

Did State Pre-Kindergarten Programs Affect the Head Start Enrollment of Children with Disabilities? A Quasi-Experimental Analysis

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Abstract

Little is known about how the expansion of state pre-kindergarten (pre-k) programs affects low-income children with disabilities in Head Start. Using almost 30 years of administrative data of all Head Start programs and a differences-in-differences design, this study tests the possibility that, as state pre-k differentially draws relatively more advantaged children from the pool of eligible 4-year-olds, Head Start taps into their relative programmatic strengths and serves more children with disabilities. We found that, overall, the introduction of state pre-k was associated with a 1 percentage point (7%) decrease in Head Start enrollment of children with disabilities. However, Head Start programs located in school systems did experience an increase in their enrollment of children with disabilities identified before Head Start enrollment. We also found that the decrease was primarily driven by children with speech impairment, suggesting that state pre-k might affect the Head Start enrollment of children with disabilities through “cream-skimming” because services for these children are relatively more common and less expensive. Implications for future research and practice are discussed.

Keywords

at risk learners, early childhood policy, longitudinal research, population description, secondary data analysis

Among young children with disabilities, those from low-income families face compounding environmental adversities such as family stress, limited access to health care (Newacheck et al., 2004), food (Sonik et al., 2016), and risk of eviction (Hartman & Robinson, 2010), and therefore have been referred to as “doubly vulnerable” (Guralnick, 1998). These children benefit from high-quality, inclusive early intervention programs as much as—if not more than—their typically developing peers (Bloom & Weiland, 2015; Phillips et al., 2017).

As of 2017, two-thirds of children with disabilities attend center-based programs in inclusive classrooms (Office of Special Education

and Rehabilitative Services, 2019). Head Start (HS)—the federal government’s preschool program for children in poverty—has been a reliable source of high-quality inclusive early childhood education (ECE) for low-income children with disabilities. Head Start requires that each program reserves at least 10% of the

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spaces for children with disabilities and serves a higher percentage of children with disabilities than found in the overall population (13% vs. 6%; Administration for Children and Families, 2018).

At the same time, the United States reported changes in the ECE landscape from the 1990s to 2010s, as states implemented pre-kindergarten (pre-k) policies to serve more 4-year-old children (Jenkins, 2014). Prior studies have examined the influence of state pre-k programs on various aspects of HS, including the overall enrollment, enrollment by age, and teacher recruitment and retention (e.g., Bassok, 2010, 2012).

However, no study has considered whether and how this large-scale policy intervention affects HS services to low-income children with disabilities, a population in need of high-quality educational experiences and which has also traditionally benefited from HS services.

This study tests the hypothesis that, as state pre-k differentially draws relatively more advantaged children from the pool of HS-eligible 4-year-olds and releases HS slots (i.e., “cream-skimming”), HS taps into their relative programmatic strengths and serves more children with disabilities. These relative strengths, which are well-documented in the prior literature and in HS regulations, include a comprehensive service model, expertise in serving the most disadvantaged children, and programming emphasis on serving children with disabilities (Zigler et al., 2006).

The main research question guiding our study is as follows: Did the introduction of state pre-k programs affect the HS enrollment of children with disabilities? Anecdotes suggest that some local HS programs have enrolled an increasing number of children with disabilities due to the pre-k expansion (V. Padilla, personal communication, September 2017); however, whether this increase in enrollment is occurring at a larger scale has not been empirically tested. If HS is indeed serving more children with

disabilities over time as a result of these processes, there would be substantial implications for research and resource allocation to serve this population, as well as large-scale needs for training, professional development, and staffing.

We took advantage of a unique longitudinal HS administrative dataset, the Program Information Report (PIR), which has rich, detailed reporting of the HS enrollment of children with disabilities from 1988 onward. We used a quasi-experimental approach (i.e., differences-in-differences) to isolate the effects of state pre-k on HS program enrollment. As pre-k programs continue to expand, this study provides a timely systems-level evaluation on whether the foremost federal ECE program has been increasingly and disproportionately serving children with disabilities. Although the compositional changes revealed in our study do not necessarily indicate the direction of changes in child outcomes, understanding the compositional shifts in HS’s service population is a first-order task to clarify who is serving which groups of children and to inform future funding, research, and programming priorities to meet the learning and developmental needs of children with disabilities at scale.

Effects of State Pre-Kindergarten on Head Start

With accumulating evidence of the benefits of ECE investments, policymakers became increasingly interested in using state pre-k programs as a lever to reduce poverty and achievement gaps in the past three decades (1990–2020) (Jenkins, 2014). Because both HS and state pre-k programs tend to locate in high-need areas and offer overlapping services, the introduction of state pre-k has led to unintended consequences on HS enrollment, teacher recruitment and retention, and other resources such as facilities (e.g., Ackerman, 2004; Bassok, 2010, 2012; Government Accountability Office [GAO], 2003). For example, using the PIR data from 2002 to 2007, Bassok (2010, 2012) found that the state pre-k expansion was associated with a decrease in the HS enrollment of 4-year-old

children and the proportion of lead and co-lead teachers with an associate degree.

However, this literature also points to the possibility that HS taps into its relative strengths in serving younger children (i.e., children under 4 years old) as state pre-k differentially draws 4-year-olds from the pool of eligible children, shifting to fill this service gap created by state pre-k expansion. For example, Bassok (2012) found that state pre-k expansion between 2002 and 2007 was associated with a slight increase in the HS enrollment of children under 4 years old. Relatedly, evidence of “cream-skimming” in the school choice literature suggests that new options in the educational market tend to draw the more advantaged students away from public schools (e.g., Altonji et al., 2015; Lacireno-Paquet et al., 2002). Moreover, market-oriented charter schools are less likely to serve special needs students, possibly because these students are more costly to educate (Lacireno-Paquet et al., 2002). Considering that most state pre-k programs have higher income eligibility

thresholds than HS (e.g., 150% FPL in state pre-k vs. 100% FPL in HS), it is possible that state pre-k draws in more relatively economically advantaged 4-year-old children, freeing up their HS slots for more disadvantaged children with disabilities, which is both a key goal and a relative strength of HS (Zigler et al., 2006).

