# Breakfast at the Desk: The Impact of Universal Breakfast Programs on Academic Performance

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**Abstract**

Between 12 and 30 percent of school-aged children reportedly skip breakfast on a given weekday. To mitigate any impacts on health and academic performance, many schools implement universally free breakfast programs for students. This paper exploits the staggered implementation of an in-classroom breakfast program in San Diego elementary schools, which provides meals to all students during class time, to determine the impacts of universally free school breakfasts on student attendance rates, classroom behavior and academic performance. Introducing universally free breakfasts increases math and reading test score gains by roughly 15 and 10 percent of a standard deviation on average, respectively. Gains are higher in schools where fewer students were previously participating in school breakfasts, particularly among students with lower achievement levels. Moreover, these effects persist in later years of treatment. Moving breakfast into the classroom does not significantly impact academic achievements in schools with pre-existing universal breakfast programs. The results suggest that offering universally free breakfasts increases participation–perhaps by reducing associated social stigmas–and that the resulting positive impacts on academic achievement are at least partly driven by year round benefits rather than only consumption at the time of testing. Universally free breakfasts appear to be a relatively inexpensive way to achieve significant student gains among underperforming students in low-income schools.

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# 1 Introduction

Medical and dietetic studies report that between 12 and 30 percent of school-aged children skip breakfast on any given weekday (NHANES survey data, 1999-2006; Nicklas et al., 1993; Sampson et al., 1995; Siega-Riz et al., 1998). This percentage is decreasing with income so that roughly 67 percent of middle-income African-Americans and low-income whites or Hispanics do not eat breakfast daily (ADA survey data, 2010). Furthermore, there is suggestive evidence that eating a breakfast which contains sufficiently balanced nutrients has a beneficial impact on both student health – in terms of nutrient intake (Bhattacharya et al., 2006), height-to-weight ratio and early physical development (Hofferth and Curtin, 2005; Millimet et al., 2010) – and cognitive skills such as focused attention and memory recall (Wesnes et al., 2003). In light of this information, many schools have attempted to increase participation in School Breakfast Programs (SBPs) by offering universally free breakfasts to all students before school. Despite these efforts, however, there is little research that has rigorously estimated the causal effects of universal school breakfast programs on academic outcomes of students. This can be attributed to at least two factors. Firstly, there are few data sources that provide both detailed information on participation in school breakfast programs and academic outcomes at the student level. Many data sets, such as the Child Development Supplement of the Panel Study of Income Dynamics (CDS-PSID) and the National Health and Nutrition Examination Survey (NHANES) contain excellent data on the breakfast and nutrient intake of children as well as measures of individual health, but do not provide comparable measures of academic performance. Secondly, most studies suffer from a lack of exogenous variation in SBP participation and cannot overcome between and within program selection issues when attempting to estimate causal impacts.[1]

[1] The direction of selection bias is ambiguous. For example, there can exist both negative and positive within-school selection into SBP since participation is voluntary. To qualify for free or reduced-price meals, a student's household income must be below a predetermined threshold usually determined at the state level. Due to greater financial need or lesser social stigmas surrounding meal subsidy programs, one might expect eligible students from families at the lower end of the income distribution to be more likely to participate in SBPs. To the extent that income levels are positively associated with academic outcomes, this introduces negative selection when examining the effect of SBPs on academic performance. On the other hand, most SBPs require students to arrive at school earlier than classes begin to receive breakfast. To the extent that parental abilities to enroll children in the program and get them to school early enough to participate may be correlated with higher levels of parental involvement in their child's academics, there

This paper exploits the staggered implementation of a new, *Breakfast in the Classroom* program (BIC) across San Diego elementary schools which provides universally free breakfasts to all students during class time.[2] Once BIC is integrated into the daily classroom experience, the proportion of students eating school breakfasts is reported to increase from 25 percent to roughly 92 percent. Additionally, uneaten meals are returned after breakfast to record the number of meals consumed.[3] Thus, this paper overcomes the main limitations in the literature on school breakfasts by 1) using near-complete treatment to avoid within-school selection biases typical of traditional SBPs, 2) using finely detailed longitudinal data with comparable treatments, comparable outcome variables and fixed effects, and 3) exploiting the plausibly exogenous variation in the timing of program implementations across schools, allowing for control of school-specific trends in outcomes over time that may be unrelated to school breakfasts.

There are at least a few ways by which BIC can affect academic performance. First, a nutritionally balanced meal provided early in the day can improve student health when the meal received otherwise is inferior. Some research suggests greater levels of health and nutrient intake can benefit cognitive functions, improving academic performance and learning efficacy (Kleinman et al., 2002; Gleason and Suitor, 2003; Florence et al., 2008). Second, in addition to improved health and nutrition, the provision of free meals in the morning may incentivize reduced tardiness and increased attendance rates among students (Murphy et al., 1998; Kleinman et al., 2002). Third, school-provided meals are likely to reduce student household food expenditure (Long, 1991). To the extent that positive income shocks are associated with increases in student performance (Dahl and Lochner, 2012), BIC may improve student outcomes through a household income effect. Fourth, because BIC is administered after class begins, time is reallocated from instruction for the program. In this way, BIC can potentially have a negative impact on students' academic outcomes. Fifth, BIC eliminates the need for students previously participating in the SBP to arrive earlier

will be some positive selection into SBP participation conditional on program eligibility.

[2]Chicago Public Schools, Dallas ISD, Little Rock School District, Memphis City Schools, Orange County Public Schools (Florida) and Prince George's County Public Schools (Maryland) are among other school districts using similar BIC programs in public elementary schools.

[3]A meal is considered consumed if any one part of the meal is eaten by the student.

than the school day begins, essentially delaying the school day starting time for these students. To the extent that later school starting times translate to increased sleep or time for before-school preparations, they too can affect student outcomes. Finally, BIC integrates students across income strata within a classroom. Under the traditional SBP, breakfast participators are usually eating in the cafeteria while non-participators are free to socialize on the school grounds before class begins. This segregation of SBP participators and non-participators likely results in a division along household income levels and is eliminated when breakfast is moved into the classroom and uniformly administered.

This paper estimates the net results of the composite effects stemming from the BIC program on student outcomes. The net effects of BIC are separately identified for both students in schools where universal free breakfasts were already provided on a voluntary, before-school basis and for students in schools where eligibility for free meals was determined by household income levels before BIC. Additionally, data on the levels of pre- and post-BIC breakfast take-up levels are used to estimate the effects of BIC on student outcomes as a function of the increase in students eating school breakfasts. Identification of these effects are driven by the varied timing of implementation across schools. This timing appears to be quasi-random with respect to the student outcomes of interest. Anticipatory effects of future BIC implementation on contemporaneous variables are tested and the null hypothesis of no effect fails to be rejected.

BIC increases student gains in math and reading by roughly 15 and 10 percent of a standard deviation, respectively, in schools that did not previously offer universally free breakfasts. Within these schools, the impact magnitudes are increasing with the percentage increase of students consuming breakfast after the introduction of BIC and are mostly driven by students with below-average achievement levels prior to BIC implementation. There are no statistically significant impacts on achievement in schools that already provided universally free breakfasts. These results suggest that fewer children who would benefit from school breakfasts participate when free meal provisions are associated with income levels–consistent with the idea that social stigmas surrounding meal assistance programs result in a less than optimal level of take-up. Moreover, increases in gains are at least as large in additional years of the program, suggesting there are benefits over time from exposure to free breakfasts rather than an initial boost from consumption during testing periods.

The impact magnitudes on test score gains are striking. For reference, 15 percent standard deviation gains in math are at least as large as gains realized from increasing teacher quality by one standard deviation (Rockoff, 2004; Aaronson, Barrow and Sander, 2007; Dobbie, 2011) and gains from decreasing classroom size by ten students (Rivken, Hanushek and Kain, 2005). Given the relatively low average cost of about two hundred dollars per newly participating student, per year, these results suggest universally free breakfasts are a relatively inexpensive way to drive student gains in schools with below average income levels. This holds policy implications for mitigating the persistent achievement gaps across socioeconomic backgrounds.

The paper proceeds as follows. Section 2 presents a brief review of some of the previous literature pertaining to public school meal programs. Section 3 describes the details of the school breakfast programs available to students in San Diego public schools. Section 4 describes the data used for this study. Section 5 discusses the research design and identification strategies employed. Section 6 presents the results, while Section 7 presents sensitivity tests. Finally, Section 8 concludes with policy implications and some remarks pertaining to future research on school breakfast programs.

## 2 Review of the School Breakfast Program Literature

For the most part, the previous literature investigating the effects of school breakfast programs fall into one of two categories: those concerned with the effects of SBPs on student health and those looking at the effects on academic or cognitive performance. A majority of the literature on school breakfast programs has focused on the impact on student health measures, such as body weight and the intake of various nutrients relative to baseline measures. Gleason and Suitor (2003) conclude that school breakfast and lunch programs increase the intake of nutrients among students, but also increase the intake of dietary fat. Hofferth and Curtin (2005) observe that students who participate do tend to have higher initial weights and find no effect of SBP on body weight after accounting for positive selection into free or reduced price lunch program participation.

The economic literature on SBPs has also focused primarily on the impact on students' weight and nutrition. Using a difference-in-differences strategy, Bhattacharya, Currie and Haider (2006) find that the availability of a SBP has no effect on the total number of calories consumed or the likelihood of eating a breakfast. They do, however, find that access to a SBP substantially improves the nutritional quality of both the student's diet as well as the diets of others in the student's household. Millimet, Tchernis and Husain (2010) use ECLS-K data to estimate the long-run effect of school breakfast and lunch program participation on childhood weight 3 years later. They find that children who gained more weight prior to Kindergarten, having steeper weight trajectories, are more likely to participate in the program. When accounting for even low levels of positive selection into SBPs, Millimet et al. find a negative effect of program participation on child weight.

The body of literature examining the effect of SBPs on academic performance is considerably smaller and more limited in scope, but necessarily overlaps with various literature on the effects of the nutritional quality and timing of meals on outcomes that may influence academic performance. Schoenthaler et al. (2000) report a 47% decrease in the rate of student rule violations, as measured by school disciplinary records, in response to randomized nutritional supplements. Using computerized tests in an experimental setting, Wesnes et al. (2003) find that skipping breakfast impairs attention and short-term memory. Moreover, the impairment increases over time during the tests. Florence et al. (2008) find that students with decreased levels of nutrition in their diet performed worse on standardized assessment, although they are unable to deal with the endogeneity of nutrient intake.[4]

Several studies look specifically at student outcomes when the treatments are SBPs. Murphy et al. (1998) test for a relationship between SBP participation and academic functioning in

[4] Additionally, though perhaps not externally valid for U.S. students, Afridi (2007) shows evidence that school meal programs in some Indian villages significantly boost attendance rates among young girls and enrollment rates among young girls from disadvantaged socioeconomic groups.

school-aged children. They collect data from three public schools, one in Philadelphia and two in Baltimore, before and after the implementation of Universally Free Breakfast Programs (UFBP). Although their results are correlational and do not account for self-selection, they find that breakfast participation nearly doubled after the UFBP implementation. Compared to other students, the subsample who increased breakfast program participation had significant increases in math grades and attendance rates. They argue that the increase of participation under UFBP among students who were already eligible under the old program suggests that the UFBP alleviates the social stigma associated with subsidized meal programs.

