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The Effect of Breakfast in the Classroom on Obesity and Academic Performance: Evidence from New York City

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ABSTRACT

Participation in the federally-subsidized school breakfast program often falls well below its lunchtime counterpart. To increase take-up, many districts have implemented Breakfast in the Classroom (BIC), offering breakfast directly to students at the start of the school day. Beyond increasing participation, advocates claim BIC improves academic performance, attendance, and engagement. Others caution BIC has deleterious effects on child weight. We use the implementation of BIC in NYC to estimate its impact on meals program participation, BMI, achievement, and attendance. While we find large effects on participation, our findings provide no evidence of hoped-for gains in academic performance, nor of feared increases in obesity. The policy case for BIC will depend upon reductions in hunger and food insecurity for disadvantaged children, or its longer-term effects.

I. INTRODUCTION

The federal School Breakfast Program (SBP) has subsidized breakfasts for needy children since 1966, with the aims of reducing food insecurity, improving nutrition, and facilitating learning (Bhattacharya, Currie, & Haider, 2006; Millimet, Tchernis, & Husain, 2010; Poppendieck, 2010). Participation in the SBP, however, typically falls well below that of its lunchtime counterpart (Bartfeld & Kim, 2010; Basch, 2011; Dahl & Scholz, 2011; Schanzenbach & Zaki, 2014). In New York City, for example, less than a third of all students take a breakfast each day, even though it has been offered free to all students since 2003 and roughly three in four students live in low income households (Leos-Urbel et al., 2013).[1]

To increase participation in the SBP, a number of school districts have adopted Breakfast in the Classroom (BIC), a program that offers free breakfast to students in the classroom at the start of the school day, rather than providing it in the cafeteria before school. The intent is to reach students unable or unwilling to arrive early to school, and to reduce stigma associated with visiting the cafeteria before school for a subsidized meal. NYC schools began implementing BIC in 2007 and today the program is offered in nearly 300 of the city's 1,700 schools.[2]

Advocates argue that moving breakfast from the cafeteria to the classroom provides myriad benefits, including improved academic performance, attendance, and engagement, in addition to reducing food insecurity among disadvantaged children. Indeed, there is robust evidence that the consumption, timing, and nutritional quality of breakfast all affect cognitive performance (e.g., Wesnes et al., 2003; Rampersaud et al., 2005). While there has been less work evaluating BIC in particular, at least one study found that moving breakfast to the classroom can

[1] A 2012 report from the Food Research and Action Center rated NYC last out of 26 urban school districts in breakfast participation among subsidy-eligible students (FRAC, 2012).
[2] "It's a Hit: Breakfast in the Classroom," *The New York Times*, November 17, 2008, A21.

substantially improve math and reading performance (Imberman & Kugler, 2014).[3] At the same time, others have warned BIC will have deleterious effects on students' weight, increasing BMI and obesity, as participants consume more daily calories or less nutritious food than they otherwise would. In NYC, the Bloomberg administration temporarily halted the expansion of BIC when an internal study found BIC students were more likely to eat two breakfasts, one at home and another during school (Van Wye et al., 2013).[4] There is, however, scant research available to guide policymakers in resolving these conflicting claims, and virtually no evidence on the impact on BMI or obesity in particular.

In this paper, we use the staggered implementation of BIC in NYC together with richly detailed longitudinal data on student height, weight, achievement, and attendance to estimate the program's impact on body mass index (BMI), obesity, academic performance and attendance. We begin by investigating whether BIC had a significant impact on schools' average daily participation in the breakfast and lunch programs. Next, we use longitudinal data on students to estimate the impact of BIC on BMI and other student outcomes. This analysis uses a difference-in-difference design, contrasting observationally similar students in schools that did and did not adopt BIC, before and after implementation. We also estimate impacts using an event study specification, including a series of indicators identifying years before and after BIC adoption, to capture potential differences in trajectories prior to adoption.[5] The estimated effects are interpreted as "intent-to-treat" effects, as the treatment here is the *offer* of BIC to all or some students in the school. As in most studies, we do not observe individual student meal

[3] A second, unpublished paper found similar results for test scores in a subset of schools in San Diego (Dotter, 2012), although two more recent studies did not (Anzman-Frasca et al., 2015; Schanzenbach and Zaki, 2014). These studies are described below.
[4] "Hiccup in the Most Important Meal," *The New York Times*, April 19, 2012, A1.
[5] We provide graphical evidence that outcomes in BIC and non-BIC schools were on similar trajectories prior to schools' adoption of BIC, a necessary condition for the difference-in-difference specification to provide unbiased estimates of causal effects.

consumption or classroom level participation in BIC. To address the partial adoption of BIC in some schools, we estimate models using three increasingly stringent measures of program coverage. Intent-to-treat effects are arguably of most interest to policymakers weighing the benefits and costs of offering BIC, in the types of schools that choose to adopt it.

We find that NYC schools offering BIC saw a substantial increase in school breakfast participation with no spillover effects on lunch participation. Further, there is no evidence BIC increased BMI or the incidence of obesity among affected students. We find insignificant effects on reading and math achievement in grades 4-8, a sharp contrast with Imberman and Kugler (2014). Finally, we find small positive effects of BIC on attendance rates, concentrated in middle school. While our data do not permit us to examine impacts on individual student eating behaviors, our findings are consistent with recent experimental evidence showing BIC has, at best, small effects on net breakfast consumption and nutrition (Schanzenbach & Zaki, 2014).

This study has important implications for the current policy debate over providing breakfast in the classroom. While BIC promises a way to address food insecurity and hunger among poor children, and potentially raise achievement, enthusiasm for the program has been tempered by concerns over potential weight gain and increases in obesity. Unfortunately, there has been little to no research on BIC's impact on obesity, leaving policymakers and school leaders to make decisions without the benefit of evidence. This paper aims to close that gap.

Our analysis comes from New York City, which is the largest provider of school meals in the country and frequently regarded as a national leader in school food policy. Nearly 200 elementary and middle schools in NYC adopted BIC between 2007-08 and 2011-12, serving 30,000 students each day. Using detailed student and school-level data from this period, we found that BIC's significant impact on SBP participation had no deleterious effects on obesity or weight gain. NYC's experience suggests BIC may be a practical way for urban school districts to reduce hunger and food security, without adverse consequences for childhood obesity.

II. BACKGROUND

A. THE EFFECTS OF SCHOOL MEALS ON HEALTH AND ACADEMIC ACHIEVEMENT

There is considerable evidence that the availability and quality of school meals programs can affect the nutritional intake and academic outcomes of participating students. For example, in a study of the SBP, Bhattacharya, Currie, and Haider (2006) used detailed survey data from the NHANES III to investigate how access to the SBP affected children's breakfast consumption and nutrient intake. They found no impact of the SBP on total calories consumed or the likelihood of eating breakfast, but found large effects on the nutritional quality of breakfasts eaten, with fewer calories from fat, and higher serum levels of vitamins C, E, and folate. Schanzenbach (2009) examined the body weight of students participating in the school lunch program and found that children eating school lunches were more likely to be obese than those bringing their own lunch, a finding she attributed to higher caloric intake among students taking school lunches. A study by Millimet, Tchernis, and Husain (2010) corroborated this finding for school lunches, but—consistent with Bhattacharya, Currie, and Haider (2006)—found that participation in the SBP was associated with lower rates of obesity.

Evidence of a causal impact of school meals on educational outcomes is mixed, but frequently positive. In one study of the long-run effects of the school lunch program, Hinrichs (2010) found sizable effects on the educational attainment of adults who were exposed to the program early in life. In contrast, using administrative data from Chile, McEwan (2013) found no short-run effects on test scores, school attendance, and grade repetition of providing free high-calorie meals to poor children. Along the same lines, Dunifon and Kowaleski-Jones (2003) found little association between school lunch program participation in the U.S. and achievement after accounting for selection into the program.[6] In a clever study examining schools' responses to test-based accountability in Virginia, Figlio and Winicki (2005) found that schools under accountability pressure substantially increased the caloric content of their meals on test days, and saw larger increases in passing rates as a result. Consistent with this type of short-run effect, Imberman and Kugler (2014) found the introduction of BIC into a large urban school district had large positive effects on reading and math achievement, even when the program was implemented a short time before the test. (We describe this study in greater detail in Section 2.2).

