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Not just for poor kids: The impact of universal free school breakfast on meal participation and student outcomes

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Abstract

This paper examines the impact of the implementation of a universal free school breakfast policy on meals program participation, attendance, and academic achievement. In 2003, New York City made school breakfast free for all students regardless of income, while increasing the price of lunch for those ineligible for meal subsidies. Using a difference-indifference estimation strategy, we derive plausibly causal estimates of the policy's impact by exploiting within and between group variation in school meal pricing before and after the policy change. Our estimates suggest that the policy resulted in small increases in breakfast participation both for students who experienced a decrease in the price of breakfast and for free-lunch eligible students who experienced no price change. The latter suggests that universal provision may alter behavior through mechanisms other than price, highlighting the potential merits of universal provision over targeted services. We find limited evidence of policy impacts on academic outcomes.

Keywords

School meals program; Child poverty policy; Universal service provision; School finance

1. Introduction

School meals are receiving increased policy attention as a potential lever for improving the nutrition and academic performance of low-income children. There is considerable evidence that nutrition, and eating breakfast in particular, is important for cognitive functioning and academic success (Benton & Parker, 1998; Greier et al., 2007; Pollitt, Cueto, & Jacoby, 1998; Wesnes, Pincock, Richardson, Helm, & Hails, 2003). A recent study of the National School Lunch Program in the mid-20th century found that participation yielded long-term positive effects on educational outcomes (Hinrichs, 2010). Nonetheless, not all students participate in the school meals program, including many who are eligible for free or reduced price meals. Further, participation in school breakfast is often substantially lower than for

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school lunch, leading policy makers to explore strategies to increase take-up (FRAC, 2012; Moore, Hulsey, & Ponza, 2009).

Low participation in school meal programs has been attributed to a number of factors. First, for those not fully subsidized, price is inversely related to participation and research suggests families are more sensitive to the price of school breakfast than the price of lunch (Maurer, 1984; Gordon et al., 2007). Second, students may be reluctant to participate due to the stigma associated with a subsidized meal; that is, they may perceive school meals as "just for poor kids" (Mitcherva & Powell, 2009; Poppendieck, 2010). Third, school meals may simply be unappealing to students, due to high nutritional standards or low quality (Poppendieck, 2010). Healthy meals also often compete with snacks and vending machine offerings that are high in sugar and fat content. Finally, in the case of breakfast, meals are often served before school hours, requiring students to arrive early in order to benefit from the program.

To increase take-up, policy makers have adopted a range of strategies. In 2010 President Obama signed the *Healthy Hunger-Free Kids Act* which, among other things, aims to expand enrollment in the school meals programs by allowing qualifying schools in high-poverty areas to provide free meals to all students without requiring students to demonstrate eligibility. New York City and several other large urban districts have gone further, making breakfasts free for all students regardless of family income. On the one hand, this strategy of universal provision has the potential to increase costs relative to a policy that narrowly targets eligible students. On the other, it can lower administrative and transaction costs associated with a targeted program, and may increase overall participation. Even students who were always eligible for free meals may be affected, if universal provision reduces stigma or improves the quality of school meals.

This paper uses school and student-level data from the New York City public schools to estimate the impact of universal free breakfast on meals program participation and academic outcomes. We exploit a discrete policy change that occurred prior to the 2003–04 school year that made school breakfast free for all students, while increasing the price of lunch for those who pay full price. By exploiting within- and between-group variation in school meal pricing before and after the policy change we derive plausibly causal estimates of the impact of the policy on program participation. Our causal interpretation is strengthened by a difference-in-difference comparison with schools that already provided free meals to all students. Using student-level data we then explore the resulting effect on student attendance and test scores. Importantly, beyond studying the effects of a reduction in the price of breakfast for paying students, this analysis examines the total effect of universal provision. That is, we are interested in whether universal provision raises participation beyond that which would be expected from a price reduction alone. Such effects may arise, for example, through a reduction in stigma or an increase in service quality.

We find that the provision of universal free breakfast resulted in a modest increase in participation for all program eligibility groups. Increases observed for those who were already eligible for free meals suggest that universal provision may have effects beyond those associated with the reduction in price. The concurrent increase in the price of lunch had no noticeable effect on the lunch participation of non-subsidized students. Consistent with the relatively modest change in meal participation–about one week's worth of participation for all groups–we find limited impact of the policy change on educational outcomes. Our estimates, however, are focused on the short-run impact; we cannot rule out the possibility of longer-run effects of the program. For instance, it may be that a reduction in stigma or improvement in service quality associated with universal provision takes more time. To date, little is known about how long it takes such mechanisms to operate.

In the next section, we provide an overview of the federal breakfast and lunch programs, and the implementation of the universal free breakfast program in New York City. We then outline our conceptual framework and review prior literature that informs our approach to the relationship between the price of school meals, meal participation, and academic outcomes. We describe the data for this analysis, our strategy for estimating the impact of the policy change on meal participation, and on school attendance and test scores. Finally, we provide our results and a series of robustness checks, and offer discussion and conclusions.

2. Policy context

In 1946 Congress passed *The National School Lunch Act* with the multi-pronged goals of providing "a measure of national security, to safeguard the health and wellbeing of the Nation's children and to encourage the domestic consumption of nutritious agricultural commodities" (Ralston, Newman, Clauson, Guthrie, & Buzby, 2008). The School Breakfast Program (SBP), which began as a pilot through *The Child Nutrition Act* of 1966, became permanent in 1975. Both the National School Lunch Program (NSLP) and SBP are administered at the federal level by the U.S. Department of Agriculture's Food and Nutrition Service which makes grants to state education agencies that in turn operate the program through agreements with local school districts or individual schools.

School meals programs affect a large number of children, with more than 31 million children participating in the NSLP each day, and more than 11 million participating daily in the SBP in FY 2009 (USDA, 2009a, 2009b). The total cost of these programs in 2009 reached $2.9 billion for the SBP and $9.8 billion for the NSLP (USDA, 2009a, 2009b). Notably, only a fraction of the children who receive school lunch also receive breakfast. For instance, Moore et al. (2009) report that in a nationally representative sample, students eligible for free or reduced-price meals participate in lunch about 70 percent of the time compared to approximately 30 percent for breakfast (see also FRAC, 2012).[1]

While any child at a participating school may purchase a meal through the national school meals program, students from families with incomes at or below 130 percent of the poverty line pay nothing for lunch or breakfast ("free-meal eligible students") and those with incomes between 130 percent and 185 percent of the poverty level are eligible for reduced-price meals ("reduced-price eligible students"). Students ineligible for subsidized meals may purchase them at "full price," although even these are typically provided at less than cost. Of the 11 million children participating daily in the SBP, 9.1 million received breakfast for free or reduced price.

In September 2003, New York City became one of the first large urban school districts to make school breakfast free for all students regardless of family income.[2] Prior to the policy change in New York City, students paying full price for breakfast were charged 25 cents per meal and those eligible for reduced price breakfast paid 5 cents per meal. In an effort to make up for lost revenue from the elimination of school breakfast fees, the New York City Department of Education (NYCDOE) at the same time increased the price of full-price lunches from $1.00 to $1.50, while the price of subsidized lunches remained unchanged. Importantly, the incidence of this policy change varied by income level: full-price payers experienced a decrease in the price of breakfast (and a sizable price increase for lunch), reduced-price lunch students saw a smaller reduction for breakfast (and no change for

[1]Reported school breakfast participation rates apply only to students in schools that actually offer school breakfast.
[2]A 2011 study by the Food Research Action Center (FRAC) found that in 2010, 25 of 29 large urban school districts surveyed provided universal free breakfast (FRAC, 2011). In contrast, a 2003 FRAC study found that few school districts provided universal free breakfast (FRAC, 2003).

lunch), and students already eligible for free lunch and breakfast experienced no change in price (see Fig. 1). The price change was exogenous from the schools' standpoint in that individual schools themselves could not choose whether to change the price of school breakfast; rather, the decision was made at the district level.

As in other school districts, some schools in New York City are certified as "universal free meal" (UFM) schools in which all students may receive school breakfast and lunch at no charge regardless of their actual program eligibility. This certification derives from Provision 2 of the National School Lunch Act, which allows schools to serve all meals at no charge for a four-year cycle (USDA, 2002). The provision is intended to reduce the administrative burden on schools as well as the paperwork and financial burden on families. UFM schools continue to document the percentage of students eligible for free, reduced, and full price lunch but do not charge for meals. They are then reimbursed by the federal government based on their reported percentages of free and reduced price eligible students. While there is no requirement that a UFM school have a minimum fraction of subsidy-eligible students, Provision 2 is more advantageous for schools with a high percentage of these students, where administrative costs are substantial and the foregone fees are minimal.[3] Importantly for our empirical strategy, schools that were UFM schools when the policy was implemented were unaffected by the price change in New York City as they already provided meals free to all students. Thus, these schools offer a natural comparison group for estimating the impact of the policy change. We will refer to non-UFM schools as "traditional" schools as they provide meal subsidies to some but not all students depending on eligibility status, in the traditional manner.

3. Conceptual framework and prior literature

3.1. Factors influencing school meal participation

The introduction of a universal free breakfast program may alter students' participation through a number of mechanisms. First, economic theory suggests that the decrease in the price of breakfast for reduced and full-price lunch students will increase breakfast participation among these groups. Previous research suggests that for students whose meals are not fully subsidized, price influences participation rates for both school breakfast and lunch (Gordon et al., 2007). Moreover, research indicates that price is one of the strongest predictors of participation, and that families are considerably more sensitive to the price of school breakfast than lunch (Maurer, 1984; Gleason, 1995). For example, Gleason (1995) estimates a price elasticity of 0.8 for school breakfast compared to 0.25 for lunch.

