The returns of an additional year of schooling: The case of state-mandated kindergarten

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Short Abstract (150 words)

In this paper, we examine the effects of state mandatory kindergarten requirements on long-run educational attainment and labor market outcomes. While in most states kindergarten began as a voluntary program, starting in the 1970s some states evolved to mandating kindergarten attendance. Several changes in state mandatory school entrance laws across—and in some instances, within—states over time provide an opportunity to causally identify the influence of an additional year of ECE on important individual education and labor market outcomes, comparing states with mandatory attendance to those with voluntary attendance. We exploit this natural experiment design using data from the Census and ACS 2000-2015. Our results will shed light shed light on the anticipated impact of universal prekindergarten programs given the national trend towards preschool for all.

Extended Abstract

I. Study motivation and significance

In light of the evidence from neuroscience, psychology, and economics demonstrating the importance of early childhood interventions in the development of human capital (Duncan & Magnuson, 2013), a number of recent proposals at the federal and state levels aim to expand public early childhood education (ECE) programs. Because early childhood is a critical period of rapid neurological development, investments during the earliest years of life, prior to school entry, have been shown to be among the most productive social policy investments with substantial returns for both the individual and society (Heckman & Masterov, 2007).

Currently amounting to $13 billion and $6.2 billion, respectively, federal and state spending on ECE programs continues to grow, with the largest allocations going towards expansions in age-4 prekindergarten (pre-k) programs, state-developed voluntary part- or full-time educational interventions (Barnett et al., 2015). Though in most states, pre-k programs target low-income children, (e.g., NJ, NC), a handful of states provide universal access to all age-eligible residents (e.g., GA, OK). Recent federal policy initiatives (e.g., Obama's Preschool for All), also push for universal access to age-4 preschool programs, which enjoys support from both legislators and voters across party lines (Greenberg, 2015). However, the empirical work on the returns to ECE are generated from high-quality, small-scale interventions targeted to low-income children, and there exists limited evidence on how such universal interventions during very early childhood may influence population-level human capital development. In this paper, we look to the origins of, and attendance mandates for, now universal American Kindergarten programs (at age 5), to shed light on how trends towards universal provision of public preschool (age 4) may influence population-level economic and educational outcomes. During the 1960s, state governments offered block grants to districts to expand Kindergarten slots in public schools, and American Kindergartens gradually moved from private and community-based facilities to becoming firmly established in elementary schools by the end of 20th century. In 1970, less than half of all five-year-olds attended Kindergarten, compared with more than 70% today (Digest of Education Statistics, 2015). Central to our project is that while in most states kindergarten began as a voluntary program, starting in the 1970s some states evolved to mandating kindergarten attendance (Tanner & Tanner,

1973). Several changes in state mandatory school entrance laws across—and in some instances, within—states over time provide an opportunity to causally identify the influence of an additional year of ECE on important individual education and labor market outcomes, comparing states with mandatory attendance to those with voluntary attendance (see Appendix Table 1).

It is important to note how our proposal differs from, and complements other related work. Both Cascio (2010) and Dhuey (2011) exploit variation in the timing of large kindergarten expansion grants from states to school districts (which largely occurred in the 1960s and 1970s) to identify the returns from kindergarten attendance. Their results differ somewhat, but do indicate that state funding of kindergarten improved educational outcomes (grade retention, graduation), reduced institutionalization, and improved earnings for non-whites and children from low socioeconomic households. Using the same identification strategy, Cascio (2009) finds evidence of an increase in the labor supply of single mothers without other young children as a result of increased kindergarten funding, but no effects for other groups of women. This corresponds with Gelbach's (2002) findings on maternal labor supply using quarter of birth to instrument for kindergarten enrollment, and Fitzpatrick's (2012) estimates using within-state discontinuities in the age-eligibility for kindergarten. Our paper examines the impacts of mandatory kindergarten attendance on long-run outcomes as a first look at how an additional year of schooling during preschool will influence long-run outcomes, in a policy context where federal and state governments are actively considering universal preschool programs.