That the consumption and quality of breakfast can have at least a short-run effect on child cognitive performance is confirmed in a number of experimental studies.[7] For example, a study in the U.K. randomly assigned 10-year-old students to different breakfast regimens at home and found students receiving a higher-energy breakfast scored higher on tests of creativity and number checking (Wyon et al., 1997). They were also less likely to report feeling bad or hungry. Wesnes et al. (2003) randomly assigned students to receive one of four types of breakfast on successive days (one of two types of cereal, a glucose drink, or no breakfast) and found that students eating a cereal breakfast performed better on a series of tests of attention and memory over the course of the morning. Simeon and Grantham-

[6] More comprehensive reviews of this literature can be found in Briefel et al. (1999), Hoyland, Dye, and Lawton (2009), Ponza et al. (1999), and Rampersaud et al. (2005).
[7] A more thorough review can be found in Pollitt and Matthews (1998) and Hoyland, Dye, and Lawton (2009).

McGregor (1989) conducted a small experiment in which under-nourished children in the West Indies were randomly assigned to receive a breakfast or a cup of tea on alternate days. After consuming breakfast, students performed better on cognitive tests of arithmetic and problem solving than when drinking only tea.

Relevant to BIC, one study we identified found that when breakfast is consumed relates to its effects on cognitive performance. In a randomized control trial, Vaisman et al. (1996) found that 11- to 13-year-old students who ate a regular breakfast before school (two hours before testing) performed no better than a control group on tests of cognitive functioning. However, students who ate a cereal and milk breakfast in class 30 minutes before testing performed significantly better.

B. Breakfast in the Classroom

Breakfast in the Classroom alters the traditional SBP by offering a free breakfast in class at the start of the school day, rather than in the cafeteria before school hours (FRAC, 2012). The intent is to increase breakfast participation among students who are unable or unwilling to arrive early to school, and to reduce stigma associated with visiting the cafeteria before school for a subsidized meal. BIC advocates have argued the program also provides an opportunity to integrate nutrition into the curriculum, as teachers can use the time to teach good eating habits. Proponents tout the social aspects of the program as well, citing the benefits of communal eating.[8]

BIC breakfasts are typically offered during the first 10-20 minutes of class. Meals are often bagged the prior evening by school food staff, placed into insulated containers, and

[8]See http://www.healthyeating.org/Schools/Tips-Trends/Article-Viewer/Article/142/breakfast-at-school-a-communal-meal-that-makes-a-difference.aspx.

refrigerated overnight. They are then delivered to classrooms in the morning, or distributed to students as they arrive ("Grab and Go"). Because breakfasts are typically assembled the night before, BIC menus generally differ from those prepared in the cafeteria. Specifically, BIC meals usually consist of cold, pre-packed items such as cereal, fresh fruit, or bagels. Cafeteria breakfasts, on the other hand, include hot meals such as pancakes or egg omelets.[9] Though they may differ in menu offerings, BIC meals are required to meet the same federal nutritional guidelines as cafeteria breakfasts. For federal reimbursement purposes, they are accounted for in the same way as traditional cafeteria breakfasts.

The Food Research and Action Center (FRAC), a national advocate for the SBP in general and BIC in particular, credits BIC for high rates of SBP participation in urban school districts like Detroit, Houston, Newark, San Antonio, Washington, D.C., and Providence (FRAC, 2012). There has been little research, however, on BIC's effects on breakfast participation, academic or behavioral outcomes, or weight. One evaluation of a 2003-04 BIC pilot in upstate New York found SBP participation doubled after implementation of the program, and found modest improvements in attendance, behavior, and tardiness (Murphy, Drake, & Weineke, 2005). The study, however, lacked a control group and involved only a small number of schools. Anzman-Frasca et al. (2015) examined the effects of BIC on SBP participation in a large urban school district and estimated that BIC increased participation by 30 percentage points, relative to matched non-BIC schools. Similarly, in re-analyzing data from an earlier U.S. Department of Agriculture experiment, Schanzenbach and Zaki (2014) found that BIC had a large positive effect on SBP participation and increased the likelihood

[9] Not all schools in NYC have kitchen facilities for preparing hot meals. These schools would likely have served cold breakfasts prior to adopting BIC. Schools with kitchens may have offered cold items as menu options.

that students ate a “nutritionally substantive” breakfast. They found the effect of BIC on SBP participation was considerably larger than the offer of free breakfast alone.

Imberman and Kugler (2014) provide strong quasi-experimental evidence on the effects of offering BIC on achievement. That study examined the impact of BIC on math and reading scores in 5th grade, and attendance and report card marks in grades 1-5. Their setting was an urban district that—like NYC—had previously offered free breakfast to all students, regardless of subsidy eligibility (Leos-Urbel et al., 2013). The district implemented BIC in 85 schools over a period of 11 weeks in 2009-10, which enabled the authors to contrast outcomes in early adopter schools (those implementing BIC before the test) with those in late adopting schools (implementing after the test). They found substantial intent-to-treat effects of BIC on reading and math achievement (0.10 s.d.), with larger effects for initially low-achieving students (0.13 – 0.14 s.d.), Hispanics (0.14 – 0.15 s.d.), and low-BMI students (0.26 s.d.). As many students already participated in the SBP, the treatment effect of BIC on the treated in this district was potentially much higher. They found no impact of BIC on attendance rates or report card grades.

Interestingly, the achievement effects found in Imberman and Kugler did not vary with the amount of time students had been offered BIC. Thus, even schools that adopted BIC as little as one week prior to testing experienced gains in test performance. While seemingly implausible at first, their finding mirrors Figlio and Winicki (2005), who found that increasing caloric content of lunch on test day can improve test performance. It also aligns with the experimental evidence described in Section 2.1 on the short-run effects of breakfast consumption and content on cognitive performance. Imberman and Kugler’s finding of no impact on grades but a large impact on test scores supports a short-run caloric effect and lack of a sustained, long-run impact on achievement, but the study's short duration makes it difficult to rule out long-run effects.

Like Imberman and Kugler (2014), an unpublished study by Dotter (2012) used the introduction of BIC in San Diego over a 4-year period to estimate its effects on achievement in 2nd – 6th grade, attendance, and classroom behavior. In contrast to NYC and the district in Imberman and Kugler (2014), San Diego had only previously offered universal free breakfasts in schools with Provision 2 status under the National School Lunch Act ("UFM schools").[10] All others offered breakfast free or at a reduced rate to subsidy-eligible students and at full price to other students. BIC in San Diego thus coincided with a shift to universal free breakfast in schools that were not already UFM, making it difficult to disentangle the BIC and price effects. Like Imberman and Kugler, Dotter found large effects of BIC on achievement (0.11 s.d. in reading and 0.15 s.d. in math), but only in schools that did not already offer free breakfast to all students. Thus, the effect should be interpreted as the combined effect of BIC and free breakfast. He found no effect on attendance, but large positive effects on teacher-reported classroom behavior, such as exhibiting "respect for people and property."

Finally, a third quasi-experimental study by Anzman-Frasca et al. (2015) examined the impact of BIC on meals program participation and achievement in a large urban school district in 2012-13. They found a large effect of the program on SBP participation (noted above), but unlike the other two studies described here, found no impact on student

[10] Under Provision 2, a school may certify children as eligible for free or reduced-price meals for up to four consecutive years—without collecting annual data on eligibility—and provide meals free of charge to all students. The intent is to reduce the administrative burden on schools and parents related to proving income eligibility. For details see: http://www.gpo.gov/fdsys/pkg/CFR-2012-title7-vol4/pdf/CFR-2012-title7-vol4-part245.pdf [last accessed May 15, 2015].

achievement in 2^{nd}-6^{th} grade. Anzman-Frasca et al. did find a positive, statistically significant effect of BIC on attendance, but the effect size was very small.

