

Access to Early Care and Education in Rural Communities: Implications for Children's School Readiness



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This study links county-level early care and education (ECE) program, economic, and demographic data to child-level data from the Early Childhood Longitudinal Study-Kindergarten Cohort of 2010–2011 to examine geographic variation in ECE program participation and provision. We find that public ECE programs, particularly Head Start, occupy a larger role in nonmetropolitan communities than in metropolitan areas. By contrast, children in rural counties are less likely to attend private center-based ECE, and nonprofit child-care program expenditures in rural areas lag. We also find rural-metropolitan differences in school readiness diminish when geographic characteristics are controlled. Results suggest that county-level context and state-level policy features shape children's early experiences, and that public ECE investments are key in narrowing disparities in ECE attendance and in children's outcomes.

Keywords: early care and education, early childhood education, school readiness, nonprofit, Head Start, rural, county, poverty

Attending high-quality early care and education (ECE), including at preschool and childcare centers, before kindergarten is widely shown to improve economic outcomes and well-being throughout the life course (Heckman, Humphries, and Veramendi 2018; Chaudry et al. 2021; Cannon et al. 2018). In turn, federal, state,

and local government spending on childcare, preschool, and other ECE programs—many designed to serve children in low-income families—has increased in the last several decades (Diffey, Parker, and Atchison 2017; Robert Wood Johnson Foundation 2018; DOE 2020). Funding for public subsidies that help families purchase

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home- and center-based childcare services has expanded over the last thirty years (Forry, Dameri, and Howarth 2013), and Early Head Start (EHS) and Head Start (HS) together provide ECE services to nearly one million low-income children from birth to age five (OHS 2019a).¹ Public ECE programs, however, continue to enroll just a fraction of children in low-income households. Fewer than 40 percent of four-year-old children in poverty participate in HS (OHS 2019a), and fewer than one of every six income-eligible children receive public childcare subsidies (Chien 2021). Increased private family spending on ECE services for young children mirrors increases in public expenditures (Kornrich and Furstenberg 2013), but many private ECE programs are too expensive for low-income families (Chaudry et al. 2021).

Although researchers and policymakers often focus on federal or state ECE program finance, local nonprofits and private businesses play a central role in the delivery of publicly funded or subsidized ECE programs. Delivery of ECE programs depends heavily on the capacity and funding of local private nonprofit organizations and for-profit firms, making the ECE playing field organizationally complex and fragmented. The inherent localness of ECE access suggests that greater attention should be paid to whether ECE program provision varies across local geographic areas. Indeed, evidence indicates state-level geographic variability around the availability of childcare subsidies, HS, publicly funded preschool, and ECE program quality metrics (Bassok and Galdo 2016; Chien 2021; Friedman-Krauss et al. 2020; Gordon and Chase-Lansdale 2001; Malik et al. 2018; Malik and Schochet 2018; NSECE Research Team 2016; OHS 2019b). However, researchers are only beginning to understand how ECE provision varies locally and how that spatial variation might shape participation in ECE programs and children's subsequent outcomes (McCoy et al. 2016; Mor-

rissey and Vinopal 2018; Paschall, Halle, and Maxwell 2020).

Nonmetropolitan areas, which we often refer to as rural areas, have been found to average lower participation rates in ECE programs than metropolitan areas (Swenson 2008; Temple 2009; Anderson and Mikesell 2019). This strongly suggests that research examining the impact of rural contexts on child well-being should be particularly concerned with local spatial differences in ECE program provision. Differences in ECE participation between metropolitan areas containing urban centers and nonmetropolitan communities are consistent with other research finding that children in low-income families growing up in rural places may lack access to programs and resources critical to healthy development and mobility. For example, rural areas have been found to lag metropolitan areas in the provision of key human service and safety net programs targeted at low-income households (Allard 2019). Numerous papers in this volume speak to rural-urban disparities across a wide array of other services and resources intended to support children, as well as how rural context shapes elementary, middle, and high school educational outcomes (see Bernsen et al. 2022, this issue; Bowen, Elliott, and Hardison-Moody 2022, this issue; Nicolai, Damaske, and Park 2022; Parker, Tach, and Robertson 2022). Thus we should expect geographic differences in ECE program resources to contribute to urban-rural disparities in ECE participation and school readiness (Drescher et al. 2022, this issue; Magnuson and Duncan 2017; Miller, Votruba-Drzal, and Setodji 2013; Votruba-Drzal, Miller, and Coley 2016; Miller, Votruba-Drzal, and Coley 2019). Local variation in ECE programming also may be relevant for understanding rural-urban variation in income mobility over the life course. Not only do ECE programs provide nonparental care that allows parents to work in the immediate term, but these programs also offer devel-

1. The Child Care and Development Block Grant (CCDBG) provides childcare subsidies for low-income working families and was funded at \$9.4 billion in 2017 (Chien 2020). The same year, Head Start/Early Head Start, which enrolls children under five in poverty, was funded at \$9.3 billion (HHS 2017). State-sponsored preschool programs vary widely in availability; in 2019, 78 percent of four-year-olds attended public preschool in Vermont, yet six states lacked public preschool altogether (Friedman-Krauss et al. 2020).

opmental support for children's long-term educational and economic success (Paschall, Halle, and Maxwell 2020; Chaudry et al. 2021). Inquiry into rural-urban differences in ECE program provision is even more urgent because of the COVID-19 pandemic, which decimated the ECE sector and likely exacerbated geographic, socioeconomic, and racial disparities in ECE access (Jessen-Howard and Workman 2020; NAEYC 2020).

This study adds to the ECE research literature by linking unique county-level ECE program data to nationally representative, child-level survey data to examine the association between the local context of ECE availability and two child-level outcomes: ECE participation and kindergarten readiness. These data allow us to assess county-level variation in the delivery of Head Start programs, annual expenditures reported by nonprofit childcare organizations, and children's attendance at public or private center-based ECE. We then move beyond identifying spatial differences in ECE infrastructure to analyzing whether geographic variation in ECE programming is associated with measures of children's math and reading skills at kindergarten entry. As a result, this study is able to make more geographic comparisons across more ECE program features and outcomes than is common in the research literature to date.

Our findings suggest that public ECE programs, particularly Head Start, play a larger role in rural communities than in metropolitan areas, whereas private nonprofit childcare program expenditures appear more highly concentrated in metropolitan areas. We also find descriptive evidence of geographic disparities in the types of ECE programs children attend, consistent with broader county-level patterns of program availability. Further, we find that rural-urban differences in school readiness measures, as measured by math and reading scores at kindergarten entry, greatly diminish when children's background and geographic characteristics are controlled, including county-level ECE supply. Combined, these results have implications for future research into the role that ECE programs play in communities and for policymakers seeking to under-

stand where to make ECE investments moving forward.

PLACING ECE PROGRAMMING IN A SPATIAL CONTEXT

Children learn and grow through interactions with their caregivers and environments (Bronfenbrenner and Morris 2006). Although the family is typically the primary developmental context for young children (Shonkoff and Phillips 2000), it has become common for children to participate in some type of ECE prior to kindergarten (Chaudry et al. 2021). ECE programs provide educational, cultural, and recreational opportunities for children, and childcare, whether in center-based or home-based settings, enables parental employment (Morrissey 2017). This public provision, however, falls short of families' needs, which means that households pay a majority of early education expenses before kindergarten (Gould and Blair 2020). Families spend an average of 10 percent of their incomes on childcare, and low-income families—those with income below 200 percent of the federal poverty line (FPL)—spend an average of 35 percent of their incomes on childcare (Malik 2019).