We present a summary of these ideas as our theory of change in Figure 1, which shows how the introduction of state pre-k would increase the share of preschool-aged children with disabilities served by HS through the collective effects of these different mechanisms.

Head Start's Relative Strengths in Serving Children With Disabilities

Both HS and state pre-k programs have positive effects on the cognitive and noncognitive outcomes of children with disabilities (e.g., reading, math, social-emotional skills; Bloom

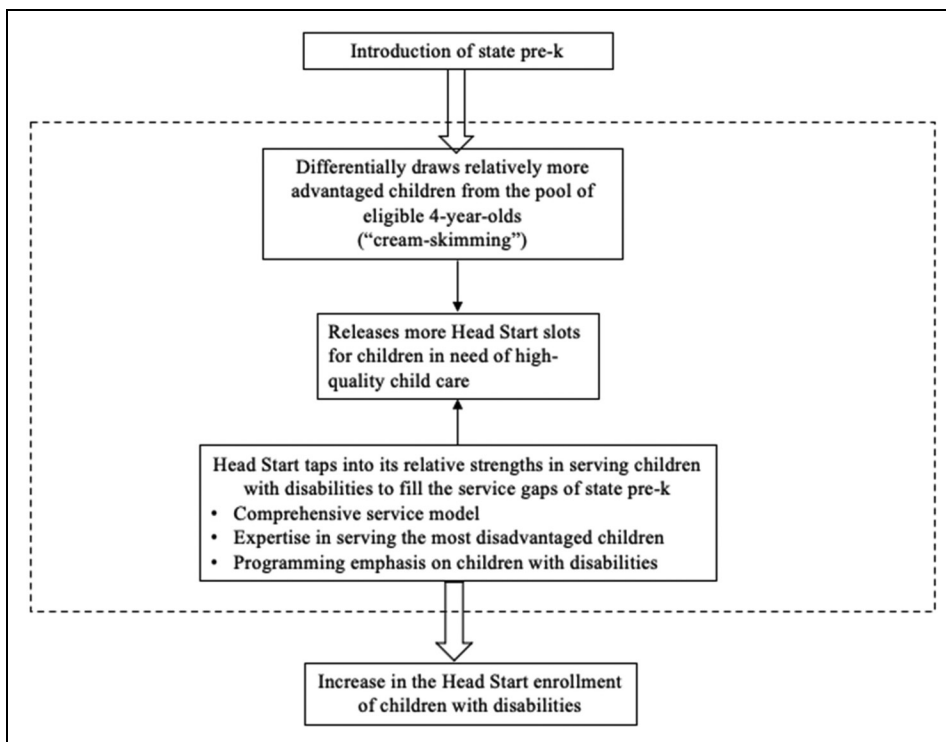


Figure 1. Conceptual Framework.

& Weiland, 2015; Lee & Rispoli, 2016; Phillips & Meloy, 2012; Puma et al., 2010, 2012; Weiland, 2016). However, studies suggest that HS's comprehensive service model, expertise in serving the most disadvantaged children, and its unique programming emphasis on serving children with disabilities would be more beneficial than other ECE program models (such as state pre-k) that primarily focus on academic outcomes (Ewen & Neas, 2005; Gilliam, 2008; Guralnick, 2011; Zigler et al., 2006).

Comprehensive Service Model and Expertise in Serving the Most Disadvantaged Children

The comprehensive service model has been a fundamental component of the HS program since its origins. It is designed to address the complex needs of children with developmental and economic challenges, and those with other serious family vulnerabilities (e.g., homelessness; Zigler et al., 2006). In HS, children receive educational preschool and the wraparound services that target children's health and social development, while their entire family system is recognized with family needs assessments, referrals for social programs, mental health supports, and regular parenting support programming. Gilliam (2008) compared the HS and pre-k models in a nationally representative survey and found that HS programs excelled at comprehensive models, smaller classes, and lower student-teacher ratios; state public school pre-k programs had teachers with higher levels of education.

There are studies that have compared the effects of HS versus state pre-k on child outcomes. Overall, this literature finds that it is unclear whether HS and state pre-k differentially affect cognitive outcomes; however, HS appears to have a relative advantage in noncognitive domains and family outcomes, which is a likely result of its comprehensive service model. In the cognitive domain, some researchers found that pre-k participation was associated with higher reading and math skills (Gormley et al., 2010; Henry et al., 2006; Jenkins et al., 2016), whereas others found

no differences in HS and state pre-k's effects on these outcomes (Zhai et al., 2011, 2013). In the noncognitive domains, HS participation is associated with better health outcomes (Gormley et al., 2010), social behaviors (Zhai et al., 2011), and approaches to learning (Johnson et al., 2019). Head Start's relative advantage is also found in family outcomes such as parenting behaviors and maternal educational attainment, although few studies have examined these outcomes in state pre-k settings (Gelber & Isen, 2013; Sabol & Chase-Lansdale, 2015). Notably, HS is found to be more effective for the most disadvantaged children such as those entering preschool with low cognitive ability or difficult temperaments (Johnson et al., 2019; Lee et al., 2014). However, some studies have found that the benefits of HS are most salient when HS children were compared to children who would otherwise receive home care (Feller et al., 2016; Zhai et al., 2011).