These three studies offer strong evidence on the academic impacts of BIC, and go far beyond what was previously available. However, they have several limitations. First, none provided evidence of the program's effect on student weight, an important outstanding question in the literature. Second, two of the three relied on relatively small samples of elementary schools. Imberman and Kugler's main estimates use 5^{th} graders in approximately 85 treatment and 19 control schools; Dotter looked at a broader range of grade levels, but a smaller number of schools (45 treatment and 22 control). His sample of non-UFM schools—where the only significant effects were found—was smaller (19 treatment and 16 control). Third, only Dotter is able to say much about long-run effects, up to four years after the first BIC implementation. Imberman and Kugler provide a clean estimate of the short-run impact of BIC, but their results may say more about calorie intake and the short-term malleability of test performance than about the long-run consequences of adjusting children's eating habits. Our analysis improves on prior work by incorporating annual student-level measures of BMI and a larger sample of students and BIC schools at both the elementary and middle school level.[11]

Three studies that we are aware of have looked at the relationship between BIC and calorie consumption or weight, although only one has a design that can support causal claims. Baxter et al. (2010) collected cross-sectional data on BMI, breakfast program participation, and energy intake (from researcher observations) for a sample of 4^{th} grade

[11] Some high schools in NYC have implemented BIC. However, as we explain in the next section, our BMI data on high school students and schools appears to be less reliable than our data for elementary and middle school. Hence our analysis in this paper is restricted to students in elementary and middle grades.

students in 17 schools, seven of which had adopted BIC. They found children in BIC consumed more calories at breakfast and had higher BMIs, on average, than children eating breakfast in the cafeteria. Van Wye et al. (2013) surveyed students in nine BIC and seven comparison schools in NYC and found students offered BIC were more likely to eat more than once in the morning, consuming 95 more calories, on average, than students in schools not offering BIC. Access to student-specific data on food consumption is an obvious advantage of these studies. However, both were correlational with a small number of schools that did not address selection into BIC. Schanzenbach and Zaki (2014) provide stronger evidence of the program's effects on breakfast consumption and obesity by re-analyzing data from an experiment conducted by the U.S. Department of Agriculture in the early 2000s (Bernstein et al., 2004). In the original experiment, treatment schools offered universal free breakfast and could choose to serve it in the cafeteria or in the classroom. In a comparison of BIC and control schools that did not offer free breakfast, the authors found large effects of BIC on participation, and a five percentage point increase in the likelihood of eating more than one breakfast, but modest effects on breakfast consumption, and no effect on BMI or nutrition. They conclude that—for most students—BIC changed the location and timing of breakfast rather than the propensity to consume it. Not surprisingly in light of this, they find BIC had no impact on achievement or behavior. While randomization of free breakfast is an important feature of this study, it is worth noting the decision to offer BIC was not random, making the comparison of BIC and other treated schools (offering free breakfast only) non-experimental. Further, the number of BIC schools (18) was small relative to the cafeteria group (61). The community context for schools in the USDA study was also quite different from ours (NYC).[12] Thus, there remain open questions about the efficacy of BIC in the

[12] The participating school districts included Boise, ID; Shelby County, AL; Harrison County, MS; Phoenix, AZ;

context of universal free breakfast in the cafeteria—the context increasingly relevant for urban school districts nationwide.

III. DATA

A. DATA SOURCES, OUTCOMES, AND SAMPLE DEFINITIONS

We draw on four primary data sources, all provided by the New York City Department of Education (NYCDOE) and its Office of School Food. The first is a database of BIC participation that includes start dates for schools that ever adopted BIC, and the extent of program coverage in the school (e.g., grades served and the number of BIC and total classrooms). The second is longitudinal school-level data on breakfast and lunch participation for all regular public schools that served elementary and/or middle grades between 2001-02 and 2011-12. This data provides annual counts of meals served, average daily attendance (ADA), and Provision 2 (UFM) status, and includes 1,000 to 1,100 schools enrolling 713,000 to 730,000 students, depending on the year. The third is administrative data for the universe of students in NYC public schools between 2006-07 and 2011-12, including demographics, educational needs and program participation, standardized test scores, and attendance rates. Finally, the fourth is annual student height and weight measurements collected through the city's *Fitnessgram* program; these are used to compute BMI and indicators of obesity, as described below. We exclude high schools, private, charter, prekindergarten, alternative, and other special schools and programs from the study.[13]

Santa Rosa, CA; and Wichita, KS.

[13] Conversations with the NYCDOE and the NYC Department of Health and Mental Health raised concerns about the quality of *Fitnessgram* data in high school. Whereas height and weight measurements in elementary and middle schools are taken by school staff (e.g., the school nurse or P.E. teacher), they are frequently self-reported in high

The student-level administrative data tracks students longitudinally as they progress through school. These data include school of record, state test scores in English Language Arts (ELA) and mathematics (both in grades 3-8 only), gender, race/ethnicity, age, household income eligibility for free or reduced price meals, recent immigrant status, days in attendance, days enrolled, and participation in other educational programs (e.g., special education and/or ELL). We standardized ELA and math scores within grade, subject, and testing year. Grade 3 test scores are used only as a lagged outcome for students in 4th grade. We calculated student attendance rates as the number of days present as a percentage of days enrolled.

NYC schools have conducted the *Fitnessgram* since 2005-06 as part of the district's standards-based physical education program.[14] *Fitnessgram* requires all schools to collect students' height and weight annually, and to assess students' aerobic fitness, muscle strength, endurance, and flexibility. At the end of the year, students receive a report that summarizes their performance and suggests ways for them to reach their "Healthy Fitness Zone," targets for better health based on their age and gender. While school coverage rates were lower in the early years of the *Fitnessgram*, by 2012 nearly 1,700 schools were participating each year, providing data on more than 860,000 students in all grades.

From the *Fitnessgram* we used students' weight (in pounds) and height (in inches) to compute the standard BMI measure, ($weight/height^2$)*703. Biologically implausible values—defined as more than four s.d. below or five s.d. above the mean for the students' gender and age in months—were set to missing. Following the CDC definition of child obesity, we

school. Our concern about measurement error in the high school data led us to exclude these students from our analysis.

[14] See Rundle et al. (2012) and Elbel et al. (2013).

classified children as obese if their BMI was at or above the 95th percentile nationally for their gender and age in months.[15] Though there is some debate in the public health literature over the best measure of adiposity in children (e.g., Cole et al., 2005; Mooney, Baecker, & Rundle, 2013), BMI is the most common. Our analyses of student weight use two outcome measures: BMI standardized by gender and age, using all students in the *Fitnessgram* (*z*-BMI), and a 0-1 indicator for BMI above the CDC obesity threshold.

Our analytic samples for BMI/obesity, achievement and attendance overlap, but differ in two key ways. First, the included grade levels vary, depending on data availability. Models for BMI and attendance include students in grades K-8, while the models for achievement include only grades 4-8. Second, the BMI sample excludes students in school-years where *Fitnessgram* participation was lower than 50 percent. These students were not excluded from the other models. In allowing these analytic samples to differ, we make full use of available data. (The online appendix reports estimates from models estimated using a fixed sample of students. The results are very similar).

B. BIC ADOPTION IN NEW YORK CITY

Figure 1 shows the cumulative number of NYC schools that adopted BIC, by month, between 2007-08 and 2011-12. (The figure is limited to schools enrolling grades K-8, and excludes private and charter schools). The largest number of adoptions occurred in early 2010-11, although a significant number of schools began offering BIC in 2008-09 and 2009-10. By the end of 2011-12, 195 elementary and middle schools had adopted the program,

[15] CDC percentiles are based on the national distribution of BMI in 2000-01, the most recent growth charts in use. See http://www.cdc.gov/growthcharts/clinical_charts.htm.

with an average daily participation of more than 30,000 students.[16] It is worth noting that some schools adopted BIC in the middle of the school year, suggesting its full effect on annually measured outcomes may not be observed until the following year.

Not every school adopted BIC school-wide, which has implications for how we define "treatment." In some cases, BIC was offered only to specific grades or a subset of classrooms within the school.[17] In the absence of data linking specific students or classrooms to BIC, we used information on the number of BIC and total classrooms, BIC grades served, and school grade span to create three increasingly stringent indicators of program coverage in a school.[18] The first indicator is equal to one for schools offering BIC in any classroom (and zero otherwise). The second is equal to one for schools offering BIC in at least 25% of its classrooms, but not school-wide, which eliminates schools piloting the program with a small number of students. Finally, the third is equal to one for schools offering BIC school-wide ("full BIC").[19] The bars in Figure 1 show the cumulative number of schools that adopted BIC according to these definitions. While the majority of schools fall only in the first category, by the end of 2011-12, 62 elementary and middle schools offered BIC to at least 25% of classrooms, and 23 offered it school-wide.

