

## Participation in State-Funded Prekindergarten in Oklahoma

Appendix A. Methods

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Appendix C. Supporting analysis

See <https://go.usa.gov/x77jE> for the full report.

### Appendix A. Methods

This appendix describes the data sources, data preparation, analysis methods, and study limitations.

#### *Data sources*

Data for the study are from five sources: Oklahoma State Department of Education student enrollment and prekindergarten (preK) site/center data, Head Start directories from Oklahoma's Head Start Collaboration Office and Head Start administrative data maintained by the U.S. Department of Health and Human Services (Head Start Early Childhood Learning and Knowledge Center, 2019), child care facility records from the Oklahoma Department of Human Services, the National Center for Education Statistics Common Core of Data (U.S. Department of Education, n.d.), and the U.S. Office of Management and Budget (U.S. Census Bureau, 2018).

*Student enrollment and student characteristics data.* The study team obtained data from the Oklahoma State Department of Education on both preK and kindergarten student enrollment as well as student demographic characteristics in kindergarten. Because children enrolled in state-funded preK are considered public school students, the student identification number assigned in preK follows enrolled students to kindergarten. Student identification numbers for children who did not participate in state-funded preK are assigned when they enroll in kindergarten.

The administrative data available from the Oklahoma State Department of Education allowed for examining and comparing the characteristics of first-time public school kindergarten students who participated in state-funded preK in the prior school year with those of students who did not participate in state-funded preK. Enrollment data, recorded as of October 1 of each year, were obtained for kindergarten students enrolled in the 2013/14 through 2018/19 school years (the six cohorts of students who entered kindergarten for the first time in the fall of 2013, 2014, 2015, 2016, 2017, and 2018). In addition, student enrollment data were obtained each year for state-funded preK students enrolled in the 2013/14 through 2017/18 school years. As discussed in more detail later in this appendix, data from the kindergarten enrollment records for 2014/15 through 2018/19 and preK enrollment records for 2013/14 through 2017/18 were used to determine which kindergarten students, enrolled as of October 1, had participated in preK in the prior year. In addition, for each kindergarten class, enrollment records from prior years were used to identify which students were enrolled in kindergarten for the first time.

The study used data on the following student characteristics as of October 1 in the kindergarten year:

- Gender.
- Race/ethnicity.
- Free or reduced-price lunch eligibility status under the national school lunch program.
- English learner status.
- Special education status.
- Public elementary school and district.
- Student's home address.<sup>1</sup>
- Unique student pseudo-identification number.

The study also used data on school and district of enrollment in the preK year for students who were enrolled in state-funded preK.

*State-funded preK site addresses.* The study team obtained one preK site-level variable from the Oklahoma State Department of Education (physical address of the site) for each state-funded Oklahoma preK program site with students enrolled in 2013/14 through 2017/18, including sites that operated for only part of the five-year period.

*Head Start site addresses and program enrollment data.* The study team obtained one center-level variable from Oklahoma's Head Start Collaboration Office (physical address) for Head Start centers included in directories for 2013/14 through 2017/18.

The study team used two variables from the state-level Program Information Reports obtained from the U.S. Department of Health and Human Services, Administration for Children and Families office through the Early Childhood Learning and Knowledge Center for the 2013/14 through 2017/18 program years (Head Start Early Childhood Learning & Knowledge Center, 2019):

- State-level Head Start funded enrollment (not disaggregated by child age or race/ethnicity).
- State-level cumulative Head Start enrollment (disaggregated by child age and race/ethnicity).<sup>2</sup>

*Child care facility records.* The study team used two variables from child care facility records maintained by the Oklahoma Department of Human Services for licensed center-based child care facilities other than state-funded preK:<sup>3</sup>

- Facility address.
- Facility type, to distinguish center-based and home-based sites.

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<sup>1</sup> The study team used student home address as of kindergarten as a proxy for student address during the prior preK year in analyses for research question 2. Student home addresses were maintained on a secure server and were used to develop the travel time measure employed in the analysis.

<sup>2</sup> The study team used Head Start enrollment data for supplemental estimates of combined enrollment in state-funded preK and Head Start (see appendix C). Funded Head Start enrollment represents the number of slots, defined as the number of age-eligible children expected to be enrolled in Head Start at a point in time. Cumulative enrollment represents the number of children ever in attendance during the program year. Given turnover during the program year, cumulative enrollment typically exceeds funded enrollment. Information on enrolled Head Start children, such as their age at entry and race/ethnicity, is recorded only for cumulative enrollment.

<sup>3</sup> The Oklahoma Department of Human Services administers licensure of center-based child care sites, out-of-school-time programs, and family-based child care programs that meet minimum state requirements. The study included data only for center-based programs because these more closely resemble the structure of state-funded preK and Head Start, with multiple children of the same age in a non-home-based setting. In addition, most four-year-old children across the country use at least some center-based care, either exclusively or in

*School district geographic data.* The National Center for Education Statistics Common Core of Data Local Education Agency (School District) Universe Survey provides school district urban-centric locale codes (city, suburban, town, and rural) for categorizing districts as rural or nonrural (U.S. Department of Education, n.d.). The study team used these district-level geographic designations for Oklahoma districts from the 2014/15 through 2016/17 school years, the most recent data available at the time of the analysis. The study team designated as rural the three rural locale codes used in the Common Core of Data (Rural–Fringe, Rural–Distant, and Rural–Remote). All other locale codes were designated as nonrural.<sup>4</sup>

In addition, school district–geocoded boundary files available through the School District Demographics System and the American Community Survey were used to facilitate the development of maps by aggregating counts of Head Start and licensed center-based child care site to the school district level based on site location. The Common Core of Data was used to associate Head Start and licensed center-based child care site sites to school districts.

*County locale type.* The study team also obtained geographic data from the U.S. Office of Management and Budget September 2018 Metropolitan–Micropolitan Statistical Areas delineation files (U.S. Census Bureau, 2018). These files provided core-based statistical areas, metropolitan or micropolitan status, and county or equivalent. Oklahoma counties in the delineation files that were considered metropolitan were designated as nonrural for this study. All other counties in the state were designated as rural.

### ***Data preparation***

Data preparation included five primary tasks:

- Merging and cleaning data.
- Identifying first-time kindergarten students in public schools.
- Identifying prior participants in state-funded preK from among first-time kindergarten students.
- Defining student characteristics.
- Calculating student travel time to nearest early learning and care sites.

Two members of the study team conducted the data preparation tasks in parallel to improve accuracy.

