (panel B) on healthy and unhealthy spending for households with school-aged children. Column 1 of Panel A shows that overall spending on healthy food decreases significantly by about \$3 per month, about 5.1 percent from the average amount of healthy purchases. Column 2 of Panel A shows that CEP exposure leads to an \$8 decrease in spending on unhealthy foods, or about 5.7 percent from the average amount of unhealthy purchases. Panel B shows that increasing overall CEP exposure would scale these estimates up, such that the percent decreases in both healthy and unhealthy spending are around 21 percent from their respective means. This seems to indicate that while households are altering their food purchases, the ratio of spending on healthy versus unhealthy foods does not change much after CEP.

To explore the changes in these categories of healthy and unhealthy spending in more detail, we next consider two food categories that are unambiguously defined by the USDA according to dietary recommendations. In particular, we examine spending on vegetables and commercially prepared pre-packaged food. Figure A2 panels (c) and (d) show how CEP exposure impacts purchases of vegetables and commercially prepared foods, respectively.

Columns 3 and 4 in table 5 show the corresponding regression results. As with overall spending on healthy and unhealthy foods, the effects for spending on vegetables and on commercially prepared foods are negative and statistically significant. We find that spending on vegetables decreases by $0.22 per month (about 2 percent), and spending on commercially prepared foods decreases by about $5 per month, a change of about 5.5 percent from the mean.

It is clear from these results that purchases from individual categories of food do not paint the full picture of the healthiness of household diets. Next, we use the composite health score described in section 3.3 to examine changes in overall diet quality. Figure 6c shows the impact of CEP exposure on the composite score measure of overall healthiness of grocery purchases. The overall health score of purchases appears to increase slightly after CEP exposure. However, table 5 column 5 shows the corresponding regression results for any CEP exposure (panel A) and overall probability of CEP exposure (panel B), which indicate a statistically insignificant change in the composite health measure that is also small in magnitude. For the average household, this indicates that the quality of at home food purchases is not decreasing, despite changes in overall spending. However, it is still not clear if the effect of CEP is uniform across all households or whether CEP has heterogeneous effects on household spending and diet quality. We next turn to examine heterogeneity of the results.

5.4 Heterogeneity in the Effect on Grocery Purchases

We begin our heterogeneity analysis by examining if CEP exposure at individual school levels (elementary, middle, and high school) differentially impacts the spending and health outcomes of interest. Results for CEP exposure by school levels are shown in Panels A-C of table 6 for total food spending, lunch and breakfast spending, and the composite diet health score. When broken out by school-level, we find that all food spending decreases for households with kids by about $38, $27, and $27 per month after CEP exposure in primary, middle and high schools, respectively (column 1). Relative to the mean level of food spending, these reductions account for about 13-19 percent of spending. These declines in overall food spending appear to be driven in large part by reductions in spending on lunch and breakfast food. Column 2 shows that monthly spending on specific lunch and breakfast foods decreased by about \$22, \$14, and \$14 for primary, middle and high school CEP exposure, respectively. Relative to the mean spending on lunch and breakfast foods, these changes are fairly large in magnitude, with spending decreasing by almost 36, 23, and 23 percent for primary, middle, and high school CEP exposure, respectively.[27] As before, there is no significant change in the composite diet health score (column 3).[28]

The effects on food spending are largest in magnitude and most significant for primary school CEP exposure. This suggests that the families exposed to CEP at lower grade levels are driving the changes in at-home food spending. This is not surprising since elementary schools tend to have much larger participation in school meals.

We hypothesize that the rollout of universal access to free school meals removes much of the potential stigma associated with receiving free meals at school. We explore this hypothesis further by breaking down the effects by groups of lunch eligibility. We use the detailed information in the Nielsen panel on household size and income categories to proxy for households that would have been previously eligible for free/reduced-price meals. We proxy for eligibility by assigning households with income less than or equal to 185 percent of the federal poverty level (FPL) as being eligible for free or reduced-price school meals, and households with income above 185 percent of the FPL as paying full price for school meals prior to CEP.[29]

Figure 7 shows event studies similar to Figure 6 for each of our main outcomes decomposed by the lunch eligibility categories. Table 7 presents the corresponding coefficient estimates for any CEP exposure and overall CEP exposure.

Panels (a) and (b) in figure 7 present event studies for total food spending and lunch

[27]To see results broken down by school level CEP exposure for lunch food and breakfast food separately, see columns 1 and 2 of appendix table A4.

[28]To see results broken down by school level CEP exposure for other categories of healthy or unhealthy food spending, see columns 3-6 of appendix table A4. As with the total food, breakfast, and lunch spending, the effects are largest in magnitude for primary school CEP exposure.

[29]Our measures of FPL status are subject to some limitations. First, the household size reported in Nielsen may not necessarily be the same as the definition used in federal guidelines. Second, we only observe income bins. While these income bins are relatively narrow, especially at lower income levels, we had to decide how to assign FPL status. We assign the FPL cutoff value to an entire income bin that contained it. To the extent that this captures some households that had incomes higher than the threshold, it should bias our results towards zero since the lower income households have the strongest effects.

and breakfast food spending by lunch eligibility. Table 7 column 1 shows that at-home food spending decreases for all households. The magnitude of the effect is similar (about 5 percent from the mean) for those previously eligible and those previously ineligible for free/reduced price meals. We cannot reject that the estimates are the same across these two groups. This suggests that both newly eligible households and already eligible households take advantage of universal free meals at school.

The pattern of results is similar for spending on lunch and breakfast-specific food items. Column 2 shows that lunch and breakfast-specific food spending decreased by about $4 for the households previously eligible for free lunches, and this is not statistically significantly different from the estimated coefficient for households that had to pay full price for lunches prior to CEP.[30] Despite the similar effect sizes, our results suggest that the previously eligible households still benefit from universal access to free school meals. It is likely that the non-monetary stigma and/or application costs did play a role in preventing these eligible households from NSLP participation prior to CEP.[31]

Finally, figure 7 panel (c) shows the effect of CEP exposure on the composite health score by lunch eligibility categories, with corresponding regression estimates presented in column 3 of table 7. Here we find that the composite diet health score is positive and significant for lower income families that would previously have been eligible for free/reduced priced meals, but very small in magnitude and insignificant for higher income families. The estimates suggest that the diet quality for low income households increases by about 0.01 points, or about 3 percent from their pre-CEP mean, after CEP becomes available in their zip code. In panel B, we see that increasing from zero to 100 percent CEP exposure increases diet quality by about 0.05 points or 16 percent relative to their pre-CEP mean. In this case, we can reject the hypothesis that this coefficient is statistically the same as the coefficient for paid lunch families, suggesting that there are some potentially beneficial effects on diet quality for the low-income at-risk families even though they were previously eligible for free

[30] To see results broken down by lunch eligibility categories for lunch and breakfast food separately, see columns 1 and 2 of appendix table A5.