Second, universal free breakfast may decrease the stigma associated with consuming school meals by removing the perception that these meals are "just for poor kids." Through this mechanism, the policy could increase participation among all eligibility groups, including free-meal eligible students who already received breakfast free of charge and were not directly affected by the price change. Third, universal provision may provide economies of scale that make the school meals program more efficient or of higher quality.

Previous research provides some evidence of stigma associated with the school meals program. Mitcherva and Powell (2009) treat school-level peer eligibility for free lunch as a proxy for stigma among high school students. Using the Panel Study of Income Dynamics Child Development Supplement, they find that a 10 percentage point increase in the proportion of students eligible for free lunch is associated with a 1.8 percentage point increase in the probability of participation in the NSLP overall, a 2.6 point increase for free

[3]Many schools with high percentages of students eligible for free and reduced meals continue to collect application forms in order to establish eligibility for federal Title I funds (Poppendieck, 2010).

lunch eligible students, and a 6.7 point increase for reduced-price eligible students. Poppendieck's qualitative study, which includes interviews with school food service directors, also suggests that stigma limits participation in school meals (Poppendieck, 2010). Marples and Spillman (1995) found that 18.5 percent of high school students surveyed would eat school lunch more often if their friends did, and other surveys find that parents of children eligible for but not receiving free or reduced-price meals cite stigma as a main reason for not applying for the program (Glantz, Berg, Porcari, Sackoff, & Pazer, 1994; Gleason, 1995). Our research design described below aims to separate the influence of price from other mechanisms that may affect school meal participation, although these other mechanisms (including stigma) are not directly observed.

3.2. School meals and student academic outcomes

Through increased participation, universal breakfast provision may have a secondary effect on academic outcomes. Free school breakfast provides an additional incentive for parents to ensure their child is in school and on time, and thus present for the entire school day. To the extent that meal programs promote greater full-day attendance in school they may promote achievement gains through a simple attendance effect. An observational study by Murphy et al. (1998) finds increased participation in the breakfast program following the implementation of a universal free breakfast program in Baltimore, as well as an association with fewer school absences and less tardiness among participants. In an experimental evaluation of a universal free school breakfast pilot program for the USDA, Bernstein, McLaughlin, Crepinsek, and Daft (2004) find significant increases in breakfast participation but no consistent pattern of positive impact on student health or academic outcomes.[4]

In addition to improving attendance, an adequate and healthy diet may improve the quality of the time spent in school through increased energy and alertness. Although we do not directly observe nutrition in this study, previous studies of varying rigor suggest that school meals may in fact improve student nutrition. In a report to the USDA, Burghardt, Gordon, Chapman, Gleason, and Fraker (1993) find that children who eat breakfast at school eat more fruit, drink more milk, and consume a wider variety of foods than children who eat no breakfast or have breakfast at home. Bhattacharya, Currie, and Haider (2006) find that the SBP considerably improves nutritional outcomes for low-income children. Gleason & Dodd (2009) find the consumption of school breakfast to be associated with lower BMI, while Schanzenbach (2009) reports that consumption of school lunch may in fact increase obesity. Millimet, Tchernis, and Husain (2010) find that the NSLP may contribute to childhood obesity, while the SBP may in fact be beneficial.

Research relevant to the link between nutrition and academic outcomes has found that better nutrition has beneficial effects on cognitive performance. Several studies, some using controlled experiments, have shown positive effects of breakfast on recall, episodic memory, short and long-term memory, visual attention and concentration, as well as decreases in impulsivity among school children (Benton & Parker, 1998; Pollitt, 1993, 1995; Pollitt & Mathews, 1998; Pollitt, Leibel, & Green-field, 1981; Pollitt, Lewis, Garza, & Shulman, 1982; Wesnes et al., 2003). Howard (2011) finds that food insecurity at home negatively influences elementary school students' non-cognitive performance in the classroom. There is also some evidence that the provision and/ or nutritional content of school meals can improve test scores and grades. Figlio and Winicki (2005) find that school districts that increased the caloric content of school lunches on test days demonstrated increased passing rates, although selection bias limits causal inference. Alternatively, using a regression-

[4]In an unpublished study, Ribar and Haldeman (2012) examine a switch from universal free school breakfast to an eligibility-based system in North Carolina. Using a difference-in-difference strategy the authors find decreased participation in school breakfast and an unexpected improvement in attendance.

discontinuity design McEwan (2013) finds no effect of Chile's policy to increase the caloric intake of meals in some schools, on school enrollment, attendance, or test scores. Finally, Imberman and Kugler (2012) using a difference-in-difference strategy find that moving breakfast provision from the cafeteria to the classroom results in significant increases in reading and math test scores.

4. Data and sample

Our analysis draws on a rich longitudinal database, compiled using student and school level data for all New York City public elementary and middle schools. Altogether, our student, school, and meal data span the period 2001–02 to 2007–08, although for reasons we discuss below, our baseline models focus on the year before and the year after the policy change (2002–03 to 2003–04). Student data include socio-demographic characteristics such as gender, race/ethnicity, and subsidized lunch eligibility, as well as educational program participation (e.g. special education, limited English proficiency). These data also include school attendance, and standardized test scores on statewide English and math tests for students in grades 3–8. School level data include average student characteristics, standardized test results, and attendance data, obtained from New York State's *Annual School Reports*. Additional school-level data provided by the New York City Office of School Food include the total number of breakfasts and lunches served at each school, the number of breakfasts and lunches served by income eligibility group, and the number of students in each eligibility group at each school.[5] We note that meals served are not exactly the same as meals consumed, and we cannot confirm whether students actually ate the meals provided. Thus, we operationalize participation in the school meals program as the number of meals served. Our analyses of program participation examine the average number of meals served per year per student in each eligibility group. For example, the average number of breakfasts served per reduced price eligible student is calculated as the total number of breakfasts served to reduced price eligible students divided by the total number of students in this category.[6] Data from the Office of School Food also indicate which schools are certified as universal free meal (UFM) schools.

Figs. 2–5 illustrate trends in breakfast and lunch participation for each meal eligibility group, displayed separately by school type (traditional versus UFM). The introduction of universal free school breakfast occurred at the beginning of the 2003–04 school year (indicated in the figure using a vertical reference line). For traditional schools which experienced the price change, Fig. 2 shows a flat breakfast participation level prior to the policy change, and a sharp increase in participation immediately following the policy change. Notably, participation increased sharply for all groups, including those already eligible for free breakfast. For UFM schools, Fig. 3 suggests a slight upward trend in breakfast participation, but there is no sharp change immediately after the price change. Figs. 4 and 5 indicate that school lunch participation remained relatively flat immediately after the policy change, although it has increased in subsequent years. Also, note that participation rates are generally much higher for lunch than for breakfast for all eligibility groups in both traditional and UFM schools. Our New York City data indicate that in traditional schools, free meal eligible students participated in lunch at approximately 3.5 times the rate of breakfast in 2002–03. Reduced and full price meal students participated in lunch roughly 6 times as much as they participated in breakfast.

[5]We calculate the number of full price meals by subtracting the number of free and reduced price meals from the total number of meals.

[6]The maximum number of breakfasts or lunches served per pupil per year is 180.

As described in greater detail in Section 5, we estimate the impact of the policy change on school meal participation in two ways; first by examining only the traditional schools affected by the policy change, then by including both traditional and UFM schools, with the latter serving as an untreated comparison group. Our preferred models utilize data for the year before and the year after the policy change (2002–03 and 2003–04), and include 667 elementary and middle schools that did not change their UFM school status during this time. We include only schools that did not change UFM status in the year following the policy change in order to not conflate the effect of the district-level policy change with any effect related to individual schools changing their UFM status.[7] Moreover, our focus on the years just before and just after the policy change limits the influence of other contemporaneous district-level policies introduced during this period.[8] Expanding our analysis beyond the two-year window would allow us to control for longer-run trends, but at a cost of reducing the sample of schools who do not switch UFM status (which may be an endogenous decision). In subsequent robustness checks we re-estimate our models using the expanded time frame.

Student-level analyses estimating the impact of the policy change on student attendance and test scores include 723,843 students in grades 3–8 (the grades in which New York City students take standardized math and reading tests) in school years 2002–03 and 2003–04. Constructing our student-level sample requires careful consideration of missing data related to children's meal eligibility status. Although many studies include eligibility for free or reduced price lunch as a standard control variable, in this study the meal eligibility variable is critical to our identification strategy. Data collection on meal eligibility relies on families submitting eligibility forms, and as a result there is a nontrivial amount of missing data, especially in UFM schools where children receive free breakfast and lunch regardless of whether eligibility forms are returned. UFM schools still must collect income eligibility forms in order to qualify for Title I funds, although individual families have weaker incentives to complete them.[9] In traditional schools, students who are not eligible for free or reduced price meals have little incentive to provide information about family income. Therefore, missing values for meal eligibility status must be addressed thoughtfully. For students missing eligibility status in the year prior to the policy change (2002–03), we fill in missing values using data from the previous year wherever possible. Further, we fix students' meal eligibility status at baseline (2002–03) in order to limit the influence of any differential missing data between the pre and post years.[10] This strategy also helps guard against any endogenous changes in meal eligibility status related to the policy change itself, including any influence on families' incentives to report income for determining meal eligibility status.[11]

Table 1 provides descriptive statistics for New York City public elementary and middle schools in school years 2002–03 and 2003–04, disaggregated by UFM status. UFM schools

[7]It is plausible that the price change induced schools to change universal free meal school status although this may be unlikely in the short run as the policy change was relatively sudden and unexpected. An examination of the number of schools that switched UFM status after the policy change does not suggest a clear pattern. Roughly the same number of schools changed from UFM to traditional (50) as changed from traditional to UFM (56) in the year after the policy change.

