

*Online Appendix*

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

*by*

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## Appendix A: Data

### A. *Defining “Treatment” States*

My analysis focuses on state programs that served 4-year-olds nearly exclusively, according to statistics and program narratives published by the National Institute for Early Education Research (NIEER) (Barnett et al., 2006).<sup>1</sup> I define such programs as those for which the difference in NIEER-reported state pre-K enrollment rates between 4- and 3-year-olds in 2005-06 was at least 8 percentage points. This definition is necessitated by my research design and the statistical power afforded by the data. In particular, it must be the case that there is a noticeable change in the likelihood of pre-K attendance in 2005-06 for children with birthdates near school entry cutoff dates. Even if a program serves only 4-year-olds, it is hard to detect an effect on attendance if the overall 4-year-old enrollment rate in the program is low. Likewise, even if a program serves a high share of 4-year-olds, an attendance effect is difficult to detect if it also serves a high share of 3-year-olds. Twenty-three of the 38 states with state-funded programs in 2005-06 met the criterion laid forth above, Illinois being the last (Appendix Table 1).

The data and research design also necessitate that I focus on states for which there were state-established dates by which the youngest enrollees were to have been 4-years-old; locally established cutoff dates are not available. In addition, the ECLS-B does not provide information on day of birth within a given month. To minimize misclassification in assignment of the kindergarten eligibility indicator, I therefore focus on states with cutoff birthdates at the beginning or end of the month in my main analysis. Four states (Vermont, Kentucky, Connecticut, and New Jersey) must be excluded due to local determination of their pre-K entry cutoff dates; three (Arkansas, Maine, and North Carolina) are excluded for having cutoff birthdates in the middle of the month. The latter states are included in a specification check in Table 5 (full sample) and Appendix Table 8 (low-income subsample).

Thus, sixteen states meet all of the above criteria for 2005-06.<sup>2</sup> Appendix Table 1 lists these treatment states by whether they are universal or targeted, according to the NIEER narratives, in descending order according to their enrollment rate. In addition to Georgia and Oklahoma, the six universal states under consideration include Florida, New York, West Virginia, and Wisconsin. There are ten targeted programs under consideration. Five of these (those in Colorado, Louisiana, Maryland, Tennessee and Texas) use eligibility for free- or reduced-price lunch as their income eligibility requirement, though that requirement need not apply to all enrollees. Two of these (Kansas and Michigan) use different income eligibility requirements. The remaining three states (Illinois, South Carolina, and Virginia) have no explicit income requirements, but rather risk factor requirements that arguably correlate strongly with income.<sup>3</sup>

I use 17 comparison states (Appendix Table 2). All of these states had state-mandated school entry cutoff birthdates that were not in the middle of the month, as of 2005-06 and 2006-07.

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<sup>1</sup> I also use data from Barnett et al. (2007) on kindergarten entry cutoff birthdates for fall 2006.

<sup>2</sup> Unfortunately, Barnett et al. (2006) does not report on Washington, D.C., so I cannot include ECLS-B observations from D.C. in the analysis.

<sup>3</sup> Such risk factors include (but are not limited to) low parental education, single parenthood, English language learner (ELL) status, homelessness, placement in foster care, and developmental delays, depending on the state.

Eight of these states (Alabama, California, Delaware, Missouri, New Mexico, Ohio, Oregon, and Washington) had pre-K programs in 2005-06 that were too small or not different enough in terms of enrollment of 3- and 4-year-olds to be included in the treatment group.<sup>4</sup> The remaining 9 comparison states (Alaska, Hawaii, Idaho, Indiana, Mississippi, North Dakota, Rhode Island, South Dakota, and Utah) did not have pre-K programs in 2005-06.

*Consideration 1: The Threshold Between Treatment and Comparison States*

There are two states with a difference in pre-K enrollment between 4-year-olds and 3-year-olds rates close to the 8-percentage-point threshold that distinguishes treatment and comparison states: Delaware (7.8 percentage points) and Illinois (8.6 percentage points). Though it yields a much larger gap in this enrollment difference between the comparison and treatment states (3.9 percentage points), removing Delaware and Illinois from the estimation sample barely changes the key findings of the paper, as shown in Appendix Table 11.

*Consideration 2: Heterogeneity in the Comparison Group*

Identification comes from comparing how test scores grow with age in different pre-K environments. A challenge is that states with different pre-K environments may also differ in other ways that affect this age gradient. Other characteristics do affect this age gradient: Even within the group of 17 comparison states considered in the paper, low-income children experience weaker growth in test scores with age than children who are not low-income (Figure 5), presumably because they have more limited learning opportunities in the absence of pre-K. By extension, states with higher population shares of low-income students may also demonstrate a shallower age gradient in test scores. Indeed, any characteristic that correlates with other learning opportunities – race, ethnicity, parental education, and so on – may affect this gradient.

Ideally, then, the treatment and comparison states in this application would have similar characteristics in levels, not just in trends (Table 1 and Appendix Table 3). Appendix Tables 12a and 12b give average demographic and background characteristics for treatment states (in full and for universal and targeted states separately) and for comparison states (in full and for those without and with pre-K programs), for the full sample and the low-income subsample, respectively. While the Hispanic and non-English at home shares in the full comparison group are not statistically different from those in the treated states overall (or in universal or targeted states), these shares in comparison states without (with) pre-K are significantly lower (higher).

By the above reasoning, we might therefore expect the age gradient in test scores to be shallower – and estimates larger – for the comparison group with pre-K, where the Hispanic/non-English shares are relatively high. Appendix Tables 13a and 13b give estimated impacts from the preferred specification for each respective comparison group. In the full sample (model with additional controls), the TSLS/IV estimate implies that pre-K attendance raises preschool age

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<sup>4</sup> In a previous version of this paper (Cascio, 2017), the comparison group also included five states with pre-K programs (Arizona, Connecticut, Kentucky, Minnesota, and Nevada) with local rules regarding age eligibility for pre-K but statewide cutoff dates for kindergarten entry that were not in the middle of the month. Because many localities may choose a common cutoff date, like September 1, inclusion of these states in the comparison group weakens the first stage, so they were eliminated from the comparison group in the present version of the paper.

test scores by 0.743 standard deviations (s.e.=0.374) when the comparison group consists only of states with (small) pre-K programs (Appendix Table 13a, Panel A); when I restrict the comparison group to states without pre-K programs (Appendix Table 13b, Panel A), this estimate falls to 0.404 (0.388). However, the more robust finding of the paper is maintained in both cases: The test score effects of attending a universal pre-K program are significantly greater than those from attending a targeted pre-K program. This is the case not only in the full sample ( $p=0.069$  and  $p=0.085$  for these respective specifications), but also in the subsample of low-income children ( $p=0.034$  and  $p=0.066$ , respectively).

One reason to work with the full set of comparison states is thus that they look more similar to the treatment states in levels than do either of the two subsets of comparison states in isolation. Another reason is that the balance tests for observables look more favorable for the research design when the estimation incorporates the full set of comparison states. In particular, using the complete comparison group in the estimates for the full sample (Table 1), I fail to reject the null on the joint significance test on the DD and DDD coefficients (poverty coefficient excluded). However, I reject that null in several instances when limiting the comparison group as in Tables Appendix Tables 13a and 13b, as shown in Appendix Table 14a. A similar finding holds in the low-income subsample (c.f. Appendix Table 3 and Appendix Table R14b).

### *Consideration 3: Definition of a Universal Program*

As discussed, a “universal” state is one where eligibility for enrollment in pre-K programs, where offered, is based only on age. A “targeted” state, by contrast, is one where eligibility for pre-K enrollment is also based on family income or other risk factors. Appendix Table 1 reveals that some targeted states actually have enrollment rates for 4-year-olds that are higher than those of universal states. This could happen if some universal states do not operate pre-K programs in every community. However, it could also reflect misclassification.

Appendix Tables 15a and 15b show the main estimates of the paper but classifying states as “high” versus “not high” enrollment instead of “universal” and “targeted”; I define “high” enrollment as a 2005-06 age 4 pre-K enrollment rate of 40% and 30%, respectively. Under the 40% definition, the “high” group includes (rounding up) WV (universal) and TX (targeted), and the “not high” group includes WI and NY (both universal). Under the 30% definition, the “high” group includes TX, SC, and MD (all targeted), and the “not high” group includes NY (universal). Each of these alternative classifications of states makes the differential in effect sizes across groups smaller in magnitude and statistically insignificant. I interpret this evidence as demonstrating that the universal-targeted distinction made in the paper captures a much more meaningful differences across programs than a definition based on enrollment rates.

### *B. ECLS-B Estimation Sample*

The empirical approach taken in this paper is made possible by detailed survey data from the Birth Cohort sample of the Early Childhood Longitudinal Study (ECLS-B). The ECLS-B is a

longitudinal survey of a stratified random sample of children born in the United States in 2001.<sup>5</sup> ECLS-B respondents were assessed and their parents and caregivers interviewed at roughly 9 months of age (wave 1), 2 years of age/toddler age (wave 2), 4 years of age/preschool age (wave 3), and kindergarten age (waves 4 and 5). My estimation sample consists of all children with non-missing preschool-age cognitive assessments and demographic and background characteristics residing at preschool age in one of the 16 treatment states or 17 comparison states, 5 years old between 8 months before and 4 months after their state's kindergarten entry cutoff, and assessed during the 2005-06 school year – a total of 5,100 observations.<sup>6</sup> Reported sample sizes are rounded to the nearest 50, per IES rules to protect confidentiality of ECLS-B respondents.

Most pertinent for this study are the data from wave 3; this wave includes test scores on children who were of preschool age, but may or may not have been actually enrolled in (or age-eligible to enroll in) state-funded pre-K. More specifically, given the fall kindergarten entry cutoffs in Appendix Table 1, the 2001 birth cohort can be split into two school entry cohorts in the wave 3 data – children eligible to enter kindergarten in fall 2006 (and pre-K in fall 2005, if relevant) and children eligible to enter kindergarten in fall 2007 (and pre-K in fall 2006, if relevant). Children in the estimation sample were then tested starting in September 2005 – when any exposure to pre-K would have been limited – through June 2006 – when a child enrolled would have had a full school year of exposure.

