Free Lunch for All!
The Effect of the Community Eligibility Provision Program on Academic Outcomes

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Abstract:

In this paper, we analyze the effect of Community Eligibility Provision, a universal free-lunch program, on middle and elementary school students' academic performance and attendance in the state of South Carolina. As part of the program, eligible schools can provide free lunch to all students, regardless of whether an individual student qualifies for free or reduced lunch. Using a difference in differences setup, we show that this program leads to about 0.03-0.04 of a standard deviation increase in Math test scores for elementary school students. We find smaller, but statistically insignificant effects on reading scores. We find no significant effect for middle schoolers' test scores. The effects are most substantial for students that were previously eligible for free lunches and students in poorer and more rural areas. We find no overall effect on attendance from the program; however, we do see a decline in absences for students in urban areas.

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I. Introduction

There is an extensive literature that provides evidence on the importance of children's nutrition for academic performance (e.g., Glewwe, et al., 2001; Winicki and Jemison, 2003). Further, because food insecurity and hunger are more prevalent among children living in poverty, this serves as another channel for the persistence of inequality. As such, policy makers have increasingly focused on interventions in child nutrition as an instrument for both educational policy and anti-poverty efforts.

Starting with the National School Lunch Act, signed into law by President Truman in 1946, a variety of federal programs aimed at improving childhood nutrition through interventions at school have been implemented. As of 2016, between the National School Lunch Program (NSLP) and the School Breakfast Program (SBP), established in 1966, over 30 million student lunches and nearly 15 million student breakfasts are provided daily (USDA, 2018; USDA, 2018). The Community Eligibility Provision (CEP) program is a federally funded program that was established as a part of the Healthy and Hunger-Free Kids Act of 2010. As part of the program, schools are subsidized to provide universal free lunch to students, regardless of an individual student's eligibility for free or reduced lunch as part of the NSLP.

Proponents of this program posit several reasons why the CEP might improve student performance and student health. First, the program may expand students' participation in the NSLP. Many students that are not eligible for the NSLP may yet be food insecure and would benefit from free lunch. Further, a substantial fraction of students, 13% of the non-certified students, are eligible for free/reduced lunch based on income but do not participate due to lack of information about the program, social stigma associated with government assistance, bureaucratic hurdles (Marples and Stillman, 1995; Domina, 2017), and/or social stigma from peers

(Poppendieck, 2010). Expanding the program to include these students will reduce the number of students that are nutritionally deficient. Second, this program reduces the administrative burden because the schools are no longer required to collect and process paperwork. This also allows more time in the lunchroom for students to eat lunch as there is no need to process payments or verify funds. Relatedly, schools do not need to attempt to collect from students who have unpaid balances. Finally, there may be positive spillovers from the expanding the program even onto students that already receive free lunch from the improved behavior and performance of students who now participate.

In this paper, we investigate the effect of the universal free lunch program, through CEP, in the state of South Carolina between 2014 and 2016 on students' academic performance and school attendance. As part of the CEP, states were phased into the program, with South Carolina only becoming eligible in 2014. We employ a difference in differences approach with individual student-level fixed effects as our main identification strategy. Our main results suggest that the program improves elementary students' math scores in the state standardized tests by 0.03-0.04 standard deviations. The effect on reading scores is smaller and statistically insignificant. We find no significant impact on middle schoolers' test scores. We do not find an overall effect on attendance from the program either. When we examine the heterogeneous effects of the program by subgroups of students, we see the effects are largest for students that were eligible for free lunch prior to implementation of the program. For elementary students in this group, the program raises their math scores by 0.07 standard deviations and reading scores by 0.025 standard deviations. Although it should be noted, we only know if a student's eligibility for free/reduced lunch before the implementation of the CEP, as such eligibility is not recorded in schools that take part in the universal lunch program. Thus, some of the effect might be on students that were previously

eligible for the NSLP, but would have been ineligible (or at least uncertified) had the program not been expanded. Additionally, we see a significant decline in absences among students in urban areas. The results are robust to instrumenting for participation using an eligibility measure.

These findings contribute to the literature on the general effects of food assistance programs and, more specifically, the literature on school meal programs on academic outcomes. There exists a substantial literature on the effect of food assistance programs, mostly the effects of the Supplemental Nutritional Assistance Program (SNAP) on a variety of outcomes. This literature has found that SNAP reduces food insecurity and reduces out-of-pocket food expenditures (Gunderson and Ziliack, 2003; Hoynes and Schanzenbach, 2009) and that early in life food assistance provides substantial long-term health benefits (Almond, Hoynes and Schanzenbach, 2011; Hoynes, Schanzenbach, and Almond, 2016). Furthermore, the timing of SNAP benefits has been shown to have positive effects on student performance and reduces the number of disciplinary actions (Gassman-Pines and Bellows, 2018; Cotti, Gordanier, and Ozturk, 2018; Gennetian, et al. 2016).

There is also a growing literature that examines the effect of school meal programs on both health and academic outcomes of students. In one vein of work, several papers verify a positive relationship between availability of free lunch and food security (Fletcher and Frisvold, 2017), free lunch and nutrition (Bhattacharya, Currie, and Haddie, 2006), and overall health outcomes (Gunderson, Kreider, and Pepper, 2012), although possibly higher BMIs (Schanzenbach, 2009).

The existing work on the effects of school meal programs provides some evidence that school meal programs do, indeed, improve performance. Hinrichs (2010) uses changes in the NLSP administrative rules in the 1960s to casually estimate the effect of participation in the program on outcomes and finds no short-term effect but large increases in educational attainment.

