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The Returns to Experience for School Principals

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The Returns to Experience for School Principals

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Abstract

Despite increasing recognition of the importance of high-quality school leadership, we know remarkably little about principal skill development. Using administrative data from Tennessee, Oregon, and New York City, we estimate the returns to principal experience as measured by student outcomes, teacher hiring and retention patterns, and teacher and supervisor ratings of principals. The typical principal leads a school for only 3–5 years and leaves the principalship after 6–7 years. We find little evidence that school performance improves as principals gain experience, despite substantial improvement in supervisor ratings. Our results suggest that strategies intended to increase principal retention are unlikely to improve school outcomes absent more comprehensive efforts to strengthen the link between principal skill development and student and school outcomes.

The Returns to Experience for School Principals

Policymakers, system leaders, families, teachers, and other education stakeholders expect principals to lead their schools towards a wide-ranging set of socially desirable outcomes. A large body of prior research highlights the multi-faceted role that principals play in schools, with responsibilities ranging from scheduling, to budgeting, to strategic staffing, to community outreach, to change management, to supervising the cafeteria during lunch. Through these actions, principals can indirectly improve student and school outcomes, with existing evidence documenting that schools led by effective principals have lower teacher turnover and higher student achievement growth (see Grissom et al., 2021, for a review of this evidence).[1] Researchers and practitioners have theorized a broad set of skills necessary to successfully execute the responsibilities of the principalship.[2] Given the wide range and complex nature of the skills required of principals, many likely enter the role without the full range of tools necessary to experience immediate success (Grissom, Mitani, & Woo, 2019). Presumably, once in the role, principals develop skills and knowledge that increase their effectiveness and, ultimately, the performance of their school.

This paper aims to answer a seemingly simple question: to what extent does principal effectiveness—and, by consequence, school performance—improve with on-the-job experience? Understanding this relationship is of critical importance for education policy, particularly given sharp declines in average experience levels of public school principals over the last several decades (Grissom et al., 2021). The principalship is notoriously unstable, with high rates of turnover and attrition creating a constant need to recruit and develop new leaders (Grissom & Bartanen, 2019a; Snodgrass Rangel, 2018). Growing consensus on the key role of school leadership and the challenges of principal turnover has led to an array of federal, state, and local policies, guidelines, and programs aimed at

[1] Recent work (Bartanen et al., 2024) documents that the methodological approaches used to estimate principals' effects on student test scores likely inflate their true magnitude. We do not revisit these arguments here, though we note that even estimates purged of this inflation suggest that effective principals can improve student achievement in their schools.

[2] A small subset of these frameworks include Bambrick-Santoyo and Peiser (2012), Grissom et al. (2021), Grissom and Loeb (2011), Heck and Hallinger (2009, 2010), Leithwood and Jantzi (2000), Platt et al. (2000), Sebastian et al. (2017), and Spillane and Hunt (2010).

training, developing, and retaining effective principals (e.g., Darling-Hammond et al., 2022; Gates et al., 2020; Manna, 2015; Rowland, 2017). Despite these investments, we still have remarkably little empirical evidence about principals' skill development and, more specifically, the magnitude of their on-the-job improvement.

We focus on the returns to principal experience—defined as the increase in an individual principal's performance over time—for two reasons. First, the typical principal is inexperienced, both as principal in their current school and in the principalship overall (see Figure 2). The high rate of principal churn negatively impacts teachers and students and is a growing policy concern. One obvious question, then, is whether policies intended to increase principal retention would also raise the average level of principal effectiveness in schools. Answering this question requires knowing how much the typical principal improves with experience.

Second, identifying the performance-based returns to principal experience can help us to better understand the fundamental question of how (and whether) principals' skills improve over time. A strong body of research demonstrates substantial returns to experience for teachers, particularly early in their careers; however, we have limited evidence of a similar phenomenon for principals.[3] While a handful of prior studies examine the relationship between principal experience and student test scores (see, e.g., Bastian & Henry, 2015; Brewer, 1993; Clark et al., 2009; Dhuey & Smith, 2014; Eberts & Stone, 1988), the findings are mixed and the methodological approaches often cannot rule out competing hypotheses, such as the selective attrition of less effective principals.[4] Further,

[3] A small sampling of such evidence on teachers includes Atteberry et al. (2015), Harris and Sass (2011), Kraft and Papay (2014), Kraft et al. (2020), Ladd and Sorensen (2017), Papay and Kraft (2015), and Rockoff (2004).

[4] Specifically, the more recent of these studies have addressed nonrandom sorting of principals to schools using a school fixed effects approach (Bastian & Henry, 2015; Clark et al., 2009; Grissom et al., 2018), which effectively compares the performance of principals who lead the same school in different years. These papers mostly find a positive relationship between experience and principal effectiveness (Bastian & Henry, 2015; Clark et al., 2009; Grissom et al., 2018). As noted by Clark et al. (2009), however, school fixed effects account for sorting of principals among schools but not the nonrandom attrition of less effective principals. Therefore, it remains unclear whether these papers are measuring the returns to principal experience or capturing a differential selection process that is correlated with principal experience. One plausible explanation of these results, for example, is that principals are more likely to leave their positions following a downturn in student achievement (Bartanen et al., 2019; Miller, 2013). Accordingly, Dhuey and Smith (2014) find no relationship between principal experience and student achievement in models that include

despite the principal's indirect influence over student outcomes, prior work largely does not examine more proximal outcomes, such as teacher retention (see Guthery & Bailes, 2022, for an exception).[5]

To address this gap, we estimate the returns to principal experience using large-scale panel data sets from three contexts: Tennessee (TN), New York City (NYC), and Oregon (OR). To guide our analysis, we develop a conceptual framework to connect principal knowledge and skills, on-the-job learning, leadership practices, and school performance. This framework establishes two important points. First, our returns to experience estimates reflect the effects of principals' on-the-job learning and any professional support they receive (e.g., leadership coaching). Second, there are multiple causal links required to connect principal experience to improved school and student outcomes. Given the indirect nature of principals' effects, our empirical analysis examines the returns to principal experience using both distal (student achievement and attendance) and more proximal (teacher hiring and turnover) outcomes, as well as perception-based measures of principal leadership effectiveness captured within supervisor and teacher ratings. Guided by our framework, we hypothesize that these proximal and performance ratings measures may more directly reflect principal skill improvement over time, particularly given recent findings demonstrating the challenges of inferring principal effectiveness from changes in student outcomes (Bartanen et al., 2024).