[16] Including regular high schools, the total number of BIC schools in 2011-12 was 279 schools with an average daily BIC participation of 36,000. Adding private, charter, pre-kindergarten, alternative, and special education schools the total number of schools was 348 with an average daily participation of 41,500.

[17] In NYC, as in other large districts, the specific timing of program changes—whether in school food or otherwise—reflects the interplay of opportunity, convenience, capacity, politics, and economics. In the case of BIC, our conversations with the Office of School Food and school personnel suggest that timing depended, in part, on the physical layout of the school, which determines the logistics for delivering breakfast to classrooms. A similar process likely plays out within schools in determining which classrooms offer BIC.

[18] BIC adoption is based on data collected by the NYC Office of School Food in November 2009, March 2011, and October 2012. Each wave provided contemporaneous information about BIC participation and start date. We used information from all three waves to construct our treatment variables.

[19] We are less confident in the reported data on specific grades offering BIC in each school, where applicable, and in the exact percentage of classrooms offering BIC. This led us to the broader classification described here. We have, however, estimated models using these alternative measures of treatment (available in the online appendix). The results are qualitatively the same.

Table 1 reports baseline mean characteristics for BIC schools and schools that never adopted BIC. (The BIC categories are not mutually exclusive, and represent our three increasing levels of program coverage). On a number of dimensions, BIC schools were more disadvantaged than those that never adopted the program. For example, they enrolled a greater percentage of students eligible for free meals (74.1% versus 67.3%) and had higher concentrations of black, Hispanic and ELL students. Standardized test scores were lower on average in BIC schools, both in reading (-0.13 s.d.) and in math (-0.16 s.d.), and were lower still in schools with more extensive BIC coverage. Schools in all five boroughs adopted BIC, though they were over-represented in the Bronx. Average daily participation in the school breakfast program was slightly lower at baseline in schools that adopted BIC versus those that did not (23.3% vs. 24.5%). Finally, students in BIC schools on average had higher BMI at baseline than those attending non-BIC schools, especially in schools with greater BIC coverage. Roughly one in four students were obese in schools that adopted BIC school-wide, compared with roughly one in five in non-BIC schools.

IV. EMPIRICAL STRATEGY

Our main empirical models are difference-in-differences regressions at the school or student level (depending on the outcome) which contrast outcomes in schools that did and did not adopt BIC, before and after implementation. Included covariates and school fixed effects account for non-random selection of schools into the program on the basis of observed characteristics or time-invariant factors correlated with the outcome of interest (e.g., meals program participation, BMI, achievement, attendance). We address the possibility that BIC and non-BIC schools were on different trajectories prior to schools' adoption of BIC through event study models, described below and shown graphically in Figures 2-3.

We estimate the impact of BIC on meals program participation using annual data at the school level. The following model is estimated for breakfast and lunch participation, for all schools combined and separately for elementary and middle schools:

$$(1) \qquad \left(\frac{ADP_{mst}}{ADA_{st}} * 100\right) = \delta * BIC_{st} + \beta' \boldsymbol{W}_{st} + \alpha_t + \gamma_s + v_{st}$$

In (1), the dependent variable is the average daily participation rate for meal *m* (breakfast or lunch) in school *s* and year *t*, defined as the average number of *m* meals served per school day (ADP_m) divided by average daily attendance (*ADA*) and multiplied by 100. This can be interpreted as the percentage of students in attendance who take a meal *m* on an average day in school *s* in year *t*. BIC_{st} is equal to one if school *s* adopted BIC prior to the end of school year *t* (and zero otherwise), and implemented alternately using our three categories of program coverage. γ_s and α_t are school and year effects, respectively, and $\boldsymbol{W}_{st}$ is a vector of school-level covariates, including total enrollment, percent female, percent by race/ethnicity, percent ELL, percent in special education, and percent eligible for free or reduced price meals. Standard errors are adjusted for clustering by school. In alternative specifications of (1), we add school-specific linear time trends to allow for differential trends over time in the outcomes.

We estimate the impact of BIC on student outcomes using annual data at the student level, again estimating separate models for elementary and middle school students. (The reason for this, as we show in section 5.1, is that the impact of BIC on breakfast participation is proportionally much larger in middle schools, where baseline participation was much lower—perhaps due to stigma.) Each model takes the following form for outcome Y_{igst} (BMI, obesity, math score, reading score, and attendance) for student *i* in grade *g*, school *s*, and year *t*:

$$(2) \qquad Y_{igst} = \delta * BIC_{ist} + \beta' \boldsymbol{X}_{it} + \alpha_t + \gamma_s + u_{it}$$

BIC_{ist}, γ_s and α_t are defined in the same manner as in (1), and $\boldsymbol{X_{it}}$ is a vector of student covariates potentially related to both the outcome and the adoption of BIC in school *s.* These include eligibility for free or reduced price meals, race and ethnicity, limited English proficiency, special education status, age in months (as of the date of BMI measurement and in the *Fitnessgram* models only), and lagged math or reading scores (in the math and reading models, respectively).[20] u_{it} is a student-year error term, and standard errors are adjusted for clustering by school. As before, *BIC* is defined alternately using the three categories of coverage defined earlier. In a second set of specifications, we allow the effect of BIC to vary by the extent of time the student has attended a BIC school, with BIC_{ist} equal to the cumulative number of days, in hundreds, that student *i* has attended *any* school offering BIC prior to the date their outcome was measured in year *t*.[21]

To test the identifying assumption that outcomes in BIC and non-BIC schools were on similar trajectories prior to adoption of the program, we estimate "event study" versions of models (1) and (2). In these regression models, we replace the *BIC* treatment variable with a set

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[20] A single variable in the model indicates whether the student is eligible for free or reduced price meals, or whether the student is enrolled in a UFM school. In cases where eligibility status is missing, this variable is equal to zero. We include an additional indicator variable equal to one for students with missing eligibility information.

[21] This treatment is intended to capture heterogeneity in student exposure to BIC, and—like the school-level treatment—is implemented using the three increasingly stringent thresholds of BIC coverage. To the extent BIC takes time to have an effect on BMI and/or achievement, this specification may be more appropriate. We have experimented with numerous variations on these treatment definitions. These alternatives are described later in the paper, where appropriate. Estimates from these alternative approaches are available in the online appendix.

of indicators corresponding to specific years before and after BIC adoption. (These indicator variables are always zero for schools that never adopted BIC, and the reference period for BIC schools is the first year of the program). All other covariates from (1) and (2) are included in these models. Any significant differences in mean outcomes that we observe in the pre-treatment period could reflect differential trends in BIC schools prior to adoption of the program. Differences in mean outcomes in the post-treatment period can be used to test for differential effects over time (as in Dotter, 2012).

V. RESULTS

A. THE IMPACT OF BIC ON SCHOOL MEALS PROGRAM PARTICIPATION

Table 2 reports estimates of the impact of BIC on average daily school breakfast and lunch program participation from model (1). Each cell in this table is a coefficient and standard error estimate from a separate regression, for the treatment definition shown in the row and the school sample shown in the column. Rows (1)-(3) are impact estimates for breakfast participation and rows (4)-(5) are estimates for lunch participation. All models include school and year fixed effects, as well as school-level covariates.

The point estimates in Table 2 show a large increase in breakfast program participation in schools offering BIC, with no corresponding change in lunch participation. Across all schools serving elementary and middle grades, we find BIC increased SBP participation rates by 11.8 percentage points, on average, from a baseline of 20.1 percent—a nearly 60 percent increase. Although point estimates from separate elementary and middle school regressions are an identical 13 percentage points, the effect size in middle school is proportionately much larger, since these schools had lower baseline participation rates (12 percent versus 23.6 in elementary schools).[22] As expected, we observe larger effects on participation rates when BIC classroom coverage is higher. For example, the estimated impact on average daily breakfast participation is 21 to 25 percentage points when at least 25 percent of classrooms offered BIC, and 29 to 32 percentage points when BIC was offered school-wide. (All coefficient estimates for breakfast program participation are statistically significant at the 0.01 level or better). This finding provides support for our three-tiered classifications of BIC coverage at the school level, as well as a strong "first stage" effect of BIC on program take-up that would be needed if BIC were to have an effect on other student-level outcomes.[23]

In contrast, we find that offering BIC had no significant impact on lunch program participation. In all cases, the coefficient estimates for lunch participation in Table 2 are small—usually less than 1 percentage point—and are statistically insignificant. Taken together, there is no evidence to suggest BIC crowded out lunch program participation or encouraged greater participation (say, by reducing stigma associated with subsidized meals).

