PRELIMINARY

Does Universal Preschool Hit the Target? Program Access and Preschool Impacts

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Abstract

This paper takes advantage of age-eligibility rules to construct an instrument for prekindergarten (pre-K) attendance in survey data where the mediating influence of program access can be directly assessed. The empirical approach exploits the relatively large difference in pre-K attendance rates between 4 year olds in adjacent kindergarten entry cohorts in states with robust state-funded pre-K programs. This approach reveals a substantial positive effect of attending pre-K on cognitive test scores at age 4, but only for low-income children enrolled in universal programs. Both universal and targeted programs displace enrollment in other center-based care, and differences in state standards cannot explain the higher impacts of universal programs for low-income children. Together, these findings suggest that universal programs offer a relatively high-quality learning experience for low-income 4 year olds not reflected in the quality metrics frequently targeted by policymakers.

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short-term effects of (universal) kindergarten and targeted early education (e.g., Head Start) in recent cohorts, and while point estimates (and thus effects sizes) are somewhat sensitive to specification, a larger impact of universal pre-K for disadvantaged children has emerged across all of the robustness checks considered.

But does this necessarily mean that universal access *per se* causes universal programs to be more productive? Not necessarily. Indeed, even if eligibility for pre-K is "as good as random" at the individual level within targeted and universal states, program access may be related to other program standards that make pre-K attendance more or less productive. For example, Table 1 showed that the universal pre-K programs in operation in 2005-06 were more likely than targeted ones to require class sizes at or below 20 students and student to staff ratios of 10:1 or better. If lower class sizes increase program benefits, class size requirements might be the actual explanation for the universal-targeted impact differential, or may diminish that differential substantially.[35] In addition, the early childhood care and education landscape might be different in states with universal pre-K programs.[36] If there are fewer formal, center-based alternatives to universal pre-K, for instance, I would find relatively large effects of universal pre-K, all else constant.[37]

Table 6 considers the second possibility, showing DD estimates of eligibility impacts from model 2 for "counterfactual" care – Head Start, other center-based care, informal non-parental care, and parental care. These variables are mutually exclusive and, along with pre-K,

[35] Though there are no experimental evaluations of class size impacts in pre-K, there are estimates from kindergarten from Project STAR. Findings from Project STAR (Krueger, 1999; Chetty et al., 2011) suggest that assignment to a small class in kindergarten yields immediate cognitive test score benefits, particularly for disadvantaged children, though not as large as the effects of exposure to universal pre-K for low-income children estimated here.
[36] The establishment of universal programs may in fact change the child care and early education sectors. See, for example, Bassok, Fitzpatrick, and Loeb (2014) and Bassok, Miller, and Galdo (2016).
[37] Feller et al. (2015) and Kline and Walters (2016) find evidence of this in re-analyses of the Head Start Impact Study: Head Start has much larger (smaller) impacts on children who would have otherwise been in parental (center-based) care.

span the space of possible education and care options for preschool-age children; the DD coefficients therefore add up to zero across all categories. The DD coefficients for pre-K (even-numbered columns of Panel A) are the first-stage model coefficients on the instrument for the TSLS estimates presented in Tables 3 and 4. Including the baseline demographic controls, they are not very different from the DD coefficients shown in Table 2, Panel A, particularly for low-income children. None of the DD estimates for the alternative care options (even-numbered columns of Panel B) are statistically significant for low-income children. However, the point estimates are similar to one another regardless of program access, and I cannot reject equality of the DD coefficients for any of the variables, including pre-K attendance. These findings suggest that cross-state differences in counterfactual care options cannot explain the effects.

To address the first possibility, I then estimate the effect of pre-K eligibility holding constant each of the NIEER program standards, one-by-one.[38] The underlying regression model is given by:

$$y_{isp} = \theta_U elig_{is} \times uni_s + \theta_T elig_{is} \times tar_s + \theta_Q elig_{is} \times Q_s + \sum_{p=0}^{1}\sum_{m=-4}^{7} \gamma_{mp} elig_{is}^{m} \times P_p + \alpha_{sp} + x_{is}'\beta_p + \upsilon_{isp}, \quad (4)$$

where p indexes the estimation sample (p=1 for universal pre-K estimates and p=0 for targeted pre-K estimates), uni_s and tar_s represent, respectively, dummies for whether s is a universal or targeted treatment state, and Q_s a dummy set to one if a particular state pre-K program standard was met in 2005-06. Because all of the regression controls are interacted with an indicator for the estimation sample, the model without $elig_{is}$ x Q_s generates the DD estimates of universal and targeted pre-K programs presented in Table 3. The model with $elig_{is}$ x Q_s then adjusts for the correlation between program access and Q_s; estimates of θ_U and θ_T are interpretable as effects of

[38] Estimates are very unstable when attempting to control for all 10 standards simultaneously.

pre-K eligibility when Q_s=0. Because is it unusual for these standards not to be met on average, I present a linear combination of the coefficients that represents attendance effects holding Q_s constant at its average value for states with targeted programs.

Table 7 present these estimates for low-income children. For comparison, column 1 repeats the baseline estimates for low-income children given in Table 3; columns 2 through 10 then represent the linear combination of estimates from model 4 for each program standard on the NIEER index.[39] There is not much fluctuation in the estimates or their difference moving across the columns. Of the 30 specifications shown, only for five is the difference in estimates between universal and targeted programs no longer statistically significant at the 10% level. Three of these cases arise when holding constant teacher BA requirements at their (higher) levels for targeted programs (column 3), but this exercise tends to have a greater effect on standard errors than the point estimates. In the other cases – for class size (column 7) and site visit (column 10) requirements for math scores – p-values on the coefficient difference are also quite close to 0.1.

While not definitive, these findings suggest that universal pre-K is not outperforming targeted pre-K for low-income children because of different standards. An alternative way of thinking about the *relative* importance of universal access and these standards would be to ask whether those standards matter *conditional on* access. For example, do targeted programs with class size requirements produce effects as large as those found for universal programs? If so, it would suggest that it is indeed class size rather than access that is driving the differential. The estimates in Table 7 do not answer these questions, because they force the same effect of each program standard on universal and targeted programs.