[8]For instance, in May 2004 the NYCDOE hired an executive chef to help make meals more nutritious and attractive to students. This initiative was focused more on lunch menus, however, as opposed to breakfast. Beginning in 2007–08, some schools began providing breakfast in the classroom rather than the cafeteria to increase participation. This program did not begin until after the data in this study, however. We know of no other concurrent district-wide policy changes that would have affected breakfast participation during this period.

[9]Note that children in families that receive other public supports such as the Supplemental Nutrition Assistance Program (SNAP) are directly certified for free meal eligibility.

[10]These strategies largely address the missing mealeligibilitydata, leaving 3.9% missing in traditional schools and 12.1% missing in UFM schools.

[11]In subsequent robustness checks, for example, we alternatively address this issue by treating all missing values in traditional schools as full price eligible and all missing values in UFM schools as free lunch eligible.

on average enroll a larger share of black and Hispanic students, and, not surprisingly, enroll a higher percentage of students that are eligible for free meals than traditional schools, 81.4 percent compared to 59.3 percent in the 2002–03 school year. We point out that UFM schools also enroll a meaningful share of reduced and full-price meal students: 9.2 percent reduced price eligible students (versus 9.6 percent in traditional schools) and 10.3 percent full price students (versus 30.8 percent). This is important given the role these groups play as controls in our difference-in-difference approach. Participation in the breakfast program as measured by the number of breakfasts served per student increased for all eligibility groups from 2002–03 to 2003–04 in both traditional and UFM schools, although the increase was larger in both absolute and percentage terms in traditional schools. The mean number of lunches served per pupil remained relatively stable for all eligibility groups in both traditional and UFM schools in the year following the price change.[12]

Table 2 provides descriptive statistics for our student-level sample, again disaggregated by UFM status. This sample is restricted to students in grades 3–8, as students in earlier grades were not tested. These statistics mirror those seen in Table 1. For example, we see that UFM schools have a larger share of free lunch eligible students and black and Hispanic students. Students in traditional and UFM schools have similar average attendance rates, but on average students in traditional schools score better on standardized reading and math tests. As expected, UFM schools have more low-income students, although traditional schools have a considerable proportion of low-income students as well.

5. Estimation strategy

We estimate the impact of the policy change on school breakfast and lunch participation, as well as on school attendance and standardized math and English Language Arts [ELA]—(hereafter, "reading") test scores.[13] As described below, we estimate impacts in two ways, first by examining only those schools affected by the policy change (traditional schools) and second by incorporating UFM schools into the analysis as an untreated comparison group. In the latter models, which are our preferred approach, we rely on a difference-in-difference design which uses within- and between-group variation in treatment over time to estimate the effect of the policy change. Effects are identified by comparing the difference in outcomes (e.g. program participation, attendance, or achievement) before and after the price change among eligibility groups in schools that experienced a change in the price of school breakfast (traditional schools) to those not experiencing changes (UFM schools). The unit of observation for our models of meals program participation is defined by the school, eligibility group and year, while our student-level models rely on student-by-year observations.[14]

5.1. Impact of the policy change on school breakfast participation

As a first step toward estimating the effects of the policy on breakfast program participation, we examine only those schools in which students experienced price changes (the traditional schools), using a pre-post design with heterogeneous treatment effects for the free, reduced, and full price student groups.[15] These models are specified as follows:

$$BK_{ist}=\beta_0+\beta_1 RP+\beta_2 FP+\beta_3 FR\times POST+\beta_4 RP\times POST+\beta_5 FP\times POST+\theta X_{ist}+\delta_s+u_{it}, \quad (1)$$

[12]All schools in the sample offered breakfast and lunch in both 2002–03 and 2003–04.
[13]All test scores are normalized to have a mean of zero and standard deviation of one within grade and year.
[14]That is, observations are defined for school *s*, income group *i*, and year *t*.
[15]As noted above, to avoid any effect of endogenous switching of UFM status related to the policy change, we include only those schools that were traditional for both the year before and the year after the policy change. In subsequent robustness checks, we include those schools that switched UFM status.

where *BK* is the natural log of the number of breakfasts served per student per year in each income group *i* (free, reduced, or full-price) in school *s* and year *t*. *FR*, *RP*, and *FP* are indicator variables that take a value of one for observations on free, reduced, and full price eligibility groups, respectively. *POST* is a dummy variable that takes a value of one for observations in the year following the policy change. *X* is a vector of mean characteristics of students in group *i* in school *s* in year *t*, δ_s is a school fixed effect, and *u* is the error term. Our preferred specification includes school fixed effects which allow us to focus on differences between eligibility groups within schools, while removing fixed unobserved differences in meal program participation across schools. In all cases, we cluster standard errors at the school level.

In model (1), coefficients β_1 and β_2 capture the extent to which participation is higher or lower for the reduced-price and full price meal groups relative to the free lunch eligible groups prior to the price change, as free lunch eligible students are the reference group. Our primary coefficients of interest β_3, β_4, and β_5 estimate the change in participation for free, reduced, and full-price groups respectively after the policy change. For reduced and full price meal groups, β_4 and β_5 estimate the overall effect of universal free breakfast provision on participation for these groups, encompassing the price reduction, as well as any change in stigma, and other effects. Given these possible mechanisms, we expect β_4 and β_5 to be positive. For the free meal group, β_3 estimates the effect of universal free service provision on participation due to all non-price effects, as these students did not experience a price change. Thus, if price were the only factor influencing participation, β_3 would be zero. It also is possible that trends in participation were present in all income groups, biasing our estimates of β_3, β_4 and β_5. If it were true that the free meal group was not affected by the policy change, then β_3 should capture this intercept shift. A modified estimate of the impact on reduced and full price eligible students, then, would be β_4 and β_5 net of these trends β_3 (i.e. $\beta_4 - \beta_3$ and $\beta_5 - \beta_3$). Of course, as discussed above, free meal eligible students may very well have been affected by the policy change, perhaps through a stigma effect or some other mechanism, which leads us to our next identification strategy.

Our second, and preferred, strategy adopts a difference-in-difference design, comparing the pre/post change in meal participation for each student eligibility group in schools affected by the policy change to those in UFM schools that were not affected by the policy change. Again, because all students in UFM schools were eligible to receive school meals free of charge throughout this period these schools should not have experienced any price or non-price (e.g. stigma) effects under the new policy. Examining the difference between student groups in UFM and traditional schools over time enables us to "net out" other citywide trends in school meal participation. As long as these trends were similar in both UFM and traditional schools, the difference between them in breakfast participation before and after the policy change should represent the effect of the price change net of outside effects. Therefore, in order to disentangle the effects of the price change from those of other factors we include UFM and traditional schools together in the following model:

$$\begin{aligned} BK_{ist} = \beta_0 + \beta_1 RP + \beta_2 FP + POST(\beta_3 FR + \beta_4 RP + \beta_5 FP) \\ + TR_s(\beta_6 FR + \beta_7 RP + \beta_8 FP) + POST \\ \times TR_s(\beta_9 FR + \beta_{10} RP + \beta_{11} FP) + \theta X_{ist} + \delta_s + \mu_{it} \end{aligned} \quad (2)$$

TR is a dummy variable which takes a value of one if a school is traditional in that it limits meal subsidies based on eligibility, and thus is not a universal free meal school. The primary coefficients of interest are β_9, β_{10}, and β_{11} which provide the difference-in-difference. These coefficients represent the differential post-policy change in breakfast participation for students in each eligibility group in the traditional schools compared to those in the UFM

schools which were not affected by the policy change. Models also include school-level demographic controls including percent Asian, black, Hispanic, and percent eligible for free and reduced price lunch, as well as a dummy variable indicating whether a school is an elementary school. Again, we cluster standard errors at the school level, and our preferred specification includes school fixed effects.

We also explore the possibility of heterogeneous treatment effects by fitting models for subsamples of schools based on the percentage of children eligible for free lunch, which has been used as a proxy for stigma in previous studies (Mitcherva & Powell, 2009). In principle, stigma associated with school meals as "just for poor kids" would be minimal in a school where all or most students were eligible. Thus, we predict that as student populations become more heterogeneous in income, stigma is likely to increase. Schools with very high or very low percentages of program-eligible children should be less affected by stigma, since all or very few students would be eligible to participate.

5.2. Impact of the policy change on school lunch participation

The change to universal free school breakfast was accompanied by an increase in the price of lunch for those who pay full price. On the one hand, we would expect the price increase to decrease participation by full price lunch students. On the other hand, if breakfast and lunch are related goods–that is, substitutes or complements–then changing the price of one may affect participation in the other. For instance, if school breakfast and lunch are complements, increased participation in breakfast may serve to increase participation in lunch as well. Alternatively, to the extent that the higher price of lunch for full price students (and higher relative price of lunch for reduced price students) induces students to substitute into breakfast, we might expect participation in lunch to decrease. Thus, despite the increase in the price of lunch for students who pay full price, we consider the expected impact on participation to be ambiguous. To investigate these possibilities, we estimate models (1) and (2) described above, with the natural log of the number of lunches per pupil by income group as the outcome of interest.