The difference-in-difference estimates are valid as causal effects only if BIC and non-BIC schools were experiencing similar trends in meals program participation prior to the adoption of BIC. In Figure 2 we show coefficients from event study regression models, in which separate indicator variables are included for BIC schools in years prior to and following BIC adoption. (Reference year zero is the year prior to adoption). For clarity, the

[22] In Table 2, the count of schools appearing in the "all schools" regressions is larger than the sum of schools appearing in the "elementary" and "middle school" only regressions, since the former includes schools serving *both* elementary and middle grades. Unfortunately, meals served data is not disaggregated by grades within schools.

[23] As another check on the quality of our data, we were able to obtain high-frequency point-of-sale (POS) data for three BIC schools, which allowed us to observe how daily meal service changed with implementation of BIC. The advantage of POS data is that it is generated by student transactions, not school counts. In two of the three schools, we observe a substantial increase in SBP participation immediately after BIC adoption, at 36 and 53 points, respectively. (The third school, which was demographically quite different from the other two, saw no increase). This analysis is provided in the online appendix. While only three schools, this detailed look provides additional confidence in the validity of the meals served data and in the BIC implementation dates.

figure shows the coefficients and confidence interval bounds for two of the three BIC categories (>25% BIC and full school). We observe virtually no trend in regression-adjusted participation rates prior to the adoption of BIC. The hypothesis that breakfast and lunch participation rates were equal to those in the reference year cannot be rejected, up to seven years prior to BIC adoption. After adoption, participation rates in BIC schools were 10-18 percentage points higher in the first year, depending on the extent of BIC coverage, and 18-37 percentage points higher in the second year. In schools where BIC was adopted school-wide, breakfast program participation continued to increase three and four years later. By comparison, the event study for lunch shows no discernible change in participation rates for any year following BIC adoption. (While the estimation sample for Figure 2 was an unbalanced panel, repeating the analysis with a smaller balanced panel of schools produced a nearly identical result.

Including school-specific linear time trends to the models in Table 2 had only modest effects on these estimated impacts. For example, among all schools, the effects on breakfast participation rates are 8.3, 17.2, and 26.4 percentage points for the three treatment intensities, respectively. All remain statistically significant at the 0.01 level. (Results are available in the online appendix).

B. THE IMPACT OF BIC ON BMI AND OBESITY

Estimates of the impact of BIC on student BMI and obesity are reported in Table 3. In this table, each cell reports the estimated BIC treatment coefficient and standard error from a separate regression. The regressions differ in their estimation sample (grades K-5 or 6-8), specification of the BIC treatment (pre-post indicator for school *s*, or cumulative days of exposure for student *i* divided by 100), and extent of program coverage in the school (any

BIC; >25% BIC; full BIC). Impact estimates for BMI are given in panel A, while estimates for obesity are in panel B. Results in later subsections are organized in an analogous manner.

We find no evidence that the offer of BIC increased BMI or the prevalence of obesity. Many of the point estimates in Table 3 are negative, which if significant would indicate that students have lower BMI and lower rates of obesity when their school offers BIC than observationally similar students attending the same schools when not offering BIC. All of the effect sizes are small, however, and none of the effects are statistically significant. Focusing on the difference-in-difference results in the first two columns, the point estimates are largest (in absolute value) for full BIC schools, as would be predicted if a treatment effect were present and were more likely in a school with greater BIC coverage. However, we cannot reject the hypothesis that the coefficients are the same across the different treatment measures. Interestingly, when treatment is measured using cumulative days of student exposure, the point estimates are sometimes positive—though never significant—hinting that prolonged BIC exposure could be associated with higher BMI.

As noted, we experimented with a number of alternative specifications for BIC treatment.[24] For example, we set the cumulative days of exposure to zero if the student was not *currently* in a BIC school; in most cases these point estimates were smaller in absolute value than those in Table 3. Alternatively, we defined cumulative days of exposure as the number of treated days prior to measurement in year t only, with a separate dummy variable indicating BIC treatment in prior years. The point estimates were again closer to zero than in Table 3. Finally, we estimated models in which three mutually exclusive categories of BIC

[24] Results using these alternative specifications are available in the online appendix.

coverage were jointly included in the model. None of the results were materially different from those in Table 3.

C. THE IMPACT OF BIC ON STUDENT ACHIEVEMENT

Table 4 reports our estimates of the impact of BIC on student achievement in ELA and mathematics. As in Table 3, each cell is the estimated treatment effect from a separate regression, with comparable estimation samples, treatment variable specifications, and BIC coverage thresholds. The main differences are that the elementary school models use only grades 4-5, since testing begins in 3rd grade and lagged achievement is included as a covariate.

We find no consistent evidence of an impact of BIC on achievement in either subject. Most point estimates are small in absolute value and vary in sign, with ELA estimates mostly negative and math estimates mixed. In ELA, we observe a statistically significant and negative effect of -0.020 s.d. (p<0.05) for middle school students attending schools with at least 25% classroom coverage, an effect that is larger with prolonged exposure to BIC (-0.005 s.d. per 100 days; p<0.05). In math, the only statistically significant effect we observe is for middle schoolers attending schools with at least 25% classrooms coverage, a positive 0.008 s.d. per 100 days (p<0.05). The point estimates are larger for students attending schools that adopted BIC school-wide, but are not significant. With a large sample and multiple models, it is not surprising to find some statistical significance. On balance, we see no strong evidence of an impact of BIC on academic performance.

Here again, point estimates for the effect of BIC on achievement tend to be larger in schools with greater BIC coverage, although this pattern is not consistent, and we cannot reject the hypothesis that the effects are the same across categories. When BIC treatment is measured using cumulative days of student exposure, the results suggest that prolonged BIC participation could be associated with lower ELA scores and higher math scores. The cumulative effects would be small, however.[25] Indeed, all of the achievement effects we observe are considerably smaller than those estimated in Imberman and Kugler (2014) and Dotter (2012). In the concluding section of the paper, we consider several potential explanations for the divergent findings.

We experimented with the same alternative specifications of the BIC treatment variable for our achievement models as we did for BMI and obesity. In no case were the results materially different.[26] Additionally, because the estimation sample differs for the BMI/obesity and achievement outcomes, we estimated both sets of models with a fixed, identical sample of students with sufficient data to be included in all models.[27] Again, the results were qualitatively very similar.

D. THE IMPACT OF BIC ON ATTENDANCE

Table 5 reports estimates of the impact of BIC on attendance rates, measured as the number of days present as a percent of days enrolled. As in earlier tables, each cell is the estimated treatment effect from a separate regression, with comparable estimation samples, treatment variable specifications, and coverage thresholds. For the attendance outcome, the elementary school models include all grades K-5 (not just the tested sample). The middle school models continue to use grades 6-8.

[25] For example, a middle school student 1 s.d. above the mean in cumulative days in a school with at least 25% classroom coverage would be predicted to have 0.006 s.d. lower ELA scores and 0.009 s.d. higher math scores.
[26] Results using these alternative specifications are available in the online appendix.
[27] For instance, students in grades K-3 contribute to the BMI/obesity and attendance estimates in Tables 3 and 5 but not to the achievement estimates in Table 4, since they lack a current and lagged test score. Moreover, some students with test scores did not have *Fitnessgram* data and thus did not contribute to the BMI estimates.

In this case the estimated effects in middle school are positive, and some are statistically significant ($p<0.05$). Students in middle schools offering BIC had 0.3 to 0.4 percentage point higher attendance rates when BIC was offered in their school, depending on the extent of BIC classroom coverage. In all cases, the estimated effect sizes are very small. In elementary school, attendance rates are already high—about 92 percent in schools that ever adopted BIC—and in middle school about four points lower, on average (88 percent). Assuming a 180-day school year, a 0.50 percentage point increase in attendance translates into 0.9 school days. Thus, the average effect found here amounts to about one quarter to less than one full school day.

In complementary work (not shown here), we looked at the potential "socializing effects" of BIC by testing for effects on responses of middle school students to NYC's School Environment Survey. This survey aims to capture student attitudes toward their school, classroom, and teachers, with items such as "I feel welcome in my school," "Most of the adults I see at school every day know my name or who I am," "I am safe in my classes," and so on. We did not find any consistent effects of BIC on responses to any of these survey items.