Kleinman et al. (2002) investigate how the introduction of UFBPs in schools affects students' nutrient intake, psychosocial functioning and academic performance. Using academic records and 24-hour dietary recall data for 96 inner city school children, they find no statistically significant changes in the mean levels of any outcomes after the introduction of UFBP. However, when restricting the sample to the students which did experience improved nutritional intake post-UFBP, they do find a significant increase in students' math GPA and behavioral scores, as well as a decrease in school-day absences. It should be noted that, as with other SBPs, students still self-select into UFBPs and therefore the significant effects they find for treatment on the treated are possibly confounded by non-random selection. Moreover, pre- and post-treatment outcome data were collected 6 months before and after treatment began. Thus the 24-hour recall data used to determine nutrient intake may not be very representative of individuals' average diet over the study period.

Figlio and Winicki (2005) show that many schools under threat of No Child Left Behind accountability sanctions will increase the caloric content of provided meals in an attempt to boost student test scores. Interestingly, they find that of the schools which do, there is a significant increase in the performance of tested students, though anecdotal reports suggested students at these schools were also given pre-test snacks rich in glucose. More recently, Frisvold (2012) uses a regression discontinuity (RD) design to estimate the effect of SBP availability on student achievement. He exploits variation across states in the minimum percentage of students eligible for free or reduced price meals within a school that dictates a SBP be mandated. Frisvold finds that SBP availability increases achievement in reading, math and science by about 8, 10 and 14 percent, respectively.

Imberman and Kugler (2012) use data from a large urban school district to estimate the impact of an in-class breakfast program. Although the identification methods differ slightly from this paper, they find similar results with respect to math and reading standardized test scores: increases of roughly 0.10 standard deviations.

# 3 Overview of School Breakfast Programs in San Diego

The School Breakfast Program (SBP) was established in 1966 under the federal Child Nutrition Act. Initially a pilot program providing federal grants to schools that serve breakfast to "nutritionally needy" students, the program was made permanent in 1975 and moved towards a per-meal reimbursement system. Today, the SBP provides free or low-cost, nutritionally balanced meals to children in public and nonprofit private schools.[5]

The traditional SBP in San Diego offers free breakfasts to eligible students at school, before the normal school day begins. To qualify, a student's household income must be below a predetermined threshold. Table 1 presents the federal poverty guidelines by household size which are used to determine eligibility for free or reduced price school meals. Students whose household income falls at or below 130 percent of the federal poverty guideline are eligible for free meals. Students with a household income between 130 and 185 percent of the guideline are eligible for reduced-price meals. As shown in Table 2, however, all students in San Diego meeting federal free or reduced price eligibility receive school breakfasts at no cost.

A portion of elementary schools in San Diego operated under Provision 2 status prior to the years of implementation for the particular breakfast program studied here. Under Provision 2,

[5] School meals provided under the federal school breakfast program must have less than 30% of total caloric content from fat, less than 10% from saturated fats and contain at least 1/4th of the USDA daily recommended dietary allowances for protein, iron, calcium and vitamins A and C. Minimum portion sizes are determined by age and grade groups. There are also minimum number of offerings required from each of the main food groups as defined by the USDA.

a school provides universally free meals to all students regardless of household income level, in exchange for a reduction in the frequency of meal reimbursement eligibility verifications. Universally Free Breakfasts (UFB) are offered at these schools on a voluntary basis before the school day officially begins. Under Provision 2 status, schools are only required to update free meal eligibility paperwork for students every 4 years, rather than annually. Thus, doing so reduces administration overhead and is thought to increase meal participation by eliminating the free meal application process. In addition to the zero price of meals increasing participation, this process may also increase participation by reducing social stigmas surrounding meal subsidy programs when participation signals eligibility by income.

The new Breakfast in the Classroom (BIC) program is motivated by a desire to increase breakfast participation among students who qualify for free meals. Before BIC, an average of 33 percent of San Diego students ate breakfast at school despite more than 60 percent being eligible for free meals. Among students attending schools with a traditional SBP, roughly 25 percent participated in school breakfast. On the other hand, about 65 percent of students participated under Provision 2 with universal free breakfasts. The BIC program attempts to further increase participation by serving free breakfasts to all students in participating schools during classroom time. Under BIC, students eat breakfast at their desk during approximately the first 15 minutes of class. Meals are centrally provided by the district's food services department and, as with all school meals, are designed to meet USDA guidelines for daily nutritional and caloric intake. Although students and parents have the option of declining the meal, classrooms report high meal participation levels from the program. Excluding meals not utilized due to student absences, 95 percent of students consume BIC meals on average.[6] Figure 1 plots the annual average percentage of students enrolled who consume school breakfasts for each school, by the percentage of students that qualify for free meals. Points represent school locations and are separated by 4 types: 1) BIC schools that previously provided UFB under Provision 2 status, 2) BIC schools that did not previously offer UFB, 3) non-BIC schools that do provide UFB and 4) non-BIC schools that do not offer UFB.

[6] A meal is considered consumed if any one part of the meal is eaten by the student.

The BIC program has been implemented in a staggered fashion across eligible elementary schools in San Diego. Figure 2 presents a map of the residential school attendance boundaries in San Diego, highlighting the boundaries of BIC-eligible schools and the years each school implemented the program. To ensure estimates capture the impacts on academic outcomes, schools are considered to be treated by BIC if the program begins at least 30 days before annual standardized testing begins. One elementary school began BIC as a pilot in Fall of 2006. The first wave consisted of five more schools implementing the program during the 2007-2008 school year, followed by four more waves of 5 to 18 schools per year staggered across the academic years through December 2011.

For an elementary school in San Diego Unified School District (SDUSD) to be eligible for the BIC program, more than 70 percent of its students meet the eligibility criteria for federal meal assistance programs. Provided the BIC program does not target specific schools on the basis of other determinants of academic outcomes, the staggered implementation and nearly complete treatment rate avoid the within-school treatment selection biases prevalent in the traditional SBP model. However, since school-choice options are available to students, between-school treatment selection may still exist. This and other concerns about the identification strategy are discussed in Section 5.

One of the criticisms of administering the breakfast program during classroom time is that it will diminish the amount of instruction per classroom-day. To help mitigate this impact, students are assigned various tasks required to distribute the prepared meals and dispose of any resulting waste. San Diego schools report an average of 15 minutes per school day towards the in-class breakfasts. Another criticism is that the program requires additional funds over the traditional SBP. Indeed, as illustrated in Figure 3, schools that have implemented BIC experienced an average increase of 183 percent in the proportion of students consuming school breakfasts. The BIC program does not necessarily cost more at the school or district level, however. All types of SBPs receive funding from multiple sources. As part of the Child Nutrition Act, federal funds are set aside annually to reimburse schools for meals provided to students on a per-meal basis. These amounts vary by the level of eligibility of each student and are outlined in Table 2. The state of California also reimburses public schools 26 cents for each meal provided to students qualifying for free or reduced price (FRP) meals. Finally, Title I funds are allocated to schools according to the proportion of students qualifying for FRP meals. In San Diego there are three tiers of Title I allocations. For example, in 2010 schools with more than 85, 60, or 40 percent FRP qualifying students received $434, $274, or $168 of Title I funds per student, respectively. Clearly, implementing BIC does not affect Title I allocations across the district, but does affect the amount of federal and state meal reimbursement funds received. School districts bear the financial burden for newly participating students who do not qualify for FRP meals but they also receive additional funds through increased participation among qualifying students after implementing BIC. Schools may actually decrease net breakfast expenditures through BIC when the number of newly participating qualified students is relatively larger than the number of students who do not qualify. This is likely to be the case in San Diego, where BIC implementation is restricted to schools where at least 70 percent of students qualify for FRP meals and previous participation among FRP-eligible students was relatively low.

# 4 Data

This study combines student level administrative data from elementary schools in San Diego Unified School District (SDUSD) with information on whether and when each school began the BIC program and breakfast meal count records. The administrative records provide a longitudinal panel which tracks students' educational careers for as long as they attend any school within SDUSD. These data contain students' attendance records, report cards, standardized testing scores and personal characteristics such as gender, ethnicity, English-learner status and postal zip code of residence. The federal Child Nutrition Act prohibits anyone not directly associated with the administration of school meal programs from observing individual level data on school meal eligibility or participation. However, the proportion of students eligible for FRP meals and the number of meals served in each school are observed in the data. The test scores used as outcomes are student results from the California Standards Test (CST) in English language arts (ELA) and mathematics. These exams are administered annually to all elementary students in grades 2 through 6. In the statistical analyses that follow, student scores are normalized using California statewide means and variances for each grade level and year. The CST replaced SAT9 testing in California during the 2001-2002 school year. Therefore, data from 2001-2002 through 2010-2011 school years are used when estimating the impacts on academic achievement and attendance. Because the behavioral measures used by teachers to evaluate students' classroom behavior changed in 2007, data from 2007 to 2011 are used to estimate the impact of BIC on classroom behavior. There are four key behavior measures, each rated on a scale between 1 and 3 in 0.25 increments: student interest level, student's level of respect shown in class, student's preparedness for class and student's assignment completion rate.

Table 3a presents summary statistics from pre-BIC years, comparing schools selected for BIC and those not selected. Table 3b presents statistics of the same variables, but compares schools with and without Provision 2 status the year before BIC implementation began. As shown in Table 4, there are 65 elementary schools in San Diego where more than 70 percent of students qualified for free or reduced price meals. Of these schools, 45 eventually implemented BIC by the end of the sample period.

# 5 Empirical Strategy

In estimating the effect of school-supplied breakfast on academic outcomes, the general equation of interest is

$$Y_{igst} = \alpha_i + \gamma_s + \lambda_t + \varphi_g + \delta BIC_{st} + X'_{igst}\beta + u_{igst} \tag{1}$$

where $i$ indexes individual students, $g$ is grade level, $s$ indexes the particular school and $t$ is a year index. The outcomes $Y_{igst}$ of interest are achievement gains, attendance and classroom behavior. $BIC_{st}$ is an indicator for whether school $s$ has implemented the Breakfast in the Classroom program. This allows for the possibility that students are exposed to BIC in one year, but move schools and are not exposed in later years. $\delta$ is the average impact of providing breakfast to students in the classroom on the outcome of interest. Identification is driven by variation in the year that each school implements the BIC program, and requires that the treatment $BIC_{st}$ is independent of unobserved determinants of the outcome. Because standardized tests differ by grade level, $\varphi_g$, indicators for each grade level $g$ are included to control for grade-level-wide deviations in performance among students. School fixed effects $\gamma_s$ are included to control for school-specific time-invariant factors that influence student outcomes. Year fixed effects $\lambda_t$ control for yearly district-wide fluctuations in student outcomes. The remaining covariates and student fixed effects $\alpha_i$ are progressively added to the baseline specification. $X_{igst}$ is a set of student level characteristics which includes gender, ethnicity, student's English learner status, indicators for zip code of residence, the attended school's year-round status and the percentage of students at attending school $s$ who are English learners in year $t$. $u_{igst}$ is an unobserved error component. Standard errors are clustered at the school level.