### C. *Key Variables*

The main outcomes of interest are cognitive test scores in early math and reading. The preschool cognitive assessment was designed to test both for developmental (age-based) milestones and for knowledge and skills considered important for school readiness and early school success.<sup>7</sup> For my main estimates, I work with reading and math scale scores from this assessment that I normalized to mean zero and variance one in the subsample of comparison states. The main test score outcome is the unweighted average of these standardized scores for reading and math. For estimation of the impacts of kindergarten attendance (Table 8), I consider outcomes from the kindergarten-age (wave 4) cognitive assessment standardized in same fashion. According to the ECLS-B guidance on the scores, “the majority of items in the kindergarten 2006/2007 battery come from the ECLS-K, although several preschool items were included in order to link the data waves within the ECLS-B cohort.”

The ECLS-B also contains rich family background information on respondents.<sup>8</sup> In addition to basic demographics (age at assessment and indicators for sex (female) and ethnicity and race

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<sup>5</sup> The ECLS-B contains oversamples of some demographic groups (Chinese and other Asians, Pacific Islanders, Native Americans, and Alaskan Natives), twins, and low and very low birth weight children. I apply sampling weights to make the estimates population representative.

<sup>6</sup> Since the same comparison group is used to estimate the impact of targeted and universal programs, the number of observations may appear to be larger when summing across regression-specific sample sizes.

<sup>7</sup> The preschool-age assessment drew on the Peabody Picture Vocabulary Test (PPVT), the Preschool Comprehensive Test of Phonological and Print Processing (Pre-CTOPPP), the PreLAS® 2000, and the Test of Early Mathematics Ability-3 (TEMA-3), as well as the cognitive assessment given to the fall 1998 kindergarten cohort of the ECLS (ECLS-K).

<sup>8</sup> All time- or age-varying family background variables are measured in wave 3, or at preschool age.

(non-Hispanic black and Hispanic)), I construct indicators for low-income (family income at or below 185% of the federal poverty line (FPL)), for low birth weight (birth weight < 2,500 grams), for low maternal education (at or below a high school degree), for a language other than English being spoken in the home, and for the presence of both biological parents in the household. I use the low-income indicator to stratify the analysis and as a control in the full-sample estimates and the remaining background and demographic characteristics as controls in my preferred model. The low-income indicator is ideal for stratification, since free or reduced-price lunch eligibility (family income  $\leq$  185% FPL) is the modal income eligibility criterion for the targeted states of interest.

The ECLS-B also assessed toddler's motor and mental development using the Bayley Short Form-Research Edition (based on the Bayley Scales of Infant Development, 2<sup>nd</sup> Edition). I standardize these measures analogously to the preschool-age test scores for the specification checks in Table 4 (full sample) and Appendix Table 4 (low-income subsample). I also include these pretest scores as additional controls in a specification check in Appendix Table 5. I focus on the mental scores but impacts on and controlling for the motor scores yield similar results.

The ECLS-B also provides detailed information on the care and education of respondents at preschool age. In particular, it provides (1) Parent reports of center characteristics for the center in which a child spends the most time; and (2) Provider reports of center characteristics for the type of non-parental care in which a child spends the most time. Source (1) is available for most children, whereas source (2) is missing for a decent share of children for which it should be available.

These data constraints guide my approach to calculating the dummy for state-funded pre-K attendance. I begin with a parent report of the child attending a free program or center.<sup>9</sup> But a concern with using this measure alone is that parents might classify a state-funded pre-K in a different way. For example, the fact that some states allow/encourage subcontracting with Head Start means some children who parents report to be in Head Start are actually enrolled in a state-funded pre-K. In cases where a parent does not report that a child is attending a free program or center, I therefore recode the pre-K indicator to one if the provider reports that a program is a public-school pre-K or a preschool (or other program) sponsored by state/local government or public schools. For example, the parent of a child attending pre-K via Head Start might report that the child is in Head Start, but not another center type. The second step recodes these as state-funded pre-K when Head Start is the primary source of non-parental care. Reassuringly, the second step changes the pre-K attendance dummy much more often for low-income children. Provider reports with which to make the second correction are sometimes missing. Parents also may not accurately report on their child's enrollment.

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<sup>9</sup> Most of these are classified as pre-K or preschool by the parent; only a small share are day care or nursery school.

## Appendix B: Cost-Benefit Analysis

The cost-benefit analysis in Table 9, discussed in Section VII, relies on a number of assumptions. The table below outlines the choices of key parameter values.

Estimate/parameter	Value	Source/Justification
$\hat{\beta}_{TSLs}^U$	0.569 (0.315)	Table 2 Panel A, additional controls, column 4
$\hat{\beta}_{TSLs}^T$	-0.082 (0.450)	Table 3, Panel B, low-income column 4
$\hat{\beta}_{TSLs}^K$	0.573 (0.132)	Table 8, Panel A, column 3
$S_{U,U}^V, S_{U,U}^B$	-0.448, -0.09	Appendix Table 9, Panel C, columns 2 and 3
$S_{T,T}^V, S_{T,T}^B$	0, -0.368	Table 6, Panel C, columns 2 and 3
$S_{K,K}^V, S_{K,K}^B$	-0.378, -0.24	Appendix Table 10, Panel C, columns 2+5 and 4
$\varphi_U^U$	\$11,875 (K-12), \$7627 (Head Start)	Age 4 population-weighted averages of state figures in Barnett et al. (2006)
$\varphi_T^T$	\$10,139 (K-12), \$6974 (Head Start)	Age 4 population-weighted averages of state figures in Barnett et al. (2006)
$\varphi_K^K$	\$11,000	Approximation
$\varphi_U^V = \varphi_K^V$	\$4,966	Lower-bound estimate from Laughlin (2013)
$\varphi_U^B, \varphi_T^B, \varphi_K^B$	\$7627, \$6974, \$7,300	Age 4 population-weighted averages of state per-pupil Head Start spending in Barnett et al. (2006)
$p$	$0.1 \times e_j$ , where $e_j$ is the present discounted value of lifetime earnings at age 4 ( $j=U,T$ ) or age 5 ( $j=K$ )	Kline and Walters (2016). It is conservative to assume that a 1 standard deviation increase in test scores increases earnings by 10%.
$e_U$	\$291,287	Chetty et al. (2011). The average present discounted value of earnings at age 10 is \$522,000 (2010 dollars). Discounted back to age 4 assuming a discount rate of 3% and inflation-adjusted to 2005 dollars.
$e_T$	$0.8 \times e_U$ ,	Kline and Walters (2016). Average lifetime earnings of low-income children is lower than the national average.
$e_K$	\$380,064	Chetty et al. (2011). The average present discounted value of earnings at age 10 is \$522,000 (2010 dollars). Discounted back to age 5 assuming a discount rate of 3% and inflation-adjusted to 2005 dollars.
$\tau$	0.2	Conservative assumption suggested in personal conversation with Nathan Hendren

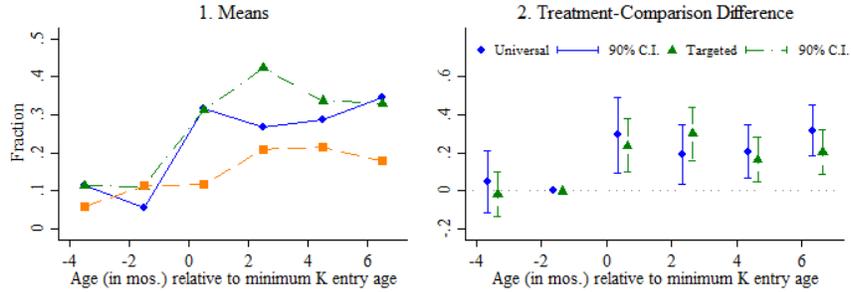
NOTE: “U” denotes universal pre-K; “T” denotes targeted pre-K, and “K” denotes universal kindergarten. All monetary values are in 2005 dollars unless otherwise noted.

## Appendix References

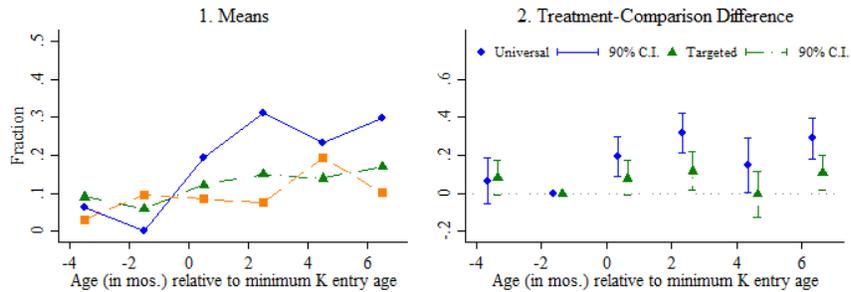
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## Appendix Figure 1. Pre-K Eligibility and Pre-K Attendance by Age, State Program Type, and Poverty Status

### A. Low-Income ( $\leq 185\%$ FPL)



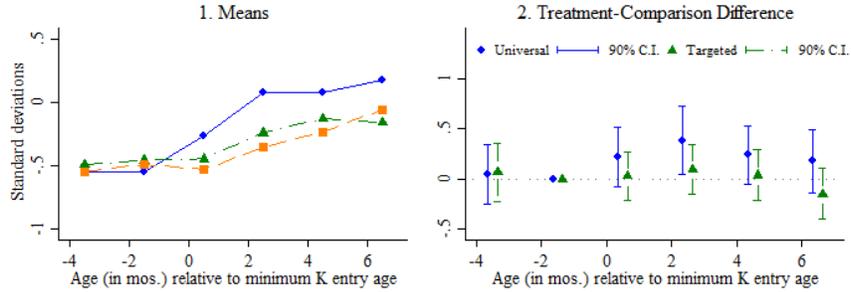
### B. Not Low-Income ( $>185\%$ FPL)



