

Abstract Title Page

Title: Reconciling Experimental and Quasi-experimental Evidence on the Impact of Full-day Kindergarten

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Abstract

Background / Context:

The primary grades have garnered much policy interest as a time to intervene early, potentially facilitating remediation of cognitive and socio-cognitive skill gaps prior to formal schooling and generating high returns on investment in the form of private and social benefits. Several papers have established the early emergence of achievement gaps by race/ethnicity and socioeconomic status (Fryer & Levitt 2004, Fryer & Levitt 2006, Lee & Burkam 2002, Murnane, Willett, Bub & McCartney 2006, Princiotta, Flanagan & Germino Hausken 2006). In addition, these gaps persist and grow throughout the primary grades. There is also a growing literature on the importance of kindergarten—both individual skills in kindergarten and the quality of kindergarten contexts—in predicting later academic and labor market success (Chetty, Friedman, Hilger, Saez, Schanzenbach & Yagan 2011, Duncan, Dowsett, Claessens, Magnuson, Huston, Klebanov, Pagani, Feinstein, Engel, Brooks-Gunn, Sexton & Duckworth 2007). Greater availability of full-day options constitutes a relatively inexpensive and readily maneuverable policy lever through which we could enhance children’s early education exposure.

The existing literature on full-day kindergarten takes two forms: studies using nationally representative data and district- and school-level evaluations. In observational studies using the ECLS-K, researchers have found significant differences between full- and half-day kindergarten students on literacy and mathematics assessments at the end of the kindergarten year (Cannon et al. 2006, DeCicca 2007, Lee et al. 2006, Votruba-Drzal et al. 2008). These full-day kindergarten advantages—as measured by test scores—failed to persist, however, over the first-grade year. In one study, marginally significant differences were found in the spring of first grade (Cannon et al. 2006). DeCicca (2007) found significant differences in mathematics and reading in the fall of first grade, but only for white children, which faded but continued to be significant in spring literacy performance. No significant differences were found between full- and half-day kindergarten students in the ECLS-K in third grade (Cannon et al. 2006, Votruba-Drzal et al. 2008) or fifth grade (Votruba-Drzal et al. 2008).

Additional smaller-scale evaluations have supported the ECLS-K findings of short-term outcomes in the kindergarten year, but no significant long-term effects as measured by test scores (Zvoch, Reynolds & Parker 2008, Hall-Kenyon, Bingham & Korth 2009). In general, findings on the impact of full-day kindergarten relative to half-day kindergarten suggest some positive associations, particularly in the early schooling years. Results related to the impact of full-day kindergarten over time, or the persistence of these positive findings, are decidedly less positive. All of these studies are still subject to concerns about selection bias in that they cannot fully address endogeneity of student assignment to—or school or district provision of—full-day kindergarten. The studies that serve as the foundation for this paper are the first in this literature to leverage exogenous variation in student assignment to explore the impact of full-day kindergarten (Gibbs 2012).

Purpose / Objective / Research Question / Focus of Study:

This paper addresses the question of how to interpret evidence on the impact of full-day kindergarten resulting from different study designs, and provides guidance on how this evidence taken in tandem may inform the design and implementation of full-day kindergarten policies. Incorporating both experimental and quasi-experimental estimates on program impact, the study

capitalizes on student assignment policies that allocated oversubscribed full-day kindergarten slots based on random lotteries and fixed cut-points on kindergarten readiness assessments, testing the causal impact on students' literacy skills at the end of the kindergarten year. The data employed comes from school districts and schools in Indiana that employed such assignment policies in the 2007–2008 school year.

While nearly all students who attend school outside the home participate in kindergarten in the United States, just over 60 percent of students in kindergarten are in full-day settings (Walston & West 2004). As displayed in Figure 1, less than 20 percent of kindergarten students were in full-day settings in 1970. Full-day kindergarten enrollment exceeded half-day participation for the first time in 1995 and by the 2000–2001 academic year, approximately 60 percent of kindergarteners were in full-day classrooms. Of the 3.7 million kindergarten students enrolled in 2001, 2.2 million attended full-day kindergarten. Despite its popularity and growing enrollment, research on the benefits of full-day kindergarten, however, is mixed and lacking in rigorous approaches to estimating program impact prior to the current studies.

Setting:

The study uses data from eight school districts across Indiana, five districts that employed lotteries to assign students to full- and half-day kindergarten settings and three districts that assigned the most academically needy students—on the basis of a cutpoint on a kindergarten readiness pretest—to oversubscribed full-day kindergarten slots. The districts are diverse in geographic location, size, and student composition.

Population / Participants / Subjects:

The study sample consists of nearly 1,000 kindergarten students across five lottery districts and approximately 1,000 students in three districts that employed a fixed cutpoint on a pretest for full-day kindergarten assignment.