Since BIC implementation is staggered at the school level, principal fixed effects and teacher covariates $T_{igst}$, and school-specific linear time trends $\theta_s t$ are also progressively added to equation (1). Teacher covariates included are teacher's years of experience, ethnicity and Cross-cultural Language and Academic Development (CLAD) certification status for student $i$ at school $s$ during grade $g$ and year $t$.[7] Principal fixed effects are also included in $T$ to control for changes in school administrators, which may be correlated with both BIC implementation and student outcomes. School-specific linear time trends $\theta_s t$ are added to ensure the estimates of $\delta$ are not merely picking up increasing or decreasing trends in outcomes over time within schools. The full model is represented by

$$Y_{igst} = \alpha_i + \gamma_s + \lambda_t + \theta_s t + \varphi_g + \delta BIC_{st} + X'_{igst}\beta + T'_{igst}\phi + u_{igst} \tag{2}$$

It is important to note that the implementation of BIC introduces one of two changes in each

[7] CLAD is certification for teaching students who are English-learners in the state of California.

school. A portion of schools within the sample previously provided universally free breakfasts (UFB) to all enrolled students as a before-school option with voluntary participation. All other schools offered before-school breakfasts which were free only for students qualifying for free or reduced price meals by household income according to the federal guidelines outline in Section 3. Thus, estimates of $\delta$ are a weighted average net effect of BIC over the traditional SBP in some schools and merely moving universally free breakfasts into part of the classroom day in other schools. That is,

$$\delta = E(Y_{i1} - Y_{i0}|X_i)$$
$$= (1-\rho)E(Y_{i1} - Y_{i0} \mid UFB = 0, X_i) + \rho E(Y_{i1} - Y_{i0} \mid UFB = 1, X_i),$$

where $\rho$ is the proportion of students attending schools which already offered UFB prior to BIC, $Y_{ij}$ is the outcome of student $i$ under BIC if $j = 1$ and without BIC if $j = 0$. Adding and subtracting the counterfactual outcome of previous UFB participators under no UFB participation, $Y_{i,UFB=0}$, we have

$$\delta = (1-\rho)E(Y_{i1} - Y_{i0} \mid UFB = 0, X_i) + \rho E(Y_{i1} - Y_{i,UFB=0} \mid UFB = 1, X_i)$$
$$-\rho E(Y_{i0} - Y_{i,UFB=0} \mid UFB = 1, X_i).$$

Thus $\delta = ATE_{BIC} - \rho ATE_{UFB}$, the average treatment effect (ATE) of an in-class universal breakfast intervention on all students relative to the standard SBP, minus the participation-weighted ATE of the before-school UFB for students in pre-BIC Provision 2 schools. To the extent that UFB has a positive effect on student outcomes, $\delta$ will underestimate the average causal effect of breakfast interventions on all students. To separately estimate the impacts of BIC for students with and without a prior UFB, both equations (1) and (2) are also estimated with an interaction between an indicator for BIC and an indicator for schools having a pre-BIC UFB program under Provision 2. The resulting equation is

$$Y_{igst} = \alpha_i + \gamma_s + \lambda_t + \varphi_g + \delta_1 BIC_{st} + \delta_2 BIC_{st} \times Prov2_s + X'_{igst}\beta + u_{igst} \qquad (3)$$

where $\delta_2$ is the average net impact of BIC on $Y_{igst}$ for schools without a previous UFB program. Since prior offerings of UFB under Provision 2 are likely nonrandom and perhaps correlated with unobserved determinants of student outcomes, estimates of $\delta_2$ should not be interpreted as a differential causal impact of BIC given prior UFB offerings. Given the staggered implementation of BIC, however, $\delta_1 + \delta_2$ is the impact of BIC for schools previously offering before-school UFB while $\delta_1$ is the impact for schools previously using the traditional SBP.

As stated above, at least 70 percent of a school's student body must qualify for free or reduced meals for a school to be eligible for the BIC program. To the extent that income levels are correlated with unobserved determinants of outcomes, BIC assignment based on income levels results in a possibly endogenous treatment. Thus, the sample is restricted to all elementary schools eligible to receive the BIC program–those with at least 70 percent of students qualifying for FRP meals. This approach is similar to estimating treatment effects by matching treatment and control observations along covariates or propensity scores (Rubin, 1974; Rosenbaum and Rubin, 1983; Hirano and Imbens, 2001). To avoid confounding estimates with outcome determinants specific to schools outside the estimation sample, students who attend both schools within the sample and schools not eligible to implement BIC are dropped from the sample.[8] Additionally, the pilot school and the first wave of 5 schools implementing BIC are dropped from the sample because of concern about non-random selection.[9]

The identifying assumption for $\delta$ in equations (1) and (2) is

$$E\left[Y_{0igst} \mid X_{igst}, s, t, BIC_{st}\right] = E\left[Y_{0igst} \mid X_{igst}, s, t\right].$$

In other words, identification of $\delta$ requires that the outcomes of interest are independent of BIC implementation, conditional on observables. If BIC targets low performing schools, estimates could be biased upwards from the ATE over all sample schools–particularly if low performing schools realize larger benefits from breakfast interventions. On the other hand, if some causes of

[8]This equated to roughly 12 percent of the treated sample.

[9]Including the first wave showed similar results with slightly larger estimate magnitudes.

poor performance in targeted schools are independent of nutrition and driven by a limiting factor (e.g. low quality instruction), the estimated effect of BIC will describe a local average treatment effect (LATE) specific to such schools and understate the effects of BIC on the average school with above 70 percent FRP meal-eligible students.

Tables 3a and 3b compare pre-BIC means and report normalized differences of outcomes between schools about to receive BIC and non-BIC schools, and schools with and without Provision 2 status prior to BIC. There do not appear to be large differences in outcomes between these groups before the program began. There are however, sizable differences in the average percentages of English learner (EL) and Hispanic students between these groups. Additionally, there are relatively smaller, but significant differences in the percentage of white students and average income levels. This motivates the inclusion of student English learner status, ethnicity, and both the percentage of EL and FRP-eligible students in the attending school each year as covariates in the baseline specification.

Figure 2 displays the staggered timing of BIC implementation in San Diego, highlighting the spatial and temporal variation in the rollout of the program. To test for targeted timing of BIC implementation on the basis of school characteristics, the number of months from the inception of the BIC program to the time a school implemented BIC is regressed on observables. These results are reported in Appendix Table A1. The only significant predictor of timing is the school's percentage of EL students, although this association is not large. 5 percent more of a school's student body having EL status corresponds to a one month earlier implementation of BIC.

As another check, the following equation is used to test for targeted BIC implementation on the basis of student achievements,

$$Y_{igst} = \alpha_i + \gamma_s + \lambda_t + \varphi_g + \sum_{\tau=0}^{m} \delta_{-\tau} BIC_{s,t-\tau} + \sum_{\tau=1}^{q} \delta_{+\tau} BIC_{s,t+\tau} + X'_{igst}\beta + T'_{igst}\phi + u_{igst} \tag{4}$$

which is similar to equations (1) and (2), but includes lagged and lead BIC treatment dummies. The set of coefficients $\{\delta_{+\tau}\}$ is tested to determine whether past outcomes can predict future BIC implementation. The results of this test suggest BIC did not differentially target schools within the sample based on student achievement. This, along with other robustness checks and sensitivity tests are discussed in Section 7.

# 6 Results

## 6.1 Impact of BIC on Standardized Test Scores

Table 5 reports the regression results for student gains in CST math and English language arts (ELA) scores. CST scores are standardized using statewide means and variances separately by grade level and year. Units of the estimated average impacts of BIC are standard deviations. To check the sensitivity of the estimates, student fixed effects, principal fixed effects and teacher covariates, followed by school specific linear time trends are progressively added to pairwise columns moving left to right.

Estimates of the overall average net impact of BIC on ELA gains range between 3 and 5 percent of a standard deviation, but are not statistically different from zero. Including an interaction for previous UFB (Provision 2), however, reveals gains of roughly 11 percent of a standard deviation from BIC in schools without prior UFB. On the other hand, there does not appear to be any significant impact for students in schools offering UFB prior to BIC implementation. Similarly for gains in math, BIC is associated with a roughly 15 percent standard deviation increase for non-Provision 2 schools, even after accounting for school administration, teachers and school-specific trends over time, although significance does fall to the 10 percent level with linear time trends. Again, there is no significant impact for Provision 2 schools.

These results suggest a significantly positive impact from school breakfasts on academic performance when meals are offered universally free. On the other hand, moving the meal into the classroom schedule may not meaningfully change this impact. This could be interpreted in two ways. First, it would appear that those who benefit significantly from school breakfasts are likely to use the program when it is offered universally free, regardless of whether it is before school or administered during classroom time. This interpretation suggests there may be a social stigma surrounding free meals when eligibility is determined by income levels, perhaps discouraging voluntary participation in students who would benefit from school breakfasts. A second interpretation is that the BIC program only increases student gains in non-Provision 2 schools because students in these schools differ in treatment efficacy for some unobserved reason. There is no evidence to support large differences on average between these two groups, however. As seen in Table 3b, there only appear to be significant differences in the average proportions of EL students and FRP-eligible students, which are controlled for. Although the average percentage of FRP-eligible students is roughly 9 percent lower for non-Provision 2 schools, Figures 1 and 3 show that non-Provision 2 schools are not distributed along one particular side of FRP eligibility for BIC participation levels or increases in breakfast participation when compared to Provision 2 schools. Therefore, the first interpretation seems more plausible.

## 6.2 Are Gains Driven by Increased Breakfast Consumption?

It is unclear to what extent the impacts of BIC can be attributed to the resulting increased breakfast consumption. The implementation of the BIC program changes other factors, such as the structure of classroom time and nature of interactions between classroom peers. To investigate impacts due to increased breakfast participation, rather than the implementation and administration of the program itself, the previous models are estimated again interacting the indicator $BIC_{st}$ with the resulting proportional increase in enrolled students eating school breakfasts.

For reference, Figure 3 plots the proportional increase in the ratio of breakfasts consumed to student enrollment after implementing BIC, by the percentage of FRP eligible students at each BIC school. The points are separated by schools with and without previous UFB offerings. BIC results in between a 25 and nearly 400 percent increase in the proportion of students eating school breakfasts.

Table 6 repeats the specifications of Table 5, but includes an interaction of $BIC_{st}$ with the proportional increase in students eating breakfasts in each school after BIC began. A 100 percent increase in the fraction of students participating in school breakfasts roughly corresponds to a 0.05

standard deviation increase in ELA gains within schools that did not previously offer universally free breakfasts. When looking at the impact on math gains, a 100 percent increase corresponds to just over 0.08 standard deviation gains and about 0.07 standard deviations when including school specific linear time trends. Given that the average increase is nearly 200 percent, these estimates agree with those of Table 5, which are roughly twice as large.

### 6.3 Do Impacts of BIC Differ Along the Distribution of Past Student Achievement?

To check for heterogeneous effects of BIC across the distribution of student achievement, students are assigned to fixed quartile groups determined by past achievement levels in ELA and math. Student quartiles are calculated using student CST scores in pre-BIC years or, in the case of schools that do not implement BIC, pre 2010 scores. The same specifications as Table 5 are run separately for each quartile and outcome. Tables 7a and 7b report the results for the main specifications including student fixed effects, principal fixed effects, teacher covariates and controls for school-specific outcome trends over time. Focusing on the full specification in the fourth column under each quartile, it becomes apparent that the overall results are primarily driven by impacts to students in the lower half of the achievement distribution. The majority of the impact in ELA gains corresponds to students in the second quartile of past ELA achievement. Among these students in schools not previously offering universally free breakfasts, the impact to ELA gains from BIC is an increase of roughly a quarter of a standard deviation. For gains in mathematics, the impact for schools not previously offering universally free breakfasts appears to be driven predominately by the first two quartiles of previous achievement levels. BIC corresponds to about a 0.2 standard deviation increase within the first quartile, with an imprecise estimate of 0.18 standard deviations for the second quartile. , There is some evidence of a positive impact in the upper quartile as well, though estimates for this quartile decrease in magnitude and precision once school-specific linear time trends are included.