II. Data

Our project relies on several sources of data and we describe them as follows:

State-level data

Historical kindergarten laws. Starting in the 1970s, some states began mandating Kindergarten attendance (Tanner, 1973). For instance, between 1985 and 1989, 10 states switched to compulsory kindergarten attendance (AR, CA, CO, CT, DE, GA, OR, MD, MA, VA) and at least three states (CA, MA, MD) switch back to a voluntary kindergarten policy between 1980 and 1995. We constructed a dataset at the state and year level with information on mandatory kindergarten adoption for the period between 1970 and 1995 from the following sources: Education Commission of the States, the Digest of Education Statistics, and each state's education department (see Appendix Table 1).

State-by-year covariates. One concern is whether other state policies or factors that affect educational investments and subsequent adult outcomes that changed concurrently with compulsory kindergarten attendance laws. Therefore, we have compiled a dataset at the state-by-year covariates such as population, Gross State Product (GSP), poverty rate, welfare use rate, legislature political party majority, per-pupil educational expenditures, school exit laws, school entry cutoff, and the adoption of state subsidized kindergarten. We gathered these data from sources: the Digest of Education Statistics, Common Core of Data, U.S. Department of Education, National Center for Education Statistics, University of Kentucky Center for Poverty Research.

Individual-level data

Census/ACS. We use data from the 2001-2015 American Community Survey (ACS) and the 2000 and 2010 decennial Census to obtain information of our outcomes of interest. The ACS is a nationally representative repeated cross section survey that gathers annual information previously contained in the long form of the decennial census about Americans wellbeing including educational

attainment, income, employment, and housing. The sample to be used in the analysis comprises pooled repeated cross-sections for individuals born between 1965 and 1990 observed in the 2000 and 2010 Census and the 2001-2009 and 2011-2015 ACS surveys. In addition, we can use previous censuses (i.e., 1990, 1980) to check for parallel trends.

Our outcomes include: High school completion, college attendance, years of schooling, labor force participation, and earnings. Since our focal cohorts were born between 1965 and 1990, the ACS and Census allow us to observe outcomes at ages between 25 and 50. We are aware that for later cohorts we have labor market observations at younger than optimal ages. As a robustness check, we will limit our analytic sample to those with labor market outcomes after age 30 (when major educational investments are largely complete). This exercise will focus on individuals observed above age 30 in the 2000-2015 Census/ACS, ignoring cohorts born after 1985 who experienced changes in Kindergarten compulsory mandates during the first part of the 1990's. We will assess how much variation in exposure to compulsory kindergarten we have left after ignoring such cohorts to determine potential bias and efficiency tradeoffs.

Assignment to Kindergarten entry year: We start by using the publicly available Census/ACS data, which has information on the quarter and state of birth to match observations to their state Kindergarten mandates and other state policies. However, we are aware that with only quarter of birth available in the public-use data, we do not have the level of detail necessary to precisely assign individuals to their school-entry year. Based on the variation in state birthdate cutoffs (which also vary across years), misallocation of children to school entry cohorts will substantially affect our estimates of outcomes for children born in Quarter 3 (July, August and September) and Quarter 4 (October, November and December), as well as those in Quarter 1 (January, February and March). Therefore, we are currently requesting access to the restricted data, which include information on month of birth. These will allow us to accurately assign individuals to Kindergarten policies in place in their state of birth.

III. Empirical strategy

The main goal of this project is to examine the effects of state mandatory kindergarten requirements on long-run educational attainment and labor market outcomes, or in other words, the effect of an additional year of schooling at the beginning of one's school career on future wellbeing. Because families' decisions to enroll children in kindergarten may not be random, comparing educational outcomes between children who did and did not attend kindergarten would provide a biased estimate because Kindergarten attendance will be confounded with unobserved characteristics of children and their families. To provide causal estimates, we use a quasi-experimental design that leverages policy changes in mandatory kindergarten attendance across and within states overtime beginning in the 1970s, when states began mandating kindergarten attendance (Tanner, 1973). Specifically, our approach exploits three different sources of variation. First, there exists between state variation since not all states require kindergarten (KG) prior to enrollment in 1st grade, and states that adopted compulsory KG do so in different years. Therefore, children from the same birth cohort but born in different states are subject to different KG requirements. Second, we observe variation within states across time as policies change leaving some cohorts affected by the KG mandate and others not (i.e., they are too old). Specifically, the year of birth relative to state mandatory KG adoption year determines who is affected by the policy change. Third, some state switch state mandatory KG on and off. For instance, between 1985 and 1989, 10 states switched to compulsory kindergarten attendance (AR, CA, CO, CT, DE, GA, OR, MD, MA,