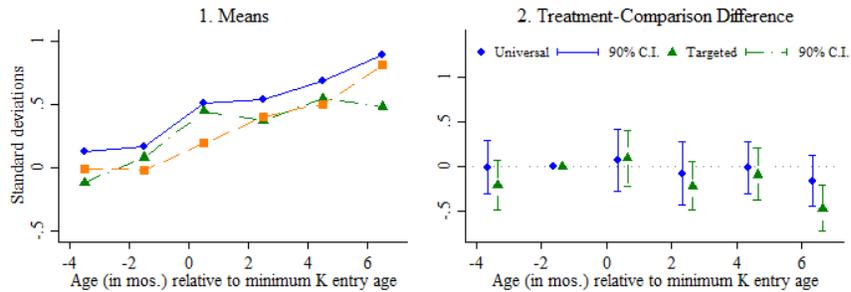
NOTE: Data are from the ECLS-B. Estimation sample is restricted to respondents with non-missing values of key variables resident in one of the analysis states at wave 3 (2005-06), born with 4 months after and 8 months before that state's cutoff birthdate for kindergarten entry, and assessed during the 2005-06 school year. The dependent variable in each panel is a dummy for pre-K attendance during wave 3, when respondents were 4 years of age. Panel A corresponds to respondents who were eligible for free- or reduced-price lunch in 2005-06; Panel B corresponds to respondents who were not. Subpanel 1 of each panel plots the average standardized test score by age relative to the minimum age for kindergarten entry (2-month bins) for treated states with universal pre-K programs, treated states with targeted pre-K programs, and comparison states; see notes to Table 1 or Appendix Tables 1 and 2. The dots in subpanel 2 of each panel represent, separately for treatment states with universal programs and treatment states with targeted programs, the coefficients on interactions between a treatment dummy and a series of dummies for age relative to the minimum age for kindergarten entry (2-month bins) from a regression that allows for direct effects of each of these (sets of) variables in addition to month x year of assessment dummies and state fixed effects. The interaction with the dummy for missing eligibility by 1 to 2 months is omitted for identification. Capped vertical lines represent 90% confidence intervals, with standard errors clustered on state by month of birth.

## Appendix Figure 2. Pre-K Eligibility and Reading Scores by Age, State Program Type, and Poverty Status

### A. Low-Income ( $\leq 185\%$ FPL)



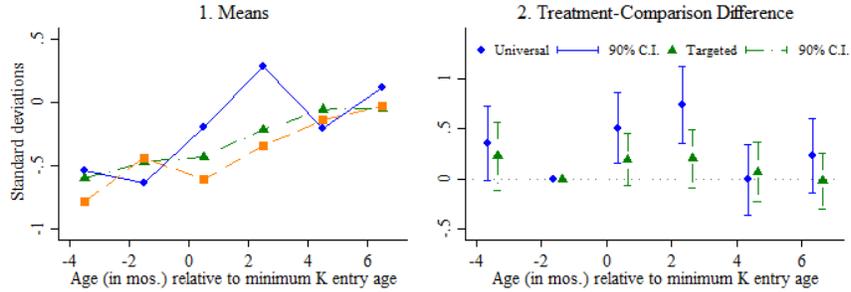
### B. Not Low-Income ( $>185\%$ FPL)



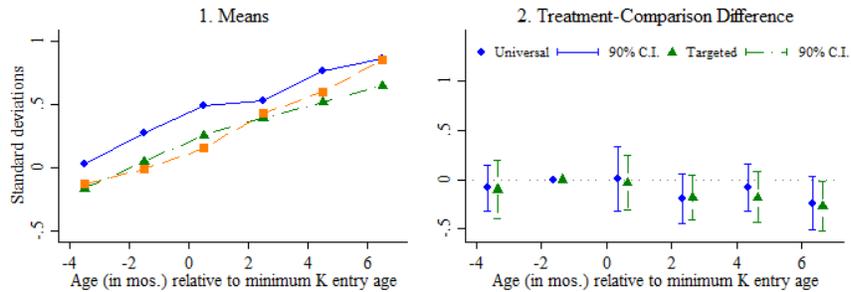
NOTE: Data are from the ECLS-B. Estimation sample is restricted to respondents with non-missing values of key variables resident in one of the analysis states at wave 3 (2005-06), born with 4 months after and 8 months before that state's cutoff birthdate for kindergarten entry, and assessed during the 2005-06 school year. The dependent variable in each panel is the standardized reading score during wave 3, when respondents were 4 years of age. Panel A corresponds to respondents who were eligible for free- or reduced-price lunch in 2005-06; Panel B corresponds to respondents who were not. Subpanel 1 of each panel plots the average standardized test score by age relative to the minimum age for kindergarten entry (2-month bins) for treated states with universal pre-K programs, treated states with targeted pre-K programs, and comparison states; see notes to Table 1 or Appendix Tables 1 and 2. The dots in subpanel 2 of each panel represent, separately for treatment states with universal programs and treatment states with targeted programs, the coefficients on interactions between a treatment dummy and a series of dummies for age relative to the minimum age for kindergarten entry (2-month bins) from a regression that allows for direct effects of each of these (sets of) variables in addition to month x year of assessment dummies and state fixed effects. The interaction with the dummy for missing eligibility by 1 to 2 months is omitted for identification. Capped vertical lines represent 90% confidence intervals, with standard errors clustered on state by month of birth.

## Appendix Figure 3. Pre-K Eligibility and Math Scores by Age, State Program Type, and Poverty Status

### A. Low-Income ( $\leq 185\%$ FPL)

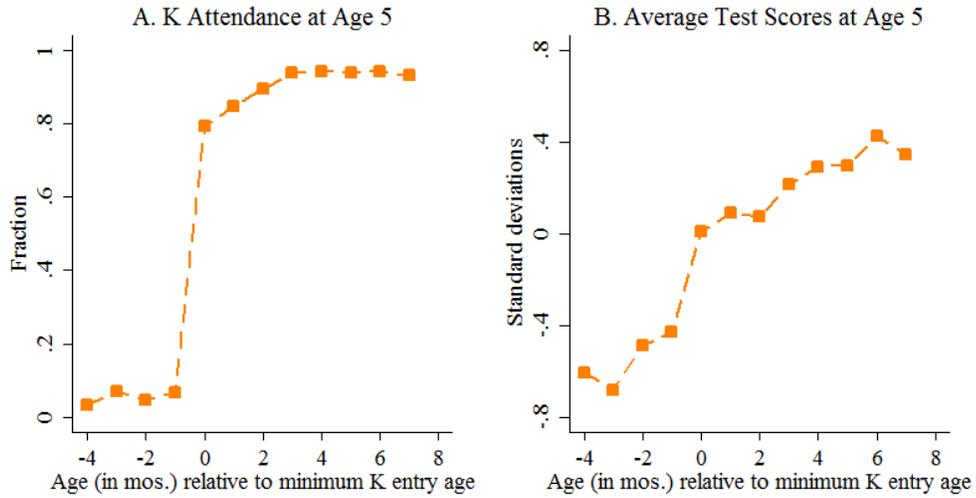


### B. Not Low-Income ( $>185\%$ FPL)



NOTE: Data are from the ECLS-B. Estimation sample is restricted to respondents with non-missing values of key variables resident in one of the analysis states at wave 3 (2005-06), born with 4 months after and 8 months before that state's cutoff birthdate for kindergarten entry, and assessed during the 2005-06 school year. The dependent variable in each panel is the standardized math score during wave 3, when respondents were 4 years of age. Panel A corresponds to respondents who were eligible for free- or reduced-price lunch in 2005-06; Panel B corresponds to respondents who were not. Subpanel 1 of each panel plots the average standardized test score by age relative to the minimum age for kindergarten entry (2-month bins) for treated states with universal pre-K programs, treated states with targeted pre-K programs, and comparison states; see notes to Table 1 or Appendix Tables 1 and 2. The dots in subpanel 2 of each panel represent, separately for treatment states with universal programs and treatment states with targeted programs, the coefficients on interactions between a treatment dummy and a series of dummies for age relative to the minimum age for kindergarten entry (2-month bins) from a regression that allows for direct effects of each of these (sets of) variables in addition to month x year of assessment dummies and state fixed effects. The interaction with the dummy for missing eligibility by 1 to 2 months is omitted for identification. Capped vertical lines represent 90% confidence intervals, with standard errors clustered on state by month of birth.

Appendix Figure 4. Kindergarten Attendance and Age 5 Test Scores by Age



NOTE: Data are from the ECLS-B. Estimation sample is restricted the subset of the original estimation sample born within 4 months after and 8 months before birthdate for kindergarten entry in their wave 4 state of residence. The dependent variable in each panel is measured during wave 4, when respondents were 5 years of age. Each panel plots averages by age relative to the minimum age for kindergarten entry across all analysis states (universal pre-K, targeted pre-K, comparison); see notes to Table 1 or Appendix Tables 1 and 2.