These results are in line with some of the plausible mechanisms described in Section 1, through which BIC can impact student achievement. First, we would expect the achievement impacts from BIC to be largest among lower performing students if inadequate nutrition in the morning is indeed a significant factor in diminished academic performance. Second, to the extent that achievement levels are correlated with household income, the proportionally larger increase in disposable income for low income households resulting from school-provided breakfasts will be more pronounced among lower-performing students. Third, BIC eliminates the segregation of school breakfast participants from non-participants before class begins. If this segregation line is correlated with student achievement, increased peer interaction throughout the achievement distribution after BIC implementation may particularly benefit students in lower achievement quantiles as well. The empirical framework of this paper does not allow for disentanglement or separate estimation of the impacts through each of these potential mechanisms. However, the fact that the impacts of BIC on student gains are most pronounced for students in the lower achievement quantiles within schools exhibiting lower household income levels suggests universal breakfast programs such as BIC have the potential to mitigate achievement gaps across socioeconomic strata.

### 6.4 Impact of BIC on Attendance Rates

Table 8 presents estimates of the impact of BIC on student attendance in elementary school. The first panel presents estimates for the impact of BIC on the percentage of days a student is absent during a given academic year. The unit here for the dependent variable is 1 percent, or nearly 2 days[10]. The dependent variable of the second panel is an indicator for the student being chronically absent, defined as being absent at least 10 percent of instructional days during the school year.

Interestingly, there is no effect of BIC on attendance in either type of school. The magnitudes of these estimates are quite small as well, given that the units are percentage of days absent. These estimates are relevant for policy, as proponents of universal school meal programs have touted their potential to reduce tardiness and absences through both improved nutrition and direct incentive for attendance by meal provision[11]. This result seems intuitive given that moving breakfast from be-

[10] There are 180 instructional days in an academic year.

[11] See, for instance, the BIC fact sheet at the Food Research and Action Center: http://frac.org/wp-

fore school to during class time eliminates the meal incentive for early arrival. This does, however, suggest that improved attendance is not a mechanism through which BIC may improve student achievement.

### 6.5 Impact of BIC on Classroom Behavior

Results for impacts on student behavior are presented in Table 9a. The behavioral measures on which students are evaluated are described above in Section 4. Each behavior measure is standardized by the district-wide means for each grade level. The coefficient estimate units are therefore standard deviations.

There are significant gains in student preparedness and respectfulness scores associated with moving universally free breakfasts from before school into the classroom. However, this effect is not found when implementing BIC in schools where UFB was not offered. The implementation of BIC is associated with an increase of just over half a standard deviation in student respectfulness scores at Provision 2 schools. Similarly, scores of student preparedness see an increase of over 30 percent of a standard deviation in Provision 2 schools.

Table 9b reports coefficients for differing program years of BIC on behavioral outcomes. Unfortunately because the behavioral measures changed in San Diego just before BIC implementation, it is not possible to test for anticipatory effects of BIC with respect to behavioral scores. As in the other specifications, there are positive gains in some behavioral scores for schools offering UFB prior to BIC. These schools see modest increases in gains for student respect scores and assignment completion. Again, the significant gains are in student respect and preparedness, with about 0.25 and 0.4 standard deviation increases, respectively, in the first and subsequent years of BIC.

There are two potential tradeoffs for students when moving breakfast from before school into the classroom. The first is that students no longer need to arrive as early to school to receive breakfast. This potentially allows students more time in the mornings for sleep or to prepare for school. Although not directly observable, these changes may contribute to better preparedness and

content/uploads/2009/09/universal_classroom_breakfast_fact_sheet.pdf behavior in the classroom. The second, is that conditional on arrival time not changing, students now have more socializing and leisure time before the school day begins. Moreover, students are no longer segregated by breakfast participation before school. Rather, almost all students participate in school breakfasts inside the classroom. The integration of students across income strata within a classroom may be one way in which the level of respect students show for others is impacted. That the impacts of BIC on student preparedness and respect are significantly larger for Provision 2 schools is consistent with the higher previous breakfast participation rates in these schools.

# 7 Sensitivity and Identification Tests

## 7.1 Accounting for Non-random Treatment Assignment

As discussed in Section 5.2, equation (4) is used to test for targeted BIC implementation on the basis of student achievements. The lead BIC treatment dummies $\{\delta_{+\tau}\}$ are tested to determine whether past outcomes $Y_{igst}$ Granger-cause BIC implementation. Although the absence of statistical significance for these anticipatory effects does not exclude the possibility of BIC targeting, it is suggestive that the identifying assumption is satisfied.[12] Additionally, the lagged periods allow an investigation into whether any effects of the BIC program persist or change over time. Indicators for each of the three years prior to a school beginning BIC are included. Because three full years of the BIC program are observed only for the earliest wave of the sample, an indicator for the third year of BIC would merely capture a wave-specific year effect. Therefore, an indicator for the first year of BIC and another combining the second and third years of BIC are used for post-implementation effects. An additional specification of (4) using the interactions of (3) is also used to differentially test these coefficients for schools that did and did not offer UFB prior to BIC. These results are presented in Table 10.

The lack of significance and relatively smaller magnitudes for the leads in Table 10 are reassuring that BIC is not targeted on the basis of CST performance. Likewise, the coefficients for the

[12] See Granger (1969) for more on Granger causality testing.

first and later years of BIC suggest that non-Provision 2 schools continue to realize positive gains in both ELA and math scores beyond the introduction year of the program. Indeed, the estimates for math and ELA are slightly larger in successive years, though not statistically different from the effects in the first year. These continued gains can be explained by some schools implementing BIC after the beginning of the academic year. Thus, the successive years are the first in which a full treatment schedule is administered. This suggests the impact from BIC is not merely a Figlio and Winicki (2005) style effect from meals being served immediately before testing periods. That is, the length of time over which breakfasts are served matters for test score gains.

Table A2 in the appendix presents similar estimates using the increase in breakfast participation, but for lead and lagged years of the BIC program. The results closely match those of Tables 6 and 10. This suggests student gains are increasing in breakfast participation and are primarily driven by breakfast consumption, rather than the administration of the BIC program.

## 7.2 Self-selection into Treatment via School Choice

As described above, the staggered implementation of the BIC program and its nearly complete treatment rate in the classroom makes it possible to sidestep within-school non-random treatment. The availability of school choice options, however, means it may be possible for students to select into a treatment school from an untreated school or vice versa. If treatment selection via school choice occurs, it is possible the estimates of interest will be biased. Figure 4 plots the proportion of students within BIC schools, separated by implementation year, that are exercising school choice over time. Years are normalized to the number of years since BIC was implemented. School choice options have increased in popularity district-wide over time, but there does not appear to be any discernible change in the rising rate of school choice, save for the proportion in wave 2 leveling off just before BIC was implemented.

To check for obvious patterns of school selection along the BIC status of schools, an indicator for student $i$ attending her residential boundary school in year $t$ is regressed on the BIC status of the boundary school and the variables of equations (1) and (2). This tests for any association between the BIC program and the proportion of students choosing to attend their local boundary school rather than exercising school choice. The first two columns of Table 11 show that implementing BIC at a student's local school weakly predicts a 1.3 percent increase in the likelihood a student attends that school, given it is not Provision 2 status. There is no significant association for students residing in a Provision 2 boundary.

In the third and fourth columns of Table 11, an indicator for student $i$ at school $s$ in year $t$ exercising school choice is regressed on the attended school's BIC status using equations (1) and (2).[13] This second specification tests the association between a school's BIC status and changes in the proportion of the school's student body that have chosen that school place of the assigned boundary school. The resulting estimates suggest that schools with an active BIC program contain roughly 2.9% fewer students attending from outside the school boundary than other school. An average of about one third of students in San Diego public schools exercise a school choice option. These estimates agree with that number, as an increase in the proportion of local resident students attending any given school decreases the percentage of students within that school who are exercising school choice by twice that amount. Although the estimates of student movement are statistically significant, the magnitudes do not suggest a large selection bias could result from these movements. For instance, consider the case where the newly attending boundary students–making up 1.5 percent of the treatment group–positively select into the BIC program. If each of these students realize an unusually large 0.5 standard deviation increase in math score gains as a result, their inclusion would inflate the coefficient estimates of about 0.15 in Table 5 by $(.0015 * 0.5)/(0.146 - .0015 * 0.5)$, or about 5.4 percent.

# 8 Conclusion

This paper exploits the staggered implementation of a new, "Breakfast in the Classroom" program (BIC) in estimating the causal effects of providing universally free school breakfasts on academic

[13] School choice is defined as a student attending a school different than the location determined by her address of residence and school zone boundaries.

achievement, student attendance rates and classroom behavior. The results show that implementing an in-class, universally free breakfast program in elementary schools with relatively low income levels increases breakfast consumption in these schools by an average of 183 percent. The BIC program increases English-language arts and math gains by an average of 11 and 15 percent of a standard deviation, respectively, in schools that did not previously offer universally free breakfasts. The overall impacts to achievement gains in these schools are driven by the impacts to students at the lower end of the achievement distribution. The gains from BIC persist after the first, partial year of the program. Moreover, estimates of gains in later years are larger than in the initial year, though the magnitudes are not statistically different. This suggests benefits to achievement occur throughout the year and are not driven solely by meals at the time of standardized testing. There are no significant changes in gains, however, for schools which already offered universally free meals outside the classroom prior to BIC.

In-class breakfasts do not impact school attendance rates, regardless of whether or not the school already offered universally free breakfasts. Moving universally free breakfasts from before school into the classroom increases gains in some student behavioral scores, particularly in students' level of preparedness for the school day. This result agrees with notions that additional free time previously forgone when eating breakfast before school is beneficial to classroom behavior, perhaps through increased sleep or preparation time.

These findings suggest school breakfasts are under-utilized by students who would benefit from them when they are not offered universally free, perhaps because of social stigmas surrounding low-income requirements for free meal eligibility. Additionally, making breakfasts universally free in schools with low income levels is a relatively inexpensive method of achieving test score gains and may help in reducing achievement gaps across income levels. The estimated gains in math from BIC are at least as large as those from increasing teacher quality by one standard deviation (Rockoff, 2004; Aaronson, Barrow and Sander, 2007; Dobbie, 2011) and greater than those from decreasing classroom size by ten students (Rivken, Hanushek and Kain, 2005). As of June 2012, school breakfasts cost state and federal governments a maximum combined total of $2.06 in reimbursements per meal. Average costs to San Diego elementary schools for these meals before reimbursement are between $1.08 and $1.20 per meal, including labor and equipment costs. Given 180 instruction days per academic year, this corresponds to an average cost of between $195 and $216 per newly participating student, per year, with the portion paid by government reimbursements depending on the distribution of household incomes among schools. For comparison, reducing class size from 30 to 20 students is estimated to cost 915 dollars per student and about 435 dollars per student for a reduction from 24 to 20 students (Reichardt, 2000). Given the relatively higher costs of reducing classroom size or increasing teacher quality, providing universally free meals in low income schools appears to be a compelling policy for mitigating achievement gaps across socioeconomic backgrounds.

Considering the literature on achievement gains and earnings, the results here also indicate that providing universally free breakfasts is a policy with the potential for high returns. For instance, Chetty, Friedman, and Rockoff (2011) estimate that a one standard deviation increase in teacher value-added for one year leads to a 25,000 dollar increase in the average student's lifetime earnings–a present discounted value of about 4,600 dollars assuming a 5 percent discount rate. Given that the estimated gains from BIC are on par with those of a one standard deviation increase in teacher quality, the discounted per-dollar return to providing universally free meals in terms of future earnings is over 12 dollars in terms of federal funding. The estimated per-dollar return is much greater–roughly 21–in terms of average per-student spending at the school level.