The high costs of center-based ECE program enrollment contribute to substantial income-based variation in program participation; children from low-income families are less likely to participate in center-based ECE relative to children from higher-income households. For example, nearly three-quarters of children age three to five regularly attended nonparental childcare in 2016, but the type of arrangement varied considerably. Thirty-eight percent were cared for by relatives or nonrelatives at the child's or caregiver's home, whereas 61 percent of children regularly attended center-based arrangements (NCES 2019). When children from low-income households do attend ECE, they are more likely to attend less expensive and lower-quality programs than children from more affluent households (Burgess et al. 2014; Magnuson and Waldfogel 2016; Chaudry et al. 2021). Lower-quality ECE offers fewer opportunities to develop the cognitive and social-emotional skills important for kindergarten readiness (Soliday Hong et al. 2019), which are

in turn predictive of later educational success (Duncan et al. 2007; Romano et al. 2010).²

Publicly funded ECE programs, including HS, EHS, and state-sponsored pre-K for which families pay little or nothing out-of-pocket, are important for narrowing income- and race-based gaps in ECE participation (Chaudry et al. 2021; Magnuson and Waldfogel 2016). Head Start and public pre-K provide part- or full-day ECE programming at centers or schools to three- and four-year-old children. Head Start serves children in poverty and provides ECE and comprehensive services, such as developmental and health screenings and mental health resources (Chaudry et al. 2021). State-sponsored prekindergarten programs often serve children across a broader income range, and a handful of states provide universal programs (Friedman-Krauss et al. 2020).

Evidence that attending high-quality private or public ECE benefits children's short- and long-term educational, health, and economic outcomes (Duncan and Magnuson 2013; Morris et al. 2018; Phillips et al. 2017; Yoshikawa et al. 2013) has led many experts to argue for greater and more consistent public funding for ECE programming in order to reduce disparities in school readiness, narrow inequality, and improve downstream mobility (Magnuson and Duncan 2017; Chaudry et al. 2021; Duncan and Sojourner 2013). To date, however, much of the policy research discussion around ECE programs focuses on federal or state spending and trends in aggregate enrollment or participation. That providing both private and public ECE programming is a highly localized activity often goes overlooked as a result. Yet early childhood programs and services are delivered through complex and fragmented local systems, including local schools, businesses, and nonprofit organizations. Community-based nonprofit organizations, such as religious organizations, community action programs, and broader youth-serving organizations (Boys & Girls Clubs, YMCA), play a particularly impor-

tant role in delivering ECE programs. A fragmented and complex funding environment also contributes to local variation in ECE provision. Most providers of ECE programming—public, nonprofit, or for-profit—draw operating revenue from multiple sources. Federal, state, and local government expenditures support ECE providers through direct program funding, revenue from subsidies, and other resources for social services targeted at children. Local service providers commonly bundle this public funding with fees paid by families, grants from local philanthropy, and private charitable donations (Allard 2017; Sandfort 2010). Finally, policy variation also drives local differences in ECE programs; provision of ECE is governed by a myriad of state and local regulations that dictate licensing, location, and administrative requirements.

To the extent that the funding and capacity of organizations operating ECE programs vary across local places, program provision itself should be expected to vary by local geography. Lower-income communities are more likely than others to face particularly high hurdles in providing an adequate supply of ECE programs. Many low-income families cannot afford to pay market-rate fees for ECE, and low-income communities may not have substantial public or philanthropic revenue streams, creating lower supply in poor places (Council of Economic Advisors 2014; Malik et al. 2018; Davis, Lee, and Sojourner 2019; Chaudry et al. 2021). Additionally, consistent with evidence that greater spatial access to social service programs is associated with higher rates of participation among low-income households (Allard, Tolman, and Rosen 2003; Herbst and Tekin 2016), we should expect that a greater local supply of ECE programs and resources will correspond to higher rates of participation. Conversely, lower levels of access to ECE programming should be expected to predict lower participation rates.

Although we should be concerned about the

2. Evidence suggests that the quality of programming matters more for children's outcomes than the funding source (public or private) or type of ECE setting, either center-based, including preschools, nursery schools, and for-profit and nonprofit childcare centers, or home-based care, such as family childcare or informal care by relatives, neighbors, babysitters, or others in the child's or caregiver's home.

presence of spatial disparities in ECE program access or capacity in all places, there is reason to pay particular attention to ECE access and participation in nonmetropolitan or rural communities. Persistent problems of rural poverty and high rates of hardship within rural communities create significant need for accessible social service and social assistance programs (Gundersen et al. 2017; Weber 2018; Ziliak 2019b). Yet social service program capacity in rural areas lags well behind that present in metropolitan areas and urban centers (Allard 2019). For example, Rasheed Malik and his colleagues (2018) estimate that, in 2017, three in five rural communities had fewer than one licensed ECE slot for every three children under age five. High-income suburban communities at the edges of metropolitan areas, on the other hand, were least likely to experience such ECE shortages. Similarly, rural communities in Minnesota are shown to have lower levels of access to licensed childcare programs, on average, than urban communities in that state (Davis, Lee, and Sojourner 2019). Rural gaps in ECE program access may reflect the challenges of operating programs in communities with small or sparse populations.

Other social and economic realities of rural America likely affect both supply of and demand for ECE programs. First, although gender roles within rural households are changing, evidence indicates that traditional gender roles around parenting remain present in rural communities, where women are less likely to work in jobs outside the home (MacTavish and Salamon 2003; Sherman 2009; Kristin 2017). Rural places average lower incomes (Thiede, Lichter, and Slack 2018; Ziliak 2018), likely reducing demand for ECE and the ability to pay for expensive programming. Moreover, the prevalence of nonstandard work and retail or service-sector jobs in rural areas often means that workers do not have access to on-site childcare, flexible scheduling, or family leave benefits, increasing pressure to find childcare options inside the home or family (Glauber and Young 2015;

McLaughlin and Coleman-Jensen 2008; Odle-Dusseau, McFadden, and Britt 2015). We also might expect families in rural communities with less population and nonprofit density than urban centers to have weaker information or referral networks about program opportunities, realities that can powerfully shape program participation (Allard 2009, 2017). Furthermore, rural areas are likely to present families with transportation challenges, long commuting distances, and high commuting costs (MacTavish and Salamon 2003; Ziliak 2019b). Many of these features of rural communities imply barriers to private ECE provision and participation; indeed, research suggests that public HS programs play a vital role in rural and low-income communities as well as for communities of color (Malik and Schochet 2018; Kim and Wang 2019).³

Despite growing research, not enough attention has been given to rural ECE program access and capacity. Most research examines only a narrow range of ECE programs within a specific state or region because of the limited data resources available that place program resources in space. Moreover, few studies explore the association between local ECE program provision and children's outcomes in early elementary school. Many pressing questions therefore remain about how ECE program resources are spatially distributed across rural versus urban communities. First, does the availability of public and nonprofit ECE program resources vary? Do public and nonprofit ECE resources vary? How does ECE participation vary? Is spatial variation in public and nonprofit ECE investments associated with child-level ECE participation or kindergarten readiness? Finally, do associations among local ECE resources, ECE participation, and children's kindergarten readiness vary across geography?

This study seeks to answer these questions to enhance our understanding of how ECE program provision and participation vary across nonmetropolitan and metropolitan America.