[31] In New York City schools, Leos-Urbel et al. (2013) also find that school breakfast participation increased among previously free-meal-eligible students after adopting universal free school breakfast, suggesting a non-price mechanism.

or reduced price school meals.[32]

5.5 Effects of CEP Exposure on Food Insecurity

We have shown evidence that low income families can benefit from the availability of universal free school meals through reducing their grocery expenditures and increasing the healthiness of their at home food consumption. Now we present results of the effect of CEP exposure on measures of household food insecurity from the CPS. Since low income households may have been food insecure prior to the program availability, it is possible that some of them may not have experienced large effects on grocery store spending if they were previously under-providing meals. Thus, even if some of the lowest income households potentially did not experience these grocery store savings, there are still benefits they could experience if access to the additional meals provided at school increases total meals consumed and improves food security.

Figure 8 shows the event-study results for effect of CEP on each measure of food insecurity. In all measures, there is a noticeable decrease in the food insecurity measure for households with school-aged children after they gain exposure to CEP in their state. Regression results in Table 8 correspond to the figure. Column 1 panel A shows after CEP becomes available in the state, the percent of households with children that ran short of money and tried to make their food or food money "go further" in the last 12 months decreased by about 2.7 percent, a change of about 11 percent from the mean.

Next, column 2 shows results for the standard definition of food insecure households, which is an an indicator for whether households answered at least 3 food security questions affirmatively. We find that after CEP becomes available within the state, the percent of households that were classified as food insecure in the last 12 months also decreases by just over 2 percentage points (panel A). For those households that were flagged as potentially food insecure by answering the question in column 1 affirmatively, about 45 percent were designated as food insecure, so this 2 percentage point decrease represents an almost 5 percent change for them.

[32] To see results broken down by lunch eligibility for other categories of health spending, see columns 3-6 of appendix table A5.

Column 3 presents results for the the 12-month food security Rasch scale score, which is a common index of food insecurity based on the number of affirmative responses to the food security questions that also takes into account the varying severity of the food security question responses. We find that the food security Rasch scale score decreases by about 0.2 points for households with kids, which is a 4 percent change from the mean score of 4.8 for households that had previously indicated they ran short of money in the last 12 months (panel A).

Finally, we estimate a Poisson specification to examine changes in the raw food security score, which is the number of affirmative responses to the 18 food security questions in the CPS. The estimation results in column 4 panel A indicate that the log odds decrease by approximately 0.14 after households with children are exposed to CEP within their state, which represents an odds ratio of about 87 percent, or a decrease of about 13 percent.

Heterogeneity of Food Insecurity Results

As with the food purchases, we are able to decompose the overall effect of CEP on food insecurity outcomes by households' relative income levels. To do this, we construct a proxy in the CPS data for a household's status relative to the FPL cutoff for free/reduced price lunch eligibility using information on their household size and income.

Appendix table A9 shows the results of this analysis. Columns 1-4 show that families previously eligible for free/reduced price meals experience larger decreases in all food insecurity measures. The differences are statistically significantly different compared to those ineligible for free/reduced price meals prior to CEP for the probability that a household is classified as food insecure (column 2) and for the food security Rasch scale score (column 3).

These findings confirm our conclusion that low-income at-risk families benefit from universal free school meals despite their prior eligibility, suggesting that non-monetary costs such as stigma and/or application time and effort may have prevented them from participating before CEP.

6 Discussion & Conclusion

We study the effect of increasing access to free school meals on household grocery store spending and diet quality. In this paper we find evidence that exposure to CEP had a meaningful impact on household grocery spending. We show that overall monthly food purchases decline by about $11, or 5 percent, when a household's zip code is exposed to any CEP. For fully exposed zip codes, the decline is as high as $39, or 19 percent. We find similar large declines in typical lunch and breakfast food spending. To the extent that some households were paying for school meals (rather than packing grocery meals) prior to CEP, the grocery savings from CEP will understate total dollars saved by the household.

The savings of $11 per month (or up to almost $39 for fully exposed zip codes) are realistic in magnitude and represent a meaningful change for low-income families that may face especially tight resource constraints. To compare the savings for families of $11-$39 per month to the cost of the program, consider the federal reimbursement scheme which currently pays about $3.41 per meal served at the federal "free" rate, and $0.32 per meal served at the federal "paid" rate.[33] Assuming a school has an ISP of 40 percent, 64 percent of the meals served will be reimbursed at the federal free rate and the remaining 36 percent will be reimbursed at the federal paid rate. The average monthly reimbursement is $0.64(\$3.41) + 0.36(\$0.32) = \$2.30$ per meal served. Therefore, the household savings of $11-$39 represent about 4.8-17 meals served to a student per month at this particular school.[34] For schools with an ISP above 62.5 percent that would get 100 percent of the meals served reimbursed at the federal rate of $3.41 per meal, this $11-$39 saving compares to about 3.2-11.4 meals served to a student per month. In practice, the real cost of providing meals to children for families will differ from schools since schools can make bulk purchases; however, this example still demonstrates that the savings we find are realistic in magnitude.

In addition to overall spending effects, we also show evidence that the composition of food purchases changes. CEP exposure is associated with large declines in both healthy and unhealthy spending of about 5 percent each. While the health score of household purchases doesn't change overall, low income households experience an increase in the dietary quality

[33]These rates are from the 2019-2020 school year for the 48 contiguous states.
[34]Calculated as savings divided by average reimbursement.

of their food purchases by about 3 percent after CEP. Relaxing the budget constraint for low income households may allow substitution toward more healthy food consumed at home.

Finally, we show large improvements in household food security following CEP exposure. CEP exposure is associated with an 11 percent decline in the percent of households that ran short of money or tried to make their food money go further, and an almost 5 percent decline in households classified as food insecure.

We also find evidence that the stigma of free school meals may be declining after universal access. Our results on the heterogeneous effects of CEP exposure by prior free/reduced price lunch eligibility reveal large benefits in terms of both spending and food insecurity for previously eligible low-income families. These results indicate that some of the poorest households that benefit the most from free lunch did not participate prior to CEP. This suggests that the non-monetary stigma and application costs of free school meals may have prevented already eligible households from participating prior to CEP.

These findings suggest that if there are low participation rates in the targeted group for a specific policy with the presence of stigma and application costs, expanding access and reducing application costs can increase participation among the targeted group. Moreover, our findings show that access to universal free school meals has meaningful immediate impacts on household spending, nutrition, and food security. These improvements to early childhood nutrition and food security from school meals may have important impacts on later life health, earnings, and education that can be transmitted across generations to impact intergenerational mobility and may help reduce existing disparities (Hoynes et al., 2016; Bütikofer et al., 2018).

References

Anderson, Michael L, Justin Gallagher, and Elizabeth Ramirez Ritchie, "School meal quality and academic performance," *Journal of Public Economics*, 2018, *168*, 81–93.

Arteaga, Irma and Colleen Heflin, "Participation in the National School Lunch Program and food security: An analysis of transitions into kindergarten," *Children and Youth Services Review*, 2014, *47*, 224–230.

Belot, Michèle and Jonathan James, "Healthy school meals and educational outcomes," *Journal of health economics*, 2011, *30* (3), 489–504.

