State Differences in Pathways to School Leadership and in Achievement Growth*

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Abstract

States regulate entry into principalships, including requirements for prior experience as a teacher or assistant principal, to guard against poor school leadership and bad outcomes for students. Such requirements might be expected to reduce the variation in principal quality and achievement growth by excluding applicants in the lower tail of the effectiveness distribution, but differences in state standardized tests, family circumstances, state economic conditions, and myriad state and local policies and conditions prevent direct analyses of their effects on principal quality. To learn more about their likely impacts, we describe pathways to the principalship in terms of prior teaching experience, and assistant principal and principal experience, across six states with substantial differences in context, regulations, and student populations. There are sizeable differences across states in the shares of principals without prior experiences as a teacher or assistant principal but only modest differences in estimates of the variance of principal effectiveness, which suggests that prior experience requirements create barriers to becoming a principal and do not succeed in raising the principal effectiveness floor. Schools serving more economically disadvantaged students and Black students are more likely to have principals without prior experience as a teacher, but the findings suggest that stricter prior experience requirements may not benefit—or could potentially even harm—students in schools that have more difficulty attracting and retaining principals. JEL: I20, H41, J20

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1. Introduction

Although personnel policies designed to improve school leadership vary widely across states, significant questions remain about the effectiveness of different regulatory approaches. Requirements that principals complete highly regulated advanced degrees in school leadership or have prior experiences as teachers or assistant principals might be expected to reduce the variation in principal quality and achievement growth by excluding applicants in the lower tail of the effectiveness distribution. While states differ significantly in their formulation and implementation of regulations about principals, differences in state standardized tests, family circumstances, educator labor markets, economic conditions, and myriad state and local policies inhibit direct analyses of their effects on principal quality. We pursue a structured multistate research design that permits a focused investigation of how regulatory differences play out empirically.

We first describe the significant variations in the pathways to the principalship in prior experience as a teacher, an assistant principal, and a principal that exist across six states with substantial differences in context, regulations, and student populations: Georgia, Massachusetts, Missouri, North Carolina, Texas, and Washington.[1] We then examine the association between the distributions principal effectiveness as measured by achievement growth and these prior experiences.

The substantial differences in state regulations and shares of principals without teaching or assistant principal experience across our sample states provide an opportunity to examine whether the connections between achievement growth and prior experiences vary across states according to state requirements and norms. For example, one might expect a stronger relationship between principal effectiveness and prior experiences in states with strict experience requirements that dictate that schools only hire principals without such experiences in dire circumstances. By comparison, one might expect a much weaker relationship in states where schools may substitute more desirable attributes along other dimensions in place of prior teaching and assistant principal experiences at the time of hiring.

[1] Virtually all states have adopted similar post-graduate education requirements, and we therefore focus on prior experiences as a teacher and assistant principal.

Our six-state analysis allows us to explore pathways to the principalship across heterogenous schooling contexts. For example, Massachusetts outperformed all states in 2015 on the 8th grade math and reading assessments of the National Assessment of Educational Progress (NAEP), whereas Missouri and North Carolina were slightly below the national average (Appendix Table A1). The states also differ dramatically in the number and size of districts: for example, over 90 percent of the districts in Texas, Missouri and Massachusetts have fewer than 10,000 students, while only two-thirds of North Carolina districts are that small (Appendix Table A2). The demographic distribution of students across the states also differs: Massachussets has many fewer economically disadvantaged students than the other states, the southern states (Georgia and North Carolina) have many more Black students than the other states, and Texas has many more Hispanic students (Appendix Table A3). Finally, in terms of numbers of schools and enrollment, Massachusetts is declining over the decade 2005-2015. but Georgia and Texas are growing (Appendix Table A4).

The states have also adopted different approaches to regulating entry into leadership positions, contributing to significant differences in backgrounds among principals. For instance, in Texas less than 4 percent of public-school principals do not have prior experience as a teacher and only 19 percent do not have prior experience as an assistant principal; the corresponding numbers in Massachusetts are 15 percent and 58 percent. These state averages mask heterogeneity by schools' racial composition and the share of economically disadvantaged students: schools with higher percentages of Black or low SES students are generally more likely to have a principal without prior experience as a teacher. State differences in the organization of schools into districts also translate into differences in the pathway to becoming a principal. Texas has ten times as many districts as North Carolina but only three times as many schools. Not surprisingly, principals are much more likely to come from outside the district in Texas compared to North Carolina, where within-district labor markets are more important.

Our analysis of the six states reveals pronounced state differences in pathways to the principalship and in other aspects of principal labor markets but relatively little cross-state variation in the estimated variance of principal value added.[2] Although our estimates of the variance of principal value added potentially suffer from modest upward bias, they are only

[2] Data-use restrictions preclude the pooling of the data for the six states.

slightly larger than those reported in existing research that undertakes the most comprehensive steps to account for such bias.[3] Additionally, we find little or no evidence that prior experience as a teacher or assistant principal is associated with higher principal value added in any of the six states. Our models relating prior experience as a teacher or assistant principal to principal effectiveness do not capture causal effects because principals without prior experience likely have unobserved, compensating characteristics that contribute to their hiring. However, the absence of systematic positive relationships suggests that principals hired without prior experience are as effective on average as those with experience, even in states with strong prior experience requirements.

These results cast doubt on the value of rigid experience-based entry requirements that may serve as barriers to the principalship and are consistent with a lack of consensus on the proper regulatory environment for school principals more broadly.[4] They also raise questions about the implications of a greater incidence of principals without prior teaching and assistant principal experience in schools with higher fractions of Black or socioeconomically disadvantaged students. If these schools face more constrained applicant pools or must make more difficult tradeoffs between formal experience and other indicators of effectiveness, then strengthening experience requirements may do little to improve leadership quality—and could even exacerbate existing inequities.

Importantly from a methodological perspective, we use common protocols across states for the construction of the analysis sample, for the definitions of all key variables of interest, and for the specification of the statistical analyses, eliminating variation resulting from researcher analytical choices from our cross-state analysis while preserving differences in institutional structures and regulations.[5] Several recent papers have demonstrated that the normal design and data preparation decisions of researchers can introduce variation in estimated impact factors that go beyond the reported sampling errors (Huntington-Klein et al. (2021), Huntington-Klein,

[3] These studies include Laing, Rivkin, Schiman, and Ward (2016), Branch, Hanushek, Rivkin, and Schiman (2020), Bartanen, Husain, and Liebowitz (2024). Our approach is designed to minimize the impact of sampling and analytical decisions at the potential cost of neglecting some confounding influences.
[4] Grissom, Egalite, and Lindsay (2021) highlight the lack of consensus in the research on the determinants of principal effectiveness, which could contribute to the inconsistent regulations and patterns of principal backgrounds.
[5] Other school-leadership studies conduct similar analyses in multiple settings including the estimation of principal value added by Branch, Hanushek, Rivkin, and Schiman (2020) and Bartanen, Husain, and Liebowitz (2024).

Portner, McCarthy, and The Many Economists Collaborative on Researcher Variation (2025)). Well-meant researcher choices potentially introduce substantial variation in reported results (Gelman and Loken (2014), Silberzahn and al. (2018), Dillon, Miller, and Smith (2023)). Our study parallels the framework used by Austin et al. (2023), in which independent teams apply standardized methods to privacy-protected state datasets, minimizing variation that arises from standard but consequential modeling decisions of researchers and facilitating direct state comparisons of results.

The next section places this work within the existing approaches to estimation of principal effects and their determinants. This is followed by a description of the administrative data for the six states along with their regulatory approaches in Section 3. Section 4 develops the conceptual framework and empirical specifications. Section 5 presents the estimates of the variance of principal achievement value added, and Section 6 describes differences in pathways to the principalship by state and school characteristics and presents estimates of the relationship between achievement growth and prior experiences as a teacher and assistant principal. This section also describes variation in principal experience and tenure, since the pathway to a school leadership position often includes prior experience as a principal. The final section summarizes the findings and discusses implications for policies designed to raise the quality of school leadership.

2. Prior Research

This work builds on multiple strands of research, much of which is summarized in Grissom, Egalite, and Lindsay (2021). These strands include the estimation of principal effectiveness, descriptions of principal characteristics, and descriptions of the pathways to the principalship.

2.a. Estimation of principal effectiveness

As Grissom, Egalite, and Lindsay (2021) discuss, disentangling the effects of principals on achievement from other influences presents a significant challenge. Existing papers adopt different strategies, but they typically involve estimation of the variance in principal effectiveness from specifications that control for student heterogeneity and school influences not

under the control of the principal.[6] More recent work, including Branch, Hanushek, and Rivkin (2012), Laing, Rivkin, Schiman, and Ward (2016), and Bartanen, Husain, and Liebowitz (2024)), has devoted considerable attention to unobserved school and neighborhood shocks and underlying school trends that might influence the estimates of principals on student achievement. These more comprehensive efforts to account for confounding factors have produced smaller estimates of the variance in principal value added than earlier estimates, in the range of 0.03 to 0.06 standard deviations of student achievement. Although these are roughly 25 to 50 percent as large as oft-cited estimates of the variance of teacher value added, the fact that a principal affects the entire school rather than a single classroom suggests that these magnitudes are both educationally and economically significant.

2.b. Pathways to a principal position

Grissom, Egalite, and Lindsay (2021) describe national trends in principal experiences as a teacher and assistant principal, experience and tenure as a principal, post-graduate schooling and demographic characteristics. Virtually all principals hold a degree above a BA, leading us to focus on prior experiences rather than formal education. Average years of prior experience as a teacher have fluctuated, trending downward since 2000, while the share of principals who served previously as an assistant principal has climbed from 50 percent in 1988 to 77 percent in 2016. As we show below, however, within these national trends are pronounced state differences in the share of principals with no prior teaching experience or no prior experience as an assistant principal in the state public schools.