Frisvold (2015) also shows that the SBP participation improves academic performance. The way school meals are delivered may also substantially affect participation. Imberman and Kugler (2014) find a substantial improvement in performance associated with breakfast in the classroom, although Corcoran, Elbel, and Schwartz (2016) find little impact. While McEwan (2013) finds no relationship between the caloric content of meals and performance, Anderson, Gallagher, and Ritchie (2018) find nutritional quality improves performance. Perhaps most tellingly, schools themselves act as if they believe that school meals make a difference in student performance. Figlio and Winicki (2005) find that schools alter their menus to provide increased caloric content around testing dates in response to school accountability initiatives.

Most relevant to our work, three papers look at the effects of universal free lunch on various outcomes. Davis and Mussaddiq (2018) investigate the adoption of the CEP in the state of Georgia and find an increase in the share of students in a healthy weight range. Gordon and Ruffini (2018) use the rollout of the CEP across different states to examine school discipline measures. They find modest reductions in elementary and middle school students, with the results largest in areas with high levels of food insecurity. Finally, Schwartz and Rothbart (2018) utilize rich administrative data to evaluate the effects of universal free lunch on student performance in New York City. Specifically, their data allows them to observe students' actual participation in school lunch. They find that the universal free lunch increases participation in lunch for both students that were previously eligible for free lunch and those that were not. Both groups have experienced positive and statistically significant increases in math and reading test scores. For the already qualified students, the increase is 0.032 standard deviations in math and 0.027 standard deviations in reading. The effect on other students is nearly twice as large. There are, however, some notable differences between their work and ours. First, our settings of study are very different from theirs.

Our data comes from across the state of South Carolina and includes substantial rural populations. Second, the student composition of our sample is also distinct from theirs. While nearly 60% of their sample are Hispanic or Asian, the two groups comprise only 10% of our sample. The vast majority of our sample are white or African American. Furthermore, the students in New York City public schools are predominately poor, with about 90% eligible for free or reduced lunch. While our sample also contains schools with a similar degree of poverty, there is much more heterogeneity. Finally, they focus on middle school students. Our data allow us to examine both middle school and elementary school students. Consequently, our study may have different external validity and policy implications from theirs.

Our results add to the evidence that suggests that free meal programs can improve student outcomes. We also show that students who previously received free lunch might yet experience gains from the CEP. Further, the gains appear to be largest in rural parts of the state. For policy makers, these results imply that the universal free lunch program is beneficial to students from a low socioeconomic background and that this can be an effective tool for improving performance and closing achievement gaps.

The paper is structured as follows: Section 2 describes the background of CEP and its adoption within South Carolina; Section 3 describes the data; Section 4 presents the econometric specifications; Section 5 comprises our main results; Section 6 considers extensions to our main analysis; Section 7 discusses the results and concludes the paper.

II. Background

Under the NLSP, lunch is provided free to students with household incomes up to 135% of the poverty line and at a reduced price to students with household incomes up to 185% of the poverty

line. Student eligibility is established either by submitting an application, which is then reviewed by local officials, or by categorical eligibility. Students are categorically eligible, if they are participants in certain assistance programs, such as SNAP, or if they are classified as part of a disadvantaged status, such as homeless or foster children.

Under the CEP, a school is eligible to receive subsidies to provide universal free lunch if the fraction of students in the school that qualifies for free lunch through categorical eligibility, Identified Student Percentage (ISP), is at least 40%. The reimbursement rate is set as the ISP multiplied by 1.6. Thus, the program is 100% subsidized in any school where the ISP exceeds 62.5%. Further, schools can participate at the school level or as part of district-wide participation. That is, a district with an ISP greater than 40% can choose to participate at the district level, where all schools provide universal free lunch regardless of a particular school's ISP. Therefore, a school with an ISP of 25% might offer free lunch to all students if the district ISP exceeds 40% and the district chooses to participate.

The decision to adopt CEP is ultimately made at the school district level, no matter a school participates the program individually or as a part of the whole district. A number of factors may influence the participation decision, such as the political environment[1] and confusion over whether participation would affect other federal money that is based on free and reduced lunch rates. utHowever, of all the factors, the cost of the program appears to be the most salient determinant for the CEP participation choice (Moore, 2017).

This is reflected in the participation rate over time. First, participation has increased substantially since the initial year. In the 2014-15 school year, 461 out of 848 schools were eligible,

[1] Prior to the 2015-2016 school year, the state Superintendent of Education was Mick Zais, the current U.S. Deputy Secretary of Education, who had "famously refused to seek funding for several federal education initiatives (Moore, 2017)."

and 216 of them participated in the program. The number of participating schools increased to 369 in the next school year. As of April 2017, about 83 percent of eligible schools were participating in the program. Second, the percentage of eligible schools that participate is much larger for schools where the reimbursement rate is 100%. Specifically, the share of eligible schools that participate with an ISP over 62.5% (100% reimbursement) is 63.7%; but the share is only 23% among those qualifying for partial reimbursement. When we restrict this further to eligible schools in a district where at least one school is participating, the participation rate is 94% and 64% respectively.

Table A1 in the Appendix reports the CEP participation statistics for the middle and elementary school in our sample.

III. Data

To analyze the question at hand, we use administrative data from the South Carolina Department of Education and the South Carolina Department of Social Services. We obtain panel data of 3rd to 8th graders for the school year 2013-14 to the school year 2015-16 from the Department of Education. We utilize one year of data prior to the rollout of the CEP in South Carolina and two years during which the CEP was in effect. We have end-of-year scores of Mathematics (MATH) and English Language Acquisition (which will be referred to as Reading from this point on) in the state standardized tests and annual attendance records for each student. We also observe if a student was on the SNAP or TANF and whether he or she received free or reduced lunch in a school year if the school does not provide universal free lunch.

