Abstract Title Page
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Title: Measuring the Impact of Full-day Kindergarten: Experimental and Quasi-experimental Evidence

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Abstract Body

Limit 5 pages single spaced.

Background/context:

Description of prior research, its intellectual context and its policy context.

The proposed paper and presentation will detail the results of a full-day kindergarten (FDK) impact study in a Midwestern state. The evaluation explores the impact of FDK as compared to half-day kindergarten (HDK) by utilizing data from natural experiments occurring in districts across the state. The state in question passed legislation which provided funding to increase access and availability of FDK in the 2007-08 school year, with grants targeted directly to school districts and charter schools. The legislation also charged the state department of education and board of education with evaluating the impact of FDK. This paper explores specifically FDK impact on participating students' literacy outcomes. The abstract outlines the study approach and design intended to address the fundamental question of whether FDK affects participants' reading readiness.

The scope of work of this evaluation capitalizes on the existence of natural experiments occurring in school districts throughout the state to more precisely estimate the treatment effect of FDK participation. The natural experiments exist in those schools and school districts that employed a lottery or fixed cut-point to determine who attended full- versus half-day kindergarten in the 2007-08 school year. Typically, the choice to allocate FDK slots in this way resulted from limited funds for the provision of FDK and over-subscription in their areas.

Purpose / objective / research question / focus of study:

Description of what the research focused on and why.

Reasons for studying the impact of FDK versus half-day kindergarten in the Midwest region abound. In addition to a direct request from the state in question, other state legislators and district superintendents across the Midwest region want to know whether investing resources in FDK, particularly when facing budget constraints, reaps benefits worthy of the investment.

The research on the benefits of full-day kindergarten is mixed. An important strain of the literature in the economics of education provides theoretical arguments about the effectiveness of educational interventions early in the life cycle. In particular, human capital investments in children's early years have a longer time horizon in which to realize the return on those investments. Moreover, there are complementarities in human capital acquisition, so skill development at a young age allows for deeper and greater skill development throughout life (Heckman and Lochner, 2000; Heckman, 2000; Carneiro and Heckman, 2003). In addition, economists have pointed to the fact that investments in early childhood—that could be viewed as preventative—are less costly than interventions later in life to address crime, substance abuse, or workforce development and training (Currie, 2001). For these reasons, societal investments in early childhood care and education may prove cost-effective and efficient (*ibid*).

Interestingly, the studies that have examined the direct link between FDK and children's reading performance have mixed results. For example, DeCicca (2006) found that FDK improves reading achievement. However, the gains are much smaller in magnitude at the end of first grade,

particularly for minority children. Other research suggests that the benefits of FDK may be seen until third grade (Cannon, Jacknowitz, & Painter, 2006). Still others argue that class size rather than length of day is related to the development of reading skills (Zvoch, Reynolds, & Parker, 2006). In FDK classrooms with high enrollment, students' reading skills developed at a slower rate than their peers in smaller-sized FDK classrooms and at a rate more similar to their peers in large-sized half-day classrooms.

These mixed results may be due to the fact that most existing studies employed non-experimental designs when examining the impact of FDK. This study capitalizes on the existence of naturally-occurring student assignment mechanisms and employs rigorous methods to fill in this gap in the research. These sites offer opportunities for comparing FDK and HDK and constitute the proposed sample for the purposes of answering the fundamental research question:

> ***Do students in FDK programs outperform their HDK peers in reading at the end of their kindergarten year?***

Setting:
Description of where the research took place.

Based on the results of an on-line survey administered by the state of Indiana and completed by FDK grant applicants, the researcher identified schools and districts that utilized a lottery or other mechanism of selection using a fixed cut-point in allocating slots for over-subscribed FDK programs. In addition, these assignment mechanisms were validated through phone screens with district and school contacts. School districts and schools that appeared to meet the criteria as natural experiments then completed fact sheets verifying the process by which they assigned students to FDK and HDK and provided documentation of the assignment procedures.

Four districts and one charter school employed random assignment of students to FDK and HDK through a lottery. In addition, five districts utilized a fixed threshold for assignment to FDK and HDK, typically a measure of academic need, that rendered these districts strong candidates for regression discontinuity designs. Tables 1 and 2 present basic information about the identified school districts.