Principals are not randomly assigned to have different types of experiences, impeding efforts to identify causal impacts of prior teaching and assistant principal experience on achievement growth. Of particular concern is the possibility that principals with more limited prior experiences may have been hired because of other offsetting strengths that are unobserved to the researcher. Nevertheless, evidence on the relationships between effectiveness as a principal and prior experiences can provide valuable information for education policymakers.

[6] These papers include Bartanen and Grissom (2023), Branch, Hanushek, Rivkin, and Schiman (2020), Chiang, Lipscomb, and Gill (2016), Dhuey and Smith (2014), Hochbein and Cunningham (2013), and Laing, Rivkin, Schiman, and Ward (2016).

Goldring, Rubin, and Herrmann (2021) summarize the mixed qualitative and quantitative evidence on the effects of assistant principal experience on effectiveness as a principal. On the one hand, six of the summarized studies find that principals believed that experience as an assistant principal provided important preparation for school leadership.[7] On the other hand, the summary shows little evidence of a relationship between principals' and teachers' perceptions of school climate, their job satisfaction, and whether they had experience as an assistant principal.

Research not included in the above summary is similarly mixed. Bowers and White (2014) find that test score proficiency is positively related to principal experience as an assistant principal in Chicago Public Schools, and Bastian and Henry (2015) find that prior experience as an assistant principal in a high value added school increases effectiveness as a principal. In contrast, Grissom, Egalite, and Lindsay (2021) find no significant relationship between prior experience as an assistant principal and principal effectiveness as measured by supervisor evaluations, and Bastian and Henry (2015) find no significant relationship between math and reading scores on state standardized tests and years of prior experience as an assistant principal. Finally, Clark, Martorell, and Rockoff (2009) find no significant relationship between math and ELA test scores and years of prior experience as an assistant principal, though they do find that service as an assistant principal in the same school increases the productivity of novice principals.

In contrast to the small but growing body of research on the effects of prior experience as an assistant principal, little work investigates the effect of principals having prior teaching experience. This amplifies the value of our descriptions of prior teaching experience and its association with principal value added. Although it may be typical for principals to have prior teaching experience, some of our states include a nontrivial share of principals with no prior teaching experience in their state's public schools. This may reflect an emphasis on the importance of general leadership skills obtained in business or military service, which may be viewed as a substitute for prior education-specific experience as a teacher.

[7] These studies include Caruso (2013), DiPaola and Tschannen-Moran (2003), Fuller, Hollingworth, and An (2019), Lee (2015), Nelson, Maria, and Boone (2008) and Parylo, Zepeda, and Bengtson (2013).

3. Data and State Regulations

This section describes the state administrative data and regulatory environments that determine eligibility to work as a school principal. There are many similarities in state data systems and regulations governing school leaders, though there are also notable differences.

3.a. State data

State departments of education provided administrative data about principals, schools, and students that allow us to estimate value-added models and describe pathways to the principalship.[8] The basic structure of the data is the same across all six states: principals and students are linked to schools and can be tracked over time even if they switch schools (within state) or switch roles and job titles. Each state's data span different years and contain slightly different information, but our strategy exploits the fact that they have similar structures and contain much information in common. For instance, each state provides information on educator experience and education, standardized test scores, and student demographics including race, gender, and free- or reduced-price lunch (FRL) eligibility status. The state data-use agreements require that we conduct separate analyses and not pool the data.

The beginning date of the longitudinal panels we utilize varies across states; we use the first school year in which principals can be linked to schools for the employment panel, which goes back to the 1990s in most states. We set a common last school year of the panels at 2014-15. Table 1 reports the time period, number of principals, and number of students for each state. Not surprisingly given the variation in state size and the time periods for which we have principal data, the total number of principals in our study differs substantially across states, exceeding 11,000 in Texas and below 700 in Massachusetts.

We consider principals of K-8 schools, and subsets of grades therein, which we define as settings where the highest grade is equal to or less than 8th grade (i.e., non-high schools). We

[8] Specifically, from the GAAWARDS database in Georgia, which contains K-12 data from the Georgia Department of Education and is administered by the Governor's Office of Student Achievement. Data for Massachusetts have been provided by the Department of Elementary and Secondary Education in Massachusetts. Data for Missouri have been provided by Missouri Department of Elementary and Secondary Education. The North Carolina data come from the North Carolina Education Research Data Center (NCERDC). This research was also made possible through data provided by the Texas Schools Project at the University of Texas at Dallas. Data for Washington have been provided by the Office of the Superintendent of Public Instruction in Washington state. We are grateful to each of these states for providing the data for this research.

exclude high schools because we cannot estimate value added for principals in high schools in all states given the limited high-school state assessments. We exclude charter schools because some states have no charter schools during the period we study (Washington) and others have very few.[9] Finally, to ensure we are capturing individuals whose main job is serving as a principal, we restrict the data to principals reported to serve in a single school for at least 0.5 FTE in a given year.

For some of our descriptive analyses about the pathway to the principalship we use all of the historical data in each state. But information about principals and their school assignments predates the ability to estimate value-added models, a task that requires annual testing and students linked to schools. Thus, for the value-added analyses we use a subset of the historical data in each state that includes just the time period over which reliable value-added models can be estimated.

A final issue related to cross-state comparisons of achievement growth is the association between movements in state test distributions and differences in actual knowledge. Because the content of state tests can differ, it is difficult to reliably relate differences in the state score distributions to differences in knowledge (Ost, Gangopadhyaya, and Schiman (2017)). We use cross-state variation in performance on the NAEP (which is a consistent achievement measure across states and over time) to gain some insight into this issue. For example, the smaller standard deviation in Texas NAEP mathematics scores relative to other states shown in Appendix Table A1 suggests that a one standard deviation move along the standardized Texas state test score distribution reflects a smaller difference in actual knowledge than, for example, a one standard deviation change in the standardized Washington state test score distribution (which has the largest standard deviation). However, importantly, the differences in standard deviations on the NAEP math test are relatively small across states, with a standard deviation of 33 in Texas, and standard deviations in the remaining five states falling narrowly between 36 to 40.[10]

[9] Where available, we do use data on employment in charter schools and high schools to determine the amount of prior employment experience and tenure of principals.

[10] The standard deviation of national NAEP scale scores for eighth grade mathematics is very stable over our sample period, falling between 36.2 and 36.8.

3.b. State regulations

All states have adopted standards to guide school leadership policies (Scott (2017, (2018)). These standards can entail the requirement of specific types of preparation and training in leadership certification programs; minimum hours of supervised field experiences prior to certification; achievement of a minimum GPA; and although not universal, most states require that principals have a master's degree, at least some prior experience as a teacher, and pass one or more licensure tests.

Although states largely have similar sets of requirements for principal licensure, there are some differences (see Appendix Table A.11). For example, all six of our sample states currently require between two and three years of prior experience in schools or the education system, a valid teacher's certificate, and, with the exception of Washington, a passing score on a standardized exam adopted by the state board. At the same time, alternative routes to administrator/principal certification are available to those who hold a bachelor's degree but did not complete a traditional certification program in Massachusetts, Missouri, North Carolina, and Washington. Completion of a leadership preparation program is required by all six states.

The states also vary in the degree of flexibility around the master's degree requirement. For example, Massachusetts has the most flexible standard, allowing for either the completion of an approved master's program with a supervised practicum, completion of an apprenticeship, or approval through a panel review. On the other hand, North Carolina is more stringent, requiring a master's degree from a public-school administration program or a different master's degree from an accredited program plus completion of a public-school administration program meeting established standards. Notably, North Carolina also has more pronounced distinctions between assistant principals and principals with respect to the expectations, responsibilities, and requirements of the position. Along with seven other states, North Carolina invests in the professional development program, AP Ready, which prepares assistant principals for the demands of the principal role and is tailored to fit regional needs (New Leaders (2018)).

Many of the standards described above were in place prior to the passage of the Every Student Succeeds Act (ESSA), which at least in theory, shifted considerable control of the public education system to state and local governments (McGuinn (2016)). ESSA gives "unprecedented recognition" for the role of principals and urges the implementation of effective principal

recruitment strategies as well as strong preparation and ongoing professional learning. States implemented some changes after ESSA (see Appendix Table A11) that were likely influenced by the increased state flexibility afforded by its passage. For example, Massachusetts has made it a priority to expand the pipeline of qualified principals in the school system and reduce waivers of requirements.[11] However, on the whole, there appears to be little legislative reform of requirements for new principals in our focus states over the timespan of our analysis:[12] a search on principal requirements in all six states' administrative code in the last 20 years revealed no significant legislative changes related to principals.[13] This is consistent with a report by the National Center for Education Statistics that compares principal characteristics in 1987-88 with those in 2011-2012 and finds little in the way of change in principal demographics over this time period (Hill, Ottem, and DeRoche (2016)).[14]

4. Conceptual Framework

The value of personnel policies for principals ultimately depends on their impacts on school quality, and this remains an open question. As discussed above, the evaluation of principal effectiveness is inherently a difficult problem, complicating the estimation of both the variance in principal value added and the effects of regulations and prior experiences on principal productivity. We use an identical empirical approach to estimate principal value added in each state—described in detail below—that accounts for primary confounding factors including student heterogeneity, unobserved school and neighborhood differences, and random school-level shocks. Importantly, while our approach may modestly overstate the variance of principal value added, it shares the same deficiency across states. Therefore, comparisons capture the general magnitude of state differences in the variance of principal value added.