E. EVENT STUDY MODELS

As we did for school breakfast and lunch participation in section 5.1, we estimated event study regression models for each of the student-level outcomes, school levels, and categories of BIC coverage. The results are summarized in Figure 3. For clarity of presentation, this figure shows only models using the intermediate category of BIC program adoption (>25% BIC). (Figures using the other definitions of treatment are similar, and provided in the online appendix. Year zero is again the year prior to adopting BIC.

As in Figure 2 we find no evidence of a differential trend in math and ELA achievement in BIC schools prior to program adoption. Differences from year zero are small in magnitude and statistically insignificant. The same holds for BMI, obesity, and attendance, especially in grades K-5. There is somewhat of an upward trend in BMI, obesity, and attendance in grades 6-8 prior to program adoption, although differences from year zero are again statistically insignificant. Consistent with our main results in Tables 3-5, we find no evidence that BIC significantly impacted BMI, achievement, or attendance, with the possible exception of increased attendance in middle school.

VI. DISCUSSION

BIC has been widely adopted by school districts across the United States, with the goal of increasing SBP participation and ensuring no child starts the school day hungry. Advocates argue moving breakfast from the cafeteria to the classroom will provide myriad other benefits as well, including improved attendance, engagement, and academic performance. One recent study supports the latter claim, finding a substantial impact on math and reading performance (Imberman & Kugler, 2014). Whether these effects represent short-run boosts in test scores or sustained, long-run impacts on academics remains unclear.

At the same time, others have warned that BIC will have deleterious effects on students' weight, increasing BMI and obesity, as participants consume more daily calories or less nutritious food than they otherwise would. BIC expansion in NYC was temporarily suspended over this very claim. The evidence base on BIC's impact on obesity, however, is thin. Our analysis using longitudinal *Fitnessgram* measures of student BMI indicates these fears are largely unwarranted. We find no evidence BIC increased BMI or the incidence of obesity among students attending schools in New York City offering the program. Nearly all of our point estimates suggest lower average body mass in schools when students are offered BIC, though these effects are small and not statistically different from zero.

At the same time, our study finds large positive effects of BIC on SBP participation, an effect that did not come at the expense of lower lunch participation. We find no evidence of an impact on reading and math achievement in schools that adopted BIC. That class time devoted to BIC did not adversely affect achievement is encouraging. But in no case do our estimates suggest the positive effects found in two out of the three prior quasi-experimental studies. They do, however, align with a recent re-analysis of experimental data showing BIC has small net effects on breakfast consumption and in turn no effect on achievement.

There are a number of reasons why our achievement effects may depart from those in earlier quasi-experimental studies. First, the "first stage" impact of BIC on program participation may have been weaker in NYC than in other settings. Table 2 revealed a substantial increase in SBP take-up in BIC schools, but this increase was smaller than that observed in San Diego (Dotter, 2012). In that study, SBP participation in BIC schools exceeded 90 percent, well above what we observe in NYC.[28] As expected, we did not observe as large an impact on school-wide participation in NYC schools that adopted BIC in a subset of classrooms, which may contribute to our overall null finding on achievement. However, we also found no effects in schools that offered BIC school-wide, where the impact on participation was much larger. Understanding variability in the effects of BIC on

[28] Imberman and Kugler (2014) do not estimate the impact of BIC on breakfast participation in their district but highlight a pilot study that documented 80 percent participation in BIC schools (versus 41 percent in all other schools). Both rates are higher than those observed in NYC.

take-up across contexts will be an important question for future research. Second, NYC was already offering free breakfast to students citywide prior to BIC (Leos-Urbel et al., 2013). Dotter (2012) found effects on achievement in San Diego schools, but only in those that did not already offer universal free breakfast. This is consistent with our findings, and may suggest few added benefits of BIC—at least for achievement—beyond those provided by free breakfast.

While our study improves on existing work in a number of ways, it has several limitations. Imperfect measures at the classroom level led us to adopt three relatively broad categories of BIC coverage aiming to capture the extent to which BIC is offered in a school. Our categories are validated by an increasingly strong relationship with SBP participation post-implementation, but could be improved with classroom- or individual-specific meals data. In ongoing work, we are using newly-acquired point-of-sale (POS) data provided by the NYC Office of School Food to track individual daily student breakfast participation for a subset of schools.

Despite these limitations, our study is one of the first to examine the effects of offering BIC on BMI and obesity. It uses annual student-level data on obesity from New York City, the largest school district in the country, where nearly 300 schools adopted BIC by 2011-12 (and roughly 200 schools serving grades K-8 were used in our models). This data includes observations on students as many as four years post-BIC implementation, allowing us to potentially detect long-run effects. Breakfast in the Classroom has received considerable scrutiny and media attention in NYC, and school districts nationwide have followed its roll-out closely. Our investigation of the impact of BIC yields evidence of significant increases in SBP participation and (small) improvements in middle school attendance, with no effect on lunch participation, academic performance, or any weight outcome, including BMI and obesity. Thus the modest positive impacts of BIC do not come at the cost of worsening childhood obesity. School districts concerned about hunger and food insecurity among their most vulnerable students might do well to consider Breakfast in the Classroom to address these issues.