We collect school-level characteristics that may affect students' academic performance from annual school report cards (also produced by the Department of Education) and the Common Core Data from the National Center for Education Statistics (NCES). These characteristics include

total enrollment, the share of teachers with advanced degrees, student-teacher ratio in core subjects, average teacher salary, and the share of students with disabilities in a school year.[2] We also collect information on whether a school is a charter school, a magnet school, or some other types of special schools, as well as the locality of a school. We exclude any non-traditional public schools from our analyses. As a result, our sample contains 551,779 observations from 223,115 students in 792 schools. About 72% of these schools are elementary schools.

[Table 1 near here]

Table 1 provides the basic descriptive statistics from our data. We observe differences in racial composition between the schools that participate in the CEP and the ones that either chose not to participate or were not eligible. We also see more of the early participants were from rural areas. Both of these characteristics (race and rurality) are likely capturing the income levels in the school district and hence are correlated with eligibility.

[Table 2 near here]

Table 2 provides statistics on the test scores. All test scores are standardized at the grade-year level. In the top panel of this table (Panel A), Math and Reading test scores are summarized by year and by the CEP participation status across both elementary and middle schools. Panels B and C report the same statistics separately for elementary schools (Panel B) and middle schools (Panel C). Poverty appears highly correlated with academic outcomes. Schools that participated in CEP, as seen in Table 1, are poorer schools with higher percentages of identified students (ISPs). The test scores in these schools are on average much lower, and absences are higher than non-participating schools.

[2] Descriptive Statistics for these variables are given in Table A2.

IV. Econometric Setup

We employ a difference-in-differences model to identify the treatment effects of the CEP. Our baseline specification is as follows:

$$Y_{igst} = \beta_0 + \beta_1 CEP_{st} \times Elementary_{igt} + \beta_2 CEP_{st} \times Middle_{igt}$$
$$+ X'_{st}\beta_3 + \gamma_{gt} + \delta_i + \varepsilon_{igst},$$

where Y_{igst} is a vector of variables reflecting outcomes for student *i* in grade *g* and school *s* in year *t*. These outcomes include standardized math and reading test scores and absences. CEP_{st} is a binary indicator which takes a value of 1 if school *s* participated in the CEP in year *t*. $Elementary_{igt}$ takes a value of 1 if student *i* is in grades 3 through 5, and $Middle_{igt}$ takes a value of 1 if student *i* is in grades 6 through 8. Accordingly, β_1 and β_2 capture the effects of the CEP on elementary school students and middle school students, respectively. X_{st} is a vector of other school characteristics that may impact students' academic performance and absenteeism. Admittedly, X_{st} may evolve endogenously with a school's adoption of the CEP. Therefore, in our empirical analysis, we start without controlling for school characteristics, and then add them to the control set and evaluate how that affects the estimated effects of the CEP. Moreover, γ_{gt} is a grade-by-year fixed effect, δ_i is a student fixed effect, and $\varepsilon_{\mathrm{igst}}$ is a random error component. We cluster the standard errors by school because the treatment is a school level intervention.

Given that only some of the eligible schools participate in the CEP, there arises a concern that endogenous participation will bias our estimates. While this is possible, it is important to note that the inclusion of individual fixed effects means that whatever unobserved quality leads to selection and causes bias must be changing over time. Further, since the decision on participation is made at the district level, the unobserved change that lead to bias must also be at the district level. Therefore, we believe that the omitted variable bias is less likely to be an issue in our case.

Nonetheless, we explore using the instrumental variable approach in section 6 and find similar results.

V. Results

a. Baseline estimates

We estimate the above model using the OLS for three outcomes: math test scores, reading tests scores, and the number of days the student was absent in a school year.[3] Table 3 reports these results. The first column for each outcome reports the results with no school-level controls. In the second column for each outcome, we control for time-varying school characteristics.[4]

[Table 3 near here]

In this table, CEP coefficients capture the total effect of the program on elementary and middle school students when compared to their counterparts who are not in the CEP program. In the parsimonious specifications, we find an average of 0.034 SD increase in math test scores in elementary schools when they switch to the CEP. Though the effect is positive, it is not significant for middle school students. The effect is positive on students' reading scores but only half the size of the effect on math scores and is not statistically significant. The estimated effects on absences are negative as expected, implying about a 1/5 of a day reduction on average in the number of days a student is absent. However, the effect is not significant for either elementary school students or middle school students. When we control for school characteristics, the estimates are generally unchanged.

[3] All test scores are standardized at the grade-year level. We utilized the raw absence records without adjustments.
[4] Descriptive statistics for these school characteristics are reported in the Appendix in Table A2.

b. Heterogeneity of the treatment effect

One might expect the effect of this program to be different by student and school characteristics. For example, the effect on students who previously received free lunch may be different than students did not. These effects could also vary by the level of poverty in the school. For example, a student who is qualified for free lunch when his or her peers are mostly wealthy might face greater social stigma associated with free lunch. In the same vein, a student from a high-income family in a school with a relatively low ISP might be very different from a similar student in a school with a very high ISP. Accordingly, we next explore heterogeneity of the treatment effects by student's poverty status, the composition of the student body, and the urban/rural classification of the school's location in this section.

By Student's SES

The first dimension of heterogeneity that we consider is simply the student's poverty status. We measure this using first, whether the student qualified for free or reduced lunch, and then whether they receive the SNAP or TANF benefits.

[Table 4 near here]

In Table 4, we explore the CEP treatment effects by the student's pre-CEP free/reduced price lunch status.[5] In this table, we report the total CEP treatment effects, that is, the coefficient for each CEP interaction with lunch group indicators (free/reduced/full priced) captures the total CEP treatment effect for that particular group of students. F-statistics reported at the bottom of the table are for tests on comparisons of these total effects across groups to assess if they are significantly different from each other. We may draw two conclusions based on these results.