[39] I pool the program standards for class size and staffing ratios into one dummy because there is no independent variation in these standards.

Unfortunately, the scope for testing whether there are differences in the effects of standards like class size conditional on access is quite limited. While there is more variation in these standards across targeted states than universal states, much of this variation hinges on Texas alone: it is a large state that requires a lot in the way of teacher credentialing and training, but otherwise does not meet any other standards on the index aside from having comprehensive learning standards. The strongest available test is then to drop Texas from the analysis sample. As shown in the last row in each panel of Table 5, doing so does increase estimates of pre-K eligibility effects for low-income children in targeted states (column 3), but not by enough to render the universal-targeted difference insignificant.

VII. What Makes Universal Pre-K Different?

Overall**,** this paper suggests that universal programs offer a relatively productive learning experience for low-income 4 year olds, and that what makes this learning experience different is not captured by observed program standards. But this begs the question: what makes universal pre-K different? Low-income children may of course benefit from direct interaction with their higher-income peers. If higher-income children enter pre-K more prepared – as suggested by the income achievement gaps of incoming students (Table 3) – universal programs may attract and retain better teachers – teachers who have warmer, more positive interactions with students.[40] The presence of higher-income children in the classroom may also change expectations of what all children should learn. If prompted to focus on relatively advanced material, for instance, teachers may accelerate the learning gains of most students.[41] These, too, are peer effects.

[40] Sabol et al. (2013) find that scores on the Classroom Assessment Scoring System (CLASS) do a better job than inputs (staff qualifications and class size) and learning environment (as measured by the Early Childhood Education Rating System – Revised, or ECERS-R) in predicting test score gains over the pre-K year.

[41] Using data from the ECLS-K, Engel, Claessens, and Finch (2013) show the more time teachers spend on more advanced mathematics content, the more children gain in math scores over kindergarten year, regardless of demographics.

The nature of sampling in the ECLS-B makes it impossible for me to estimate direct peer effects in pre-K classrooms. However, interviews of the pre-K teachers of low-income children and school administrators in the ECLS-B can provide insight into the more indirect peer effects. These interviews spanned many topics, including basic background information, such as teacher education, experience, and class size, as well as teacher beliefs and attitudes, the learning environment, and curriculum and activities.

Table 8 summarizes selected characteristics of pre-K teachers of low-income children, separately by whether the program is universal or targeted. Reassuringly, the basic background statistics reflect NIEER reports of the variation in program standards. In particular, teachers in universal programs report smaller class sizes, while teachers in targeted programs report higher levels of completed education. Teachers in targeted programs also report more experience and more job satisfaction, and directors of those programs if anything report less teacher turnover and more use of direct assessments – all of which might appear to favor targeted programs. But there is a difference in teacher beliefs about their role: compared to only about half of targeted pre-K teachers, over 63% of universal pre-K teachers strongly agree with the statement that "Children who begin formal reading and math instruction in preschool will do better in elementary school."

Using my research design, I unfortunately cannot explore whether teacher beliefs such as these can explain the difference between the estimates for universal and targeted programs. More specifically, I only observe this information for the children who actually enroll – and the subset thereof for whom provider reports are non-missing – making these findings the most speculative of the paper. But this should be a topic for future research, as should the issue of whether and how this apparent academic orientation might be reflected in specific classroom practices.

VIII. Conclusion

Using age eligibility rules and state policy variation, this paper shows that universal state pre-K programs are significantly more beneficial for disadvantaged children in the short-term than targeted state pre-K programs. This finding is robust to a number of specification checks and falsification exercises and continues to hold even when observed program standards are held constant. Though imprecise, effect sizes for targeted pre-K are also remarkably similar to the short-term test score benefits found in recent trials randomizing access to targeted preschool (Puma et al., 2010; Kline and Walters, 2016; Lipsey et al., 2013). Likewise, effect sizes for universal pre-K echo those associated with exposure to the earliest years of universal elementary education (Anderson et al., 2011; Fitzpatrick, Grissmer, and Hastedt, 2011). This suggests that universal pre-K functions more like "school" than targeted programs – an idea in need of further research, but supported by a preliminary analysis of data from interviews of pre-K teachers and school administrators in the ECLS-B.

An important limitation of the findings is that they only pertain to short-term effects for a set of outcomes weighted toward the cognitive domain. Indeed, the research design employed in this paper is not capable of uncovering longer-term effects, as the children who are ineligible for pre-K one year become eligible the next. Non-cognitive outcomes may also be as important as cognitive ones for predicting longer-term gains in well-being (Chetty et al., 2011; Heckman et al., 2013). Future research should work toward developing ways to estimate directly the differences in longer-term effects of targeted and universal programs. Data limitations have also meant that I have focused only on one cohort, which may not be representative of preschool-age children today. This suggests the potential value of estimating even short-term differences in the effects of universal and targeted pre-K in other data.

Until that time, it is worth noting that the immediate cognitive test score gains from educational intervention appear predictive both of later academic performance (Duncan et al. 2007) and of adult outcomes like earnings (Chetty et al., 2011). This suggests that the differences in early test score impacts of universal and targeted pre-K programs documented here could well manifest over the longer term. Moreover, that my focus has been on a recent cohort is valuable: if anything, the impacts of early childhood intervention appear to have declined over time (Duncan and Magnuson, 2013). This makes the relative size of the impacts for universal pre-K all the more striking and worthy of future investigation.