3. Gaps in achievement by family income for both elementary school and middle-school children tend to be larger in urban than in rural areas, which may reflect inequality in access to high-quality ECE in urban areas and the general limited presence of ECE in rural communities (Drescher et al. 2022, this issue; Chaudry et al. 2021; McCoy et al. 2016; Votruba-Drzal, Miller, and Coley 2016; Phillips et al. 2017).

We examine geographic variation in ECE program provision and provide insights into how spatial variation might matter to ECE program participation and school readiness. Our descriptive findings contribute to more accurate portrayals of the rural early childhood program landscape, which should inform scholarly work around nonmetropolitan safety nets and help guide future ECE programmatic investments in rural communities. Although our findings are relevant to public and private philanthropic investments in ECE programs moving forward, we also expect that the health, fiscal, and economic consequences of COVID-19 have exacerbated geographic disparities in ECE provision and participation. An additional contribution of this study, therefore, is to feature promising secondary and administrative data that might yield greater future insights into how ECE program provision varies by rural and urban geography.

DATA AND METHODS

This study links unique county-level ECE program data from 2009 to the 2007–2011 American Community Survey (ACS) and child-level data from the Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K:2011).⁴ The ECLS-K:2011 is the most recent longitudinal dataset containing a representative sample of children attending kindergarten across the United States that includes information on children's ECE participation, direct assessments of

school readiness, and geographic markers of children's residence. Combined, these data allow us to assess spatial variation in the provision of ECE programming and to link spatial measures of ECE program provision to child-level outcomes in ECLS-K:2011 data for the year prior to kindergarten attendance (the child's prekindergarten year, 2009).

To ensure adequate ECLS-K:2011 sample sizes for geographic comparisons of ECE access and participation, we sort U.S. counties into a four-category metropolitan-nonmetropolitan typology. This typology is based on Office of Management and Budget definitions of metropolitan areas and county-level urban-rural continuum codes created by the U.S. Department of Agriculture (USDA) Economic Research Service.⁵ Counties within metropolitan area boundaries are categorized as metropolitan (or urban) counties, and counties outside metropolitan area boundaries are categorized as nonmetropolitan (or rural) counties. We make further distinction between large urban counties (populations over 250,000) and small ones (populations under 250,000). Similarly, we sort nonmetropolitan counties into large nonmetro or rural counties (population centers over twenty thousand) and small nonmetro or rural counties (population center less than twenty thousand).⁶

For *ECE program data*, we draw on several county-level data sources on participation and availability for our descriptive and multivariate

4. In accordance with IES requirements, all sample sizes for the ECLS-K:2011 are rounded to the nearest ten.
5. Although categorizing counties as metropolitan or nonmetropolitan produces a simple classification scheme, it is important to note these categorical or symbolic distinctions between urban and rural places smooth over the lived and social meanings of urban and rural places. Moreover, our categories smooth over the shifting and blurring of urban or rural boundaries at the edges of metropolitan areas (Lichter and Brown 2011; Lichter and Ziliak 2017). Metropolitan county categories also smooth over important suburban and central city differences when thinking about poverty, inequality, and safety net or human service provision (see Allard 2017).
6. For more information on our data and methods, see the online technical appendix. Technical appendix table 1 provides more detail about the metropolitan and nonmetropolitan codes used here (see also USDA 2020). USDA urban-rural continuum codes used in these analyses were released in 2013 and are based on data from the 2010 Census. The original USDA urban-rural continuum codes delineate three categories of metro counties and six categories of nonmetro counties, organized based on population size and proximity to a metro area. Our categories are as follows: large metro counties (with population 250,000 or greater), encompassing USDA codes 1 and 2; small metro counties (with population less than 250,000), encompassing USDA code 3; large nonmetro (rural) counties (with urban population of thousand or more), encompassing USDA codes 4 and 5; and small nonmetro (rural) counties (with urban population of less than twenty thousand), encompassing USDA codes 6, 7, 8, and 9.

analyses. First, county-level data from the 2007 to 2011 Five-Year Estimates of the ACS indicate the population of children in poverty by age, the percent of three- and four-year-olds enrolled in school, and the percentage of those enrolled who attend private school. Second, we report county-level nonprofit program expenditures per poor child under five years (in 2009 dollars) for nonprofit organizations that self-report as child day care or preschool service providers in the National Center for Charitable Statistics (NCCS) (2021) Core File for tax year 2009.⁷ Third, we use two HS data sources to estimate the number of HS program slots in each county. We use the 2009 grantee-level HS Program Information Reports (PIR), published by the Office of Head Start (OHS), to determine the number of program slots provided by each HS grantee in 2009. PIR data alone, however, fail to capture the true geographic distribution of HS slots because data are linked to the location of the grantee's administrative headquarters and grantees often offer HS services and operate HS centers at other locations, including in counties other than where the administrative headquarters is located. To address this issue, we link OHS center-level data from 2013 (the earliest year available) to grantee-level data using the grant number, program number, and program type. These linked data allow us to determine where grantees in the PIR data were offering HS services in 2013 and calculate the share of each grantee's slots operated in a given county. We then use the county distribution of HS program slots in 2013 to calculate a county-level distribution of HS slots from the 2009 PIR

data.⁸ If we are not able to match any of a county's grantees to HS centers, we assume that that county's grantees operated all their centers in the same county where the administrative headquarters is located. If no HS centers or PIR grantees were located in a county, we assume that the country had no HS program slots. To create a measure of programming relative to potential demand, using data on poverty from the 2007–2011 ACS, we calculate the number of HS program slots per one hundred poor children age three to four years per county. Finally, our data set also includes two state-level ECE policy measures (for 2009): enrollment in state-sponsored preschool for four-year-olds (Barnett et al. 2010) and the maximum childcare subsidy reimbursement rate for center care for a four-year-old from the Child Care and Development Fund Database (Urban Institute 2019).

The *Early Childhood Longitudinal Study-Kindergarten Cohort of 2010–2011* (ECLS-K: 2011) is a nationally representative dataset of approximately eighteen thousand children who attended kindergarten in the United States in the 2010–2011 academic year, collected by the National Center for Education Statistics (NCES) (IES 2019). We examine two measures of ECE attendance: whether the child attended HS or non-HS center care (inclusive of for-profit and nonprofit centers and other public programs such as state preschool), both parent-reported for the year prior to kindergarten. In addition, we use separate math and reading test scores that reflect school readiness in the fall of kindergarten.⁹ The ECLS-K:2011 also includes detailed information about the child and house-

7. For details on these NCCS data, see the technical appendix. Note that ACS data contain information on three- and four-year-olds' preschool attendance, and Head Start enrolls three- and four-year-olds, but nonprofit childcare programs serve children across the early childhood age spectrum.

8. This imputation procedure assumes that the grantees in a given county operated centers in a similar geographic pattern as 2013. Descriptive analyses comparing county-level enrollment based on administrative headquarters locations in the PIR data alone indicate that there was relatively little change in HS provision between 2009 and 2013. For more on the imputation procedure, see the technical appendix.