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

State	Birthday Cutoff for Pre-K	Quality Checklist (out of 10)			Total	Teacher Train. & Creds. (4)	Staffing Ratios & Class Size (2)	Other (4)	Annual spending per child		
		% enrolled by age							Pre-K	Head Start	K-12
		age 4	age 3	diff.							
<u>A. Universal Programs</u>											
Oklahoma	Sept. 1	70.2	0	70.2	9	3	2	4	\$6,167	\$5,809	\$7,475
Georgia	Sept. 1	51.5	0	51.5	8	2	2	4	\$3,978	\$7,149	\$10,492
Florida	Sept. 1	46.5	0	46.5	4	0	2	2	\$2,163	\$7,386	\$9,739
West Virginia	Sept. 1	39.9	4.5	35.4	7	2	2	3	\$7,758	\$6,637	\$11,262
Wisconsin	Sept. 1	32.1	0.7	31.4	5.1	2.9	0.1	2.1	\$4,590	\$6,695	\$12,789
New York	Dec. 1	28.6	0.5	28.1	5.6	1.4	2	2.2	\$3,512	\$8,794	\$15,235
<i>pop-weighted avg.</i>	-	<i>41.5</i>	<i>0.3</i>	<i>41.2</i>	<i>5.8</i>	<i>1.3</i>	<i>1.8</i>	<i>2.6</i>	<i>\$3,569</i>	<i>\$7,627</i>	<i>\$11,875</i>
<u>B. Targeted Programs</u>											
Texas	Sept. 1	44.3	4.5	39.8	4	3	0	1	\$2,653	\$7,091	\$9,076
South Carolina	Sept. 1	31	4.2	26.8	8	3	2	3	\$3,219	\$6,718	\$10,542
Maryland	Sept. 1	30.7	1	29.7	7	3	2	2	\$4,663	\$7,522	\$10,773
Illinois	Sept. 1	23	14.4	8.6	9	4	2	3	\$3,298	\$6,812	\$11,402
Louisiana	Sept. 30	21.6	0	21.6	7.8	2.05	2	3.75	\$5,012	\$6,620	\$10,241
Michigan	Dec. 1	16.2	0	16.2	6	3	2	1	\$3,934	\$6,670	\$11,437
Kansas	Aug. 31	14.5	0	14.5	3	2	0	1	\$2,554	\$6,404	\$9,676
Colorado	Oct. 1	13.5	2.2	11.3	4	1	2	1	\$3,056	\$6,941	\$9,877
Virginia	Sept. 30	11.1	0	11.1	7	2	2	3	\$5,375	\$7,216	\$11,626
Tennessee	Sept. 30	10.6	0.5	10.1	9	3	2	4	\$4,061	\$7,238	\$7,561
<i>pop-weighted avg.</i>	-	<i>27.2</i>	<i>4.1</i>	<i>23.1</i>	<i>6.2</i>	<i>2.9</i>	<i>1.3</i>	<i>2.0</i>	<i>\$3,537</i>	<i>\$6,974</i>	<i>\$10,139</i>

NOTE: Source is Barnett, et al. (2006), and figures correspond to the 2005-06 academic year. Monetary figures are in nominal dollars. The other components of the quality checklist come from comprehensive early learning standards, comprehensive services provided (vision, hearing, health, and one support service, at least one meal), and a site visit requirement; see notes to Figure 2 for complete description of the checklist. Head Start spending corresponds to 2004-05, and K-12 spending includes both current and capital expenditures. Spending on pre-K is a lower bound, since programs may receive funding from local or federal sources not reported.

**Appendix Table 2. Characteristics of the Comparison States**

State	Birthday Cutoff for Pre-K and K	% enrolled in state funded pre-K by age		
		age 4	age 3	diff.
<u>A. Comparison States with Pre-K Programs</u>				
Alabama	Sept. 1	1.7	0	1.7
California	Dec. 2	9.9	4.5	5.4
Delaware	Aug. 31	7.8	0	7.8
Missouri	Jul. 31	4	2.3	1.7
New Mexico	Sept. 1	6.8	0.6	6.2
Ohio	Sept. 30	4.4	1	3.4
Oregon	Sept. 1	5	2.6	2.4
Washington	Aug. 31	6	1.4	4.6
<i>pop-weighted avg.</i>	-	7.5	3.0	4.4
<u>B. Comparison States without Pre-K Programs</u>				
Alaska	Sept. 1	0	0	0
Hawaii	Dec. 31	0	0	0
Idaho	Sept. 1	0	0	0
Indiana	Aug. 1	0	0	0
Mississippi	Sept. 1	0	0	0
North Dakota	Aug. 31	0	0	0
Rhode Island	Sept. 1	0	0	0
South Dakota	Sept. 1	0	0	0
Utah	Sept. 1	0	0	0
<i>pop-weighted avg.</i>	-	0.0	0.0	0.0
<u>C. All Comparison States</u>				
<i>pop-weighted avg.</i>	-	5.9	2.4	3.5

SOURCE: Barnett, et al. (2006, 2007).

**Appendix Table 3. Descriptive Statistics and Balance Tests on Key Variables, by Family Income and Program Type**

	Children:		States:					
	Low-income		Not Low-Income					
	Universal		Targeted		Universal		Targeted	
	Mean	Coef. (se)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>A. Treatment variable</b>								
Pre-kindergarten <sup>a</sup>	0.081	0.227 (0.063)	0.113	0.226 (0.050)	0.025	0.206 (0.050)	0.074	0.041 (0.038)
<b>B. Background characteristics</b>								
Age in months <sup>a</sup>	48.551 [3.060]	-0.042 (0.074)	48.516 [3.224]	-0.107 (0.072)	48.502 [3.196]	-0.146 (0.076)	48.003 [3.359]	-0.077 (0.060)
Female	0.493	0.039 (0.082)	0.512	0.009 (0.064)	0.436	0.086 (0.057)	0.529	-0.011 (0.055)
Black non-Hispanic	0.349	0.014 (0.060)	0.345	0.031 (0.055)	0.077	0.065 (0.029)	0.082	0.042 (0.026)
Hispanic	0.206	0.000 (0.059)	0.375	-0.066 (0.050)	0.188	-0.038 (0.047)	0.156	0.037 (0.045)
Low birth weight	0.075	0.043 (0.025)	0.096	0.030 (0.028)	0.073	0.014 (0.020)	0.065	0.012 (0.019)
Maternal education ≤ HS <sup>a</sup>	0.663	0.069 (0.061)	0.695	0.035 (0.068)	0.249	0.054 (0.063)	0.281	-0.025 (0.051)
Both biological parents in HH <sup>a</sup>	0.511	-0.063 (0.057)	0.547	0.003 (0.056)	0.877	-0.113 (0.052)	0.812	0.020 (0.051)
Non-English at home <sup>a</sup>	0.199	-0.002 (0.050)	0.243	-0.005 (0.041)	0.111	0.013 (0.036)	0.091	0.014 (0.041)
<i>p</i> -value: joint test for background chars		0.61		0.44		0.04		0.41
Observations <sup>b</sup>	150	1550	200	1750	150	1850	250	2200

<sup>a</sup> Measured at preschool age, or in 2005-06 (wave 3 interview).

<sup>b</sup> rounded to the nearest 50, per IES guidelines.

NOTE: A child is considered low income if his (preschool-age or 2005-06) family income is at or below 185% FPL. Odd-numbered columns give means for respondents in treatment states ineligible for pre-K in 2005-06 [standard deviations for non-binary variables]. Even-numbered columns give DD coefficients (standard errors) on the interaction between a dummy for being eligible for pre-K in 2005-06 and a dummy for residing in a treatment state (*elig x treat*) from a separate regression that also includes dummies for state of residence, month x year of assessment, and 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 cutoffs not in the middle of the month; see Appendix Table 1. Comparison states have statewide age at kindergarten entry regulations that are not in the middle of the month; see Appendix Table 2. 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 after and 8 months before the cutoff date and who are assessed during the school year. Means and regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, “Children’s Birth Certificates” [collection at 9 mos.], “Parent-Guardian Interviews,” “Direct Child Assessments,” and “Early Care and Education Providers” [collection at 48 mos.]

**Appendix Table 4. Sensitivity of Estimated Effects of Pre-K to the Choice of Outcome:  
Low-Income Subsample**

	Pre-K: First Stage (1)	Test Scores		
		RF (ITT) (2)	IV (TOT) (3)	OLS (4)
<u>A. Baseline</u>				
Universal (N=1,550)	0.226 (0.062)	0.263 (0.107)	1.160 (0.544)	-0.037 (0.055)
Targeted (N=1,750)	0.223 (0.051)	-0.018 (0.102)	-0.082 (0.450)	-0.015 (0.051)
<i>p</i> -value on difference	0.966	0.020	0.032	0.728
<u>B. Reading score only</u>				
Universal (N=1,550)	0.226 (0.062)	0.272 (0.109)	1.201 (0.551)	0.028 (0.056)
Targeted (N=1,750)	0.223 (0.051)	-0.039 (0.102)	-0.177 (0.447)	-0.007 (0.058)
<i>p</i> -value on difference	0.966	0.012	0.021	0.593
<u>C. Math score only</u>				
Universal (N=1,550)	0.226 (0.062)	0.253 (0.130)	1.118 (0.629)	-0.102 (0.068)
Targeted (N=1,750)	0.223 (0.051)	0.003 (0.117)	0.013 (0.515)	-0.024 (0.056)
<i>p</i> -value on difference	0.966	0.080	0.096	0.286
<u>D. Mental score (age 2)<sup>a</sup></u>				
Universal (N=1,550)	0.234 (0.064)	-0.006 (0.089)	-0.025 (0.373)	-0.038 (0.060)
Targeted (N=1,750)	0.207 (0.051)	0.159 (0.103)	0.772 (0.519)	-0.117 (0.062)
<i>p</i> -value on difference	0.701	0.063	0.068	0.111
<u>E. = 1 if parent reports not ready for K (age 4)</u>				
Universal (N=1,550)	0.229 (0.062)	-0.143 (0.073)	-0.623 (0.357)	0.002 (0.029)
Targeted (N=1,750)	0.223 (0.051)	-0.038 (0.057)	-0.172 (0.256)	-0.081 (0.026)
<i>p</i> -value on difference	0.932	0.188	0.220	0.010

<sup>a</sup> Additional controls include age at assessment and dummies for month x year of assessment in wave 2 of the ECLS-B, and panel weights incorporate observation in wave 2.