5.3. Impact on student attendance and academic achievement

Increases in school breakfast participation may translate into subsequent gains in student achievement via the mechanisms described above, including improved attendance and nutrition. However, estimating this relationship presents several challenges. First, data on individual meal consumption is unavailable in most administrative databases, including ours. Further, school meal participation is likely endogenous to student outcomes. For instance, parents or students that place a high value on nutrition may also place a high value on academics. To address this, we exploit the exogenous one-time policy change in the price of school meals, which may influence breakfast consumption but should have little direct effect on achievement. Again, effects should vary by income level. Those eligibility groups most affected by the price change (full and reduced-price eligible students) should experience the largest change in breakfast participation. If participation has a causal effect on achievement, these groups should in turn experience the largest impact on achievement. Thus, in this analysis we compare students who did not experience a change in the price of school meals (i.e. free meal eligible students) to students who did experience a decrease in the price of school breakfast and an increase (actual or relative) in the price of school lunch (i.e. reduced and full price meal students, or "not-free"). As in (2), we use a difference-in-difference strategy utilizing UFM schools that experienced no change in price as a comparison group, to estimate the effect of the universal free breakfast policy on attendance and achievement using the following model:

$$A_{ist}=\beta_0+\beta_1 NF_i+POST(\beta_2 FR_i+\beta_3 NF_i)+TR_s(\beta_4 FR_i+\beta_5 NF_i)+POST\times TR_s(\beta_6 FR_i+\beta_7 NF_i)+\theta X_{ist}+\delta_s+u_{it}, \quad (3)$$

where A_{ist} is the attendance (or achievement) for student *i* in school *s* in year *t*, and *TR*, *POST*, and *FR* are as defined as in (2). *NF* takes a value of one for students who are not free lunch eligible, i.e. reduced and full price, those who experienced a change in the price of breakfast. The primary coefficients of interest are β_6 and β_7 which provide the difference-in-difference. These coefficients represent the differential post-policy change in student outcomes for students who experienced a change in the price of breakfast in the traditional schools compared to those in the UFM schools not affected by the policy change. We estimate separate models without fixed effects, with school fixed effects, and with student fixed effects. In all cases, we cluster standard errors at the school level. Our preferred model includes school fixed effects due to the short panel and school-level nature of the breakfast policy change. We also explore the possibility of heterogeneous treatment effects by estimating models separately by student race/ethnicity, allowing for the possibility that factors affecting meals participation (such as stigma) affect students differentially by race.

6. Results

6.1. Impact of universal free breakfast on school meal participation

Table 3 presents results examining the impact of the move to universal free school breakfast on school breakfast participation. Models 1 and 2 include the sample of traditional schools only. Both models yield similar results and thus we focus our discussion on model 2, which includes school fixed effects. Consistent with expectations, the negative coefficients on the reduced and full-price meal income group indicators show that students from these groups generally participate less in the school breakfast program than free meal eligible students. The coefficients on the interactions between *POST* and each of the three meal groups indicate that breakfast participation increased for all three groups in the year following the policy change. The full-price group which saw the largest decrease in the price of breakfast experienced the largest increase in participation, 55 percent. On a baseline of 11 meals per student per year, however, this represents only about 6 additional meals (about one week's worth).[16] The increase in breakfast participation for the reduced price group, which saw a smaller decline in price, was 33 percent, or about 5.5 additional meals (on a baseline of 16 meals). Again, these increases in breakfast participation may be attributable to the price change in addition to non-price effects (such as a change in stigma). The free meal eligible group, which experienced no price change, demonstrates a proportionally smaller increase in breakfast participation at 15 percent, also equating to about 6 additional meals (on a baseline of 37 meals).[17] This increase for the free meal eligible group may be attributable to non-price effects of the policy change, such as changes in stigma, or concurrent trends in breakfast participation among free meal eligible students.

To address the possibility of citywide trends in breakfast participation across all groups, models 3 and 4 incorporate both traditional and UFM schools into the model. These two models yield similar results and thus we focus our discussion on model 4 which includes school fixed effects. The negative coefficients on the main effects for reduced and full-price meal groups show that students from these groups generally participate less in the school breakfast program than free meal eligible students in both traditional and UFM schools. The

[16] See Table 1.

[17] The differences between the change in breakfast participation for full price compared to free lunch eligible students, and reduced price compared to free lunch eligible students are statistically significant, suggesting that the price change increased participation by 40 percent for full price students and by 18 percent for reduced price eligible students. This interpretation, however, assumes that the increase in participation among the free lunch eligible was strictly due to existing trends and not the universal provision policy.

coefficients for the interactions between *POST* and each of the three meal groups indicate that breakfast participation increased for all three groups in the year following the policy change. The positive coefficients for the interactions between *TR*, *POST*, and each of the three meal groups indicate that participation in school breakfast increased *more* for students in traditional schools than UFM schools, and allow us to distinguish an effect of the policy change that goes beyond the price change. Again, the increase was largest for the full-price group (36 percent), which experienced the largest decrease in the price of breakfast. The increase in breakfast participation was smaller for the reduced price meal group (21 percent) which experienced a smaller decrease in price. The free meal group which experienced no price change saw a positive but smaller increase in breakfast participation of 5 percent, which should be attributable to all non-price effects of the universal provision.

Finally, in models 5 and 6 we explore the possibility of heterogeneous treatment effects stratifying the sample of schools by the percentage of children eligible for free lunch. Schools with student populations that are more heterogeneous in income may experience greater stigma associated with school meals. If so, these schools may experience larger increases in breakfast participation after the policy change, relative to the population of all schools which has a higher concentration of students eligible for free meals. In contrast to model 4 which includes all 667 schools regardless of the percentage of the student body eligible for free lunch, model 5 includes only those 91 schools with less than 33 percent of the student body eligible for free lunch. The results in model 5 indicate considerably larger increases in breakfast participation for reduced and full-price lunch eligible students in traditional schools with fewer poor students relative to the increases in model 4. There is no significant change for free meal eligible students in this subsample of traditional schools.[18] Model 6 includes only those 210 schools with less than 66 percent of the student population eligible for free lunch. By the same logic, we might expect these schools to have less stigma associated with school meals than those in model 5 (but more than in the sample of all schools in 4). Results indicate larger increases for all three eligibility groups, compared to those in model 4, especially for free lunch eligible students; a 20 percent increase in breakfast participation compared to the 5 percent increase for free lunch eligible students in the full sample of schools. These findings are consistent with the hypothesis that the move to universal free breakfast decreased stigma associated with school meals, although they cannot provide definitive evidence that the increase in participation is due to a reduction in stigma. Alternatively, these increases could be related to other factors. For instance, schools with fewer poor students may have devoted less attention or resources to the breakfast program prior to the policy change.

Table 4 presents estimates of the impact of the policy change on school lunch participation. We focus our discussion on the preferred model (4), although all models yield similar conclusions. The negative coefficients on the main effects for reduced and full price students indicate that these students participate in school lunch less than free lunch eligible students. The coefficients of interest on the interactions between *POST*, *TR*, and each of the three meal eligibility groups indicate no significant change in lunch participation for any group. Thus, the increase in the price of lunch for full price students from $1.00 to $1.50 does not seem to have affected participation, nor is there any evidence of substitution away from lunch toward breakfast. These flat levels of lunch participation despite a price increase could possibly be due, for instance, to increased familiarity with school meals through participating in the free breakfast program (i.e. school breakfast and lunch as complements), decreased stigma, or a generally low price elasticity for school lunches among participating full price students.

[18]This may be related to the small number of children eligible for free lunch in these schools and the relatively small number of schools in this subsample.

In summary, we find that the move to universal free breakfast increased breakfast participation for all eligibility groups, including free meal eligible students who already received breakfasts at no cost. While this change was proportionally larger for reduced and full price students, given the low participation at baseline, the average increase in the total number of breakfasts was quite modest. The increase in the price of lunch for students paying full price does not appear to have affected lunch participation for this group. It is important to emphasize that these are all short-run effects, given the nature of our research design. To the extent universal free breakfast provision reduces stigma and improves service quality over the long-run, our analysis will underestimate the effects of the new policy.[19] As noted earlier, there is little rigorous empirical evidence available on how long it takes mechanisms such as a reduction in stigma to operate.

6.2. Impact of the policy change on academic outcomes

To examine the impact of the universal free school breakfast policy on student academic outcomes we use student-level data. We assess the policy's impact on three academic outcomes: (1) attendance (defined as the percentage of enrolled school days attended per year); (2) reading achievement; and (3) math achievement. Table 5 provides results for the difference-in-difference models that include both traditional and UFM schools, including separate models without fixed effects, with school fixed effects, and with student fixed effects. We focus our discussion on models with school fixed effects, our preferred specification given the short panel and school-level nature of the breakfast policy intervention. Note that models with student fixed effects yield similar point estimates. First, examining attendance rates, model 2 yields positive but insignificant values for the coefficients of interest, the Traditional × Post interactions for both free meal eligible and non-free meal eligible students. Model 5 indicates no significant change in reading scores for students in traditional schools relative to those in UFM schools. Model 8 suggests no change in math scores for students in traditional schools relative to those in UFM schools.

To the extent that stigma or other factors associated with school meal participation affect students differently by race/ethnicity, the policy change may have differential effects by racial subgroups. We explore this possibility by estimating separate models for black, Hispanic, Asian, and white students, deriving separate estimates of the impact of the policy change on attendance. All models include school fixed effects. As shown in Table 6, the results indicate a small significant increase in attendance for black students eligible for free lunch (who were not directly affected by the price change) and for Asian students not eligible for free lunch (who were directly affected by the price change). Although statistically significant, these attendance rate increases of less than 0.5 percentage points are quite small, translating to about 1 extra day of school per year.[20]

6.3. Sensitivity checks[21]

In order to provide the cleanest estimate of the policy's impact on breakfast participation our preferred models include a panel of schools that did not switch UFM status in the year before and after the policy change. As a sensitivity check we relax this restriction to include all elementary and middle schools in our data regardless of whether they switched UFM status. Again our baseline findings of a positive impact on breakfast participation for reduced and full price meal students are robust to this alternate specification. The coefficient

[19]As described previously, we focus on these short term effects so as not to conflate the effects of the policy with changing UFM status or with other district policy changes. Models using a larger number of years are presented in sensitivity checks below.
[20]Models estimating the impact of the policy change on test scores by racial subgroup find no significant effects. See appendix.
[21]See appendix for tables.

for free meal students in traditional schools after the policy change remains positive in this specification but is slightly smaller (0.04 compared to 0.05) and loses statistical significance.