[5] This measure is from 2014 data as there is no such measure for students in the CEP schools. Schools that are participating in the CEP no longer collect paperwork and track free lunch eligibility. Nevertheless, among the students who are in the non-CEP participating schools, less than 10% of the students changed their free or reduced lunch status in the subsequent years included in the analysis.

First, the students who received free lunch pre-CEP implementation enjoy the most significant gains in test scores from the CEP. Their math scores increase by 0.072 SD, and reading scores increase by 0.025 SD. These gains are significantly higher than the effects for the near-poor (reduced price) and the non-poor (full price) students. (F-statistics 15.17 and 11.62, respectively.) Second, at the middle school level, there is a significant decrease in the absences among students who used to pay the full or reduced price for lunches. But there is no significant impact on the attendance of the previous free lunch recipients (though all coefficients are negative). These may be due to possible spillover effects, for example from reduced discipline issues due to the CEP adoption (Gordon and Ruffini, 2018).

Next, we use a more restrictive measure of poverty, participation in the SNAP and TANF programs. Compared to students who were previously on free or reduced lunch, students who receive the SNAP or TANF benefits tend to be in an even lower income bracket.

[Table 5 near here]

In Table 5, we identify the CEP treatment effects by the SNAP and TANF participation status of the students in 2014. Overall, the patterns are comparable to Table 4. The results suggest the biggest gains in math scores are for the poor elementary students. The same is true for reading scores: the CEP adoption increases reading test scores significantly among elementary school students who were on benefits. We find a significant reduction in absences only for non-SNAP/TANF students.

Student Body SES Composition

Next, we consider possible differential treatment effects by the school's poverty level. In this model specification, we define *Non-Poor* schools as schools with less than 40 percent identified students (ISP < 40%). These schools do not qualify for the CEP on their own and may participate

in the program if the entire district qualifies and chooses to participate as a district. *Near Poor* schools are defined as schools with 40 to 62.5 (not including) percent identified students ($40 \leq$ ISP $<62.5\%$). These schools are categorically eligible for the CEP but face some increase in costs if they participate. Finally, we define *Poor* schools as those with 62.5 percent or more identified students (ISP $\geq 62.5\%$). The expansion to universal lunch is 100% subsidized for them. The poverty status of the students, on the other hand, is captured by their free or reduced lunch status in 2013-2014. This table again reports the total treatment effects by poverty status the school's poverty level. F-statistics for comparisons of the treatment effects are not reported due to space limitations but available upon request.

[Table 6 near here]

We find that the largest effects are for the poor students in poor schools regarding increases in math test scores at both the elementary school level and at the middle school level. At the elementary school level in the poor schools, the adoption of the CEP increases the math scores for the poor students by 0.081 SD. For the same group of students at the poor middle schools, the effect is smaller (a 0.044 SD increase).

The results are similar regarding reading scores of elementary students. The only statistically significant improvement we find is among poor students in poor schools (a 0.027 SD increase). Even though the estimate for poor students in non-poor schools is higher in the magnitude at 0.036 SD, it is not statistically different from zero. (Similar magnitude non-significant effect is estimated for non-poor students in these non-poor schools). For middle schoolers, the CEP is associated with statistically significant and higher reading scores only for non-poor students in non-poor schools.

Furthermore, the implementation of the CEP is associated with almost a full day decrease in absences for the poor students in non-poor elementary schools, with a similar magnitude effect on non-poor students in these schools. There is also a substantial reduction in absences among non-poor students at near-poor middle schools.

School's Location

Another source of differential treatment effects from universal free lunch maybe through the location of the school. Poor students in urban schools (living in urban locations themselves) are more likely to have access to other free food sources such as churches, soup kitchens, and food pantries than those in rural schools. The locality may also be associated with differential social support systems. As a result, students in rural versus urban schools may benefit from universal lunch differently.

[Table 7 near here]

In Table 7, we differentiate the treatment effects by the urban/rural location of the school. The estimated effect of the CEP on math scores is a 0.054 SD increase in rural elementary schools (more than the average effect we estimated earlier), whereas the average CEP effect on reading scores in urban schools is zero both for elementary and middle schoolers. The estimated effect on absences is largest in urban schools, on the other hand, although the only statistically significant effect is on elementary schools in urban locations. In total, the CEP adoption is associated with a 0.759 of a day reduction in absences in urban elementary schools relative to their non-CEP counterparts.

The rural parts of South Carolina are in general have more severe poverty than other areas of the state. Hence, it is possible that the rural dummy captures the poverty status of the student but not the access mechanism we discuss above. For this reason, we differentiate students in urban

and rural schools with their poverty status (captured by their SNAP/TANF participation) in the next table.

[Table 8 near here]

The estimates in Table 8 suggest that the most substantial gains from the CEP adoption is for poor students in rural schools in terms of math scores (a 0.091 SD increase). There are also improvements in reading for poor elementary students in rural areas. The only significant reductions in absences are observed among students in urban locations. The poor and non-poor students experience about a 0.7 and 0.8 reduction in absences on average in urban elementary schools, respectively.

VI. Extensions and Robustness

Prior Academic Performance

Up to this point, we have focused on the poverty status of students. However, the CEP may also result in differential impacts on students with different academic standings. Accordingly, we divide students into three groups based on their performance in the previous academic year, using the definition of achievement levels by the Department of Education: *Exemplary*, *Met*, and *Not Met*. These classifications are grade and subject specific.

[Table 9 near here]

Table 9 reports the CEP treatment effects for students with these different previous achievement levels separately for elementary and middle schools. Results indicate that CEP improves percentile scores of the worst performing students relative to the better-performing students and may this help to close the achievement gap.

