Estimating the Effects of Subsidized School Meals on Child Health: Evidence from the Community Eligibility Provision in Georgia Schools*

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Abstract

For many children in the United States, school meals represent a vital source of reliable and nutritious food. Utilizing variation caused by the Community Eligibility Provision (CEP) in Georgia schools, we estimate models of school-level child health measured by the percentage of healthy weight children and average Body Mass Index (BMI) score. CEP eligibility is used as an instrument for CEP participation and the percentage of students enrolled in free and reduced-price school lunches, as well as in the reduced form. We find that CEP participation increases the percentage of healthy weight students in a school and reduces average BMI. We find no statistically significant evidence to support a deleterious effect from either the CEP or free school meals on child health outcomes. Subsample analyses suggest that the effect of school meals on health varies across grade and location type, with no effect on high schools or rural schools.

Keywords: Child health, Obesity, School meals, Community Eligibility Provision

1 Introduction

During an academic year, children consume between one-third and one-half of their daily calories in school (Schanzenbach 2009, Briefel et al. 2009). A major portion of the food eaten in school comes from subsidized school meals provided through School Food Programs (SFPs) like the National School Lunch Program (NSLP) and the School Breakfast Program (SBP). The NSLP is the nation's largest SFP and the second largest nutrition assistance program behind the Supplemental Nutrition Assistance Program (SNAP). The NSLP subsidizes meal provisions in over 95% of all U.S. public schools at an annual cost of $13.6 billion dollars.[1] During 2016, 30.4 million children participated in the NSLP, 21.6 million of whom were from low-income households receiving Free or Reduced-price Lunch (FRL).[2] For many of the nation's children, school meals represent a critical source of nutritious and consistently available food. For the most at-risk children, school meals may make the difference between going hungry and having the food necessary for successful learning and development.

Although the primary goal of SFPs is to improve the nutrition, food security, and health of children, existing empirical evidence suggests not all effects from school meals are beneficial. One pivotal question often raised by researchers and policymakers is to what extent programs like the NSLP and SBP affect child Body Mass Index (BMI) scores. While results are mixed, many studies suggest that children receiving school lunch are more likely to have higher BMIs than their peers (Schanzenbach 2009, Millimet et al. 2010). With millions of children eating

[1] FRAC 2017.
[2] FRAC 2017, USDA 2017a.

subsidized meals in school each day, the proposed link between SFPs and detrimental weight outcomes has caused school meal programs to face mounting opposition from certain groups.

We contribute to the literature by addressing endogeneity in school meal participation using the exogenous variation in free school lunch and breakfast enrollment caused by the Healthy Hunger Free Kids Act's (HHFKA's) Community Eligibility Provision (CEP). Unlike the traditional system where individual families must apply for each child to receive free and reduced-price school meals through the NSLP and SBP, the CEP gives eligible schools serving low-income children a way to provide free lunch and breakfast to *all students* attending their school, no exceptions. Therefore, the CEP produces a change in free school meal availability that is independent of the eligibility and take-up decision of families. During the 2015-2016 school year, more than 18,000 schools (half of all eligible schools) in nearly 3,000 school districts adopted the CEP, reaching around 8.5 million children nationwide (USDA, 2016).

In this study, we estimate the CEP's effect on child health in the state of Georgia both directly and as an instrument for free school meal enrollment percentage. More specifically, we first estimate models of school-level child health outcomes using school CEP eligibility as an instrument for CEP participation. We then use CEP eligibility as an instrument for free school meal enrollment which we measure using Free and Reduced-price Lunch Percentage (FRL%). We also estimate the CEP's intent-to-treat effect on our school-level measures of child health in the reduced form.

Our results suggest that CEP participation and subsequent increases in free school meal enrollment increase the percentage of a school's students who fall within the healthy weight range and reduce school-level average BMI scores for elementary and middle schools as well as schools in urban areas, suburbs, and towns. Unlike many previous studies, we find no statistically significant evidence to support a deleterious effect of school meals on our school-level child health outcomes. Furthermore, we find nearly identical results for our model of CEP participation relative to the effect of the average change in free school lunch enrollment following participation. These similarities in our results suggest that the change in child health caused by the CEP is likely driven by increased free meal enrollment rather than alternative mechanisms. Our intent-to-treat analyses also indicate that CEP eligibility increases healthy weight percentage and reduces average BMI for the same school types as our primary analyses.

We also find evidence that the CEP has a differential impact among schools in different location types. While rural schools serve children in Georgia's poorest counties, urban schools

are far more likely to participate in the CEP even though their free and reduced-price lunch enrollment rates are higher on average during the period prior to the CEP's roll-out. Furthermore, while we find statistically significant effects of the CEP on weight outcomes for urban schools and schools in suburbs/towns, the effects for rural schools are insignificant. Given this heterogeneity in participation and subsequent health impacts, the results of our study suggest that a health disparity between disadvantaged children from different areas may develop or worsen if the CEP cannot be made effective, feasible, and attractive to schools in all location types.

Our study represents a significant contribution to the literature by providing causally interpretable estimates of the effect of CEP participation and free school meal enrollment on aggregate measures of child health. To our knowledge, we are the first study to estimate the CEP's effect on child health. We also contribute to the literature by estimating the effect of school meals on health after the HHFKA's sweeping nutrition standard changes which are not reflected in studies conducted before the act's implementation. Our results indicate that enrolling more children in free school meals leads to improved health outcomes, suggesting that programs like the CEP may be effective policy tools in the fight against childhood obesity and overweight.

2 Literature Review

In recent years, a growing literature has explored the various avenues through which school meals may impact child health. Historically, there are two channels researchers have focused on. The first is food insecurity. Existing evidence suggests that food insecurity leads to poorer subsequent child health outcomes including parent-assessed child health (Cook et al. 2006, Kirkpatrick et al. 2010), mental health (Melchior et al. 2012, Whitaker et al. 2006), malnutrition risk (Eicher-Miller et al. 2009), and child weight (Kuku et al. 2012, Gundersen and Kreider 2009). Since children from households with lower incomes are more likely to experience food insecurity, providing free and reduced-price meals to students in low-income schools may play a significant role in preventing food insecurity. Huang and Barnidge (2015) find that NSLP participation is associated with a reduction in food insufficiency risk of nearly 14%. Rates of child food insecurity are also higher during summer months when children stop receiving meals in school (Huang et al. 2016). Arteaga and Heflin (2014) instrument for NSLP participation

with child age relative to state Kindergarten cut-off dates and provide additional evidence that NSLP participation reduces food insecurity.

The second primary channel is diet quality. The effect of SFPs on diet quality depends on the quality of school meals relative to what a child would consume were they to bring meals from home. For lower income households, we expect that the change in quality from switching to school meals would be positive if low quality processed foods are the more affordable and available alternative. Conducted after the HHKA's changes to school meal minimum nutrition standards, Smith (2017) compares the effect of NSLP and SBP participation on the diets of children across the distribution of initial diet quality. The author finds that both programs improve the diets of nutritionally disadvantaged children, but the effect varies considerably across the quality distribution and leads to a decrease in diet quality for children towards the distribution's upper tail.

Some existing studies also attempt to estimate the direct effect of SFP participation on child health. While results are mixed, several studies find that participation in school meals may worsen weight outcomes. Schanzenbach (2009) uses the discontinuity in income eligibility for reduced-price lunch to compare children directly above and below the cutoff. The author finds that students who are eligible for reduced-price school lunch are more likely to be obese relative to their peers. Millimet et al. (2010) also find that NSLP participation leads to an increase in child BMI after controlling for self-selection into the SBP. Alternatively, the authors find that SBP participation reduces child BMI, implying that free breakfast in schools may partially offset the weight differential among children from low- and high-income families. Capogrossi and You (2017) employ a difference-in-differences (DID) model, coupled with matching, to compare children participating in both the NSLP and SBP to children in only one of the two programs. The authors show that participating in the NSLP increases the probability that children will be overweight with more prominent effects in the South, Northeast, and rural areas of the country.

Other studies suggest that school meals do not increase obesity and overweight risk among children. Schanzenbach and Zaki (2014) examine short run effects of the Universal Free Breakfast and Breakfast in Class programs among a randomized group of 153 schools in 6 districts. The authors find no impact of either program on BMI, other health outcomes, or a child's score on the Bad Behavior Index except among some specific subgroups. Hinrichs (2010) exploits changes in the Federal government's allocation formula used to distribute SFP funds across

states. When examining the long run effects, the author finds no effect of school meals on BMI. With a worst-case bounding model that allows for misreporting and self-selection into the NSLP, Gundersen et al. (2012) find that participation in school lunch significantly reduces rates of food insecurity (3.8%), poor health (29%), and obesity(17%). In the most similar study to our own, Schwartz and Rothbart (2017) exploit variation in NSLP participation caused by the switch to universal free meals in New York city. The authors find little evidence that receiving free lunch increases BMI among either grades, and some evidence that NSLP participation improves weight outcomes for non-poor children who began receiving free meals through the universal program.