Bhatia, Rajiv, Paula Jones, and Zetta Reicker, "Competitive foods, discrimination, and participation in the National School Lunch Program," *American Journal of Public Health*, 2011, *101* (8), 1380–1386.

Bhattacharya, Jayanta, Janet Currie, and Steven J Haider, "Breakfast of champions? The School Breakfast Program and the nutrition of children and families," *Journal of Human Resources*, 2006, *41* (3), 445–466.

Borusyak, Kirill and Xavier Jaravel, "Revisiting event study designs," *Available at SSRN 2826228*, 2017.

Bütikofer, Aline, Eirin Mølland, and Kjell G Salvanes, "Childhood nutrition and labor market outcomes: Evidence from a school breakfast program," *Journal of Public Economics*, 2018, *168*, 62–80.

Callaway, Brantly and Pedro HC SantAnna, "Difference-in-differences with multiple time periods," *Journal of Econometrics*, 2020.

Carr, Jillian B and Analisa Packham, "Snap benefits and crime: Evidence from changing disbursement schedules," *Review of Economics and Statistics*, 2019, *101* (2), 310–325.

Chaisemartin, Clément De and Xavier d'Haultfoeuille, "Two-way fixed effects estimators with heterogeneous treatment effects," *American Economic Review*, 2020, *110* (9), 2964–96.

Coleman-Jensen, Alisha, Matthew P. Rabbit, Christian A. Gregory, and Anita Singh, "Household Food Security in the United States in 2018," *Economic Research Report, USDA Economic Research Service*, 2019, *270.*

Davis, Will, "Should Kids Have Their Lunch and Eat It Too? Estimating the Effect of Universal Free School Meals on Child Weight," 2020.

_ **and Tareena Musaddiq**, "Estimating the Effects of Universal Free School Meal Enrollment on Child Health: Evidence from the Community Eligibility Provision in Georgia Schools," *Available at SSRN 3155354*, 2019.

Figlio, David N and Joshua Winicki, "Food for thought: the effects of school accountability plans on school nutrition," *Journal of public Economics*, 2005, *89* (2-3), 381–394.

Fletcher, Jason M and David E Frisvold, "The relationship between the school breakfast program and food insecurity," *Journal of Consumer Affairs*, 2017, *51* (3), 481–500.

Frisvold, David E, "Nutrition and cognitive achievement: An evaluation of the School Breakfast Program," *Journal of public economics*, 2015, *124*, 91–104.

Goodman-Bacon, Andrew, "Difference-in-differences with variation in treatment timing," Technical Report, National Bureau of Economic Research 2018.

Gordanier, John, Orgul Ozturk, Breyon Williams, and Crystal Zhan, "Free lunch for all! the effect of the community eligibility provision on academic outcomes," *Economics of Education Review*, 2020, *77*, 101999.

Gordon, Nora E and Krista J Ruffini, "School nutrition and student discipline: Effects of schoolwide free meals," Technical Report, National Bureau of Economic Research 2018.

Hamrick, Karen S and Margaret Andrews, "SNAP participants eating patterns over the benefit month: a time use perspective," *PloS one*, 2016, *11* (7).

Handbury, Jessie and Sarah Moshary, "School food policy affects everyone: Retail responses to the national school lunch program," *Available at SSRN 3897936*, 2021.

Hoynes, Hilary, Diane Whitmore Schanzenbach, and Douglas Almond, "Long-run impacts of childhood access to the safety net," *American Economic Review*, 2016, *106* (4), 903–34.

Hut, Stefan and Emily Oster, "Changes in Household Diet: Determinants and Predictability," *Working Paper*, 2019.

Kuhn, Michael A, "Who feels the calorie crunch and when? The impact of school meals on cyclical food insecurity," *Journal of Public Economics*, 2018, *166*, 27–38.

Laurito, Agustina and Amy Ellen Schwartz, "Does School Lunch Fill the "SNAP Gap" at the End of the Month?," *Southern Economic Journal*, 2019, *86* (1), 49–82.

Leos-Urbel, Jacob, Amy Ellen Schwartz, Meryle Weinstein, and Sean Corcoran, "Not just for poor kids: The impact of universal free school breakfast on meal participation and student outcomes," *Economics of education review*, 2013, *36*, 88–107.

Maurice, Alison, Randy Rosso, Crystal FitzSimons, and Kathryn Furtado, "Community Eligibility: The Key to Hunger-Free Schools: School Year 2018-2019," Technical Report, Food Research and Action Center, https://frac.org/wp-content/uploads/community-eligibility-key-to-hunger-free-schools-sy-2018-2019.pdf 2019.

Nord, Mark and Gary Bickel, "Measuring Children's Food Security in U.S. Households, 1995-99," Technical Report, USDA Food Assistance & Nutrition Research Program No. (FANRR-25), https://www.ers.usda.gov/publications/pub-details/?pubid=46624 2002.

Ozturk, Orgul, Pelin Pekgun, and Krista Ruffini, "Free School Meals and Demand for Community Food Resources," *Available at SSRN 3899868*, 2021.

Rao, Mayuree, Ashkan Afshin, Gitanjali Singh, and Dariush Mozaffarian, "Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis," *BMJ Open*, 2013.

Ruffini, Krista, "Universal access to free school meals and student achievement: Evidence from the Community Eligibility Provision," *Journal of Human Resources*, 2021, pp. 0518–9509R3.

Schanzenbach, Diane Whitmore, "Do school lunches contribute to childhood obesity?," *Journal of Human Resources*, 2009, *44* (3), 684–709.

School Nutrition Association, "The State of School Nutrition," Technical Report, http://docs.schoolnutrition.org/files/School%20Nutrition%20Operations%20Report%202014.pdf 2014.

Schwartz, Amy Ellen and Michah W Rothbart, "Let them eat lunch: The impact of universal free meals on student performance," *Journal of Policy Analysis and Management (Forthcoming)*, 2017.

Shapiro, Jesse M, "Is there a daily discount rate? Evidence from the food stamp nutrition cycle," *Journal of public Economics*, 2005, *89* (2-3), 303–325.

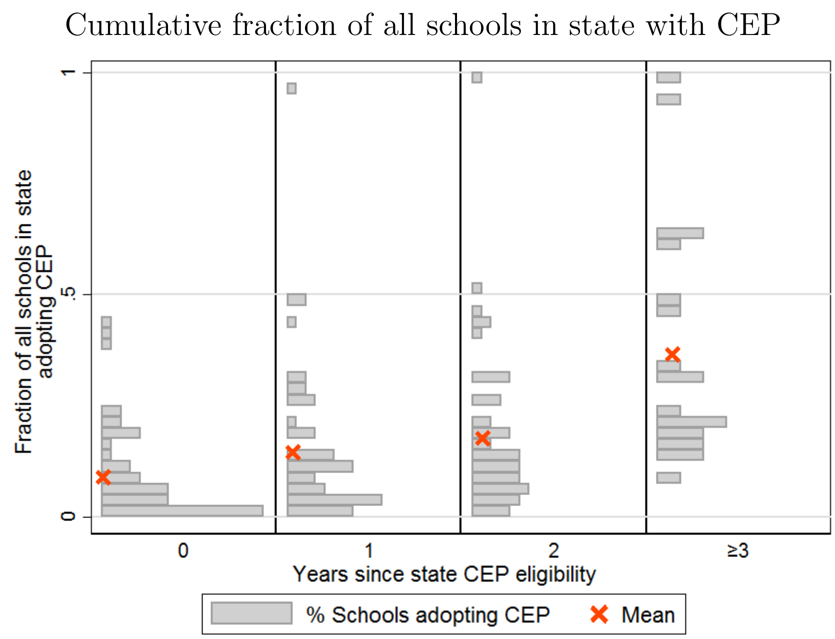
Todd, Jessica E, Lisa Mancino, Ephraim S Leibtag, and Christina Tripodo, "Methodology behind the quarterly food-at-home price database," Technical Report 2010.