Programming Emphasis on Children With Disabilities

Additionally, several programming features of HS are likely to be advantageous for low-income children with disabilities. First, HS requires its programs to provide services to all children with disabilities, regardless of their IDEA status (Head Start Program Performance Standards [HSPPS], §1302.60). Children must be evaluated by a multidisciplinary team to meet two criteria to be determined eligible for IDEA: (1) whether or not the child has a disability; and (2) whether or not the child has educational needs because of that disability (20 U.S.C. § 1414). This is in stark comparison to the fact that most state pre-k programs are only required to serve children eligible for IDEA, and only 29 out of the 73 state pre-k programs prioritize children with disabilities for enrollment (GAO, 2019). Second, HS programs are required to provide all necessary modifications to the environment, instructional formats, and individualized accommodations to support the full participation of all children with disabilities (HSPPS, §1302.61).

Schochet et al. (2020) compared the effectiveness of HS and pre-k specifically when serving children with disabilities. Consistent with the broad literature comparing the effects of HS and state pre-k, they found that the effects of HS and pre-k did not differ across cognitive outcomes, but that HS was associated with higher approaches to learning and prosocial skills. Children in HS were also more likely to have their disabilities verified by doctors, and children with multiple disabilities benefitted most in reading and math from HS participation compared to non-HS participants (Lee & Rispoli, 2016).

Taken together, these relative strengths may propel HS to serve more children with disabilities to meet their diverse needs in the context of state pre-k expansion (Bassok et al., 2018; Zigler et al., 2006). This possibility was suggested by Zigler et al. (2006) 15 years ago, when state pre-k programs started to gain traction, but has never been tested empirically.

Selection Into Different Types of Center-Based ECE

Overall, parents of children with disabilities who are economically disadvantaged are challenged to find care that can accommodate the needs of the child and the family (Chaudry et al., 2011; Knoche et al., 2006; Sullivan et al., 2018). When looking for child care, parents emphasize the warmth of the environment, availability and quality of specialized services and staff, and “convenience factors” such as length of service and proximity (Chaudry et al., 2011). Qualitative studies generally report a high level of awareness, recognition, and satisfaction for HS among parents of children with disabilities, although there is no direct comparison of parents’ preferences for HS and pre-k (Ward et al., 2006; Chaudry et al., 2011). Results from quantitative studies are mixed. Some studies found that parents treat HS and pre-k programs equally in the child care search (Bassok et al., 2018), but Cobo-Lewis et al. (2019) found that if HS programs were highly resourced, children with disabilities tended to stay longer than those without disabilities.

Present Study

This study tested the hypothesis of whether HS has been serving an increasing proportion of children with disabilities with the introduction of state pre-k programs.

To further understand the nuances in this compositional change in HS, we explored three sources of heterogeneity in the HS enrollment: (1) subgroups of children with disabilities; (2) timing of identification; and (3) HS program location. Our research questions are:

1. Did the introduction of state pre-k programs affect the HS enrollment of children with disabilities?
2. Did the effects of pre-k introduction on the HS enrollment of children with disabilities vary by disability type (e.g., health impairment, speech impairment), timing of identification (i.e., HS enrollment of children whose disabilities were identified before and after program enrollment), or by HS program location (i.e., school systems, community-based organizations, tribal providers, and government agencies)?

We examined the variation in state pre-k’s influence on the HS enrollment of the subgroups of children because children with different types of disabilities have distinct needs and may be differentially affected by the adoption of state pre-k programs. Particularly, children with severe behavioral or emotional disabilities have the alternative to be served in a more intensive treatment environment (in addition to the inclusive classroom) in HS (HSPPS, §1302.61). Therefore, the increase in the HS enrollment may be more prominent among children with more severe disabilities than those with mild to moderate disabilities.

It is also possible that the effects of pre-k on the HS enrollment of children with disabilities vary by timing of identification (i.e., HS enrollment of children with

disabilities identified *before* and *after* HS). The enrollment by timing of identification sheds light on the changing patterns of the HS enrollment of different groups of children. The enrollment of children with disabilities identified before HS (“pre-identified children”) represents the group of children who were diagnosed upon HS entry and were thus in need of immediate specialized services. The enrollment of children with disabilities identified after HS (“post-identified children”) constitutes the group of children whose disabilities have not yet been discovered by their parents and those whose parents have suspected but have not obtained a formal diagnosis due to well-documented barriers, such as delays in the identification process and lack of knowledge on exceptionality and available services (Artiles, 2019). Changes in the enrollment of pre-identified children could signal a need for resources and specialized expertise in serving these children, and fluctuations in the enrollment of post-identified children could direct efforts to screen and identify at-risk children in the community.

Another important feature of HS programs that may influence the enrollment of children with disabilities is the location or auspices under which HS operates. Although HS is known to have overall higher quality than non-HS programs, the quality and perceived quality *within* HS varies (Bassok et al., 2016, 2018). Because parents of children with disabilities value the availability and quality of special education services when choosing child care (Chaudry et al., 2011), HS programs offered in different locations may be differentially affected by the introduction of pre-k programs due to variation in their capacity to provide specialized services. Specifically, HS programs in schools have generally been identified as higher quality as measured by teacher qualifications (Gilliam, 2008), the Inclusive Classroom Profile (ICP) scores (Soukakou et al., 2014), and classroom interaction (Tsao et al., 2008), compared to their counterparts in CBOs. Head Start programs located in school systems are also more likely to access school disability resources. Therefore, HS programs located in

schools may enroll more children with disabilities with the state pre-k expansion.

Method

Data

This study combined data from multiple sources. The primary dataset was the publicly available administrative data of all HS programs nationwide, the Program Information Report (PIR), from 1988 to 2015. The Administration for Children and Families uses PIR to collect information about enrollment, staff qualification, and social services from all HS programs annually. Programs are offered by grantee agencies who receive HS grants and provide HS services directly or through delegate agencies. Grantee agencies and their delegate agencies submit PIR forms separately. A unique feature of the PIR data is that an entire section is dedicated to children with disabilities with rich information about enrollment. Programs also report their location (e.g., school systems, community-based organizations). The longitudinal nature of the PIR data allows us to implement the differences-in-differences strategy and exploit the rich variation of states’ pre-k adoption timing during the 28-year period. Our analytic sample included the universe of active HS programs from 1988 to 2015, resulting in 51,008 observations in 50 states and Washington DC, excluding American Samoa, Guam, Northern Mariana Island, Palau, Puerto Rico, and Virgin Islands. The sample was unique at the program-by-year level.