To preview our results, we find no evidence that student test scores or attendance rates increase, on average, as principals gain experience. We additionally find no evidence that either teacher retention or hiring (as measured by the observable characteristics of newly hired teachers) improve with principal experience. By contrast, principals in TN earn substantially higher rubric-based supervisor ratings as they gain experience, moving from the 37$^{\text{th}}$ to the 56$^{\text{th}}$ percentile, on average, between their first and sixth years. This

principal fixed effects, suggesting that selective attrition may indeed drive the apparent returns to experience in other studies.

[5] Using a principal fixed effects approach, Guthery and Bailes (2022) find that as principals gain experience in the same school, they hire larger percentages of teachers that remain in the school for at least three or more years.

improvement is not mirrored in teachers' survey-based ratings: In both TN and NYC, principals tend to earn their highest ratings in their first year in a school.

Ultimately, our empirical findings paint an important yet inconsistent picture of principal leadership improvement and the returns to experience. In our discussion of these findings, we advance several hypotheses that may explain the discordance between ratings from supervisors and school performance outcomes like changes in student achievement. Our study highlights a need to develop independent, objective measures of principal skills and practices (measures we lack in our data), explore and evaluate interventions aimed at developing principals' ability to affect student and school outcomes, and to examine potential policy constraints that may currently inhibit the manifestation of improved principal skills. On their own, efforts to increase principal retention may not simultaneously improve school outcomes. In light of this, we discuss potential policy avenues to address the need for effective principals.

Conceptualizing Principal Returns to Experience

Human capital theory (Becker, 1962, 1975) posits that improvements in professional productivity occur through on-the-job acquisition of "knowledge and skills" (Coff, 2002, p. 108) beyond initial training. Skills and knowledge may be general or specific to one's occupation, industry, or workplace (Neal, 1995; Poletaev & Robinson, 2008). Disagreements exist as to whether skill development can be accelerated through formal training,[6] but there is strong evidence that employee productivity improves over time, on average (Crook et al., 2011).

Because employee "improvement" is a broad concept that can describe both internal and external processes of learning, cognition, and skill transfer (Soderstrom & Bjork, 2015), researchers often favor the term *returns to experience* to denote the effect of job experience on realized productivity gains. Importantly, worker productivity is usually proxied through observed outcomes or outputs, such as wage growth. Experience, which encompasses all manner of formal and informal on-the-job learning opportunities, is measured by time in

[6] Contrast, for instance, findings from Mincer (1988) and Barrett and O'Connell (2001) with those from Heckman et al. (2002).

role. The implicit logic is that more time in a job leads to more opportunities for knowledge and skill acquisition, ultimately increasing performance outcomes.

Few empirical studies study managerial returns to experience. Although managerial inputs have been credibly linked to organizational performance (e.g., Bertrand & Schoar, 2003; Bloom et al., 2013), the mechanisms through which managers' productivity improves over time are less well understood. Manager effects on organizational productivity are largely indirect, and the few studies in this area suggest that managers accrue mainly organization-specific knowledge and skills that translate into beneficial activities, such as strategic staffing and resource allocation (Crook et al., 2011; Kor & Mahoney, 2005).

In education, the returns to experience for classroom teachers have been studied extensively. These studies are underpinned by the understanding (and supported by value-added studies of teacher effectiveness) that teachers directly affect student learning. Teacher productivity improvement is proxied through student test score gains as teachers accrue additional years in the role. Similarly, years of experience proxy all inputs to teacher improvement, such as "on-the-job training, informal on-the-job learning, out-of-work training (such as formal education) and any other factors that improve teacher effectiveness over time" (Papay & Kraft, 2015, p.106).

By contrast, principal returns to experience have received relatively little attention. Although some have debated principals' status as "managers" in the traditional sense (Neumerski, 2013), principals spend a large portion of time engaging in managerial duties such as building operations, personnel issues, and finance (Sebastian et al., 2017). Additionally, unlike with teachers, principal effects on key student outcomes are primarily indirect, mediated through a variety of school level pathways. For example, while principals typically do not teach students, they create schoolwide conditions and climate to support teaching and learning (Grissom et al., 2021; Hallinger & Heck, 1998).

Suggestive evidence relates skill in these practices (or time devoted to them) to improved school performance as indicated by, for example, increased student achievement or graduation rates (Liebowitz & Porter, 2019). We therefore define principal improvement as the process through which principal knowledge and skills increase. Following human capital theory (and expectations embedded within national standards for principal practice), principal improvement can and should produce measurable changes in school performance. However, we distinguish principal improvement—which is largely unobservable—from principal *returns to experience*, which is the observable increase in individual principal performance over time.

A Framework for Principal Returns to Experience

Figure 1 displays a conceptual framework for the returns to principal experience. Solid-bordered boxes indicate constructs we are able to measure (directly or through proxy) in our data. Dashed borders indicate constructs that are known or assumed from prior research to drive principal improvement, but which cannot be observed in our data. While we discuss each piece in more depth below, the overarching logic of our framework is that as they gain (years of) experience in the role, principals encounter opportunities for professional support and on-the-job learning, which may increase their knowledge or skills. This knowledge and skill acquisition may lead to "productivity returns," defined as improvements across a range of proximal and distal outcomes, including student achievement. We include measures in our analysis for each of the three indicators of principal productivity: leadership practices, malleable school conditions, and student outcomes. This returns to experience process operates within a principal's school, district, and state context, which may drive heterogeneity along various dimensions. The next sections describe the components of the framework from left to right.

Formal and Informal Learning

Principals learn new knowledge and skills through three main pathways: pre-service training, professional support, and on-the-job learning. A large body of research is dedicated to describing and evaluating pre-service preparation and principal "readiness" (see, e.g., Bastian & Drake, 2023; Grissom, Mitani, & Woo, 2019; Perrone & Tucker, 2019). Importantly, pre-service professional experiences likely do not entirely prepare principals for the range of their responsibilities (Liebowitz & Porter, 2022). Once hired, principals may continue to develop from professional support and on-the-job learning. Given our focus on the returns to experience, we focus here on describing these latter two pathways.