USDA, "National School Lunch - Participation and Meals Served," Technical Report, US Department of Agriculture, www.fns.usda.gov/pd/child-nutrition-tables 2019.

Volpe, Richard, Abigail Okrent, and Ephraim Leibtag, "The Effect of Supercenter-Format Stores on the Healthfulness of Consumers' Grocery Purchases," *American Journal of Agricultural Economics*, 2013, *95* (3), 568–589.

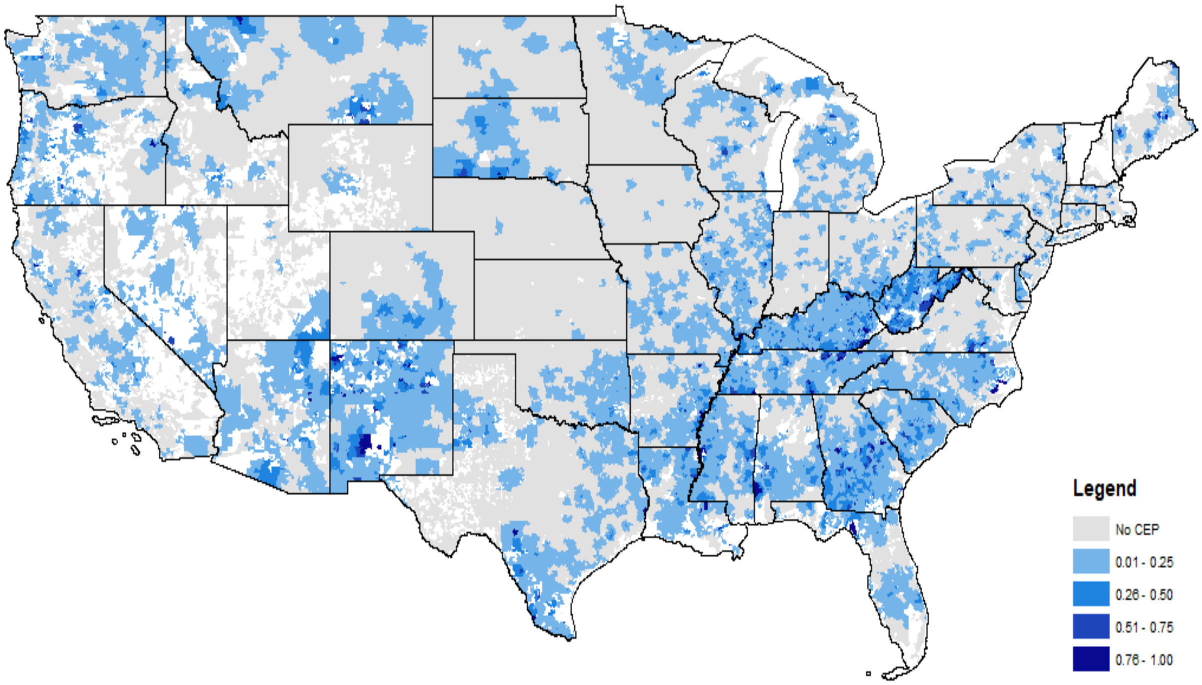
Figures

Figure 1: **School adoption timing relative to state CEP roll out**



Notes: Observations are at the state-year level. Timing is relative to availability of CEP at the state level. In each year, the grey histogram shows the distribution of the fraction of schools adopting CEP across eligible states in years since the state first allowed CEP. Red Xs show the national average fraction of schools adopting CEP in years since the state first allowed CEP.

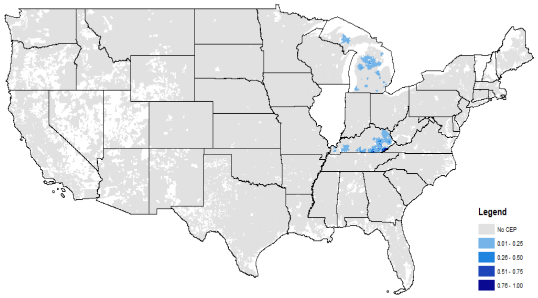
Figure 2: **Percent of zip code areas with CEP**



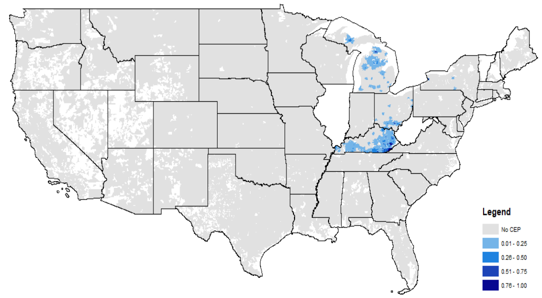
Notes: Shows the maximum exposure to CEP in our sample period. Exposure is measured as the weighted average of the percent of a zip code area exposed to CEP based on school attendance boundary overlap, weighted by the number of schools in each level: primary, middle, and high school. Zip codes with missing CEP data are not shown.