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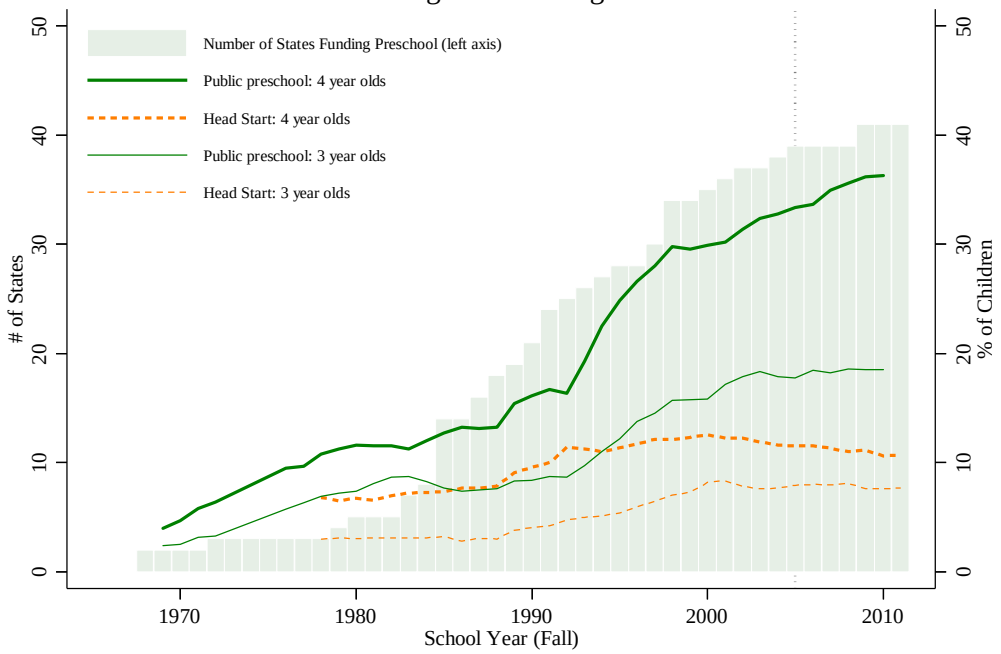
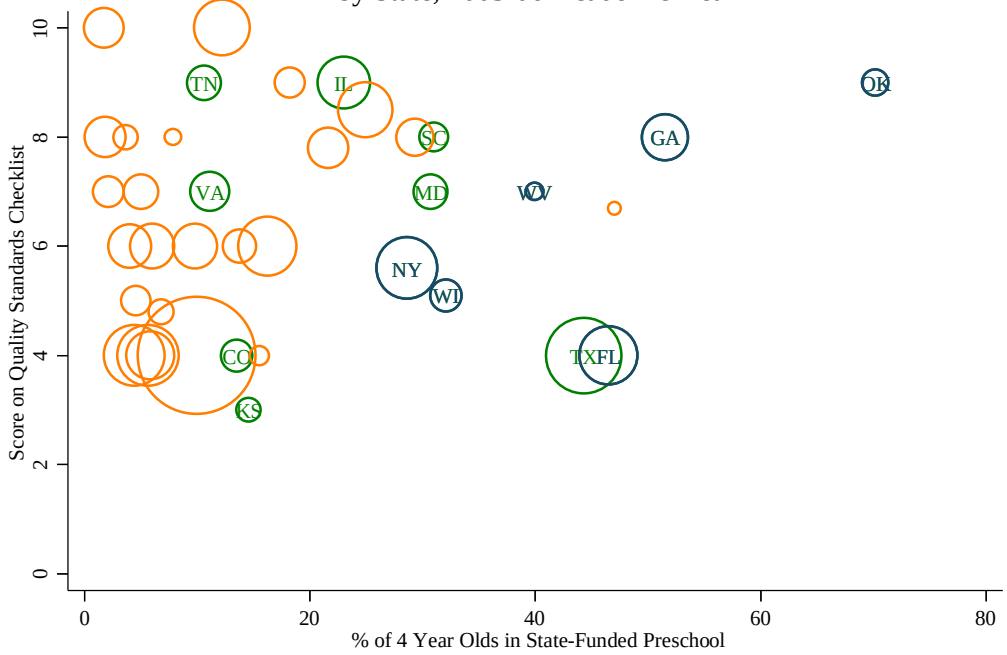
Figure 1. Trends in Public Preschool Enrollment Rates and Prekindergarten Funding: 1968-2011