Professional support includes formal in-service learning and training opportunities, as well as coaching, feedback, and mentorship from principal supervisors. Ideally, professional learning deepens principals' existing knowledge and skills, particularly those that are school or district-specific (Hart, 1991; Rogers & VanGronigen, 2023). Professional development and coaching interventions have yielded mixed results on principal learning and performance, as programs vary in quality, scope, and fidelity of implementation (Goff et al., 2014; Hoogstra et al., 2008). However, some types of professional support appear to be more effective than others. For instance, principals appear to benefit from formal mentoring but not university coursework (Grissom & Harrington, 2010). Steinberg and Yang (2022) link principal professional learning intended to strengthen early career principals' skills in strategic planning and data use to improvements in students' math performance and reductions in teacher turnover. Others find similar benefits to specific professional learning models focused on particular types of principal skill development (R. Jacob et al., 2015; Stosich et al., 2024; Turnbull et al., 2009). Finally, district-level or external principal supervision and coaching can also drive principal learning (Honig & Rainey, 2020; Thessin, 2019). Access to strong district supervision may also influence the extent to which principals' skills and knowledge improve over time. However, principals' access to high-quality opportunities varies greatly across geographic and school/district contexts (Darling-Hammond et al., 2022). Moreover, access to any principal professional support is not always better than nothing, as programs can be vulnerable to design and implementation issues that limit their effectiveness (Goldring et al., 2020; Herrmann et al., 2019).

Overall, research suggests that the quality of principal preparation and in-service professional support vary, and such support tends to be minimal or even absent. Consequently, many principals can expect to learn by doing "on the job," especially managerial and non-instructional expertise not taught in preparation programs (A. D. Johnson et al., 2021). Principals learn on the job when they must respond to changes or additions to their role expectations and responsibilities, a phenomenon known as "principal work intensification" (Wang et al., 2023). Principals also learn in response to school and district-specific expectations and context (Bengtson, 2014). For example, principals have been observed to develop context-specific skills and competencies related to school turnaround (Hitt et al., 2018), special education services (DeMatthews et al., 2020), and district/school crises (De Voto et al., 2023).

Ideally, on-the-job learning makes up only one component of principal learning. Yet, given the disparities in the content and quality of principals' formal pre-service and in-service training experiences (when they exist at all), on-the-job experiences are the only type of learning that all principals are certain to receive. Principal on-the-job learning is especially critical within the U.S. educational system, in which student and community needs, policies, and subsequent expectations for principals vary greatly across schools and districts.

Knowledge and Skills

Knowledge and skill acquisition is an important part of human capital development and a critical intermediate step between learning and practice in our framework. However, frameworks for principal knowledge and skills are diffuse and often contested: A 2009 review of 66 measures of principal skill assessments found "little consensus in the field around what should be assessed" (p. 17) despite the prevalence of national principal leadership standards (Goldring et al., 2009).

Within education leadership, principal effectiveness is defined similarly to the "knowledge and skills" framework from human capital theory. Practical standards for school principals, such as those developed by the National Policy Board for Educational Administration (NPBEA), describe principals' successful development in terms of "knowledge, skills, dispositions, and other characteristics required of educational leaders to achieve real student success in school" (NPBEA, 2015, p. 6). The knowledge and skills defined in the NPBEA standards include such difficult-to-measure concepts as professional norms (e.g., integrity), approachability, up-to-date knowledge of pedagogy and assessment, social-emotional insight, and understanding of processes of adult and child learning (NPBEA, 2015, 2018). The standards likewise emphasize the need for principals to gain school and community-specific awareness to support culturally and racially diverse students

(Farley et al., 2019), as researchers and advocates have asserted the need for principals to possess multicultural competency (e.g., Evans, 2007; Gooden & O'Doherty, 2015; Khalifa et al., 2016).

Few studies have attempted to measure principal knowledge and skills. Perhaps the most common method for measuring general principal knowledge is the licensure exam that most states require principals to take before receiving an administrator license. Licensure exams are designed to align with the dominant expectations for principal practice set out in the PSEL and NELP standards, although content varies across exams, many of which are state-specific (such as in OR and NY). The widely used School Leader Licensure Assessment (SLLA) tests principal knowledge in six categories of leadership (instructional, organizational, ethical, strategic, climate and cultural leadership, and community engagement) and problem-solving and analysis. However, because licensure exams are taken before an individual assumes the principalship, they provide limited insight into how knowledge and skills might develop within principals over time. One analysis of Tennessee principal scores on the SLLA found that they were not predictive of future job performance (Grissom et al., 2017), suggesting that pre-service knowledge may not translate to effective practice later on.

Outside of licensure, a limited number of studies have attempted to capture principal knowledge and skills through surveys, simulations, and interviews. There is some evidence that experienced principals exhibit stronger reasoning and problem-solving skills than inexperienced principals (Brenninkmeyer & Spillane, 2008). However, Leithwood and Stager (1989) identified marked differences in veteran principals' problem-solving ability when confronting uncertain and complex situations, suggesting that principals do not acquire problem-solving skills equally as they gain on-the-job experience.

Certainly, understanding how principal gains in knowledge and skills unfold once they are in the role is important given the evidence that these gains may happen unevenly. Mastering certain tasks may permit principals to allocate more time towards higher-impact activities such as implementing new instructional programs. Horng et al. (2010) find that new principals spend considerably more time on administrative tasks than experienced principals, suggesting that principals learn to be more efficient in these tasks over time. Similarly, Rogers et al. (2021) find that principal supervisors are more likely to emphasize developing skills in operations and management (e.g., budgeting, scheduling) when working with first-year principals. In contrast, more experienced principals rate themselves higher in the domains of instruction management, internal relations, and organization management, but not in administration or external relations (Grissom & Loeb, 2011).

In sum, the scant evidence on principal knowledge and skill acquisition suggests that the bulk of resources for principal learning are concentrated on ensuring that principals enter the field at a baseline competency of generalized knowledge. Once in the role, however, principals have few consistent opportunities to acquire role-relevant knowledge and skills, and may acquire these skills unevenly. Furthermore, absent formalized supports, on-the-job learning is likely to comprise the bulk of in-service principal knowledge and skill acquisition. Principals may therefore be predisposed to develop school-specific knowledge and skills that reflect their unique organizational context. These skills are valuable for addressing school needs in a specific time and place but are also vulnerable to shifts in school context over time. Additionally, school-specific knowledge and skills may not generalize to other schools or districts. Principals in systems with high rates of principal churn or more labor market volatility may, therefore, have little incentive to gain the specific knowledge and skills necessary to improve school and student performance in their particular school.