3 The Community Eligibility Provision

While 2010's Healthy Hunger-Free Kids Act (HHKA) affected almost every aspect of school nutrition, one of its most noteworthy additions was the Community Eligibility Provision (CEP) which became nationally available in 2014.[3] The provision allows high-poverty schools with an Identified Student Percentage (ISP) of 40% or more to provide free lunch and breakfast through the NSLP and SBP to all students in their school, regardless of family income. A school's ISP is the percentage of their student body who are considered "identified" for free meals. More specifically, identified students are children from households that are automatically eligible for free school meals through participation in other government nutrition assistance programs, Head Start or Early Head Start, Medicaid, or by meeting other special criteria (e.g. migrant or homeless child).[4] Individual children are identified through either "direct certification," which relies on data matching, or by an appropriate official who determines eligibility for homeless, migrant, foster care, and Head Start services. The actual CEP participation decision for each school is made by the school's district. Districts also have the option of district-wide enrollment if the average ISP of their schools falls above the 40% threshold.

While the 40% ISP cutoff is a discontinuity in eligibility, schools with ISP's just above the threshold are far less likely to participate in the program due to the USDA's school meal

[3]Prior to 2014, the CEP was available in earlier periods for schools in 11 pilot states. Illinois, Kentucky, and Michigan were the first states to pilot the provision during 2011; the District of Columbia, New York, Ohio, and West Virginia were added in 2012; and Florida, Georgia, Maryland, and Massachusetts were added in 2013.

[4]Students can be "identified" if (i) their families are SNAP, TANF, or FDPIR recipients, (ii) the student is a Head Start or Early Head Start participant, (iii) the student is a migrant, runaway, homeless, or foster child, or (iv) the student is on Medicaid.

reimbursement scheme. As was the case for all schools before the CEP, non-CEP eligible and eligible non-participating schools receive a set amount of reimbursement from the USDA for each lunch and breakfast served through the NSLP and SBP. The amount reimbursed depends on whether or not the meal was paid for at the normal rate, reduced-price, or free, with free meals receiving the highest level of reimbursement and paid meals receiving the lowest. For example, during the 2017-2018 school year the reimbursement rates for paid, reduced-price, and free lunches were $0.39, $3.00, and $3.40, respectively (USDA 2017b).

For schools choosing to participate in the CEP, the reimbursement scheme varies by ISP even though all meals are provided for free to students. Of the total number of meals, a share of 1.6xISP are reimbursed at the free rate and (100-1.6xISP) are reimbursed at the much lower paid rate. For a school with an ISP of 40%, this translates into 64% of meals being reimbursed at the free rate and 36% at the paid rate. Once a school's ISP is 62.5% or greater, however, all meals are reimbursed at the free rate. The difference in average meal reimbursement amount for a school with an ISP of 40% relative to schools with an ISP at or above the 62.5% level is considerable, with the 40% school receiving roughly $1.08 less per lunch and $0.52 less per breakfast.

To illustrate how CEP participation changes with ISP, Figure 4 shows the CEP participation rate by ISP level. With a participation rate of 0.079, very few barely eligible schools choose to adopt the CEP. CEP participation is strictly increasing in ISP up to the level where all school meals are reimbursed at the free rate, at which point the participation rate fluctuates between roughly 0.85 and 1. Naturally, schools with higher ISP's are also likely to be higher need, implying that they may take-up the CEP at a higher rate for reasons other than the cost of implementation. Alternatively, if factors other than program cost were driving the CEP participation decision, it seems unlikely that the point where the participation rate stops increasing with ISP would be at exactly the level where all meals are reimbursed at the free rate.

It is also important to note that a school's ISP differs from their FRL% as Identified Students are only a subset of those who qualify for free or reduced-price meals (Levin and Neuberger 2013). This discrepancy is by design, since the CEP's primary purpose is to provide at-need children who were inadequately reached by the existing system with free meals. More specifically, the CEP is meant to address the low free and reduced-price meal participation rate among certain groups of eligible children. Under the traditional system, participation in free and reduced price meals for such groups has been thought to be below desired levels for two main

reasons. One potential reason is inadequate information or application support for families. Children who are eligible to apply for free and reduced price meals through the NSLP and SBP come from disadvantaged families which may be unaware of the options available to them. Without adequate information, parents could be unsure about their eligibility status, and if they are, may not fully understand or be able to complete the application process. While school counselors and other designated staff help to identify and enroll eligible students, many eligible children who would benefit from school meals remain unreached.

Another potential reason for low rates of both free and reduced price school meal enrollment and utilization is stigma (Askelson et al. 2017). Alternatively, if every child in a school receives meals for free through the CEP, no one child can be singled out as low-income by their peers in the lunch line and no child is denied a meal due to a negative account balance (USDA 2016). In the past, New York City and several other large urban school districts have made combinations of school lunch and breakfast universally free for students. Studies show that such universal free meal provisions increase breakfast participation (Ribar and Haldeman 2013; Leos-Urbel et al. 2013). Since its introduction, early evidence suggests that the CEP is correlated with significantly higher levels of school meal participation (Logan et al. 2014). This evidence implies that the CEP significantly impacts the number of students consuming school meals and ensures that every child has at least two healthy meals available to them each day. In addition to providing free meals to students, CEP participating schools are no longer required to collect and process individual NSLP and SBP free and reduced price meal applications, reducing costs and administrative burden. Non-eligible and non-participating schools continue operating under the existing system, determining student eligibility through the usual NSLP and SBP free and reduced-price meal applications.

During the 2014-15 school year, 14,000 schools (1 in 10 nationwide) in 2,200 school districts participated in the program. Of these, 7,000 schools served the nation's highest-poverty level children, implying that 3 in 5 of all such schools participated in the CEP nationwide (Neuberger et al. 2015). In the following 2015-2016 school year, more than 18,000 schools (half of all eligible schools) in nearly 3,000 school districts adopted the CEP, reaching nearly 8.5 million children (USDA 2016).

With regards to variation caused by the CEP, we expect the change in free school meal availability to affect child health outcomes at three primary margins. The first is children who were ineligible for either free or reduced-price meals during the pre-CEP period. If these chil-

dren were bringing meals from home rather than purchasing meals through the NSLP and SBP, making school meals free might adequately incentivize a switch to the now cheaper option. The second margin is students who were already eligible for free or reduced-price meals but did not enroll. Depending on why families choose not to enroll their children, we expect different changes following CEP participation. For example, if certain low-income families were unaware of their eligibility, we would expect them to begin taking advantage of free school meals following enrollment. Alternatively, if eligible children did not participate because they preferred meals brought from home, we would expect no change in their behavior. Finally, the third margin is children who were eligible for reduced-price, but not free, school meals during the pre-CEP period. While the average cost of a reduced-price meal may seem negligible, it is possible that offering free meals will be enough to induce school meal participation.

4 Data

Our study utilizes several sources of data from schools in Georgia over the 2011 to 2016 school years.[5] Data include variables related to school-level average child health outcomes, CEP participation and eligibility, percent of students enrolled in Free and Reduced-price Lunch (FRL%), and student sociodemographic variables. Data on child health outcomes come from the FitnessGram. Each year, K-12 public schools in Georgia are required to participate in the FitnessGram which includes a collection of tests administered by a physical education instructor measuring the physical fitness, height, and weight of children attending the school. FitnessGram data aggregated at the school-level are available for our sample period from the Georgia Department of Education (GaDOE).[6] Our primary outcomes of interest from the FitnessGram relate to child body composition. We do not use the FitnessGram's other physical/athletic tests in this study since children have direct control over their effort. Alternatively, outcomes related to BMI do not depend on performance and are objectively measured by the test's administrators. We restrict our primary dataset to include schools which are observed in all six years,

[5]Throughout this study, we reference each school year using the year when students return to school, i.e. 2011-2012 is referred to as simply 2011, 2012-2013 as 2012, etc.

[6]Data can be found on the GaDOE website for the 2011-2014 school years: http://www.gadoe.org/Pages/Home.aspx. Data for the 2015 and 2016 school years were obtained through an open data request.

giving us a balanced panel of 2,145 schools.[7]

For the most part, changes in BMI at the school-level are difficult to interpret and compare both within and across groups of schools serving children of different ages. One contributing reason is that only observing the mean abstracts from where in the weight distribution a change in average BMI comes from. For example, obese or underweight children losing weight can cause an identical decrease in mean BMI with obviously different health implications. The second issue is that child BMI score interpretations vary with age and gender. To remove some of this ambiguity, we focus our attention on another FitnessGram variable showing the percentage of children at each school who fall "In the Healthy Fitness Zone" (InHFZ%) of BMI. A child is considered in the BMI healthy fitness zone if their score falls within the 5th and 85th percentile range as determined by the Centers for Disease Control and Prevention (CDC).[8] Comparable to the CDC's measure, InHFZ% is equivalent to the percentage of healthy weight children at a school. Unlike mean BMI, changes in InHFZ% have direct implications for child health. An increase (decrease) in InHFZ% relates to an improvement (worsening) of school-level health regardless of where in the weight distribution the change occurs. Going one step further, the combination of changes in mean BMI and InHFZ% suggests additional information. For example, if mean BMI decreases and InHFZ% increases, then the dominant change in weight most likely comes from overweight and obese children losing weight and moving into the healthy weight range. This interpretation does not imply that other weight changes are not occurring elsewhere in the BMI distribution, but it does allow us to identify the most probable location of the change.