VA) and at least three states (CA, MA, MD) switch back to a voluntary kindergarten policy between 1980 and 1995. [1]
The sample to be used in our analysis comprises pooled repeated cross-sections of individuals born between 1965 and 1990 observed in the 2000 and 2010 Census and the 2001-2009 and 2011-2015 ACS surveys. We will estimate the following multivariate regression equation:

$$Y_{ismbt} = \delta MKG_{smb} + \alpha AgeCutoff_{smb} + X_{isb}\beta + \tau_m + \theta_b + \pi_s + \mu_t + \varepsilon_{ismbt} \quad (1)$$

where Y_{isbt} denotes the outcomes of interest (i.e. educational attainment or labor market outcomes) for individual *i* born in state *s* in month (or quarter) *m* and year *b* and observed in the Census or ACS at year *t*. MKG_{smb} is a dichotomous variable equal to 1 if KG is mandatory in state *s* for a child born in month *m* year *b* and zero otherwise. The parameter of interest, δ, captures the effect of exposure to mandatory KG or the effect of an extra year of schooling during early childhood. Because during the years of interest some states changed the school-entry age cutoff, we include as a covariate $AgeCutoff_{smb}$ which corresponds to the state's age/birthdate cutoff relative to Oct 1 for a child born in state *s*, month *m* and year *b*. Due to cross-state differences in school-entry age and birthdate cutoffs, we need the respondent's month and year of birth to accurately assign mandatory KG policy exposure to each individual. In addition, our regressions include birth cohort fixed effects, θ_b, which capture any unobserved shock common to all children born in the same year. Similarly, state of birth fixed effects, π_s, absorb time-invariant characteristics of states, which helps to address the potential for endogeneity of mandatory KG policy adoption. μ_t are survey-year fixed effects that account for unobserved variables common to the individuals surveyed in a specific year. Estimations will be population weighted with standard errors clustered by state.

An important assumption underlying our empirical strategy is the exogeneity of state's adoption of mandatory KG. As mentioned above, one may be concerned that other changes that would have affected children's long-term human capital outcomes occurred at the same time as states implemented mandatory KG policies. To address this possibility, we first will descriptively examine the observed determinants of states with compulsory KG. Our regression model in equation 1 also include a vector of state of birth characteristics measured at kindergarten entry year (X_{isb}) which include variables such as welfare use rate, poverty rate, per-pupil educational expenditures, school exit laws, and the adoption year of state subsidized kindergarten. We will construct a state-by year dataset with these variables from publicly available sources (as described next in the data section) and request to be linked at the state and year of birth level. As sensitivity checks, we will examine the stability of our estimates to the inclusion/exclusion of these state-by-year of KG entrance covariates. In addition, we will estimate specifications that add state-specific linear trends.

Intuitively, our empirical strategy compares the long-term outcomes of individuals who were exposed to mandatory kindergarten entrance with their peers *living in the same state* who were not exposed to this policy because they were older, relative to children in states that did not require kindergarten, holding constant other education and social policies that could be correlated with the mandates. In other words, we compare the outcomes of individuals exposed to the kindergarten mandates with two sets of

[1] We will test whether switching on and off is not related to the outcomes or factors that could affect children's human capital.

counterfactuals: children from the same state but from older cohorts who were not affected by the policy change and children from the same cohort but in different states which did not adopt kindergarten mandates. We will perform several robustness and falsification test to strengthen the validity of our identification strategy. For example, as a placebo test we will estimate models that falsely assign mandatory KG policies to children that were too old to be subjected to the policy change. Also, we will check for parallel pre-trends between states that have adopted mandatory kindergarten policies versus states that have not using the 1980 and 1990 publicly available Census data.

Moreover, we will explore the heterogeneity of the effects of Kindergarten mandates by performing our analysis separately for different subsamples: by urban versus rural states, by race, and by child gender. In addition, we will estimate equation 1 using quarter of birth instead of month of birth and compare the results to illustrate the potential problems and estimation bias due to misassignment of children to school-entry cohorts and exposure to kindergarten policies.