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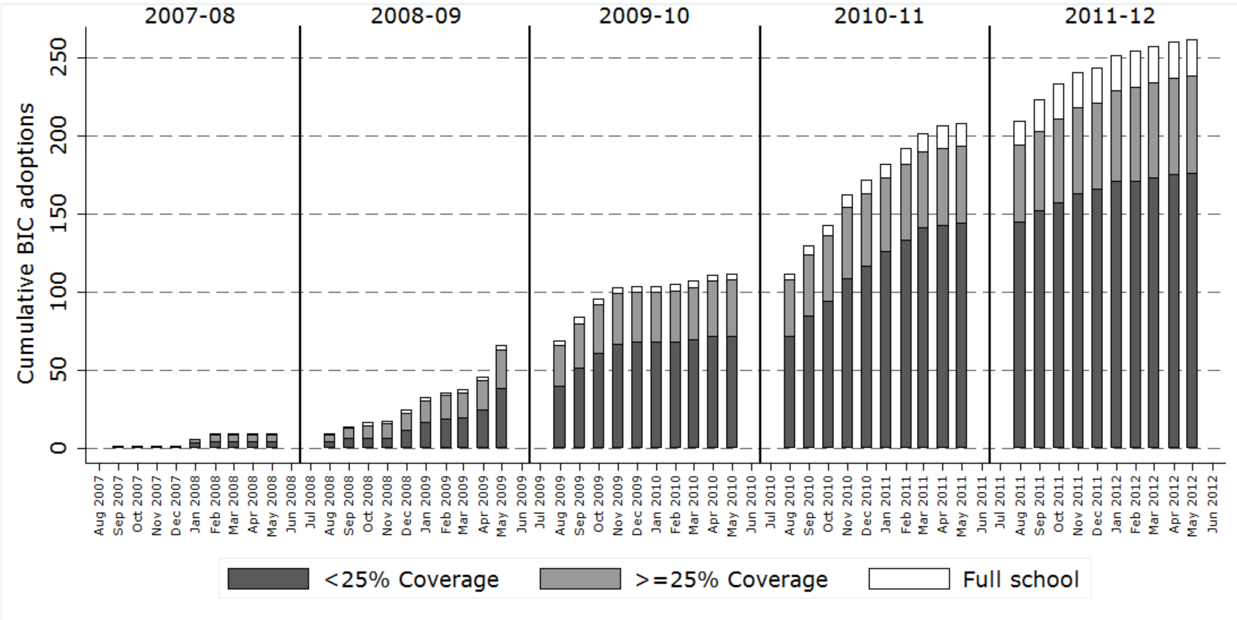
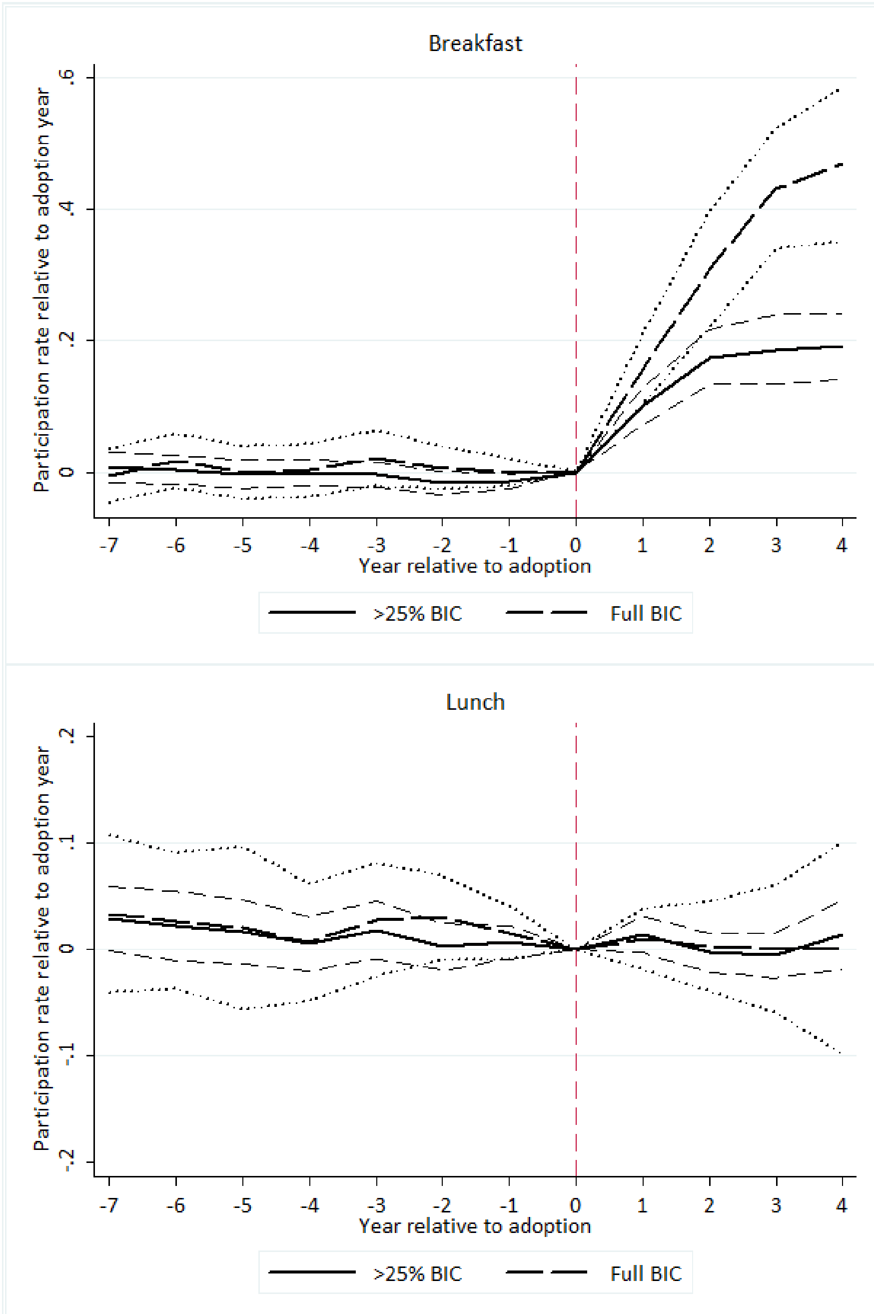
Figure 1: Cumulative Breakfast in the Classroom Adoptions by Month, New York City



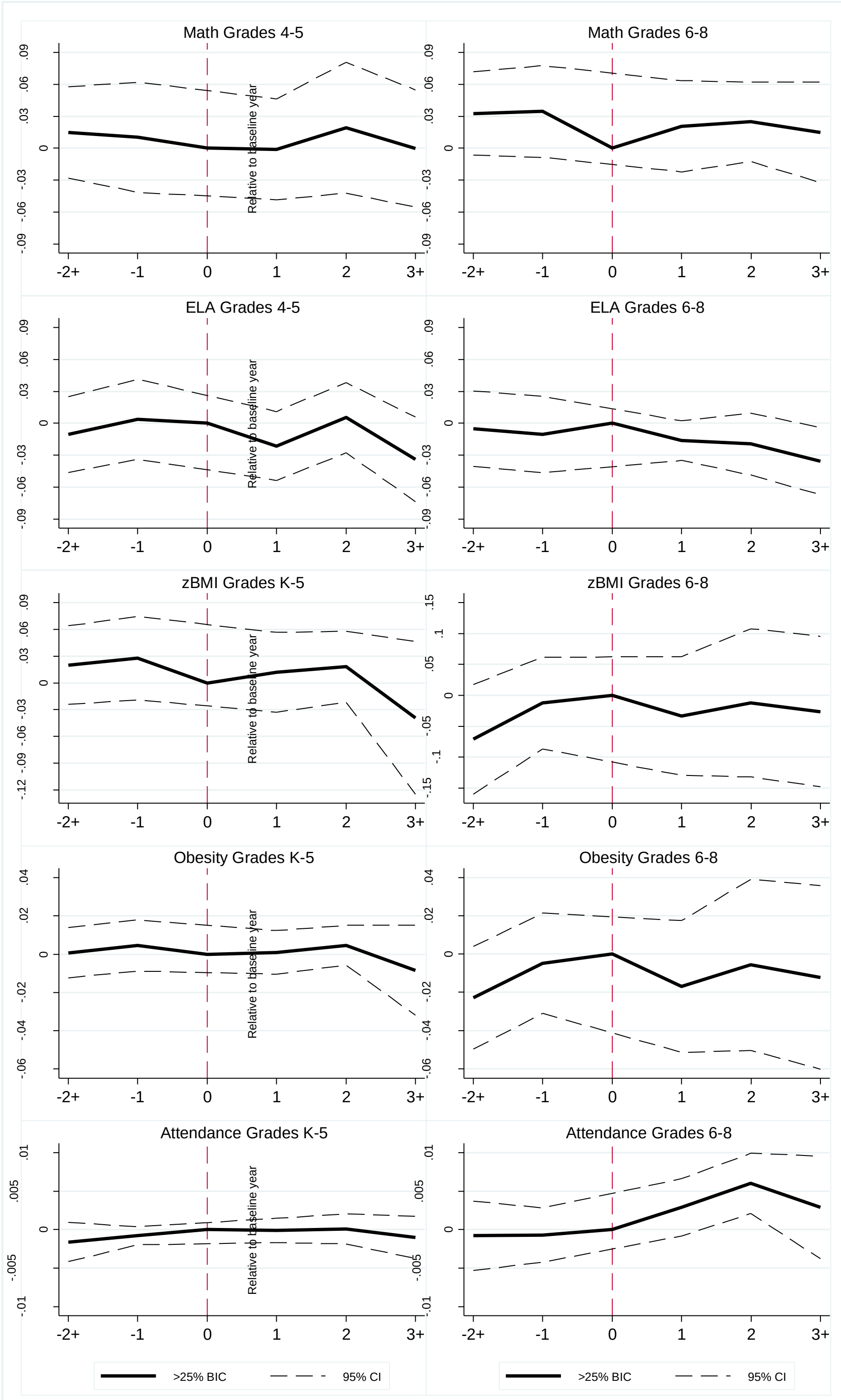
Notes: reflects all schools adopting BIC prior to June 30, 2012 that offered BIC to any of the grades K-8. Only regular public schools are included; private, charter, alternative, and special education (District 75) schools are excluded, as are suspension or other special programs.

Figure 2: Estimated Impact of BIC on Annual Breakfast and Lunch Participation Rates: Elementary and Middle Schools



Notes: Event study coefficients from regressions of annual meal participation rates on school-level covariates, school and year fixed effects, and indicators for years before and after BIC adoption. (These indicators are equal to zero for schools that never adopted BIC, and year zero is year prior to offering BIC). Dashed and dotted lines represent a robust 95% confidence interval.

Figure 3: Estimated Impact of BIC by Year, Event Study Regressions



Notes: baseline year zero is the year prior to BIC adoption.