We collect CEP participation and eligibility data for the 2014-2016 school years from the Center on Budget and Policy Priorities (CBPP) who gathers and provides the data in a joint effort with the Food Research and Action Center (FRAC).[9] The USDA began requiring that each state submit a list containing the CEP eligibility, participation status, and ISP of all schools and districts in 2014, implying that even though Georgia was a pilot state for the CEP in 2013, information is only available for the 2014 school year onward. We therefore exclude the 2013 school year from our analysis.

Data on school FRL% for the 2012-2016 school years are collected from GaDOE.[10] Alter-

[7]Including the unbalanced portion of our panel does not meaningfully change our results.
[8]*See* Plowman and Meredith (2013).
[9]Data are available through the CBPP's website: https://www.cbpp.org.
[10]Data are available directly from the GaDOE website: http://www.gadoe.org/Pages/Home.aspx

natively, FRL% data for the 2011 school year are not available through GaDOE. We instead use the National Center for Education Statistics' (NCES') Common Core of Data (CCD) for 2011.[11] Data on FRL% from GaDOE are censored from above and below at 95% and 5%, respectively. Since CEP participation guarantees that all school meals are provided for free to students, we change the FRL% of participating schools in the post period from 95% to 100%.

Data used to identify each school's location type (i.e. urban, rural, suburban, etc.) also come from the CCD. We collect school-level revenue, expenditure, and average student sociodemographic data for the entire analysis period through The Governor's Office of Student Achievement (GOSA).[12] Finally, county level data on poverty percentages by age range and median household income for each year come from the Census Bureau's Small Area Income and Poverty Estimates (SAIPE) program.

Summary statistics over the 2011-2016 school years for our dependent variables of interest, independent variables of interest, and control variables are presented in Table 1. As Table 1 shows, the mean BMI for our sample is approximately 20.35. Unlike adult BMI which has a direct interpretation across age/gender, a child BMI score of 20.35 falls within the obese weight category for a six-year-old boy and the healthy weight category for a 14-year-old boy. As an alternative view, our InHFZ% variable shows that roughly 58.88% of Georgia students fall within the healthy weight category over the sample period, implying that 41.12% of children are some combination of underweight, overweight, and obese. Our "Ever CEP Eligible" variable shows us that roughly 47% of Georgia's K-12 schools were eligible for the CEP at some point during the 2014-2016 period. Our "Ever CEP Participating" variable indicates that approximately 26.87% of all schools participated in the CEP at some point during the post-period, implying a CEP take-up rate of roughly 57%. The set of control variables used in our models include: Number of Students, Percent Black Students, Percent White Students, Percent Migrant Students, Percent Special Education Students, Percent ESL Students, and Percent Gifted Students.

Figures 1, 2, and 3 provide graphical illustrations of the across-year change in mean FRL%, InHFZ%, and BMI, respectively, for both ever CEP eligible and never eligible schools. Figure 1 shows that the eligible group's average FRL% is considerably higher than that of the never eligible group in all periods. As we would expect, there is a sizable increase in the average FRL% of eligible schools beginning in the 2013 school year while the rate remains nearly constant for the never eligible group over the post-treatment period.

[11] Data are available directly through the CCD website: https://nces.ed.gov/ccd/pubschuniv.asp.

[12] Data are available directly from the GOSA website: https://gosa.georgia.gov/downloadable-data.

Figure 2 shows that there is a considerable difference between the average InHFZ% of the never eligible and eligible groups, with the never eligible group having a higher percentage of healthy weight students on average in all years. Figure 2 also shows that the InHFZ% of both groups increased substantially beginning in the 2015 school year. This increase is primarily due to a change in the CDC's healthy weight cutoff values beginning in 2015, leading to more children falling within the 5th-85th percentile range. Since the InHFZ% change affects both types of schools simultaneously, any impact on our results will be removed with the use of year fixed effects.

Finally, Figure 3 shows us that the mean BMI of CEP eligible schools is larger than that of never eligible schools during both the 2011 and 2012 years. The average BMI of both school types also decreased from 2011 to 2012 with similar negative percent changes. The reason for this decrease is most likely improvements in school meal minimum nutrition standards caused by the HHFKA directly before and during this period. Interestingly, the average BMI level of CEP eligible schools begins to fall below that of never eligible schools starting in the 2013 school year which is the first year Georgia implemented the provision as a pilot state. The average BMI of both school types continues to decrease during 2014 and 2015, but increases in 2016 to roughly 2014 levels.

5 Methodology

The primary model used in our analysis is a two-stage least squares instrumental variables model (2SLS-IV). Given the panel structure of our data, we also control for school- and year-level sources of unobserved heterogeneity using fixed effects. The first stage of our 2SLS-IV model for school i in year t is given as:

$$X_{it} = Z_{it}\gamma + \phi ELIG_{it} + \alpha_i^1 + \lambda_t^1 + v_{it} \tag{1}$$

where X_{it} is either CEP participation or FRL%, Z_{it} is a vector of time-variant control variables, $ELIG_{it}$ is a binary variable equal to 1 if school i is eligible to participate in the CEP in year t and 0 otherwise, α_i^1 captures school-level sources of time-invariant unobserved heterogeneity, λ_t^1 captures year-level sources of unobserved heterogeneity, and v_{it} is the first stage model's normally distributed idiosyncratic error term.

The second stage of our 2SLS-IV model is then given as:

$$Y_{it} = Z_{it}\beta + \delta X_{it} + \alpha_i^2 + \lambda_t^2 + e_{it} \tag{2}$$

where Y_{it} is either InHFZ% or mean BMI, and all other variables are defined as they were in equation (1).

Estimation of our model involves substituting X_{it} in equation (2) with its predicted value from equation (1), $\hat{X}_{it}$. In addition to the relevance condition which can be tested through the results of our first stage model, proper estimation of our effect of interest, δ, requires that the standard excludability assumption hold. For our model using CEP eligibility as an instrument for CEP participation, it is unlikely that CEP eligibility affects child health outcomes through some mechanism other than participation. The same assumption is unlikely to hold for our use of CEP eligibility as an instrument for FRL% under the strict interpretation of δ being the effect of increased free and reduced-price lunch enrollment on Y since the CEP makes breakfast free to students as well. We instead view the change in FRL% caused by CEP eligibility as a proxy for general free school meal enrollment, implying that δ partially captures the effect of both free lunch and breakfast on our school-level health outcomes.

Since CEP eligibility is technically determined by an ISP of 40% or above, a regression discontinuity (RD) design would seem like a natural approach for our analyses. Unfortunately, using an RD model is not well suited for the case of CEP eligibility. As spoken to in Section 3, very few barely eligible schools with ISP's around the 40% level participate in the CEP due to the meal reimbursement rates provided by the USDA. This variation in reimbursements gives us too few schools to perform an RD.

Aside from our use of CEP eligibility as an instrument, the panel dimension of our data allows us to remove unobserved sources of time-invariant school- and year-level heterogeneity from our model using fixed effects. Fixed effects are crucial to our estimation, as school and year factors which are unobserved in the data almost certainly influence both Y_{it}, X_{it}, and $ELIG_{it}$. Potential examples of these unobserved effects include school institutional practices, style and layout of cafeteria, the School Food Association tasked with administration of a school's lunch program, availability of school counseling and nursing services, and year specific economic conditions. Most importantly, schools with higher ISP's necessarily have more students from families enrolled in qualifying government assistance programs. Under the assumption that the overall share of students at a school enrolled in these programs does not

change across the pre- and post-CEP period with eligibility, the effect from program participation on our school-level health outcomes is removed using fixed effects.

In addition to our 2SLS-IV estimations, we also estimate the effect of CEP eligibility on InHFZ% and mean BMI using a difference-in-differences (DID) model. Our DID model is given as:

$$Y_{it} = Z_{it}\eta + \theta ELIG_{it} + \alpha_i + \lambda_t + u_{it} \tag{3}$$

where Y_{it}, Z_{it}, and $ELIG_{it}$ maintain the same interpretation they are given in (1) and (2), α_i captures school-level sources of time-invariant unobserved heterogeneity, λ_t captures year-level sources of unobserved heterogeneity, and u_{it} is the reduced form model's normally distributed idiosyncratic error term. The results of our DID model show the effect of offering schools the ability to participate in the CEP, but abstracts away from the effect of actual participation or free school meal provision on student health, thus giving us an intent-to-treat effect.

6 Results

Beginning with our model using CEP eligibility as an instrument for CEP participation, Panel A of Table 2 shows the estimated effect of CEP eligibility on CEP participation from our model's first stage for the full sample of schools, elementary, middle, and high schools. For the full sample of schools, we estimate that CEP eligibility increases CEP participation by roughly 48.9 percentage points conditional on our set of control variables and school/year fixed effects. Similar results also hold for schools serving children of different ages, with elementary schools seeing the smallest effect and high schools seeing the largest effect at 41 and 61 percentage points, respectively.