The universal free breakfast policy may take time to change behavior. Alternatively, the changes in breakfast participation found in our baseline models could be a function of trends that existed even before the policy change. Therefore, as an additional sensitivity check we estimate the same models as above, expanding the time frame to two years before and two years after the policy change (school years 2001–02 to 2004–05) and add a linear time trend. The time trend is positive and significant in both traditional and UFM schools, indicating that on average breakfast participation was on the rise. Similar to the results presented in Table 3, the expanded model indicates additional increases in breakfast participation for reduced and full-price students in traditional schools of roughly the same magnitude. The coefficient of interest for free lunch eligible students in traditional schools remains positive but is not significant. However, unlike the preferred models presented in Table 3, these expanded time frame analyses include all schools whether or not they switched UFM status, as including only schools that remained consistently UFM or traditional over the four-year time period would reduce the sample size considerably.[22] Thus, we prefer the shorter time frame estimates so as not to conflate the effects of the policy with changing UFM status or with other district policy changes.

We also expand the time frame for student-level models estimating the impact of the policy change on academic outcomes to include two years before and two years after the policy change (school years 2001–02 through 2004–05). This approach does not meaningfully change the magnitude or significance of any coefficients of interest. As an additional check, we make an alternative assumption about missing values for meal eligibility status, treating all missing values in traditional schools as full price lunch (as full price students in these schools have no incentive to return eligibility forms) and all missing values in UFM schools as free lunch eligible (as choosing UFM schools is advantageous to schools that serve large numbers of free meal eligible students). Again, this does not substantially change the magnitude or significance of any coefficients of interest.

6.4. Study limitations

Although this analysis provides strong estimates of the impact of the policychange on school meal participation and academic outcomes in the short run, it is important to consider its limitations. First, while the policy appears to have increased breakfast participation, we are unable to directly observe mechanisms other than price that may be behind the increase. Although a reduction in stigma is consistent with our findings (and prior research), some other mechanism(s)–for instance, a change related to the delivery or quality of school breakfast–may account for the increase in participation even by students who did not experience a price change. Similarly, although breakfast participation may be beneficial to students nutritionally, our data does not allow us to observe the quality of meals or the effect of breakfast participation on student nutrition or health.

Further, our use of UFM schools as a comparison group assumes that no other policy or trend differentially influenced UFM and traditional schools. We do not have reason to believe this is the case, especially over this short time frame, although we cannot rule out the possibility. Finally, although the school meal data used in this analysis is an improvement over most prior research that we are aware of, data on meals served are at the school-by-

[22]Compared to the 667 schools that did not change UFM status from SY 2003 to SY 2004, 549 schools remained either UFM or traditional for the entire period from SY 2002 to SY 2005.

income group-level, rather than the student-level, which limits the nuance of our information regarding patterns in meal participation.

6.5. Generalizability

School meals programs serve millions of children each day nationwide, yet we should be cautious in generalizing these study results to other locations and time periods. Many other large cities which, similar to New York City, serve large numbers of low income children likely face many similar issues in delivering school breakfast. At the same time, breakfast participation overall in New York City lags behind that in many other large cities, a concern that has led some New York City schools to recently adopt a Breakfast in the Classroom program (FRAC, 2012). It is not well understood why overall participation in New York City is low, although how and when students arrive at school (i.e. walking or public transportation versus a school bus) or available food preparation facilities may play a role. Finally, the generalizability of our findings to other periods in time may be limited by other changes related to school meal provision that have occurred in subsequent years, such as attempts to make meals healthier and more attractive.

7. Discussion and policy implications

The findings presented here suggest the potential for universal service provision to increase participation in public programs through mechanisms other than price, such as a reduction in stigma. New York City's policy change making breakfast free for all students appears to have increased breakfast participation by students from all eligibility groups, even those who were already eligible for free meals. For reduced price eligible students who had previously paid just five cents for breakfast, the move to free breakfast appears to have increased participation by about 20 percent. For full price students who had been paying 25 cents before the free breakfast policy, the increase was about 35 percent. In these schools there also was a 5 percent increase in breakfast participation by free meal eligible students who were not directly affected by the price policy change.

Stigma associated with school meals as a service "for poor kids" has been documented widely in the literature (Marples & Spillman, 1995; Mitcherva & Powell, 2009; Poppendieck, 2010). In the same vein, policies aimed at populations at risk for obesity may face the danger of stigmatization with non-universal targeting of benefits (Solomons, 2005). In such cases, stigma can decrease uptake by those most in need of services. In New York City, the move to universal free breakfast may have decreased stigma and yielded increased breakfast participation even for students previously eligible for free meals. Further, increases in breakfast participation for those eligible for reduced or full price meals (many of whom could be considered moderately low income) were larger in schools where we would expect stigma to be greater; those with lower proportions of students previously receiving free meals.[23] At the same time, this study cannot measure stigma directly, and increased breakfast participation could alternatively be due to other concurrent, unobserved non-price mechanisms such as improvements in the quality or efficiency of food delivery.

Cost-efficiency is another consideration in determining whether to provide public services universally or to target based on need. On the one hand, targeted service provision may lower costs and focus resources on those expected to benefit most. On the other hand, targeting entails administrative costs associated with verifying eligibility or need, and collecting and processing fees. In the case examined here, the reduction in revenue from a move to universal free breakfast in New York City appears to be minimal, with reduced

[23]We find a 20 percent increase in breakfast participation among free meal eligible students in schools with less than two-thirds of the student body eligible for free meals.

price students previously paying only a nickel and full price students a quarter per meal. We estimate the total revenue lost from not charging for the roughly 3.5 million breakfasts served to reduced and full price eligible students in traditional schools during school year 2003–04 to be approximately $300,000. However, this does not account for savings due to reduced administrative costs associated with collecting and processing breakfast fees. Further, this lost revenue was more than offset by the increase in the price of lunch from $1.00 to $1.50 for the roughly 5 million full price lunches served in 2003–04, which we estimate increased revenue by more than $2.5 million. Even with the increase in school breakfast participation for reduced and full price meal students, free meal eligible students continued to participate most, accounting for 80 percent of all breakfasts served in traditional schools in 2003–04.

The findings presented here also underscore the persistent challenge of low participation in school breakfast programs. While proportionally large, these changes in breakfast participation associated with universal free provision equate to rather modest increases in the average number of meals served per student given the relatively low baseline breakfast participation rates. Breakfast participation increased from 11 to 17 breakfasts per year for full price students, 17 to 23 for reduced price eligible students, and 38 to 45 for free meal eligible students. Low participation in school breakfast relative to school lunch is well-documented (Moore et al., 2009). Although breakfast participation rates increased following the policy change in New York City, they remained well below lunch participation rates which averaged 67, 100, and 144 meals per student per year for full price, reduced price, and free meal eligible students, respectively.

Even when free for all, school breakfast is voluntary. Further, unlike school lunch, breakfast traditionally is not fully incorporated into the school day and students must arrive at school early in order to participate. Importantly, in the time period since the introduction of the universal free breakfast policy considered in this paper, New York City and other large cities have begun to explore other avenues to increase participation. Most notably, some schools now provide breakfast in the classroom. This approach entails both free breakfasts for all students and meal provision in a potentially more convenient location. While disentangling the effect of each of these components of breakfast in the classroom on participation will present its own set of research challenges, this paper provides strong estimates of the unique effect of making breakfast free for all.

Finally, this paper also set out to improve our understanding of the relationship between school meals and academic outcomes. We find little evidence of changes in student attendance or test scores resulting from the policy change, which may be consistent with the relatively small changes in meal participation. Thus, although we conclude that increases in breakfast participation of the magnitude observed here do not improve academic outcomes we cannot draw conclusions about whether larger increases may yield academic benefits.

In conclusion, this paper indicates that New York City’s move to universal free school breakfast provision prior to the 2003–04 school year increased breakfast participation by all student groups including those previously eligible for free meals, suggesting non-price mechanisms such as a reduction in stigma. Despite these increases, participation rates for breakfast, which tend to be much lower than for lunch, remained low. Further, these increases in breakfast participation were not large enough to meaningfully influence educational outcomes. Our results point both to the potential benefits of universal rather than targeted service provision and to the need for additional strategies, such as those undertaken in New York City and nationwide in subsequent years, to improve the quality and nutritional value of school meals and to reduce logistical barriers to participation.

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Appendix A

See Tables A.1–A.4.

Table A.1

Breakfasts served per student (log) by eligibility group, school years 2002–03 to 2003–04 (unbalanced panel, includes schools that switch UFM status).