Figure 3: **CEP zip code exposure by school year**

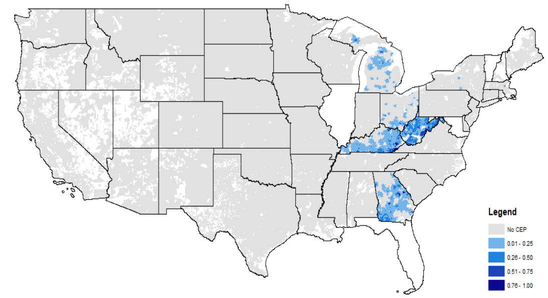
(a) 2011-2012



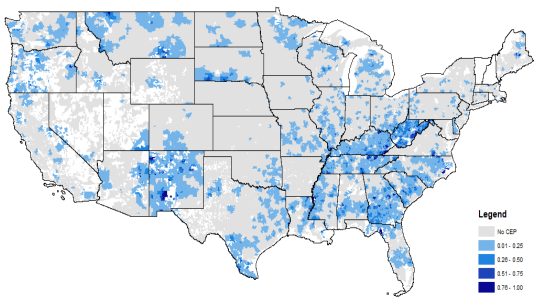
(b) 2012-2013



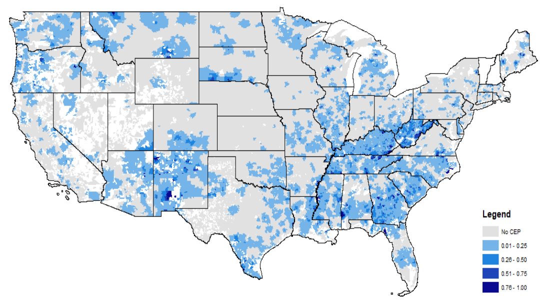
(c) 2013-2014



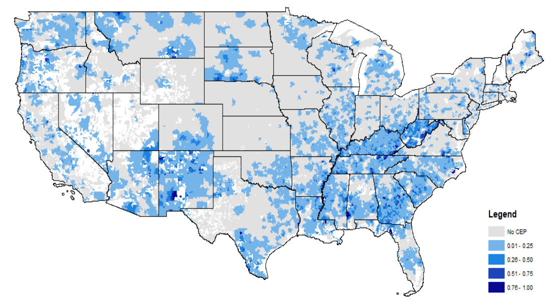
(d) 2014-2015



(e) 2015-2016

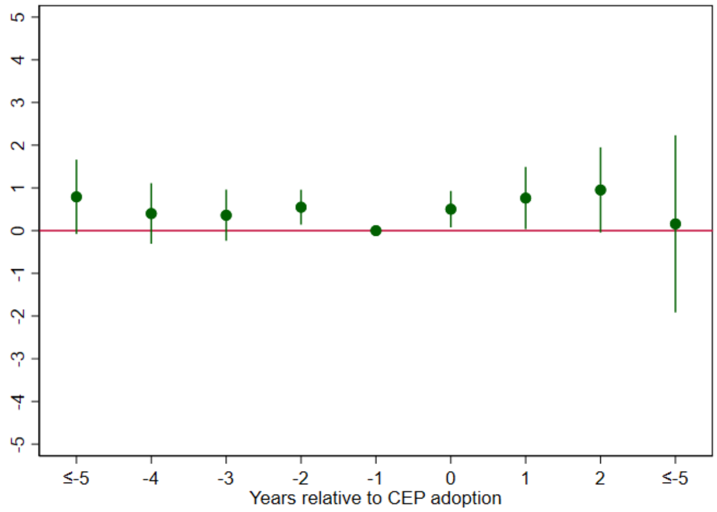


(f) 2016-2017



Notes: Shows the weighted average of the percent of a zip code area exposed to CEP based on school attendance boundary overlap, weighted by the number of schools in each level: primary, middle, and high school. Overall exposure to CEP is shown for each year from 2011 to 2016. States with missing CEP adoption dates are not shown.

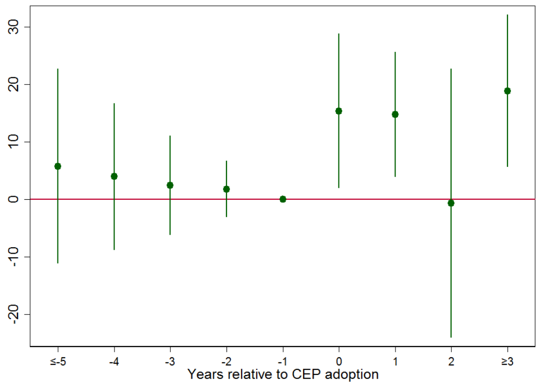
Figure 4: **CEP Exposure and Predicted Food Spending Based on Demographics**



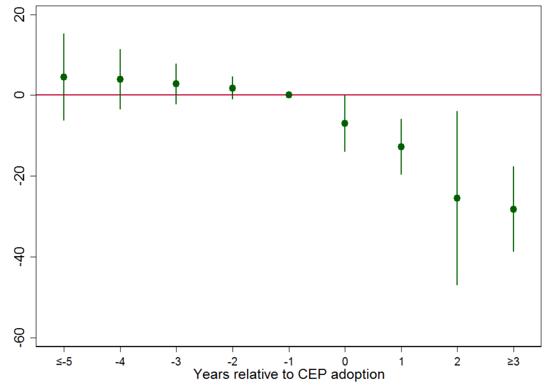
Notes: Event time is relative to the first school year a zip code experiences any CEP exposure. The outcome is total food spending predicted based on demographic characteristics, including married, household size, income bins, lunch eligibility, WIC participation, maximum household education, and maximum household employment bins. The regression includes zip code and year-by-month fixed effects and standard errors are clustered at the zip code level.

Figure 5: **First Stage Effect of CEP on NSLP Meals Served**

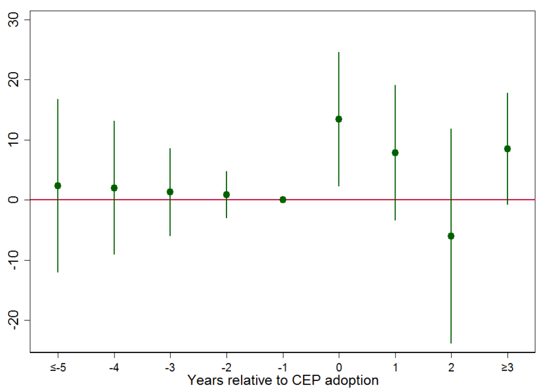
(a) Free and Reduced Price Lunches per Student



(b) Paid Lunches per Student



(c) Free and Reduced Price Breakfasts per Student



(d) Paid Breakfasts per Student

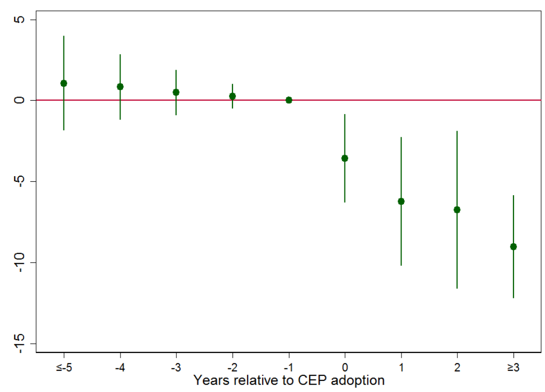
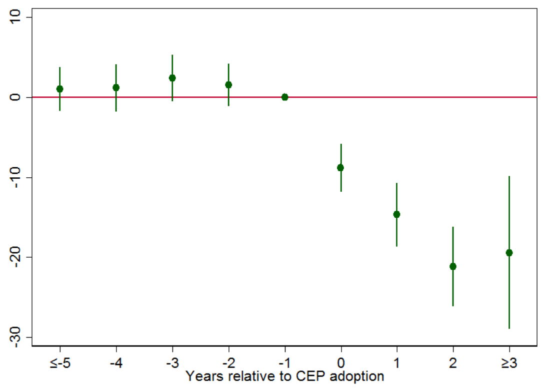
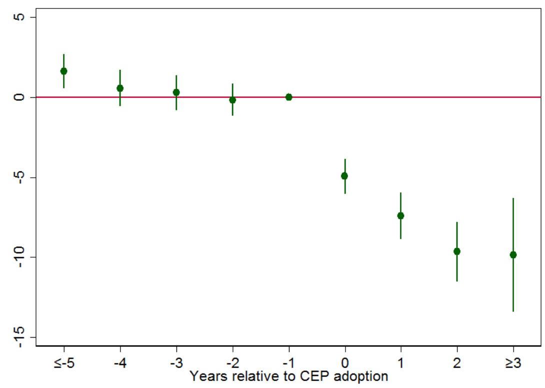