Moving to our model's second stage, Panel B and C of Table 2 show the estimated effect of instrumented CEP participation on InHFZ% and mean BMI, respectively, for the full sample of schools and schools serving different grades. Starting with Panel B of Table 2, we find that participation in the provision increases the percentage of healthy weight students by roughly 1.06 percentage points for the full sample. While statistically insignificant, the magnitude of our estimate for elementary schools is similar in magnitude at roughly 0.94 percentage points. The effect is largest for middle schools with a predicted increase in InHFZ% from participation

of about 2.47 percentage points. Alternatively, we estimate a negative, yet statistically insignificant, effect of CEP participation on InHFZ% for high schools.

If we consider the school meal environment and food autonomy of schools serving students of different ages during the pre-CEP years, these results seem unsurprising. First, elementary schools had the highest level of pre-CEP FRL% among the ever-eligible group, implying that the effect of offering free meals to all students may be smaller since more students were already enrolled in free and reduced-price school meals in the first place. Second, under the assumption that high school students have greater food autonomy, we may expect to see little to no effect from offering them free meals if they prefer alternative options. We use food autonomy to refer to a student's autonomy in making their own daily food consumption choices. Autonomous decisions range from students preparing their own meals from home to students leaving campus to buy fast food for lunch. Alternatively, older students may be more sensitive to the stigma surrounding free and reduced-price meal participation which we would expect to reduce following CEP implementation.

Moving now to Panel C of Table 2, we see that CEP participation is estimated to decrease mean BMI for the full sample of schools and all schools serving different grade types to various degrees. For the sample of all schools, CEP participation is estimated to decrease mean BMI by roughly 0.171 points. For a 6 year old boy, this change translates into a little less than half a pound of body weight; while the same change corresponds to slightly over a pound of body weight for a 17 year old boy. Therefore, while the magnitude of the estimated mean BMI decrease is largest for elementary schools, second largest for middle schools, and smallest for high schools, the effective decrease in actual weight for each school type is ambiguous. Alternatively, we only find the effect of CEP participation on BMI to be statistically significant for elementary and middle schools. While this may be the effect of statistical power due to restricting sample sizes, it may also be the result of food autonomy increasing with the age of a school's students. The weight of younger children is also likely to vary more in the short run following implementation of the CEP.

Looking now to our model using CEP eligibility as an instrument for FRL%, Panel A of Table 3 shows the results of our model's first stage for the full sample of schools and by school grade type. Our results indicate that CEP eligibility has a substantial and highly significant effect on FRL% for the full sample and each school grade type. For the full sample of schools, CEP eligibility is estimated to increase FRL% by roughly 10.39 percentage points. Relative

to the full sample, the change in FRL% attributed to CEP eligibility is smallest for elementary schools at 7.35 percentage points, second largest for middle schools at 11.74 percentage points, and largest for high schools at 18.26 percentage points.

The most obvious reason why elementary schools see a smaller effect of CEP eligibility on FRL% relative to the sample of middle and high schools is due to differences in FRL% during the pre-CEP period. More specifically, the average FRL% during the 2011 and 2012 school years for elementary schools was 81% which is higher than the pre-period average levels for middle and high schools at 77% and 71%, respectively. When interpreting these results, it is also important to consider the realistic potential for increases in FRL% among the CEP eligible group. Even though pre-period FRL% does not directly determine each school's ISP, CEP eligible schools naturally provide more free or reduced-price lunches on average during the pre-treatment period.[13] Given that FRL% cannot exceed a value of 100%, participating in the CEP will change FRL% less for eligible schools than one may initially think.

Panels B and C of Table 3 show the effect of instrumented FRL% on InHFZ% and mean BMI, respectively, for the full sample of schools, as well as elementary, middle, and high schools. Beginning with Panel B of Table 3, we find that a one percentage point increase in FRL% increases the percentage of healthy weight students for the full sample of schools by 0.05 percentage points. Given that adoption of the CEP necessarily implies that FRL% goes to 100, the average implied change in FRL% from CEP participation at a pre-treatment mean of 79% implies that the CEP is expected to change InHFZ% by roughly 1.05 percentage points overall. This effect is extremely similar to the corresponding change in InHFZ% from CEP participation of 1.06 percentage points found in Table 3. After calculating the same relative change for elementary schools, middle schools, and high schools, we find that the implied average change in FRL%'s effect on InHFZ% following CEP participation is effectively the same in magnitude and level of statistical significance as our results from Panel B of Table 2. These similarities suggest that the CEP's effect on free meal enrollment represents the provision's primary effect on a school's percentage of healthy weight students.

Looking to Panel C of Table 3, we estimate that an increase in FRL% leads to lower school-level mean BMI for the full sample of schools and schools serving students of different grade types. Similar to Panel B, we find that the change in mean BMI from the implied change in FRL% following CEP participation is extremely similar in magnitude and statistical sig-

[13]The average FRL% for the never eligible and eligible groups during the pre-treatment period are 45% and 79%, respectively.

nificance to the estimated effects of CEP participation in Panel C of Table 2. Together, we interpret the results of Tables 2 and 3 as suggestive evidence that the effects of CEP participation on school-level child weight outcomes most likely driven by changes in free school meal enrollment. While it may be the case that changes in either the stigma surrounding free and reduced-price meal participation or school spending/revenue caused by the CEP affects child health, we find little difference between our results using instrumented participation and FRL% which we would not expect if these alternative mechanisms produced large changes health.

Table 4 shows the estimated intent-to-treat effect of CEP eligibility on InHFZ% and mean BMI for the full sample of schools and schools of different grade types produced by our DID model. Since our intent-to-treat estimation only looks at the estimated effect of being eligible for treatment, the effects are similar in direction and statistical significance to the results of our 2SLS-IV models, but they are smaller in magnitude. Once again, we do not find statistically significant evidence to support the theory that CEP participation worsens school-level child health outcomes.

Due to the likelihood that the effect of enrolling students in free meals will differ across dimensions other than the age of students, we also estimate our results separately by school location type. Using data from the CCD, we assign each school a location type "urban", "rural", or "suburban/town". The primary reasons why we would expect the relationship between school meals and child health to differ for schools in different areas *a priori* relate to food insecurity and institutional beliefs and practices. For example, disadvantaged children attending an urban school may be more likely to live in a food desert, which in turn would imply that the nutritional quality of meals, rather than their caloric content, is the greatest concern. Alternatively, families in rural areas may be less likely to enroll their child in a nutrition assistance program due to stigma or personal beliefs regarding government assistance programs.

Looking at the pre-CEP period mean FRL% of CEP eligible schools by location type, we do indeed see differences. CEP eligible rural schools enroll roughly 72% of their students in free and reduced-price lunches during the pre-CEP period while urban schools have an average pre-treatment FRL% of approximately 84%. The fact that the average pre-period FRL% of urban schools is 12 percentage points higher than rural schools is especially surprising given the fact that CEP eligible schools in rural counties serve a poorer population of students on average. More specifically, the county-level pre-CEP period poverty rate for CEP eligible schools in rural counties is roughly 4 percentage points higher than that of urban schools, and their median

household income is nearly 11 percentage points lower. Additionally, CEP eligible schools in suburbs/towns are located in counties with the lowest average poverty rate and the highest median household income, but they have a pre-treatment period average FRL% of roughly 81% which is 9 percentage points higher than rural schools.

Reasons why rural schools enrolled fewer students in free and reduced-price lunches during the pre-CEP period are unclear. One plausible cause would be if rural schools are smaller or spend less on each student, implying that the administrative burden of enrolling children in the NSLP and SBP is a binding constraint. When examining this possibility more closely, however, we find that CEP eligible rural schools are slightly larger and only spend roughly 5% less per full time enrolled student relative to urban schools during the pre-CEP period. Regardless of why rural schools seem to serve a smaller percentage of their meals at a free or reduced-price, it is likely that these differences will ultimately affect CEP take-up rates in addition to any subsequent effect of the provision on child health.

Beginning with the first stage results of our primary model, Panel A of Table 5 shows the estimated effect of CEP eligibility on CEP participation by school location type. The effect is statistically significant below the 1% level for schools in all location types which one would expect. What is more surprising is the fact that the largest effect of eligibility on participation occurs for schools in urban areas rather than rural areas or suburbs/towns where the provision can cause the most effective change in the percentage of students enrolled in free school meals.

Moving to Panels B and C of Table 5, we see that instrumented CEP participation has a statistically significant positive effect on the InHFZ% of urban schools, with an estimated change of 2.6 percentage points following participation. While the effect of participation on InHFZ% is positive for rural schools and schools in suburbs/towns, it is not statistically significant. Alternatively, the effect of CEP participation on mean BMI score is negative for schools in all location types, but only statistically significant for suburbs/towns. These results suggest that while the percentage of healthy weight children increases for rural schools following participation in the CEP, some children are gaining weight while others are losing weight, leading to an insignificant overall effect on mean BMI. For schools in suburbs and towns, children are losing weight following participation in the CEP, but they are not moving into the healthy weight range at a high enough rate to produce a detectable effect. Surprisingly, CEP participation does not have a statistically significant effect on either the InHFZ% or mean BMI of rural schools even though they have the lowest average FRL%'s during the pre-CEP period. Similar to our

primary results, we still find no evidence supporting a deleterious effect of CEP participation on health.