	Traditional only		Traditional & UFM	
	(1)	(2)	(3)	(4)
Reduced	−1.07*** (0.05)	−1.08*** (0.06)	−0.72*** (0.05)	−0.73*** (0.05)
Full	−1.80*** (0.08)	−1.81*** (0.09)	−0.75*** (0.08)	−0.74*** (0.09)
Post × Free	0.12*** (0.02)	0.13*** (0.04)	0.12*** (0.02)	0.11*** (0.03)
Post × Reduced	0.29*** (0.07)	0.30*** (0.08)	0.15*** (0.04)	0.15*** (0.03)
Post × Full	0.60*** (0.09)	0.61*** (0.09)	0.21** (0.08)	0.19** (0.07)
Traditional × Free			0.03 (0.04)	0.01 (0.10)
Traditional × Reduced			−0.33*** (0.08)	−0.35*** (0.12)
Traditional × Full			−1.02*** (0.11)	−1.05*** (0.15)
Post × Traditional × Free			0.01 (0.03)	0.04 (0.05)
Post × Traditional × Reduced			0.15* (0.09)	0.17** (0.08)
Post × Traditional × Full			0.40*** (0.13)	0.44*** (0.12)
Constant	2.53*** (0.15)	3.15*** (0.51)	2.70*** (0.15)	3.48** (1.60)
Demographic controls	Yes	Yes	Yes	Yes
School fixed effects	No	Yes	No	Yes
R-sqr	0.426	0.681	0.35	0.658
No. schools	433	433	802	802
Observations	2016	2016	4219	4219

Demographic controls: percent Asian, Black, Hispanic, eligible for free/reduced lunch.

Models include elementary school dummy.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.010$.

Table A.2

Breakfasts served per student (log) by eligibility group, expanded time frame (school years 2001–02 to 2004–05).

	Traditional only		Traditional & UFM	
	(1)	(2)	(3)	(4)
Reduced	−1.10*** (0.05)	−1.12*** (0.05)	−0.77*** (0.04)	−0.78*** (0.05)
Full	−1.83*** (0.07)	−1.84*** (0.07)	−0.97*** (0.07)	−0.95*** (0.07)
Time Trend	0.15*** (0.03)	0.08*** (0.03)	0.16*** (0.02)	0.11*** (0.02)
Post × Free	−0.09 (0.06)	−0.01 (0.06)	−0.14*** (0.04)	−0.08** (0.03)
Post × Reduced	0.19** (0.08)	0.27*** (0.07)	−0.02 (0.05)	0.03 (0.04)
Post × Full	0.51*** (0.09)	0.59*** (0.08)	0.22*** (0.08)	0.22*** (0.07)
Traditional × Free			0.03 (0.03)	0.05 (0.06)
Traditional × Reduced			−0.30*** (0.07)	−0.30*** (0.08)
Traditional × Full			−0.82*** (0.09)	−0.84*** (0.10)

	Traditional only		**Traditional & UFM**	
	(1)	**(2)**	**(3)**	**(4)**
Post × Traditional × Free			0.03 (0.03)	0.02 (0.04)
Post × Traditional × Reduced			0.19*** (0.07)	0.19*** (0.07)
Post × Traditional × Full			0.28*** (0.11)	0.32*** (0.10)
Constant	2.57*** (0.14)	−0.19 (1.36)	2.60*** (0.13)	2.01** (0.79)
School fixed effects	No	Yes	No	Yes
R-sqr	0.393	0.632	0.345	0.616
No. schools	525	525	813	813
No. observations	4313	4313	8416	8416

Demographic controls: percent Asian, Black, Hispanic, eligible for free/reduced lunch.

Models include Elementary School dummy.

Note: Unbalanced panel, includes schools that switched UFM status

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.010$.

	Breakfast		Lunch	
Category:	*Before*	*After*	*Before*	*After*
Free	$0.00	$0.00	$0.00	$0.00
Reduced	0.05	0.00	0.25	0.25
Full	0.25	0.00	1.00	1.50

Fig. 1.

School meal prices by eligibility group, before and after policy change. *Note*: School meal prices before policy change are for school year 2002–03 and after policy change are for school year 2003–04. “Reduced” indicates reduced price school meal, and “Full” indicates full price school meal.

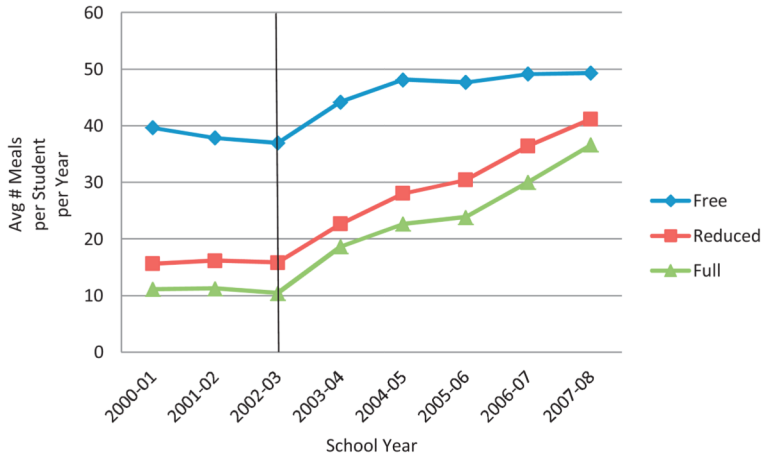

Fig. 2.

Breakfast participation in traditional schools by eligibility group, 2000–01 to 2007–08. *Note*: The vertical line in the figure marks the introduction of the school meal price change policy. “Free” indicates eligible for free school meals, “Reduced” indicates eligible for reduced price school meals, and “Full” indicates eligible for full price school meals. “Traditional” schools are those that provide meal subsidies to some but not all students depending on eligibility status, in the traditional manner.

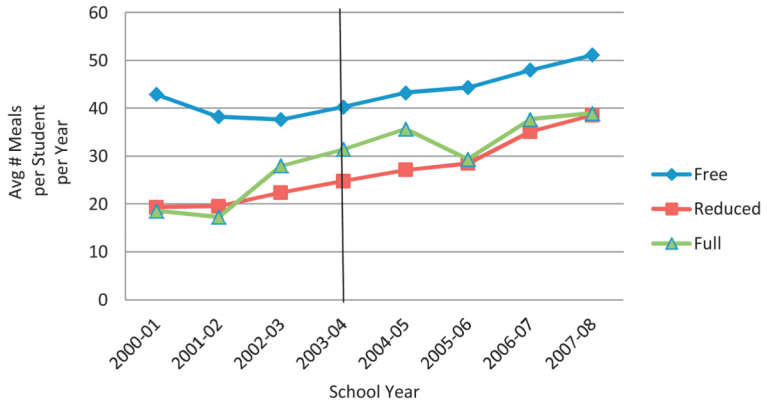

Fig. 3.

Breakfast participation in UFM schools by eligibility group, 2000–01 to 2007–08. *Note*: The vertical line in the figure marks the introduction of the school meal price change policy. "Free" indicates eligible for free school meals, "Reduced" indicates eligible for reduced price school meals, and "Full" indicates eligible for full price school meals. "UFM" schools are those that provide free school meals to all students regardless of eligibility status.

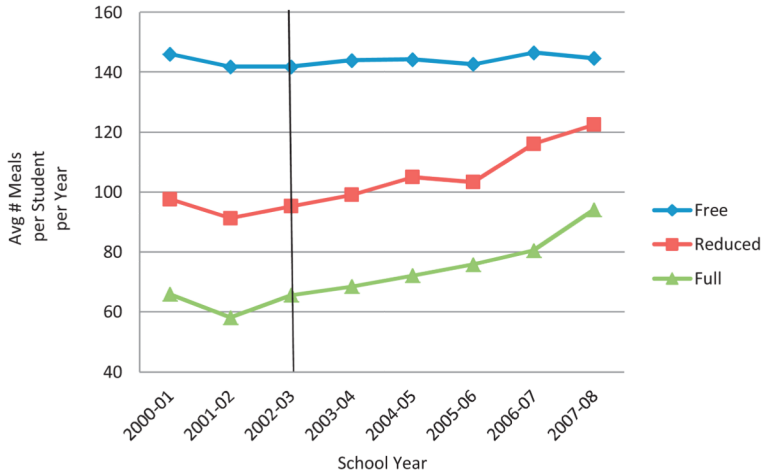

Fig. 4.

Lunch participation in traditional schools by eligibility group, 2000–01 to 2007–08. *Note*: The vertical line in the figure marks the introduction of the school meal price change policy. “Free” indicates eligible for free school meals, “Reduced” indicates eligible for reduced price school meals, and “Full” indicates eligible for full price school meals. “Traditional” schools are those that provide meal subsidies to some but not all students depending on eligibility status, in the traditional manner.

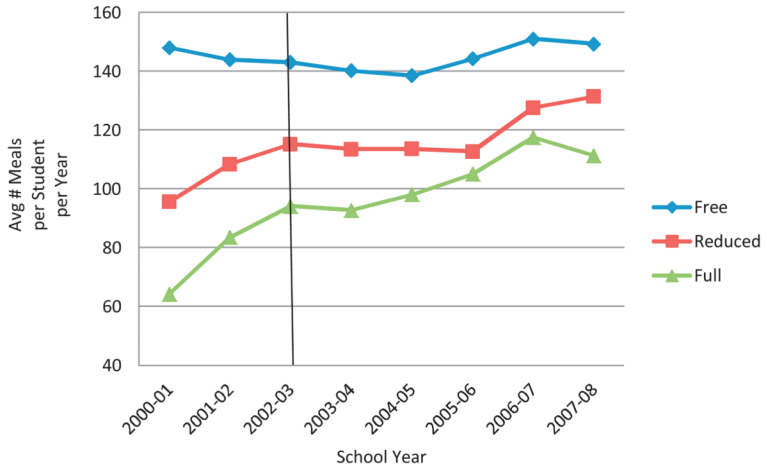

Fig. 5.

Lunch Participation in UFM Schools by Eligibility Group, 2000–01 to 2007–08. *Note*: The vertical line in the figure marks the introduction of the school meal price change policy. "Free" indicates eligible for free school meals, "Reduced" indicates eligible for reduced price school meals, and "Full" indicates eligible for full price school meals. "UFM" schools are those that provide free school meals to all students regardless of eligibility status.