We obtained the start year of states’ pre-k programs from Barnett et al. (2009), who explicitly reported the start year of each state’s pre-k programs based on data collected in the annual surveys of state pre-k programs conducted by the National Institute of Early Education Research (NIEER) in Rutgers University. We supplemented and cross-validated the information using the State of Preschool Yearbook 2018 by NIEER (Friedman-Krauss et al., 2018).

The state demographic, economic, and social welfare covariates from 1988 to 2015 were from the publicly available University of Kentucky Center for Poverty Research National Welfare Data. Covariates related to

K-12 school quality were from the Common Core of Data from 1988 to 2015.

Measures

In this section, we describe the key features of this study's measures. More detailed descriptions of some measures are available in Appendix A in the online supplemental material.

State Pre-Kindergarten Status. Following Friedman-Krauss et al. (2018), we defined state pre-k as programs that are (1) funded and administered by the state; (2) distinct from subsidized child care; (3) not primarily designed to serve children with disabilities; and (4) with a primary focus on providing ECE to preschool-aged (3- and 4-year-old) children for at least 2 days per week, although most pre-k programs primarily serve 4-year-olds. Pre-k status was a dummy indicator variable that equals 1 in the years a state had pre-k and 0 if otherwise. Some states have multiple pre-k programs with slightly different foci or target populations. If a state started its pre-k program as a supplemental program to HS, the pre-k program starting year is defined as the year the program was offered to a broader population of preschool-aged children. Appendix B in the supplemental material lists the pre-k start year for each state by pre-k status: those with pre-k by 1988 ("always-prek states"), those that started pre-k between 1988 and 2015 ("prek-adopting states"), and those that never had pre-k ("never-prek states") as of 2015.

HS Enrollment of Children With Disabilities. We constructed three types of measures of the HS enrollment of children with disabilities for our study to address our primary and secondary research questions.

Proportion of Children With Disabilities. We used two measures of the HS enrollment of children with disabilities to ensure that a broad range of children with disabilities were represented (Shapiro & Weiland, 2019). The first measure was a summed total of children diagnosed with different types of disabilities. This measure included children diagnosed

with a disability who were eligible for IDEA and those diagnosed but who were ineligible for IDEA (personal communication, National Center on Program Management and Fiscal Operations, February 4, 2021). The disabilities were usually diagnosed by a doctor or a health professional, although regional variations may have existed (Puma et al., 2010; Shapiro & Weiland, 2019). The different types of disabilities included health impairment, emotional/behavioral disorder, speech impairment, intellectual disability, hearing impairment, orthopedic impairment, visual impairment, learning disability, autism, traumatic brain injury, multiple, and other disabilities. The proportion of children with disabilities was then calculated by dividing the summed total of children with different types of disabilities by the cumulative program enrollment.

The second measure was the total number of children with an Individualized Education Program (IEP). The PIR collects information on children with diagnosed disabilities and children with an IEP separately. This measure was typically equal or slightly smaller than the enrollment of children with diagnosed disabilities, suggesting that the majority of the children with disabilities in HS were eligible for IDEA and had an IEP. We obtained the proportion of children with an IEP by dividing the total number of children with an IEP by the cumulative enrollment. Note that IEP records may not capture all students with disabilities because the classification of disability status can vary across states and programs (Shapiro & Weiland, 2019).

Proportions of Children With Disabilities Identified Before and After HS Enrollment. We calculated the proportions by dividing the total number of children whose disabilities were identified before HS enrollment ("pre-identified") and after ("post-identified") by the cumulative enrollment. The sum of pre- and post-identified enrollment equaled the total number of children with disabilities.

Proportions of Children Diagnosed With Different Types of Disabilities. The proportions were calculated by dividing the total number of children diagnosed with a certain type of

disability (described above) by the cumulative program enrollment. The enrollment of children with autism, traumatic brain injury, and other disabilities was not reported until 1994. The results of these disabilities should be interpreted with this limitation in mind.

Covariates. We controlled for an extensive set of time-varying state economic, political, and educational characteristics that are likely to correlate with the HS enrollment of children with disabilities and the adoption of state pre-k. Specifically, we controlled for the proportion of SNAP benefits recipients, the proportion of TANF/AFDC recipients, gross state product (in 2015 dollars), unemployment rate, poverty rate, K-12 pupil-teacher ratio, K-12 per pupil expenditure (in 2015 dollars), the fraction of House representatives who were Democrats, and population.

Summary Statistics

Panel A of Table 1 shows the summary statistics of HS program-level outcomes and HS locations by state pre-k status in 1988. Overall, states with or without pre-k were similar in terms of their HS enrollment of children with disabilities, although states that adopted pre-k during our study period (1988–2015) served a slightly larger proportion of children with disabilities, post-identified children, and children with speech impairment. In pre-k-adopting states, the vast majority of HS programs (72%) were located in community-based organizations, and 20% were in school systems. Panel B of Table 1 presents the state characteristics by pre-k adoption status in 1988. Overall, states with or without pre-k were similar in their welfare provision and economic conditions. States that had pre-k before 1988, and those that never adopted pre-k before 2015, had a much larger population density and more representatives who were Democrats. We present the rollout trend of state pre-k programs from 1988 to 2015 and the overall national trends in the HS enrollment of children with disabilities in Appendix C in the online supplemental materials.