Panel A of Table 6 shows the first stage estimations for the effect of CEP eligibility on FRL% by school location type. Unsurprisingly, the effect of eligibility on FRL% is largest for rural schools with an increase of roughly 12.3 percentage points. Urban schools see the second largest effect from eligibility at 10.4 percentage points, and suburbs/towns see the lowest at 8.4 percentage points.

Panels B and C of Table 6 show our results from the second stage model instrumenting for FRL% with CEP eligibility. Similar to our primary results by school grade type, we find the implied average change in FRL% following CEP participation to cause extremely similar effects to those of Table 5 on both InHFZ% and mean BMI for all school location types. This lends further support to the assumption that the primary effect of CEP on health is caused by free school meal provisions rather than alternative mechanisms.

Finally, Table 7 shows the results of our DID model by school location type. Similar to our primary results, we find that, while smaller in magnitude, the intent-to-treat effect of CEP eligibility on both InHFZ% and mean BMI are the same sign and general levels of statistical significance for all school location types relative to our instrumental variable results from Table 5.

7 Sensitivity Analysis

We now test the validity of our instrument and the sensitivity of our results. Specifically, we perform a placebo test using data from the pre-treatment period. In placebo testing, the primary analysis is replicated using a pseudo outcome that is expected *not* to be affected by the treatment (Athey and Imbens 2017). In other words the true value of the point estimate for the pseudo outcome should be zero. Rejecting the null hypothesis in this case would bring the credibility of the original analyses into question. Various pseudo outcomes have been used in the literature for such testing. Common examples include, but are not restricted to, lagged outcomes (Imbens et al. 2001, Imbens 2015), covariates in regression discontinuity designs (Lee 2008) and difference in average outcomes of two comparison groups after adjusting for pre-treatment variables (Heckman and Hotz 1989, Imbens and Rubin 2015, Rosenbaum 1987).

For the purpose of our analysis we use pre-period (or lagged) outcomes as the pseudo outcomes in our test.

Our falsification test involves designating the group of schools that were eligible to participate in the CEP at some point during the 2014-2016 period and indicating a false post-treatment period of 2012. We then estimate our placebo test using a DID model with only data from the 2011 and 2012 school years. Our approach can be likened to comparing the pre-trends in InHFZ% and mean BMI for the ever and never eligible groups. Finding an effect of CEP eligibility for schools during the pre-period would suggest that there were differences in the pre-trends of our two groups prior to the CEP's introduction.

Table 8 shows the results of our pseudo test using future CEP eligibility status as a false treatment indicator for schools during the pre-CEP period. Our results indicate no statistically significant effect of our false treatment on either InHFZ% or mean BMI except for the InHFZ% of elementary schools which is found to be statistically significant at the 10% level. This finding implies that there were potential differences in the pre-trends of elementary school InHFZ% among the group that would eventually be eligible for the CEP and the group that would not. Besides this specific result, our falsification test suggests that the pre-trend outcome levels between the eligible and ineligible groups were not statistically different prior to treatment. Furthermore, since the effect of false-CEP eligibility on InHFZ% is negative for our full sample, elementary, and middle schools, the positive effects of true CEP participation we estimate are likely conservative. Since the effects of false-CEP eligibility have a positive effect on mean BMI for elementary and middle schools, the negative effect we observe in our primary results are likely conservative as well.

8 Conclusion and Discussion

In this study, we contribute to the literature on the effect of school meals on child health by estimating the Community Eligibility Provision's (CEP's) effect on school-level measures of child health for all K-12 schools in the state of Georgia. We use CEP eligibility as an instrument for both CEP participation and the subsequent change in free school meals as measured by the percentage of students enrolled in free and reduced-price lunch (FRL%). We also measure the intent-to-treat effect of CEP eligibility on our child health outcomes in a difference-in-

differences model.

Our primary results suggest that the CEP increases the percentage of a school's students who fall within the healthy weight range and reduces school-level average BMI. We find no statistically significant evidence to support a deleterious effect from either CEP participation or the subsequent change in free meal enrollment on our school-level child health outcomes. The CEP's effect on child health differs in statistical significance and magnitude across schools serving children of different ages, with the largest effect on InHFZ% occurring for middle schools and on mean BMI for elementary schools. We do not find a statistically significant effect of either CEP participation or FRL% on the school-level health outcomes of high schools.

In addition to our primary results, we estimate the CEP's effect on child health separately for schools in urban areas, rural areas, and suburbs/towns. Again, we find no evidence supporting a deleterious effect from CEP participation, free school meal enrollment, or CEP eligibility for schools in any location type. We estimate a relatively large and significant increase in InHFZ% following CEP participation for urban schools, but do not find a significant change in mean BMI. Alternatively, we find no significant change in InHFZ% for schools in suburbs/towns even though the program significantly decreases their mean BMI. Most interestingly, we find no statistically significant effect from free school meal provisions or CEP participation on the outcomes of rural schools in Georgia even though they had the most to gain from the program relative to their poverty level and low rate of pre-CEP period FRL%.

While we use FRL% as a measure of general free school meal enrollment rather than just lunch, our results for FRL% stand in contrast to those of Schanzenbach (2009) and Millimet et al. (2010) who find that school lunch participation increases child weight. One possible cause of this discrepancy is the nested effect of additional free school breakfast within FRL%. Since we cannot differentiate between the effects of NSLP and SBP participation, the beneficial effects of FRL% and CEP participation on health may be driven by changes in breakfast rather than lunch. Alternatively, Schwartz and Rothbart (2017) find similar evidence of a positive effect from the universal free school lunch program on the health of non-poor eighth graders in New York City even though universal free breakfast had been in place for years prior.

Another potential reason why our results differ from those finding a detrimental effect of school meals on weight is changes to school meal quality. In addition to creating the CEP, 2010's Healthy Hunger Free Kids Act(HHFKA) also changed the nation's minimum nutrition standards for school meals. Prior to the HHFKA's revised standards, meals served in school

may have been of lower quality relative to meals brought from home. If so, increased meal participation could lead to the negative health effects observed by existing studies. In light of these nutrition standard changes, it is generally important that we revisit the relationship between school meals and child health.

Finally, the variations in free school meal enrollment following participation in the CEP also occur at different margins than other sources of variation like family income eligibility. Most notably, the CEP affects children who were already eligible for free meals but chose not to participate, *and* children living in families with incomes above the existing free and/or reduced-price eligibility range. CEP participation removes child-level self-selection into free school meal programs entirely, implying that the negative health effects found in existing studies may be due to adverse selection into school meals under the traditional system; a theory supported by Millimet et al. (2010).

Given that our results suggest increased free school meal provisions through the CEP lead to improved school-level outcomes of child health, an important question then becomes - what factors determine school participation? While not explicitly presented here, results from a simple model of CEP participation gives some insight into possible determinants. First, schools with higher levels of FRL% in the pre-treatment period are less likely to sign up for the CEP. This relationship may be due to schools who already have the vast majority of their students receiving free or reduced-price meals deciding that the small increase in enrollment caused by the CEP is not worth the effort. This stands in contrast to the assumption that high FRL% schools are more likely to sign up because the CEP removes the administrative burden of collecting and processing free and reduced-price meal applications. Looking to our results for schools in areas with high average pre-treatment FRL%'s suggests that these schools may still experience significant benefits to student health from CEP participation they may not be aware of.

Unsurprisingly, CEP eligible schools with identified student percentages below 62.5% are also found to participate less often since CEP schools with ISPs between 40% and 62.5% only have a portion of their meals reimbursed by the USDA at the free rate. This finding suggests that program costs do play a role in each school's participation decision. Furthermore, we find that schools with higher ISPs within the 40%-62.5% range are more likely to participate which also supports the significance of program cost. If barely eligible schools are kept from participating in the CEP because of reimbursement rates, our results suggest that the USDA may be able to significantly improve child health by changing the CEP's current reimbursement scheme.

County-level poverty also seems to play a complex role in a school's CEP participation decision. For example, we find that the overall percentage of a school's county living in poverty is negatively correlated with CEP participation, indicating that schools in counties that are poorer overall are less likely to adopt the provision on average. While this relationship may again be due to schools with higher pre-treatment period FRL%'s deciding that switching to the CEP will not cause a significant enough change to be worthwhile, our results indicate that the poorest counties do not have more children enrolled in free school meals in actuality. Alternatively, schools in counties with higher levels of child poverty are more likely to participate, implying that the distribution of poverty within a school's county plays a part in their CEP decision.

In relation to poverty, we find that schools in urban areas are more likely to participate in the program than schools in suburbs/towns while rural schools are not. Rural schools in Georgia have the lowest pre-CEP period average FRL% and serve children in the state's poorest counties. Therefore, the low uptake rate among rural schools stands in contrast to the CEP's primary goal of providing free school meals to children who were not adequately reached by the existing system. Furthermore, we do not find a statistically significant effect of CEP participation on child health in rural counties, implying that there is heterogeneity in the effect of offering children free school meals on health across area types. If disadvantaged schools in different areas continue to participate at different rates, the CEP may unintendedly perpetuate location specific disparities in child health.