[11] In Massachusetts, a principal candidate can have their requirements waived by the commissioner, which leads to educators being placed in positions for which they are not certified.
[12] The only notable exception is a Washington House Bill in 2002 that added the requirement of candidates to have held a valid teacher or educational staff associate certificate and demonstrated school experience (see Appendix Table A11).
[13] It is possible, however, that there are more significant changes in regulatory interpretation of state laws; unfortunately, it is infeasible to track such changes.
[14] The report found that across the two periods, only one to three percent of public-school principals had a bachelor's degree or less. The percentage of those with a master's degree was 62 percent in 2011-2012 compared to 53 percent in 1987-1988. Likewise, public school principals in 2011-2012 had only about one less year of teaching experience than in 1987-88.

Similarly, estimation of the relationship between achievement value added and prior experiences as a teacher and assistant principal do not identify the causal effects of these experiences because principals without such experiences likely have offsetting characteristics or job histories that contributed to their hiring. Consequently, a failure to find significant relationships between effectiveness and prior experiences does not constitute evidence that such experiences do not augment principal effectiveness. Such a finding could indicate no impact or could indicate that others in the applicant pool have compensating factors that offset any of the benefits. Regardless, such a finding would raise questions about the efficacy of prior experience requirements, given that the requirements do not raise effectiveness or exclude ineffective principals from the applicant pool.

Throughout the analysis we focus on math achievement, the subject in which prior research indicates schools have the largest effects.[15] Importantly, we do not control for teacher effectiveness because raising the quality of instruction through personnel practices constitutes one channel through which a principal could raise achievement.

4.a. Estimation of the variance in principal value added

The estimation of the value added of principals is similar to that for teacher value added but has some advantages and faces some unique challenges. In the estimation of teacher value added, the small samples of students in classrooms leads to potentially large sampling errors that are eliminated with principals who deal with all students in school. Further, by focusing on overall school performance, biases related to assignment of teachers to students within schools are not present. But offsetting these advantages, with just one principal in any given school, it is more difficult to separate the impact of principals from other school-level factors that affect student achievement.

The value added of principals is based on the estimation of models like Equation (1) that express achievement (A) for student *i* in school *s* and grade *h*, with principal *p* and in year *t*, as a function of individual, school, and principal factors.

$$(1) \qquad A_{ishpt} = f(A_{ist-1}) + \beta X_{ist} + \gamma S_{st} + \delta_h + \phi_t + \theta_{ps} + \varepsilon_{ishpt}$$

[15] The larger impact of teachers on math tests as opposed to reading is documented in Hanushek and Rivkin (2010, (2012), Koedel, Mihaly, and Rockoff (2015), and Bacher-Hicks and Koedel (2023).

$f(A_{ist-1})$ is a cubic polynomial of prior year standardized test scores in math and reading; X_{ist} is a vector of student controls that includes indicators for gender, race/ethnicity, free and reduced price lunch eligibility, special education, and whether the student is in their first year at school *s* due to a non-structural move (i.e. it is not the first grade offered in the school); the vector S_{st} consists of school averages of the student variables in X_{ist}; the terms δ_h and ϕ_t are indicators for grade and year, respectively; θ_{ps} is a principal-by-school fixed effect; and ε_{ishpt} is a random error.

We estimate equation (1), then remove the influence of fixed school factors by demeaning θ_{ps} within schools in a second step. To demean θ_{ps} we subtract the school-average fixed effect, $\bar{\theta}_{ps} = \sum_{p=1}^{P_s} \pi_p \theta_{ps}$ where π_p is the ratio of years principal *p* leads school *s* to the total number of years school *s* appears in the data panel, and P_s is the number of principals who served at school *s*. We denote the demeaned values as $\theta'_{ps} = \theta_{ps} - \bar{\theta}_{ps}$, where θ'_{ps} can be interpreted as the difference in school performance during the tenure of principal *p* relative to school performance during the tenure of other principals at the same school. Note that school fixed effects cannot be included in models that include school-by-principal fixed effects due to perfect collinearity. The vectors X and S account for the effects of time-varying student characteristics.[16]

A concern is that if θ'_{ps} is estimated over the full term of each principal in a school, it is likely a biased estimate of the effectiveness of the principal. Both the first and last year of a principal's spell, for instance, are likely to provide error-prone signals about the value added of the principal. Principal transitions may be related to a variety of circumstances that affect achievement. For instance, a principal may be removed because of poor performance, or a principal who has decided to leave may devote less care and energy to the school's management in their final year. Consistent with such concerns, Miller (2013) illustrates a substantial decline in

[16] Our approach differs from studies such as Grissom, Kalogrides, and Loeb (2015) and Chiang, Lipscomb, and Gill (2016) that estimate principal fixed effects using models that also include school fixed effects, and Bartanen, Husain, and Liebowitz (2024), who use random effects models that sidestep the collinearity issue in fixed effect models at the potential cost of introducing specification error. Those specifications include a single indicator for each principal, and the appearance of a principal in multiple schools creates linkages among schools that foster comparisons of all principals who share the same connected network as described in these papers.

average achievement in the year prior to a principal transition, and this negative shock might not only reduce achievement growth in that year but inflate growth in the first year following the transition if the shock is transitory. This concern is heightened if principal fixed effects are estimated across the stays of principals at multiple schools, where the weight of these transition years is likely to increase relative to the non-transition years that we believe provide better information on principal value added.

To minimize the influences of any turbulence around principal transitions and to downplay the first year, when principals have far less effect on operations, we exclude the first and last years of all principal spells. We believe these trimmed spells best facilitate the estimation of systematic differences among principals. Importantly, trimming also alters the interpretation of the variance estimates, as we estimate the variance in value added during principal spells over the set of principals who remain in a school for at least three years.

An important technical issue is that the variance in estimated value added during a principal spell also reflects sampling error, the variance of which may differ in magnitude across states. The sources of such random error include test measurement error, random differences among school cohorts, and random school productivity shocks. To address this problem, we develop a randomized-inference procedure described in Appendix B by which the sampling variance of θ'_{ps} can be estimated separately for each state. We use these estimates to adjust the estimates of the variance in principal effectiveness for each state. Despite these steps, the possibility that unobserved trends at the school or neighborhood level remains, which may inflate the variance estimates. Importantly, the variance magnitudes we estimate are similar to, or only slightly larger than, the magnitudes in studies that account most comprehensively for confounding factors, including one overlapping state (Texas), reported in Branch, Hanushek, and Schiman, 2020. We believe that, even if our variance estimates are modestly overstated, they still provide informative comparisons across states that differ substantially in the structure of their principal labor markets.

4.a. Linking achievement growth to principals' prior assistant principal and teacher experiences

Equation (2) substitutes a vector of principal characteristics in place of the principal-school fixed effects to estimate the relationships between achievement growth and prior principal experiences as an assistant principal and teacher:

$$(2) \qquad A_{ishpt} = f(A_{ist-1}) + \beta X_{ist} + \eta C_{ps} + \gamma S_{st} + \delta_h + \phi_t + \psi_s + \varepsilon_{ishpt}$$

The vector C includes an indicator for no prior experience as a public-school assistant principal or teacher, an indicator for prior experience as a teacher but not as an assistant principal, and principal experience indicators (the omitted category includes principals with prior assistant-principal experience).

As stated above, η does not identify the causal effects of prior experiences due to the potential relationship between prior experiences (C) and unobserved determinants of principal effectiveness. In general, it is not possible to sign that relationship definitively. It seems likely that the experience indicators would be negatively correlated with the error due to the selection process for principals. In particular, skills not observed by the researcher would be expected to compensate for limited prior experiences. We would expect such compensation to be stronger in states with weaker prior experience requirements, as administrators would have greater leeway to substitute among different productive factors. In any case, a finding of no significant returns to experience is consistent with the possibility that other unobserved skills can compensate for a lack of prior experiences. If this finding holds, requiring prior experiences would exclude some individuals from the applicant pool whose effectiveness would be as high, on average, as those with prior experiences as a teacher or as an assistant principal.

5. The variance in principal effectiveness

Table 2 reports the unadjusted estimates of the variance of principal value added based on Equation 1, estimates of the sampling variance (estimated following the procedure outlined in Appendix B), and estimates of the variance of principal value added adjusted for the sampling variance (difference between rows 1 and 2, expressed in standard deviation units). Note Table 2 includes estimates for only five of the six states because estimates are not available for North Carolina. The adjusted estimates of a one standard deviation change in value added during principal spells range from 0.042 in Missouri to 0.064 in Massachusetts. Importantly, larger differences appear in the unadjusted variance estimates, and the much smaller variation across states following the adjustment highlights the importance of accounting for sampling error. All of the variance estimates in the table are statistically significant, per the testing procedure outlined in Appendix B.

Interestingly, the estimate of 0.056 standard deviations for Texas is quite similar to an alternative estimate for Texas of 0.052 standard deviations based on a different empirical approach that accounts more comprehensively for unobserved school trends discussed above (Branch, Hanushek, Rivkin, and Schiman (2020)). The close similarity with estimates produced using the alternative method supports the belief that upward bias is likely modest.

At first inspection, these differences in effectiveness might seem small, since the standard deviation of within-school gains for teachers has been estimated at more than twice the magnitude (Hanushek and Rivkin (2010)). But principals affect all students in a school, while teachers affect only students in their classroom. If the hiring of a more effective principal were to increase value added by 0.05 standard deviations for *all students* in the school, the impact of hiring a one-standard-deviation more effective principal would be substantially greater in most schools than that of hiring a single one-standard-deviation more effective teacher.

6. Principal pathways and value added

There are large differences in the prior backgrounds of principals across states, variation that is at least partially the result of different organizational and regulatory environments.[17] We first describe key differences in the pathways to the principalship in the six states overall and by school racial composition, share economically disadvantaged, and district size. We then estimate the relationships between principal value added and prior experiences as a teacher and assistant principal. Importantly, prior experiences in private schools or in other states will not be counted because these experiences are not observed in the state administrative data.[18] It is possible that some principals taught in other states or outside of the public schools, and thus the tables and figures may overstate the shares with no prior experience.