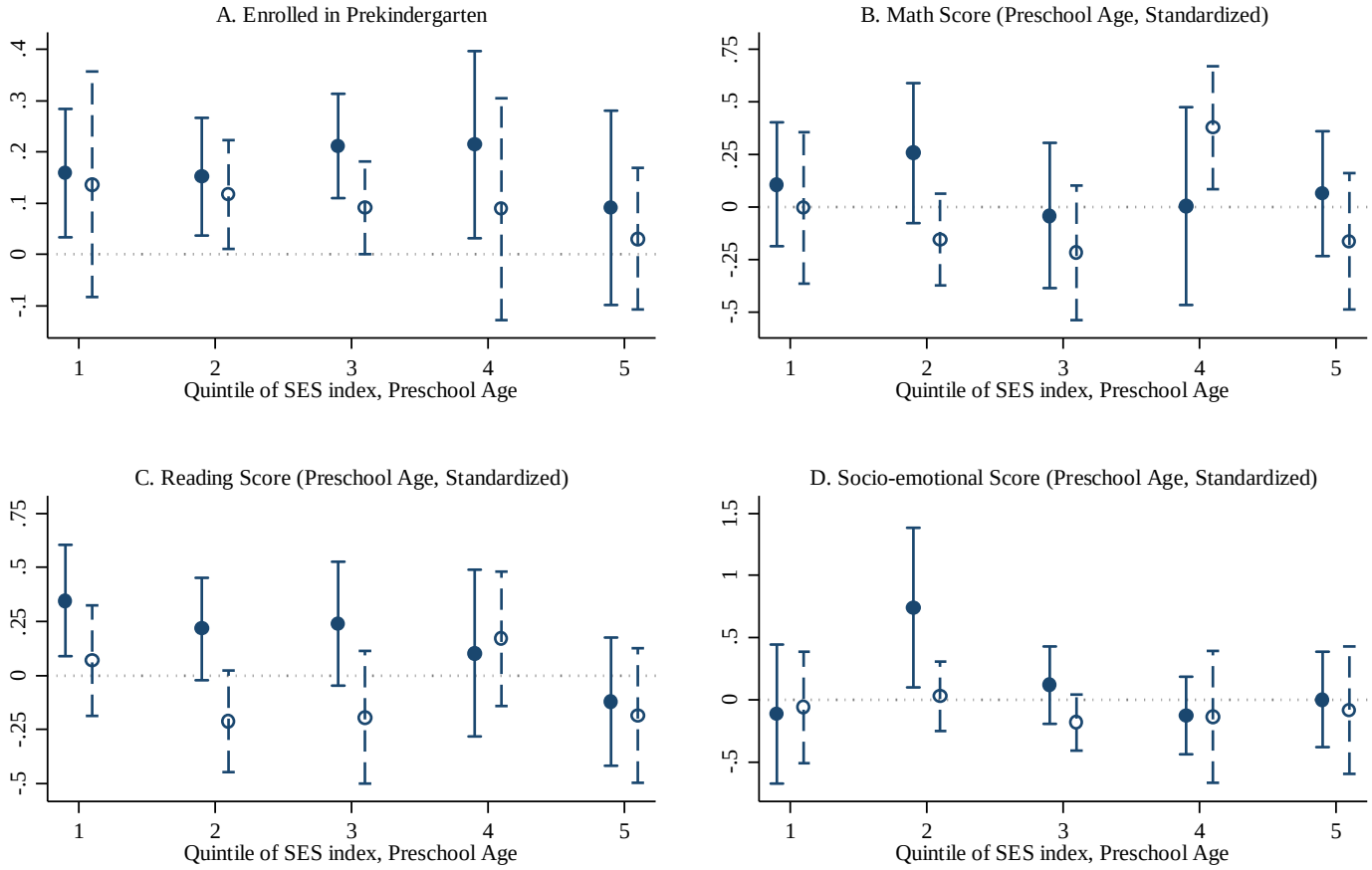
Notes: Data on public preschool enrollment rates by age are calculated from the October Current Population Survey (CPS) School Enrollment supplements. Head Start enrollment rates divide Head Start enrollments reported by the Head Start Bureau by cohort size estimates based on Vital Statistics data on live births. State funding dates were constructed from program narratives published by NIEER (Barnett et al., 2016).

Figure 2. Prekindergarten Access and Quality
by State, 2005-06 Academic Year



Notes: Data are from Barnett et al. (2006). Dot sizes represent the size of the state's 4-year-old population.

Figure 3. Effects of Eligibility on Pre-K Enrollment and Test Scores by Program Type and SES Quartile



Notes: Solid dots represent estimates of model 2 for universal pre-K programs, and hollow dots represent estimates of model 2 for targeted pre-K programs. The underlying regressions include as controls state fixed effects, month of eligibility fixed effects, month of assessment fixed effects, and the baseline demographic and background variables listed in Table 2 Panel B. Regressions are weighted by sampling weights, and standard errors are clustered on state. Capped vertical lines represent 95% confidence intervals on the estimates.

Table 1. Characteristics of State Pre-Kindergarten Programs Under Study

State	Birthday Cutoff for Pre-K	% of 4 y.o.'s enrolled	Quality Checklist (out of 10)	Comp. Learning Standards (1)	Tch. Training & Cred. Require-ments (4)	Staffing Ratios (2)	Comp. Services (Health Svcs. & Meals) (2)	Required Site visits (1)
				A. Universal Programs				
Oklahoma	Sept. 1	70.2	9	1	3	2	2	1
Georgia	Sept. 1	51.5	8	1	2	2	2	1
Florida	Sept. 1	46.5	4	1	0	2	0	1
West Virginia	Sept. 1	39.9	7	1	2	2	1	1
Wisconsin	Sept. 1	32.1	5.1	1	2.9	0.1	0.1	0.9
New York	Dec. 1	28.6	5.6	0	1.4	2	1.2	1
pop-weighted avg.		*41.5*	*5.8*	*0.7*	*1.3*	*1.8*	*0.9*	*1.0*
enr-weighted avg.		*44.9*	*6.0*	*0.8*	*1.4*	*1.9*	*1.0*	*1.0*
				B. Targeted Programs				
Texas	Sept. 1	44.3	4	1	3	0	0	0
South Carolina	Sept. 1	31	8	0	3	2	2	1
Maryland	Sept. 1	30.7	7	1	3	2	1	0
Illinois	Sept. 1	23	9	1	4	2	1	1
Kansas	Aug. 31	14.5	3	0	2	0	1	0
Colorado	Oct. 1	13.5	4	0	1	2	0	1
Virginia	Sept. 30	11.1	7	0	2	2	2	1
Tennessee	Sept. 30	10.6	9	1	3	2	2	1
pop-weighted avg.		*29.0*	*6.1*	*0.7*	*2.9*	*1.2*	*0.8*	*0.5*
enr-weighted avg.		*36.0*	*5.4*	*0.8*	*3.0*	*0.8*	*0.5*	*0.3*

Source: Barnett et al. (2006). Figures correspond to the 2005-06 academic year.

Table 2. Descriptive Statistics and Balance Tests on Key Variables, by Family Income and Program Type

States:	Universal states				Targeted states			
Children:	Low income		Not Low Income		Low income		Not Low Income	
	Mean	Coef. (se)	Mean	Coef. (se)	Mean	Coef. (se)	Mean	Coef. (se)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment variable								
Pre-kindergarten[a]	0.254	0.207***	0.416	0.157**	0.223	0.156**	0.263	0.068
		(0.055)		(0.067)		(0.059)		(0.045)
Background characteristics								
Age in months[a]	52.384	0.053	52.300	-0.095***	52.225	-0.011	51.642	-0.031
		(0.071)		(0.029)		(0.077)		(0.035)
Female	0.516	0.074	0.467	0.083	0.476	-0.004	0.487	-0.003
		(0.110)		(0.066)		(0.080)		(0.064)
Black non-Hispanic	0.297	-0.005	0.096	0.061***	0.280	0.012	0.101	0.027
		(0.061)		(0.019)		(0.038)		(0.023)
Hispanic	0.206	0.005	0.134	-0.026	0.402	-0.071	0.177	0.042
		(0.049)		(0.042)		(0.045)		(0.047)
Low birth weight	0.086	0.034*	0.075	0.016	0.104	0.010	0.067	0.020
		(0.017)		(0.018)		(0.020)		(0.019)
Non-English at home[a]	0.183	-0.031	0.091	0.008	0.254	-0.037	0.101	0.005
		(0.045)		(0.033)		(0.049)		(0.032)
Maternal education ≤ HS[a]	0.727	0.081	0.251	0.048	0.749	0.079	0.227	-0.065
		(0.059)		(0.044)		(0.063)		(0.054)
Both biological parents in HH [a]	0.506	-0.037	0.828	-0.086**	0.586	0.006	0.850	0.035
		(0.050)		(0.038)		(0.038)		(0.042)
Observations[b]	550	1,850	650	2,200	650	1,900	900	2,400