While the results of our study provide important evidence regarding the CEP's effect on school-level measures of child health, future research is needed to understand the effect of free school meals on health at the child-level. As spoken to throughout our study, school-level measures of health identify specific moments of the underlying child-level distribution, making it impossible to determine where an effect is coming from. A promising avenue for future research will be to estimate the effects of school meal programs on child-level health for children from different sociodemographic and economic groups. Furthermore, our study ignores other mechanisms through which free school meal provisions could either improve or harm the lives of children and their families. One such mechanism is the CEP's removal of child-level stigma surrounding the receipt of free meals in school. Given the similarity of our results using CEP participation and FRL%, however, we believe that the CEP's effect on health is driven by the subsequent increase in free school meal enrollment rather than these alternative mechanisms.

Finally, additional work is needed to better understand the possible interactions, decisions,

and outcomes schools face when choosing whether or not to participate in the CEP. Aside from the observable determinants of participation, one possible factor which we have not seen considered in the literature is school-level stigma. If schools choose not to adopt the CEP because they feel that it will negatively effect their public perception, our results indicate that the choice may come at the expense of forgone improvements to the health of their students.

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Tables and Figures

Table 1: Variable Summary Statistics 2011-2016

	Mean	StD	Min	Max	Count
Percent Students In Healthy Fitness Zone	58.88	10.51	1.47	92.08	8797
Mean Body Mass Index Score	20.35	2.27	14.97	27.25	8797
Percent Free and Reduced Price Lunches	63.02	26.27	5	100	8797
Ever CEP Eligible	.472	.4992	0	1	8797
Ever CEP Participating	.2687	.4433	0	1	8797
Number of Students	866.08	476.37	75	4192	8797
Percent Black Students	33.37	27.90	0	100	8797
Percent White Students	46.44	28.47	0	99	8797
Percent Migrant Students	.3066	1.325	0	24	8797
Percent Special Education Students	10.95	3.4	0	30	8797
Percent ESL Students	5.63	9.70	0	79	8797
Percent Gifted Students	10.71	8.41	.1	74.3	8797

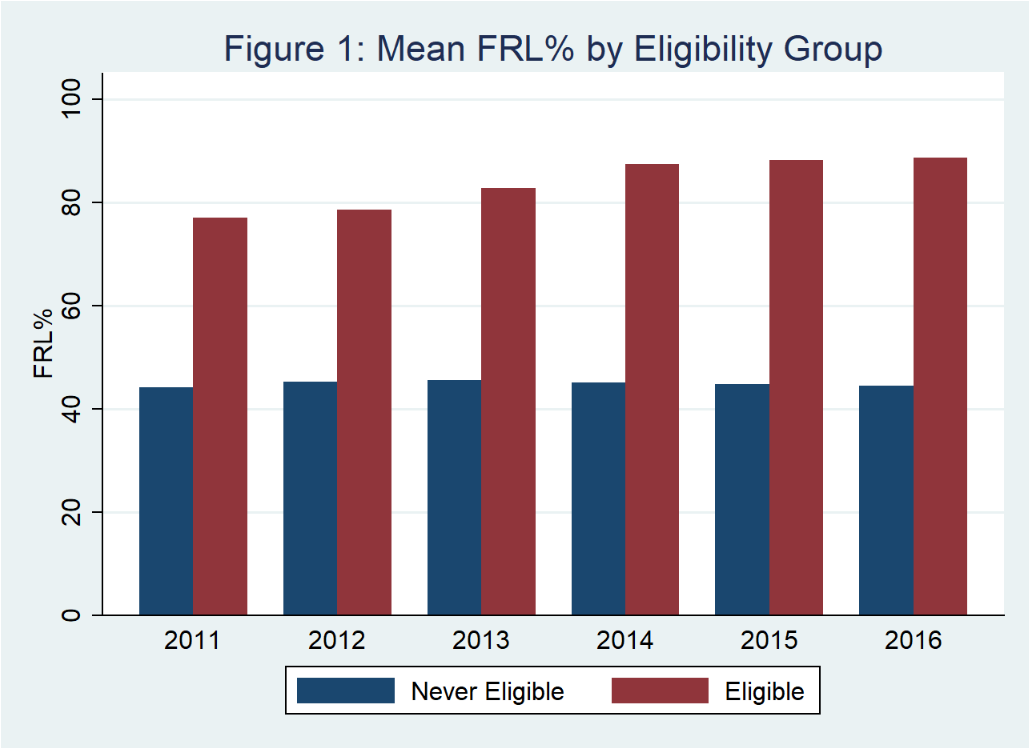
Figure 1: Mean FRL% by Eligibility Group
FRL%
0
20
40
60
80
100
2011
2012
2013
2014
2015
2016
Never Eligible
Eligible

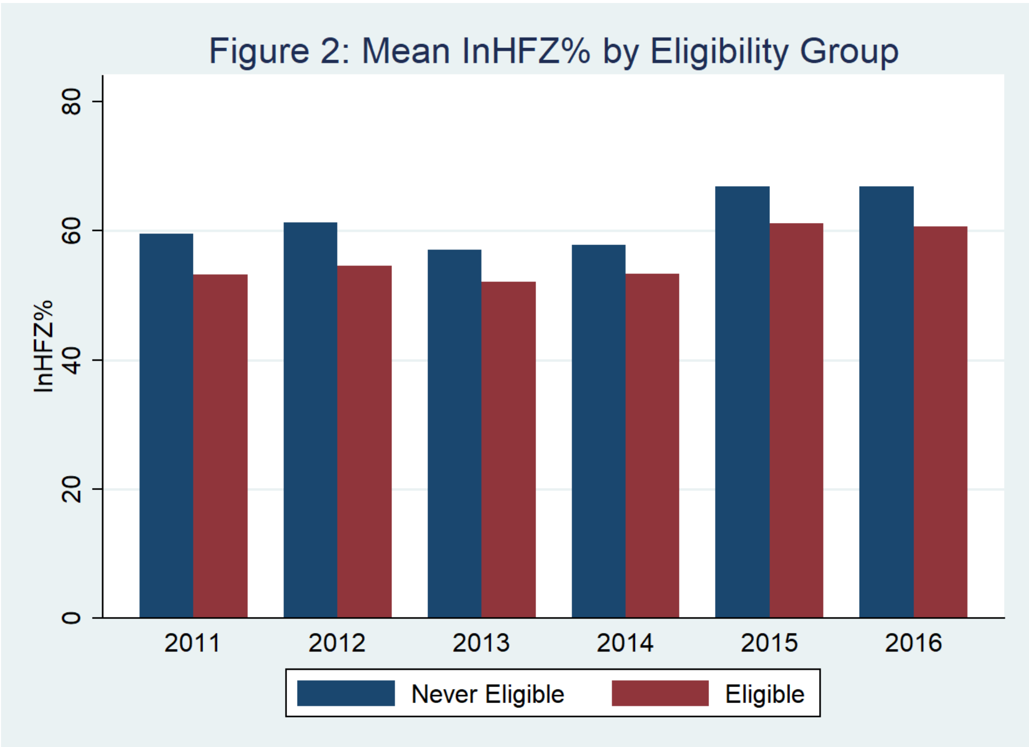
Figure 2: Mean InHFZ% by Eligibility Group
InHFZ%
0
20
40
60
80
2011
2012
2013
2014
2015
2016
Never Eligible
Eligible

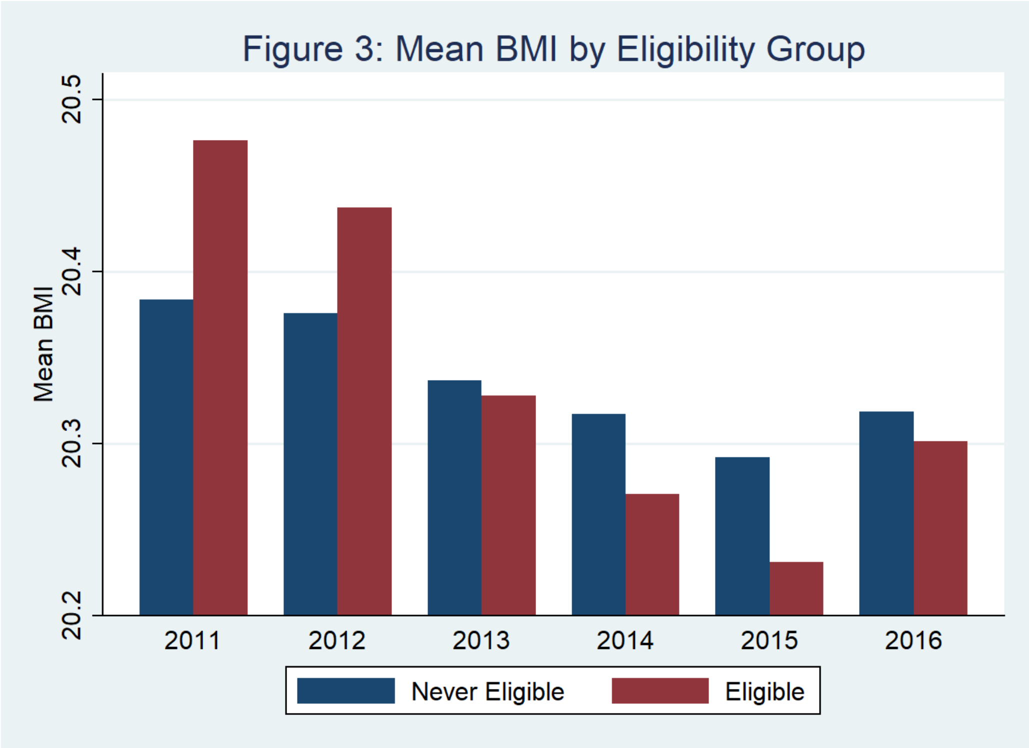
Figure 3: Mean BMI by Eligibility Group
Mean BMI
20.2
20.3
20.4
20.5
2011
2012
2013
2014
2015
2016
Never Eligible
Eligible