We also consider principals' prior experiences in the same district or school, and differences by school socioeconomic composition. Specifically, we divide schools by percent

[17] This study focuses on prior teaching and assistant principal experiences and not other career-path dimensions including effectiveness as a teacher and assistant principal, experience in other administrative positions, or work histories outside of public education. Goldhaber, Holden, and Chen (2019) and Liebowitz and Porter (2022) consider the relationship between effectiveness as a teacher and as a principal and other types of administrative experience. Moreover, Grissom, Woo, and Bartanen (2020) find positive relationships between performance rating as a principal and ratings as a teacher and assistant principal.

[18] This issue may be more important in Massachusetts where large cities are located close to places in other states that might be feeders for schools hiring principals. See below for further discussion.

Black, percent Hispanic and percent low income into three categories: less than 25%, 25-75%, and greater than 75%.[19] Following these descriptions, we report estimates of the relationships between achievement gains and prior experiences as a teacher and assistant principal based on Equation (2).

6.a. Prior teaching and assistant principal experience

Table 3 reports the proportion of first-time principals that had no prior teaching experience and no prior managerial experience as an assistant principal in their state public schools for the 2014-2015 academic year, by school racial composition and economically disadvantaged share (the complete distribution of prior managerial and teaching experience is found in Appendix Tables A7-A9). Given the standard view that principals should be instructional leaders, we were surprised to find the lack of teaching experience in MA and WA. Just 3.8 percent of new principals in Texas, but a surprising 15.2 percent in Massachusetts, and 17.8 percent in Washington, had no teaching experience in state public schools. Even more striking is the difference in prior experience as an assistant principal in a state public school. 57.6 percent of new principals in Massachusetts had no such experience, multiple times the rate for new principals in North Carolina (9.3 percent) and Texas (19.3 percent).[20]

A concern with these comparisons is that we cannot observe out-of-state experience in our state data panels. To get a sense of how important this might be, we take a deeper look at Massachusetts—due to its geography, educators there likely have higher interstate mobility than in the other states. Specifically, we use IPUMS data to estimate the proportion of K-12 educators (teachers, principals, and other educator positions) who lived outside of Massachusetts five years earlier. A total of 7.7 percent lived in a different state, but only 2.5 percent lived in the surrounding states of Connecticut, Vermont, New Hampshire, or Rhode Island. This may have a substantial effect on the share of principals without prior teaching experience given the baseline of 15 percent, but it is unlikely to have a substantial effect on the share of principals without prior assistant principal experience given a baseline share of 58 percent.

[19] Note that these are schools divided by specified shares of students in each school with the identified characteristic, not by percentiles of the student population per se. We organize the table this way in order to compare distributions among schools with similar demographic compositions in the six states.

[20] Note that this table was constructed after data access expired for the Georgia research team.

The patterns of differences in prior teaching experience by race, ethnicity and income differ from one another and across states. In Missouri and Massachusetts schools with a Black enrollment share that exceeds 25% are more than twice as likely to have a principal with no prior experience as a teacher, while in Texas the large difference appears to occur at a much higher level of Black enrollment. In contrast, in North Carolina a very small share of principals lack prior teaching experience, and there is also little variation by Black enrollment share. Nonetheless, the top panel suggests that higher Black enrollment share schools generally have greater difficulty attracting and retaining principals with experience as teachers.

State differences in the patterns by Hispanic enrollment share and income are even more striking. The Hispanic enrollment share in Texas far exceeds that in the other states, and there is a small negative relationship between share with no prior teaching experience and Hispanic enrollment share in Texas. In contrast, the other four states exhibit strong, positive relationships between share with no prior teaching experience and Hispanic enrollment share. Finally, the states differ substantially in the association between share with no prior teaching experience and percent economically disadvantaged.

The patterns for the fraction of principals with no prior assistant principal experience differ substantially from those for teachers. The fraction with no prior assistant principal experience increases with the black enrollment share in only two of the four states with information in multiple Black enrollment share categories and increases with Hispanic enrollment share in only three of the five states. Again, there is no consistent pattern by low-income share.

It is useful to put these two distributions together and additionally examine differences by district size and where principals served as teachers and assistant principals. Figure 1 summarizes the salient differences in the joint distributions of teaching and assistant principal experience by district size. The left bar of the graph for each state shows the distribution of new principals that had experience as an assistant principal, as well as where the stint as an assistant principal occurred. The middle bar describes the distribution of teaching experience for new

principals who had not been assistant principals. The right bar shows the proportion of new principals with neither type of prior experience.[21]

We begin with a discussion of the experience distribution for Texas in Panel A to clarify the structure of the figure. The left bar illustrates that 86 percent of principals have assistant principal experience, with 19 percent having worked as assistant principals in the same school (blue rectangle), roughly half in the same district but not in the same school (orange rectangle), and around 15 percent in another Texas district (grey rectangle). Out of the 14 percent of principals with no prior assistant principal experience, 1 percent had no teaching experience while most of the remainder had teaching experience in the same district but not the same school.

Internal labor markets seem particularly important in Georgia and North Carolina, two states with smaller numbers of relatively large districts. In these states, the vast majority of principals accumulated experience in the same district before their first stint as a principal. By comparison, principals in Washington, Massachusetts, and Missouri, three states with large numbers of small districts, were relatively more likely to gain experience in other districts.

Because of the heterogeneity in district structures and urbanicity—items that might affect elements of the labor market for principals, we also consider differences by district size. Table 4 shows that it is more likely that principals without prior teaching experience in the state are generally found in large districts (greater than 10,000 students) than in small districts (less than 10,000 students). In addition, Figure 1 shows that the probability that a principal obtains assistant principal experience in another district is higher in smaller compared to larger districts. This makes sense given the smaller pool of potential principals and principal positions in smaller districts. It is also not surprising that the probability of having obtained experience in the same school is higher in smaller districts where the school constitutes a larger fraction of the internal labor market.

6.b. Value-added differences by pathway

Next, we examine whether prior teaching and assistant principal experience are related to principal value added. The coefficients reported in Table 5 come from the estimation of variants of Equation (2). Coefficients reported in horizontal Panel A start with specifications that neither

[21] See Appendix Table A10 for the full joint distribution.

control for principal experience nor school fixed effects; specifications reported in Panel B control for principal experience, and the specifications reported in Panel C control for both experience and school fixed effects. Standard errors are clustered at the school level in all specifications.

The table reveals little or no evidence of systematic differences in value added by either prior teaching experience or assistant principal experience in any state, including those with very strong requirements, despite the large differences in the experience distributions illustrated in Figure 1. For example, in the top row of the table, only two of the six coefficients on the indicator for no prior experience as a teacher or assistant principal in the state public schools is negative, and none of the estimates in any specification are significant at conventional levels. The absence of positive, significant coefficients on prior teaching or assistant principal experience indicate that principals without prior teaching or assistant-principal experience are observed to be as effective on average as those with such experiences, conditional on being hired. This suggests any benefits of prior experience are not large enough to offset other factors considered in the hiring process and raises doubts about prior experience as a teacher or assistant principal playing a special role in the development of principal skills beyond other types of experiences.

6.c. Differences in principal experience and tenure

Service as an elementary or middle school principal is an important steppingstone to another, potentially more desirable principal position such as high school principal, as districts likely value such experience. Districts likely also value stability, as frequent transitions can disrupt school operations and adversely affect achievement (Miller (2013)). Unstable school leadership in schools serving high-poverty children evokes particular concern, leading us to describe tenure and experience distributions by student demographic characteristics.

Table 6 highlights the key elements of the distribution of principal experience and tenure. The proportion of new principals is remarkably similar across the states, particularly given the differences in growth in the number of schools and enrollment. Interestingly, Texas and Georgia had strong enrollment growth over the 2005-2015 decade, but Massachusetts had significant declines (Appendix Table A4). Nonetheless, neither the proportion of new principals nor the proportion of more experienced principals (five years or more) varies hugely across the states.

The overall pattern lines up with national figures showing that principals tend to have 6-7 years of experience on average and median spells of roughly 4 years (Taie and Goldring (2017).

There is more variation in years of tenure, though it is also fairly similar across states. As seen in Table 6, North Carolina and Texas have fewer principals with long tenure in their school, whereas principals in Missouri and Washington are more likely to have long tenure – almost 10 percent have served at least eleven years in the current position (Appendix Table A4).

Table 7 shows the variation across states in the distribution of prior principal experience by student characteristics. The right panel reveals large differences in the extent to which principals with little experience are concentrated in high poverty schools.[22] Massachusetts and Missouri exhibit particularly strong ordering by poverty rate, where the probability of having a principal in their first or second year is roughly one third in schools with at least 75 percent of students eligible for a subsidized lunch but less than 20 percent in schools with less than 25 percent economically-disadvantaged students.

Patterns by race are shown in the left panels of the table. The probability of having a principal in their first or second year in schools where Black enrollment exceeds 75 percent of the total is greater than 30 percent in Missouri and North Carolina and approaches 50 percent in Texas. In other states, however, the patterns are less consistent. As noted above, the three states with the largest differences by the Black enrollment percentage possess divergent district structures, regulatory environments, and practices in terms of prior experiences as a teacher or assistant principal. This suggests the need for other policies to stabilize leadership in schools that currently exhibit extensive turnover.

7. Conclusion

States differ markedly in rules governing school leadership and the structure of principal labor markets. We describe differences in the pathways to the principalship and associations between principal value added and prior principal experiences for six very different states. Separate state teams adopted common protocols that permit comparison across states,

[22] Principal turnover may adversely affect education quality, and a higher share of inexperienced principals is associated with a higher rate of turnover. Béteille, Kalogrides, and Loeb (2012) find adverse turnover effects.

uncontaminated by differences in researcher choices. Although we do not identify the causal effects of prior experiences on principal value added and it is likely that time-varying school influences introduce modest upward bias to the variance estimates, the state comparisons provide policy-relevant information on principal labor market regulations.