Nevertheless, when we use the pre-CEP math test scores to group the students, students with better academic performance tend to miss fewer days of schools after the adoption of the CEP. Yes

the impact of the CEP on absences is only statistically significant among middle school students who scored *Exemplary*. For this group, the implementation of the CEP is related to a 0.59 day of decrease in absences.[6]

Robustness: Alternative methods

Based on our discussion with the administrators of the program in South Carolina, it is clear that a school's participation in the CEP is not decided by the school itself, but rather at the district level. Thus, self-sorting to the CEP at the school level, with expectations or planned actions that may directly impact test scores or attendance of that school, should not be a source of bias in our estimates. However, there may be selection bias through other mechanisms or district level sorting. We address this concern by following the literature and instrumenting for participation by eligibility (both for the program, i.e., ISP 40% cutoff and for the no-cost universal free lunch program, i.e. ISP $\geq$ 62.5%).

[Table 10 near here]

Table 10 reports the difference-in-differences estimates with a two-stage Instrumental Variables setup. We report two sets of results. The first set utilizes the eligibility for the program (ISP $\geq$ 40%) as an instrument. In the second set, the instrument used is the indicator for eligibility for no-cost universal free lunch ((ISP $\geq$ 62.5%). Estimates are much larger than the setup where possible endogeneity was ignored. In the first set, the first column reports a 0.133 SD increase in math scores for elementary school students associated with CEP adoption in their school. There is also an increase of 0.062 SD in reading, but this effect is not statistically significant. Moreover,

[6] When we use the pre-CEP reading scores to classify students and investigate the heterogeneous effects of the CEP on absence, the pattern of estimates is similar but slightly more statistically significant.

the CEP reduces the number of absences by 0.888 of a day. However, we do not find any significant impacts on the middle school students in this set of regressions.

In the second set of IV estimates, when using eligibility for no-cost universal free lunch, we are by design putting higher weight on the participation of the poor schools in the CEP program. As a result, as expected, our estimates are even stronger. In our baseline estimates, we showed that poor students and poor schools are the main beneficiaries of the switch to universal free lunch. In this set of estimates, we report a 0.253 SD increase in math scores of the elementary school students and a 0.113 SD increase in math scores of the middle school students following the CPE adoption. We also estimate a larger and statistically significant increase in reading scores for elementary school students. Overall, CEP adoption is associated with 0.090 SD increase in reading scores. The effects on attendance are also stronger as well, with a reduction of 1.2 days in absences in elementary schools. An almost two-day reduction in absences for middle school students is estimated, but the estimate is not statistically significant. These results, overall, are consistent with our previous finding that most of the effects are at the elementary school level for the math scores and also stronger for the high poverty schools and students.

VII. Conclusions

We examine the impact of a universal free lunch program, the CEP, on test scores and attendance of South Carolina students in grades 3 through 8. Although the existing literature has estimated the impact of school-based nutrition programs on achievement, this study considers the heterogeneous effects of a free lunch program by socioeconomic background and rural-urban status. Using a difference-in-differences design, exploiting differences over time by schools' CEP status, we show that the CEP increases math scores in elementary schools by 0.034 standard deviations, on average. When distinguishing the heterogeneous effects by socioeconomic status,

using students' pre-CEP free- or reduced-price lunch status, the SNAP and TANF participation status, and student body socioeconomic status as proxies for socioeconomic background, we show that, in all cases, the most impoverished students enjoy the most significant gains in test scores from the adoption of the CEP. Similarly, students in rural areas benefit more from the CEP than their urban counterparts.

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Table 1: Descriptive Statistics

	All	ISP≥0.4 (2014)	ISP≥ 0.625 (2014)	Ever CEP	CEP in both 2015 & 2016	CEP Switchers
Female	48.9	48.9	49.0	49.5	49.3	50.2
Race						
White	54.2	42.7	21.1	29.1	29.8	28.1
Black	35.1	46.7	68.8	62.6	63.4	60.9
Hispanic	8.0	8.8	9.0	6.7	5.2	9.3
Asian and Pacific Islander	2.0	1.2	0.6	0.9	0.9	1.4
SNAP/TANF (2014)	40.7	53.6	67.3	60.1	61.3	56.4
Lunch Status (2014)						
Full Price	38.9	23.6	17.6	17.6	15.4	22.1
Free	54.7	70.0	84.7	77.1	78.9	72.9
Reduced Price	6.4	6.4	5.3	5.3	5.7	5.0
Urban	53.7	50.0	54.1	50.2	38.8	69.3
Total No. of Students	223,115	116,286	36,220	46,731	23,504	14,789

Percentages are reported in each cell.

Table 2: Descriptive Statistics - Test Scores and Attendance by CEP

	2014		2015				2016			
	(Pre-CEP)		CEP		Non-CEP		CEP		Non-CEP	
Panel A: All	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Math	0.0726	1.103	-0.374	0.862	0.0748	0.997	-0.375	0.858	0.110	0.999
Reading	0.00835	1.024	-0.352	0.907	0.0639	0.999	-0.377	0.935	0.0989	0.978
Number of Absences	5.681	5.644	7.707	7.958	6.503	6.235	7.247	7.788	6.813	6.626
Number of Observations	153,197		31,373		179,043		43,385		144,781	
Panel B: Elementary										
Math	0.110	1.127	-0.358	0.873	0.0762	0.997	-0.370	0.869	0.119	1.002
Reading	0.0147	1.021	-0.351	0.897	0.0678	1.001	-0.376	0.948	0.112	0.979
Number of Absences	5.540	5.395	7.273	7.091	6.050	5.640	6.776	6.743	6.189	5.861
No. of Observations	116,723		20,147		110,495		20,623		61,487	
Panel C: Middle										
Math	-0.0475	1.012	-0.403	0.842	0.0727	0.997	-0.380	0.847	0.103	0.997
Reading	-0.0119	1.037	-0.355	0.923	0.0576	0.997	-0.378	0.924	0.0892	0.977
Number of Absences	6.129	6.357	8.486	9.262	7.235	7.028	7.674	8.604	7.274	7.103
No. of Observations	36,474		11,226		68,548		22,762		83,294	