Further research on school meal programs is needed. From a policy perspective, it is useful to quantify any impacts of universally free meal programs in schools with higher income levels. If the large impacts found here can also be had in wealthier schools, it may warrant policy revisions or expansions of Provision 2 of the National School Lunch Act to incentivize wider user of universally free school meals. Additionally, more research is needed on the existence of social stigmas associated with assistance programs to better understand the determinants of participation. There is also much to be learned about if and how the effects of these programs are related to the nutritional quality of the foods served. Future such additions to the literature will help inform the current policy debates on reforming the content, delivery and funding of school meals.

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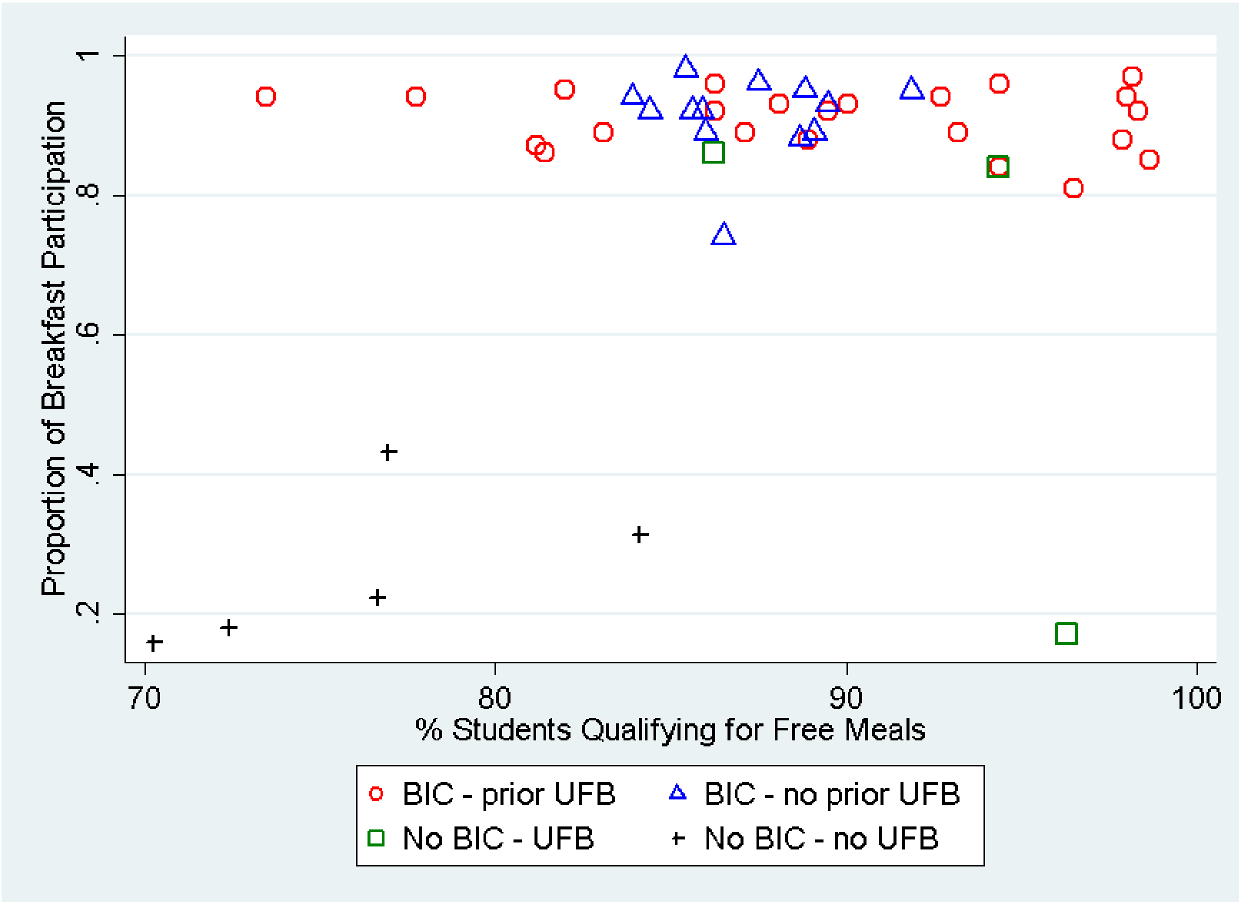
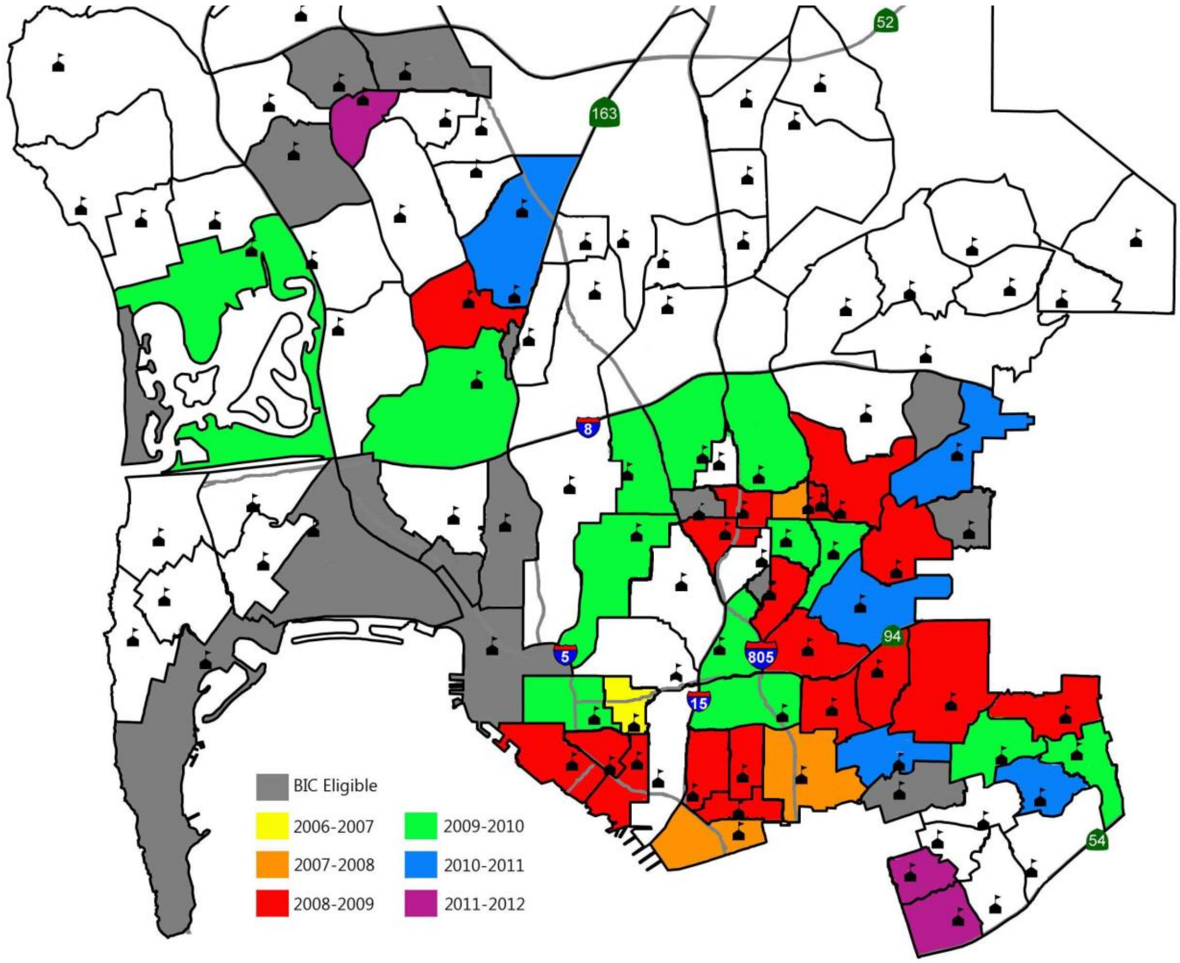
Figure 1. Average Proportion of Students using School Breakfast by School



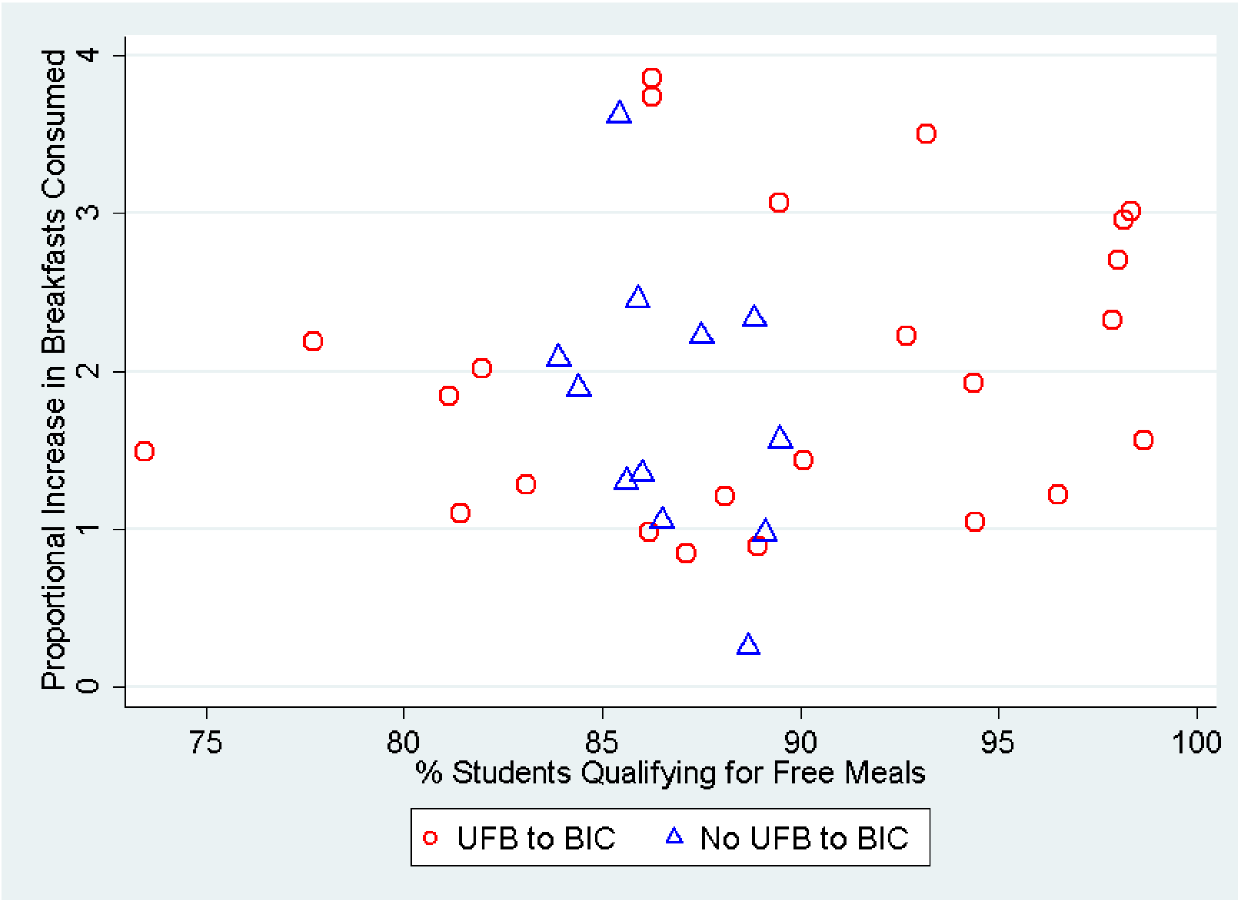

Notes: Figure presents average proportion of students within each sample school participating in school breakfasts. Symbols correspond to different BIC status and pre-BIC universally free meal status. Averages are calculated using 2010-2011 academic year data.