Cross-state estimates in the variation of principal value added are remarkably similar even though there are dramatic differences in the state regulatory policies and the shares of principals without prior experience as a teacher or assistant principal. For instance, in 2015 in Texas, less than 4 percent of first-time public-school principals had no prior experience as a teacher and only 19 percent had no prior experience as an assistant principal; the corresponding numbers in Massachusetts were 15 and 58 percent. The modest differences in the variance of principal value added across states, despite such large differences in prior experiences, suggests that prior experience requirements may not be having the desired effect of raising the quality of school leaders.

Much of the existing state regulation of principals attempts to reduce the variation in principal impacts, specifically by putting a floor on the quality of applicants for principal positions. Regulations dealing with training requirements such as the ubiquitous requirement of graduate level leadership training fit this purpose. So do requirements for prior teacher or assistant principal experience. Although we are not able to identify the causal effects of these prior experiences on principal effectiveness, our analysis provides little support for the efficacy of such regulatory policies. The absence of significant relationships between prior teaching or assistant principal experience and student achievement growth is consistent with either no benefits of the prior experiences or positive benefits that are offset by other characteristics of principals without these experiences. In either case, the results raise questions about the efficacy and distributional consequences of entry requirements.

Importantly, education and experience requirements increase the "cost" of becoming a principal and likely discourage some with strong leadership skills from entering the profession. Adverse effects on principal supply may be particularly harmful for schools serving high fractions of Black and low-income students that may have more difficulty attracting and retaining effective school leaders. The findings in this study echo the findings of research on teachers showing substantial overlap in effectiveness across educators with different credentials,

post-graduate schooling, and experience. As is the case for teachers, these results suggest the possibility that it may be more productive to focus on the evaluation and support of principals than on entry requirements.

Project Organization

The project was conducted under the auspices of the National Center for the Analysis of Longitudinal Data in Education Research (CALDER). It was coordinated at the Texas Schools Project of the University of Texas at Dallas by Steven Rivkin. Members of the state-specific teams are: Georgia (Wes Austin andTim Sass); Massachusetts (Bingjie Chen); Missouri (Cory Koedel, Eric Parsons); North Carolina (Helen Ladd and Mavzuna Tureava); Texas (Eric Hanushek, Jin Luo, Greg Phelan, Steven Rivkin); and Washington (Dan Goldhaber and Kris Holden).

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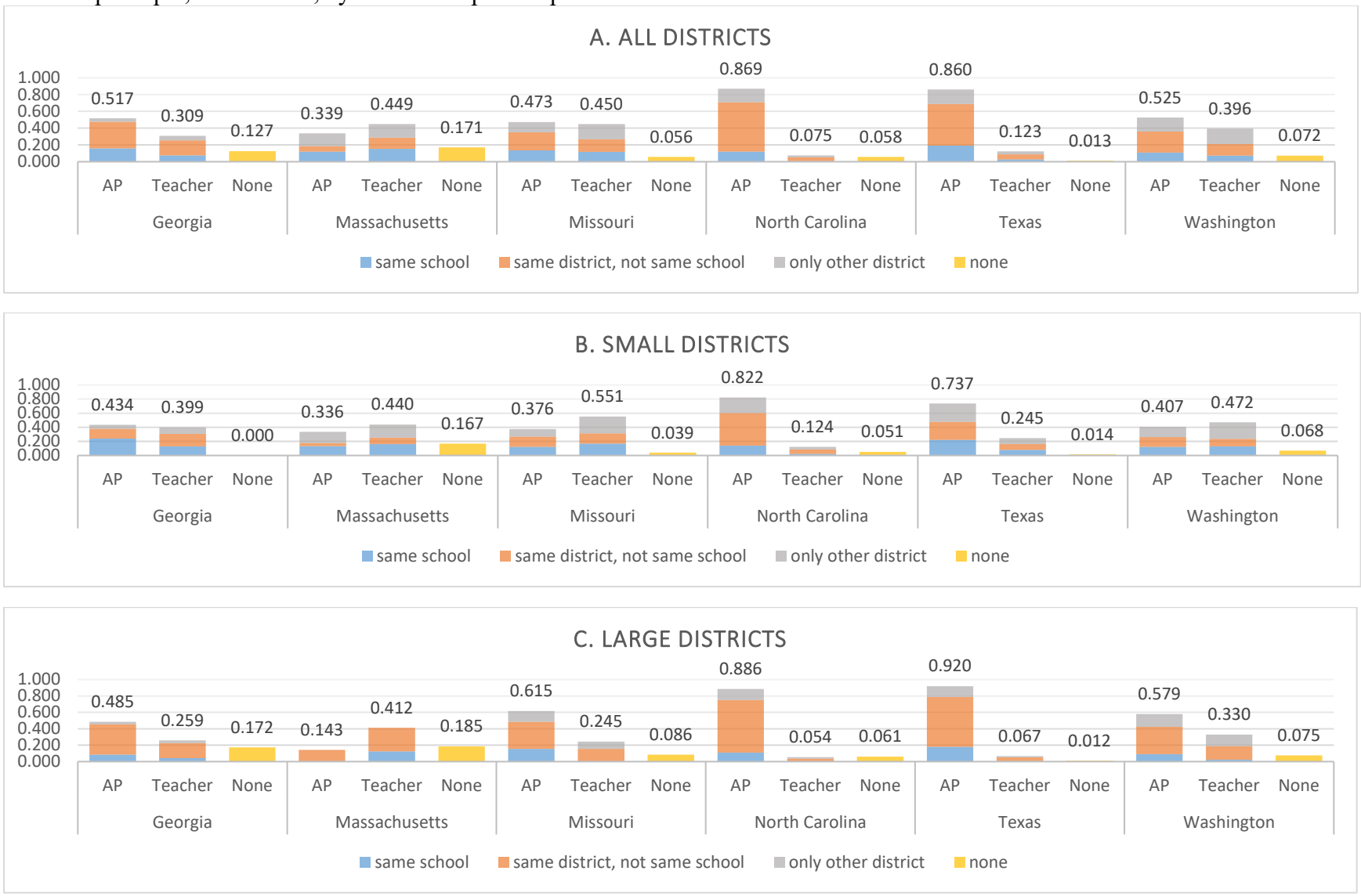
Figure 1. Proportion of principals with prior experiences as an assistant principal, and for those with no prior experience as an assistant principal, as a teacher, by location of prior experience and state.



Notes: The samples include all principals who work in K-8 schools (defined in Table 1) in the 2014-15 school year who (a) appear after the first year of each state's panel or (b) appear in the first year of the panel as a teacher. For educators appearing in the first year as a teacher, all prior experience is assumed to be teacher experience. The left bar for each state shows the share of principals with prior experience as an assistant principal, by location, regardless of whether they had prior experience as a teacher. The middle bar for each state shows that share of principals with prior teaching experience but no prior experience as an assistant principal, by location.

Table 1. Sample Years and Observations Across All States

	Employment Data		Value-added Sample Data			
	From	To	From	To	Principal-Year Observations (Unique Principals)	Student-Year Observations (Unique Students)
Georgia	2006-2007	2014-2015	2008-2009	2014-2015	1010 (401)	314,980 (203,555)
Massachusetts	2007-2008	2014-2015	2009-2010	2014-2015	2055 (664)	538,438 (298,647)
Missouri	1991-1992	2014-2015	2006-2007	2014-2015	4595 (1252)	1,052,578 (528,119)
North Carolina	1998-1999	2014-2015	1998-1999	2014-2015	18,677 (4,449)	3,809,076 (1,908,307)
Texas	1994-1995	2014-2015	1995-1996	2014-2015	49,135 (11,431)	9,359,523 (4,936,073)
Washington	1983-1984	2014-2015	2006-2007	2014-2015	3791 (906)	947,199 (485,986)

Table 2. Estimated Within-School Standard Deviation in Value-Added during principal spells to Math Test Scores Accounting for Sampling Error, by State

	GA	MA	MO	TX	WA
1. Estimated variance based on actual data	0.012	0.009	0.008	0.023	0.008
2. estimated variance under the null of no true quality variation based on the average of 300 iterations	0.009	0.005	0.006	0.019	0.005
3. Estimated standard deviation of principal quality (square root of difference between 1 and 2)	0.049	0.064	0.042	0.056	0.051

Notes: Variance estimates for North Carolina are unavailable. The value-added models regress student test scores on a cubic polynomial of prior year achievement, student indicators for gender and race/ethnicity, an indicator for whether the student is in their first year in the school, and indicators for participation in LEP, SPED, and FRL programs. We also include school-averaged versions of these variables, year and grade indicators, and principal-by-school fixed effects. After estimating the models, we demean the principal-by-school fixed effects by school means. School means are the weighted average of principal-by-school fixed effects, weighted by the years of service for each principal. Appendix A describes the adjustment of the variance estimates to account for state differences in sampling variance.