NOTE: A child is considered low income if his (preschool-age or 2005-06) family income is at or below 185% FPL. The first stage and RF (ITT) columns give coefficients on the interaction between a dummy for being eligible for kindergarten in 2006-07 (same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state (*elig x treat*). (See Table 1 or Appendix A for a definition of treatment and comparison states.) The IV (TOT) and OLS columns give coefficients on pre-K attendance (*prek*), in the first case instrumenting with *elig x treat* using TSLS. All coefficients are from separate regressions that also include as controls dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, and all demographic and background characteristics listed in Table 1 Panel B except the low-income indicator. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Direct Child Assessments" [collection at 24 mos., 48 mos.], "Parent-Guardian Interviews" and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 5. Sensitivity of Estimated Effects of Pre-K on Test Scores to Controlling for Age 2 Scores**

	Pre-K:	Test Scores		
	First Stage (1)	RF (ITT) (2)	IV (TOT) (3)	OLS (4)
<u>A. Full Sample</u>				
Universal (N=3,400)	0.210 (0.046)	0.128 (0.063)	0.609 (0.313)	-0.054 (0.045)
Targeted (N=3,950)	0.112 (0.034)	-0.009 (0.065)	-0.084 (0.571)	-0.067 (0.040)
<i>p</i> -value on difference	0.043	0.038	0.178	0.790
<u>B. Low-Income Subsample</u>				
Universal (N=1,550)	0.232 (0.063)	0.252 (0.102)	1.086 (0.505)	-0.016 (0.053)
Targeted (N=1,750)	0.206 (0.050)	0.002 (0.104)	0.008 (0.495)	0.012 (0.050)
<i>p</i> -value on difference	0.707	0.028	0.055	0.653

NOTE: A child is considered low income if his (preschool-age or 2005-06) family income is at or below 185% FPL. The first stage and RF (ITT) columns give coefficients on the interaction between a dummy for being eligible for kindergarten in 2006-07 (same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state (*elig x treat*). (See Table 1 or Appendix A for a definition of treatment and comparison states.) The IV (TOT) and OLS columns give coefficients on pre-K attendance (*prek*), in the first case instrumenting with *elig x treat* using TSLS. All coefficients are from separate regressions that also include as controls dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, all demographic and background characteristics listed in Table 1 Panel B except the low-income indicator, age 2 motor and mental scores, age at the wave 2 assessment, and dummies for month x year of wave 2 assessment. Missing values of wave 2 assessments are imputed with (weighted) sample means and indicators for imputation also included as regressors. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth. SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, “Children’s Birth Certificates” [collection at 9 mos.], “Direct Child Assessments” [collection at 24 mos., 48 mos.], “Parent-Guardian Interviews” and “Early Care and Education Providers” [collection at 48 mos.]

**Appendix Table 6. IV Estimates of the Impact of Pre-K Attendance on Parental Perceptions of Kindergarten Readiness, by Reason: Low-Income Subsample**

	Reason Not Ready for Kindergarten (=0 if deemed ready):				
	Academic (1)	Social (2)	Behavioral (3)	Physical (4)	Speech Concerns (5)
Universal (N=1,550)	-0.265 (0.170)	0.010 (0.093)	-0.003 (0.145)	0.046 (0.044)	-0.158 (0.094)
Targeted (N=1,750)	-0.044 (0.077)	0.104 (0.086)	-0.080 (0.130)	0.057 (0.047)	-0.073 (0.097)
<i>p</i> -value on difference	0.173	0.268	0.598	0.616	0.442
	Medical (6)	Limited English (7)	Young in Class (8)	Limited Preschool (9)	
Universal (N=1,550)	-0.063 (0.077)	0.016 (0.030)	-0.038 (0.031)	-0.050 (0.027)	
Targeted (N=1,750)	0.001 (0.051)	-0.011 (0.019)	0.002 (0.006)	-0.039 (0.023)	
<i>p</i> -value on difference	0.394	0.309	0.213	0.569	

NOTE: Dependent variables are coded as zero for children of parents who report no concern over their kindergarten readiness. Not every parent who reports concern over kindergarten readiness gives a reason – and parents can give multiple reasons – so the coefficients need not add up to those reported in Appendix Table 4 Panel E. Each cell entry represents an IV estimate of the impact of pre-K attendance on a dummy for a parent reporting (in wave 3) concerns that a child is not ready for kindergarten for the reason given. The instrument for pre-K attendance is the interaction between a dummy for being eligible for kindergarten in 2006-07 (same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state (elig x treat). All underlying regressions include dummies for for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, and all demographic and background characteristics listed in Table 1 Panel B. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth. SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, “Children’s Birth Certificates” [collection at 9 mos.], “Parent-Guardian Interviews,” “Direct Child Assessments,” and “Early Care and Education Providers” [collection at 48 mos.]

**Appendix Table 7. Balance Tests on Key Variables, by Program Type:  
+/- 4 Months from Cutoff**

	Universal	Targeted	Uni - Tar
	DD Coef.	DD Coef.	DDD Coef.
	(se)	(se)	(se)
	(1)	(2)	(3)
<u>A. Treatment variable</u>			
Pre-kindergarten <sup>a</sup>	0.221 (0.055)	0.125 (0.038)	0.096 (0.056)
<u>B. Background characteristics</u>			
Age in months <sup>a</sup>	-0.156 (0.063)	-0.140 (0.054)	-0.016 (0.057)
Female	0.117 (0.053)	0.060 (0.050)	0.057 (0.057)
Black non-Hispanic	0.030 (0.041)	0.016 (0.032)	0.015 (0.042)
Hispanic	-0.021 (0.046)	-0.011 (0.037)	-0.010 (0.042)
Low birth weight	0.028 (0.016)	0.012 (0.013)	0.015 (0.016)
Maternal education $\leq$ HS <sup>a</sup>	0.012 (0.044)	-0.048 (0.050)	0.060 (0.044)
Both biological parents in HH <sup>a</sup>	-0.079 (0.047)	0.025 (0.041)	-0.105 (0.051)
Non-English at home <sup>a</sup>	-0.009 (0.034)	-0.024 (0.032)	0.016 (0.036)
Family income $\leq$ 185% FPL <sup>a</sup>	-0.075 (0.047)	-0.080 (0.048)	0.005 (0.051)
<u>C. p-value: joint test for background chars.</u>			
All background characteristics	0.01	0.10	0.26
Excluding poverty	0.01	0.24	0.25
Observations <sup>b</sup>	2,000	2,350	4,350

<sup>a</sup> Measured at preschool age, or in 2005-06 (wave 3 interview)

<sup>b</sup> rounded to the nearest 50, per IES guidelines.

NOTE: Sample is limited to children who turn age 5 between 4 months after and 4 months before the cutoff date and who are assessed during the school year. Each column gives DD coefficients (standard errors) on the interaction between a dummy for being eligible for pre-K in 2005-06 and a dummy for residing in a treatment state (*elig x treat*) from a separate regression that also includes dummies for state of residence, month x year of assessment, and 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 cutoffs not in the middle of the month; treatment states with universal programs are FL, GA, NY, OK, WI, and WV, and treatment states with targeted programs are CO, IL, KS, LA, MI, MD, SC, TN, TX, and VA. Comparison states have statewide age at kindergarten entry regulations; some comparison states have relatively small pre-K programs (AL, CA, DE, MO, NM, 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). Means and regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth. SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 8. Sensitivity of Estimated Effects of Pre-K on Test Scores to Estimation Sample: Low-Income Subsample**

	Pre-K:	Test Scores		
	First Stage	RF (ITT)	IV (TOT)	OLS
	(1)	(2)	(3)	(4)
<u>A. Baseline</u>				
Universal (N=1,550)	0.226 (0.062)	0.263 (0.107)	1.160 (0.544)	-0.037 (0.055)
Targeted (N=1,750)	0.223 (0.051)	-0.018 (0.102)	-0.082 (0.450)	-0.015 (0.051)
<i>p</i> -value on difference	0.966	0.020	0.032	0.728
<u>B. Sample +/- 4 months from threshold<sup>a</sup></u>				
Universal (N=900)	0.242 (0.083)	0.347 (0.129)	1.434 (0.677)	-0.042 (0.078)
Targeted (N=1,000)	0.241 (0.061)	0.049 (0.112)	0.202 (0.443)	0.026 (0.075)
<i>p</i> -value on difference	0.985	0.029	0.060	0.474
<u>C. Identification +/- 4 months from threshold<sup>b</sup></u>				
Universal (N=1,550)	0.218 (0.083)	0.397 (0.121)	1.816 (0.826)	-0.036 (0.055)
Targeted (N=1,750)	0.269 (0.063)	0.047 (0.114)	0.173 (0.412)	-0.014 (0.052)
<i>p</i> -value on difference	0.571	0.009	0.038	0.725
<u>D. Expanded sample (+ middle of month cutoffs)<sup>c</sup></u>				
Universal (N=1,600)	0.230 (0.061)	0.249 (0.107)	1.080 (0.527)	-0.023 (0.055)
Targeted (N=1,900)	0.211 (0.048)	0.008 (0.095)	0.036 (0.443)	0.015 (0.049)
<i>p</i> -value on difference	0.776	0.037	0.059	0.521
<u>E. Restricted sample (Aug. 31/Sept. 1 cutoffs)<sup>d</sup></u>				
Universal (N=900)	0.296 (0.066)	0.178 (0.125)	0.602 (0.409)	0.008 (0.101)
Targeted (N=850)	0.329 (0.048)	-0.037 (0.131)	-0.113 (0.388)	-0.002 (0.094)
<i>p</i> -value on difference	0.645	0.103	0.081	0.936

<sup>a</sup> Sample further limited to respondents with birthdays within 4 months of the cutoff birthdate for kindergarten entry in their wave 3 state of residence.

<sup>b</sup> Interactions between *treat* and indicators for birth 4-5 months and 6-7 months after cutoff included as controls.

<sup>c</sup> Sample expanded to include respondents residing in treatment states with middle-of-month cutoffs (targeted: AR, NC; universal: ME) not born in the cutoff birthdate month.

<sup>d</sup> Sample limited to treatment and comparison states with Aug. 31 or Sept. 1 cutoffs (Appendix Tables 1 and 2).