Figure 2. Implementation of Breakfast in the Classroom Program in San Diego



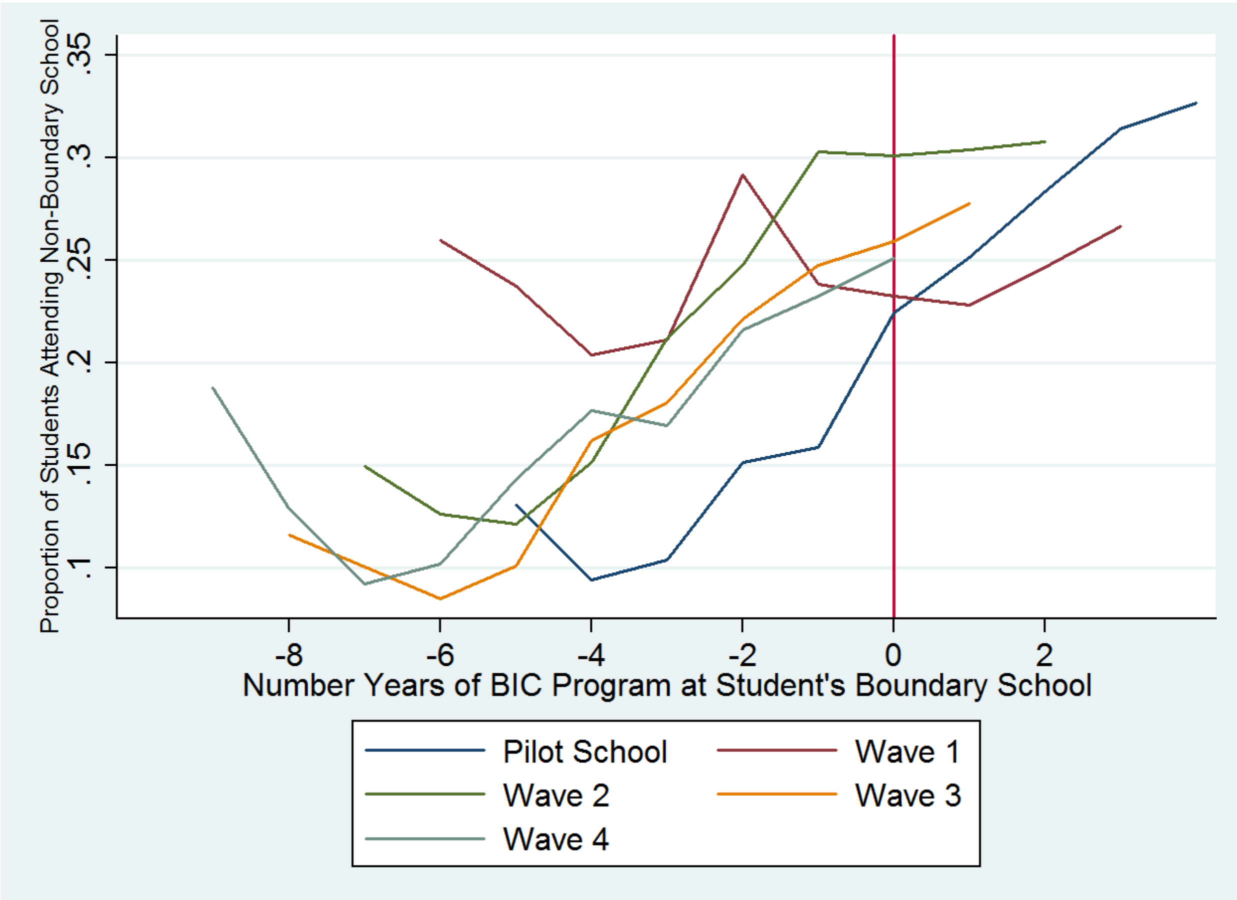

Notes: Figure presents implementation timing of the BIC program across San Diego elementary schools. BIC eligible schools are schools where at least 70 percent of the student body qualifies for free school meals. Areas in grey are eligible schools that have yet to have implemented the BIC program as of July 2012.

Figure 3. Proportional Change in the Fraction of Students Using School Breakfasts After BIC




Notes: Figure presents proportional increase of students participating in school breakfasts after BIC implementation, by school. Symbols differentiated schools that did or did not offer universally free meals prior to BIC. Units of increase on the vertical axis are 100 percent increases in the proportion of enrolled students eating school breakfasts. Increases are calculated using 2010-2011 academic year data.

Figure 4. Proportion of Students Exercising School Choice, by BIC Implementation Wave




Notes: Figure presents proportion of students exercising school choice by attending a school other than the location determined by residence, over time. Years are normalized by year of the BIC program. Lines are plotted separately by year the BIC program was implemented.

**Table 1. Federal Income Guidelines for Free or Reduced Price Meals (*as of July 2011*)**

| | Federal Poverty Guidelines | Maximum Household Income (*US Dollars*) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Free Meals (130% of Poverty Guideline) | | | Reduced Price Meals (185% of Poverty Guideline) | | |
| Household Size | Annual | Annual | Monthly | Weekly | Annual | Monthly | Weekly |
| 1 | 10,890 | 14,157 | 1,180 | 273 | 20,147 | 1,679 | 388 |
| 2 | 14,710 | 19,123 | 1,594 | 368 | 27,214 | 2,268 | 524 |
| 3 | 18,530 | 24,089 | 2,008 | 464 | 34,281 | 2,857 | 660 |
| 4 | 22,350 | 29,055 | 2,422 | 559 | 41,348 | 3,446 | 796 |
| 5 | 26,170 | 34,021 | 2,836 | 655 | 48,415 | 4,035 | 932 |
| 6 | 29,990 | 38,987 | 3,249 | 750 | 55,482 | 4,624 | 1,067 |
| 7 | 33,810 | 43,953 | 3,663 | 846 | 62,549 | 5,213 | 1,203 |
| 8 | 37,630 | 48,919 | 4,077 | 941 | 69,616 | 5,802 | 1,339 |

Source: Federal Register, Vol. 76, No. 58, 5/25/11, p. 16725.

Notes: Threshold income levels adjusted annually based on the Consumer Price Index. Reported levels apply to the 48 contiguous United States, the District of Columbia, Guam and the Territories.

**Table 2. Federal School Breakfast Reimbursement Rates: July 2011 - June 2012**

| | Non-Severe Need | Severe* Need | Price to Student (San Diego) |
|---|---|---|---|
| Free | 1.51 | 1.80 | 0.00 |
| Reduced Price | 1.21 | 1.50 | 0.00 |
| Paid | 0.27 | 0.27 | 1.00 |

Source: Federal Register, Vol. 76, No. 139, 7/20/11, p. 43259.

Notes: Reported reimbursement rates are in US dollars and apply to the 48 contiguous United States, the District of Columbia, Guam and the Territories.
* Schools where at least 40 percent of lunches served two years prior were free or reduced price qualify as "severe need" and receive higher rates of reimbursement.

**Table 3a. Summary Statistics: Last Year Before Implementation**

| | Never Selected | Selected for BIC | Difference |
|---|---|---|---|
| CST Math | -0.335 | -0.343 | 0.007 |
| | (0.084) | (0.034) | (0.075) |
| CST ELA | -0.378 | -0.442 | 0.064 |
| | (0.084) | (0.035) | (0.076) |
| % Days Absent | 4.948 | 4.415 | 0.533 |
| | (0.500) | (0.142) | (0.393) |
| Behavior: Respects | -0.442 | -0.28 | -0.162 |
| | (0.358) | (0.098) | (0.262) |
| Behavior: Interest | -0.36 | -0.366 | 0.006 |
| | (0.335) | (0.077) | (0.228) |
| Behavior: Preparedness | -0.608 | -0.278 | -0.33 |
| | (0.371) | (0.078) | (0.243) |
| Behavior: Completes | -0.509 | -0.284 | -0.226 |
| | (0.344) | (0.075) | (0.229) |
| % Free or Reduced Price | 79.503 | 87.335 | -7.832*** |
| | (2.001) | (1.064) | (2.077) |
| English Learner | 0.444 | 0.605 | -0.161*** |
| | (0.053) | (0.025) | (0.051) |
| Teacher Experience | 12.728 | 11.814 | 0.915 |
| | (1.413) | (0.521) | (1.218) |
| Black | 0.259 | 0.144 | 0.115** |
| | (0.071) | (0.019) | (0.055) |
| Hispanic | 0.546 | 0.726 | -0.181*** |
| | (0.063) | (0.028) | (0.059) |
| White | 0.091 | 0.034 | 0.057*** |
| | (0.027) | (0.006) | (0.020) |

*, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses. Estimates averaged during year before rollout of BIC program, separated by treated and non-treated schools.

**Table 3b. Summary Statistics: Comparion by Provision 2 Status, Last Year Before Implementation**

| | Not Provision 2 | Pre-BIC Provision 2 | Difference |
|---|---|---|---|
| CST Math | -0.272 | -0.33 | 0.058 |
| | (0.067) | (0.055) | (0.087) |
| CST ELA | -0.306 | -0.423 | 0.118 |
| | (0.079) | (0.037) | (0.088) |
| % Days Absent | 4.345 | 4.319 | 0.025 |
| | (0.351) | (0.215) | (0.416) |
| % Free or Reduced Price | 80.087 | 89.512 | -9.425*** |
| | (1.426) | (1.565) | (2.113) |
| English Learner | 0.474 | 0.685 | -0.212*** |
| | (0.048) | (0.018) | (0.052) |
| Teacher Experience | 11.948 | 11.174 | 0.774 |
| | (1.333) | (0.764) | (1.556) |
| Black | 0.197 | 0.103 | 0.094* |
| | (0.042) | (0.020) | (0.047) |
| Hispanic | 0.590 | 0.790 | -0.200*** |
| | (0.055) | (0.034) | (0.065) |
| White | 0.128 | 0.026 | 0.101** |
| | (0.046) | (0.007) | (0.048) |

*, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses. Estimates averaged during year before rollout of BIC program for Provision 2 and non-Provision 2 schools.

**Table 4. Tabulation of Schools by Meal Status**

| | BIC School | | |
|---|---|---|---|
| | No | Yes | Both |
| Not Provision 2 | 16 | 19 | 35 |
| Pre-BIC Provision 2 | 6 | 26 | 32 |
| Both | 22 | 45 | 65 |

Notes: Includes all schools where at least 70% of students qualify for free or reduced price meals.