Table 3. Proportion of First-Time principals with no prior experience as a teacher or assistant principal, AY 2014-2015, by school racial composition, share low income and state

	% Black			% Hispanic			% economically disadvantaged			All
	<=25%	25-75%	>75%	<=25%	25-75%	>75%	<=25%	25-75%	>75%	
1. no prior experience as a teacher										
Georgia	*	*	*	*	*	*	*	*	*	0.155
Massachusetts	0.126	0.316	**	0.092	0.278	**	0.111	0.129	0.235	0.152
Missouri	0.054	0.130	0.240	0.075	0.273	**	0.063	0.035	0.182	0.088
North Carolina	0.060	0.076	0.063	0.059	0.110	**	0.067	0.051	0.084	0.066
Texas	0.035	0.047	0.094	0.051	0.039	0.025	0.072	0.035	0.032	0.038
Washington	0.173	**	**	0.142	0.283	**	0.241	0.145	0.217	0.178
2. no prior experience as an assistant principal										
Georgia	*	*	*	*	*	*	*	*	*	0.427
Massachusetts	0.541	0.737	**	0.552	0.583	**	0.611	0.565	0.559	0.576
Missouri	0.557	0.391	0.480	0.522	0.636	**	0.313	0.548	0.545	0.525
North Carolina	0.073	0.120	0.125	0.086	0.135	**	0.133	0.066	0.122	0.093
Texas	0.195	0.159	0.359	0.237	0.181	0.173	0.114	0.220	0.180	0.193
Washington	0.480	**	**	0.480	0.434	**	0.414	0.427	0.609	0.470

Notes: **indicates small cell sizes for which proportions are not reported. *indicates that figures could not be produced because data access expired for the research team in Georgia prior to the production of this table.

Table 4. Proportion of First-Time principals with no prior experience as teacher or assistant principal, AY 2014-15 K-8 principals, by district size and state

	No Prior Teaching Experience	No Prior Experience as Assistant Principal
Panel A. Small Districts (fewer than 10,000 students)		
Georgia	0.080	0.414
Massachusetts	0.207	0.607
Missouri	0.055	0.590
North Carolina	0.141	0.172
Texas	0.012	0.258
Washington	0.091	0.540
Panel B. Large Districts (more than 10,000 students)		
Georgia	0.197	0.435
Massachusetts	0.193	0.664
Missouri	0.105	0.350
North Carolina	0.190	0.112
Texas	0.022	0.079
Washington	0.109	0.406

Notes: Individuals in the table include all principals who work in K-8 schools (defined in Table 1) in the 2014-15 school year who (a) appear after the first year of each state's panel or (b) appear in the first year of the panel as a teacher. For educators appearing in the first year as a teacher, all prior experience is assumed to be teacher experience. Prior experience includes any experience as a teacher in the data regardless of sector (e.g. K-8 or high school), and we include prior experience as a teacher in a charter school where data is available.

Table 5. Differences in Achievement Growth by Pathway to the Principal Position, by State and controls (sample restricted to the first time an educator is observed as a principal)

	Georgia	Massachusetts	Missouri	North Carolina	Texas	Washington
A. No controls for principal experience or school fixed effects						
No prior experience as a public-school assistant principal or teacher	-0.011	0.017	0.005	0.008	0.002	-0.001
	(0.016)	(0.009)	(0.012)	(0.005)	(0.015)	(0.013)
Prior experience as a teacher but not as an assistant principal	-0.006	0.035***	0.014	-0.000	0.004	0.019**
	(0.021)	(0.012)	(0.009)	(0.010)	(0.005)	(0.009)
B. Controls for principal experience						
No prior experience as a public-school assistant principal or teacher	-0.014	0.017	0.003	0.005	0.001	-0.003
	(0.015)	(0.009)	(0.013)	(0.005)	(0.015)	(0.013)
Prior experience as a teacher but not as an assistant principal	-0.006	0.039***	0.012	-0.001	0.003	0.017
	(0.015)	(0.012)	(0.009)	(0.010)	(0.005)	(0.009)
C. Controls for principal experience and school fixed effects						
No prior experience as a public-school assistant principal or teacher	0.035	-0.002	-0.045	0.007*	0.013	0.039**
	(0.042)	(0.019)	(0.031)	(0.004)	(0.022)	(0.017)
Prior experience as a teacher but not as an assistant principal	-	0.037	0.022	0.021***	0.003	0.020
		(0.027)	(0.027)	(0.007)	(0.013)	(0.014)
Observations	285833	684144	703579	2,476,359	2805267	1237479

Notes: The value-added models regress student test scores on indicators for 1) prior experience as a teacher but not as an assistant principal; 2 no prior experience as a teacher or an assistant principal (prior experience as an assistant principal is the excluded category), a cubic polynomial of prior year achievement, student indicators for gender and race/ethnicity, an indicator for whether the student is in their first year in the school, and indicators for participation in LEP, SPED, and FRL programs. We also include school-averaged versions of these variables, year and grade indicators, and indicators for principal experience or school fixed effects in some specifications. In Georgia, cells that represent less than 10 individuals are masked with a dash (-).

Table 6. Distribution of K-8 School Principal Tenure and Experience in 2014-15, by State

	1-2	5 or more
Years of Experience as Principal		
Georgia[a]	0.23	0.54
Massachusetts[b]	0.26	0.54
Missouri	0.23	0.58
North Carolina	0.26	0.56
Texas	0.29	0.51
Washington	0.25	0.58
Years of Tenure at Current School		
Georgia[a]	0.32	0.41
Massachusetts[b]	0.38	0.39
Missouri	0.35	0.42
North Carolina	0.43	0.31
Texas	0.31	0.32
Washington	0.40	0.36

Notes: Individuals in the sample include only principals who work in K-8 schools (defined in Table 1), in the 2014-15 school year. Prior experience includes any experience as a principal in the data regardless of sector (e.g. K-8 or high school), and we include prior experience as a principal in a charter school where data is available. By construction, all individuals in the sample have at least 1 year of experience & 1 year of tenure at current school. We ignore gaps in service and calculate the sum over all years for tenure at current school. We define "pre-service windows" in each state to deal with left censuring of experience and use these to identify whether individuals have 5 or more years of experience or tenure.

Table 7. Share of schools in 2014-15 who have a principal in their first or second year in the principal role, by school demographic characteristics and state

	% Black			% Hispanic			% economically disadvantaged			All
	<=25%	25-75%	>75%	<=25%	25-75%	>75%	<=25%	25-75%	>75%	
Georgia	*	*	*	*	*	*	*	*	*	0.155
Massachusetts	0.253	0.318	0.182	0.229	0.323	0.415	0.195	0.276	0.326	0.259
Missouri	0.219	0.237	0.305	0.224	0.237	b	0.137	0.215	0.317	0.229
North Carolina	0.252	0.266	0.366	0.260	0.271	c	0.195	0.255	0.285	0.262
Texas	0.282	0.313	0.451	0.279	0.289	0.297	0.244	0.290	0.300	0.289
Washington	0.249	0.257	a	0.243	0.270	0.242	0.259	0.234	0.286	0.250

Notes: The columns are defined as K-8 schools (defined in Table 1) as either having less than or equal to 25%, 25% to 75%, or greater than 75% of their students as the indicated category in the 2014-15 school year. Each entry represents the proportion of schools in the given category that have a principal in their first or second year in the principal role. [a] WA has no schools with more than a 75% Black student population. [b] MO has a very small number of schools with more than a 25% Hispanic student population. [c] NC has only 2 school in >75% category. *Information is not available for Georgia because this table was produced following the expiration of data access for the research team in Georgia.

Electronic Appendices

Appendix A. Characteristics of Sample States

Appendix Tables A1-A4 provide comparisons of achievement, the structure of schools and districts, and student demographics for our six states. Appendix Tables A1 shows means and standard deviations for 8th grade NAEP scores in Mathematics and Reading that illuminate substantial differences across both dimensions. First, average NAEP scores are much higher in Massachusetts than all other states; they exceed the next highest state by about 25 percent of a standard deviation in math and 20 percent in reading. The differences in achievement for the other states tend to be far smaller and the rank ordering of the remaining states differs by subject. Importantly, these scores reflect myriad family, school and community influences and do not indicate differences in school quality. Second, the range of the standard deviation in mathematics across states is almost twice as large as the range in reading. The smaller standard deviation in Texas NAEP mathematics scores relative to other states suggests that a one standard deviation move in the standardized Texas state test score distribution reflects a smaller difference in actual knowledge than, for example, a one standard deviation change in the standardized Washington state test score distribution (which has the largest standard deviation).

Appendix Tables A2 shows the number of school districts, number of schools, school size, and enrollment share by district size, where a threshold of ten thousand students divides small and large districts. Differences among the number and size of districts illuminate striking differences in administrative structures across states that almost certainly affect the structure of the principal labor market. On the one hand, over 90 percent of the districts in Texas, Missouri and Massachusetts have fewer than 10,000 students. On the other hand, one third of North Carolina and almost 20 percent of Georgia districts have enrollment that exceeds 10,000, and the fewer number of districts creates relatively larger administrative units. Most of North Carolina's 115 districts, for example, are geographically large and county wide. Georgia schools tend to be much larger and Washington and Missouri schools much smaller than other states. This likely affects the use of assistant principals and potentially the structure of the principal pipeline—e.g., district internal labor markets might be relatively more important in the states with fewer and larger districts.

Appendix Tables A3 presents percentiles of student demographics at the school level in 2014-15, and here too we observe large differences across states. For instance, consistent with much higher NAEP scores, the Massachusetts distribution of share eligible for a subsidized lunch lies to the left of the other states. While the 25th percentile school in Massachusetts has only 17 percent of low-income students, the shares of students at the 25th percentile is more than twice as high in all the other states. The difference at the 50th percentile is smaller but still sizeable.[3]

There are also large differences in racial and ethnic diversity. Black enrollment shares are much smaller in the non-southern states than in North Carolina and Georgia. Washington in particular has only a small number of schools with even a 5 percent Black enrollment share. Hispanic enrollment is especially low in Missouri, while the median school in Texas is almost 50 percent Hispanic.

Appendix Tables A4 shows the changes in schooling across the six states between 2005 and 20215. While Massachusetts lost significant numbers of schools and students, Texas and Georgia showed dramatic growth in both.