*Merging and cleaning data.* First, the raw student enrollment record files, which included data on preK and kindergarten students for each year, were separated into preK and kindergarten files. Second, the preK files were matched to the next kindergarten year using the unique student pseudo-identification number (for example, 2013/14 preK file merged with 2014/15 kindergarten file). The study team dropped 27,783 preK records that did not match kindergarten records, which represented students who attended preK but did not attend public kindergarten. Finally, once all preK/kindergarten adjacent files were merged for each of the five cohort years, the files were appended into a combined dataset.

*Identifying first-time kindergarten students in public schools.* The study team used the student-level enrollment records to identify first-time kindergarten students in the cohort years examined (table A1). The number of records obtained for each school year matches the number of enrolled kindergarten students reported by the Oklahoma State Department of Education in its annual enrollment reports (Oklahoma State Department of

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combination with home-based care (Gordon et al., 2013). Finally, given the complexities of also accounting for home-based care options (which include the child’s own home, where distance is zero), the study focused on private center-based programs.

<sup>4</sup> The National Center for Education Statistics determines district locale from school-level locale codes, weighted by the number of students in each locale type (U.S. Department of Education, n.d.). Thus, a district locale code may change from year to year. In 2015/16, 0.26 percent of students were in districts that had a change in the district’s rural/nonrural designation from 2014/15. In 2016/17, 0.54 percent of students were in districts that had a change in the locale designation from 2015/16. The locale codes from 2016/17 were used for the data analyzed for 2016/17 through 2018/19.

Education, 2019). From student identification numbers the study team identified students with kindergarten enrollment records in multiple years. For these students only the record associated with the first school year in which they were enrolled was retained. The study team dropped 7–8 percent of the records for each kindergarten class for these repeat enrollments. The remaining records capture first-time kindergarten enrollment. In total, the study analyzed 245,319 first-time kindergarten enrollment records (table A1).

**Table A1. Number of total kindergarten enrollment records and first-time kindergarten enrollment records for 2014/15–2018/19 Oklahoma public school kindergarten students**

Type of enrollment record	Kindergarten enrollment year					Five years combined
	2014/15	2015/16	2016/17	2017/18	2018/19	
Total kindergarten enrollment records	55,127	53,452	52,184	51,878	52,515	265,156
Repeat enrollment records	4,146	4,087	3,746	3,961	3,897	19,837
First-time kindergarten enrollment records	50,981	49,365	48,438	47,917	48,618	245,319

Source: Authors' analysis of data from the Oklahoma State Department of Education (2019).

*Identifying participants in state-funded preK from among first-time kindergarten students.* For each first-time kindergarten student in a given year, the study team created an indicator variable flagging students who were matched from the preK and kindergarten enrollment files. A matched record indicated that the student was a state-funded preK participant.

*Defining student characteristics.* The study team used student records to create a series of indicator variables (value of 0 or 1) for student gender, race/ethnicity, free or reduced-price lunch eligibility status, English learner status, special education status, and school district rural status. These indicator variables were used to describe the composition of the study population and as covariates in regression analyses (table A2). Fewer than 1 percent of cases had missing values for student gender, and those cases were assigned a missing-value indicator. None of the other student characteristics had missing values.

**Table A2. Characteristics of 2014/15–2018/19 Oklahoma public school kindergarten students, five years combined**

Characteristic	Percent
Gender	
Male	50.9
Female	48.5
Gender missing	0.6
Race/ethnicity	
American Indian	12.3
Asian	2.1
Black	8.6
Hispanic	17.6
Pacific Islander	0.4
White	48.4
Multirace	10.6
National school lunch program eligibility status	
Eligible for free lunch	57.1
Eligible for reduced-price lunch	7.3
Not eligible	35.6
English learner status	
English learner student	13.2
Not English learner student	86.8
Special education status	
Identified for special education	10.6
Not identified for special education	89.4
District locale type	
Rural	26.9
Nonrural	73.1

Note:  $n = 245,319$  students. ,

Source: Authors' analysis of data from the Oklahoma State Department of Education. ,

*Calculating student travel time to nearest early learning and care sites.* Home address was used for both participants and nonparticipants in state-funded preK to measure distance from the home address to the addresses of the nearest center-based preK sites (state-funded preK, Head Start, or licensed center-based child care sites). Home addresses were available for nonparticipants in state-funded preK only for the kindergarten year.<sup>5</sup> The study team used the Esri World Geocoder to geocode student home, state-funded preK center, Head

<sup>5</sup> The use of kindergarten home address introduced some measurement error in the distance measures because some students could have moved between their preK and kindergarten years. Data from the American Community Survey for Oklahoma for 2013 through 2017 show that approximately 84 percent of 5- to 17-year-olds were in the same residence as one year earlier, indicating an average 16 percent one-year migration rate for school-age students (U.S. Census Bureau, 2017). In addition, for 7 percent of students a zip code was the only available component of the home address, and for 20 percent of students a zip code was the only available component for home or site address or both. This means that some distances were recorded as zero if the student lived in the same zip code as the site. See further discussion in the limitations section of this appendix. Some students' home addresses recorded in the administrative data were outside the local area, even out of state. These cases resulted in extreme distances. To eliminate the influence of these outliers, cases with travel times exceeding 60 minutes were set to missing, and a missing indicator was set to 1. Overall, the missing data frequency for the travel time measures used in the analyses was less than or equal to 0.5 percent.

Start center, and licensed center-based child care site addresses. ArcGIS Pro software used the resulting latitudes and longitudes to calculate the linear distances between student addresses and all licensed state-funded preK, Head Start, and licensed center-based child care sites. This distance was used to identify the five closest sites. Next, the study team calculated the driving distance (kilometers) and estimated the driving time (minutes) for each selected student-site combination using the GEOCODEHERE Stata module, which incorporates the programming interface from Here Technologies' Maps application mapping and location data services. For each site type the study team identified the closest site in travel time in minutes based on driving time.<sup>6</sup> On average over 2014/15–2018/19 students lived approximately 5 minutes from the nearest state-funded preK site, 9 minutes from the nearest Head Start site, and 5 minutes from the nearest licensed center-based child care site (table A3).

**Table A3. Travel time variables to nearest state-funded prekindergarten, Head Start, and licensed child care centers for 2014/15–2018/19 Oklahoma public school kindergarten students (minutes)**

Type of early learning and care program	Mean	Standard deviation	Minimum	1st percentile	50th percentile	99th percentile	Maximum
State-funded prekindergarten	5.35	4.28	0.00	0.37	4.15	20.92	58.68
Head Start center	8.81	6.63	0.00	0.50	7.35	30.78	60.00
Licensed center-based child care site	4.89	5.19	0.00	0.05	3.10	24.83	59.85

Note: Each travel time variable had missing data for 0.05 percent of the cases examined. To eliminate the influence of outliers, cases with travel times exceeding 60 minutes were set to missing. ,

Source: Authors' analysis of data from the Oklahoma State Department of Education. ,

## Analysis methods

This section summarizes the analyses conducted for each research question discussed in the main text of the report. Appendix C describes supplementary analyses and findings that include estimates of participation in Head Start using aggregate data.