[Insert Table 1 and Table 2]

Population / Participants / Subjects:
Description of participants in the study: who (or what) how many, key features (or characteristics).

Notably, the kindergarten enrollments reported in the Tables 1 and 2 are larger than the sample of kindergartners in the study, as only those students who were assigned to kindergarten settings on the basis of lottery results or the fixed cut-point are included in the study sample. In addition, it is more likely that the sample from sites that employed lotteries have sufficient power to detect estimates of treatment effect. Because regression discontinuity studies require larger sample sizes than experiments—and, in particular, sufficient observations around the cut-point—the places that used fixed cut-points for assignment to the treatment and comparison conditions will provide additional results to bolster or counter the experimental estimates of treatment impact. Moreover, the regression discontinuity results may provide insight into the effects of homogeneous ability-

grouping on kindergarteners' literacy skill development. For the purposes of this preliminary paper, only lottery results are estimated and presented. The student sample included in analyses of lottery district data is presented in Table 3.

[Insert Table 3]

Intervention / Program / Practice:
Description of the intervention, program or practice, including details of administration and duration.

Legislation that dramatically increased funding for FDK—intended to increase access and availability—served as the policy trigger for this study. The intervention being explored is participation in FDK, relative to participation in HDK, in the 2007-08 school year.

Research Design:
Description of research design (e.g., qualitative case study, quasi-experimental design, secondary analysis, analytic essay, randomized field trial).

To determine whether students in FDK outperform their peers in HDK, or the effect of the treatment on the treated, the researcher capitalizes on student assignment processes being employed in school districts across the state. By using this self-selected subset of school districts and schools that chose to assign students to the treatment group (participation in FDK) randomly or on the basis of a fixed cut-point, this study has the potential to produce meaningful estimates of the impact of FDK participation on students' early literacy skills. It is more likely that the sites that employed lotteries will produce such estimates of treatment effect, but the places that used fixed cut-points for assignment to the treatment and comparison conditions will provide additional results to bolster or counter those estimates of treatment impact.

Data Collection and Analysis:
Description of the methods for collecting and analyzing data.

Data collection for this study focused on gathering existing data sources. The school districts identified as natural experiments conducted pre- and post-testing of their kindergarten students. This assessment data is linked by the state to student demographics. In addition, teacher data, including experience, education, and certification, as well as the student-teacher ratios in half- and full-day classrooms will allow the research team to explore descriptively any implementation differences that could explain differential effects of HDK and FDK.

The identified districts used either the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) or a statewide reading assessment to assess children's literacy skills at the beginning and end of the school year. Scores from the assessments employed are standardized by their means for comparison and analysis across districts and schools.

The basic model for assessing the impact of FDK in lottery districts is:

$$Y_{ijk} = \pi_0 + FDK_{ijk}\pi_1 + CH_{ijk}\pi_2 + CL_{ijk}\pi_3 + PRE_{ijk}\pi_4 + \varepsilon \qquad (1)$$

where *Y* is the literacy outcome measure for student *i* in classroom *j* in school district *k*. *FDK* is the treatment indicator variable, which takes a value of zero for assignment to half-day and one for assignment to full-day, regardless of receipt of treatment, resulting in an intent-to-treat estimate. *CH* is a vector of child-level characteristics and *CL* is a vector of classroom-level characteristics. *PRE* is a pre-test covariate for each student *i*. It is important to note that lotteries were conducted at the district level, with individual students randomly assigned to full- or half-day status. For this reason, district fixed effects are included in estimated models of the impact of treatment.

The analysis of regression discontinuity data will be similar to the approach above, but will employ 2SLS to model FDK participation in the first stage as a function of the fixed cut-point. The simple participation and outcome equations are as follows:

$$P_{ijk} = \alpha_0 + cutscore_{ijk}\alpha_1 + \varepsilon \qquad (2)$$

$$Y_{ijk} = \beta_0 + FDK_{ijk}\beta_1 + \hat{P}_{ijk}\beta_2 + CH_{ijk}\beta_3 + CL_{ijk}\beta_4 + \varepsilon \qquad (3)$$

While sufficient power is a concern in the regression discontinuity approach, as mentioned previously, these results will be employed to further understand the findings from the lottery districts and perhaps to provide insight into the effects of homogeneous ability-grouping on kindergarteners' literacy skill development.