Leadership Practices

Leadership practices represent our first measure of the returns to principal experience and the measure that is most proximal to principal knowledge and skill acquisition. In the NPBEA standards, knowledge, skills, and dispositions manifest in principal leadership practices. which include the strategic decision-making practices described above as well as other articulated practices or behaviors related to school leadership (e.g., Leithwood & Jantzi, 2000; Marzano et al., 2005). Grissom and Loeb (2011) provide a commonly used organizing framework, which distills empirical evidence of effective principal leadership practices into five overarching categories: instructional management, internal relations, organizational management, administration, and external relations. Importantly, principals do not evenly divide their time across these categories, and each type of practice likely impacts school performance differently. For example, Horng et al. (2010) found that principals' time spent on organizational management activities (e.g., budgeting, operations, dealing with teacher concerns) was associated with stronger school performance, teacher satisfaction and parents' positive assessment of the school, whereas time spent on day-to-day instructional activities such as coaching teachers and observing lessons was not. However, context-driven variation in principal leadership practices can make it difficult to establish clear causal links between specific practices and school outcomes. Principals in lower-performing schools and schools with high concentrations of economically disadvantaged students are likely to spend more time on instruction and student-centered practices (Goldring et al., 2008; Huang et al., 2018).

Importantly, Figure 1 displays two-way arrows between knowledge and skills and leadership practices. As individuals "learn by doing" through trial and error or actively seek solutions to problems on the job, they gain additional knowledge and skills (Levitt & March, 1988). Principal learning can lead to reinforcement of existing practices, changes to current practices, or even adoption of new practices. For example, principals may change their leadership practices as they gain familiarity with the demands of the job, school needs, and community expectations. As principals spend more time in their schools, they may develop greater trust and relationships with teachers, leading them to feel more comfortable giving critical feedback to teachers on their instruction. The amount of time principals spend on administrative tasks also drops substantially after principals' first year (Horng et al., 2010), suggesting that principal leadership practices may shift as they gain facility with tackling "low-hanging fruit" tasks such as managing class schedules, student attendance, and discipline.

Similarly, as additional time on the job allows principals to understand district structures, they may be better able to advocate for additional resources for their staff and students. More time in the position may help principals develop stronger relationships with students and families and provide them with relational authority resulting in improved school and student culture. These practices may be responsive to students' cultural background and communities (Khalifa et al., 2016) as well as the principal's perception of student and teachers' needs. Indeed, while most state and district-level observation rubrics are written generally to apply to principals and schools broadly, they typically include language that encourages principals to adapt their leadership practices to suit school context. For instance, the Tennessee administrator rubric evaluates principals on their demonstrated ability to "leverage educator strengths" and "strategically utilize community resources"—practices that will vary across schools and communities.

Principal leadership practices are challenging to examine empirically because they are not directly observed in administrative data. Instead, researchers use third-person ratings and evaluation scales to proxy for practices. These ratings have been shown to be relatively subjective, with known biases toward principals in lower-performing schools or those with greater numbers of economically disadvantaged students (Grissom et al., 2018), or reflective of the relationship between the rater (usually a central office administrator) and the principal (Nelson, 2020). At the same time, ratings are arguably the most proximal available "windows" into principal practice and can be a valuable tool for understanding how, if at all, principal leadership influences school and student outcomes.

Malleable School Conditions

Principal effects on student outcomes are primarily indirect (Hallinger & Heck, 1998; Sebastian & Allensworth, 2012); that is, their effects on students are mediated through *malleable school factors* (Hallinger & Heck, 1998; Sebastian & Allensworth, 2012). Malleable school conditions, our second measure of returns to principal experience, include the practices and effectiveness of teaching staff, which principals shape through strategic teacher hiring and retention as well as instructional feedback and coaching (Grissom & Bartanen, 2019b; Grissom et al., 2015; Horng et al., 2010; Loeb et al., 2012; Robinson et al., 2008). Principals can further shape the overall effectiveness of teaching staff by hiring and retaining teachers whose identities (e.g., race/ethnicity) and areas of expertise (e.g., special education) reflect the needs and composition of students (Bartanen & Grissom, 2023; Edwards & Anderson, 2023). Principals are also instrumental in shaping school climate. Principals who are effective in this area implement routines, rules, and practices that promote a positive learning environment. For instance, principals can create climates that support student safety and well-being (Jacobson et al., 2007), develop trust among families, teachers, and students (Louis & Murphy, 2017; Sebastian & Allensworth, 2012), and encourage teachers to hold high expectations and take collective responsibility for student learning (Park et al., 2019). A positive school climate also supports productive working conditions and professional capacity for teachers (S. M. Johnson et al., 2012; Youngs & King, 2002).

School conditions are not equally malleable. Principals have limited control over conditions such as the quality of school facilities or neighborhood attendance boundaries (Bartanen et al., 2024; Chiang et al., 2016).[7] Other conditions, such as the pool of teachers who apply to vacant positions in the school, may be partially under the principal's control but also determined by the local labor market. These (semi-)fixed conditions affect both overall student and school performance and the particular behaviors that principals engage in to meet their school's needs, but they are not as sensitive to principal practices as malleable conditions.

The principal's ability to influence malleable conditions that contribute to school performance may depend on the length of their tenure within a school. Certain school policies or practices, such as student assignments to teachers or procedures for walking in the hallways, can be changed immediately. Other conditions, such as teacher effectiveness or community trust, may be more challenging to change. Even if these changes are effective, it may take time for them to have a measurable impact on school and student academic outcomes. There are also methodological barriers associated with measuring principal effects on school conditions: Due to the lagged and indirect nature of principals' impacts, any impacts of a new principal on schoolwide conditions must account for the leadership of the prior principal(s) (Bartanen et al., 2019). We can therefore understand

[7] We acknowledge that some principals may exert partial influence over what we term "fixed" (e.g., a principal might advocate for improvements to school facilities); however, for the vast majority of the principals in our data, this state, district, and school context is essentially fixed. Bartanen et al. (2024) formalize the distinction between (semi-)fixed and malleable conditions.

the trajectory of school conditions under a new principal as a function of two processes: the gradual manifestation of a new principal's effect and the corresponding fade-out of the prior principal's. With each additional year of principal experience in the school, school conditions become a greater reflection of the current principal's own leadership practices.