*Research question 1: What percentage of first-time kindergarten students in the 2014/15 through 2018/19 school years had participated in Oklahoma's state-funded preK in the prior year? How did student participation in state-funded preK vary over time, by geographic locale, and by student characteristics?*

*Statewide participation in state-funded preK.* The study team began with tabulations at the state level pooled over the five years 2014/15 through 2018/19 that showed the percentage of first-time public school kindergarten students who participated in state-funded preK the year before their kindergarten enrollment. The percentage was calculated as the ratio of the number of first-time public school kindergarten students who participated in state-funded preK in the prior year (according to student records) divided by the total number of first-time public school kindergarten students. The same procedure was used to tabulate participation at the state level for each of the five years covered in the study.

*Participation in state-funded preK by geographic locale.* The study team calculated the percentage of students who participated in state-funded preK over five years as the ratio of the number of first-time public school kindergarten students in the county, school district, or geographic locale type (rural/nonrural) who participated in state-funded preK in the prior year (according to student records) divided by the total number of first-time public school kindergarten students in the geographic locale. These calculations provided the unadjusted participation percentages presented in the report.

<sup>6</sup> In some cases the closest site in travel time based on driving time was different from the closest site in driving distance. For sensitivity analyses the study team also identified the closest sites based on driving distance. See section on supplemental and sensitivity analyses in this appendix.

For each county and school district the study team used the calculated percentage of first-time public school kindergarten students who participated in state-funded preK across the five years. The study team then used geographic information system (GIS) maps using ArcGIS Pro software to visually depict levels of participation in the state-funded preK program by county and districts. The study team also produced maps by rural and nonrural county and district designations.

*Participation in state-funded preK by student characteristics.* The study team calculated percentages of students at the state level who participated in state-funded preK by student characteristics: gender, race/ethnicity, free or reduced-price lunch eligibility status, English learner status, and special education status. The study team calculated percentages of students who participated in state-funded preK from a combined dataset across the five years of kindergarten cohorts (sum of number of student participants for each of the five years, divided by the sum of the number of first-time public school kindergarten students for each of the five years) and separately by year. These calculations provided the unadjusted participation percentages for each characteristic presented in the main report.

For the unadjusted participation rates pooled over five years, the study team calculated standardized differences based on Cox's index:

$$d_{cox} = \omega \left[ \ln \left( \frac{\rho_i}{1 - \rho_i} \right) - \ln \left( \frac{\rho_c}{1 - \rho_c} \right) \right] / 1.65$$

where  $\rho_i$  is the probability of participation for students in one group and  $\rho_c$  is the probability of participation for students in a comparison (or reference) group.<sup>7</sup> The standardized difference,  $d_{cox}$ , is a measure of the magnitude of the differences in participation in state-funded preK across subgroups. A standardized difference equal to or greater than 0.25 standard deviation units was considered to be a substantial difference in the percentage of students who participated in state-funded preK across subgroups, and a difference of 0.12 standard deviation units to less than 0.25 standard deviation units was considered to be a moderate difference.

*Research question 2: To what extent was students' participation in state-funded preK related to travel time to state-funded preK and alternative preK options?*

Using student-level data pooled across the 2014/15–2018/19 kindergarten cohorts, the study team ran the following ordinary least squares model to estimate the relationships between measures of local preK access, as indicated by travel time, and participation in state-funded preK across all student groups:

$$Y_{idt} = \alpha + \beta A_{it} + \delta X_{it} + \varepsilon Z_{dt} + \gamma_d + \tau_t + e_{idt}$$

where  $Y_{idt}$  is a dichotomous indicator variable equal to 1 if kindergarten student  $i$  in district  $d$  in year  $t$  attended state-funded preK at time  $t-1$  and equal to 0 otherwise;  $A_{it}$  is a vector of three distance measures from the student's home, including travel time (in minutes) to the nearest state-funded preK site, travel time (in minutes) to the nearest Head Start site, and travel time (in minutes) to the nearest licensed center-based child care site;  $X_{it}$  is a vector of student-level characteristics;  $Z_{dt}$  is an indicator of the district's urban/rural locale at time  $t$ ; and  $\gamma_d$  and  $\tau_t$  are the fixed effects for district and year, respectively.<sup>8</sup> Student characteristics included the same variables examined in the descriptive analysis (gender, race/ethnicity, free or reduced-price lunch eligibility status,

<sup>7</sup> For most student and district characteristics the study team generated standardized differences using a single reference group; for free or reduced-price lunch eligibility status the study team generated standardized differences using two reference groups. Students not eligible for the national school lunch program was used as the reference group for the main analysis, and students eligible for free lunch was used as an alternative reference group, to allow direct comparison of students eligible for reduced-price lunch with students eligible for free lunch.

<sup>8</sup> Similar to the analyses for research question 1, the study team used the model without district fixed effects (table B4 in appendix B, model 3) for examination of rural/nonrural differences in participation.



English learner status, and special education status). The study team followed a similar approach as that for research question 1 in using the model coefficients to calculate predicted probabilities for each covariate.

*Supplemental and sensitivity analyses.* The statistical models used to address research question 2 provided supplemental findings related to research question 1. They provided estimated subgroup differences in participation in state-funded preK that accounted for other differences between students and between districts. To assess the predictive strength of each variable, the study team used the coefficients from the estimated linear probability model to calculate predicted probabilities, which compared the marginal effect of a given characteristic on the probability of having participated in state-funded preK while holding all other characteristics at their actual values. For example, for a given characteristic such as student gender, the study team calculated the probability with gender set to male for all cases (with other characteristics at their actual value) and then recalculated the probability with gender set to female for all cases. The difference in the average predicted probability represented the marginal effect of gender on the probability of participation, according to the estimated model.

These predicted probabilities (or percentages) provided the regression-adjusted estimated participation in state-funded preK for each characteristic (that is, with other characteristics held constant) and enabled determining whether differences across student characteristics observed in the descriptive analysis persist after student-level characteristics as well as time and geographic characteristics are controlled for. As for the unadjusted participation rates, the study team calculated standardized differences (based on Cox's index) for the adjusted participation rates and applied the designations of substantial and moderate subgroup differences. In the main report footnotes highlight instances in which estimated subgroup differences from the statistical models indicated findings that differed from the primary findings presented for research question 1.