Table 1

School-level sample descriptive statistics by traditional vs. UFM school, school years 2002–03 & 2003–04.

	Traditional		UFM	
	2002–03	2003–04	2002–03	2003–04
% Black	29.3 (30.5)	29.3 (30.3)	34.9 (30.2)	34.8 (29.9)
% Asian	15.4 (18.0)	15.9 (18.3)	12.9 (16.8)	13.0 (16.9)
% Hispanic	28.7 (22.3)	28.8 (22.3)	41.6 (25.2)	41.9 (25.1)
% White	26.5 (28.6)	26.0 (28.4)	10.6 (15.8)	10.4 (15.6)
% Free lunch eligible	59.3 (29.1)	59.3 (28.7)	81.4 (12.7)	80.3 (12.7)
% Reduced price eligible	9.6 (6.0)	10.9 (6.3)	9.2 (4.3)	9.9 (4.6)
% Full price eligible	30.8 (25.7)	30.2 (25.2)	10.3 (11.9)	9.9 (13.3)
% Limited English proficiency	8.7 (7.0)	9.9 (8.0)	12.3 (8.8)	14.3 (10.4)
# Free breakfasts per pupil	38.4 (19.5)	44.8 (21.4)	37.7 (17.6)	41.3 (18.0)
# Reduced breakfasts per pupil	16.7 (16.7)	22.6 (22.1)	22.8 (17.5)	25.4 (18.9)
# Full breakfasts per pupil	11.1 (15.3)	17.2 (21.6)	26.9 (28.2)	33.1 (34.7)
# Free lunches per pupil	143.1 (23.3)	143.7 (22.4)	143.3 (20.3)	141.4 (19.9)
# Reduced lunches per pupil	98.4 (42.5)	100.3 (38.7)	118.4 (30.9)	116.2 (30.2)
# Full lunches per pupil	67.9 (38.2)	67.4 (40.6)	96.3 (43.8)	95.4 (45.9)
Average total enrollment	812 (328)	792 (320)	840 (394)	810 (372)
No. elementary schools	245	245	298	298
No. middle schools	65	65	60	60
No. schools (total)	310	310	358	358

Note: Standard deviations in parentheses.

Table 2

Student-level sample descriptive statistics by traditional vs. UFM school, school years 2002–03 & 2003–04.

	Traditional		UFM	
	2002–03	**2003–04**	**2002–03**	**2003–04**
% Black	30.9 (46.2)	29.6 (45.7)	35.2 (47.8)	34.1 (47.4)
% Hispanic	33.9 (0.5)	36.0 (0.5)	43.1 (0.5)	40.3 (0.5)
% Asian	13.8 (34.5)	13.3 (33.9)	12.7 (33.3)	13.6 (34.3)
% White	21.3 (41.0)	19.2 (39.4)	9.0 (28.6)	10.0 (30.0)
% Free lunch eligible	66.3 (47.3)	68.0 (46.6)	85.0 (35.7)	84.5 (36.2)
% Reduced price eligible	9.4 (29.2)	8.9 (28.5)	7.3 (26.0)	7.3 (26.0)
% Full price eligible	24.2 (42.9)	23.0 (42.1)	7.7 (26.6)	8.2 (27.4)
% Limited English proficiency	7.8 (26.8)	8.8 (28.3)	9.7 (29.6)	9.6 (29.5)
% Female	49.8 (50.0)	48.9 (50.0)	50.3 (50.0)	49.3 (50.0)
% Grade 3	16.2 (36.9)	17.6 (38.0)	19.7 (39.7)	17.5 (38.0)
% Grade 4	15.6 (36.3)	17.3 (37.8)	19.0 (39.2)	17.1 (37.6)
% Grade 5	15.5 (36.2)	17.2 (37.7)	19.1 (39.3)	17.5 (38.0)
% Grade 6	17.8 (38.2)	16.2 (36.9)	14.6 (35.3)	15.9 (36.6)
% Grade 7	17.7 (38.2)	16.0 (36.7)	13.9 (34.6)	16.1 (36.7)
% Grade 8	17.2 (37.7)	15.7 (36.4)	13.7 (34.4)	16.0 (36.7)
Avg school attendance rate	91.7 (9.0)	92.6 (8.3)	91.7 (9.0)	92.4 (8.6)
Avg reading *Z*-score	0.102 (1.033)	0.068 (1.036)	30.083 (0.953)	30.055 (0.960)
Avg math *Z*-score	0.086 (1.034)	0.054 (1.023)	30.065 (0.961)	30.040 (0.979)
Number of students	207,508	206,416	214,932	214,848

Note: Sample contains students in grades 3–8; standard deviations in parentheses.

Table 3

Breakfasts served per student (log) by school type and eligibility group, school years 2002–03 & 2003–04.

	Traditional only		Traditional & UFM		Traditional & UFM by PFL	
	(1)	(2)	(3)	(4)	PFL < 33% (5)	PFL < 66% (6)
Reduced	−1.03*** (0.06)	−1.04*** (0.07)	−0.67*** (0.05)	−0.68*** (0.05)	−0.69* (0.36)	−0.53*** (0.13)
Full	−1.74*** (0.09)	−1.75*** (0.09)	−0.74*** (0.08)	−0.73*** (0.08)	−0.47 (0.38)	−0.68*** (0.21)
Post × Free	0.14*** (0.02)	0.15*** (0.03)	0.10*** (0.01)	0.10*** (0.01)	0.21 (0.13)	−0.01 (0.09)
Post × Reduced	0.32*** (0.07)	0.33*** (0.08)	0.11*** (0.02)	0.12*** (0.02)	0.20 (0.13)	0.08 (0.06)
Post × Full	0.53*** (0.09)	0.55*** (0.10)	0.21*** (0.07)	0.18*** (0.07)	0.08 (0.14)	0.20 (0.13)
Traditional × Free			0.02 (0.04)	1.54 (1.19)	−4.22*** (0.83)	−5.77** (2.24)
Traditional × Reduced			−0.34*** (0.08)	1.17 (1.20)	−4.50*** (0.83)	−6.20*** (2.23)
Traditional × Full			−0.98*** (0.11)	0.52 (1.19)	−5.70*** (0.85)	−6.84*** (2.26)
Post × Traditional × Free			0.05** (0.02)	0.05** (0.02)	−0.05 (0.15)	0.20** (0.09)
Post × Traditional × Reduced			0.22*** (0.07)	0.21*** (0.08)	0.41** (0.17)	0.32*** (0.09)
Post × Traditional × Full			0.34*** (0.11)	0.36*** (0.12)	0.76*** (0.18)	0.42*** (0.15)
Constant	3.46*** (0.12)	0.93 (1.74)	2.73*** (0.15)	2.01 (1.47)	0.34 (1.53)	0.45 (1.10)
School fixed effects	No	Yes	No	Yes	Yes	Yes
R-sqr	0.308	0.657	0.351	0.652	0.756	0.723
No. schools	310	310	667	667	91	210
No. observations	1672	1672	3581	3581	508	1157

Note: Models include demographic controls not shown (percent Asian, Black, Hispanic, eligible for free/reduced lunch), elementary school dummy, and clustered standard errors. Sample is a balanced panel of schools that did not switch UFM status.

PFL = percentage of students in school eligible for free lunch.

Columns 1–2 include all traditional schools. Columns 3–4 include traditional and UFM schools. Column 5 includes traditional and UFM schools with less than 33% of students eligible for free lunch. Column 6 includes schools with less than 66% of students eligible for free lunch.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.010$.

Table 4

Lunches served per student (log) by school type and eligibility group, school years 2002–03 & 2003–04.

	Traditional only		Traditional & UFM	
	(1)	(2)	(3)	(4)
Reduced	−0.50*** (0.04)	−0.50*** (0.04)	−0.23*** (0.02)	−0.22*** (0.02)
Full	−0.97*** (0.06)	−0.97*** (0.05)	−0.53*** (0.05)	−0.52*** (0.05)
Post × Free	−0.01 (0.01)	0.02 (0.01)	−0.02*** (0.01)	−0.01 (0.01)
Post × Reduced	0.02 (0.04)	0.05 (0.04)	−0.03*** (0.01)	−0.01 (0.01)
Post × Full	−0.03 (0.06)	−0.01 (0.06)	−0.05 (0.05)	−0.01 (0.05)
Traditional × Free			−0.04 (0.02)	−0.62 (0.71)
Traditional × Reduced			−0.31*** (0.05)	−0.90 (0.71)
Traditional × Full			−0.48*** (0.08)	−1.07 (0.71)
Post × Traditional × Free			0.01 (0.01)	0.01 (0.02)
Post × Traditional × Reduced			0.05 (0.04)	0.05 (0.04)
Post × Traditional × Full			0.02 (0.07)	−0.00 (0.08)
Constant	4.75*** (0.07)	5.21*** (0.69)	4.88*** (0.08)	4.04*** (0.65)
School fixed effects	No	Yes	No	Yes
R-sqr	0.317	0.403	0.314	0.610
No. schools	309	309	667	667
No. observations	1743	1743	3490	3490

Note: Models include demographic controls not shown (percent Asian, Black, Hispanic, eligible for free/reduced lunch), elementary school dummy, and clustered standard errors. Sample is a balanced panel of schools that did not switch UFM status. Columns 1–2 include all traditional schools. Columns 3–4 include traditional and UFM schools.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.010$.

Table 5

Attendance rates, reading and math *Z*-scores, student-level model (grades 3–8), school years 2002–03 & 2003–04.