Analytic Strategy

Selection bias is the primary challenge to securing an accurate estimation of the influences of pre-k on HS because states' pre-k policies were not randomly determined. States may implement pre-k programs due to numerous observed and unobserved factors. Our estimates would be biased if unobserved state characteristics were correlated with states' pre-k adoption and the HS enrollment of children with disabilities. The estimates may also have been biased by concurrent events—such as changes in HS and special education policies—that simultaneously affect the HS enrollment of children with disabilities. To address this issue, we exploited variation in the timing of states' pre-k program implementation using a differences-in-differences (DID) design (Angrist & Pischke, 2008). The DID design recognized the differences across states that adopted and did not adopt pre-k at a given year. However, if the trends of the HS enrollment in states with and without pre-k moved in parallel in the absence of pre-k adoption, the divergence in the treatment states from the established trends in the comparison states (i.e., states without pre-k in a given year) would represent the treatment effects—the effects of pre-k on the HS enrollment of children with disabilities. To implement this strategy, we included state and year fixed effects and controlled for a wide range of time-varying state characteristics to rule out any remaining bias. We estimated the following DID model:

$$\begin{aligned} \%Disabenr_{pst} = & c + \beta_1 Prek_{st} + \theta X_{st} \\ & + \gamma_s + \delta_t + \varepsilon_{st} \end{aligned} \quad (1)$$

where $\%Disabenr_{pst}$ was an outcome variable (e.g., the proportion of children of disabilities, the proportion of children with an IEP) in HS program p in state s in year t . $Prek_{st}$ was the indicator of whether state s had pre-k in year t . γ_s and δ_t are state and year fixed effects. X_{st} was a vector of time-varying state covariates. The coefficient of interest, β_1 , was the average treatment effect of having pre-k at the state level. Standard errors were clustered by state.

Table 1. Descriptive Statistics of Head Start Outcomes and State Characteristics in 1988 by State Pre-K Status as of 2015.

Variable	(1) Prek-Adopting	(2)	(3) Always-Prek	(4)	(5) Never-Prek	(6)
	Mean	SD	Mean	SD	Mean	SD
<i>Panel A: HS Outcomes and Location</i>						
Proportion of children with disabilities	15.36	7.92	13.90	6.93	14.52	5.80
Proportion of children with an IEP	15.05	7.95	13.68	6.93	13.89	5.77
Proportion of pre-identified children	4.67	4.08	4.52	4.24	5.81	4.26
Proportion of post-identified children	10.69	6.75	9.38	5.95	8.71	5.16
Proportion of children with health impairment	0.97	2.02	1.14	1.92	0.80	1.79
Proportion of children with emotional/behavioral disorder	0.37	0.84	0.61	1.40	0.62	1.21
Proportion of children with speech impairment	9.96	7.14	8.35	5.87	8.00	5.37
Proportion of children with intellectual disability	0.32	0.86	0.14	0.49	0.25	0.66
Proportion of children with hearing impairment	0.15	0.52	0.22	0.99	0.36	1.15
Proportion of children with orthopedic impairment	0.46	0.95	0.40	0.80	0.58	0.88
Proportion of children with visual impairment	0.24	0.54	0.29	0.75	0.32	0.67
Proportion of children with learning disabilities	0.46	1.50	0.68	1.71	0.80	1.65
Proportion of children with autism	0.03	0.26	0.03	0.30	0.06	0.21
Proportion of children with traumatic brain injury	0.01	0.08	0.01	0.08	0.02	0.09
Proportion of children with multiple disabilities	2.43	3.25	2.08	3.17	2.79	3.49
Proportion of children with other disabilities	0.85	2.22	0.79	2.94	1.53	2.58
Community-based organizations	0.72		0.71		0.67	
School system	0.20		0.21		0.10	
Government agency	0.04		0.04		0.02	
Tribal provider	0.05		0.04		0.21	
<i>Panel B. State Characteristics</i>						
Percent of Food Stamps/SNAP recipients	7.97	3.18	8.27	2.72	6.25	1.34
Percent receiving AFDC/TANF	3.78	1.17	5.25	1.29	2.95	0.75
Gross State Product per capita (thousands)	38.53	7.41	43.75	8.51	36.05	5.61
Poverty rate	13.45	5.05	13.53	3.44	11.50	1.85
Unemployment rate	5.52	1.50	5.99	1.80	5.12	1.03
K-12 pupil-teacher ratio	17.30	1.62	18.06	2.81	17.85	2.73
K-12 expenditure per pupil (thousands)	7.56	1.99	8.73	2.07	7.54	1.49
Fraction of House representatives who are Democrats	0.62	0.18	0.63	0.10	0.46	0.13
Population density (per square mile)	198.81	237.51	286.84	918.69	29.66	26.25
Observations	738		873		144	

Note. The proportion of children with autism, traumatic brain injury, and other disabilities was not available until 1994. The estimates were reported using the 1994 data.

Identifying Assumptions. The main identifying assumption of a DID design is the parallel trends assumption. This requires that the trends in the HS enrollment of children with disabilities is parallel in states with and without pre-k in the absence of the pre-k adoption. To assess this assumption, we used an event-study model (Angrist & Pischke, 2008). The event-study model specifically tested the pre-treatment trends in the outcome variable

between states with and without pre-k by the event time—the number of years relative to the year when states introduced pre-k. We found that there were no significant differences in the HS enrollment of children with disabilities between the treatment and comparison states in the pre-treatment years, strengthening the validity of our DID model. More details of the event study and additional tests and considerations for the identifying assumptions can be

found in Appendix D in the online supplemental material. Nevertheless, we cannot completely rule out the existence of confounding factors; our results thus should not be interpreted as causal.

Results

In this section, we report results from the main and heterogeneity analyses using our primary DID model specified in Equation (1). Our results are robust to various sensitivity checks, which are reported in Appendix E in the online supplemental material.