Notes: Coefficients in the even-numbered columns are on the interaction between a dummy for being eligible for kindergarten in 2006-07 (the same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treatment state from a regression that also includes dummies for state of residence, for month of assessment, and for month age five relative to the state kindergarten entry cutoff birthdate in 2006-07 . Treatment states are those with state-funded pre-K programs focused much more on 4 year olds than 3 year olds and statewide minimum age at pre-K entry regulations; treatment states with universal programs are FL, GA, NY, OK, WI, WV, and treatment states with targeted programs are CO, IL, KS, MD, SC, TN, TX, VA. Comparison states have statewide age at kindergarten entry regulations; some comparison states have pre-K programs that serve a significant relative share of 3 year olds (AL, AZ, CA, CT, DE, KY, MN, MO, NM, NV, OH, OR, WA), while others lack pre-K programs (AK, HI, ID, IN, MS, ND, RI, SD, UT). A child is deemed eligible for K in 2006-07 if he /she turned age 5 in time to start K in fall 2006, given his/her date of birth and the kindergarten entry age regulations in effect in 2006-07 reported by Barnett, et al. (2007). Sample is limited to children who turn age 5 between 4 months afterand 8 months before the cutoff date, and a child is considered low income if his (wave 3) family income is at or below 185% FPL. Means and regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state. [a] Measured at preschool age (wave 3 interview). [b] rounded to the nearest 50. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3. Impacts on Cognitive Test and Socio-emotional Scores at Preschool Age

States:	Universal		Targeted	
Children:	Low income	Not low income	Low income	Not low income
	(1)	(2)	(3)	(4)
		A. Math Scale Scores (Standardized)		
Ineligible mean	-0.680	0.089	-0.643	-0.132
DD Coef. on eligible x treated state	0.206**	-0.004	0.018	-0.055
	(0.085)	(0.104)	(0.095)	(0.098)
TSLS Coef. on pre-K enrollment	0.996**	-0.022	0.116	no f.s.
	(0.452)	(0.601)	(0.580)	
OLS Coef. on pre-K enrollment	0.159	0.139***	0.157**	0.250***
	(0.095)	(0.050)	(0.068)	(0.051)
Observations[a]	1,850	2,200	1,900	2,400
		B. Reading Scale Scores (Standardized)		
Ineligible mean	-0.645	0.056	-0.582	-0.102
DD Coef. on eligible x treated state	0.228*	0.026	-0.073	-0.084
	(0.126)	(0.083)	(0.090)	(0.073)
TSLS Coef. on pre-K enrollment	1.102*	0.156	-0.466	no f.s.
	(0.592)	(0.483)	(0.572)	
OLS Coef. on pre-K enrollment	0.081	0.210**	0.089	0.290***
	(0.066)	(0.088)	(0.070)	(0.066)
Observations[a]	1,850	2,200	1,900	2,400
		C. Socio-emotional Scores (Standardized)		
Ineligible mean	-0.438	0.123	-0.236	0.200
DD Coef. on eligible x treated state	0.158	0.161	-0.118	-0.040
	(0.119)	(0.121)	(0.075)	(0.128)
TSLS Coef. on pre-K enrollment	0.797	1.121	-0.804	no f.s.
	(0.547)	(1.218)	(0.716)	
OLS Coef. on pre-K enrollment	-0.056	0.006	0.001	0.080
	(0.052)	(0.052)	(0.073)	(0.054)
Observations[a]	1,600	1,950	1,650	2,150
Additional controls? [b]	Y	Y	Y	Y

Notes: The DD coefficient is that on the interaction between a dummy for being eligible for kindergarten in 2006-07 (synonymous with a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state from a regression that also includes dummies for state of residence, for month of assessment, and for month age five relative to the state kindergarten entry cutoff birthdate in 2006-07; see notes to Table 2 for description and listing of treatment and comparison states. The TSLS coefficient uses eliglble x treated state as an instrument for pre-K enrollment in a specification with the same controls. Sample is limited to children who turn age 5 between 4 months after and 8 months before the kindergarten entry cutoff birthdate, and a child is considered low income if his (wave 3) family income is at or below 185% FPL. Means and regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state.

[a] rounded to the nearest 50.

[b] Additional controls include dummies for female, Hispanic, black non-Hispanic, and low birth weight and (measured in the preschool wave) age at assessment and dummies for non-English at home, mom has high school degree or less, and both biological parents in household.