Table 3: CEP and Academic Outcomes: Test Scores and Attendance

	Math		Reading		Absence	
	(1)	(2)	(1)	(2)	(1)	(2)
CEP Elementary	0.034**	0.036**	0.015	0.015	-0.236	-0.224
	[0.016]	[0.016]	[0.011]	[0.011]	[0.151]	[0.151]
CEP Middle	0.006	0.004	-0.011	-0.014	-0.228	-0.208
	[0.019]	[0.019]	[0.012]	[0.012]	[0.358]	[0.350]
School Characteristics	No	Yes	No	Yes	No	Yes
Observations	551,779	551,779	551,779	551,779	551,779	551,779
R-squared	0.849	0.849	0.864	0.864	0.729	0.730

Notes: Outcome variables are test scores standardized by year and grade and number of absences per school year. Each regression also includes student fixed effects and grade by year fixed effects. ** indicate significance at 5% level.

Table 4: CEP and Academic Outcomes by Student's Prior Free or Reduced Price Lunch Status

	Math	Reading	Absence
CEP Elementary x Full	-0.024	0.006	-0.193
	[0.030]	[0.020]	[0.182]
CEP Elementary x Reduced	-0.031	-0.021	-0.314
	[0.031]	[0.027]	[0.233]
CEP Elementary x Free	0.072***	0.025**	-0.236
	[0.017]	[0.012]	[0.189]
CEP Middle x Full	-0.008	0.019	-0.652***
	[0.034]	[0.018]	[0.219]
CEP Middle x Reduced	-0.000	-0.023	-0.605**
	[0.029]	[0.020]	[0.292]
CEP Middle x Free	0.011	-0.020*	-0.100
	[0.018]	[0.012]	[0.402]
Observations	456,317	456,317	456,317
R-squared	0.845	0.859	0.717
F-stat			
CEP Elem x Full = CEP Elem x Reduced	0.04	1.00	0.28
CEP Elem x Full = CEP Elem x Free	11.62***	0.96	0.06
CEP Elem x Reduce = CEP Elem x Free	15.17***	3.11*	0.13
CEP Midd x Full = CEP Midd x Reduced	0.05	4.76**	0.04
CEP Midd x Full = CEP Midd x Free	0.37	5.06**	2.97*
CEP Midd x Reduce = CEP Midd x Free	0.28	0.02	4.32**

Notes: Students' free/reduced priced lunch status in the 2013-14 school year is considered. Outcome variables are test scores standardized by year and grade and number of absences per school year. Each regression also includes school characteristics, student fixed effects and grade by year fixed effects. *, **, and *** indicate signficiance at 10%, 5%, and 1% levels, respectively.

Table 5: CEP and Academic Outcomes by Student's Program Participation Status

	Math	Reading	Absence
CEP Elementary x Neither SNAP nor TANF	0.008	0.003	-0.224*
	[0.019]	[0.014]	[0.133]
CEP Elementary x SNAP or TANF	0.054***	0.023**	-0.221
	[0.017]	[0.012]	[0.177]
CEP Middle x Neither SNAP nor TANF	-0.010	-0.008	-0.497*
	[0.024]	[0.014]	[0.255]
CEP Middle x SNAP or TANF	0.014	-0.018	-0.008
	[0.019]	[0.012]	[0.426]
Observations	551,779	551,779	551,779
R-squared	0.849	0.864	0.730
F-stat			
CEP Elem x Neither SNAP nor TANF = CEP Elem x SNAP or TANF	6.91***	2.85*	0.00
CEP Midd x Neither SNAP nor TANF = CEP Midd x SNAP or TANF	1.80	0.61	5.08**

Notes: Students' participation in SNAP and TANF in the 2013-14 school year are considered. Outcome variables are test scores standardized by year and grade and number of absences per school year. Each regression also includes school characteristics, student fixed effects, and grade by year fixed effects. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Table 6: CEP and Academic Outcomes by Student's Program Participation Status and Socioeconomic Composition of the school

	Math	Reading	Absence
CEP Elementary x Non-Poor School x Non-Poor Student	0.086	0.037	-0.669***
	[0.064]	[0.043]	[0.243]
CEP Elementary x Non-Poor School x Poor Student	0.020	0.036	-0.893**
	[0.062]	[0.065]	[0.402]
CEP Elementary x Near-Poor School x Non-Poor Student	-0.025	0.004	-0.118
	[0.026]	[0.021]	[0.199]
CEP Elementary x Near-Poor School x Poor Student	0.012	0.013	-0.094
	[0.022]	[0.018]	[0.305]
CEP Elementary x Poor School x Non-Poor Student	0.022	-0.013	-0.275
	[0.024]	[0.017]	[0.175]
CEP Elementary x Poor School x Poor Student	0.081***	0.027*	-0.265
	[0.021]	[0.014]	[0.208]
CEP Middle x Non-Poor School x Non-Poor Student	0.085	0.054***	-0.205
	[0.060]	[0.021]	[0.235]
CEP Middle x Non-Poor School x Poor Student	-0.034	-0.026	0.323
	[0.046]	[0.024]	[0.354]
CEP Middle x Near-Poor School x Non-Poor Student	-0.040	-0.028*	-0.728**
	[0.029]	[0.016]	[0.308]
CEP Middle x Near-Poor School x Poor Student	-0.010	-0.022	-0.346
	[0.025]	[0.014]	[0.516]
CEP Middle x Poor School x Non-Poor Student	-0.000	0.004	-0.109
	[0.030]	[0.024]	[0.583]
CEP Middle x Poor School x Poor Student	0.044*	-0.008	0.294
	[0.026]	[0.021]	[0.745]
Near-Poor School	0.015	0.005	0.154
	[0.018]	[0.011]	[0.125]
Poor School	0.015	0.034**	0.280
	[0.029]	[0.014]	[0.222]
Near-Poor School x Poor Student	-0.020*	0.010	-0.040
	[0.012]	[0.009]	[0.114]
Poor School x Poor Student	-0.043**	0.004	-0.391**
	[0.020]	[0.013]	[0.175]
Observations	551,779	551,779	551,779
R-squared	0.849	0.864	0.730