**Table 5. Estimates of BIC on Student Gains: Standardized CST Scores**

| | CST ELA Gains | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *BIC* | 0.008 | 0.088*** | 0.031 | 0.108** | 0.051 | 0.114** | 0.046 | 0.112* |
| | (0.029) | (0.033) | (0.034) | (0.045) | (0.044) | (0.051) | (0.046) | (0.063) |
| *BIC + BIC*UFB* | | -0.018 | | -0.005 | | -0.001 | | -0.016 |
| | | (0.032) | | (0.038) | | (0.054) | | (0.069) |
| N | 65,951 | 65,951 | 65,951 | 65,951 | 65,951 | 65,951 | 65,951 | 65,951 |
| Student FE | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Principal FE/Teachers | No | No | No | No | Yes | Yes | Yes | Yes |
| School Time Trends | No | No | No | No | No | No | Yes | Yes |

| | CST Math Gains | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *BIC* | 0.01 | 0.095** | 0.029 | 0.141** | 0.102* | 0.193*** | 0.094 | 0.147* |
| | (0.040) | (0.048) | (0.048) | (0.055) | (0.061) | (0.055) | (0.065) | (0.080) |
| *BIC + BIC*UFB* | | -0.017 | | -0.022 | | 0.025 | | 0.046 |
| | | (0.046) | | (0.056) | | (0.086) | | (0.090) |
| N | 66,634 | 66,634 | 66,634 | 66,634 | 66,634 | 66,634 | 66,634 | 66,634 |
| Student FE | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Principal FE/Teachers | No | No | No | No | Yes | Yes | Yes | Yes |
| School Time Trends | No | No | No | No | No | No | Yes | Yes |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses are clustered at the school level. Dependent variables are student-level gains in math and English language arts CST scores. Scores are normalized using statewide mean and variance for each grade and year. Each model includes school, grade, and year fixed effects, indicators for school type and year-round status, as well as a set of student level covariates. Reported coefficients are 1) the impact of BIC for schools not previously offering universally free meals, and 2) the sum of coefficients that are the impact for schools previously offering universally free meals.

**Table 6. Estimates of Increase in Breakfasts after BIC on Student Gains: Standardized CST Scores**

| | CST ELA Gains | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *BIC * % change-in-meals* | 0.014 | 0.052*** | 0.025* | 0.057** | 0.023 | 0.051** | 0.022 | 0.048* |
| | (0.010) | (0.016) | (0.014) | (0.022) | (0.025) | (0.024) | (0.026) | (0.026) |
| *BIC*change + BIC*change*UFB* | | 0.008 | | 0.016 | | 0.000 | | -0.001 |
| | | (0.010) | | (0.017) | | (0.036) | | (0.046) |
| N | 65,951 | 65,951 | 65,951 | 65,951 | 65,951 | 65,951 | 65,951 | 65,951 |
| Student FE | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Principal FE / Teachers | No | No | No | No | Yes | Yes | Yes | Yes |
| School Time Trends | No | No | No | No | No | No | Yes | Yes |

| | CST Math Gains | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *BIC * % change-in-meals* | 0.014 | 0.056** | 0.025 | 0.079*** | 0.05 | 0.089*** | 0.052 | 0.065* |
| | (0.013) | (0.022) | (0.021) | (0.025) | (0.035) | (0.027) | (0.036) | (0.038) |
| *BIC*change + BIC*change*UFB* | | 0.008 | | 0.009 | | 0.019 | | 0.042 |
| | | (0.014) | | (0.024) | | (0.054) | | (0.056) |
| N | 66,634 | 66,634 | 66,634 | 66,634 | 66,634 | 66,634 | 66,634 | 66,634 |
| Student FE | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Principal FE / Teachers | No | No | No | No | Yes | Yes | Yes | Yes |
| School Time Trends | No | No | No | No | No | No | Yes | Yes |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses are clustered at the school level. Dependent variables are student gains in math and English language arts CST scores. Scores are normalized using statewide mean and variance for each grade and year. Each model includes school, grade, and year fixed effects, indicators for school type and year-round status, as well as a set of student level covariates. Reported coefficients are 1) the impact of BIC for schools not previously offering universally free meals, and 2) the sum of coefficients that are the impact for schools previously offering universally free meals.Units are standard deviation changes per 100 percent increase in the proportion of enrolled students eating breakfast.

**Table 7a. Estimates of BIC on Student Gains in ELA by Previous Achievement Levels: Standardized CST Scores**

| | CST ELA Gains | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First Quartile | | | | Second Quartile | | | |
| *BIC* | 0.006 | 0.092 | -0.028 | 0.016 | 0.100* | 0.233*** | 0.096 | 0.262*** |
| | (0.075) | (0.100) | (0.077) | (0.130) | (0.056) | (0.060) | (0.063) | (0.083) |
| *BIC + BIC*UFB* | | -0.047 | | -0.059 | | 0.005 | | -0.030 |
| | | (0.084) | | (0.099) | | (0.069) | | (0.079) |
| N | 20,194 | 20,194 | 20,194 | 20,194 | 17,200 | 17,200 | 17,200 | 17,200 |
| Student FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Principal FE/Teachers | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| School Time Trends | No | No | Yes | Yes | No | No | Yes | Yes |

| | CST ELA Gains | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Third Quartile | | | | Fourth Quartile | | | |
| *BIC* | -0.032 | -0.021 | -0.019 | 0.014 | 0.068 | 0.080 | 0.064 | 0.070 |
| | (0.068) | (0.070) | (0.073) | (0.080) | (0.060) | (0.071) | (0.049) | (0.058) |
| *BIC + BIC*UFB* | | -0.034 | | -0.036 | | 0.039 | | 0.038 |
| | | (0.100) | | (0.119) | | (0.104) | | (0.129) |
| N | 12,671 | 12,671 | 12,671 | 12,671 | 15,886 | 15,886 | 15,886 | 15,886 |
| Student FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Principal FE/Teachers | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| School Time Trends | No | No | Yes | Yes | No | No | Yes | Yes |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses are clustered at the school level. Dependent variables are student-level gains in math and English language arts CST scores. Scores are normalized using statewide mean and variance for each grade and year. Each model includes school, grade, and year fixed effects, indicators for school type and year-round status, as well as a set of student level covariates. Reported coefficients are 1) the impact of BIC for schools not previously offering universally free meals, and 2) the sum of coefficients that are the impact for schools previously offering universally free meals. Quartiles of past achievement levels in ELA and math are taken from the distribution of average standardized cst score for years proir to the implementation of BIC.

**Table 7b. Estimates of BIC on Student Gains in Math by Previous Achievement Levels: Standardized CST Scores**

| | CST Math Gains | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First Quartile | | | | Second Quartile | | | |
| *BIC* | 0.091 | 0.245*** | 0.088 | 0.217** | 0.112 | 0.252** | 0.085 | 0.182 |
| | (0.068) | (0.052) | (0.080) | (0.099) | (0.077) | (0.110) | (0.085) | (0.141) |
| *BIC + BIC*UFB* | | -0.012 | | -0.010 | | 0.024 | | 0.020 |
| | | (0.085) | | (0.114) | | (0.096) | | (0.102) |
| N | 19,446 | 19,446 | 19,446 | 19,446 | 16,730 | 16,730 | 16,730 | 16,730 |
| Student FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Principal FE/Teachers | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| School Time Trends | No | No | Yes | Yes | No | No | Yes | Yes |

| | CST Math Gains | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Third Quartile | | | | Fourth Quartile | | | |
| *BIC* | 0.003 | 0.106 | 0.025 | 0.048 | 0.119* | 0.148*** | 0.101 | 0.095 |
| | (0.121) | (0.198) | (0.136) | (0.234) | (0.070) | (0.051) | (0.083) | (0.094) |
| *BIC + BIC*UFB* | | -0.067 | | 0.012 | | 0.067 | | 0.141 |
| | | (0.131) | | (0.154) | | (0.151) | | (0.150) |
| N | 12,951 | 12,951 | 12,951 | 12,951 | 17,507 | 17,507 | 17,507 | 17,507 |
| Student FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Principal FE/Teachers | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| School Time Trends | No | No | Yes | Yes | No | No | Yes | Yes |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses are clustered at the school level. Dependent variables are student-level gains in math and English language arts CST scores. Scores are normalized using statewide mean and variance for each grade and year. Each model includes school, grade, and year fixed effects, indicators for school type and year-round status, as well as a set of student level covariates. Reported coefficients are 1) the impact of BIC for schools not previously offering universally free meals, and 2) the sum of coefficients that are the impact for schools previously offering universally free meals. Quartiles of past achievement levels in ELA and math are taken from the distribution of average standardized cst score for years proir to the implementation of BIC.

**Table 8. Estimates of BIC on Student Absences**

| | Percentage of School Days Absent | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *BIC* | -0.050 | -0.009 | -0.100 | -0.024 | 0.017 | 0.028 | 0.132 | 0.105 |
| | (0.146) | (0.144) | (0.125) | (0.128) | (0.134) | (0.118) | (0.145) | (0.115) |
| *BIC + BIC*UFB* | | -0.076 | | -0.144 | | -0.010 | | 0.145 |
| | | (0.157) | | (0.138) | | (0.205) | | (0.222) |
| N | 157,295 | 157,295 | 157,295 | 157,295 | 157,295 | 157,295 | 157,295 | 157,295 |
| Student FE | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Principal FE/Teachers | No | No | No | No | Yes | Yes | Yes | Yes |
| School Time Trends | No | No | No | No | No | No | Yes | Yes |

| | Chronic Absentee | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *BIC* | -0.003 | -0.006 | -0.010 | -0.011 | -0.008 | -0.009 | -0.001 | 0.002 |
| | (0.008) | (0.009) | (0.006) | (0.008) | (0.007) | (0.008) | (0.008) | (0.010) |
| *BIC + BIC*UFB* | | -0.001 | | -0.009 | | -0.006 | | -0.003 |
| | | (0.008) | | (0.007) | | (0.010) | | (0.011) |
| N | 157,295 | 157,295 | 157,295 | 157,295 | 157,295 | 157,295 | 157,295 | 157,295 |
| Student FE | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Principal FE/Teachers | No | No | No | No | Yes | Yes | Yes | Yes |
| School Time Trends | No | No | No | No | No | No | Yes | Yes |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses are clustered at the school level. Dependent variables are percentage of days in academic school year student was absent and whether student was chronically absent during the school year (defined as absent at least 10 percent of school days). Each model includes school, grade, and year fixed effects, indicators for school type and year-round status, as well as a set of student level covariates. Reported coefficients are 1) the impact of BIC for schools not previously offering universally free meals, and 2) the sum of coefficients that are the impact for schools previously offering universally free meals.

**Table 9a. Estimates of BIC on Student Gains: Behavioral Scores**

| | Respects People and Property | | Shows Interest in Learning | | Prepares and Organizes | | Completes Assignments When Due | |
|---|---|---|---|---|---|---|---|---|
| *BIC* | 0.093 | -0.155 | 0.182 | 0.111 | 0.194 | 0.089 | -0.096 | -0.185 |
| | (0.262) | (0.159) | (0.150) | (0.160) | (0.137) | (0.177) | (0.132) | (0.157) |
| *BIC + BIC*UFB* | | 0.603** | | 0.284 | | 0.325*** | | 0.071 |
| | | (0.266) | | (0.217) | | (0.111) | | (0.137) |
| N | 38,180 | 38,180 | 38,227 | 38,227 | 38,208 | 38,208 | 38,219 | 38,219 |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses are clustered at the school level. Dependent variables are student gains in individual in-class behavioral scores. Scores are normalized using district-wide mean and variance for each gradelevel. Each model includes school, grade, year and student fixed effects; indicators for school type and year-round status; a set of student level covariates; teacher ethnicity, years of experience and certification level; principal fixed effects and school-specific linear time trends. Reported coefficients are 1) the impact of BIC for schools not previously offering universally free meals, and 2) the sum of coefficients that are the impact for schools previously offering universally free meals.