In order to assess the impact of FDK, it is important to verify randomization in the lottery districts by comparing pre-treatment covariates by group. Table 4 presents this comparison.

[Insert Table 4]

While randomization appears to have been implemented successfully, the treatment group has a statistically significantly larger proportion of male students. For all other variables, any differences between the treatment and control groups are insignificant. Table 5 presents the results of an ordinary least squares (OLS) regression, similar to the model employed in estimates of treatment impact on the literacy outcome, with the literacy pre-test as the dependent variable.

[Insert Table 5]

A few other caveats about random assignment through the lotteries are essential. Notably, over 99 percent of lottery participants complied with their treatment assignment (ie., there are only three treatment group crossovers). While the level of compliance is very high, there are many late-comers who enrolled in the district or school after random assignment. These students are excluded from the analyses presented in this paper. Finally, students are assumed to have dropped out of the study if they are not observed at post-test. Attrition rates differ noticeably by treatment status, with 61 HDK students (14 percent of the control group) and 60 FDK students (nine percent of the treatment group) missing from the sample at post-test.

Findings / Results:

Description of main findings with specific details.

This section presents preliminary results from the analysis of lottery site data; the preliminary findings presented herein will be supplemented by missing data analysis and analysis of fixed cut-point site data. Analyses were conducted for the outcome of interest, the literacy post-test measure, and are presented in Table 6. Model I includes only the indicator variable for FDK assignment as a predictor, while Model II also incorporates the literacy pre-test score. Finally, Model III includes student characteristics as covariates. All models employ district fixed effects and robust standard errors, clustered at the classroom level.

[Insert Table 6]

The results suggest that assignment to FDK does not affect literacy skills at the end of the kindergarten year, as measured by the assessments in question. The coefficients on FDK status are insignificant (i.e, not different from zero) in all three models. An analysis of the impact of treatment on the treated was also conducted in a two-stage least squares framework, employing random assignment as an instrument for FDK participation. Because of the low frequency of treatment group crossover, these results do not differ meaningfully from the OLS results.

While the model displayed in Table 6 assumed a constant treatment effect across the distribution of students in FDK classrooms, descriptive inspection of the data suggested that the treatment effect may differ for students entering FDK with low literacy pre-test scores. For this reason, separate regressions were run for each quartile of the literacy pre-test score distribution. For the lowest quartile, results are presented in Table 7.

[Insert Table 7]

Interestingly, for the group entering in the lowest quartile of literacy skills, participation in FDK has a sizeable positive and statistically significant effect on their end-of-kindergarten literacy skills. Across the three specifications, the magnitude of that impact is on the order of a .3 to .4 effect size. Treatment effects were insignificant for the other three quartile regressions. Separate regressions were also estimated for the lower half of the distribution of literacy pre-test scores and the upper half of the distribution of literacy pre-test scores. The results for the lower half of the distribution are also positive, though smaller in magnitude than the coefficients in Table 7 and marginally statistically significant (at the 10% level).

Conclusions:

Description of conclusions and recommendations based on findings and overall study.

The evidence presented in this paper suggests that FDK does not result in an overall treatment effect when considering literacy skills as the outcome of interest. Assignment to FDK does make a difference, however, for those students with low literacy skills upon kindergarten entry. Students in the lower portion of the literacy pre-test score distribution experienced large, positive gains as a result of FDK assignment. The presence of heterogeneous treatment effects may have important implications for policymakers and will be explored in greater detail with regression discontinuity analyses in this same study. In addition, next steps include follow-up with students assigned to FDK and HDK by lottery or fixed cut-point to explore the persistence of FDK impact on a variety of outcomes, including grade retention and primary grades mathematics and reading assessments.

Appendices

Not included in page count.

Appendix A. References

References are to be in APA version 6 format.