Notes: Non-Poor schools are defined as schools with ISP < 40%. Near-Poor schools are defined as schools with ISP in [40%, 62.5%). Poor schools are defined as schools with ISP ≥ 62.5%. Students' participation in SNAP and TANF in the 2013-14 school year are considered as poor. Outcome variables are test scores standardized by year and grade and number of absences per school year. Each regression also includes school characteristics, Student fixed effects, and grade by year fixed effects. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Table 7: CEP and Academic Outcomes by School's Location

	Math	Reading	Absence
CEP Elementary x Rural	0.054**	0.022	0.124
	[0.021]	[0.014]	[0.196]
CEP Elementary x Urban	0.014	0.014	-0.759**
	[0.020]	[0.017]	[0.337]
CEP Middle x Rural	0.010	-0.011	0.064
	[0.025]	[0.014]	[0.440]
CEP Middle x Urban	0.000	-0.014	-0.856
	[0.025]	[0.021]	[0.619]
Urban	0.003	0.009	-0.199
	[0.013]	[0.007]	[0.136]
Observations	540,961	540,961	540,961
R-squared	0.849	0.865	0.730
F-stat			
CEP Elem x Urban = CEP Elem x Rural	2.23	0.12	4.32**
CEP Midd x Urban = CEP Midd x Rural	0.09	0.02	1.38

Notes: Schools' locality is considered. Outcome variables are test scores standardized by year and grade and number of absences per school year. Each regression also includes school characteristics, student fixed effects, and grade by year fixed effects. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Table 8: CEP and Academic Outcomes by School's Location and Student's Program Participation Status

	Math	Reading	Absence
	(1)	(2)	(3)
CEP Elementary x Rural x Neither SNAP nor TANF	-0.005	0.006	0.110
	[0.025]	[0.017]	[0.182]
CEP Elementary x Rural x SNAP or TANF	0.091***	0.031**	0.112
	[0.021]	[0.016]	[0.226]
CEP Elementary x Urban x Neither SNAP nor TANF	0.028	0.009	-0.687**
	[0.028]	[0.023]	[0.291]
CEP Elementary x Urban x SNAP or TANF	0.004	0.017	-0.787**
	[0.023]	[0.017]	[0.379]
CEP Middle x Rural x Neither SNAP nor TANF	-0.026	-0.012	-0.289
	[0.028]	[0.015]	[0.341]
CEP Middle x Rural x SNAP or TANF	0.033	-0.011	0.278
	[0.024]	[0.015]	[0.510]
CEP Middle x Urban x Neither SNAP nor TANF	0.025	0.007	-0.912**
	[0.038]	[0.027]	[0.439]
CEP Middle x Urban x SNAP or TANF	-0.020	-0.030	-0.797
	[0.024]	[0.021]	[0.789]
Urban	0.000	0.011	-0.106
	[0.016]	[0.009]	[0.112]
Urban x SNAP or TANF	0.007	-0.005	-0.237
	[0.015]	[0.009]	[0.149]
Observations	540,961	540,961	540,961
R-squared	0.849	0.865	0.730

Notes: Students' participation in SNAP and TANF in the 2013-14 school year and schools' locality are considered. Outcome variables are test scores standardized by year and grade and number of absences per school year. Each regression also includes school characteristics, student fixed effects, and grade by year fixed effects. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Table 9: CEP and Test Scores by Student's Prior Achievement Level

	Math	Reading	Absence
CEP Elementary x Not Met	0.359***	0.230***	-0.267
	[0.019]	[0.014]	[0.235]
CEP Elementary x Met	-0.012	0.016	-0.237
	[0.017]	[0.016]	[0.177]
CEP Elementary x Exemplary	-0.319***	-0.174***	-0.193
	[0.030]	[0.018]	[0.150]
CEP Middle x Not Met	0.250***	0.168***	0.061
	[0.023]	[0.015]	[0.447]
CEP Middle x Met	-0.065***	-0.058***	-0.322
	[0.019]	[0.014]	[0.342]
CEP Middle x Exemplary	-0.304***	-0.195***	-0.590**
	[0.050]	[0.026]	[0.249]
Observations	455,829	455,547	455,829
R-squared	0.848	0.860	0.716

Notes: Students' performance in the standardized test of the corresponding subject in the 2013-14 school year is considered. Outcome variables are test scores standardized by year and grade. Each regression also includes school characteristics, student fixed effects, and grade by year fixed effects. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. F-stats for comparisons of coefficients is not reported to preserve space, but they indicate all estimated effects are statistically significantly different from each other at 1% level. The full table is available upon request.

Table 10: Test Scores and Attendance - Baseline IV DID Estimates

	Eligibility for the program as IV			Eligibility for the no-cost UFL as IV		
	Math	Reading	Absence	Math	Reading	Absence
CEP						
Elementary	0.133**	0.062	-0.888*	0.253***	0.090***	-1.266**
	[0.066]	[0.049]	[0.515]	[0.047]	[0.034]	[0.566]
CEP Middle	-0.043	-0.051	0.110	0.113**	0.020	-1.855
	[0.055]	[0.033]	[0.627]	[0.047]	[0.037]	[1.475]
Observations	551,779	551,779	551,779	551,779	551,779	551,779
R-squared	0.849	0.864	0.729	0.848	0.864	0.728

Notes: Outcome variables are test scores standardized by year and grade and number of absences per school year. Firsts et of results utilize eligibility for the CEP program (ISP≥40%) as an instrument for CEP participation, the second set of estimates use eligibility for the no-cost universal free lunch (ISP≥62.5%) as the instrument for participation. Each regression includes student fixed effects and grade by year fixed effects and school controls. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. The first stage estimates are reported in the appendix.