9. For more information on the child assessments, see IES/USDA, "Early Childhood Longitudinal Studies (ECLS) Program: Direct Cognitive Assessments," <http://nces.ed.gov/ecls/assessments2011.asp> (accessed November 12, 2021). Internal consistency scores for each dependent variable are available in the codebook (Tourangeau et al. 2017). At kindergarten, the reading portion of the assessment measured children's language and oral skills; phonological awareness; print familiarity; letter and letter-sound knowledge; print conventions; word recognition; and vocabulary. The mathematics assessment included questions regarding number sense; geometry; data

hold at the fall of kindergarten, including child sex; race-ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or other race); child age in months; whether the child's primary language was not English; whether the child had a disability; household size (adults and children); parent education (less than high school, high school degree or some college, or college degree or higher); parent employment (all parents in household employed, not employed); parent marital status (married or not married); household poverty status (below 100 percent of the FPL, between 100 and 200 percent of the FPL, above 200 percent of the FPL); number of books in the home (logged); and whether the household reported participating in the Supplemental Nutrition Assistance Program since the child was born. We include these as controls given their relevance for ECE participation, school readiness, and eligibility for public ECE programs, particularly HS. We also control for the non-Hispanic white percentage of the county population using data from the 2007 to 2011 ACS. We limit our sample to children with nonmissing data on sex, census tract, and dependent variables (sample sizes vary with dependent variable).¹⁰

In our analyses, we first descriptively examine our county-level and ECLS-K:2011 data. One set of analyses focuses on nonmetropolitan and metropolitan county differences in preschool enrollment, HS capacity, and nonprofit childcare expenditures. A second set examines differences in county preschool enrollment, HS capacity, and nonprofit childcare expenditures across demographic characteristics and the nonmetropolitan or metropolitan residential location of children in the ECLS-K:2011. We then estimate a series of multivariate models examining the associations between ECE access, county characteristics, child and family characteristics, and child outcomes (including

ECE participation and school readiness) in the ECLS-K:2011:

$$Y_{ij(t-1)} = Geog_{ij(t-1)} + X_{ij(t-1)} + ECE_{j(t-1)} + Demog'_{ij(t-1)} + Policy_{j(t-1)} \quad (1)$$

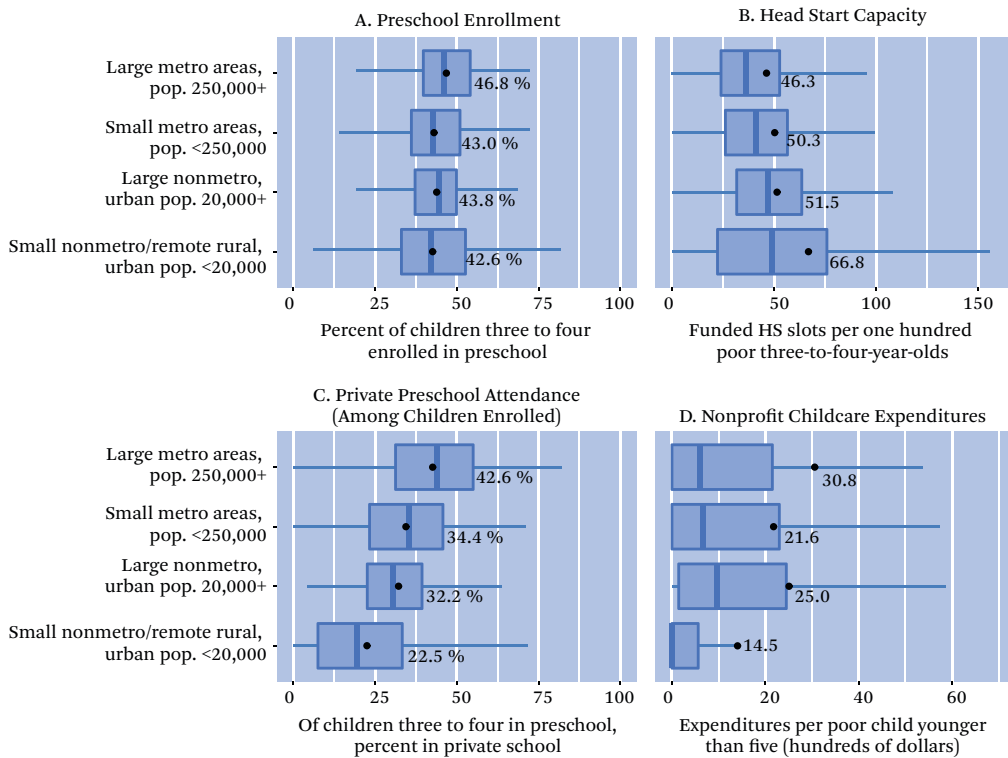
where Y represents ECE participation in the year prior to kindergarten ($t - 1$), for child i in county j at kindergarten (K) entry (t) or 2010; $Geog$ reflects the metropolitan or nonmetropolitan county code for the child's residence at K entry; X is a vector of child and household characteristics, as reported at K entry; ECE contains county-level measures of ECE resources in the year before kindergarten for county j (nonprofit childcare expenditures and HS capacity); $Demog$ represents the non-Hispanic white percentage of a child's county; and $Policy$ represents state-level policy variables. Standard errors are clustered at the state level. In models examining the factors associated with children's school readiness, we replace Y with math or reading scores at time t and add covariates for child-level participation in HS or other center-based care during the prekindergarten year. To test whether associations between county ECE capacity, children's ECE participation, and children's school readiness varied by geography, we also tested individual models that added interaction terms to equation (1).

FINDINGS

To provide insight into how ECE program participation and capacity varies by geography, figure 1 examines ACS preschool program enrollment rates among children three to four years of age, HS slots per one hundred poor children age three to four years, rates of private school attendance among three-to-four-year-old children attending preschool, and nonprofit childcare expenditures per poor child under five years of age across different types of metropol-

analysis; probability; and spatial relations. Assessments were administered in English or Spanish, dependent on a screener for children who spoke a language other than English at home. One hundred items were included on the reading test and ninety-six on the math test. Reliabilities were high, 0.92 for math and 0.95 for reading (Tourangeau et al. 2017). Both math and reading scores were standardized using the grand mean, 0 signaling the mean and 1 indicating a standard deviation from the mean.

10. We use multiple imputation using Stata's MI procedure to create ten datasets with imputed variables for missing covariates. We do not impute dependent or main independent variables.

Figure 1. Early Childhood Program Provision by USDA Urban-Rural Continuum Code, 2009

Source: Authors' tabulation (U.S. Census Bureau 2020; Tourangeau et al. 2017; Economic Research Service 2020; NCCS 2009; OHS 2019a).

Note: Labeled dots represent means; box and whisker plots represent distribution. Outliers (points that were more than 1.5 x the interquartile range below the first quartile or above the third quartile) are not shown. Counties with missing nonprofit expenditure data coded as having no nonprofit human service programming (see Allard 2017). To reduce the effects of a few outlying counties, we excluded seven counties from descriptive analysis because they reported one thousand or more Head Start slots per one hundred poor children three to four years old. For more information, see online technical appendix and appendix table 1.

itan and nonmetropolitan counties.¹¹ Figure 1, panel A indicates that the average rate of preschool enrollment among three- and four-year-olds in the 2007–2011 ACS was between 42 and 47 percent across counties.¹² Urban counties in the largest metropolitan areas had participation rates roughly 4 percentage points higher

on average than smaller metro counties and nonmetro counties. A percentage-point difference of this magnitude is equivalent to nearly a 10 percent difference in preschool enrollment between the largest metro area counties and the smallest rural counties.

Figure 1, panel B examines the mean funded

11. Technical appendix tables 4 through 6 provide additional descriptive analysis of early childhood program participation and provision by nonmetropolitan and metropolitan geography, including descriptive findings using the modified seven-category USDA urban-rural continuum code and metro versus rural analyses broken out by region of the country.