To explore the robustness of findings to the functional form of the statistical models, the study team estimated all models for research questions 1 and 2 using probit as an alternative to the linear probability models. A probit model is appropriate for a dichotomous outcome, such as program participation. There were no meaningful differences in the results (that is, the standardized differences reported in table B5 in appendix B were similar and did not cross the threshold of 0.12 or 0.25 standard deviation units). Consequently, results from the linear probability models are reported for ease of interpretation.

To explore the robustness of findings related to the measures of travel time to local early learning and care programs for research question 2, the study team estimated models with two measures of access. The findings included in the main report were derived by identifying the closest early learning and care program of each type (state-funded preK, Head Start, and licensed center-based child care site) based on lowest travel times and then using minutes of travel time as the metric. For the sensitivity analyses the study team estimated models with two alternative measures of access: kilometers to the closest facility of each type based on driving distance (in kilometers) and minutes of driving time to the closest facility of each type based on driving distance (in kilometers). The results from these alternative measures of travel were similar to the findings presented in the main report. The probability of having participated in state-funded preK decreased as the measure of distance to the nearest state-funded preK increased, and the probability increased as the measure of distance to the nearest alternative centers (Head Start or licensed center-based child care site) increased.

## **Limitations**

This study has several limitations due to constraints of the data available for analyzing participation in preK programs among four-year-olds in Oklahoma. First, the study analyzed data on public school kindergarten cohorts and retrospectively examined which kindergarten students had participated in state-funded preK in the prior year. Information on the characteristics of students who did and those who did not participate in the state-funded preK program was available only for students who had enrolled in public school kindergarten. Oklahoma state agencies



do not collect student-level data for four-year-olds who do not attend state-funded preK. The Regional Educational Laboratory Southwest and its partners did not identify surveys or alternative student-level data sources with sufficient sample size to analyze patterns of participation in state-funded preK among four-year-olds in Oklahoma.

Because the starting point for the analysis was kindergarten cohorts, the study was not able to include children who moved out of state between the preK year and kindergarten or children who attended kindergarten at a private school or who were home schooled. Approximately 7 percent of Oklahoma children enroll in a private school or do not enroll in kindergarten (U.S. Census Bureau, 2016). Thus, the main findings apply to the population of children who attended public school kindergarten in Oklahoma. Supporting analysis using aggregate data to estimate overall participation in state-funded preK for four-year-olds suggested that excluding these two groups of children was not likely to substantially affect estimates of participation in state-funded preK (see appendix C).

Student enrollment records for Head Start, licensed center-based child care sites, or other types of early learning and care settings were not available for analysis. Thus, it was not possible to determine whether students who did not attend state-funded preK had attended some other early learning and care program or to examine predictors of early learning and care participation overall. Additionally, a Head Start site may collaborate with a district to offer state-funded preK. As a supporting analysis, the study team calculated an upper-bound estimate of combined participation in Head Start and state-funded preK using statewide aggregate enrollment data from the Oklahoma State Department of Education and Head Start (see appendix C).

Another limitation concerns the student address information. First, ideally, the study would have used the address for all first-time kindergarten students in the prior year, when their family was deciding whether the child would participate in state-funded preK. Instead, the study had to rely on addresses as of the kindergarten year. This means that the distance variables were measured with error for students who moved between the preK year and kindergarten years. Second, some of the student and site addresses were incomplete or were post office boxes or rural routes. For these addresses, distance calculations were based on zip codes. Approximately 20 percent of students had at least one address (home, state-funded preK, Head Start, or licensed center-based child care site) that relied on the zip code for geocoding. For cases in which both the student address and site address were geocoded with zip codes and the zip codes were the same, the resulting distance was calculated as zero. These measurement errors due to the use of kindergarten addresses and the lack of precise addresses for some students and preK sites likely resulted in an underestimate of the relationship between distance and participation in state-funded preK.

A further limitation is that the available administrative data did not capture other hypothesized determinants of state-funded preK participation. For example, the student-level administrative data did not record parent employment status or work schedules, costs and availability of all alternative early learning and care options, or the number of state-funded preK slots or preK classrooms in each school district. Data on these other characteristics of families or the availability of other preK options would allow for a more complete examination of factors that might be related to participation in state-funded preK.

Finally, this descriptive study did not attempt to provide evidence about why there might be differences in state-funded preK participation across student subgroups, which are likely the result of a confluence of factors, such as parent awareness of and access to preK options, parent preferences, and features of the available early learning and care opportunities.

## References

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## Appendix B. Supporting tables and figures

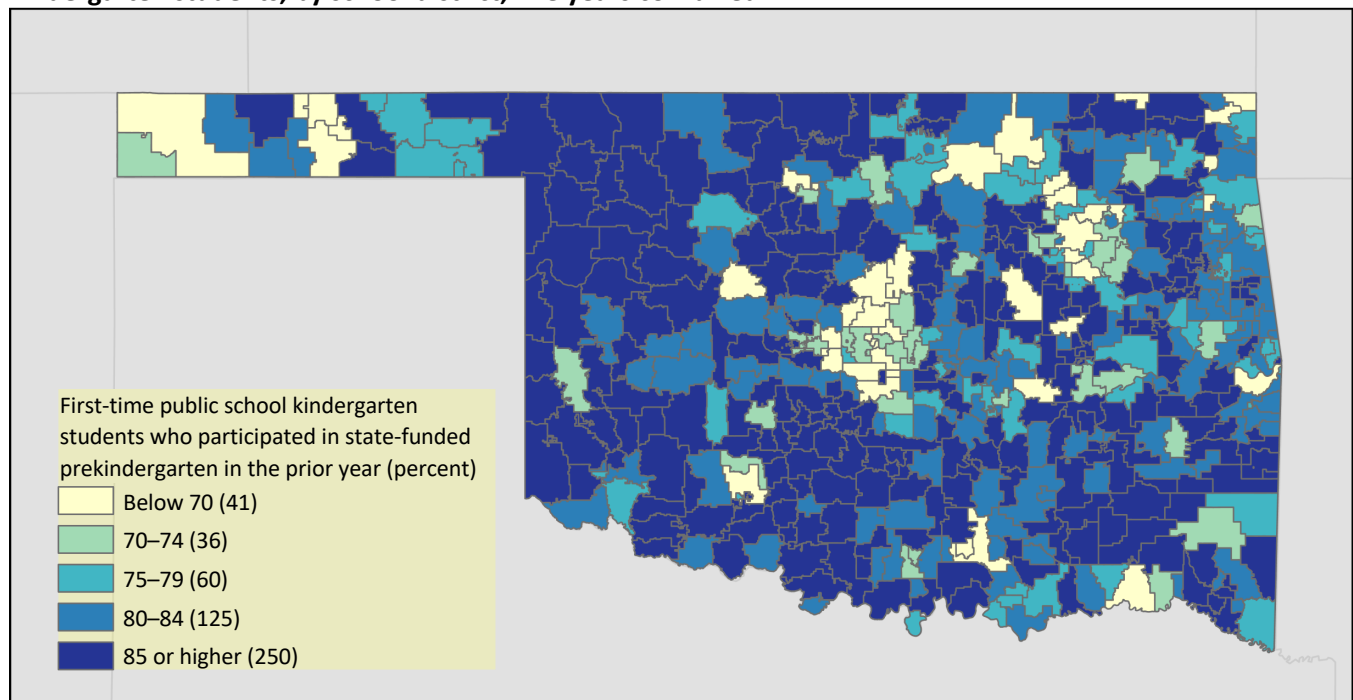
This appendix includes tables and figures displaying detailed results of the analyses discussed in the main report.