	Attendance rate			**Reading *Z*-score**			**Math *Z*-scores**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Non-Free	1.65*** (0.08)	1.39*** (0.08)		0.39*** (0.02)	0.31*** (0.01)		0.33*** (0.02)	0.26*** (0.01)	
Post × Free	0.42*** (0.08)	0.35*** (0.06)	0.24 (0.22)	0.00 (0.01)	−0.02*** (0.01)	0.66*** (0.02)	0.01 (0.01)	−0.01 (0.01)	0.68*** (0.02)
Post × Non-Free	0.52*** (0.10)	0.41*** (0.07)	0.43* (0.22)	0.02 (0.02)	−0.00 (0.01)	0.66*** (0.02)	0.01 (0.02)	−0.01 (0.01)	0.68*** (0.02)
Traditional × Free	−0.21 (0.13)	−0.10 (0.11)	−0.08 (0.13)	−0.00 (0.02)	−0.01 (0.01)	0.01 (0.01)	−0.03 (0.02)	−0.03*** (0.01)	−0.01 (0.01)
Traditional × Non-Free	0.18 (0.11)	−0.09 (0.15)	−0.29* (0.15)	0.11*** (0.04)	0.01 (0.02)	0.00 (0.02)	0.08*** (0.03)	0.01 (0.02)	0.02 (0.02)
Traditional × Free × Post	−0.01 (0.14)	0.11 (0.09)	0.13 (0.14)	−0.02 (0.02)	0.01 (0.01)	−0.01 (0.01)	−0.00 (0.02)	0.02* (0.01)	−0.00 (0.01)
Traditional × Non-Free × Post	0.00 (0.14)	0.14 (0.10)	0.12 (0.12)	−0.02 (0.03)	0.01 (0.01)	0.04** (0.01)	−0.04 (0.03)	−0.01 (0.01)	−0.03* (0.02)
Constant	89.91*** (0.16)	89.90*** (0.13)	90.41*** (0.72)	0.20*** (0.03)	0.21*** (0.02)	−2.20*** (0.06)	0.32*** (0.03)	0.33*** (0.02)	−2.20*** (0.08)
School fixed effects	No	Yes	No	No	Yes	No	No	Yes	No
Student fixed effects	No	No	Yes	No	No	Yes	No	No	Yes
R-sqr	0.070	0.568	0.875	0.187	0.671	0.901	0.189	0.672	0.911
No. schools	815	815	815	815	815	815	815	815	815
No. observations	723,843	723,843	636,167	723,843	723,843	636,167	723,843	723,843	636,167

Note: Models include demographic controls not shown (Asian, Black, Hispanic, female, limited English proficiency), grade dummies (grades 3–7), and clustered standard errors.

Unbalanced panel, with meal eligibility status fixed at baseline.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.010$.

Table 6

Student-level attendance rate models by race (grades 3–8), school years 2002–03 & 2003–04.

	Black (1)	Hispanic (2)	Asian (3)	White (4)
Post × Free	0.22*** (0.08)	0.33*** (0.06)	0.55*** (0.07)	0.82*** (0.10)
Post × Non-Free	0.31*** (0.10)	0.27*** (0.09)	0.43*** (0.08)	0.76*** (0.11)
Traditional × Free	−0.09 (0.14)	−0.04 (0.13)	−0.01 (0.21)	−0.23 (0.23)
Traditional × Non-Free	−0.30 (0.18)	0.02 (0.18)	0.18 (0.24)	−0.02 (0.26)
Traditional × Free × Post	0.37*** (0.14)	−0.07 (0.12)	0.16 (0.11)	−0.20 (0.14)
Traditional × Non-Free × Post	0.23 (0.15)	0.07 (0.13)	0.25** (0.10)	−0.20 (0.14)
Constant	89.88*** (0.14)	89.92*** (0.15)	93.68*** (0.18)	89.88*** (0.21)
School FE	Yes	Yes	Yes	Yes
R-sqr	0.016	0.010	0.020	0.031
No. schools	813	815	803	782
No. observations	247,374	272,083	94,043	110,343

Note: Unbalanced panel. All models include demographic controls (Asian, Black, Hispanic, female, limited English proficiency), grade dummies (grades 3–7), and clustered standard errors.

Meal eligibility status fixed at baseline.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.010$.

Table A.3

Attendance Rates, Reading and Math *Z*-scores, Student-level Model (Grades 3–8), School Years 2001–02 to 2004–05.

	Attendance rate			**Reading *Z*-score**			**Math *Z*-scores**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Time trend	−0.38*** (0.02)	−0.38*** (0.02)	−1.25*** (0.13)	−0.01*** (0.00)	−0.01*** (0.00)	0.54*** (0.01)	0.01* (0.00)	0.01** (0.00)	0.59*** (0.01)
Non-Free	1.51*** (0.07)	1.23*** (0.06)		0.40*** (0.02)	0.32*** (0.01)		0.34*** (0.02)	0.27*** (0.01)	
Post × Free	0.67*** (0.08)	0.61*** (0.06)	0.60*** (0.07)	0.00 (0.01)	−0.01 (0.01)	−0.00 (0.01)	0.00 (0.01)	−0.01 (0.01)	−0.00 (0.01)
Post × Non-Free	1.11*** (0.10)	0.95*** (0.07)	1.01*** (0.08)	0.04* (0.02)	−0.00 (0.01)	0.01 (0.01)	0.00 (0.02)	−0.03*** (0.01)	−0.02 (0.01)
Traditional × Free	−0.22** (0.11)	−0.07 (0.07)	0.02 (0.07)	−0.00 (0.02)	−0.00 (0.01)	0.02** (0.01)	−0.02 (0.02)	−0.02** (0.01)	0.00 (0.01)
Traditional × Non-Free	0.20** (0.10)	0.04 (0.11)	−0.10 (0.07)	0.10*** (0.03)	0.01 (0.02)	0.00 (0.01)	0.09*** (0.03)	0.01 (0.01)	0.02* (0.01)
Traditional × Free × Post	0.10 (0.12)	0.19** (0.08)	0.07 (0.11)	−0.01 (0.02)	0.01 (0.01)	−0.01 (0.01)	0.00 (0.02)	0.01 (0.01)	−0.01 (0.01)
Traditional × Non-Free × Post	−0.11 (0.13)	0.06 (0.08)	0.07 (0.11)	−0.04 (0.03)	0.01 (0.01)	0.03** (0.01)	−0.05* (0.03)	−0.01 (0.01)	−0.01 (0.01)
Constant	90.82*** (0.15)	90.79*** (0.12)	95.69*** (0.65)	0.22*** (0.03)	0.23*** (0.02)	−2.76*** (0.06)	0.30*** (0.03)	0.32*** (0.02)	−2.97*** (0.07)
School fixed effects	No	Yes	No	No	Yes	No	No	Yes	No
Student fixed effects	No	No	Yes	No	No	Yes	No	No	Yes
R-sqr	0.070	0.596	0.816	0.188	0.667	0.861	0.192	0.660	0.876
No. schools	827	827	827	827	827	827	827	827	827
No. observations	1,335,462	1,335,462	1,335,462	1,335,462	1,335,462	1,335,462	1,335,462	1,335,462	1,335,462

Note: Unbalanced panel. All models include demographic controls (Asian, Black, Hispanic, female, limited English proficiency), grade dummies (grades 3–7), and clustered standard errors.

Meal eligibility status fixed at baseline.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.010$.

Table A.4

Student-level reading & math *Z*-score models by race (grades 3–8), school years 2002–03 & 2003–04.

	Black		Hispanic		Asian		White	
	Read (1)	Math (2)	Read (3)	Math (4)	Read (5)	Math (6)	Read (7)	Math (8)
Post × Free	−0.04*** (0.01)	−0.02*** (0.01)	−0.02** (0.01)	−0.01 (0.01)	0.05*** (0.01)	0.04*** (0.01)	−0.01 (0.01)	−0.00 (0.01)
Post × Non-Free	−0.04*** (0.01)	−0.03** (0.01)	−0.00 (0.01)	−0.01 (0.01)	0.02 (0.02)	0.01 (0.02)	0.01 (0.02)	−0.01 (0.02)
Trad × Free	0.00 (0.01)	−0.02* (0.01)	0.01 (0.01)	−0.03** (0.01)	0.00 (0.03)	0.00 (0.02)	−0.05* (0.03)	−0.07*** (0.02)
Trad × Non-Free	−0.01 (0.02)	−0.03 (0.02)	0.01 (0.02)	−0.00 (0.02)	0.05 (0.03)	0.06** (0.02)	−0.03 (0.03)	−0.03 (0.02)
Trad × Free × Post	0.02 (0.01)	0.02* (0.01)	0.01 (0.01)	0.02* (0.01)	−0.00 (0.01)	−0.01 (0.02)	0.01 (0.02)	0.02 (0.02)
Trad × NF × Post	0.02 (0.02)	−0.00 (0.02)	−0.01 (0.02)	0.00 (0.02)	0.04* (0.02)	−0.02 (0.02)	−0.00 (0.02)	−0.02 (0.02)
Constant	−0.17*** (0.02)	−0.12*** (0.02)	−0.10*** (0.01)	0.05*** (0.02)	0.42*** (0.03)	0.78*** (0.03)	0.27*** (0.03)	0.40*** (0.03)
School FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sqr	0.131	0.060	0.358	0.189	0.243	0.210	0.374	0.343
No. schools	813	813	815	815	803	803	782	782
No. observations	247,374	247,374	272,083	272,083	94,043	94,043	110,343	110,343

Note: Unbalanced panel. All models include demographic controls (Asian, Black, Hispanic, female, limited English proficiency), grade dummies (grades 3–7), and clustered standard errors.

Meal eligibility status fixed at baseline.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.010$.