12. These rates are generally similar to figures from other sources. A study using the Current Population Survey (CPS) found that in 2011, 59 percent of three- and four-year-olds in families above 200 percent of the FPL, and 42 percent of children in families under 200 percent of the FPL, participated in preschool (Burgess et al. 2014).

HS slots per hundred children ages three to four years in poverty in 2009. Per capita HS slots varied across metropolitan and nonmetropolitan counties to a much greater degree than overall preschool enrollment rates. The most pronounced differences are between the smallest nonmetro counties and all other types of counties. Average HS per capita provision was roughly 44 percent higher in small nonmetro counties than in metropolitan counties with population over 250,000. These large metro counties had about forty-six HS slots per hundred poor children three to four years of age on average, relative to sixty-seven slots in small nonmetro counties. Similar patterns exist when looking at median per capita HS slots, although the differences between geographies are less pronounced. The typical metropolitan county with a population over 250,000 had about thirty-six HS slots per hundred poor children three to four years of age, whereas the typical small nonmetro county had roughly fifty-two. Although preschool enrollment rates were higher in urban counties than in rural ones, these findings suggest that HS is a particularly important provider of ECE in rural communities. Further, among nonmetro counties, HS provision appears more prevalent in areas with smaller population centers: the average small nonmetro county averaged fourteen more HS slots than nonmetro counties with larger population centers. The importance of public preschool in rural regions is underscored by evidence that the share of three- and four-year-old children in preschool attending private schools was much lower in rural areas than in urban ones (see figure 1, panel C). On average, 43 percent of children in preschool in urban counties from the largest metropolitan counties attended private preschools, relative to less than 25 percent of their peers in the smallest rural counties.¹³

To further assess the importance of private nonprofit provision of ECE in urban versus rural counties, figure 1, panel D displays the

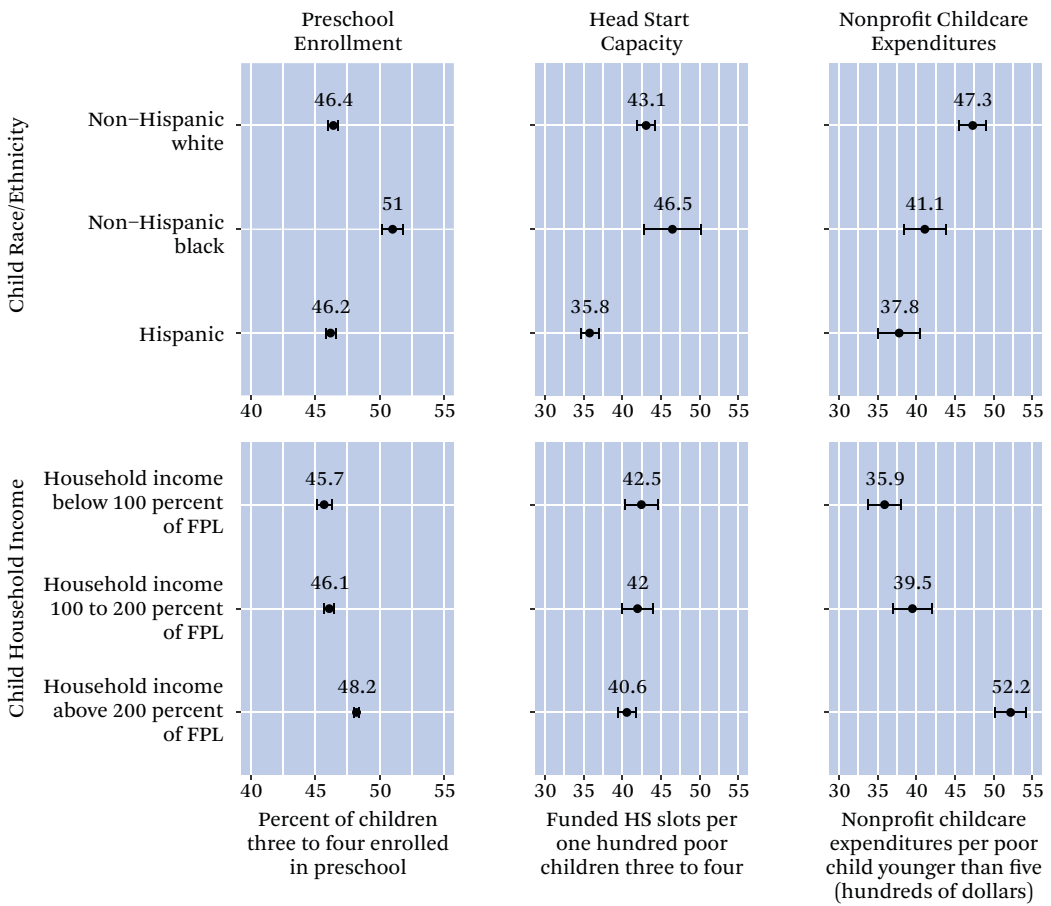
mean and distribution of expenditures per poor child under age five by nonprofit childcare organizations across nonmetropolitan and metropolitan geography in 2009. In contrast to HS, which shows greater capacity in nonmetropolitan versus metropolitan areas, we see the opposite pattern for nonprofit childcare expenditures; the largest metro areas had a substantial nonprofit resource advantage relative to smaller nonmetro communities. For example, the average urban county in a metropolitan area with more than 250,000 people reported roughly \$3,080 in nonprofit childcare organization expenditures per poor child under five years relative to \$1,450 in the average small rural county. Mean differences in nonprofit childcare expenditures are distorted somewhat by the fact that some metro and large nonmetropolitan counties have much more expansive nonprofit childcare sectors than others. As a result, median nonprofit childcare expenditures per poor child under five indicate that the typical large metropolitan county spending is quite comparable to that in small metro and large nonmetro counties (\$960, \$950, and \$1,080, respectively). Nevertheless, the resource disadvantage in less populated rural communities is underscored by the fact that the typical, or median, small nonmetro county reported no expenditures for nonprofit childcare organizations in 2009 (see technical appendix table 2 online).¹⁴

Figure 2 presents the average values of the same ECE program provision measures by race, ethnicity, and household income across our sample of children from the ECLS-K:2011 (see also technical appendix table 3). Children in our sample, regardless of race, ethnicity, or household income relative to the FPL, lived in counties where the average preschool enrollment rate was near fifty percent. Mean county preschool enrollments were higher for non-Hispanic black children versus Hispanic children in our sample (51.0 percent versus 46.2 percent). On average, Hispanic children in the

13. Technical appendix table 6 provides ECE program provision descriptive information by region, and appendix table 7 provides ECE program information for the two states that had universal public preschool in 2009—Georgia and Oklahoma—and their neighboring states. Technical appendix tables 10 and 11 display ECE program provision by non-Hispanic black and Hispanic shares of the county population, respectively.

14. See technical appendix online.

Figure 2. Early Childhood Program Provision in the ECLS-K:2011: Weighted Means and Standard Errors by Child Characteristics



Source: Authors' tabulation (U.S. Census Bureau 2020; Tourangeau et al. 2017; Economic Research Service 2020; NCCS 2009; OHS 2019a).

Note: Plots show means and 95 percent confidence intervals for county-level ECE provision measures, by characteristics of children in the ECLS-K:2011. Observations rounded to the nearest ten in accordance with NCCS requirements. All child-level variables assessed at the fall of kindergarten. Counties with missing nonprofit expenditure data coded as having no nonprofit human service programming (see Allard 2017). To reduce the effects of a few outlying counties, we excluded seven counties from descriptive analysis if they report one thousand or more Head Start slots per hundred poor children three to four years old. For more information, see online technical appendix table 2.