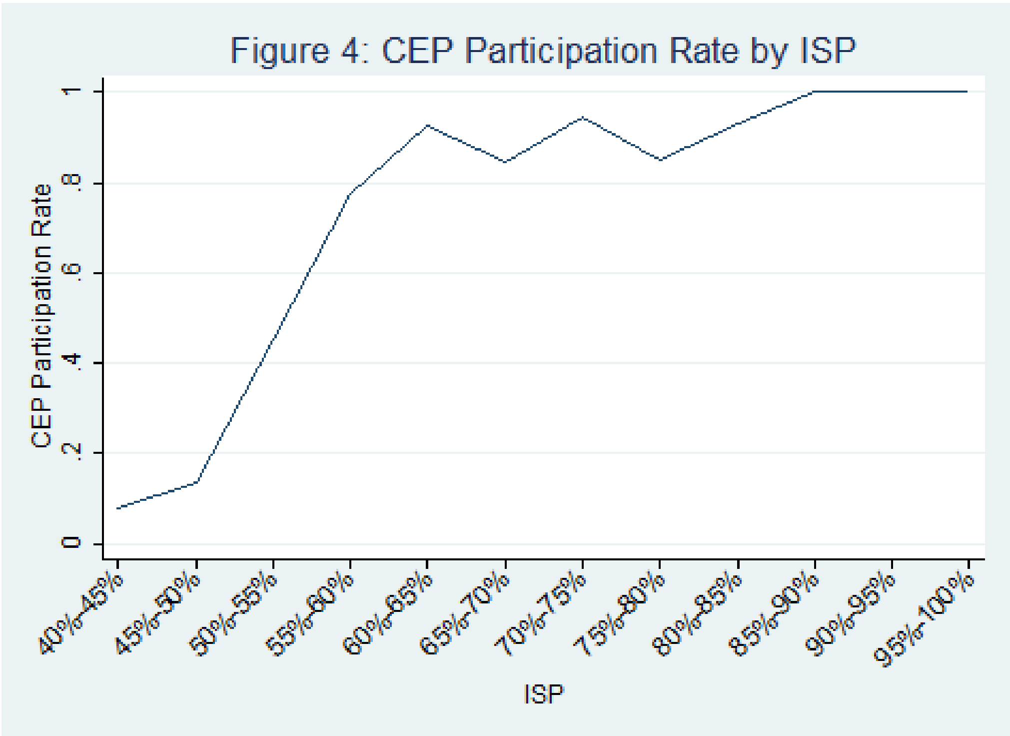
Figure 4: CEP Participation Rate by ISP
CEP Participation Rate
0
.2
.4
.6
.8
1
40%-45%
45%-50%
50%-55%
55%-60%
60%-65%
65%-70%
70%-75%
75%-80%
80%-85%
85%-90%
90%-95%
95%-100%
ISP

Table 2: 2SLS-IV Estimated Effect of CEP Participation by School Grade Type

Panel A: First Stage Estimate on CEP Participation

	All Schools	Elementary Schools	Middle Schools	High Schools
CEP Eligible	0.489***	0.420***	0.544***	0.611***
	(0.1799)	(0.0238)	(0.0412)	(0.0535)
F-stat	80.37	33.47	24.11	19.26

Panel B: Second Stage Estimates on Percent of Students in Healthy Fitness Zone

	All Schools	Elementary Schools	Middle Schools	High Schools
CEP	1.06*	0.941	2.47*	−0.72
	(0.57)	(0.76)	(1.52)	(1.46)

Panel C: Second Stage Estimates on Mean Body Mass Index Score

	All Schools	Elementary Schools	Middle Schools	High Schools
CEP	−0.171***	−0.198**	−0.145*	−0.0576
	(0.0514)	(0.0835)	(0.0885)	(0.1257)
N	7416	3922	1480	1091

Robust standard errors in parentheses. Control variables include number of students, percent black students, percent white students, percent migrant students, percent special education students, percent ESL students, percent gifted students, and year/school fixed effects.

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

Table 3: 2SLS-IV Estimated Effect of FRL% by School Grade Type

Panel A: First Stage Estimates on FRL%				
	All Schools	Elementary Schools	Middle Schools	High Schools
CEP Eligible	10.39***	7.350***	11.74***	18.26***
	(0.1799)	(0.603)	(1.049)	(2.05)
F-stat	59.93	32.52	18.30	11.07
Panel B: Second Stage Estimates on Percent of Students in Healthy Fitness Zone				
	All Schools	Elementary Schools	Middle Schools	High Schools
FRL%	0.05*	0.05	0.11*	−0.02
	(0.03)	(0.04)	(0.07)	(0.05)
Panel C: Second Stage Estimates on Mean Body Mass Index Score				
	All Schools	Elementary Schools	Middle Schools	High Schools
FRL%	−0.008***	−0.0114**	−0.0067*	−0.0019
	(0.0024)	(0.0048)	(0.0041)	(0.0042)
N	7416	3922	1480	1091

Robust standard errors in parentheses. Control variables include number of students, percent black students, percent white students, percent migrant students, percent special education students, percent ESL students, percent gifted students, and year/school fixed effects.

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

Table 4: Reduced Form Effect of CEP Eligibility on In-HFZ% and Mean BMI by School Grade Type

	All Schools	Elementary Schools	Middle Schools	High Schools
Panel A: Percent of Students in Healthy Fitness Zone				
CEP Eligible	0.52*	0.396	1.34	−0.439
	(0.51)	(0.37)	(0.89)	(0.97)
Panel B: Mean Body Mass Index Score				
CEP Eligible	−0.0835***	−0.0834**	−0.0787	−0.0352
	(0.0295)	(0.0835)	(0.0885)	(0.1257)
N	7416	3922	1480	1091

Robust standard errors in parentheses. Control variables include number of students, percent black students, percent white students, percent migrant students, percent special education students, percent ESL students, percent gifted students, and year/school fixed effects.

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

Table 5: 2SLS-IV Estimated Effect of CEP Participation by School Location Type

	Urban	Rural	Suburbs/Towns
Panel A: First Stage Estimates on CEP Participation			
	Urban	Rural	Suburbs/Towns
CEP Eligible	0.749***	0.482***	0.402***
	(0.0427)	(0.0296)	(0.0258)
F-stat	88.44	27.87	25.95
Panel B: Second Stage Estimates on Percent of Students in Healthy Fitness Zone			
	Urban	Rural	Suburbs/Towns
CEP	2.60**	0.52	1.05
	(1.3)	(0.86)	(1.03)
Panel C: Second Stage Estimates on Mean Body Mass Index Score			
	Urban	Rural	Suburbs/Towns
CEP	−0.0676	−0.114	−0.236***
	(0.1086)	(0.0804)	(0.0897)
N	840	3142	3434

Robust standard errors in parentheses. Control variables include number of students, percent black students, percent white students, percent migrant students, percent special education students, percent ESL students, percent gifted students, and year/school fixed effects.

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

Table 6: 2SLS-IV Estimated Effect of FRL% by School Location Type

Panel A: First Stage Estimates on FRL%			
	Urban	Rural	Suburbs/Towns
CEP Eligible	10.40***	12.32***	8.395***
	(1.6178)	(0.8685)	(0.7109)
F-stat	18.02	25.49	30.87
Panel B: Second Stage Estimates on Percent of Students in Healthy Fitness Zone			
	Urban	Rural	Suburbs/Towns
FRL%	0.19**	0.02	0.05
	(0.09)	(0.03)	(0.05)
Panel C: Second Stage Estimates on Mean Body Mass Index Score			
	Urban	Rural	Suburbs/Towns
FRL%	−0.0049	−0.0045	−0.0113***
	(0.0078)	(0.0031)	(0.0043)
N	840	3142	3434

Robust standard errors in parentheses. Control variables include number of students, percent black students, percent white students, percent migrant students, percent special education students, percent ESL students, percent gifted students, and year/school fixed effects.