NOTE: A child is considered low income if his (preschool-age or 2005-06) family income is at or below 185% FPL. The first stage and RF (ITT) columns give coefficients on the interaction between a dummy for being eligible for kindergarten in 2006-07 (same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state (*elig x treat*). (See Table 1 or Appendix A for a definition of treatment and comparison states in the baseline sample.) The IV (TOT) and OLS columns give coefficients on pre-K attendance (*prek*), in the first case instrumenting with *elig x treat* using TSLS. All coefficients are from separate regressions that include as controls dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, and all characteristics listed in Table 1 Panel B except the low-income indicator. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 9. Impacts on Alternative Care Arrangements, by State Program Type: Full Sample**

	Alternatives:						
	Pre-K: First Stage (1)	Head Start (2)	Other center-based care (3)	Any formal (2+3) (4)	Informal non-parental care (5)	Parental care (6)	Any informal (5+6) (7)
<u>A. Ineligible Means</u>							
Universal	0.05	0.12	0.44	0.56	0.14	0.25	0.39
Targeted	0.09	0.12	0.34	0.46	0.18	0.27	0.45
<u>B. Reduced form (coef (se) on <i>elig x treat</i>)</u>							
Universal (N=3,400)	0.211 (0.047)	-0.019 (0.035)	-0.095 (0.055)	-0.114 (0.066)	-0.002 (0.029)	-0.095 (0.040)	-0.097 (0.045)
Targeted (N=3,950)	0.118 (0.034)	-0.013 (0.031)	0.001 (0.041)	-0.011 (0.046)	-0.029 (0.034)	-0.078 (0.039)	-0.107 (0.040)
<i>p</i> -value on difference	0.057	0.871	0.070	0.122	0.436	0.700	0.851
<u>C. Instrumental Variables (coef (se) on <i>prek<sub>it</sub></i>)</u>							
Universal (N=3,400)	n.a.	-0.090 (0.155)	-0.448 (0.219)	-0.539 (0.239)	-0.012 (0.136)	-0.450 (0.219)	-0.461 (0.239)
Targeted (N=3,950)	n.a.	-0.107 (0.248)	0.011 (0.343)	-0.096 (0.371)	-0.245 (0.294)	-0.659 (0.332)	-0.904 (0.371)
<i>p</i> -value on difference	n.a.	0.947	0.159	0.222	0.385	0.511	0.222

NOTE: Reduced-form coefficients in Panel A are on the interaction between a dummy for being eligible for kindergarten in 2006-07 (same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state (*elig x treat*). (See Table 1 or Appendix A for a definition of treatment and comparison states.) The instrumental variables coefficients in Panel B are on pre-K attendance (*prek*), estimated by instrumenting with *elig x treat* using TSLS. All coefficients are from separate regressions that also include as controls dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, and all demographic and background characteristics listed in Table 1 Panel B. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth. "n.a." means "not applicable."

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 10. Impacts on Alternative Care Arrangements to Kindergarten: Full Sample**

	Alternatives:								
	Public K: First Stage (1)	Private K (2)	Grades 1-2 (3)	Head Start (4)	Other center-based care (5)	Any formal (4+5) (6)	Informal non-parental care (7)	Parental care (8)	Any informal (7+8) (9)
	<u>A. Ineligible means</u>								
All states	0.05	0.02	0.00	0.13	0.58	0.71	0.11	0.11	0.21
	<u>B. Reduced form (coef (se) on <i>elig</i>)</u>								
All states (N=2,400)	0.657 (0.036)	0.070 (0.024)	0.000 (0.000)	-0.158 (0.033)	-0.319 (0.048)	-0.477 (0.045)	-0.179 (0.037)	-0.071 (0.031)	-0.250 (0.038)
	<u>C. Instrumental Variables (coef (se) on kindergarten attendance)</u>								
All states (N=2,400)	n.a.	0.107 (0.040)	0.000 (0.000)	-0.241 (0.049)	-0.485 (0.068)	-0.726 (0.060)	-0.273 (0.058)	-0.108 (0.046)	-0.381 (0.059)

NOTE: Reduced-form coefficients in Panel A are on a dummy for being eligible for kindergarten in 2006-07 (*elig*). The instrumental variables coefficients in Panel B are give coefficients on K attendance, instrumenting with *elig* using TSLS. All coefficients are from separate regressions that also include as controls dummies for state of (wave 4) residence and month x year of (wave 4) assessment, a linear term in month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, an interaction between that linear term and *elig*, and all demographic and background characteristics listed in Table 1 Panel B. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth. Sample is limited to the subset of the original estimation sample born within 4 months after and 4 months before the minimum kindergarten entry age in their wave 4 state of residence. "n.a." means "not applicable."

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates," [collection at 9 mos.] "Parent-Guardian Interviews," [collection at 48 mos.], "Direct Child Assessments," "Early Care and Education Providers," and "School Questionnaires" [collection at kindergarten entry]

**Appendix Table 11. Impacts of State-funded Pre-K on Preschool-Age Test Scores Dropping DE and IL from Estimation Sample**

	Pre-K:	Test Score (Average Reading and Math):			
	First Stage	Ineligible Mean	RF (ITT)	IV (TOT)	OLS
	(1)	(2)	(3)	(4)	(5)
<u>A. Full Sample</u>					
<u>1. Universal (N=3,400)</u>					
With additional controls	0.211 (0.047)	-0.183	0.118 (0.065)	0.562 (0.315)	-0.069 (0.048)
<u>2. Targeted (N=3,600)</u>					
With additional controls	0.121 (0.038)	0.277	-0.032 (0.064)	-0.261 (0.529)	-0.087 (0.046)
<u>3. p-value on Universal-Targeted Difference (N=7,000)</u>					
With additional controls	0.082		0.030	0.095	0.711
<u>B. By Family Income</u>					
<u>1. Universal</u>					
Low-income (N=1,550)	0.226 (0.062)	-0.572	0.257 (0.108)	1.137 (0.543)	-0.038 (0.055)
Not low-income (N=1,850)	0.189 (0.047)	0.165	0.008 (0.102)	0.041 (0.530)	-0.079 (0.077)
<i>p</i> -value on difference	0.552		0.128	0.201	0.64
<u>2. Targeted</u>					
Low-income (N=1,600)	0.226 (0.058)	-0.524	-0.019 (0.112)	-0.085 (0.490)	-0.032 (0.052)
Not low-income (N=2,000)	0.037 (0.039)	-0.073	-0.046 (0.087)	no f.s.	-0.140 (0.083)
<i>p</i> -value on difference	0.003		0.862		0.263
<u>3. p-value on Universal-Targeted Difference</u>					
Low-income	0.995		0.034	0.047	0.928
Not low-income	0.002		0.611	n.a.	0.46

NOTE: The first stage and RF (ITT) columns give coefficients on the interaction between a dummy for being eligible for kindergarten in 2006-07 (same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state (*elig x treat*). Sample drops Delaware (comparison) and Illinois (targeted state). (See Table 1 or Appendix A for a definition of treatment and comparison states.) The IV (TOT) and OLS columns give coefficients on pre-K attendance (*prek*), in the first case instrumenting with *elig x treat* using TSLS. All coefficients are from separate regressions that also include as controls dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, and the demographic and background controls listed in Table 1 Panel B. A child is considered low income (Panel B) if his (preschool-age or 2005-06) family income is at or below 185% FPL, the threshold for eligibility for reduced-price lunch and the modal income-eligibility criterion for the targeted programs under study. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 12a. Means for Treatment Groups and Prospective Comparison Groups: Full Sample**

	Treatment Groups						Comparison Groups		
	Universal		Targeted		All		All	With Pre-K	No Pre-K
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
<b>A. Treatment variable</b>									
Pre-kindergarten <sup>a</sup>	0.214	*‡	0.193	*‡	0.201	*‡	0.130	0.155	0.069
<b>B. Background characteristics</b>									
Age in months <sup>a</sup>	52.361		51.974		52.132		52.112	52.069	52.214
	[5.801]		[5.071]		[5.390]		[5.237]	[5.362]	[4.923]
Female	0.486		0.484		0.485		0.486	0.483	0.491
Black non-Hispanic	0.186	*‡	0.181	*†‡	0.183	*†‡	0.115	0.119	0.108
Hispanic	0.170	†	0.243	‡	0.213	†‡	0.251	0.307	0.118
Low birth weight	0.076		0.080		0.079		0.073	0.074	0.072
Maternal education ≤ HS <sup>a</sup>	0.464		0.447		0.454		0.466	0.474	0.449
Both biological parents in HH <sup>a</sup>	0.681		0.723		0.706		0.700	0.697	0.707
Non-English at home <sup>a</sup>	0.136	†‡	0.157	‡	0.148	‡	0.168	0.212	0.063
Family income ≤ 185% FPL <sup>a</sup>	0.449		0.431	*†	0.438	*†	0.485	0.494	0.464
Observations <sup>b</sup>	1,150		1,750		2,900		2,250	1,600	650

<sup>a</sup> Measured at preschool age, or in 2005-06 (wave 3 interview).

<sup>b</sup> rounded to the nearest 50, per IES guidelines.

\* significantly different from the full comparison group ( $p < 0.05$ ).

† significantly different from the comparison states with pre-K ( $p < 0.05$ ).

‡ significantly different from the comparison states without pre-K ( $p < 0.05$ ).

NOTE: Columns give means for each group [standard deviations for non-binary variables]. 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 cutoffs not in the middle of the month; treatment states with universal programs are FL, GA, NY, OK, WI, and WV, and treatment states with targeted programs are CO, IL, KS, LA, MI, MD, SC, TN, TX, and VA. Comparison states have statewide minimum age at kindergarten entry cutoffs not in the middle of the month; some comparison states have relatively small pre-K programs (AL, CA, DE, MO, NM, OH, OR, WA), while others lack pre-K programs (AK, HI, ID, IN, MS, ND, RI, SD, UT). Sample is limited to children who turn age 5 between 4 months after and 8 months before the cutoff date and who are assessed during the 2005-06 school year. Means are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 12b. Means for Treatment Groups and Prospective Comparison Groups: Low-Income Subsample**

	Treatment Groups						Comparison Groups		
	Universal		Targeted		All	All	With Pre-K	No Pre-K	
	(1)	(2)	(3)	(4)	(5)	(6)			
<b>A. Treatment variable</b>									
Pre-kindergarten <sup>a</sup>	0.239	‡	0.282	*†‡	0.264	*‡	0.161	0.203	0.052
<b>B. Background characteristics</b>									
Age in months <sup>a</sup>	52.445		52.306		52.364		52.361	52.303	52.512
	[5.831]		[4.927]		[5.312]		[5.113]	[5.110]	[5.062]
Female	0.515		0.483		0.497		0.468	0.477	0.445
Black non-Hispanic	0.293	*†	0.291	*†	0.292	*†	0.184	0.172	0.215
Hispanic	0.213	*†	0.349	‡	0.292	‡	0.327	0.386	0.176
Low birth weight	0.085		0.101	†	0.094		0.081	0.077	0.093
Maternal education ≤ HS <sup>a</sup>	0.729	‡	0.745	*‡	0.738	‡	0.682	0.711	0.608
Both biological parents in HH <sup>a</sup>	0.504		0.562		0.538		0.561	0.570	0.538
Non-English at home <sup>a</sup>	0.187	†‡	0.234	‡	0.215	‡	0.247	0.307	0.093
Observations <sup>b</sup>	550		700		1,250		1,000	700	300

<sup>a</sup> Measured at preschool age, or in 2005-06 (wave 3 interview).