ECLS-K:2011 lived in counties that had thirty-six HS slots per poor hundred three- and four-year-olds, relative to forty-three slots and forty-seven slots for non-Hispanic white and black children, respectively. Mean nonprofit childcare expenditures per poor child under five did not significantly differ by the race or ethnicity of children in our sample, roughly \$4,000 in 2009.

As shown in the bottom panel of figure 2, children entering kindergarten with household incomes over 200 percent of the FPL lived in counties with higher preschool enrollment rates than their peers in low-income households, although the differences are relatively small (48.2 percent versus 45.7 percent). We find no significant differences in county-level HS slots per capita by household income rela-

tive to the poverty line. We do find, however, large differences in mean nonprofit childcare expenditures by household income. Children in households with incomes over 200 percent of the FPL lived in counties with average nonprofit childcare expenditures that were about 40 percent higher than their counterparts living near or in poverty (approximately \$5,220 versus \$3,590 respectively).

Table 1 displays weighted frequencies and means for our child-level dependent variables (ECE participation and school readiness), county-level ECE capacity, economic, and demographic characteristics, and state-level policy variables for children in our ECLS-K:2011 sample by the modified USDA urban-rural code.¹⁵ Children living in less populated non-metropolitan counties were nearly 30 percent less likely to have attended any center care in the year before kindergarten than those in large metro areas (35.8 percent versus 48.8 percent). At the same time, we find evidence that children in the ECLS-K:2011 from small nonmetro counties were more likely to have attended HS than those in large urban counties (24.3 percent to 14.6 percent). Further, HS attendance among children varied based on county population size: those in the least populated nonmetro counties were more likely to enroll in HS than those in more populous nonmetro counties (24.3 percent versus 18.5 percent, respectively). These descriptive findings highlight, again, the importance of HS in rural communities as well as the child poverty in these counties, given HS program eligibility. At kindergarten, children in nonmetro counties averaged lower math and reading test scores than those in metro counties.¹⁶ Children in large, nonmetro counties scored about one-twentieth of a standard deviation below the mean in math, whereas those in suburban counties scored about one-fifth of

a standard deviation above the overall mean. In reading, children in small nonmetro counties scored one-tenth of a standard deviation below the mean; those in large metro areas scored one-tenth above the mean.

The second panel of table 1 shows how county-level ECE program capacity indicators vary by geography for children in the ECLS-K:2011. Similar to the national county analyses, we find that children in our ECLS-K:2011 sample living in small nonmetro counties had access to more than twice the per capita HS capacity as children living in large metro counties (seventy-seven versus thirty-eight slots). Again, among ECLS-K sample children, mean county-level nonprofit childcare expenditures per poor child under five in 2009 were more than twice as high in metro areas than rural counties—averaging nearly \$5,000 in large metro areas, nearly \$6,000 in smaller metro counties, and less than \$2,000 in rural counties. The bottom panel of table 1 presents key state-level features. On average, children lived in states in which between 19 and 26 percent of four-year-olds were enrolled in state-sponsored pre-K programs, and maximum preschooler childcare subsidy rates averaged between \$600 to \$700, but neither of these state policy factors significantly differed by metropolitan or non-metropolitan county status.

Although we find important descriptive differences in ECE program provision and participation between urban and rural spaces, it is not clear whether these differences reflect the effects of geography or are a function of other factors. To explore this further, we estimate a series of descriptive regression models that assess the cross-sectional predictors of two sets of child outcomes: ECE program participation in the year prior to kindergarten and two measures of kindergarten readiness. Figure 3 pres-

15. Additional descriptive characteristics for children in the ECLS-K data are provided in technical appendix tables 8–9 and 12–13. Specifically, characteristics of children analogous to those in table 1 but by the seven-category rural-urban code are provided in technical appendix table 8. Racial and ethnic characteristics of children's counties of residence by the four-category rural-urban code are detailed in technical appendix table 9. Multiple demographic and economic characteristics of children's counties of residence by the four-category code are displayed in technical appendix table 12. Appendix table 13 provides more detail on the mean number of children and adults in the household for children in the ECLS-K by the four-category rural-urban code.

16. Math and reading scores in table 1 reflect the average deviation of the scores of children living in that county type from the mean scores for the entire sample.

Table 1. Characteristics of ECLS-K:2011 Sample by Urban-Rural Continuum Code

	In Metro Areas of +250,000 Population (1)	In Metro Areas of <250,000 Population (2)	Large Nonmetro, Urban Population +20,000 (3)	Small Nonmetro or Remote Rural, Urban Population <20,000 (4)
Dependent variables:				
Attended center care in pre-K	48.8% ^a	45.9% ^b	42.3%	35.8% ^{ab}
Attended Head Start in pre-K	14.6% ^a	11.5% ^b	18.5% ^b	24.3% ^{ab}
Math score at fall of K(std)	0.08 (0.01)	0.21 (0.03) ^a	-0.05 (0.05) ^a	-0.02 (0.03) ^a
Reading score at fall of K(std)	0.10 (0.01) ^a	0.016 (0.03) ^b	0.01 (0.05)	-0.10 (0.03) ^{ab}
County-level characteristics:				
Nonprofit childcare expenditures per poor child younger than five (in \$100)	49.28 (0.82) ^a	58.10 (1.85) ^b	21.87 (1.20) ^b	18.11 (0.97) ^{ab}
# of Head Start slots per one hundred poor three-to-four-year- olds (2009)	37.62 (0.50) ^a	35.07 (0.90) ^b	44.18 (0.42) ^c	76.71 (2.43) ^{abc}
Percent non-Hispanic white	60.9% ^a	78.0% ^a	83.1% ^a	83.6% ^a
State-level characteristics:				
Percent of four-year-olds enrolled in state pre-K	23.6%	21.5%	19.2%	26.4%
Max. childcare subsidy reimbursement (four-year-old, center care, in \$)	616.75 (1.78)	709.87 (6.25)	663.37 (8.15)	601.34 (8.62)
Observations	13,600	1,750	840	1,250

Source: Authors' tabulation (U.S. Census Bureau 2020; DOE 2020; Tourangeau et al. 2017; Economic Research Service 2020; NCCS 2009; Barnett et al. 2010; Urban Institute 2019).

Note: Weighted frequency or mean shown. Superscript letter pairs indicate within-row cell-pair mean differences statistically significant from zero at or below the .05 level. Observations rounded to the nearest ten, in accordance with NCCS requirements. All child-level variables assessed at the fall of kindergarten. All county variables assessed in 2009. All differences in population significant across rural-urban categories.