Student Outcomes

Student outcomes are the final "return" to principal experience in our framework.[8] If changes in principal leadership practices manifest with experience and these alter the malleable conditions in schools, it stands to reason that principal experience might also contribute to differences in student outcomes. Indeed, a number of studies attribute substantial variation in student outcome to the principal leading the school (e.g., Coelli & Green, 2012; Dhuey & Smith, 2014; Grissom et al., 2015) and link principal experience to improvements in student test scores (e.g., Bastian & Henry, 2015; Clark et al., 2009; Coelli & Green, 2012).

However, recent findings from Bartanen et al. (2024) complicate the traditionally understood relationship between principal practices, malleable school conditions, and school performance. Specifically, they document that existing estimates of the magnitude of principal effects are substantially inflated by fluctuations in school-level factors over which the principal has no control (e.g., the retirement of a highly effective teacher) but that nonetheless become incorrectly attributed to their leadership effectiveness. This finding is relevant to our examination of the relationship between principal experience and school conditions and performance because it suggests that the principal's ability to drive changes in student outcomes is more limited than previously supposed.[9] Thus while we will begin by examining the relationship between principal experience and these more distal

[8] Principal returns to experience can extend beyond school-based student outcomes to include post-secondary and workforce outcomes, such as college-going, income, or civic engagement, as well as unobservable outcomes that contribute to student quality of life. Although these outcomes are important markers of the broader purpose of education and are viable avenues for future research, they are beyond the scope of our data and analysis.

[9] Importantly, the concerns raised by Bartanen et al. (2024) do not preclude us modeling the relationship between principal experience and school conditions and outcomes insofar as these fluctuations in school performance are not systematically related to principal experience (e.g., entering cohorts of students are not on lower growth trajectories when their principal is less experienced, or vice versa).

outcomes, these recent findings highlighting the challenges in connecting principal performance to student achievement will also guide us to examine whether principal improvements manifest in more proximal malleable school conditions.

Research Questions

To summarize, while we assume that principals acquire new "knowledge and skills" in the role over time, it is less clear that these skill gains translate into measurable improvements in malleable school conditions or traditional measures of school performance. Our framework explicitly distinguishes principal skills and school performance, allowing for improvements in one outcome to be independent of improvements in another. To be clear, understanding the relationship between principal experience and school performance is important, particularly in the context of human capital decision-making that weighs the costs and benefits of retaining or replacing principals. However, in examining principal improvement, it would be incomplete and potentially misleading to rely solely on measures of school performance. As we describe below, our analysis supplements measures of school performance—student test scores and attendance rates—with more direct measures of principals' leadership behaviors and their effects on malleable school conditions to answer the following research questions:

1. To what extent does school performance (as measured through student outcomes) increase as principals gain experience?

2. To what extent do malleable school conditions improve as principals gain experience?

3. To what extent do principals' leadership practices improve as they gain experience?

Data, Sample, and Measures

This study analyzes longitudinal administrative data from three distinct contexts: Tennessee (TN), New York City (NYC), and Oregon (OR). In addition to the diversity these sites provide in terms of geographic region and urbanicity, they also vary in their policy requirements for school leaders.[10] Analyzing our questions of interest across these

[10] As with teacher development, the policy context for principal development is primarily that of local control. Therefore, not surprisingly, TN, OR, and NYC vary in their approach to principal licensure,

three varied contexts allows us to examine the robustness of our findings. Specifically, we can evaluate whether results differ based on geographical location and by potential differences in educational policies, or whether patterns in our findings are consistent regardless of locale. As such, we can speak to the generalizability of our results and the potential implications they have for the educational leadership field writ large.

The data from Tennessee cover the 2006–07 through 2018–19 school years, and are provided by the Tennessee Department of Education via the Tennessee Education Research Alliance at Vanderbilt University. We also include data from New York City, provided by the New York City Department of Education, from the 1998–99 through 2016–17 school years. Finally, we include data from Oregon from the 2006–07 through the 2018–19 school years, provided by the Oregon Department of Education. All three datasets contain detailed information about all employees in the K–12 public school system, including job title, school placement, and demographic information. We connect these staff data to student files which include demographic and enrollment information, as well as achievement scores on statewide end-of-year exams for grades 3–8. The TN data also include end-of-course exams for high school students. Appendix B provides descriptive statistics for each context.

Measuring Principal Experience

Like most education-sector administrative datasets, the TN, NYC, and OR data do not contain measures of job-specific experience. Thus, we must construct measures of principal experience using the observable years of each dataset, with left-censoring for individuals who enter the principalship (or a given school) prior to the first year of each dataset. These individuals are excluded from our analyses. In TN and NYC, however, we can access staff-level data prior to the aforementioned analytic years, which greatly limits

professional development, and evaluation. As our conceptual frame indicates, context plays an important role in the process of principal improvement. However, a full description of these contextual differences (for which we lack measures) would be beyond the scope of our analysis, particularly given the numerous policy and programmatic changes that occurred (and continue to occur) within each region during the years for which we have data.

this censoring.[11]

Figure 2 shows the distribution of principal experience using the three most recent years of data in each context. The left plots show histograms for both *total* principal experience (i.e., not counting the current year, how many years have you served as a principal?) and *school-specific* principal experience (i.e., not counting the current year, how many years have you served as the principal in this school?). The distribution of experience has a rightward skew, with many principals having only limited experience and relatively few principals with substantial experience. In TN and NYC, for instance, fewer than 10% of principals had 15+ years of experience as a principal. In OR, where we must cap experience at 10+ years, roughly 20% of principals fall into this group, which is similar to TN and NYC.

While these contexts are similar in terms of the distribution of total principal experience, they differ in terms of school-specific experience. Namely, there are almost no principals in NYC who led two different schools, meaning that the distributions of school-specific and total experience are almost identical. In TN and OR, there is still quite a bit of overlap, but we do see some principals who transfer across schools, particularly in OR. In NYC, the turnover rate is quite low, but nearly all departing principals exit the principalship entirely, though some may seek to transfer outside of the city.