***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4. Falsification Test: Impacts on Cognitive and Socio-emotional Test Scores at Age 2

States:	Universal		Targeted	
Children:	Low income	Not low income	Low income	Not low income
	(1)	(2)	(3)	(4)
		A. Mental Scale (Standardized)		
Ineligible mean	-0.601	-0.036	-0.399	0.095
DD Coef. on eligible x treated state	0.043	-0.034	-0.080	-0.101
	(0.128)	(0.067)	(0.109)	(0.105)
TSLS Coef. on pre-K enrollment	0.201	-0.239	-0.551	no f.s.
	(0.573)	(0.467)	(0.757)	
Observations[a]	1,700	2,000	1,700	2,250
		B. Motor Scale Scores (Standardized)		
Ineligible mean	-0.096	-0.082	-0.162	0.033
DD Coef. on eligible x treated state	-0.030	-0.057	0.025	-0.095
	(0.155)	(0.166)	(0.130)	(0.175)
TSLS Coef. on pre-K enrollment	-0.130	-0.485	0.161	no f.s.
	(0.619)	(1.162)	(0.793)	
Observations[a]	1,650	2,000	1,700	2,200
		C. Socio-emotional Scores (Standardized)		
Ineligible mean	-0.373	0.096	-0.316	0.123
DD Coef. on eligible x treated state	-0.082	0.064	0.016	-0.079
	(0.163)	(0.122)	(0.125)	(0.110)
TSLS Coef. on pre-K enrollment	-0.343	0.427	0.074	no f.s.
	(0.666)	(0.933)	(0.562)	
Observations[a]	1,450	1,800	1,450	1,950
Additional controls? [b]	Y	Y	Y	Y

Notes: The DD coefficient is that on the interaction between a dummy for being eligible for kindergarten in 2006-07 (synonymous with a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state from a regression that also includes dummies for state of residence, for month of assessment, and for month age five relative to the state kindergarten entry cutoff birthdate in 2006-07; see notes to Table 2 for description and listing of treatment and comparison states. Sample is limited to children who turn age 5 between 4 months after and 8 months before the kindergarten entry cutoff birthdate, and a child is considered low income if his (wave 3) family income is at or below 185% FPL. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state.

[a] rounded to the nearest 50.

[b] Additional controls include dummies for female, Hispanic, black non-Hispanic, and low birth weight and (measured in the preschool wave) age at assessment and dummies for non-English at home, mom has high school degree or less, and both biological parents in household.

***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Additional Robustness Tests on Baseline Difference-in-Differences Estimates: Cognitive Test Scores

States:	Universal		Targeted	
Children:	Low income	Not low income	Low income	Not low income
	(1)	(2)	(3)	(4)
	A. Math Scale Scores (Standardized)			
Baseline[a]	0.206**	-0.004	0.018	-0.055
	(0.085)	(0.104)	(0.095)	(0.098)
Age 2 scores as controls[b]	0.199**	0.014	0.039	-0.027
	(0.076)	(0.110)	(0.096)	(0.096)
Pre-K states only in comp. group[c]	0.286***	0.009	0.081	-0.034
	(0.092)	(0.108)	(0.102)	(0.089)
+/- 4 months from cutoff [d]	0.324**	0.081	0.018	-0.013
	(0.132)	(0.125)	(0.114)	(0.103)
Low income: Maternal ed ≤ HS	0.205*	-0.015	0.032	-0.073
	(0.116)	(0.079)	(0.157)	(0.078)
Low income: ≤130% FPL	0.110	0.054	0.083	-0.092
	(0.092)	(0.088)	(0.117)	(0.085)
Drop TX	0.206**	-0.004	0.048	-0.015
	(0.085)	(0.104)	(0.121)	(0.107)
	B. Reading Scale Scores (Standardized)			
Baseline[a]	0.228*	0.026	-0.073	-0.084
	(0.126)	(0.083)	(0.090)	(0.073)
Age 2 scores as controls[b]	0.230**	0.032	-0.048	-0.057
	(0.112)	(0.075)	(0.098)	(0.075)
Pre-K states only in comp. group[c]	0.295**	0.021	-0.026	-0.078
	(0.122)	(0.087)	(0.095)	(0.082)
+/- 4 months from cutoff [d]	0.253	0.106	-0.019	-0.019
	(0.160)	(0.146)	(0.090)	(0.086)
Low income: Maternal ed ≤ HS	0.392***	-0.086	-0.003	-0.133
	(0.100)	(0.067)	(0.134)	(0.079)
Low income: ≤130% FPL	0.207	0.073	0.043	-0.142**
	(0.144)	(0.064)	(0.111)	(0.064)
Drop TX	0.228*	0.026	-0.001	-0.130*
	(0.126)	(0.083)	(0.091)	(0.074)

Notes: The DD coefficient is that on the interaction between a dummy for being eligible for kindergarten in 2006-07 (synonymous with a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state from a regression that also includes dummies for state of residence, for month of assessment, and for month age five relative to the state kindergarten entry cutoff birthdate in 2006-07. See Table 2 for a definition of treatment and comparison states. Unless otherwise given, sample is limited to children who turn age 5 between 4 months after and 8 months before the kindergarten entry cutoff birthdate, a child is considered low income if his (wave 3) family income is at or below 185% FPL, regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state.

[a] Additional controls include age at assessment, dummies for female, Hispanic, black non-Hispanic, low birth weight, non-English at home, mom has high school degree or less, and both biological parents in household.

[b] Missing test scores imputed and indicated with dummy variables to maintain sample size.

[c] Comparison states limited to those with state-funded pre-K programs in 2005-06 (AL, AZ, CA, CT, DE, KY, MN, MO, NM, NV, OH, OR, WA)

[d] Sample is limited to children who turn age 5 between 4 months after and 4 months before the kindergarten entry cutoff birthdate.

Table 6. The First Stage and Impacts on Alternative Care Arrangements, by Family Income and Program Type

States:	Universal states				Targeted states			
Children:	Low income		Not Low Income		Low income		Not Low Income	
	Ineligible Mean	Coef. (se)	Ineligible Mean	Coef. (se)	Ineligible Mean	Coef. (se)	Ineligible Mean	Coef. (se)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment variable:								
Pre-kindergarten	0.122	0.207***	0.286	0.168**	0.132	0.156**	0.159	0.062
		(0.050)		(0.071)		(0.059)		(0.042)
Alternatives to Pre-K:								
Head Start	0.177	-0.067	0.019	0.007	0.197	-0.098	0.024	0.031
		(0.096)		(0.021)		(0.094)		(0.022)
Other center-based care	0.174	-0.049	0.369	-0.121	0.0803	0.000	0.388	-0.074
		(0.051)		(0.077)		(0.038)		(0.070)
Informal non-parental care	0.208	-0.032	0.122	0.044	0.202	-0.002	0.231	0.022
		(0.051)		(0.055)		(0.065)		(0.058)
Parental care	0.318	-0.058	0.204	-0.097**	0.389	-0.056	0.197	-0.040
		(0.086)		(0.039)		(0.084)		(0.055)
Additional controls? [a]		Y		Y		Y		Y
Observations[b]	550	1,850	650	2,200	650	1,900	900	2,400