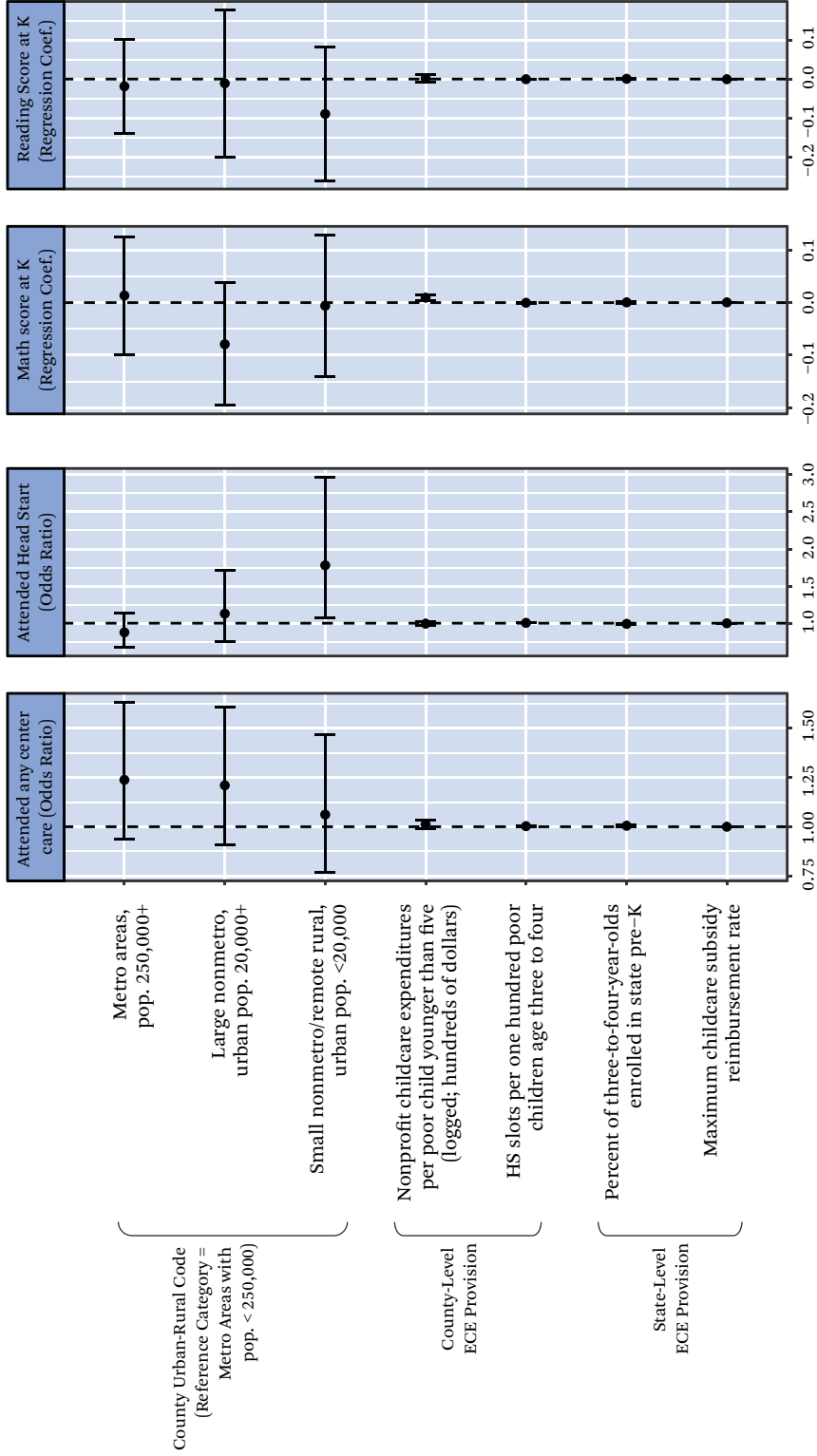
ents the odds ratios for the binary center and HS participation measures and coefficients for the continuous math and reading score measures across county geography, county ECE capacity, and state ECE policy variables only.¹⁷

We see little evidence of a residual association between county metropolitan or nonmetropolitan status and ECE participation when controlling for county-level indicators of ECE provision and child- and household-level fac-

tors, with one exception. Living in small non-metropolitan counties was associated with 1.78 greater odds of participating in HS, relative to children in small metropolitan counties (the reference category). Notably, this is the case even when controlling for county HS capacity, which, as expected, is positively associated with HS participation as well as any center care attendance. Higher state-level enrollment in state pre-K was positively associated with any

17. Full model results are reported in technical appendix table 4. Regression coefficients, odds ratios, and 95 percent confidence intervals for these estimates are visualized in technical appendix figure 1. Appendix tables 14 through 17 provide full results for the progressive regression models for each of the four main dependent variables. Appendix table 18 provides the full model results for the seven-category USDA code.

Figure 3. Factors Associated with ECE Participation in the Year Prior to Kindergarten and School Readiness



Source: Authors' tabulation (U.S. Census Bureau 2020; DOE 2020; Tourangeau et al. 2017; Economic Research Service 2020; NCCS 2009; Barnett et al. 2010; Urban Institute 2019).

Note: Each column represents a separate regression. Odds ratios shown for binary dependent variables (attended center care or Head Start). Coefficients shown for math and reading scores. All child-level variables assessed at the fall of kindergarten, except for household food insecurity, which is assessed at the spring. All county-level variables assessed at 2009 (the year prior to children's K entry), or for ACS variables, in the five-year 2007–2011 estimates. Standard errors clustered at the state level. Estimates use weights as specified by IES. Full model results reported in online technical appendix table 4.

center attendance ($OR = 1.005$), and negatively associated with HS attendance ($OR = 0.991$).

Similarly, after controlling for ECE context and background characteristics, few geographic differences in school readiness measures were evident. Interestingly, higher county nonprofit childcare expenditures were associated with higher math scores, and the non-Hispanic white percentage of the county was associated with lower reading scores. We interpret these findings as evidence that ECE availability predicts child-level participation in ECE, whereas, conditional on ECE participation, child and household level covariates and local resource levels capture much of the variation in children's school readiness levels. Together, the findings regarding county-level HS capacity and state public preschool enrollment suggest that public investment in ECE infrastructure affects children's propensity to attend ECE.

As found in other research, child and family background characteristics are highly associated with ECE participation and children's math and reading scores (panel E in technical appendix table 4 online). Family income and structure, public assistance participation, and parent education—indicators of household effective demand for ECE—were predictive of ECE attendance. We find a negative association between non-Hispanic black and Hispanic racial or ethnic identity and center care attendance, but positive associations with HS participation, highlighting the importance of HS in addressing racial and ethnic disparities as well as geographic disparities in ECE access. Consistent with previous research (Yoshikawa et al. 2013), attending center-based care during the pre-K year was associated with higher math and reading scores in kindergarten compared to children who did not. Finally, children in

households in which parents were married and in which at least one parent attended college were more likely to participate in center care and averaged higher test scores than their peers, whereas household size was negatively associated with center care attendance and test scores.¹⁸

To better understand whether associations between ECE access, participation, and kindergarten readiness vary by geography, we also tested a set of analyses exploring interactions between ECE program access and place (results available upon request). We find that per capita nonprofit childcare expenditures are negatively associated with center-based program attendance in large nonmetro counties relative to smaller metro areas. We also find that per capita nonprofit childcare expenditures interact with residing in large metro areas such that nonprofit expenditures are no longer predictive of HS or math scores attendance in these communities. It is possible that nonprofit childcare expenditures are a proxy for local resources and ECE availability in rural or nonmetro areas but less so in more urban communities with more variation in and more robust ECE infrastructure. Associations between HS capacity, ECE participation, and kindergarten readiness did not vary by geography, however.