The right plots in Figure 2 illustrate the distribution of principal experience in terms of the "rate of survival." That is, among those whom we observe entering the principalship (or becoming a principal at a specific school), what percentage remain after a given number of years? Overall, turnover rates are highest early on and it is relatively uncommon for a principal to remain in the role for 10+ years. Perhaps even more striking is the low percentage of principals who remain in a school for an extended period. In TN

[11] Specifically, the staff-level data begin in 2001–02 in TN and 1957–58 in NYC. In Appendix Table A1 we show the yearly percentages of principals who have censored experience measures. This table also shows the percentage of principals or principal-by-schools that are excluded from analysis in each year. In TN, this ranges from 38% of principals in the first analysis year to 2% in the final analysis year for school-specific experience and 52% to 8% for total experience. As a result of the greater prevalence of left-censoring in OR, in the first year of the data, 70% of principals are missing school-specific experience and 83% are missing a measure of total experience in the principalship. However, due to consistent turnover, by the final year of analysis just over 2% are left-censored for their school-specific experience and 13% for their total experience.

and OR, far fewer than half of principals remain at least five years in their school (roughly 50% do so in NYC). Though the pattern of short-tenured principals across all three contexts is striking, it is consistent with evidence from the National Teacher and Principal Survey (NTPS) (2022) that the average total years of experience for U.S. public school principals is 4.5 years and only 13.1% have been in their schools 10 or more years.

There are two main empirical challenges that stem from the distribution of principal experience in these contexts. First, because relatively few principals remain in the principalship or their school for a long period, we have limited variation from which to estimate the returns to experience using the standard approaches in the literature. Second, because relatively few principals lead multiple schools, it is difficult to separate the potential returns to total experience and school-specific experience. We return to these issues below in our discussion of our modeling strategies.

Measuring Student Outcomes, School Conditions, and Principal Leadership Practices

Our primary outcome measure in this study is student achievement. Specifically, we draw on achievement scores in math and reading in grades 3–8 for each dataset, as well as end-of-course (EOC) exams for high school students in TN. The grade 3–8 exams are required for every student across each year of the study period, while the EOC exams vary by year, with earlier years having fewer tested subjects in high school. We construct a common measure of student achievement by standardizing exam scores within subject, grade, and year for grades 3–8. For EOC exams, which can have students from multiple grades (e.g., the Algebra I exam includes large numbers of ninth and tenth grade students), we standardize scores within course-grade-year. We also examine student attendance data in TN and OR (these data are unavailable for NYC), operationalized as the percentage of school days attended ranging from 0–100%.

Next, we examine two malleable school conditions closely related to principals' theorized human capital management efforts: teacher retention and hiring. Prior work demonstrates that highly effective principals retain teachers at higher rates (Boyd et al., 2011; Grissom & Bartanen, 2019b; Ladd, 2011), that longer-tenured principals hire teachers who remain in their school longer (Guthery & Bailes, 2022), and that teacher composition is hypothesized as a key mechanism through which principals can influence student outcomes (Grissom & Bartanen, 2019b; B. Jacob, 2011). Therefore, we also examine the extent to which principals improve at retaining teachers as they gain experience. More specifically, we construct a binary measure that takes a value of one if teacher i in school s in year t is no longer a teacher in school s in year $t + 1$, and zero otherwise. We also examine whether principals hire teachers whose characteristics are theoretically related to their efficacy, constructing a continuous measure of a newly hired teacher i's years of experience, a binary indicator of whether they are a novice teacher (zero years of prior experience), and (when available) their prior value-added to students' test scores (averaged across reading and math).

Finally, we examine principals' rubric-based observation ratings from their supervisors and survey-based perception ratings from their teachers, which we view as plausible measures of principals' leadership practices. We have both datasets for TN and teacher rating data for NYC. Scores from supervisors are rubric-based evaluations that principals receive as part of TN's statewide educator evaluation system (TEAM) implemented in 2011–12. Fifty percent of the TEAM evaluation for principals comes from ratings of principal performance on a rubric derived from the Tennessee Instructional Leadership Standards.[12] These ratings are based on formal observations conducted by the principal's supervisor. Prior work shows that principals' ratings across indicators are highly inter-related and can be reduced to a single underlying performance score using factor analysis (Grissom et al., 2018). In this analysis, we use principals' average yearly observation scores—the exact measure used by the state to calculate summative evaluation ratings. We refer to this measure as "supervisor ratings."[13] "Teacher ratings" come from

[12] For more information about TEAM, see http://team-tn.org/evaluation/administrator-evaluation/.

[13] Using the average observation score instead of the factor score described in Grissom et al. (2018) allows us to include principals in districts that used alternative observation rubrics (approximately one-quarter of principals in the state), as these districts do not report domain-specific scores for principals. For principals for whom we can calculate factor scores, however, the average observation score and the factor score are correlated at 0.95 or higher each year.

teachers' responses to Likert-scale items regarding school leadership.[14] For TN, these come from a yearly statewide survey. After confirming that the items load singularly on a latent construct, we use the predicted factor score as a teacher's perception of principal performance. For NYC, these ratings are part of the NYC School Survey, which is annually administered by the NYC Department of Education. However, the data come aggregated the school-by-year level and we standardize them within year.

Methods

The main goal of our analysis is to estimate the marginal effect of principal experience on measures of principal effectiveness and school performance. We face two main empirical challenges. The first, which is inherent to any returns to experience analysis (including teachers), is to credibly isolate the effect of additional experience from potential confounders—in this case, factors that do not reflect actual improvements in principal effectiveness but are nonetheless correlated with both experience and school or principal performance measures. The second challenge, which is more specific to the case of principals, is that there are relatively few principals who work in multiple schools (as a principal), which makes it difficult to disentangle the marginal returns to *total* experience and *school-specific* experience. Below, we describe how our empirical approach addresses each of these issues.

Baseline Model for the Returns to Experience

The standard approach to estimate returns to experience—typically applied to teachers—is to use a longitudinal "within-person" fixed effects design. Intuitively, this approach uses an individual as their own comparison rather than comparing less experienced to more experienced individuals. The key benefit of this approach is to avoid bias from selective attrition: the tendency for less effective individuals to leave the profession at higher rates. Selective attrition is well-established for teachers (e.g., Boyd et al., 2008; Krieg, 2006; Murnane, 1984) and has some support among principals (e.g.