Notes: Coefficients in the even-numbered columns are on the interaction between a dummy for being eligible for kindergarten in 2006-07 (the same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treatment state from a regression that also includes dummies for state of residence, for month of assessment, and for month age five relative to the state kindergarten entry cutoff birthdate in 2006-07; see notes to Table 2 for a description and listing of the treatment and comparison states. Sample is limited to children who turn age 5 between 4 months afterand 8 months before the cutoff date, and a child is considered low income if his (wave 3) family income is at or below 185% FPL. Means and regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state.

[a] Additional controls include dummies for female, Hispanic, black non-Hispanic, and low birth weight and (measured in the preschool wave) age at assessment and dummies for non-English at home, mom has high school degree or less, and both biological parents in household. [b] rounded to the nearest 50. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Do program standards mediate the universal-targeted gap for low-income kids?

		Add interaction of eligibility with dummy for state program requiring:								
	Baseline	Comp. learning stds.	Teacher BA	Specialized Pre-K Training	15+ Hrs Inservice/Yr	Asst. Teacher CDA+	Max Class Size ≤20 [b]	Health Services	One Meal	Site Visits
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
					A. Math Scale Scores (Standardized) (N≈3,700)					
Universal DD est.	0.206	0.221	0.248	0.178	0.186	0.197	0.173	0.207	0.204	0.186
	(0.085)	(0.091)	(0.206)	(0.099)	(0.095)	(0.086)	(0.088)	(0.086)	(0.086)	(0.087)
Targeted DD est.	0.018	0.020	0.015	0.018	0.021	0.019	0.023	0.019	0.019	0.021
	(0.095)	(0.093)	(0.098)	(0.095)	(0.094)	(0.095)	(0.094)	(0.093)	(0.094)	(0.095)
Difference	0.188	0.201	0.233	0.160	0.165	0.178	0.150	0.188	0.185	0.166
p-value	*0.015*	*0.000*	***0.333***	*0.071*	*0.055*	*0.049*	***0.113***	*0.012*	*0.024*	***0.105***
					B. Reading Scale Scores (Standardized) (N≈3,700)					
Universal DD est.	0.228	0.296	0.121	0.240	0.294	0.217	0.169	0.237	0.217	0.165
	(0.126)	(0.121)	(0.135)	(0.122)	(0.121)	(0.126)	(0.123)	(0.099)	(0.114)	(0.126)
Targeted DD est.	-0.073	-0.065	-0.065	-0.073	-0.081	-0.072	-0.064	-0.070	-0.069	-0.065
	(0.089)	(0.072)	(0.091)	(0.089)	(0.090)	(0.091)	(0.076)	(0.076)	(0.074)	(0.076)
Difference	0.301	0.361	0.186	0.313	0.375	0.289	0.233	0.307	0.286	0.230
p-value	*0.019*	*0.001*	***0.176***	*0.012*	*0.003*	*0.034*	*0.048*	*0.000*	*0.006*	*0.065*
					C. Socio-emotional Scores (Standardized) (N≈3,200)					
Universal DD est.	0.158	0.146	0.187	0.299	0.157	0.117	0.188	0.156	0.145	0.194
	(0.119)	(0.146)	(0.178)	(0.075)	(0.147)	(0.120)	(0.120)	(0.125)	(0.112)	(0.122)
Targeted DD est.	-0.118	-0.120	-0.120	-0.119	-0.118	-0.115	-0.125	-0.120	-0.111	-0.125
	(0.075)	(0.079)	(0.076)	(0.075)	(0.075)	(0.063)	(0.077)	(0.074)	(0.073)	(0.077)
Difference	0.276	0.266	0.307	0.418	0.275	0.232	0.313	0.276	0.256	0.319
	0.025	*0.072*	***0.105***	*0.000*	*0.074*	*0.050*	*0.019*	*0.030*	*0.027*	*0.022*

Notes: The table reports estimates from a pooled , fully-interacted version the baseline specification, without (column 1) and with (columns 2-10) interactions between the eligibility indicator and the program characteristic listed in the column. (See model 4.) The DD Columns 2-10 present a linear combination of coefficient estimates: $\Theta_p+\Theta_Q*Q_{s|T}$, where $p=U,T$ (for universal or targeted), and $Q_{s|T}$ represents the average value of Q_s for low-income children in states with targeted pre-K programs. Sample is limited to children with (wave 3) family income at or below 185% FPL. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state.

Table 8. Characteristics of Pre-K Programs Serving Low-Income Children in the ECLS-B

	Universal pre-K	Targeted pre-K
A. Teacher Turnover		
Hires in past 12 mos/total employment	0.260	0.273
Departures in past 12 mos/total employment	0.191	0.140
B. Teacher Credentials		
Years of experience in the profession	10.783	12.662
Years of experience at this school	4.880	5.781
4-year college degree +	0.670	0.882
2-year college degree +	0.756	0.950
C. Teacher Attitudes		
Enjoy job	0.728	0.804
Strongly agrees that:		
Pre-K is important for success in K	0.593	0.712
Reading/math instruction in preschool helps children do better in elem. school	0.632	0.498
Children should learn to read in K	0.307	0.366
D. Class size, Curriculum, and Assessment		
# Children	13.895	15.408
Direct assessment used	0.561	0.695
Written curriculum used	0.906	0.895
Observations	150	150

Notes: Samples are limited to low-income respondents in treatment states. Means are weighted by sampling weights.