Figure 6: **Effect of CEP on Grocery Purchases for Households with Kids**

(a) All Food Spending



(b) Lunch and Breakfast Food Spending



(c) Composite Health Score
of Grocery Purchases

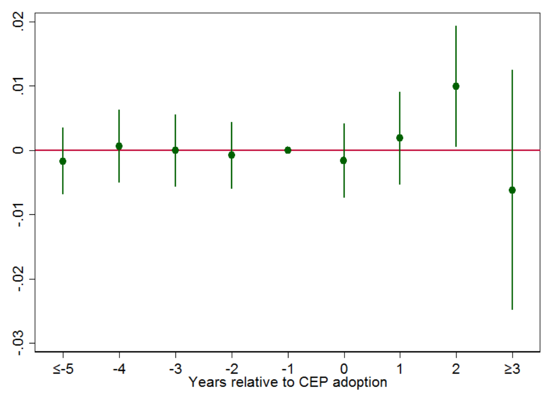
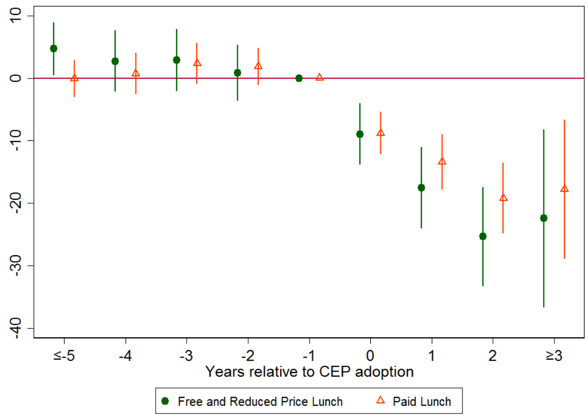
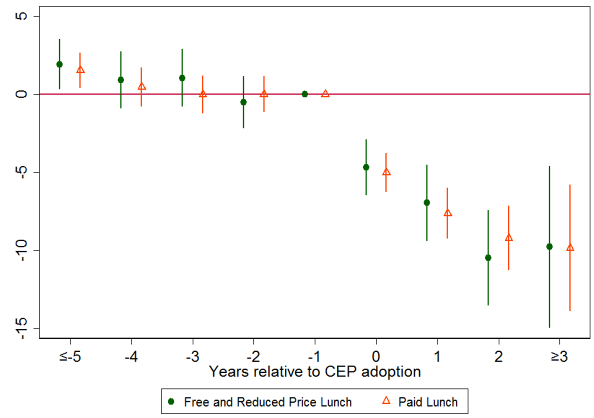


Figure 7: **Effect of CEP on Grocery Purchases for Households with Kids, by Lunch Eligibility**

(a) All Food



(b) Lunch and Breakfast Food



(c) Composite Health Score

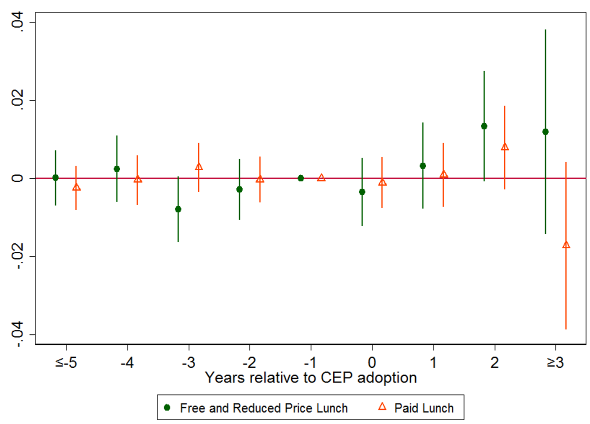
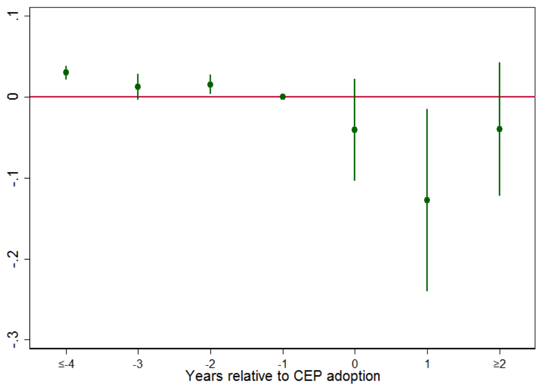
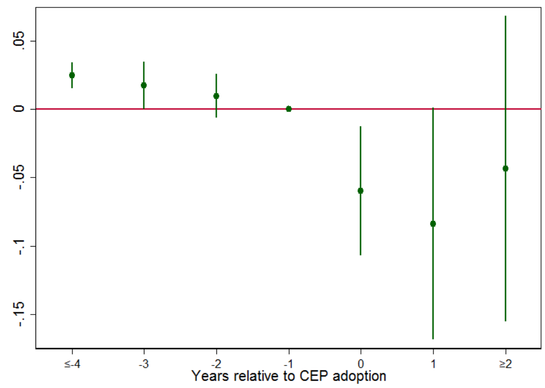


Figure 8: **Food Insecurity for Households with Kids**

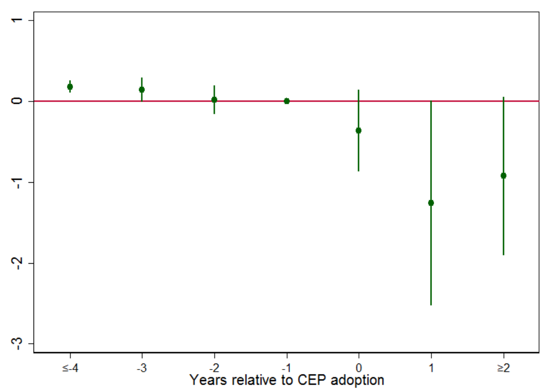
(a) Ran short of money, tried to make food or food money go further (last 12 months)



(b) Food Insecure Household (12 month food security score ≥ 3)



(c) Food Security Rasch Scale Score (12 months)



Tables

Table 1: Summary Statistics for Households in Adopting versus Non-Adopting Zip Codes