Main Effects

Table 2 shows the unstandardized DID estimates of the effects of pre-k introduction on the HS enrollment of children with disabilities and those with an IEP. For each outcome, we started with a state and year fixed effects model and then added time-varying state covariates. Contrary to our overall prediction, we found that the introduction of state pre-k was associated with a 1.2 percentage point (pp) decrease in the proportion of children with disabilities in HS ($p < .05$; Column 1). Once we controlled for state covariates, the effect was reduced to 1 pp, but remained significant at the 0.05 level (Column 2). To put it in practical terms, on average 13.84% of the HS enrollment from 1988 to 2015 were children with disabilities (about 98,000 children). A 1 pp decrease from 13.84% thus represents a 7.23 percent decrease in the total number of children with disabilities enrolled in HS—an average

decrease of 7,081 children across states per year. The findings on HS children with an IEP are almost identical, suggesting that our results are robust to different measures of disability status (Columns 3 and 4).

Dynamic Effects

We estimated two additional specifications to understand how the effects of state pre-k continued over time. We estimated an event study model that allows for a post-treatment linear trend by including the number of years after state pre-k adoption and its squared term. We also replaced the event time dummies in the event study analysis with time period (spline) dummies indicating whether the state was 1–5, 6–10, 11–15, or 15 and more years after pre-k adoption. Results in Appendix F in the online supplemental material show that most of the effects of pre-k occurred instantly in the first few years of the policy and remained constant afterward.

Heterogeneous Effects

Next, we examined how state pre-k affected the HS enrollment of children with different types of disabilities in Table 3. Each column represents a separate regression with the most restricted model controlling for state and year fixed effects and time-varying state characteristics. Of the 12 disabilities, state pre-k adoption primarily affected the enrollment of children with speech impairment. HS experienced a 1.16 pp decrease in the proportion of children with speech impairment

Table 2. Effects of Pre-K on the Head Start Enrollment of Children With Disabilities.

Variable	(1) Proportion of Children With Disabilities	(2) Proportion of Children With Disabilities	(3) Proportion of Children With an IEP	(4) Proportion of Children With an IEP
Pre-k adoption	–1.197* (0.509)	–0.963* (0.419)	–1.223* (0.545)	–0.975* (0.466)
Observations	51,008	51,008	51,008	51,008
R-squared	0.126	0.130	0.129	0.133
State & year FE	Y	Y	Y	Y
State covariates	N	Y	N	Y

Note. Clustered standard errors in parentheses.

*** $p < .001$, ** $p < .01$, * $p < .05$

Table 3. Effects of Pre-K on the Head Start Enrollment of Children With Disabilities by Disability Types.

Variable	(1) Proportion of Children With Health Impairment	(2) Proportion of Children With Emotional/ Behavioral Disorder	(3) Proportion of Children With Speech Impairment	(4) Proportion of Children With Intellectual Disability	(5) Proportion of Children With Hearing Impairment	(6) Proportion of Children With Orthopedic Impairment	(7) Proportion of Children With Visual Impairment	(8) Proportion of Children With Learning Disabilities	(9) Proportion of Children With Autism	(10) Proportion of Children With Traumatic Brain Injury	(11) Proportion of Children With Multiple Disabilities	(12) Proportion of Children With Other Disabilities
Pre-k adoption	−0.061 (0.065)	−0.014 (0.040)	−1.156*** (0.383)	−0.057 (0.036)	0.053*** (0.019)	−0.001 (0.021)	−0.005 (0.015)	0.060 (0.077)	−0.055*** (0.019)	−0.004 (0.006)	−0.022 (0.119)	−0.049 (0.355)
Observations	51,008	51,008	51,008	51,008	51,008	51,008	51,008	51,008	40,393	40,393	51,008	40,393
R-squared	0.076	0.048	0.137	0.046	0.017	0.050	0.024	0.040	0.091	0.003	0.159	0.282
State & year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State covariates	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note. Clustered standard errors in parentheses. Only the most restricted models (state and year fixed effects controlling for state covariates) are shown due to the limited space. The enrollment information of children with traumatic brain injury, autism, and other disabilities was only available from 1994 to 2015.

*** $p < .001$, ** $p < .01$, * $p < .05$

when states introduced pre-k programs ($p < .01$). We also found a minimal but statistically significant decline in the HS enrollment of children with autism ($b = -0.06$, $p < .001$). Because children with autism account for a very small fraction of HS total enrollment of children with disabilities and these data were not available for the full time periods of our study, we interpret these findings as echoing the general

declining trend in the HS enrollment of children with disabilities. An unexpected finding is the positive but small coefficient on the enrollment of children with hearing impairment ($b = 0.05$, $p < .001$). Given that nine out of the 12 coefficients on different types of disabilities were negative, this might be a statistical anomaly and does not negate the general declining trend we found across disability types.

Table 4. Effects of Pre-K on the Head Start Enrollment of Children With Disabilities by Timing of Identification.

Variable	(1) Proportion of Pre-Identified Children	(2) Proportion of Pre-Identified Children	(3) Proportion of Post-Identified Children	(4) Proportion of Post-Identified Children
Pre-k adoption	-0.548 (0.338)	-0.364 (0.279)	-0.667** (0.286)	-0.628** (0.261)
Observations	51,008	51,008	51,008	51,008
R-squared	0.143	0.146	0.127	0.129
State & year FE	Y	Y	Y	Y
State covariates	N	Y	N	Y

Note. Clustered standard errors in parentheses.

*** $p < .001$, ** $p < .01$, * $p < .05$

Table 5. Effects of Pre-K on the Head Start Enrollment of Children With Disabilities by Head Start Location.