Appendix Table A1. Impacts on Cognitive Test and Socio-emotional Scores at Preschool Age: No Additional Controls

States:	Universal		Targeted	
Children:	Low income	Not low income	Low income	Not low income
	(1)	(2)	(3)	(4)
		A. Math Scale Scores (Standardized)		
Ineligible mean	-0.680	0.089	-0.643	-0.132
DD Coef. on eligible x treated state	0.167*	-0.056	-0.002	-0.056
	(0.083)	(0.094)	(0.095)	(0.115)
TSLS Coef. on pre-K enrollment	0.810**	-0.356	-0.010	no f.s.
	(0.401)	(0.627)	(0.591)	
OLS Coef. on pre-K enrollment	0.172*	0.210***	0.166**	0.337***
	(0.095)	(0.065)	(0.077)	(0.052)
Observations[a]	1,850	2,200	1,900	2,400
		B. Reading Scale Scores (Standardized)		
Ineligible mean	-0.645	0.056	-0.582	-0.102
DD Coef. on eligible x treated state	0.198	-0.011	-0.069	-0.081
	(0.135)	(0.102)	(0.101)	(0.080)
TSLS Coef. on pre-K enrollment	0.960	-0.069	-0.443	no f.s.
	(0.596)	(0.626)	(0.626)	
OLS Coef. on pre-K enrollment	0.083	0.293**	0.097	0.395***
	(0.077)	(0.109)	(0.084)	(0.085)
Observations[a]	1,850	2,200	1,900	2,400
		C. Socio-emotional Scores (Standardized)		
Ineligible mean	-0.438	0.123	-0.236	0.200
DD Coef. on eligible x treated state	0.181	0.120	-0.111	-0.028
	(0.138)	(0.121)	(0.070)	(0.132)
TSLS Coef. on pre-K enrollment	0.922	0.884	-0.770	no f.s.
	(0.612)	(1.151)	(0.656)	
OLS Coef. on pre-K enrollment	-0.041	0.037	-0.013	0.121**
	(0.074)	(0.057)	(0.083)	(0.058)
Observations[a]	1,600	1,950	1,650	2,150

Notes: The DD coefficient is that on the interaction between a dummy for being eligible for kindergarten in 2006-07 (synonymous with a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state from a regression that also includes dummies for state of residence, for month of assessment, and for month age five relative to the state kindergarten entry cutoff birthdate in 2006-07; see notes to Table 2 for description and listing of treatment and comparison states. The TSLS coefficient uses eliglble x treated state as an instrument for pre-K enrollment in a specification with the same controls. Sample is limited to children who turn age 5 between 4 months after and 8 months before the kindergarten entry cutoff birthdate, and a child is considered low income if his (wave 3) family income is at or below 185% FPL. Means and regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state.

[a] rounded to the nearest 50.

***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Appendix Table A2. Additional Robustness Tests on Baseline Difference-in-Differences Estimates: Pre-K Enrollment and Socio-Emotional Test Scores

States:	Universal		Targeted	
Children:	Low income	Not low income	Low income	Not low income
	(1)	(2)	(3)	(4)
		A. Pre-K Enrollment		
Baseline[a]	0.207***	0.168**	0.156**	0.062
	(0.050)	(0.071)	(0.059)	(0.042)
Age 2 scores as controls[b]	0.210***	0.165**	0.143**	0.068*
	(0.051)	(0.067)	(0.061)	(0.040)
Pre-K states only in comp. group[c]	0.202***	0.187**	0.160**	0.080
	(0.060)	(0.082)	(0.066)	(0.047)
+/- 4 months from cutoff [d]	0.222***	0.185**	0.175***	0.041
	(0.056)	(0.084)	(0.057)	(0.051)
Low income: Maternal ed ≤ HS	0.176***	0.194***	0.167***	0.069
	(0.034)	(0.070)	(0.060)	(0.042)
Low income: ≤130% FPL	0.199***	0.162**	0.090**	0.100**
	(0.060)	(0.059)	(0.036)	(0.046)
Drop TX	0.207***	0.168**	0.106	0.057
	(0.050)	(0.071)	(0.074)	(0.049)
		B. Socio-emotional Scores (Standardized)		
Baseline[a]	0.158	0.161	-0.118	-0.040
	(0.119)	(0.121)	(0.075)	(0.128)
Age 2 scores as controls[b]	0.173	0.150	-0.074	-0.035
	(0.130)	(0.124)	(0.096)	(0.122)
Pre-K states only in comp. group[c]	0.201	0.285**	-0.092	0.062
	(0.129)	(0.125)	(0.086)	(0.137)
+/- 4 months from cutoff [d]	0.218	0.230*	-0.155	-0.009
	(0.152)	(0.127)	(0.111)	(0.160)
Low income: Maternal ed ≤ HS	0.186	0.176**	-0.098	-0.023
	(0.192)	(0.071)	(0.138)	(0.141)
Low income: ≤130% FPL	0.114	0.169*	-0.038	-0.064
	(0.177)	(0.097)	(0.140)	(0.116)
Drop TX	0.158	0.161	-0.132	-0.061
	(0.119)	(0.121)	(0.097)	(0.164)

Notes: The DD coefficient is that on the interaction between a dummy for being eligible for kindergarten in 2006-07 (synonymous with a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state from a regression that also includes dummies for state of residence, for month of assessment, and for month age five relative to the state kindergarten entry cutoff birthdate in 2006-07. See Table 2 for a definition of treatment and comparison states. Unless otherwise given, sample is limited to children who turn age 5 between 4 months after and 8 months before the kindergarten entry cutoff birthdate, a child is considered low income if his (wave 3) family income is at or below 185% FPL, regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state.

[a] Additional controls include age at assessment, dummies for female, Hispanic, black non-Hispanic, low birth weight, non-English at home, mom has high school degree or less, and both biological parents in household.

[b] Missing test scores imputed and indicated with dummy variables to maintain sample size.

[c] Comparison states limited to those with state-funded pre-K programs in 2005-06 (AL, AZ, CA, CT, DE, KY, MN, MO, NM, NV, OH, OR, WA)

[d] Sample is limited to children who turn age 5 between 4 months after and 4 months before the kindergarten entry cutoff birthdate.