IV. Preliminary analysis and expected results

According to Appendix Table 1, 24 states (including DC) have ever implemented mandatory Kindergarten since 1970, while 27 states have not. Table Appendix Table 2 shows some summary statistics of socio-demographic State characteristic in 1970 by mandatory Kindergarten status and it is clear that there were very few differences between states that ever adopted and never adopted mandates. Also, in the bottom panel, we present Kindergarten enrollment ratio using state/year observations between 1970 and 1995. In addition, using data at the state/year level, we have estimated some regression analyses to examine the relation between Kindergarten enrollment and whether KG is mandatory in a given state and year. Table Appendix Table 3 shows the results where column 1 only controls for state and year fixed effects, column 2 only control for state covariates overtime, and column 3 include both state and year fixed effects and state characteristics. The results show evidence that adoption of KG mandates increased KG enrollment by between 5 and 7 percentage points. This finding serves as key evidence to further study the effects of state mandatory Kindergarten requirements on later in life outcomes, which is the main goal of this paper.

V. Appendix Tables

Appendix Table 1: States with Kindergarten Attendance Mandates by year, 1970-2000, from Authors' data collection

State	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	**1985**	1986	1987	1988	**1989**	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
AZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	1
AR	0	0	0	0	0	0	0	0	0	0	0	0	0	***1***	1	**1**	1	1	1	**1**	1	1	1	1	1	1	1	1	1	1	1
CA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
CO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0
CT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
DE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**	1	1	1	**1**	1	1	1	1	1	1	1	1	1	1	1
DC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
FL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	0	**1**	0	0	0	0	0	0	0	0	0	0	0
HI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ID	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0
IN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0
IA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	**1**	0	1	0	0	0	0	0	0	0	0	0
ME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0
MD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
MA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
MN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
MS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0
MO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
NV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
NH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
NJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
NM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**	1	1	1	1	1	1	1	1	1	1	1
NY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0
NC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
ND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
OH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	1	1	1	1	1	1	1	1	1	1	1
OR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0
PA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0
RI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**1**	1	1	1	**1**	1	1	1	1	1	1	1	1	1	1	1
SD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	**1**	0	1	0	0	0	0	0	0	0	0	0
TN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
TX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	1
VT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**1**	1	1	1	**1**	1	1	1	1	1	1	1	1	1	1	1
WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WV	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0

Appendix Table 2: Summary Statistics

	Descriptive Statistics - MKG sample						
	Never mandatory KG			Ever mandatory KG			
	Mean	SD	Obs	Mean	SD	Obs	Mean Diff
State covariates in 1970							
Gross State Product by pop	0.48%	0.00	27	0.49%	0.00	24	0.000
PovertyRate	13.50	4.52	27	16.31	7.26	24	2.813
AFDC recepients/pop	0.82%	0.00	27	0.94%	0.00	24	0.001
Expenditures per pupil	4,845.57	1,083.95	27	4,801.51	1,166.88	24	-44.059
Pupil teacher ratio	22.09	2.03	27	22.25	1.74	24	0.165
White ratio	90.78%	0.08	27	83.05%	0.19	24	-0.077*
Black ratio	7.48%	0.08	27	12.84%	0.16	24	0.054
Other race ratio	1.74%	0.04	27	4.10%	0.13	24	0.024
% of state house that is Democrat	50.26%	0.23	27	59.65%	0.29	23	0.094
State-year observations 1970-1995							
Kindergarten enrollment ratio	0.82	0.20	1,132	0.86	0.17	183	0.035**
Primary enrollment ratio	0.96	0.08	1,143	1.00	0.07	183	0.044***

note: *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 3: Relationship between KG enrollment and State KG compulsory requirements

	(1)	(2)	(3)
VARIABLES	Kindergarten_enrollment_rate		
	\		
if state has a mandatory kindergarten(1=yes,0=no)	0.048	0.057*	0.069**
	(0.056)	(0.030)	(0.029)
Observations	1,315	1,256	1,256
R-squared	0.536	0.182	0.658
State and year fiexed effects	Y	N	Y
State observables covariates	N	Y	Y

Robust standard errors in parentheses clustered at the state level
State observable covariates include : Gross State Product over population ratio, AFDC ratio, SNAP ratio, percentage of population that is black, percentage of the population that is other race, education expenditures per pupil, percent of the House that is Democrat

*** p<0.01, ** p<0.05, * p<0.1

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