Variable	(1) Proportion of Children With Disabilities	(2) Proportion of Children With Disabilities	(3) Proportion of Pre-Identified Children	(4) Proportion of Pre-Identified Children	(5) Proportion of Post-Identified Children	(6) Proportion of Post-Identified Children
Pre-k adoption	-1.360** (0.511)	-1.149** (0.429)	-0.730** (0.330)	-0.547* (0.281)	-0.651** (0.292)	-0.634** (0.254)
(Community-based organizations)						
School systems	1.376** (0.654)	1.351** (0.646)	0.350 (0.315)	0.340 (0.305)	1.054* (0.534)	1.039* (0.533)
Government agencies	0.974** (0.478)	0.936* (0.471)	0.464 (0.293)	0.441 (0.294)	0.451 (0.396)	0.437 (0.397)
Tribal providers	-0.634 (0.890)	-0.552 (0.905)	-0.693 (0.543)	-0.631 (0.554)	0.038 (0.533)	0.059 (0.535)
School systems x pre-k	0.503 (0.716)	0.545 (0.714)	0.790** (0.313)	0.803** (0.304)	-0.290 (0.572)	-0.258 (0.572)
Government agencies x pre-k	-0.904 (0.644)	-0.821 (0.641)	-0.380 (0.390)	-0.328 (0.392)	-0.440 (0.442)	-0.405 (0.442)
Tribal providers x pre-k	2.621** (1.095)	2.502** (1.121)	0.795 (0.578)	0.708 (0.593)	1.813** (0.740)	1.780** (0.751)
Observations	51,008	51,008	51,008	51,008	51,008	51,008
R-squared	0.136	0.140	0.150	0.153	0.133	0.136
State & year FE	Y	Y	Y	Y	Y	Y
State covariates	N	Y	N	Y	N	Y

Note. Head Start programs located in community-based organizations are the reference group. Clustered standard errors in parentheses.

*** $p < .001$, ** $p < .01$, * $p < .05$

Table 4 presents the results by timing of identification. We found that there was a 0.63 pp decrease in the HS enrollment of post-identified children ($p < .01$), which accounted for over half of the main effect found on the total enrollment of children with disabilities. The HS enrollment of pre-identified children accounted for the other half of the main effect, though this effect was not significantly different from zero.

Table 5 presents the differential effects of state pre-k on HS programs in different locations (i.e., CBOs, school systems, government agencies, and tribes), with HS located in CBOs as the reference group. Each column represents a state and year fixed effects model including interaction terms between HS program location and pre-k adoption status. Columns 1 and 2 suggest that the effects of state pre-k on the overall enrollment of children with disabilities did not significantly differ across programs located in CBOs, schools, and government agencies. There was, however, a statistically significant 2.5 pp increase in tribal providers' enrollment of children with disabilities. To further understand this pattern, we explored whether state pre-k differentially affected the HS enrollment of pre- and post-identified children in different HS locations (Columns 3 to 6). Interestingly, when we controlled for program location, the effects of state pre-k were equally distributed to the HS enrollment of pre- and post-identified children. This suggests that the timing of identification was correlated with HS location. When we compared the effects of state pre-k within the same type of HS location, state pre-k affected the HS enrollment of both post- and pre-identified children for HS programs located in CBOs. We further found that, compared with HS programs in CBOs, programs in school systems experienced a 0.8 pp increase in their enrollment of pre-identified children ($p < .01$). Descriptively, 69% of the HS programs in our sample were CBOs and 20% were school systems. Therefore, the significant effects we found on HS programs in schools are unlikely to be an artifact of concentration of HS programs in schools. As for the enrollment of post-identified children, we found that programs in CBOs, schools, and government agencies were non-

differentially affected by state pre-k, however, tribal providers saw a 1.8 pp increase in this type of enrollment ($p < .01$).

Discussion

Using almost 30 years of national HS program data, this study offered the first quasi-experimental evidence on the influences of the sweeping state pre-k expansion on the HS enrollment of low-income children with disabilities. We tested the possibility that HS taps into its relative strengths of serving children with disabilities (i.e., expertise in serving this group of children and a comprehensive, all-inclusive service model) and has been serving more children with disabilities. We further revealed the differential effects of state pre-k on the HS enrollment by disability types, timing of identification, and HS program locations. Our study highlighted the changing contexts in which low-income children with disabilities receive critical ECE services and this has important implications for future research and practices to serve children with disabilities effectively and efficiently.

We found that, overall, HS did not experience an increase in its enrollment of children with disabilities when states introduced their pre-k programs.

Instead, the introduction of state pre-k led to a slight decrease in the HS enrollment of children with disabilities (1 pp, 7%). This finding added to the literature on the effects of state pre-k on HS enrollment by age, teacher education, and access to facilities and resources (Ackerman, 2004; Bassok, 2012), and further showed the multifaceted influences state pre-k has on HS. Although we observed a statistically significant decrease in HS overall enrollment of children with disabilities, this effect is practically modest—the average number of children affected by the 1 percentage point decrease is about 7,000 per year in all states.

We found evidence for our hypothesis that state pre-k differentially draws children with mild to moderate disabilities from the pool of eligible children potentially through “cream-skimming,” although we cannot directly test this in the study. Specifically, the introduction of state pre-k was associated with a 1.2 pp decrease in the HS enrollment of children with speech impairment, which accounted for almost all the effects of state pre-k on the HS enrollment of children with disabilities. In fact, the main effects disappeared when we removed children with speech impairment from the analysis. This is not surprising considering children with speech impairment represent the largest disability group served in HS and also the most common designation in this age group nationally (Markowitz et al., 2006). Compared with services for other types of disabilities, speech-language services are among the most widely available services in the market (American Speech-Language-Hearing Association, 2019). This may explain why the HS enrollment of children with speech impairment was affected most when state pre-k opened up additional child care options.

Although we did not observe an increase in the HS enrollment of children with disabilities overall, we found that HS programs located in school systems experienced an increase in their enrollment of pre-identified children.