**Table B1. First-time enrollment in Oklahoma public school kindergarten in 2014/15–2018/19 and participation in state-funded prekindergarten in the prior year**

Kindergarten enrollment year	First-time public school kindergarten students		
	Total number	Number who participated in state-funded preK in the prior year	Percentage who participated in state-funded preK the prior year
2014/15	50,981	37,354	73.3
2015/16	49,365	36,617	74.2
2016/17	48,438	35,849	74.0
2017/18	47,917	35,721	74.5
2018/19	48,618	36,170	74.4
Five years combined	245,319	181,711	74.1

Source: Authors' analysis of data from the Oklahoma State Department of Education.

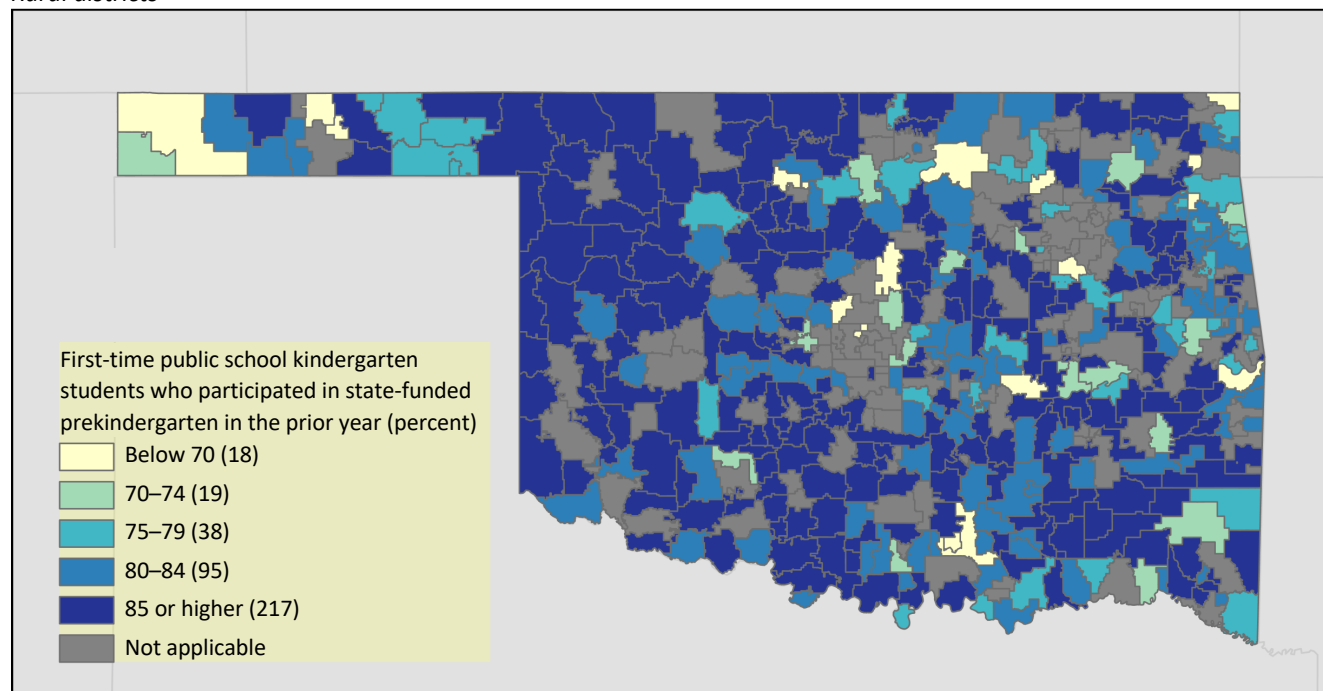
**Map B1. Participation in state-funded prekindergarten among 2014/15–2018/19 Oklahoma public school kindergarten students, by school district, five years combined**



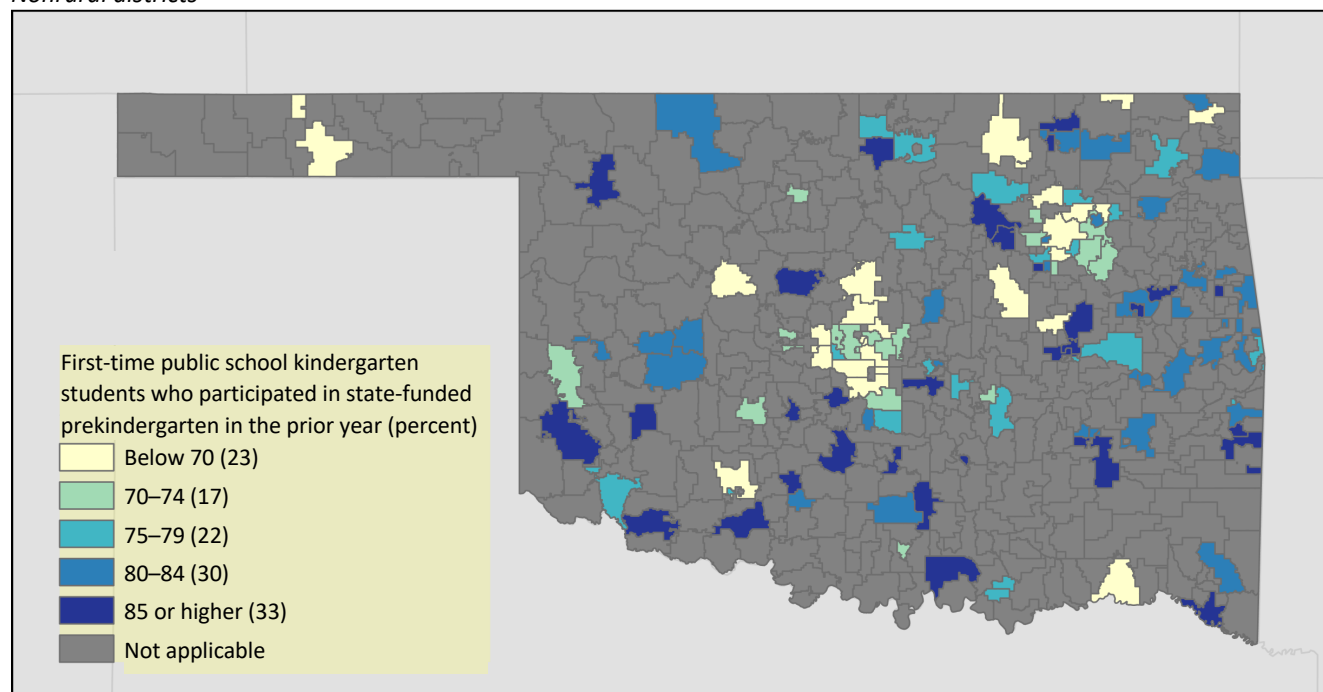
Note: Numbers in parentheses are number of school districts. Thresholds for levels of state-funded prekindergarten participation were derived using the Jenks Natural Breaks algorithm, which classifies thresholds based on natural groupings inherent in the data to maximize the differences between groups. Source: Authors' analysis of data from the Oklahoma State Department of Education and from U.S. Department of Education (n.d.).