Appendix Table A1. 8th grade scores on National Assessment of Educational Progress (NAEP) tests, math and reading

	Math		*Reading*	
	Mean	SD	*Mean*	*SD*
GA	279	36	*262*	*35*
MA	297	39	*274*	*35*
MO	281	36	*267*	*34*
NC	281	38	*261*	*38*
TX	284	33	*261*	*35*
WA	287	40	*267*	*36*

Figures are reported from U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2015 Mathematics and Reading Assessments. Panel A figures represent mean and standard deviation of 8th grade composite scores for all students tested in each sample state.

Appendix Table A2. Numbers of districts, schools serving K-8 and enrollment share, by district enrollment in 2014-15

	# Districts		# Schools		Mean School Size		Enrollment Share	
	Small dist.	Large dist.	Small dist.	Large dist.	Small dist.	Large dist.	Small dist.	Large dist.
GA	146	34	608	1174	563.2	707.5	0.709	0.291
MA	395	10	1109	316	417.0	426.9	0.792	0.208
MO	253	20	557	309	398.3	497.2	0.591	0.409
NC	77	38	548	1260	423.4	606.8	0.226	0.774
TX	1111	108	2060	3565	442.9	704.7	0.266	0.734
WA	264	31	816	795	366.0	517.7	0.435	0.565

Notes: Small and large districts are defined as having student enrollment less than or greater than 10,000 for grades K-12. All other statistics are restricted to K-8 settings, as defined by schools that have a maximum grade of 9 or less (e.g. excluding K-12 schools).

Appendix Table A3. Percentile cutoffs for student demographic characteristics, for K-8 school in 2014-15

	% Economically Disadvantaged			% Black			% Hispanic		
	25th %ile	50th %ile	75th %ile	25th %ile	50th %ile	75th %ile	25th %ile	50th %ile	75th %ile
GA	0.452	0.649	0.830	0.137	0.326	0.660	0.047	0.088	0.171
MA	0.173	0.349	0.668	0.016	0.037	0.098	0.037	0.074	0.239
MO	0.382	0.566	0.741	0.014	0.057	0.171	0.018	0.034	0.065
NC	0.435	0.611	0.956*	0.079	0.218	0.410	0.070	0.122	0.208
TX	0.436	0.663	0.841	0.015	0.056	0.150	0.240	0.472	0.788
WA	0.354	0.554	0.728	0.005	0.015	0.043	0.090	0.147	0.261

Appendix Table A4. Change in Number of K-8 Schools and Enrollment, 2005-2015

State	Change in Schools (percent)	Change in Enrollment (percent)
GA	6.40%	22.30%
MA	-4.30%	-5.80%
MO	2.70%	0.50%
NC	5.18%	4.96%
TX	8.04%	13.50%
WA	1.70%	5.20%

Appendix Table A5. Distribution of K-8 School Principal Tenure and Experience in 2014-15, by State

	1	2	3	4	5	6 to 10	11 or more
Panel A. Years of experience as a principal							
Georgia[a]	0.12	0.11	0.14	0.09	0.09	0.45 with 6 or more [a]	
Massachusetts[b]	0.14	0.12	0.10	0.09	0.54 with 5 or more [b]		
Missouri	0.09	0.14	0.11	0.08	0.08	0.32	0.18
North Carolina	0.14	0.12	0.10	0.08	0.09	0.29	0.18
Texas	0.15	0.14	0.12	0.09	0.08	0.29	0.14
Washington	0.14	0.11	0.10	0.07	0.07	0.26	0.25
Panel B. Years of tenure at current school as a principal							
Georgia[a]	0.18	0.14	0.16	0.11	0.09	0.32 with 6 or more [a]	
Massachusetts[b]	0.22	0.16	0.13	0.11	0.39 with 5 or more [b]		
Missouri	0.16	0.19	0.13	0.10	0.08	0.25	0.09
North Carolina	0.24	0.19	0.16	0.10	0.09	0.17	0.05
Texas	0.22	0.19	0.15	0.10	0.07	0.20	0.05
Washington	0.23	0.17	0.13	0.10	0.08	0.20	0.08

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Appendix Table A6. Share of schools in 2014-15 who have a principal in their first or second year in the principal role, by school characteristics and state

Panel A. Share of schools by student demographics

	% economically disadvantaged			% Black		
	<=25 %	25 to 75 %	>75 %	<=25 %	25 to 75 %	>75 %
Georgia	0.221	0.206	0.229	0.203	0.210	0.255
Massachusetts	0.195	0.276	0.326	0.253	0.318	0.182
Missouri	0.137	0.215	0.317	0.219	0.237	0.305
North Carolina	0.211	0.251	0.287	0.253	0.265	0.354
Texas	0.237	0.286	0.293	0.278	0.301	0.444
Washington	0.259	0.234	0.286	0.249	0.257	*[a]

Panel B. Share of schools by average math and reading test scores

	<= 25th percentile	25th to 75th percentile	> 75th percentile
Georgia	0.243	0.222	0.178
Massachusetts	0.359	0.233	0.174
Missouri	0.297	0.232	0.149
North Carolina	0.295	0.265	0.220
Texas	0.334	0.284	0.225
Washington	0.307	0.223	0.230

Appendix Table A7. Distribution of prior experience as a teacher for AY 2014-15 K-8 principals, by district size and state

	0	1	2	3 to 5	6 to 10	11 or more
Panel A. Small Districts (less than 10K)						
Georgia	0.080	*	*	0.06	0.246	0.606
Massachusetts	0.207	0.148	0.141	0.504 with 3 or more [a]		
Missouri	0.055	*	0.025	0.169	0.463	0.273
North Carolina	0.141	0.048	0.048	0.229	0.405	0.130
Texas	0.012	0.012	0.022	0.236	0.400	0.318
Washington	0.091	*	0.015	0.136	0.370	0.377
Panel B. Large Districts (10K +)						
Georgia	0.197	*	*	0.070	0.311	0.403
Massachusetts	0.193	0.160	0.101	0.546 with 3 or more [a]		
Missouri	0.105	*	0.041	0.229	0.373	0.236
North Carolina	0.190	0.065	0.074	0.276	0.355	0.041
Texas	0.022	0.010	0.022	0.290	0.424	0.232
Washington	0.109	0.018	0.030	0.193	0.407	0.244

Panel C. All Districts						
Georgia	0.155	*	*	0.067	0.288	0.475
Massachusetts	0.204	0.151	0.132	0.513 with 3 or more [a]		
Missouri	0.073	0.016	0.031	0.191	0.431	0.260
North Carolina	0.175	0.059	0.066	0.262	0.370	0.068
Texas	0.019	0.011	0.022	0.273	0.417	0.259
Washington	0.101	0.014	0.023	0.166	0.390	0.306

Notes: In Texas, cells that represent less than 5 individuals are masked with an asterisk (*). In Georgia, Massachusetts, Missouri, and Washington, cells that represent less than 10 individuals are masked with an asterisk (*)

Appendix Table A8. Distribution of prior experience as an assistant principal for AY 2014-15 K-8 principals, by district size and state

	0	1	2	3 to 5	6 to 10	11 or more
Panel A. Small Districts (less than 10K)						
Georgia	0.414	0.264	0.155	0.166	* with 6 or more [a]	
Massachusetts	0.607	0.096	0.134	0.151	* with 6 or more [b]	
Missouri	0.590	0.092	0.097	0.169	0.044	*
North Carolina	0.172	0.141	0.178	0.383	0.115	0.011
Texas	0.258	0.100	0.133	0.340	0.153	0.015
Washington	0.540	0.083	0.065	0.198	0.106	*
Panel B. Large Districts (10K +)						
Georgia	0.435	0.178	0.146	0.218	* with 6 or more [a]	
Massachusetts	0.664	*	0.118	0.134	* with 6 or more [b]	
Missouri	0.350	0.147	0.147	0.226	0.124	*
North Carolina	0.112	0.089	0.155	0.439	0.191	0.014
Texas	0.079	0.056	0.133	0.468	0.235	0.029
Washington	0.406	0.133	0.113	0.226	0.113	*

Panel C. All Districts

Georgia	0.427	0.210	0.149	0.199	*	with 6 or more [a]
Massachusetts	0.619	0.092	0.131	0.147	*	with 6 or more [b]
Missouri	0.505	0.111	0.115	0.189	0.073	*
North Carolina	0.131	0.105	0.162	0.422	0.168	0.013
Texas	0.136	0.070	0.133	0.428	0.209	0.025
Washington	0.468	0.110	0.091	0.213	0.110	0.008

Notes: In Texas, cells that represent less than 5 individuals are masked with an asterisk (*). In Georgia, Massachusetts, Missouri, and Washington, cells that represent less than 10 individuals are masked with an asterisk (*)

Appendix Table A9. Distribution of AY 2014-2015 K-8 principals by location of prior principal experience in another position, by district size and state

	Same district and not the same school	Only other district	None
Small Districts			
Georgia	0.086	*	0.874
Massachusetts	0.024	0.153	0.824
Missouri	0.106	0.197	0.697
North Carolina	0.242	0.086	0.672
Texas	0.146	0.143	0.711
Washington	0.159	0.208	0.633
Large Districts			
Georgia	0.083	*	0.898
Massachusetts	0.101	0.084	0.815
Missouri	0.213	0.162	0.624
North Carolina	0.329	0.071	0.600
Texas	0.234	0.081	0.685
Washington	0.274	0.162	0.565

All Districts			
Georgia	0.084	0.027	0.889
Massachusetts	0.040	0.138	0.823
Missouri	0.144	0.185	0.671
North Carolina	0.302	0.076	0.622
Texas	0.206	0.100	0.693
Washington	0.220	0.183	0.596

Appendix Table A10. Distribution teaching and assistant principal experience for AY 2014-15 K-8 principals by location of assistant principal and teaching experience and district size