Prior studies have identified school-based HS programs as being of higher-quality than HS programs in other locations (Gilliam, 2008; Soukakou et al., 2014; Tsao et al., 2008) and that parents of children with disabilities value the availability of specialized services (Chaudry et al. 2011). Our results echoed these findings by showing that HS programs in school systems have enrolled more pre-identified children, possibly because of their easier access to the disability resources, such as skilled staff with specialized training and transition services; indeed, 51% of the licensed speech-language pathologists are based in

schools (American Speech-Language-Hearing Association, 2019). Additionally, studies examining the effects of state pre-k on the ECE landscape have found that public awareness and respect for school-based ECE have been increasing as state and local pre-k programs establish a linkage between ECE and the K-12 system (Schulman & Blank, 2007; Wilinski, 2017). It may also be the case that many school-based pre-k programs only offer half-day programs (Friedman-Krauss et al., 2018). HS programs located in schools could therefore take over the other half day as children conveniently transitioned from pre-k to HS classrooms.

An unexpected finding was the increase in enrollment among tribal providers. However, research on tribal HS is extremely rare, and no studies have examined the experiences of children with disabilities in these HS programs. The lack of information on tribal HS does not allow us to make meaningful interpretations of this finding, and more research is needed.

Implications for Future Research and Practice

By revealing the changing ECE landscape for children with disabilities with the expansive adoption of state pre-k, our study highlights the importance of understanding four questions in future research and practice. First, although examining child outcomes is beyond the scope of this study, an important next step is to understand how the changes in the HS environment affect the learning outcomes of children with disabilities and, more broadly, whether the changing ECE landscape leads to improvements in child outcomes through joint effort by HS and pre-k. It is clear that HS and pre-k adopt distinctive models with different priorities. It is also clear that pre-k has led to structural changes in HS, including, but not limited to, changes in student body and teacher education. These changes could have profound effects on child outcomes by directly shaping the instructional and peer environment and indirectly influencing parents' selection into different programs.

Second, it is important to understand how children with disabilities are served in

inclusive HS and state pre-k classrooms, and how the changing structural and process factors contribute to the development of these children. State pre-k is likely to have downstream effects on various HS program inputs such as teacher qualifications, class size, and level of inclusion, which are considered the “active ingredients” of effective ECE programs (Hill et al., 2003; Libetti & Mead, 2019). To adapt to the influences of state pre-k, HS may face tradeoffs and adjust program inputs. For example, Bassok (2010) found that HS may be hiring more BA-level teachers to match the pre-k teacher qualifications while reducing the hiring of AA-level teachers. A clear understanding of how HS classroom processes have changed and how those changes affect the quality of services for children with disabilities will provide meaningful insights into HS operations. Although state pre-k may have been serving a growing number of children with disabilities, there is a lack of systematic, comprehensive understanding of how children with disabilities are served in diversely designed state pre-k programs. For example, to what extent are teachers and staff trained to work with children with disabilities? Are the classroom interactions designed to accommodate the learning needs of these children in most states? As the state pre-k spending per child varies widely from \$777 to \$17,545 (Friedman-Kraus et al., 2018), are these programs sufficiently funded to serve children with disabilities?

Relatedly, there is an urgent need to understand how effective state pre-k programs are in serving children with disabilities. Only two studies thus far have used quasi-experimental designs to examine the effectiveness of pre-k programs on children with disabilities (i.e., Phillips & Meloy, 2012; Weiland, 2016). The large, positive effects of pre-k on children with disabilities found in these two studies are cause for optimism. However, more research on pre-k programs implemented in different states is needed to test whether the positive gains are generalizable to the broader population of children with disabilities across the country.

Last, but not least, given the myriad ECE services available to children with disabilities,

it is paramount to understand how to coordinate the available ECE resources scattered across different programs to meet the complex needs of children with disabilities and their families. Some local pre-k administrators have been exploring collaborative models between pre-k and HS. For example, some school districts in Kansas have established the Kansas Early Learning Communities, an initiative that integrates HS, state pre-k, and special education preschool. The relative strengths of each program are integrated into mixed classrooms to ensure that the classrooms meet the highest standard in each area (Dropkin, 2013). Another encouraging example is the Community Action Project of Tulsa County in Oklahoma, which builds strong, formal collaborations between the local pre-k and HS to provide education and therapies to children with disabilities, as well as collective efforts to support food services, facility needs, and cost-sharing (Office of Head Start, 2018).

Limitations

One limitation of the study is that we cannot directly test whether the children left HS for pre-k because child-level data are not available in PIR, nor can we directly test whether there was a concurrent rising trend in the pre-k enrollment of children with disabilities because no reliable pre-k data are available. We also acknowledge the limitations of using DID to draw strong causal inference. Because we cannot completely rule out the possibility of the existence of unobserved time-varying state characteristics and other confounders, our results should not be interpreted as causal. For example, the decrease in HS's enrollment of post-identified children might be due to the improved supports and services offered to students in HS, which has prevented a later disability diagnosis or IEP.

Because HS is operated as a national program, we group state pre-k programs into one treatment variable to obtain a national and rigorous understanding of pre-k programs' influences on HS services to children with disabilities. We note that state pre-k programs differ substantially in four dimensions: (1)

scope (half- or full-day; 3- and 4-year-olds or just 4-year-olds); (2) scale (targeted or universal programs); (3) eligibility (e.g., income thresholds); (4) locations (e.g., statewide or high needs communities; McCoy et al., 2016). Therefore, although we observed a slight decrease in the average HS enrollment of children with disabilities at the state level, differences in specific state and city pre-k programs may create local variations in their effects on HS. Local studies documenting how different dimensions of pre-k models affect HS could help reveal the more nuanced dynamics between pre-k and HS. Local HS and pre-k programs should work with special education services and adapt their policies whenever needed to meet the local needs in their communities.

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