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Appendix B. Tables and Figures

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Table 1. Characteristics of Study Districts: Lottery Sites.

	Locale Type	% Free or Reduced-Price Lunch	% Minority	Elementary Schools	Elementary Enrollment	K Enrollment	K Teachers (FTE)
Lottery Districts							
District 1	City, Small	61	48	7	3076	562	18
District 2	City, Midsize	59	26	1	677	119	4
District 3	Suburb, Large	42	36	4	855	116	5
District 4	Suburb, Large	20	16	11	4719	748	18
District 5	Rural, Distant	19	4	1	464	81	3

Source: NCES Common Core of Data & State Department of Education, Accountability System for Academic Progress.

Table 2. Characteristics of Study Districts: Regression Discontinuity Sites.

	Locale Type	% Free or Reduced-Price Lunch	% Minority	Elementary Schools	Elementary Enrollment	K Enrollment	K Teachers (FTE)
RD Districts							
District 1	City, Small	57	28	11	3348	580	26
District 2	City, Small	47	66	9	3271	530	19
District 3	Rural, Distant	36	5	2	627	93	3
District 4	Suburb, Large	34	13	4	1774	245	7
District 5	Town, Distant	31	6	2	918	129	3

Source: NCES Common Core of Data & State Department of Education, Accountability System for Academic Progress.

Table 3. Study Sample: Lottery District Students.

	FDK students	HDK students
District 1	234	156
District 2	37	15
District 3	9	3
District 4	363	199
District 5	19	50
Total	**662**	**423**

Note: Includes those students for whom results of the lottery could be determined and pre-test scores were non-missing.

Table 4. Summary Statistics.

	FDK students n=662	HDK students n=423	p-value
Literacy pre-test (z-scores)	.003	.011	0.943
Age at pre-test (years)	5.656	5.654	0.911
Free or reduced-price lunch eligibility (%)	37.81	33.18	0.183
Male (%)	49.78	45.63	0.026
White (%)	68.27	69.74	0.118
Black (%)	3.77	2.13	0.482
Hispanic (%)	17.78	17.02	0.470

Note: Means are calculated with district fixed effects.
Inference is based on robust standard errors, clustered by district.

Table 5. Pre-test Model Results.

OLS Estimates	Literacy Pre-test	
	I	II
FDK	-.008	.035
	(.105)	(.093)
Age	—	.481**
		(.076)
Female	—	.300**
		(.015)
Poverty	—	-.636**
		(.098)
Nonwhite	—	-.136
		(.269)
District Fixed Effects	Yes	Yes
R^2	.0001	.1362
n	1,070	1,070

Note: Robust standard errors in parentheses, clustered on district.
*significant at 5% level, **significant at 1% level

Table 6. Preliminary Post-test Model Results.

OLS Estimates	**Literacy Post-test**		
	I	**II**	**III**
FDK	.064	.102	.108
	(.104)	(.103)	(.103)
Literacy Pre-test	—	.595**	.588**
		(.035)	(.036)
Age	—	—	-.029
			(.079)
Female	—	—	.054
			(.058)
Poverty	—	—	-.020
			(.080)
Nonwhite	—	—	-.060
			(.065)
District Fixed Effects	Yes	Yes	Yes
R^2	.0096	.3712	.3728
n	972	972	972

Note: Robust standard errors in parentheses, clustered on classroom.
*significant at 5% level, **significant at 1% level

Table 7. Preliminary Post-test Model Results: Lowest Pre-test Quartile.

OLS Estimates	**Literacy Post-test**		
	I	**II**	**III**
FDK	.313*	.371*	.389*
	(.148)	(.150)	(.149)
Literacy Pre-test	—	1.453**	1.437**
		(.321)	(.311)
Age	—	—	-.233
			(.155)
Female	—	—	.204
			(.113)
Poverty	—	—	-.032
			(.113)
Nonwhite	—	—	-.082
			(.157)
District Fixed Effects	Yes	Yes	Yes
R^2	.0553	.1335	.1542
n	244	244	244

Note: Robust standard errors in parentheses, clustered on classroom.
*significant at 5% level, **significant at 1% level