CONCLUSION

This study examines rural-urban variation in early care and education supply, children's ECE participation, and children's school readiness, with a focus on differences between rural and urban communities. Findings suggest geographic disparities in ECE capacity, which translate into geographic disparities in the types of ECE children attend in the year prior to kindergarten. We find that public pro-

18. The online technical appendix includes additional models and sensitivity tests. Results from them are nearly identical with the main models presented here. Technical appendix table 18 shows the full regression models for our four dependent variables, using the seven-category rural-urban definitions. As true of the four-category models, we find that children in rural counties are more likely than their counterparts in small metro counties to attend Head Start. We also find small differences in any center care attendance for children in small rural counties adjacent to metro areas, and lower math scores for children in large nonmetro counties, relative to small metro counties, controlling for background characteristics. Additional sensitivity tests include additional controls for racial and ethnic composition, models include measures for the number of children and the number of adults separately, and another set of models that include additional county-level economic characteristics (see technical appendix tables 19 through 22). Results for these additional models are substantively similar to those in the main specification (figure 3; see also technical appendix table 4).

grams—specifically Head Start—occupy a larger role in nonmetropolitan compared to metropolitan communities, while private nonprofit resources for childcare are more highly concentrated in metropolitan locations. HS appears to fill important supply gaps in ECE in rural counties, serving a vital role in narrowing urban-rural gaps in ECE participation—and presumably in children’s school readiness and later outcomes. Some descriptive evidence indicates that public ECE program participation rates and provision are greater in less populous rural counties than in more populous rural counties. We also find that higher state-level enrollment in state-sponsored preschool is associated with lower odds that a child attends HS; these results may reflect the considerable overlap in ages and backgrounds of children enrolled in HS and public preschool. Greater public ECE investments in all geographic areas are key in narrowing disparities in ECE attendance and improving children’s readiness for kindergarten.

Descriptive findings regarding urban-rural differences in ECE program capacity and participation are consistent with prior work examining social program provision in rural areas (see Malik and Schochet 2018; Kim and Wang 2019; Nolan, Waldfogel, and Wimer 2017; Warwick 2017; Ziliak 2019b). Evidence that private ECE program provision and participation are more robust in urban than rural counties echoes research elsewhere showing the private nonprofit safety net to be more robust in major cities and less so in smaller metros, suburbs, or rural areas (Allard 2017, 2019). Similarly, evidence that public ECE provision, particularly HS, is a critical source of ECE capacity in rural areas parallels research findings elsewhere that public assistance benefits make up a much higher share of county income in rural or nonmetropolitan areas than in urban areas (Ziliak 2019a).

In general, we find fewer geographic disparities in children’s school readiness than previous research (Miller, Votruba-Drzal, and Setodji 2013). These results may reflect this study’s use of multiple measures that capture local characteristics and ECE capacity as well as an analytic

sample of children drawn from a more recent year. Importantly, we find no significant geographic differences in children’s math and reading scores at kindergarten entry after controlling for child-, household-, county-, and state-level factors—suggesting that policies that expand ECE public programming can mitigate geographic differences in early opportunity and early educational outcomes. School readiness, particularly math, is predictive of later academic success (Duncan et al. 2007), so the lack of geographic disparities in our findings adds to the evidence for policies that enhance the availability of high-quality, affordable ECE.

We interpret findings carefully and within the context of the study’s limitations. Results presented here show descriptive patterns rather than causal associations between geography, ECE availability, ECE participation, and school readiness. To this point, decisions around residential location may be shaped by unobserved preferences that also highly correlate with household investments in children’s development. County-level measures of capacity are less vulnerable to selection bias than municipal or school district-level measures, but selection may still be an issue. Furthermore, our county-level metropolitan-nonmetropolitan continuum measures may fail to capture important distinctions within different types of urban and rural geographies, particularly in light of evidence of considerable heterogeneity in educational outcomes among rural regions (see Drescher et al. 2022, this issue). For example, given sample size limitations, our ECLS-K analyses cannot accurately assess differences in ECE attendance and school readiness between economically disadvantaged rural communities and more advantaged rural communities. In addition, our county-level measures of access are somewhat blunt indicators of the context of ECE provision and participation. Nonprofit childcare expenditure data from the NCCS likely undercount overall philanthropic and other private investments in early childhood because the data only reflect nonprofits that identify primarily as childcare providers, and our NCCS and HS data do not include for-profit centers.¹⁹ In addition,

19. Thirty-two percent of children were enrolled in for-profit centers in 2012 (NSECE Research Team 2014).

data limitations force us to assume that the spatial distribution of HS program slots was similar in 2009 and 2013, when we have more geographically textured data. Our matching approach requires reasonable assumptions (for more detail, see the technical appendix), but we believe that the matched dataset is better than alternative approaches that take only grantee headquarters location into account. Finally, the ECLS-K:2011 kindergarten-year data, although constituting the most recent nationally representative dataset that includes geographic identifiers, children's ECE participation, and direct child assessments, are now more than ten years old, a period during which the landscape of public ECE has changed considerably.

The gaps and limitations in currently available ECE data, however, do suggest several avenues for future research. There remains relatively little research exploring trends in ECE provision by geography and little consistent data through which researchers could explore such trends (for example, Gordon and Chase-Lansdale 2001; Malik et al. 2018). Such data gaps are striking given how private and public funds are invested in ECE and how central expansion of ECE is to policy recommendations for reducing societal inequality, especially in the aftermath of the pandemic that dramatically reduced the availability of ECE (Bassok, Markowitz, and Bellows 2021; Chaudry et al. 2021). Future investments should focus on developing new data resources and improving the use of what limited data are currently available. Part of the challenge may be to find ways to link spatial data about ECE program provision—ideally with finer spatial granularity than county levels and with quality information about the ECE programs—to ongoing surveys of children or administrative records. These types of linked data resources would allow researchers to link context to outcomes and generate stronger evidence about the causal impacts of ECE accessibility. Moreover, ample room remains for future scholarship to consider how ECE program provision and participation varies across rural areas with larger black or Hispanic communities, the nature of the local economy, and proximity to urban centers. Finally, our findings suggest that future

research examine the strength and resilience of local ECE systems, given the dramatic and uneven effects of the pandemic and its economic fallout on ECE program provision and costs (Malik et al. 2020; Bassok, Markowitz, and Bellows 2021).

Our study contributes to a growing discussion about how policy and philanthropy can reduce spatial variation in ECE program provision and thus narrow observed spatial gaps in children's outcomes. Observed geographic variation in both public and private ECE provision are driven in part by differences in policies at the federal, state, and local levels. Solutions for improving ECE program access and reducing spatial disparities in ECE program capacity, therefore, implicate public and private actors operating in many different areas of policy (Forry, Daneri, and Howarth 2013; Gormley 2017; Greenberg et al. 2018; Davis, Krafft, and Forry 2017; Chaudry et al. 2021). First, federally funded HS programs constitute a large share of rural ECE program capacity, with considerable variability across counties, suggesting there is room to expand program investments within nonmetropolitan and metropolitan America alike given the role HS plays in supporting children's short- and long-term health and economic success (Haan and Leuven 2020; Deming 2009). Additional funding for HS (and EHS) would narrow ECE supply and quality gaps between rural and metropolitan areas (Kim and Wang 2019; Malik and Schochet 2018; Paschall, Halle, and Maxwell 2020) as well as other urban-rural disparities in well-being. HS also plays an important role in narrowing racial and ethnic disparities in ECE attendance. Combined, reasons for bipartisan support for proposals that expand public ECE investment are numerous. Second, geographic disparities in private ECE program provision require greater philanthropic attention. Private investments appear most concentrated in urban settings, and our findings suggest that these may have important downstream consequences for children. Building private ECE capacity—particularly high-quality programming—in currently underserved areas should be a key priority for philanthropy and one that would pave the way to greater public provision as well.

Ultimately, the ability of local economies

and households to recover from the pandemic will hinge on how well our systems of early childhood education and childcare can bounce back from both the public health challenges of the near-term and the long-term fiscal challenges that await.

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