<sup>b</sup> rounded to the nearest 50, per IES guidelines.

\* significantly different from the full comparison group ( $p < 0.05$ ).

† significantly different from the comparison states with pre-K ( $p < 0.05$ ).

‡ significantly different from the comparison states without pre-K ( $p < 0.05$ ).

NOTE: Columns give means for each group [standard deviations for non-binary variables]. See notes to Appendix Table 12a for description of treatment and comparison states. Sample is limited to low-income children who turn age 5 between 4 months after and 8 months before the cutoff date and who are assessed during the 2005-06 school year; low-income is defined as having family income at or below 185% of the federal poverty line at preschool age (wave 3 interview). Means are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, “Children’s Birth Certificates” [collection at 9 mos.], “Parent-Guardian Interviews,” “Direct Child Assessments,” and “Early Care and Education Providers” [collection at 48 mos.]

**Appendix Table 13a. Impacts of State-funded Pre-K on Preschool-Age Test Scores  
Comparison Group Limited to States With Pre-K Programs**

	Pre-K: First Stage (1)	Test Score (Average Reading and Math):			
		Inelig. Mean (2)	RF (ITT) (3)	IV (TOT) (4)	OLS (5)
<u>A. Full Sample</u>					
<u>1. Universal (N=2,750)</u>					
With additional controls	0.203 (0.051)	-0.183	0.151 (0.071)	0.743 (0.374)	-0.044 (0.052)
<u>2. Targeted (N=3,300)</u>					
With additional controls	0.111 (0.038)	- 0.235	-0.014 (0.065)	-0.125 (0.577)	-0.077 (0.045)
<u>3. p-value on Universal-Targeted Difference (N=6,050)</u>					
With additional controls	0.064		0.012	0.069	0.542
<u>B. By Family Income</u>					
<u>1. Universal</u>					
Low-income (N=1,250)	0.233 (0.070)	-0.572	0.362 (0.114)	1.551 (0.667)	-0.008 (0.057)
Not low-income (N=1,500)	0.177 (0.050)	0.165	-0.018 (0.112)	-0.104 (0.622)	-0.067 (0.085)
<i>p</i> -value on difference	0.411		0.033	0.114	0.536
<u>2. Targeted</u>					
Low-income (N=1,400)	0.234 (0.061)	-0.497	0.050 (0.111)	0.211 (0.472)	0.009 (0.053)
Not low-income (N=1,900)	0.030 (0.041)	-0.018	-0.078 (0.091)	no f.s.	-0.173 (0.088)
<i>p</i> -value on difference	0.004		0.41		0.091
<u>3. p-value on Universal-Targeted Difference</u>					
Low-income	0.991		0.011	0.034	0.784
Not low-income	0.002		0.553	n.a.	0.272

NOTE: Comparison states are limited to the subset of comparison states with pre-K programs (AL, CA, DE, MO, NM, OH, OR, WA). The first stage and RF (ITT) columns in Panels A, B.1, and B.2 give coefficients on the interaction between a dummy for being eligible for kindergarten in 2006-07 (same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state (*elig x treat*). The IV (TOT) and OLS columns in Panels A, B.1 and B.2 give coefficients on pre-K attendance (*prek*), in the first case instrumenting with *elig x treat* using TSLS. All coefficients are from separate regressions that also include as controls dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, and the demographic and background controls listed in Table 1 Panel B. A child is considered low income (Panel B) if his (preschool-age or 2005-06) family income is at or below 185% FPL, the threshold for eligibility for reduced-price lunch and the modal income-eligibility criterion for the targeted programs under study. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 13b. Impacts of State-funded Pre-K on Preschool-Age Test Scores  
Comparison Group Limited to States Without Pre-K Programs**

	Pre-K: First Stage (1)	Test Score (Average Reading and Math):			OLS (5)
		Inelig. Mean (2)	RF (ITT) (3)	IV (TOT) (4)	
<u>A. Full Sample</u>					
<u>1. Universal (N=1,800)</u>					
With additional controls	0.217 (0.050)	-0.183	0.088 (0.087)	0.404 (0.388)	-0.081 (0.067)
<u>2. Targeted (N=2,400)</u>					
With additional controls	0.131 (0.040)	-0.235	-0.089 (0.096)	-0.685 (0.804)	-0.117 (0.054)
<u>3. p-value on Universal-Targeted Difference (N=4,200)</u>					
With additional controls	0.073		0.014	0.085	0.663
<u>B. By Family Income</u>					
<u>1. Universal</u>					
Low-income (N=850)	0.200 (0.062)	-0.572	0.078 (0.118)	0.390 (0.585)	-0.056 (0.093)
Not low-income (N=950)	0.206 (0.056)	0.165	0.072 (0.129)	0.351 (0.609)	-0.083 (0.095)
<i>p</i> -value on difference	0.935		0.974	0.964	0.825
<u>2. Targeted</u>					
Low-income (N=1,050)	0.192 (0.051)	-0.497	-0.131 (0.124)	-0.679 (0.658)	0.003 (0.077)
Not low-income (N=1,350)	0.049 (0.050)	-0.018	-0.041 (0.123)	no f.s.	-0.255 (0.098)
<i>p</i> -value on difference	0.042		0.594		0.05
<u>3. p-value on Universal-Targeted Difference</u>					
Low-income	0.917		0.048	0.066	0.615
Not low-income	0.001		0.302	n.a.	0.185

NOTE: Comparison states are limited to the subset of comparison states without pre-K programs (AK, HI, ID, IN, MS, ND, RI, SD, UT). The first stage and RF (ITT) columns in Panels A, B.1, and B.2 give coefficients on the interaction between a dummy for being eligible for kindergarten in 2006-07 (same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state (*elig x treat*). The IV (TOT) and OLS columns in Panels A, B.1 and B.2 give coefficients on pre-K attendance (*prek*), in the first case instrumenting with *elig x treat* using TSLS. All coefficients are from separate regressions that also include as controls dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, and the demographic and background controls listed in Table 1 Panel B. A child is considered low income (Panel B) if his (preschool-age or 2005-06) family income is at or below 185% FPL, the threshold for eligibility for reduced-price lunch and the modal income-eligibility criterion for the targeted programs under study. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 14a. Balance Tests on Key Variables, by Program Type and Comparison Group: Full Sample**

<i>Comparison group limited to:</i>	States without pre-K			States with pre-K		
	Universal	Targeted	Uni - Tar	Universal	Targeted	Uni - Tar
	DD Coef. (se)	DD Coef. (se)	DDD Coef. (se)	DD Coef. (se)	DD Coef. (se)	DDD Coef. (se)
	(1)	(2)	(3)	(4)	(5)	(6)
<b>A. Treatment variable</b>						
Pre-kindergarten <sup>a</sup>	0.222 (0.050)	0.129 (0.037)	0.093 (0.047)	0.202 (0.051)	0.104 (0.037)	0.098 (0.048)
<b>B. Background characteristics</b>						
Age in months <sup>a</sup>	-0.108 (0.073)	-0.120 (0.067)	0.012 (0.048)	-0.109 (0.073)	-0.094 (0.065)	-0.014 (0.051)
Female	-0.012 (0.062)	-0.078 (0.066)	0.066 (0.051)	0.131 (0.048)	0.032 (0.045)	0.100 (0.049)
Black non-Hispanic	0.051 (0.041)	0.031 (0.042)	0.020 (0.039)	0.038 (0.035)	0.021 (0.031)	0.017 (0.035)
Hispanic	-0.033 (0.045)	-0.024 (0.046)	-0.009 (0.037)	-0.033 (0.045)	-0.014 (0.037)	-0.019 (0.036)
Low birth weight	0.044 (0.021)	0.038 (0.020)	0.006 (0.014)	0.012 (0.014)	0.002 (0.012)	0.010 (0.014)
Maternal education ≤ HS <sup>a</sup>	-0.001 (0.056)	-0.052 (0.058)	0.050 (0.047)	0.034 (0.049)	-0.018 (0.054)	0.052 (0.043)
Both biological parents in HH <sup>a</sup>	0.016 (0.053)	0.093 (0.047)	-0.077 (0.042)	-0.086 (0.042)	0.023 (0.039)	-0.108 (0.043)
Non-English at home <sup>a</sup>	-0.006 (0.038)	-0.002 (0.036)	-0.005 (0.034)	-0.007 (0.034)	-0.006 (0.029)	-0.001 (0.030)
Family income ≤ 185% FPL <sup>a</sup>	-0.085 (0.061)	-0.048 (0.060)	-0.037 (0.045)	-0.098 (0.046)	-0.073 (0.047)	-0.025 (0.046)
<b>C. <i>p</i>-value: joint test for background chars.</b>						
All background characteristics	0.04	0.04	0.55	0.00	0.54	0.17
Excluding poverty	0.13	0.03	0.68	0.08	0.87	0.17
Observations <sup>b</sup>	1,800	2,400	4,200	2,750	3,300	6,050

<sup>a</sup> Measured at preschool age, or in 2005-06 (wave 3 interview).

<sup>b</sup> rounded to the nearest 50, per IES guidelines.