**Map B2. Participation in state-funded prekindergarten among 2014/15–2018/19 Oklahoma public school kindergarten students, by rural and nonrural district locale, five years combined**

*Rural districts*



*Nonrural districts*



Note: Numbers in parentheses are number of school districts. Thresholds for levels of state-funded prekindergarten participation were derived using the Jenks Natural Breaks algorithm, which classifies thresholds based on natural groupings inherent in the data to maximize the differences between groups. Source: Authors' analysis of data from the Oklahoma State Department of Education and from U.S. Department of Education (n.d.).

**Table B2. Enrollment in Oklahoma public school kindergarten in 2014/15–2018/19 and in state-funded prekindergarten (preK) in the prior year, and standardized differences (Cox's Index) for group differences in preK participation, by student and district characteristics, five years combined**

Characteristic	First-time public school kindergarten students			Standardized difference in state-funded preK participation (unadjusted)
	Number	Number who participated in state-funded preK in the prior year	Percentage who participated in state-funded preK in the prior year	
Total	245,319	181,711	74.1	na
Gender				
Female	118,927	88,437	74.4	0.015
Male <sup>a</sup>	124,924	92,313	73.9	na
Race/ethnicity				
American Indian	30,135	23,790	78.9	0.173*
Asian	5,063	3,579	70.7	0.095
Black	21,064	14,431	68.5	0.157*
Hispanic	43,207	32,645	75.6	0.056
Pacific Islander	1,001	517	51.6	0.588**
White <sup>a</sup>	118,731	87,643	73.8	na
Multirace	26,118	19,106	73.2	0.021
National school lunch program eligibility status				
Eligible for free lunch	140,138	103,562	73.9	0.025
Eligible for reduced-price lunch	17,960	14,399	80.2	0.241*
Not eligible <sup>a</sup>	87,221	63,750	73.1	na
National school lunch program eligibility status				
Eligible for free lunch <sup>b</sup>	140,138	103,562	73.9	na
Eligible for reduced-price lunch	17,960	14,399	80.2	0.216*
Not eligible	87,221	63,750	73.1	0.025
English learner status				
English learner student	32,500	24,889	76.6	0.094
Not English learner student <sup>a</sup>	212,819	156,822	73.7	na
Special education status				
Identified for special education	25,893	22,405	86.5	0.537**
Not identified for special education <sup>a</sup>	219,426	159,306	72.6	na
District locale type				
Rural	66,061	54,044	81.8	0.362**
Nonrural <sup>a</sup>	179,258	127,667	71.2	na

\* Moderate difference between the subgroup and the reference group in unadjusted state-funded preK participation (standardized difference [Cox's index] is between 0.12 standard deviation units and less than 0.25 standard deviation units).

\*\* Substantial difference between the subgroup and the reference group in unadjusted state-funded preK participation (standardized difference [Cox's index] , is 0.25 or greater). ,  
na is not applicable or because the subgroup serves as the reference group. ,  
a. Reference group for calculating standardized difference.  
b. Alternative reference group for calculating standardized difference.  
Source: Authors' analysis of data from the Oklahoma State Department of Education.

**Table B3. Percentage of 2014/15–2018/19 Oklahoma public school kindergarten students who participated in state-funded prekindergarten in the prior year, by student and district characteristics, individual years**

Characteristic	2014/15	2015/16	2016/17	2017/18	2018/19
Total	73.3	74.2	74.0	74.5	74.4
<b>Gender</b>					
Female	73.3	74.8	74.4	74.8	74.4
Male	73.2	73.5	73.6	74.9	74.4
<b>Race/ethnicity</b>					
American Indian	78.6	79.2	79.6	78.2	79.1
Asian	68.3	70.1	70.2	74.7	69.6
Black	67.3	69.3	67.7	69.3	69.2
Hispanic	74.7	75.1	76.1	76.4	75.6
Pacific Islander	54.6	52.4	47.3	54.2	51.0
White	73.2	73.9	73.6	74.2	74.3
Multirace	71.5	73.5	73.1	73.9	73.7
<b>National school lunch program eligibility status</b>					
Eligible for free lunch	72.5	73.9	74.2	74.5	74.3
Eligible for reduced-price lunch	81.2	78.7	81.6	79.6	79.6
Not eligible	72.6	73.8	72.4	73.6	73.3
<b>English learner status</b>					
English learner student	74.1	75.2	77.7	78.4	78.2
Not English learner student	73.1	74.0	73.5	74.0	73.9
<b>Special education status</b>					
Identified for special education	85.6	87.4	86.2	87.0	86.6
Not identified for special education	71.9	72.8	72.6	73.0	72.8
<b>District locale type</b>					
Rural	81.6	81.5	82.2	81.9	81.8
Nonrural	70.2	71.5	71.0	71.8	71.6

Source: Authors' analysis of data from the Oklahoma State Department of Education.