	(1) Full Sample	(2) Zero CEP %	(3) Positive CEP %
Married	0.637	0.638	0.632
	(0.481)	(0.481)	(0.482)
Any Kids (0-17)	0.237	0.238	0.229
	(0.425)	(0.426)	(0.42)
Household Size	0.0592	0.0591	0.0599
	(0.236)	(0.236)	(0.237)
Hispanic	0.826	0.83	0.801
	(0.379)	(0.376)	(0.399)
White	0.0949	0.0898	0.131
	(0.293)	(0.286)	(0.337)
Black	0.0787	0.0801	0.0684
	(0.269)	(0.272)	(0.252)
Other Race	2.413	2.415	2.396
	(1.306)	(1.306)	(1.305)
Eligible for Free/Reduced Price Lunch	0.239	0.234	0.275
	(0.427)	(0.423)	(0.447)
Ineligible for Free/Reduced Price Lunch	0.761	0.766	0.725
	(0.427)	(0.423)	(0.447)
Household Income: \$0-25k	0.166	0.164	0.18
	(0.372)	(0.37)	(0.384)
Household Income: \$25-50k	0.312	0.311	0.325
	(0.463)	(0.463)	(0.468)
Household Income: \$50-100k	0.381	0.383	0.373
	(0.486)	(0.486)	(0.484)
Household Income: \$100k+	0.14	0.143	0.122
	(0.347)	(0.35)	(0.327)
Currently WIC Participating	0.00674	0.0065	0.00844
	(0.0818)	(0.0804)	(0.0915)
Max HH Educ: HS or less	0.192	0.19	0.207
	(0.394)	(0.392)	(0.405)
Max HH Educ: Some College or more	0.808	0.81	0.793
	(0.394)	(0.392)	(0.405)
Max HH Employ: <30 hrs	0.0967	0.0945	0.112
	(0.296)	(0.293)	(0.316)
Max HH Employ: 30-34 hrs	0.0474	0.0469	0.051
	(0.212)	(0.211)	(0.22)
Max HH Employ: 35+ hrs	0.856	0.859	0.837
	(0.351)	(0.348)	(0.37)
Observations	5,616,103	4,867,772	700,753

Table 2: CEP Exposure and Household Characteristics

	(1) Predicted Food	(2) Married	(3) Household Size	(4) Income: \$0-25k	(5) Income: \$25-50k	(6) Income: \$50-100k	(7) WIC	(8) Low Educ	(9) Employed: <30 hrs	(10) Employed: 30-34 hrs
Panel A: Post CEP Exposure										
Post CEP	0.112	0.00188	0.00319	0.00142	-0.00264	0.00401	0.00102*	-0.00519*	-0.000126	-0.00110
	(0.368)	(0.00319)	(0.00897)	(0.00266)	(0.00333)	(0.00348)	(0.000594)	(0.00274)	(0.00262)	(0.00181)
Observations	4,571,519	6,286,505	6,286,505	6,286,505	6,286,505	6,286,505	6,286,505	6,286,505	4,571,519	4,571,519
R-squared	0.244	0.219	0.193	0.200	0.154	0.149	0.093	0.239	0.169	0.113
Panel B: CEP Exposure %										
CEP Overall %	0.425	0.0197	-0.0584	0.0228	-0.0188	0.0201	0.00238	0.0107	0.0212	-0.00618
	(2.197)	(0.0181)	(0.0465)	(0.0149)	(0.0196)	(0.0199)	(0.00308)	(0.0172)	(0.0169)	(0.0113)
Observations	4,419,664	6,078,291	6,078,291	6,078,291	6,078,291	6,078,291	6,078,291	6,078,291	4,419,664	4,419,664
R-squared	0.240	0.215	0.189	0.197	0.151	0.146	0.090	0.236	0.165	0.109

Table 3: First Stage Effect of CEP on NSLP Meals Served

	(1) Free/Reduced Priced Lunches per Student	(2) Paid Lunches per Student	(3) Free/Reduced Priced Breakfasts per Student	(4) Paid Breakfasts per Student	(5) Free/Reduced Priced Meals per Student	(6) Paid Meals per Student
% CEP Schools	17.66***	-13.94***	10.64***	-6.18***	28.29***	-20.12***
	(3.51)	(4.07)	(3.57)	(1.57)	(6.17)	(5.22)
N	294	294	294	294	294	294
R-Squared	0.88	0.98	0.93	0.89	0.90	0.97
Mean of Dependent	66.74	37.45	34.67	7.25	101.42	44.70
Pct Change	26.45	-37.23	30.68	-85.20	27.90	-45.02

* p <0.10, ** p <0.05, *** p <0.01

Note: Each cell represents a separate regression. All regressions have state and year fixed effects and include additional state controls. Some states are excluded if there was incomplete CEP adoption data, see text for details. Additional state controls include unemployment rates and demographic characteristics (fraction black, Hispanic, and other races, fraction of individuals with high school degree and with some college or more, and fraction below the federal poverty level). Standard errors are in parentheses and are clustered at the state level. Treatment is based on the overall percent of schools that have adopted CEP within the state, which proxies for probability of CEP Exposure.

Table 4: Effect of Overall CEP Exposure on Grocery Purchases

	(1) All Food Spending ($)	(2) Lunch Food Spending ($)	(3) Breakfast Food Spending ($)	(4) Lunch & Breakfast Food Spending ($)
Panel A: Post CEP Exposure				
Kids x Post CEP	-10.65***	-4.362***	-0.864***	-5.450***
	(1.458)	(0.526)	(0.0739)	(0.559)
N	4,498,536	4,502,115	4,495,281	4,501,487
R-Squared	0.55	0.51	0.37	0.51
Mean of Dependent	206.25	54.97	6.17	61.60
Pct Change	-5.16	-7.94	-14.02	-8.85
Panel B: CEP Exposure %				
Kids x CEP Overall %	-38.84***	-16.58***	-3.401***	-21.25***
	(11.51)	(3.867)	(0.596)	(4.185)
N	4,369,278	4,372,759	4,366,059	4,372,122
R-Squared	0.55	0.51	0.37	0.51
Mean of Dependent	206.38	55.02	6.17	61.65
Pct Change	-18.82	-30.14	-55.08	-34.47

* p <0.10, ** p <0.05, *** p <0.01

Note: Each cell represents a separate regression. All regressions have household and year-month fixed effects and include additional household controls. SE are clustered at the household level. Household controls are measured at time of survey and consist of the following: married, kids, Hispanic, white, black, household size, household income categories, WIC participation, maximum household education level, and maximum hours of work for the head of household

Table 5: Effect of Overall CEP Exposure on Healthiness of Grocery Purchases

	(1) Healthy Food Spending ($)	(2) Unhealthy Food Spending ($)	(3) Vegetables Spending ($)	(4) Commercially Prepared Foods Spending ($)	(5) Composite Diet Health Score
Panel A: Post CEP Exposure					
Kids x Post CEP	-2.864***	-8.081***	-0.223**	-4.995***	0.00168
	(0.431)	(1.085)	(0.109)	(0.781)	(0.00259)
N	4,500,646	4,498,856	4,501,714	4,500,521	4,470,379
R-Squared	0.53	0.54	0.44	0.52	0.34
Mean of Dependent	56.61	143.12	12.52	90.27	-0.27
Pct Change	-5.06	-5.65	-1.78	-5.53	0.63
Panel B: CEP Exposure %					
Kids x CEP Overall %	-12.22***	-30.64***	-1.292	-14.59**	-0.000286
	(3.202)	(8.503)	(0.867)	(6.277)	(0.0185)
N	4,371,256	4,369,627	4,372,292	4,371,277	4,342,030
R-Squared	0.53	0.54	0.44	0.52	0.34
Mean of Dependent	56.66	143.19	12.53	90.33	-0.27
Pct Change	-21.57	-21.40	-10.31	-16.15	-0.11