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

Table 7: Reduced Form Effect of CEP Eligibility on In-HFZ% and Mean BMI by School Location Type

Panel A: Percent of Students in Healthy Fitness Zone			
	Urban	Rural	Suburbs/Towns
CEP Eligible	1.95**	0.25	0.42
	(0.98)	(0.47)	(0.46)
Panel B: Mean Body Mass Index Score			
	Urban	Rural	Suburbs/Towns
CEP Eligible	−0.0506	−0.0551	−0.0949**
	(0.0932)	(0.0446)	(0.0424)
N	851	3145	3435

Robust standard errors in parentheses. Control variables include number of students, percent black students, percent white students, percent migrant students, percent special education students, percent ESL students, percent gifted students, and year/school fixed effects.

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

Table 8: Falsification Test of Future CEP Eligibility on In-HFZ% and Mean BMI During 2011 and 2012 by School Grade Type.

	All Schools	Elementary Schools	Middle Schools	High Schools
Panel A: Percent of Students in Healthy Fitness Zone				
CEP Eligible 2012	−0.34	−0.63*	−0.41	0.24
	(0.24)	(0.36)	(0.45)	(0.51)
Panel B: Mean Body Mass Index Score	All Schools	Elementary Schools	Middle Schools	High Schools
CEP Eligible 2012	−0.0136	0.0703	0.0264	−0.0279
	(0.0332)	(0.0445)	(0.0629)	(0.0706)
N	2937	1556	588	431

Robust standard errors in parentheses. Control variables include number of students, percent black students, percent white students, percent migrant students, percent special education students, percent ESL students, percent gifted students, and year/school fixed effects.

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

Appendix A: Alternative Specification

Under the assumption that CEP participation only (or at least primarily) affects our weight outcomes of interest by enrolling more students in free meals, we would expect the treatment effect to vary by the number of new students enrolled. For example, assume two schools, A and B, both participate in the CEP during the post-CEP period. Furthermore, assume that the FRL% of school A in the last pre-CEP year (2012) is 50, and the FRL% of school B in 2012 is 90. While the FRL% of both schools necessarily goes to 100 after adopting the CEP, the *relative changes* in FRL% from their respective 2012 levels are different at 50 for school A and 10 for school B. If larger changes in the share of students enrolled in free school meals produce greater changes in subsequent school-level weight outcomes, we would expect the treatment effect of CEP participation on InHFZ% and mean BMI to be greater for school A than school B.

To capture this differential effect of CEP participation by FRL% change between pre- and post-CEP participation, we use an alternative specification of our two-stage regression model. The first-stage of our alternative model for school i in year t is given as:

$$(100 - FRL\%_{i2012}) * CEP_{it} = Z_{it}\gamma + \phi ELIG_{it} + \alpha_i^1 + \lambda_t^1 + v_{it} \tag{4}$$

where $(100 - FRL\%_{i2012}) * CEP_{it}$ is the percentage-point increase in the percentage of students enrolled in free and reduced-price lunch following CEP participation interacted with a dummy variable for CEP participation and all other variables are defined in the same way as the first-stage model given by equation (1).

The second-stage model of our alternative specification is given as:

$$Y_{it} = Z_{it}\beta + \delta(100 - FRL\%_{i2012}) * CEP_{it} + \alpha_i^2 + \lambda_t^2 + e_{it} \tag{5}$$

where Y_{it} is either InHFZ% or mean BMI, and all other variables are defined as they were in equation (4).

Similar to our primary two-stage regression model, estimating the effect of interest, δ, involves substituting the estimated value of $(100 - FRL\%_{i2012}) * CEP_{it}$ from (4) into equation (5). Unlike our primary specification, however, the alternative model above allows the treatment effect of CEP participation to vary by the percentage-point change in the percentage of

students enrolled in free and reduced-price lunch. Given our findings that increases in FRL% and participation in the CEP both lead to higher InHFZ% and lower mean BMI, we expect the effect of CEP participation to be higher for schools with larger values of $(100 - FRL\%_{i2012})$, *a priori*.

The results of our alternative specification are given below in Tables 9 and 10 by school grade type and school location type, respectively. Beginning with Panel A of Table 9, we see that CEP eligibility leads to a statistically significant increase in the number of new children enrolled in free meals post-CEP participation for the full sample of schools and all school grade types. Additionally, the magnitudes of our coefficients differ from those of our model using CEP eligibility as an instrument for FRL% directly in Panel A of Table 3 by roughly 1 percentage-point on average. Unlike our model using CEP eligibility as an instrument for FRL%, the first stage effect in our alternative specification is only identified off of a one time change in FRL% among the eligible group of schools who choose to participate in the CEP. While using a different source of identification causes little variation in our coefficients, the F-statistics are smaller for our alternative model relative to our primary results.

Mirroring our primary findings, Panel B of Table 9 shows that the change in FRL% caused by CEP participation is estimated to have a positive effect on InHFZ% for all schools, elementary schools, and middle schools; but a negative and statistically insignificant effect for high schools. For the CEP participating subset of all schools, the mean change in the percentage of students enrolled in FRL was roughly 18.2 percentage points, implying an expected change in InHFZ% following CEP participation of roughly 1 percentage-point. This change for all schools is extremely close to the 1.06 and 1.05 percentage point changes implied by the estimates from our model of CEP participation and FRL%, respectively. Additionally, we find little variation in the implied change in InHFZ% among elementary, middle, or high schools produced by our alternative specification relative to our primary results.

Looking to Panel C of Table 9, we see that our alternative specification produces coefficients similar in magnitude and level of statistical significance to those of our primary results in Panel C of Table 3 for the full sample of schools and all school grade types. The only notable difference is that the effect of additional FRL enrollments for elementary schools is statistically significant at the 1% level, but the change is marginal relative to our primary results.

Table 10 illustrates the results of our alternative specification by school location type. Looking to Panel A of Table 10, we see that the effect of CEP eligibility on additional free lunch

enrollments following CEP participation is roughly the same in magnitude and level of statistical significance relative to our first stage results from Panel A of Table 3. Similarly to our results by school grade type in Table 9, the F-statistics of our alternative specification are smaller for each location type relative to our primary results. With regards to Panels B and C of Table 10, we again find no noteworthy differences between the effects of our primary and alternative specifications.

Overall, we interpret the estimations from our alternative model as supportive of our primary results. If there were notable differences between model types, it would imply that the variation in free and reduced-price meals caused by CEP eligibility was partially explained by mechanisms other than the change from a school's pre-CEP FRL% to universal enrollment following participation. Given the similarity of our findings across models, however, we feel confident that variation in free meal enrollment among the CEP eligible group is only occurring for schools that choose to adopt the provision rather than some other omitted factors changing concurrently with eligibility.

Table 9: 2SLS-IV Estimated Effect of CEP Participation Interacted with Change in FRL% by School Grade Type

Panel A: First Stage Estimate on CEP Participation Interacted with Change in FRL%				
	All Schools	Elementary Schools	Middle Schools	High Schools
CEP Eligible	9.538***	6.614***	10.156***	17.265***
	(0.512)	(0.582)	(1.064)	(2.013)
F-stat	34.56	13.14	9.97	9.31
Panel B: Second Stage Estimates on Percent of Students in Healthy Fitness Zone				
	All Schools	Elementary Schools	Middle Schools	High Schools
$(100 - FRL\%_{2012}) * CEP$	0.05*	0.06	0.132*	−0.02
	(0.03)	(0.05)	(0.08)	(0.05)
Panel C: Second Stage Estimates on Mean Body Mass Index Score				
	All Schools	Elementary Schools	Middle Schools	High Schools
$(100 - FRL\%_{2012}) * CEP$	−0.0088***	−0.0127***	−0.0078*	−0.002
	(0.0026)	(0.0053)	(0.0047)	(0.0044)
N	7416	3922	1480	1091

Robust standard errors in parentheses. Control variables include number of students, percent black students, percent white students, percent migrant students, percent special education students, percent ESL students, percent gifted students, and year/school fixed effects.

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

Table 10: 2SLS-IV Estimated Effect of CEP Participation
Interacted with Change in FRL% by School Location Type

Panel A: First Stage Estimates on CEP Participation Interacted with Change in FRL%			
	Urban	Rural	Suburbs/Towns
CEP Eligible	10.5423^{***}	11.509^{***}	7.5129^{***}
	(1.356)	(0.8383)	(0.692)
F-stat	9.66	18.70	12.20
Panel B: Second Stage Estimates on Percent of Students in Healthy Fitness Zone			
	Urban	Rural	Suburbs/Towns
$(100 - FRL\%_{2012}) * CEP$	0.18^{**}	0.02	0.06
	(0.09)	(0.04)	(0.06)
Panel C: Second Stage Estimates on Mean Body Mass Index Score			
	Urban	Rural	Suburbs/Towns
$(100 - FRL\%_{2012}) * CEP$	-0.0048	-0.0048	-0.0126^{***}
	(0.0077)	(0.0034)	(0.0048)
N	840	3142	3434

Robust standard errors in parentheses. Control variables include number of students, percent black students, percent white students, percent migrant students, percent special education students, percent ESL students, percent gifted students, and year/school fixed effects.

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