[14] Examples of these survey questions include, "The principal at my school communicates a clear vision for this school," "The staff feels comfortable raising issues and concerns that are important to them with school leaders," and "I like the way things are run at this school."

Grissom & Bartanen, 2019a). As a starting point, we begin with the general model:

$$Y_{ist} = \beta ExpTotal_{it} + \mu_i + \tau_t + \epsilon_{ist} \quad (1)$$

where Y is a performance measure for principal i in school s in year t. In Equation 1, the parameter of interest is β, which is the marginal effect of experience ($ExpTotal$) on performance. μ_i and τ_t are principal and year fixed effects, respectively. Year fixed effects account for secular trends that would otherwise be erroneously attributed to the marginal effect of experience.[15] Equation 1 is a general framework; we provide details on model specification (e.g., unit of observation, specific covariates included) in Appendix C.

The inclusion of both principal and year fixed effects in the returns to experience creates a practical challenge due to the (near) perfect collinearity of experience and time.[16] Effectively, an individual gains exactly a year of experience with each calendar year, meaning that the year fixed effects cannot be identified without additional assumptions (Papay & Kraft, 2015). To overcome this issue, analysts typically place constraints on the experience profile via a parameterization decision. More specifically, they parameterize experience as a set of indicator variables rather than a continuous variable, where the

[15] The nature of the year fixed effects—and what they actually account for—depends on the particular outcome variable and whether it has been standardized within year. In the case of an unstandardized variable, such as teacher turnover, the year fixed effects will capture any time-varying factors that change the turnover propensity of all teachers in the state, such as the implementation of a high-stakes educator evaluation system, legal changes affecting teachers' tenure and due-process protections, or labor market conditions. For outcome variables that have been standardized within year, such as student test scores, the year fixed effects account for average changes in the distribution of principal effectiveness over time. If, for instance, the effectiveness of new principals is increasing over time and the outcome variable is standardized within year, estimates of the returns to principal experience in a model without year fixed effects will be biased downwards. To see why, consider a simplified example where principal performance improves by x with each additional year of experience and the average effectiveness of entering principals also improves by x each year. In this scenario, as long as principals leaving the profession are not systematically above average in terms of effectiveness, the distribution of principal quality increases across years. However, the outcome variable does not measure true principal performance, but rather reflects a principal's performance relative to the average principal in that year. A given principal, then, who improves by x each year, appears to improve less than x because of the global mean shift in the standardized outcome.

[16] There is a perfect correlation for the bulk of principals who have "continuous careers," meaning that they do not leave the principalship and subsequently return. For returners, the discontinuity theoretically could be used to identify the year fixed effects for the entire sample, but in practice there are too few principals in this group and, further, using this group requires an assumption that temporarily leaving the principalship has no effect on productivity or improvement, which is not likely to hold.

indicators correspond to experience "buckets" (e.g., 2–3 years of experience). These buckets allow for identification of the year fixed effects under an assumption that the marginal effect of experience is zero within each bucket. Thus, the buckets are often chosen based on a prior belief about regions of the experience distribution where improvement is flat. For teachers, this region is often assumed to be the middle-to-late career, such as 10+ years of experience (see Rockoff, 2004). By specifying a 10+ years of experience bucket where no improvement occurs, the year fixed effects can be isolated and applied to the full sample.[17]

For principals, the parameterization choice is more difficult because there are relatively few highly experienced principals (particularly among those with uncensored experience); specifying a single 10+ years bucket is not feasible. Instead, our preferred approach specifies multiple experience buckets: 0, 1, 2–3, 4–6, 7–9, and 10+ years. Using multiple buckets that encompass the bulk of the experience distribution affords the necessary variation to precisely estimate coefficients for both experience and year fixed effects. The benefit of increased precision comes with a cost of greater potential for bias. More specifically, within-bin improvement will be erroneously attributed to the year fixed effects, leading to upward bias of the year fixed effects and downward bias in the estimated returns to experience. Thus, it is important to demonstrate that our results are robust to model specification. To do this, we fit robustness checks that vary the size and location of the experience buckets or omit year fixed effects. Appendix D shows that our results are quite similar across these differing approaches.

A second potential threat to internal validity is non-random sorting, whereby principals over their career systematically transfer to, for instance, more favorable schools or schools to which they are a better fit, creating a spurious correlation between performance and experience even in models with principal fixed effects. To account for this potential threat, we add to Equation 1 controls for time-varying school contextual

[17] There is an additional assumption required, which is that the year fixed effects estimated from the "bucketed" individuals are generalizable to the entire sample.

characteristics and replace principal fixed effects with principal-by-school fixed effects:[18]

$$Y_{ist} = \beta ExpTotal_{it} + \mu_{i,s} + \tau_t + \phi \mathbb{X}_{ist} + \epsilon_{ist} \tag{2}$$

Equation 2 is our preferred specification, where $\mu_{i,s}$ is a principal-by-school fixed effect and $\mathbb{X}$ is a set of time-varying observable characteristics for school context. In student-level models, $\mathbb{X}$ includes student characteristics (race/ethnicity, gender, flags for gifted, special education, EL, and grade repetition) and school-by-year averages of these characteristics. Appendix C describes the exact specification for each outcome variable and a justification for the covariates included. Our assumption is that the principal-by-school fixed effects and time-varying student/school characteristics fully account for any non-random principal-to-school sorting. We believe this is plausible, as a potential confounder would have to be both time-varying and uncorrelated with the vector of controls.[19] In all models, we cluster standard errors at the principal-by-school level.

General vs. School-Specific Returns to Experience

Principals may improve through building general human capital that increases their effectiveness in any school or through building school-specific human capital that only applies to their current context. To differentiate these two pathways, we aim to leverage the subset of principals who work in multiple schools. Ideally, we would simply add to the baseline model a set of indicators for school-specific experience to jointly estimate both experience profiles (total and school-specific). However, particularly in NYC (very few

[18] We also considered including both principal and school fixed effects (instead of principal-by-school fixed effects), but this is challenging due to the limited mobility of principals (see Bartanen & Husain, 2022). There are not sufficient numbers of "switcher" principals to jointly identify principal and school FE. Nonetheless, estimates from principal and school FE models are very similar to our preferred specification with principal-by-school fixed effects.