**Table 9b. Lead and Lagged Estimates of BIC on Behavioral Score Gains**

| | Respects People and Property | Shows Interest in Learning | Prepares and Organizes | Completes Assignments When Due |
|---|---|---|---|---|
| *BIC Year 1* | 0.053 | 0.011 | 0.044 | -0.022 |
| | (0.069) | (0.097) | (0.068) | (0.057) |
| *BIC Year 1 + BIC Year 1*UFB* | 0.223*** | 0.066 | 0.386*** | 0.196** |
| | (0.069) | (0.070) | (0.102) | (0.075) |
| *BIC Years 2-3* | 0.137 | -0.053 | 0.076 | 0.047 |
| | (0.087) | (0.125) | (0.119) | (0.091) |
| *BIC Year 2-3 + BIC Year 2-3*UFB* | 0.273*** | 0.069 | 0.418*** | 0.225** |
| | (0.086) | (0.095) | (0.124) | (0.106) |
| N | 38,628 | 38,675 | 38,655 | 38664 |
| p-values: F-test | | | | |
| All BIC coef. = 0 | 0.025 | 0.803 | 0.005 | 0.171 |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses are clustered at the school level. Dependent variables are student gains in individual in-class behavioral scores. Scores are normalized using district-wide mean and variance for each gradelevel. Each model includes school, grade, year and student fixed effects, indicators for school type and year-round status, a set of student level covariates, teacher ethnicity, years of experience and certification level, and school principal fixed effects. Reported coefficients are 1) the impact of BIC for schools not previously offering universally free meals, and 2) the sum of coefficients that are the impact for schools previously offering universally free meals. Coefficients separately estimate effects of the first year of treatment and the following years of treatment. Units are standard deviation changes.

## Table 10. Lead and Lagged Estimates of BIC on Student Gains: Standardized CST Scores

| | Math | | | | | | ELA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *BIC(t-3)* | 0.070 | 0.025 | | 0.086 | 0.029 | | 0.012 | -0.025 | | 0.021 | -0.041 | |
| | (0.049) | (0.055) | | (0.054) | (0.057) | | (0.037) | (0.045) | | (0.037) | (0.048) | |
| *BIC(t-3) + BIC(t-3)*UFB* | | 0.080 | | | 0.098 | | | 0.025 | | | 0.042 | |
| | | (0.052) | | | (0.062) | | | (0.041) | | | (0.047) | |
| *BIC(t-2)* | 0.047 | -0.003 | | 0.097 | 0.033 | | -0.013 | -0.028 | | 0.010 | -0.044 | |
| | (0.085) | (0.085) | | (0.094) | (0.098) | | (0.054) | (0.065) | | (0.054) | (0.070) | |
| *BIC(t-2) + BIC(t-2)*UFB* | | 0.025 | | | 0.066 | | | -0.036 | | | -0.008 | |
| | | (0.087) | | | (0.093) | | | (0.058) | | | (0.055) | |
| *BIC(t-1)* | 0.070 | 0.099 | | 0.179 | 0.199 | | 0.019 | 0.015 | | 0.057 | -0.011 | |
| | (0.107) | (0.113) | | (0.132) | (0.139) | | (0.074) | (0.077) | | (0.081) | (0.097) | |
| *BIC(t-1) + BIC(t-1)*UFB* | | -0.031 | | | 0.061 | | | -0.028 | | | 0.002 | |
| | | (0.112) | | | (0.133) | | | (0.082) | | | (0.084) | |
| *BIC Year 1* | 0.114 | 0.256* | 0.168*** | 0.333* | 0.436** | 0.233*** | 0.064 | 0.15 | 0.137*** | 0.144 | 0.153 | 0.165*** |
| | (0.139) | (0.143) | (0.058) | (0.172) | (0.169) | (0.059) | (0.099) | (0.104) | (0.046) | (0.105) | (0.121) | (0.050) |
| *BIC Year 1 + BIC Year 1*UFB* | | -0.024 | -0.012 | | 0.135 | 0.031 | | -0.018 | 0.003 | | 0.008 | 0.002 |
| | | (0.143) | (0.056) | | (0.196) | (0.086) | | (0.112) | (0.040) | | (0.126) | (0.055) |
| *BIC Years 2-3* | 0.162 | 0.306 | 0.204** | 0.427** | 0.520** | 0.298*** | 0.126 | 0.212* | 0.191*** | 0.259** | 0.236 | 0.244*** |
| | (0.169) | (0.188) | (0.101) | (0.202) | (0.213) | (0.106) | (0.111) | (0.115) | (0.062) | (0.123) | (0.148) | (0.077) |
| *BIC Year 2-3 + BIC Year 2-3*UFB* | | 0.056 | 0.052 | | 0.258 | 0.134 | | 0.062 | 0.073 | | 0.147 | 0.138* |
| | | (0.172) | (0.080) | | (0.219) | (0.101) | | (0.122) | (0.059) | | (0.139) | (0.071) |
| N | 67,157 | 67,157 | 67,157 | 67,157 | 67,157 | 67,157 | 66,461 | 66,461 | 66,461 | 66,461 | 66,461 | 66,461 |
| p-values: F-test | | | | | | | | | | | | |
| BIC(t-3)=BIC(t-2)=BIC(t-1)=0 | 0.245 | | | 0.242 | | | 0.519 | | | 0.656 | | |
| BIC(t)=BIC(t+1,2)=0 | 0.609 | | | 0.11 | | | 0.231 | | | 0.032 | | |
| All BIC(t) = 0 | 0.335 | 0.065 | | 0.024 | 0.005 | | 0.305 | 0.02 | | 0.069 | 0.012 | |
| BIC(t)=BIC(t+1,2)=BIC*UFB=0 | | 0.125 | 0.071 | | 0.047 | 0.008 | | 0.09 | 0.01 | | 0.042 | 0.013 |
| All BIC(t) and BIC(t)*UFB = 0 | | 0.032 | | | 0.004 | | | 0.022 | | | 0.03 | |
| Principal FE / Teachers | No | No | No | Yes | Yes | Yes | No | No | No | Yes | Yes | Yes |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses are clustered at the school level. Dependent variables are student gains in math and English language arts CST scores. Scores are normalized using statewide mean and variance for each grade and year. Each model includes school, grade, year and student fixed effects, indicators for school type and year-round status, and a set of student characteristic covariates. Reported coefficients are for lead and lagged years of treatment, separately by pre-BIC universally free meal offerings.

**Table 11. Changes in School Choice during Breakfast in the Classroom**

| | Dependent Variable | | | |
|---|---|---|---|---|
| | Attending Local School | | Exercising School Choice | |
| *BIC at Local School* | 0.0153* | 0.0129* | | |
| | [0.00869] | [0.00695] | | |
| *BIC at Local * Local is Provision2* | | 0.00383 | | |
| | | [0.0145] | | |
| *Local School is Provision2* | | -0.000689 | | |
| | | [0.0139] | | |
| *BIC at Attending School* | | | -0.0356*** | -0.0287*** |
| | | | [0.0110] | [0.0104] |
| *BIC at Attending* Attending is Provision2* | | | | -0.00745 |
| | | | | [0.0201] |
| *Attending is Provision2* | | | | -0.0632*** |
| | | | | [0.0223] |
| N | 152,786 | 152,786 | 152,786 | 152,786 |
| p-values | | | | |
| *BIC at Local + Interaction* = 0 | | 0.2998 | | |
| *BIC + Interaction* = 0 | | | | 0.0469 |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in brackets are clustered at the school level. Dependent variables are 1) an indicator for the student attending the boundary school assigned by address of residence, and 2) an indicator for the student attending a school other than her boundary school. Each model includes all fixed effects, covariates and school-specific linear time trends specified in the previous regressions.

**Table A1. Regression of Months to BIC Implementation on Observables**

| | Months to BIC Implementation |
|---|---|
| % Students Free/Reduced Price Eligible | -0.166 |
| | [0.119] |
| CST Math Gains | -0.358 |
| | [0.578] |
| CST ELA Gains | 0.0173 |
| | [0.287] |
| % Day Absent | -0.222 |
| | [0.226] |
| % English learner students | -0.206** |
| | [0.0807] |
| Years of Teacher Experience | 0.0204 |
| | [0.0433] |
| Female | -0.06 |
| | [0.161] |
| White | 0.545 |
| | [0.766] |
| Black | 0.357 |
| | [0.431] |
| Other | 1.508 |
| | [0.904] |
| Observations | 5,666 |
| R-squared | 0.366 |
| F-test | 0.0107 |
| F-test: Outcomes and %free/reduced | 0.2327 |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in brackets are clustered at the school level. Dependent variable is the number of months from when the first BIC program implementations began to the BIC implementation date in the student's school. Independent variables are observations one year before the BIC rollout began.

**Table A2. Lead and Lagged Estimates of Increase in Breakfasts after BIC on Student Gains: CST Scores**

| | CST Math Gains | | | CST ELA Gains | | |
|---|---|---|---|---|---|---|
| *BIC(t-3) * % change-in-meals* | 0.021 | 0.006 | | 0.014 | 0.012 | |
| | (0.024) | (0.024) | | (0.013) | (0.015) | |
| *BIC(t-3)*change + BIC(t-3)*change*UFB* | | 0.027 | | | 0.014 | |
| | | (0.031) | | | (0.017) | |
| *BIC(t-2) * % change-in-meals* | 0.009 | -0.024 | | 0.005 | 0.000 | |
| | (0.032) | (0.048) | | (0.018) | (0.023) | |
| *BIC(t-2)*change + BIC(t-2)*change*UFB* | | 0.014 | | | 0.004 | |
| | | (0.032) | | | (0.019) | |
| *BIC(t-1) * % change-in-meals* | 0.000 | 0.046 | | 0.019 | 0.031 | |
| | (0.047) | (0.065) | | (0.026) | (0.030) | |
| *BIC(t-1)*change + BIC(t-1)*change*UFB* | | -0.028 | | | 0.009 | |
| | | (0.048) | | | (0.026) | |
| *BIC Year 1 * % change-in-meals* | 0.050 | 0.134* | 0.096*** | 0.048 | 0.094** | 0.064** |
| | (0.075) | (0.077) | (0.033) | (0.041) | (0.039) | (0.024) |
| *BIC Year 1*change + BIC Year 1* change*UFB* | | -0.006 | 0.021 | | 0.013 | 0 |
| | | (0.087) | (0.055) | | (0.050) | (0.038) |
| *BIC Year 2-3 * % change-in-meals* | 0.090 | 0.192** | 0.152*** | 0.098* | 0.142*** | 0.110*** |
| | (0.097) | (0.092) | (0.038) | (0.056) | (0.048) | (0.029) |
| *BIC Year 2-3*change + BIC Year 2-3* change*UFB* | | 0.039 | 0.064 | | 0.067 | 0.053 |
| | | (0.108) | (0.072) | | (0.064) | (0.050) |
| N | 67,157 | 67,157 | 67,157 | 66,461 | 66,461 | 66,461 |
| p-values: F-tests | | | | | | |
| BIC(t-3)=BIC(t-2)=BIC(t-1)=0 | 0.676 | | | 0.497 | | |
| BIC(t)=BIC(t+1,2)=0 | 0.445 | | | 0.080 | | |
| All BIC(t) = 0 | 0.000 | 0.003 | | 0.089 | 0.006 | |
| BIC(t)=BIC(t+1,2)=BIC*UFB=0 | | 0.115 | 0.005 | | 0.006 | 0.004 |
| All BIC(t) and BIC(t)*UFB = 0 | | 0.000 | | | 0.006 | |

Notes: *, **, *** denote significance at the 10%, 5% and 1% levels respectively. Standard errors in parentheses are clustered at the school level. Dependent variables are student gains in math and English language arts CST scores. Scores are normalized using statewide mean and variance for each grade and year. Each model includes school, grade, year and student fixed effects, indicators for school type and year-round status,a set of student level covariates, teacher ethnicity, years of experience and certification level, and school principal fixed effects. Reported coefficients are for lead and lagged years of treatment, separately by pre-BIC universally free meal offerings. Units are standard deviation changes per 100 percent increase in meals served.