Intervention / Program / Practice:

The intervention was assignment to—and participation in—full-day kindergarten, but notably the student assignment policies from which the research designs are established also affect student composition in the classroom. While the treatment of full-day kindergarten itself was randomly assigned or assigned based on a fixed cutpoint on a pretest to individual students, the treatment was administered to whole classrooms, and classroom composition was also necessarily determined by the assignment policy.

Research Design:

The two sub-studies included in this paper employ experimental and regression discontinuity designs respectively. In the first case, districts that randomly assigned oversubscribed full-day kindergarten slots via lottery are included in the experimental study. Data from school districts that allocated oversubscribed slots based on academic need, using a fixed cutpoint on a kindergarten readiness pretest to determine assignment to full- or half-day, comprises the second study. The experimental and quasi-experimental results are presented in tandem to discuss the implications of student assignment policies, and the resulting composition of classrooms, in interpreting study findings and using the evidence collectively to inform policy.

Data Collection and Analysis:

The model for assessing the impact of full-day kindergarten on literacy skills in lottery sites is:

$$Y_{ik} = \beta_0 + \beta_1 ASSIGN_i + (\beta_2 CH_i) + \gamma_k + \varepsilon_{ik} \quad (1)$$

where Y is the outcome measure for student i who attended kindergarten in school k . $ASSIGN$ is the treatment indicator variable, which takes a value of zero for assignment to half-day kindergarten and one for assignment to full-day, regardless of receipt of treatment, resulting in an intention-to-treat estimate. CH is a vector of child-level characteristics for each student i . Because students were randomly assigned and child-level variables are balanced at baseline, models are run both with and without the inclusion of this vector. Outcome models employ school fixed effects to control for initial school context and leverage only within-school variation in treatment assignment. School fixed effects also contribute to precision.

For the purposes of outcomes analysis, standard errors are heteroskedasticity-robust, clustered at the kindergarten classroom level. Because of possible concerns about Huber-White standard errors and poor performance in the presence of the relatively small number of clusters (46 classrooms), it is also important to employ robustness checks, such as the Wild cluster-bootstrap percentile-t procedure, imposing the null hypothesis (Cameron, Gelbach & Miller 2008).

An analysis accounting for noncompliance with treatment assignment was also conducted in a two-stage least squares (2SLS) framework, employing random assignment to full-day kindergarten as an instrumental variable (IV) for full-day kindergarten participation. To estimate the impact of enrolling in full-day kindergarten, the IV approach adjusts the effects of being assigned to full-day kindergarten via the lottery to account for the proportions of students assigned to full-day kindergarten who instead attend half-day kindergarten and students assigned to half-day kindergarten who instead attend full-day kindergarten. The 2SLS models are as follows:

$$FDK_i = \alpha_0 + \alpha_1 ASSIGN_i + (\alpha_2 CH_i) + \mu_i \quad (2)$$

$$Y_{ik} = \delta_0 + \delta_1 FDK_i + (\delta_2 CH_i) + \gamma_k + \varepsilon_{ik} \quad (3)$$

where assignment status ($ASSIGN$) is used to predict actual participation (FDK), and the residuals are employed in the second-stage estimation of treatment impact on outcomes. The IV models produce an estimate of the local average treatment effect, or the LATE, which generalizes to compliers with random assignment. Because of the low frequency of treatment group crossovers, these results will not differ meaningfully from the OLS, or intention-to-treat, results. Again, all models employ school fixed effects and robust standard errors, clustered at the classroom level.

The regression discontinuity analysis also employs a 2SLS design. Because of the fuzzy regression discontinuity design in this case (imperfect compliance with treatment assignment), the analyses require the two stages of analysis. In the first stage, the binary assignment variable—based on pre-test score relative to the cutpoint—is used as an instrument for actual participation in full- or half-day kindergarten. The instrumental variable (IV) model is as follows:

$$FDK_i = \alpha_0 + f(PRE_i) + \alpha_1 (c_i \leq 0) + (\alpha_2 CH_i) + \mu_i \quad (4)$$

In the second stage of the model, the instrumented values of program participation are included as well as school fixed effects. The outcome model is:

$$Y_{ik} = \delta_0 + g(PRE_i) + \delta_1 FDK_i + (\delta_3 CH_i) + \gamma_k + \varepsilon_{ik} \quad (5)$$

Because the specification of the functional form of the running variable, pre-test score, is critical to the interpretation of results, $f(\cdot)$ and $g(\cdot)$ are entered both linearly and quadratically. Third and fourth order polynomials of the running variable do not improve overall model fit when looking at early literacy outcomes.

Findings / Results:

Experimental findings suggest that students who are assigned to—and those who participate in—kindergarten in a full-day setting outperform their peers in half-day settings (0.31 standard deviations) in the same schools. In particular, I find that nonwhite, predominately Hispanic students benefit (0.52 s.d.) from full-day kindergarten in comparison to their half-day kindergarten peers. These heterogeneous treatment effects have implications for narrowing or closing the achievement gap early in formal schooling, and in fact constitutes 117 percent of the control group's race/ethnicity gap.