A. Small Districts

Assistant principal experience	**Teaching experience**	GA	MA	MO	NC	TX	WA
Same school	Same school	0.120	0.047	0.044	0.027	0.078	0.032
Same school	Same district and not the same school	0.120	0.033	0.044	0.042	0.081	0.031
Same school	Only other district	*	0.054	0.034	0.055	0.063	0.060
Same school	None	*	*	*	0.016	*	*
Same district and not the same school	Same school	*	*	0.018	0.046	0.029	*
Same district and not the same school	Same district and not the same school	0.137	0.042	0.076	0.225	0.138	0.071
Same district and not the same school	Only other district	*	*	0.051	0.148	0.087	0.068
Same district and not the same school	None	*	*	*	0.044	*	*
Only other district	Same school	*	*	*	0.007	0.008	*
Only other district	Same district and not the same school	*	*	*	0.027	0.019	*
Only other district	Only other district	0.057	0.16	0.109	0.161	0.234	0.145
Only other district	None	*	*	*	0.024	*	*
None	Same school	0.131	0.16	0.169	0.022	0.078	0.130

None	Same district and not the same school	0.177	0.092	0.146	0.064	0.084	0.106
None	Only other district	0.091	0.188	0.236	0.038	0.083	0.236
None	None	*	0.167	0.039	0.051	0.014	0.068

B. Large Districts

Assistant principal experience	**Teaching experience**	GA	MA	MO	NC	TX	WA
Same school	Same school	*	*	0.051	0.018	0.033	0.020
Same school	Same district and not the same school	0.086	*	0.051	0.048	0.113	0.047
Same school	Only other district	*	*	0.054	0.028	0.034	0.024
Same school	None	*	*	*	0.015	*	*
Same district and not the same school	Same school	*	*	*	0.026	0.020	0.015
Same district and not the same school	Same district and not the same school	0.332	0.143	0.264	0.396	0.462	0.201
Same district and not the same school	Only other district	0.035	*	0.064	0.137	0.117	0.096
Same district and not the same school	None	*	*	*	0.084	0.010	0.022

Only other district	Same school	*	*	*	0.002	*	*
Only other district	Same district and not the same school	*	*	0.032	0.026	0.011	0.019
Only other district	Only other district	0.032	*	0.099	0.082	0.115	0.135
Only other district	None	*	*	*	0.024	0.005	*
None	Same school	0.042	0.126	*	0.002	0.006	0.024
None	Same district and not the same school	0.182	0.286	0.156	0.035	0.045	0.166
None	Only other district	0.035	*	0.089	0.017	0.016	0.140
None	None	0.172	0.185	0.086	0.061	0.012	0.075

C. All districts

Assistant principal experience	Teaching experience	Panel C. All Districts GA	MA	MO	NC	TX	WA
Same school	Same school	0.061	0.042	0.047	0.021	0.047	0.026
Same school	Same district and not the same school	0.098	0.031	0.047	0.046	0.103	0.040
Same school	Only other district	*	0.048	0.041	0.036	0.043	0.041
Same school	None	*	*	*	0.016	*	*
Same district and not the same school	Same school	0.022	*	0.017	0.032	0.023	0.014
Same district and not the same school	Same district and not the same school	0.262	0.064	0.143	0.344	0.359	0.140
Same district and not the same school	Only other district	0.033	*	0.056	0.141	0.107	0.083
Same district and not the same school	None	*	*	*	0.072	0.007	0.014
Only other district	Same school	*	*	*	0.004	*	*
Only other district	Same district and not the same school	*	*	0.017	0.027	0.013	0.015

Only other district	Only other district	0.041	0.136	0.105	0.106	0.153	0.140
Only other district	None	*	0.018	*	0.024	0.005	0.012
None	Same school	0.074	0.153	0.116	0.008	0.029	0.073
None	Same district and not the same school	0.180	0.134	0.150	0.044	0.057	0.138
None	Only other district	0.055	0.162	0.184	0.023	0.037	0.185
None	None	0.127	0.171	0.056	0.058	0.013	0.072

Notes: In Texas, cells that represent less than 5 individuals are masked with an asterisk (*). In Georgia, Massachusetts, Missouri, and Washington, cells that represent less than 10 individuals are masked with an asterisk (*)

Appendix Table A.11. Requirements for principal role and major reforms across sample states

	2018 Requirements			Major Reforms in Last 15-20 Years
	Practicum Requirement	**Prior Experience**	**Waiver of Requirements?**	**Every Student Succeeds Act Consolidated State Plan (effective 2017) and Other Legislation**
GA	750 hours	Yes, no minimum specified	Not specified	Four-tiered certification structure adopted in 2014. Principal candidates must earn an Educational Leadership – Tier II certificate. [a]
MA	Minimum 500 hours	3 years	Yes	Implemented the Massachusetts Tests for Educator Licensure, which is designed to align with the subject matter knowledge requirements for educators. [b]
MO	Minimum 300 hours	2 years	Not specified	Paths toward certification: traditional (bachelor's degree in some education field earning an initial certificate), alternative (bachelor's degree in a different discipline, return to a college of education and teach simultaneously to earn initial certificate), temporary authorization (bachelor's degree in another discipline, take self-directed courses and teach under a mentor; pass exit examinations and work under a one-year renewable certificate to earn initial certificate), ABCTE (bachelor's degree, meet ABCTE requirements and be issued Initial Professional Certificate). [c]
NC	Yes, no minimum specified	3 years	Not specified	No additional changes were made to the licensing protocol. [d]
TX	Yes, no minimum specified	2 years	Not specified	No additional changes were made to the licensing protocol. [e]
WA	Minimum 540 hours	3 years	Not specified	Will develop, improve, and implement programs that establish, expand, or improve alternative routes for certification, as well as mechanisms for recruiting and retaining school leaders. [f] Substitute House Bill 2415 (2002): In addition to the administrative certificate, the amendment requires candidates to have held a valid teacher or educational staff associate certificate and demonstrated school experience. [g]

Information retrieved from https://www.ecs.org/50-state-comparison-school-leader-certification-and-preparation-programs/

[a] https://www.gapsc.com/Rules/Current/Certification/505-2-.153.pdf?dt=%3C%#Eval('strTimeStamp')%20%%3E

[b] http://www.doe.mass.edu/federalgrants/essa/stateplan/ [c] https://dese.mo.gov/sites/default/files/ESSA-Plan-Final.pdf

[d] https://www2.ed.gov/admins/lead/account/stateplan17/ncconsolidatedstateplan.pdf

[e] https://tea.texas.gov/About_TEA/Laws_and_Rules/ESSA/Every_Student_Succeeds_Act/

[f] http://www.k12.wa.us/ESEA/ESSA/pubdocs/ESSAConsolidatedPlan-Final.pdf?_sm_au_=iVVw1VFTFRRvqwQH

[g] http://lawfilesext.leg.wa.gov/biennium/2001-02/Pdf/Bills/Session%20Laws/House/2415-S.SL.pdf?cite=2002%20c%2078%20%C2%A7%201;

Appendix B. Randomized Inference Procedure

We report the standard deviation of principal value added within schools in each state based on calculations using the value-added estimates from equation (1), demeaned by school, as described in the text. The reporting of these values requires an adjustment to account for sampling variance. This appendix describes the procedure we use for the adjustment, which estimates and removes sampling variance from the total variance of the principal value-added estimates.

We estimate the sampling variance using a randomized inference procedure, which is implemented as follows. First, we vertically separate the principal identifiers from the rest of the dataset. Next, we shuffle them at random, keeping principal spells intact (e.g., if a principal spent four years at school A, when the principal spells are re-shuffled, the principal is assigned randomly to a new school for a four-year spell). Then we reattach the reshuffled principal identifiers to the school data so that principal spells are effectively assigned to schools at random. This reshuffling process preserves the true covariance structure in the real data—it just moves the principal spells across schools.[23]

With the dataset of randomly-assigned principal spells, we re-estimate equation (1) in the text and produce the estimates $(\hat{\theta}_{ps} - \overline{\hat{\theta}}_{ps})$ for each principal *p*. The variance of these estimates is under the condition that the true values are zero because we randomly assign the principal spells, but the estimated variance will be non-zero due to sampling variance. We repeat the reshuffling and re-estimation procedure 300 times and at each iteration we store the estimated variance of the principal value-added estimates. This gives the empirical distribution when we know the true principal effects are zero by virtue of the random assignment. If our estimates using the real data—i.e., using principals' real school assignments—are outside of the 95 percent confidence interval of the empirical distribution estimated with known null effects, we can say that our variance estimates are statistically distinguishable from zero.

Beyond testing for statistical significance, we also report the magnitude of the variance of the principal fixed effects in each state (by their standard deviations). To arrive at these estimates, and noting that the true variance of principal value added is equal to the total variance minus the sampling variance, we subtract the average value of [var $(\hat{\theta}_{ps} - \overline{\hat{\theta}}_{ps})$] over the 300 random-assignment iterations—our estimate of the sampling variance—from the value based on the real data. The calculation for the adjusted standard deviations reported in the paper is as follows:

$$\sqrt{\text{var}(\hat{\theta}^{rd}_{ps} - \overline{\hat{\theta}}^{rd}_{ps}) - \frac{1}{300}\sum_{n=1}^{300}\text{var}(\hat{\theta}^{n}_{ps} - \overline{\hat{\theta}}^{n}_{ps})} \qquad \text{(A1)}$$

where the superscript *rd* refers to an estimate taken from the real data and the superscript *n* refers to an estimate taken from the *n*th iteration of the randomized inference procedure.

[23] An additional challenge is that the random assignment of principals to schools must not break true principal spells across schools—e.g., a principal who spent five years at school A in the real data must not have that spell split into two and three year spells at schools B and C in the random-assignment scenario. This would create additional principal-by-school variance not present in the real data, which could influence the estimation-error variance. The coding structure for the simulations includes constraints that prevent such splits from occurring.