* p <0.10, ** p <0.05, *** p <0.01

Note: Each cell represents a separate regression. All regressions have household and year-month fixed effects and include additional household controls. SE are clustered at the household level. Household controls are measured at time of survey and consist of the following: married, kids, Hispanic, white, black, household size, household income categories, WIC participation, maximum household education level, and maximum hours of work for the head of household

Table 6: Effect of School-Level CEP Exposure on Grocery Purchases

	(1) All Food Spending ($)	(2) Lunch & Breakfast Food Spending ($)	(3) Composite Diet Health Score
Panel A: Elementary School CEP Exposure			
Kids x CEP Primary %	-38.34***	-22.01***	0.00617
	(12.50)	(4.584)	(0.0193)
N	4,367,175	4,370,026	4,339,943
R-Squared	0.55	0.51	0.34
Mean of Dependent	206.39	61.66	-0.27
Pct Change	-18.58	-35.69	2.31
Panel B: Middle School CEP Exposure			
Kids x CEP Middle %	-27.13***	-14.35***	-0.00971
	(9.506)	(3.814)	(0.0170)
N	4,271,344	4,274,008	4,244,805
R-Squared	0.55	0.51	0.34
Mean of Dependent	206.35	61.67	-0.27
Pct Change	-13.15	-23.27	-3.64
Panel C: High School CEP Exposure			
Kids x CEP High %	-26.88***	-14.23***	0.00298
	(8.441)	(3.015)	(0.0145)
N	4,337,604	4,340,288	4,310,437
R-Squared	0.55	0.51	0.34
Mean of Dependent	206.34	61.63	-0.27
Pct Change	-13.03	-23.09	1.11

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Each cell represents a separate regression. All regressions have household and year-month fixed effects and include additional household controls. SE are clustered at the household level. Household controls are measured at time of survey and consist of the following: married, kids, hispanic, white, black, household size, household income categories, WIC participation, maximum household education level, and maximum hours of work for the head of household

Table 7: Effect of Overall CEP Exposure on Grocery Purchases by Prior Lunch Eligibility

	(1) All Food Spending ($)	(2) Lunch & Breakfast Food Spending ($)	(3) Composite Diet Health Score
Panel A: Post CEP Exposure			
Kids x Post CEP x FRP Lunch	-8.989***	-4.183***	0.0100**
	(2.559)	(0.969)	(0.00473)
Kids x Post CEP x Paid Lunch	-10.79***	-5.786***	-0.000276
	(1.614)	(0.620)	(0.00289)
N	4,498,536	4,501,487	4,470,379
R-Squared	0.55	0.51	0.34
Pre CEP Mean for FRP Lunch	199.19	58.72	-0.33
Pre CEP Mean for Paid Lunch	205.89	61.62	-0.26
Pct Change: FRP Lunch	-4.51	-7.12	3.03
Pct Change: Paid Lunch	-5.24	-9.39	-0.11
Prob (FRP = Paid)	0.52	0.13	0.05
Panel B: CEP Exposure %			
Kids x CEP Overall % x FRP Lunch	-27.78	-11.74	0.0536*
	(19.95)	(7.449)	(0.0314)
Kids x CEP Overall % x Paid Lunch	-37.96***	-23.90***	-0.0174
	(12.60)	(4.662)	(0.0230)
N	4,369,278	4,372,122	4,342,030
R-Squared	0.55	0.51	0.34
Pre CEP Mean for FRP Lunch	199.23	58.75	-0.33
Pre CEP Mean for Paid Lunch	205.94	61.64	-0.26
Pct Change: FRP Lunch	-13.95	-19.99	16.23
Pct Change: Paid Lunch	-18.43	-38.77	-6.79
Prob (FRP = Paid)	0.64	0.14	0.06

* p <0.10, ** p <0.05, *** p <0.01

Note: Each cell represents a separate regression. All regressions have household and year-month fixed effects and include additional household controls. SE are clustered at the household level. Household controls are measured at time of survey and consist of the following: married, kids, hispanic, white, black, household size, household income categories, WIC participation, maximum household education level, and maximum hours of work for the head of household. Free/Reduced Price (FRP) versus Paid Lunch Eligibility is defined by estimating whether the household is below versus above 185% of the federal poverty level, respectively, based on household size and income.

Table 8: Effect of CEP on Food Insecurity for Households with Kids
(CPS December Supplement)

	(1) Ran short of money, tried to make food or food money go further	(2) Food Insecure Household	(3) Food Security Rasch Scale Score	(4) Food Security Raw Score (Poisson)
Panel A: Post CEP Exposure				
Kids x Post CEP	-0.0270***	-0.0211***	-0.197***	-0.139***
	(0.00524)	(0.00581)	(0.0623)	(0.0256)
N	577,031	569,293	119,382	568,816
R-Squared	0.11	0.13	0.05	
Mean of Dependent †	0.24	0.45	4.80	2.97
Pct Change †	-11.16	-4.67	-4.10	-13.00
Panel B: CEP Exposure % of Schools				
Kids x % CEP Schools	-0.123***	-0.123***	-1.158***	-0.744***
	(0.0374)	(0.0308)	(0.258)	(0.166)
N	577,031	569,288	119,382	568,811
R-Squared	0.11	0.13	0.05	
Mean of Dependent †	0.24	0.45	4.80	2.97
Pct Change †	-50.85	-27.32	-24.11	-52.46

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Each cell represents a separate regression. All regressions have state and year fixed effects and include additional household and state controls. Some states are excluded if there was incomplete CEP adoption data, see text for details. Household controls are measured at time of survey and consist of the following: married, kids, Hispanic, white, black, household size, household income categories, WIC participation, maximum household education level, and maximum hours of work for the head of household. Additional state controls include unemployment rates and demographic characteristics (fraction black, Hispanic, and other races, fraction of individuals with high school degree and with some college or more, and fraction below the federal poverty level). Standard errors are in parentheses and are clustered at the state level. Note that all of the CPS survey questions and outcome variables used reference the past 12 months. A household is designated as food insecure in column (2) if their 12 month food security score is ≥ 3. The outcome in column (4) is the count of all food insecurity questions that are answered affirmatively, between 0 and 18. Treatment is based on the overall percent of schools that have adopted CEP within the state, which proxies for probability of CEP Exposure. Treatment timing is lagged to account for the timeframe of the CPS survey questions.

† Note that the mean of the dependent variable are calculated in columns (2)-(4) *conditional* on whether a household answers affirmatively to the question in column (1), as this is what flags them as potentially food insecure. The percent changes in columns(2)-(3) are also calculated with respect to this conditional mean. In column (4) the percent change is based on interpreting the log odds ratio from the estimated coefficient.