Table 1: Mean school characteristics by BIC adoption status and classroom coverage, baseline

	Never BIC	Ever BIC	Ever BIC w/>=25% coverage	Ever full school BIC
Breakfast participation rate	24.5	23.3	23.9	24.6
Lunch participation rate	76.5	79.7	82.6	82.4
BMI z-score	0.008	0.082	0.102	0.147
Percent obese	20.8	22.5	23.7	24.9
Reading z-score (grades 3-8)	0.017	-0.128	-0.258	-0.283
Math z-score (grades 3-8)	0.002	-0.158	-0.292	-0.310
Attendance rate	92.1	91.1	90.1	91.2
Percent eligible for free lunch	67.3	74.1	81.4	80.6
Percent ELL	11.7	12.8	12.7	14.5
Percent special education	13.9	14.6	15.4	17.1
Percent Asian	12.4	8.3	3.7	4.8
Percent black	33.5	37.1	40.4	34.6
Percent Hispanic	38.5	43.9	51.5	55.9
Percent white	14.7	9.7	3.3	3.5
Percent male	50.7	50.9	50.1	50.0
Percent enrollment grades K-5	60.1	58.9	61.3	65.1
Percent in Brooklyn	33.2	28.5	23.3	7.9
Percent in Manhattan	17.3	20.6	25.9	42.1
Percent in Queens	24.3	16.7	7.8	10.5
Percent in Staten Island	4.8	4.3	0.0	0.0
Percent in Bronx	20.3	29.9	43.1	39.5
Percent UFM school	45.1	42.5	45.6	45.9
School starting time	8:20 a.m.	8:19 a.m.	8:21 a.m.	8:19 a.m.
Total enrollment	657	724	683	660
N (observed in 2007)	807	281	116	38

Notes: only regular public schools serving any of the elementary and middle grades are included in the above. All means are for the 2006-07 academic year, and thus are prior to schools' adoption of BIC. "Never BIC" refers to schools that had not adopted BIC as of June 30, 2012. "Ever BIC" refers to any school that adopted BIC prior to June 30, 2012. "Ever BIC with >=25% Coverage" refers to any school that adopted BIC prior to June 30, 2012 and offered BIC to at least 25% of classrooms. "Ever Full BIC" refers to any school that adopted BIC school-wide prior to June 30, 2012. In the few cases where BIC coverage changed over time, we classified schools according to their highest extent of coverage.

Table 2: Impact of BIC adoption on meals program participation, 2001 – 2012

	All schools	Elementary	Middle
Breakfast:			
(1) Post BIC adoption	0.118***	0.130***	0.130***
	(0.009)	(0.012)	(0.020)
(2) Post BIC adoption: school with >25% coverage	0.211***	0.231***	0.251***
	(0.016)	(0.020)	(0.031)
(3) Post BIC adoption: full school	0.290***	0.319***	0.319***
	(0.032)	(0.044)	(0.032)
Lunch:			
(4) Post BIC adoption	-0.001	0.008	-0.014
	(0.005)	(0.005)	(0.014)
(5) Post BIC adoption: school with >25% coverage	-0.008	0.007	-0.014
	(0.008)	(0.007)	(0.020)
(6) Post BIC adoption: full school	-0.005	-0.002	0.048
	(0.018)	(0.018)	(0.048)
N – breakfast (school x year)	12,407	7,833	2,598
Mean breakfast participation pre-2008	0.201	0.236	0.120
N – lunch (school x year)	12,062	7,518	2,565
Mean lunch participation 2008	0.732	0.813	0.629

Notes: each cell is a coefficient estimate from a separate regression model. In rows (1) and (4), the coefficient is for the "post BIC adoption" indicator equal to one in school-years where BIC was offered in the school. For rows (2) and (4), this indicator is equal to one only if BIC was offered to at least 25% of classrooms in the school. For rows (3) and (6), this indicator is equal to one only if BIC was offered school-wide. The columns represent subsamples: all schools, elementary schools only (including elementary/ middle combinations), and middle schools only (including middle/high combinations). The dependent variable is the annual breakfast or lunch participation rate for a given school and year, measured as average daily meals served divided by average daily attendance. Standard errors, robust to clustering within schools, are in parentheses (*** p<0.001, ** p<0.01, * p<0.05).

Table 3: Impact of BIC on obesity and BMI

	Pre-post		Cumulative days	
	Grade K-5	Grade 6-8	Grade K-5	Grade 6-8
Panel A: Impact on zBMI				
(1) Post BIC adoption	-0.0036	-0.0239	0.0030	0.0064
	(0.0114)	(0.0184)	(0.0044)	(0.0041)
(2) Post BIC adoption: school with >25% coverage	-0.0076	-0.0147	-0.0044	0.0079
	(0.0157)	(0.0320)	(0.0070)	(0.0067)
(3) Post BIC adoption: full school	-0.0156	-0.0225	-0.0243	0.0024
	(0.0315)	(0.0161)	(0.0176)	(0.0088)
Panel B: Impact on obesity				
(4) Post BIC adoption	-0.0007	-0.0087	0.0020	0.0026
	(0.0030)	(0.0070)	(0.0013)	(0.0015)
(5) Post BIC adoption: school with >25% coverage	0.0004	-0.0074	0.0013	0.0027
	(0.0045)	(0.0125)	(0.0021)	(0.0026)
(6) Post BIC adoption: full school	-0.0024	-0.0020	-0.0035	0.0010
	(0.0089)	(0.0059)	(0.0059)	(0.0033)
Observations	2,131,469	980,088	2,131,469	980,088

Notes: Standard errors in parentheses, robust to clustering at the school level. Obese is defined as being above the 95th percentile nationally for one's gender and age in months, based on the 2000 CDC BMI-for-age charts. All models include student covariates, grade, school, and year effects. Covariates include age, gender, race/ethnicity, low income status, LEP, immigrant, and special education status. Low income is measured by eligibility for free or reduced price meals or enrollment in a Universal Free Meal school. Age is measured in months at the time of the Fitnessgram. We exclude charter school students, students attending citywide special education schools (District 75), students in schools where Fitnessgram coverage is less than 50 percent, and students with biologically implausible BMIs.

Table 4: Impact of BIC on ELA and math achievement

	Grades 4-5 Pre-post		Grades 6-8 Pre-post		Grades 4-5 Cumulative days		Grades 6-8 Cumulative days	
	ELA	Math	ELA	Math	ELA	Math	ELA	Math
(1) Post BIC adoption	-0.011 (0.008)	-0.005 (0.011)	-0.000 (0.008)	0.007 (0.011)	-0.003 (0.002)	-0.001 (0.004)	-0.002 (0.002)	0.005 (0.003)
(2) Post BIC adoption: school with >25% coverage	-0.021 (0.014)	-0.005 (0.018)	-0.020* (0.009)	0.005 (0.017)	-0.006 (0.003)	-0.001 (0.004)	-0.005* (0.002)	0.008* (0.004)
(3) Post BIC adoption: full school	-0.041 (0.027)	0.028 (0.037)	-0.015 (0.019)	-0.008 (0.034)	-0.007 (0.009)	0.014 (0.010)	-0.005 (0.004)	0.012 (0.009)
Observations	717,486	744,934	1,097,593	1,126,258	717,486	744,934	1,097,593	1,126,258

Notes: Standard errors robust to clustering at the school level shown in parentheses (* $p<0.05$). All Models control for lagged z-score, race/ethnicity, low income status, LEP, immigrant, and special education status. Low income is measured by eligibility for free or reduced price meals or enrollment in a Universal Free Meal school. Excludes charter school students and students attending citywide special education schools (District 75).

Table 5: Impact of BIC on attendance

	Pre-post		Cumulative days	
	Grade K-5	Grade 6-8	Grade K-5	Grade 6-8
(1) Post BIC adoption	<0.001 (0.001)	0.003* (0.001)	<0.001 (<0.001)	0.001* (0.000)
(2) Post BIC adoption: school with >25% coverage	0.001 (0.001)	0.004* (0.002)	<0.001 (<0.001)	0.001 (0.001)
(3) Post BIC adoption: full school	<0.001 (0.001)	0.004 (0.003)	<0.001 (0.001)	<0.001 (0.001)
Observations	2,496,321	1,228,769	2,496,321	1,228,769

Notes: Standard errors robust to clustering at the school level shown in parentheses (* p<0.05). All Models control for race/ethnicity, low income status, LEP, immigrant, and special education status. Low income is measured by eligibility for free or reduced price meals or enrollment in a Universal Free Meal school. Excludes charter school students and students attending citywide special education schools (District 75).