**Table B4. Results from linear probability model of the associations between student and district characteristics and travel time measures with 2014/15–2018/19 Oklahoma public school kindergarten students who participated in state-funded prekindergarten in the prior year, five years combined**

Covariate	Coefficient (Standard error)			
	Model 1	Model 2	Model 3	Model 4
Female [Male]	0.0141*** (0.0018)	0.0141*** (0.0018)	0.0136*** (0.0018)	0.0125*** (0.0017)
American Indian [White]	0.0456*** (0.0027)	0.0457*** (0.0027)	0.0296*** (0.0027)	0.0117*** (0.0028)
Asian [White]	–0.0615*** (0.0070)	–0.0624*** (0.0070)	–0.0477*** (0.0070)	–0.0172* (0.0071)
Black [White]	–0.0475*** (0.0035)	–0.0472*** (0.0035)	–0.0179*** (0.0036)	0.0020 (0.0038)
Hispanic [White]	–0.0084* (0.0034)	–0.0085* (0.0034)	0.0038 (0.0034)	0.0098** (0.0034)
Pacific Islander [White]	–0.2421*** (0.0161)	–0.2424*** (0.0161)	–0.2182*** (0.0160)	–0.2174*** (0.0162)
Multirace [White]	–0.0058 (0.0030)	–0.0061* (0.0030)	0.0023 (0.0030)	0.0099** (0.0030)
Eligible for reduced-price lunch [Not eligible]	0.0652*** (0.0033)	0.0652*** (0.0033)	0.0579*** (0.0033)	0.0390*** (0.0033)
Eligible for free lunch [Not eligible]	0.0019 (0.0020)	0.0014 (0.0020)	–0.0026 (0.0020)	–0.0304*** (0.0021)
English learner student [Not English learner student]	0.0536*** (0.0037)	0.0541*** (0.0037)	0.0679*** (0.0037)	0.0695*** (0.0039)
Identified for special education [Not identified for special education]	0.1393*** (0.0024)	0.1392*** (0.0024)	0.1306*** (0.0024)	0.1232*** (0.0024)
District locale type–Nonrural [Rural]			–0.0946*** (0.0021)	–0.0255 (0.0190)
Travel time to nearest state-funded preK (minutes)			–0.0019 (0.0023)	–0.0234*** (0.0027)
Travel time to nearest Head Start (minutes)			–0.0207*** (0.0016)	0.0109*** (0.0020)
Travel time to nearest licensed center-based child care site (minutes)			0.0384*** (0.0022)	0.0037 (0.0029)
Constant	0.7095*** (0.0019)	0.7007*** (0.0025)	0.7714*** (0.0035)	0.7353*** (0.0142)
Year fixed effect included	No	Yes	Yes	Yes
District fixed effect included	No	No	No	Yes
Travel time missing indicators included	No	No	Yes	Yes



\* Significant at  $p < .05$ ; \*\* significant at  $p < .01$ ; \*\*\* significant at  $p < .001$ .

Note:  $n = 245,319$ . Reference group shown in brackets. Indicators for missing gender and missing travel time measures are included in the relevant regressions, but the coefficients are not reported. Models 1 and 2 estimated associations between student and district characteristics and participation in state-funded preK prior to accounting for student's district locale type and travel time measures. Results from model 3 were used to estimate differences between students in rural and nonrural districts. Model 3 excludes district fixed effects because most districts did not have variation in rural or nonrural designation over time. Results from model 4 were used to estimate all other differences by student and district characteristics and travel time. See appendix A for a description of model 4.

Source: Authors' analysis of data from the Oklahoma State Department of Education, the Oklahoma Head Start Collaboration Office Head Start directors, and the Oklahoma Department of Human Services child care facility records.

**Table B5. Unadjusted and regression-adjusted percentage of 2014/15–2018/19 Oklahoma public school kindergarten students who participated in state-funded prekindergarten (preK) in the prior year, and standardized differences (Cox's index) for group differences in preK participation, five years combined**

Characteristic	Unadjusted		Regression-adjusted	
	Percentage of kindergarten students who participated in state-funded preK the prior year	Standardized differences in percentage of students who participated	Percentage of kindergarten students who participated in state-funded preK the prior year	Standardized differences in percentage of students who participated
<b>Gender</b>				
Female	74.4	0.015	76.6	0.041
Male <sup>a</sup>	73.9	na	75.3	na
<b>Race/ethnicity</b>				
American Indian	78.9	0.173*	77.0	0.045
Asian	70.7	0.095	74.3	0.044
Black	68.5	0.157*	76.1	0.017
Hispanic	75.6	0.056	76.7	0.038
Pacific Islander	51.6	0.588**	54.3	0.582**
White <sup>a</sup>	73.8	na	75.6	na
Multirace	73.2	0.021	76.8	0.040
<b>National school lunch program eligibility status</b>				
Eligible for free lunch	73.9	0.025	74.6	0.092
Eligible for reduced-price lunch	80.2	0.241*	79.5	0.078
Not eligible <sup>a</sup>	73.1	na	77.4	na
<b>National school lunch program eligibility status</b>				
Eligible for free lunch <sup>b</sup>	73.9	na	74.6	na
Eligible for reduced-price lunch	80.2	0.216*	79.5	0.169*
Not eligible	73.1	0.025	77.4	0.092
<b>English learner status</b>				
English learner student	76.6	0.094	82.0	0.251**
Not English learner student <sup>a</sup>	73.7	na	75.0	na
<b>Special education status</b>				
Identified for special education	86.5	0.537**	87.0	0.495**
Not identified for special education	72.6	na	74.6	na
<b>District locale type</b>				
Rural	81.8	0.362**	81.0	0.320**
Nonrural <sup>a</sup>	71.2	na	71.5	na

\* Moderate difference between the subgroup and the reference group in unadjusted state-funded preK participation (standardized difference [Cox's index] , is between 0.12 standard deviation units and less than 0.25 standard deviation units).

\*\* Substantial difference between the subgroup and the reference group in unadjusted state-funded preK participation (standardized difference [Cox's , index] is 0.25 or greater).

na is not applicable because the subgroup serves as the reference group. ,

Note: Regression-adjusted participation rates are based on the predicted probability from model 4 in table B4 except for rural/nonrural rates, which are , based on model 3 in table B4. ,

a. Reference group for calculating standardized difference. ,

b. Alternative reference group for calculating standardized difference. ,

Source: Authors' analysis of data from the Oklahoma State Department of Education, the Oklahoma Head Start Collaboration Office Head Start directors, and the Oklahoma Department of Human Services child care facility records. ,

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## **Reference**

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## Appendix C. Supporting analyses

This appendix describes supporting analyses for the study that were designed to provide context for some limitations in the student-level data on participation among four-year-olds in state-funded preK, Head Start, and licensed center-based child care sites in Oklahoma (see appendix A). The appendix first summarizes the results of an analysis of an alternative aggregate measure of state-funded preK participation that includes all four-year-olds. The appendix then summarizes the results of an accounting of Head Start enrollment that provides an upper-bound estimate of statewide participation in state-funded preK and Head Start.

### *Estimated participation in state-funded prekindergarten among the population of four-year-old children in Oklahoma*

The main analysis using student-level data from the Oklahoma State Department of Education excluded Oklahoma four-year-olds who moved out of state before enrolling in kindergarten, enrolled in private kindergarten, or did not enroll in kindergarten (for example, they were home schooled). This section presents estimated state-funded preK participation for the full population of four-year-olds in Oklahoma using aggregate state-level data for the same five years examined in the main analyses (preK participation for school years 2013/14 through 2017/18).