Appendix Tables

Table A1: Descriptive Statistics: CEP Participations

	Both Years			2015			2016		
All Schools	All	Elem.	Midd.	All	Elem.	Midd.	All	Elem.	Midd.
Percentage									
Participating in CEP	25.2	25.9	23.5	19.0	19.2	18.5	31.5	32.8	28.2
Participating in CEP as a District	18.2	17.7	19.8	15.2	14.5	17.0	21.5	21.2	22.1
Eligible as an Individual School	68.5	70.8	62.5	70.5	72.3	65.5	66.5	69.3	59.6
Eligible as a District	48.1	47.0	51.1	49.9	49.2	52.1	46.3	44.7	50.2
Eligible for 100% Reimbusement	22.7	25.9	14.3	23.0	26.3	14.0	22.4	25.5	14.6
Average ISP in All Schools	47.3	48.8	43.1	48.3	49.7	44.5	46.2	48.0	41.8
Average ISP in Participating Schools	64.0	65.6	59.3	65.4	66.8	61.1	63.2	64.9	52.3
No. of Schools	1,506	1,093	413	756	556	200	750	537	213
Among All Eligible Schools (ISP ≥40%)									
Percentage									
Participating in CEP	36.6	36.3	37.6	26.8	26.4	28.2	47.1	47.0	47.2
Participating in CEP as a District	26.5	24.8	31.7	22.2	20.9	26.0	31.3	29.3	37.6
No. of Schools	1,032	774	258	533	402	131	499	372	127
Among Schools with 40%≤ISP< 62.5%									
Percentage									
Participating in CEP	23.2	21.4	27.6	15.3	13.7	19.4	31.7	29.8	36.5
Participating in CEP as a District	16.0	13.6	22.1	13.4	11.8	17.6	18.6	15.7	26.6
No. of Schools	690	491	199	359	256	103	331	235	96
Among Schools with ISP≥ 62.5%									
Percentage									
Participating in CEP	63.7	62.2	71.2	50.6	48.6	60.7	77.4	76.6	80.6
Participating in CEP as a District	48.0	44.6	64.2	39.8	36.5	56.7	56.4	53.0	71.3
No. of Schools	342	283	59	174	146	28	168	137	31
Only in Districts with at Least One School in CEP									
Among Schools with % ISP >= 40									
	Both Years			2015			2016		
	All	Elem.	Midd.	All	Elem.	Midd.	All	Elem.	Midd.
Percentage									
Participating in CEP	78.8	78.9	78.2	73.0	73.1	72.5	82.7	82.9	82.2
Participating in CEP as a District	57.0	54.0	66.0	60.4	58.0	66.7	42.6	51.7	65.5
No. of Schools	480	356	124	196	145	51	284	211	73
Among Schools with 40%≤ISP< 62.5%									
Percentage									
Participating in CEP	65.3	63.3	69.6	55.6	53.0	60.6	71.9	70.0	76.1
Participating in CEP as a District	45.0	40.1	55.7	48.8	45.7	55.1	42.2	36.8	55.3
No. of Schools	245	166	79	99	66	33	146	100	46
Among Schools with % ISP >= 62.5									
	Both Years			2015			2016		
	All	Elem.	Midd.	All	Elem.	Midd.	All	Elem.	Midd.
Percentage									
Participating in CEP	93.8	92.6	93.3	90.7	89.9	94.4	94.2	94.6	92.6
Participating in CEP as a District	69.8	66.4	84.2	71.1	68.1	88.1	68.7	65.4	81.9
No. of Schools	235	190	45	97	79	18	138	111	27

Table A2: Descriptive Statistics-School Characteristics

	All		CEP		Non-CEP		*CEP vs non-CEP*
Variable	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	*t-stat*
Middle School (= 1)	0.283	0.450	0.269	0.444	0.286	0.452	0.682
Elementary School (= 1)	0.717	0.450	0.731	0.444	0.714	0.452	0.682
Total Enrollments	565.5	236.9	448.8	199.7	589.1	236.9	10.95***
% Teachers with Advanced Degrees	61.46	10.26	60.05	10.51	61.75	10.19	2.99***
Student-Teacher Ratio in Core Subjects	20.17	4.336	18.92	4.642	20.42	4.227	6.23***
Average Teacher Salary (1982-84 USD)	21093	1517	20232	1525	21267	1455	12.73***
% Students with Disability	12.96	4.608	12.66	5.335	13.02	4.446	1.41
Urban (= 1)	0.482	0.500	0.276	0.448	0.523	0.500	8.95***
No. of Observations (School-Year)	2,331		391		1,940		

Table A3: First stage Estimates for the IV models

	Eligibility for the program as IV		**Eligibility for the no-cost UFL as IV**	
Eligibility Elementary	0.230***	-0.025***	0.364***	-0.066***
	[0.024]	[0.006]	[0.046]	[0.013]
Eligibility Middle	-0.027***	0.314***	-0.033***	0.414***
	[0.006]	[0.036]	[0.012]	[0.095]
School Characteristics	Yes	Yes	Yes	Yes
F-stat	12.96***	14.46***	15.02***	14.63***
Observations	551,779	551,779	551,779	551,779
R-squared	0.734	0.664	0.749	0.646