NOTE: Each entry in columns 1, 2, 4, and 5 gives a DD coefficient (standard error) on the interaction between a dummy for being eligible for pre-K in 2005-06 and a dummy for residing in a treatment state (*elig x treat*) from a separate regression that also includes dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07. Columns 3 and 6 give the difference in these DD coefficients between states with universal programs and states with targeted programs. 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 after and 8 months before the cutoff date and who are assessed during the 2005-06 school year. Columns 1-3 limit the comparison states to those without pre-K programs, whereas columns 4-6 limit the comparison states to those with pre-K programs. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 14b. Balance Tests on Key Variables, by Program Type and Comparison Group: Low-Income Subsample**

<i>Comparison group limited to:</i>	States without pre-K			States with pre-K		
	Universal	Targeted	Uni - Tar	Universal	Targeted	Uni - Tar
	DD Coef. (se)	DD Coef. (se)	DDD Coef. (se)	DD Coef. (se)	DD Coef. (se)	DDD Coef. (se)
	(1)	(2)	(3)	(4)	(5)	(6)
<b>A. Treatment variable</b>						
Pre-kindergarten <sup>a</sup>	0.200 (0.061)	0.213 (0.045)	-0.013 (0.069)	0.237 (0.069)	0.230 (0.060)	0.006 (0.071)
<b>B. Background characteristics</b>						
Age in months <sup>a</sup>	-0.098 (0.088)	-0.228 (0.083)	0.130 (0.073)	-0.017 (0.096)	-0.048 (0.089)	0.031 (0.074)
Female	-0.125 (0.093)	-0.121 (0.083)	-0.004 (0.090)	0.130 (0.084)	0.087 (0.069)	0.043 (0.088)
Black non-Hispanic	0.021 (0.078)	0.018 (0.075)	0.004 (0.069)	0.010 (0.067)	0.028 (0.059)	-0.019 (0.062)
Hispanic	-0.040 (0.070)	-0.107 (0.073)	0.066 (0.066)	0.020 (0.067)	-0.040 (0.053)	0.059 (0.060)
Low birth weight	0.068 (0.047)	0.049 (0.053)	0.019 (0.030)	0.034 (0.026)	0.019 (0.028)	0.015 (0.026)
Maternal education $\leq$ HS <sup>a</sup>	-0.057 (0.072)	-0.110 (0.072)	0.053 (0.069)	0.128 (0.067)	0.097 (0.075)	0.030 (0.070)
Both biological parents in HH <sup>a</sup>	0.063 (0.069)	0.108 (0.068)	-0.045 (0.066)	-0.122 (0.063)	-0.054 (0.061)	-0.068 (0.066)
Non-English at home <sup>a</sup>	-0.036 (0.053)	-0.022 (0.048)	-0.014 (0.063)	0.019 (0.055)	0.010 (0.045)	0.009 (0.056)
<b>C. <i>p</i>-value: joint test for background chars.</b>						
All background characteristics	0.40	0.01	0.63	0.08	0.62	0.91
Observations <sup>b</sup>	850	1,050	1,900	1,250	1,400	2,650

<sup>a</sup> Measured at preschool age, or in 2005-06 (wave 3 interview).

<sup>b</sup> rounded to the nearest 50, per IES guidelines.

NOTE: Each entry in columns 1, 2, 4, and 5 gives a DD coefficient (standard error) on the interaction between a dummy for being eligible for pre-K in 2005-06 and a dummy for residing in a treatment state (*elig x treat*) from a separate regression that also includes dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07. Columns 3 and 6 give the difference in these DD coefficients between states with universal programs and states with targeted programs. 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 low-income children who turn age 5 between 4 months after and 8 months before the cutoff date and who are assessed during the 2005-06 school year; low-income is defined as having family income at or below 185% of the federal poverty line at preschool age (wave 3 interview). Columns 1-3 limit the comparison states to those without pre-K programs, whereas columns 4-6 limit the comparison states to those with pre-K programs. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 15a. Impacts of State-funded Pre-K on Preschool-Age Test Scores  
High Enrollment v. Low Enrollment instead of Universal v. Targeted  
High Enrollment if NIEER Age 4 Pre-K Enrollment Rate  $\geq 40\%$**

	Pre-K: First Stage (1)	Test Score (Average Reading and Math):			
		Inelig. Mean (2)	RF (ITT) (3)	IV (TOT) (4)	OLS (5)
<u>A. Full Sample</u>					
<u>1. High Enrollment (N=3,500)</u>					
With additional controls	0.212 (0.040)	-0.197	0.053 (0.064)	0.250 (0.295)	-0.061 (0.045)
<u>2. Low Enrollment (N=3,850)</u>					
With additional controls	0.103 (0.034)	-0.232	-0.008 (0.064)	-0.077 (0.621)	-0.103 (0.043)
<u>3. p-value on High-Low Difference (N=7,350)</u>					
With additional controls	0.011		0.369	0.555	0.377
<u>B. By Family Income</u>					
<u>1. High Enrollment</u>					
Low-income (N=1,650)	0.275 (0.055)	-0.538	0.118 (0.109)	0.429 (0.392)	0.005 (0.056)
Not low-income (N=1,900)	0.154 (0.045)	0.11	0.003 (0.089)	0.019 (0.566)	-0.126 (0.072)
<i>p</i> -value on difference	0.052		0.448	0.579	0.122
<u>2. Low Enrollment</u>					
Low-income (N=1,650)	0.166 (0.050)	-0.517	0.096 (0.107)	0.581 (0.657)	-0.054 (0.051)
Not low-income (N=2,150)	0.047 (0.038)	-0.004	-0.091 (0.084)	no f.s.	-0.136 (0.084)
<i>p</i> -value on difference	0.043		0.199		0.433
<u>3. p-value on High-Low Difference</u>					
Low-income	0.082		0.861	0.809	0.339
Not low-income	0.016		0.299	n.a.	0.908

NOTE: Treated states are now divided into two groups based on NIEER-reported pre-K enrollment of 4-year-olds in 2005-06; a state is classified as "high enrollment" if this enrollment rate was at least 40%. (See Appendix Table 1 for enrollment rates.) The first stage and RF (ITT) columns in Panels A, B.1, and B.2 give coefficients on the interaction between a dummy for being eligible for kindergarten in 2006-07 (same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state (*elig x treat*). (See Table 1 or Appendix A for a definition of treatment and comparison states.) The IV (TOT) and OLS columns in Panels A, B.1 and B.2 give coefficients on pre-K attendance (*prek*), in the first case instrumenting with *elig x treat* using TSLS. All coefficients are from separate regressions that also include as controls dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, and the demographic and background controls listed in Table 1 Panel B. A child is considered low income (Panel B) if his (preschool-age or 2005-06) family income is at or below 185% FPL, the threshold for eligibility for reduced-price lunch and the modal income-eligibility criterion for the targeted programs under study. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]

**Appendix Table 15b. Impacts of State-funded Pre-K on Preschool-Age Test Scores  
High Enrollment v. Low Enrollment instead of Universal v. Targeted  
High Enrollment if NIEER Age 4 Pre-K Enrollment Rate  $\geq 30\%$**

	Pre-K: First Stage (1)	Test Score (Average Reading and Math):			
		Inelig. Mean (2)	RF (ITT) (3)	IV (TOT) (4)	OLS (5)
<u>A. Full Sample</u>					
<u>1. High Enrollment (N=3,850)</u>					
With additional controls	0.204 (0.037)	-0.231	0.046 (0.061)	0.224 (0.292)	-0.066 (0.043)
<u>2. Low Enrollment (N=3,500)</u>					
With additional controls	0.084 (0.035)	-0.179	-0.006 (0.067)	-0.075 (0.791)	-0.104 (0.046)
<u>3. p-value on High-Low Difference (N=7,350)</u>					
With additional controls	0.003		0.445	0.674	0.428
<u>B. By Family Income</u>					
<u>1. High Enrollment</u>					
Low-income (N=1,800)	0.273 (0.049)	-0.54	0.114 (0.101)	0.420 (0.368)	-0.028 (0.054)
Not low-income (N=2,050)	0.141 (0.041)	0.068	-0.008 (0.083)	-0.057 (0.581)	-0.105 (0.070)
<i>p</i> -value on difference	0.022		0.381	0.512	0.359
<u>2. Low Enrollment</u>					
Low-income (N=1,500)	0.134 (0.050)	-0.501	0.095 (0.120)	0.705 (0.940)	-0.032 (0.053)
Not low-income (N=2,000)	0.043 (0.040)	0.034	-0.098 (0.089)	no f.s.	-0.162 (0.088)
<i>p</i> -value on difference	0.136		0.244		0.234
<u>3. p-value on High-Low Difference</u>					
Low-income	0.021		0.879	0.744	0.941
Not low-income	0.023		0.321	n.a.	0.502

NOTE: Treated states are now divided into two groups based on NIEER-reported pre-K enrollment of 4-year-olds in 2005-06; a state is classified as "high enrollment" if this enrollment rate was at least 30%. (See Appendix Table 1 for enrollment rates.) The first stage and RF (ITT) columns in Panels A, B.1, and B.2 give coefficients on the interaction between a dummy for being eligible for kindergarten in 2006-07 (same as a dummy for being eligible for pre-K in 2005-06 in a treatment state) and a dummy for being in a treated state (*elig x treat*). (See Table 1 or Appendix A for a definition of treatment and comparison states.) The IV (TOT) and OLS columns in Panels A, B.1 and B.2 give coefficients on pre-K attendance (*prek*), in the first case instrumenting with *elig x treat* using TSLS. All coefficients are from separate regressions that also include as controls dummies for state of residence, month x year of assessment, and month age five relative to the state kindergarten entry cutoff birthdate in 2006-07, and the demographic and background controls listed in Table 1 Panel B. A child is considered low income (Panel B) if his (preschool-age or 2005-06) family income is at or below 185% FPL, the threshold for eligibility for reduced-price lunch and the modal income-eligibility criterion for the targeted programs under study. Regressions are weighted by longitudinal sampling weights, and standard errors (in parentheses) are clustered on state x month of birth.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) of children born in calendar year 2001, "Children's Birth Certificates" [collection at 9 mos.], "Parent-Guardian Interviews," "Direct Child Assessments," and "Early Care and Education Providers" [collection at 48 mos.]