Results from the districts that employed fixed cut-points to assign the most academically needy students to full-day kindergarten is not consistent with the experimental estimates. The regression discontinuity design generates an estimate of the local average treatment effect (LATE) by comparing the outcomes of students above and near the cut-score (in half-day kindergarten) with those below and near the cut-score (in full-day kindergarten). Over 70 percent of students participated in the setting corresponding to their pre-test score. I find that students in full-day kindergarten near the margin of interest do not outperform their half-day kindergarten counterparts. Importantly, interpreting these findings in conjunction with the lottery evidence requires consideration of heterogeneous treatment effects across the distribution of kindergarten entry literacy skills, homogeneous versus mixed ability grouping of students, and peer effects under different student assignment policies.

Conclusions:

To address these issues, I discuss the context in which treatment occurs under the different assignment policies and the mechanisms through which peer effects may operate differently. Comparisons of similar students—i.e., those in the middle of the pre-test distribution—across the two designs will be made. I will present evidence from the lottery districts that suggests that full-day kindergarten impact is concentrated in the upper and lower tails of pre-kindergarten literacy skills, and will generate regression discontinuity estimates from the lottery data for comparison. I re-weight the samples to reflect the student composition of the other, and also restrict lottery analysis to subpopulations represented in the regression discontinuity sites. I also use peer composition to explore the importance of the student classroom makeup in predicting literacy skills. Ultimately, I will focus on lessons for design of full-day kindergarten policies, including targeted versus universal provision.

Appendix A. References

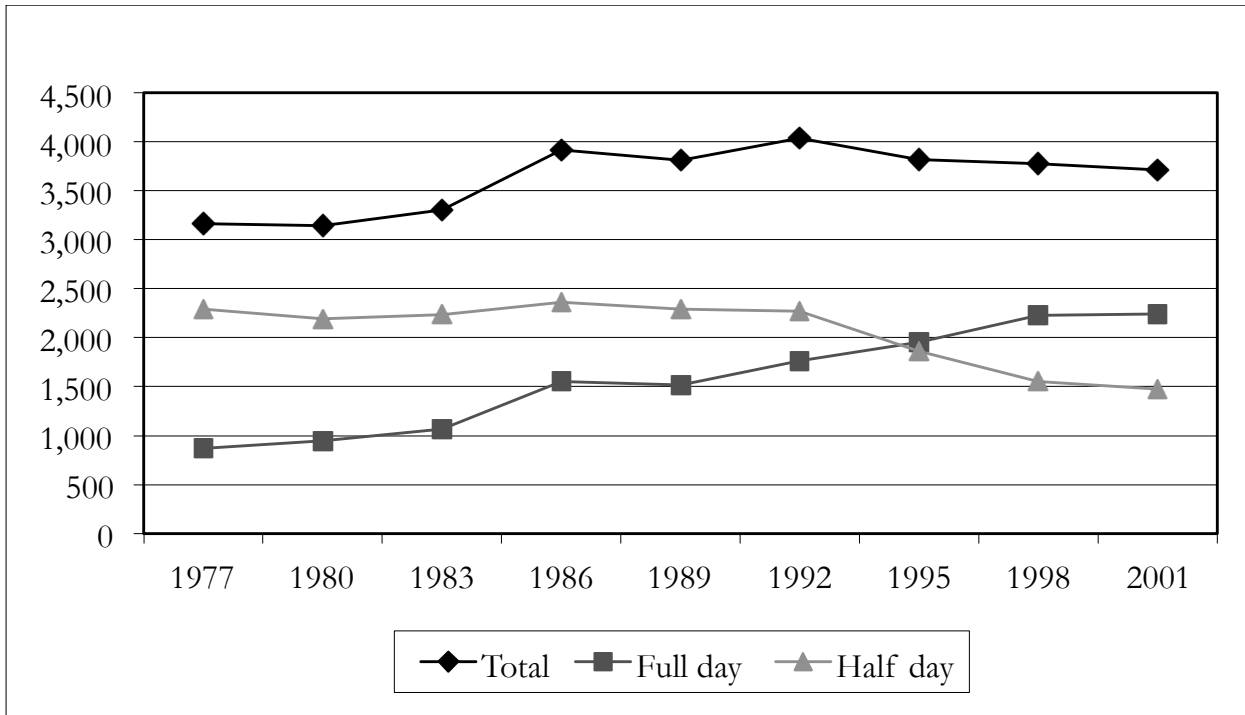
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Appendix B. Tables and Figures

Figure 1. Kindergarten Enrollment (in thousands) Over Time



Source: U.S. Department of Commerce, Bureau of the Census, Current Population Survey (CPS), October Supplement, selected years 1977-2001.