The study team calculated state-funded preK participation as the ratio of state-funded preK enrollment for four-year-olds as of October 1 of each year, as reported by the Oklahoma State Department of Education, to the estimated number of four-year-olds in the state population in each year. The numerator was the Oklahoma State Department of Education combined participation count of all four-year-olds in part- and full-day state-funded preK programs in a given year. The denominator was the estimated size of each four-year-old cohort based on the Annie E. Casey Kids Count database, an online database of national and state child indicators supported by the Annie E. Casey Foundation (Annie E. Casey Foundation, n.d.). In Oklahoma the size of each annual cohort of four-year-olds was approximately 53,000 children, according to the Kids Count Database.

Calculations using these aggregate data estimated that approximately 75 percent of four-year-olds were enrolled in state-funded preK across the five years examined in the study, with a range from 74 percent to 77 percent in individual years (table C1). This estimate is similar to the study finding that 74 percent of kindergarten students had participated in state-funded preK in the prior year. This estimate suggests that students who attend public school kindergarten in Oklahoma participated in state-funded preK at rates similar to those among all four-year-olds.

**Table C1. Estimated participation in state-funded prekindergarten among all four-year-olds and among 2014/15–2018/19 Oklahoma public school kindergarten students in the prior year, by year, 2013/14–2017/18**

Prekindergarten (preK) enrollment year	Estimated number of four-year-olds	Reported number of students who participated in state-funded preK	Estimated percentage of four-year-olds who participated in state-funded preK	Estimated percentage of public school kindergarten students who participated in state-funded preK in the prior year
2013/14	53,056	40,823	76.9	73.3
2014/15	53,027	40,085	75.6	74.2
2015/16	53,356	39,405	73.9	74.0
2016/17	53,069	39,081	73.6	74.5
2017/18	52,748	39,540	75.0	74.4
Five years combined	265,256	198,934	75.0	74.1

Note: State-funded preK participation is shown as of October 1 each year. The final column is also reported in table B1 in appendix B.

Source: Authors' analysis of data from the Oklahoma State Department of Education and Annie E Casey Foundation (n.d.).

### *Estimated combined participation in state-funded preK and Head Start in Oklahoma*

The main analysis in the study using student-level data from the Oklahoma State Department of Education did not account for participation in other preK programs, including Head Start. Because Head Start does not maintain centralized individual-level records of children enrolled in the program, the study team used state-level Head Start enrollment data for programs in Oklahoma for the same years examined in the main analysis (that is, the preK enrollment for school years 2013/14 through 2017/18). These enrollment counts are compiled from administrative reports submitted by individual Head Start grantees, known as the Program Information Report (Head Start Early Childhood Learning and Knowledge Center, 2019). This section presents estimated participation in either state-funded preK (summarized in tables B1 and B2 in appendix B) or in federally funded Head Start programs in Oklahoma (based on the Program Information Reports).

The study team used aggregate data from Head Start Program Information Reports for Oklahoma for the same program years, as were used in the analysis of participation in state-funded preK. The Program Information Reports provided data on funded enrollment in aggregate for three- and four-year-olds combined and cumulative enrollment in aggregate and disaggregated by student characteristics (for example, age and race/ethnicity). Funded enrollment is the equivalent of the number of “slots”—the number of children who can be served at a point in time. Cumulative enrollment is the count of every child served in the program year, even if only for one day. Cumulative enrollment typically exceeds funded enrollment because some enrolled children leave during a program year and other children fill the slots. The study team based Head Start enrollment counts on funded enrollment for Oklahoma across all Head Start grantees in the state. Because funded enrollment was not disaggregated by student characteristics, the study team applied the distribution of student characteristics reported for cumulative enrollment to the count of funded enrollment. Thus, the study did not have precise counts of the distribution of funded enrollment specifically for four-year-olds. The count was estimated based on funded enrollment and the age distribution of cumulative enrollment.

In state-funded preK classrooms that were collaboration sites with Head Start, students who were eligible for Head Start and enrolled filling a Head Start funded seat could have been counted twice, once for the Head Start enrollment count and once for the state-funded preK enrollment count. The study could not account for the possible double counting of students as enrolled in Head Start and in state-funded preK. Thus, the combined count of enrollment in state-funded preK and Head Start should be viewed as an upper-bound estimate, given the potential for double counting some students.

An estimated 32,000 four-year-olds participated in Head Start in Oklahoma during the five years examined. Estimated Head Start enrollment decreased each year, from approximately 7,000 students in 2013/14 to fewer than 6,000 students in 2017/18. Combining this Head Start enrollment with state-funded preK enrollment results in an upper-bound estimate of 87 percent of four-year-old children who participated in one or both programs, on average over the five years (table C2).<sup>9</sup> This estimate is approximately 13 percentage points higher than that for participation in state-funded preK alone over the five years (74 percent), with gaps ranging from 10 percentage points to 17 percentage points for individual years. This finding suggests that 74–87 percent of four-year-old children participated in a least one of these programs on average across the study period, considering the expected double counting of some students as both state-funded preK and Head Start participants.

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<sup>9</sup> This estimate is similar to the combined participation rate of 86 percent estimated by Friedman-Kraus et al. (2019).

**Table C2. Estimated combined participation in state-funded prekindergarten and Head Start among all four-year-olds in Oklahoma, 2013/14–2017/18**

Prekindergarten (preK) enrollment year	Estimated number of four-year-olds	Reported number of students who participated in state-funded preK	Estimated number of four-year-olds who participated in Head Start	Estimated combined percentage of four-year-olds who participated in state-funded preK and Head Start
2013/14	53,056	40,823	7,013	90.2
2014/15	53,027	40,085	6,830	88.5
2015/16	53,356	39,405	6,373	85.8
2016/17	53,069	39,081	6,050	85.0
2017/18	52,748	39,540	5,926	86.2
Five years combined	265,256	198,934	32,192	87.1

Source: Authors' analysis of data from the Oklahoma State Department of Education and Head Start Early Childhood Learning and Knowledge Center (2019).

## References

- Annie E. Casey Foundation. (n.d.). *Kids Count*, online database. Retrieved July 23, 2019, from <https://www.aecf.org/work/kids-count/>.
- Friedman-Kraus, A. H., Barnett, W. S., Weisenfeld, G. G., Kasmin, R., DiCrecchio, N., & Horowitz, M. (2019). *The state of preschool 2018: State preschool yearbook*. Rutgers University, Graduate School of Education, National Institute for Early Education Research. <https://eric.ed.gov/?id=ED595313>.
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