[19] We can also support the plausibility of this assumption by demonstrating that there is little sorting on observables (with respect to principal experience). To do this, we estimate our primary specifications with and without controlling for the vector of student and school characteristics. To the extent that our coefficient estimates for the experience buckets are not sensitive to the inclusion of these observables, we can feel more confident that unobservables are not a major threat to internal validity. We show these results in Appendix Tables D1 and D2. Despite substantially increasing the R^2 (demonstrating that our observables have explanatory power), including observables has virtually no effect on the coefficient estimates for the experience buckets.

principals who switch schools) and OR (relatively short panel), we lack sufficient variation to precisely estimate both sets of coefficients. We instead rely on a modified approach that requires fewer parameters to be estimated. Specifically, we estimate:

$$Y_{ist} = \delta ExpSchool_{ist} + \gamma(ExpSchool_{ist} \times AnyPriorExp_{i,s}) + \mu_{i,s} + \tau_t + \phi \mathbb{X}_{ist} + \epsilon_{ist} \tag{3}$$

where $\mu_{i,s}$ is a principal-by-school fixed effect and $AnyPriorExp$ is a binary indicator for whether the principal had any principal experience prior to entering their current school. In this model, δ captures the marginal effect of experience (incorporating both general and school-specific returns) for first-time principals—those who have no prior experience leading a different school. These coefficients are effectively equivalent to those obtained by estimating the baseline model in Equation 2 restricted to the sample of first-time principals.

The interaction $ExpSchool \times AnyPriorExp$ in Equation 3 tests whether principals with prior experience see different rates of improvement as they remain in their school. To the extent that some of the returns to experience for first-time principals reflect improvement in general skills, estimates of this interaction will be negative. That is, principals with some prior experience will improve less rapidly than first-time principals. Note that the main effect for $AnyPriorExp$—which captures the *levels* difference in effectiveness between first-time and not-first-time principals—is absorbed by the principal-by-school fixed effect. For parsimony, we estimate a single coefficient for the $ExpSchool \times AnyPriorExp$ interaction by using the continuous experience measure interacted with the binary indicator for prior experience.[20] Overall, this approach affords some flexibility to distinguish between general and school-specific improvement while still being empirically tractable.

[20] The results do not change qualitatively by using the set of experience buckets for either school-specific experience or the number of years of prior experience. We prefer the parsimonious, single-interaction term because it is more precisely estimated and easier to interpret.

Results

Student Outcomes

We begin by examining the relationship between principal experience and school performance—as measured by student outcomes. Table 1 shows estimates for the marginal effect of principal experience on student math test scores from each of the three contexts: Tennessee, New York City, and Oregon. The reading results, which are similar, are shown in Appendix Table A2. We show results for both model specifications described in the methods section (Equations 2 and 3).

In the baseline specification (columns 1, 3, and 5), we find that student test scores do not increase, on average, as principals gain experience. In TN and NYC, we estimate fairly precise null coefficients for the experience buckets, demonstrating that there is no difference in test scores relative to the principal's first year as principal. In OR, there is a slight upward trend as a function of total experience, though the estimates are not statistically significant at conventional levels (either for any individual experience bucket or jointly).

The results from our second specification (columns 2, 4, and 6) are similar. Here, the experience buckets capture the combined returns (general and school-specific) to experience for first-time principals (i.e., those who have not been in a principal position prior to their current school). The interaction term, *School Exp.* × *Any Prior Exp.*, tests whether this estimated trajectory is different for principals who have at least some prior principal experience in a different school. Again, we find null coefficients for the set of experience buckets (main effects), indicating that test scores do not improve, on average, as a principal remains in her school. The interaction term is zero in TN and OR, but negative and significant in NYC. Combined with the null main effects, this negative interaction in NYC indicates that, for the small subset of principals who enter a school with prior principal experience (less than 5% of unique principal-by-school spells), test scores actually *decrease* over time. Again, however, this is a small and potentially idiosyncratic group of principals, so we suggest caution in interpreting this result. Overall, the results are quite consistent across the three contexts.[21]

Given the importance of modeling decisions in estimating the returns to experience, we conduct an extensive set of robustness checks to ensure that our null results are not driven by downward bias towards zero. Appendix D shows these results, which are qualitatively similar to our preferred models.[22] In some checks, we find a small positive relationship for math achievement in NYC, but it is not consistent and the reading results often change in the opposite direction. In no cases is the point estimate for an experience bin greater than 0.03 SD. Thus, we feel confident that parameterization decisions are not driving our findings.

While perhaps initially surprising, the null results in Table 1 are consistent with recent work—using the same datasets analyzed here—questioning the presumed link between principal performance and improved student outcomes (Bartanen et al., 2024). That is, a likely explanation for these null findings is that changes in student test scores are neither a valid nor reliable indicator of a principal's performance. By extension, trying to make inferences about principal improvement on the basis of student test score performance may be misleading. This explanation may also help to explain the inconsistency in the prior literature regarding the relationship between principal experience and student achievement.

However, as an important addendum to the results in Table 1, we do find evidence that student test scores tend to be higher when a school has a more experienced principal. When replacing principal-by-school fixed effects (our preferred specification) with school fixed effects, there is a clear positive correlation between principal experience and student achievement (see Appendix Tables A5 and A6). The key difference in these specifications is that a school fixed effects approach cannot rule out that this relationship is driven by

[21] Given that many first-time principals have served as an assistant principal (e.g., Bastian & Henry, 2015; Grissom, Bartanen, & Mitani, 2019), we also examined whether prior AP experience moderated the returns to experience trajectory. The results shown in Appendix Table A4 show no evidence of an interaction, however.

[22] Specifically, we estimate our two primary specifications while, in sequence: (1) omitting year fixed effects, (2) adding controls for students' prior-year test scores in math and reading, and (3) changing experience buckets. For (3), we use buckets that are narrower, wider, and encompass different regions of the experience distribution.

selective attrition. In other words, the positive correlation observed in school fixed effects models is explained by the tendency for principals to leave their positions amidst a decline in student achievement—a pattern also documented in several prior studies (Bartanen et al., 2019; Miller, 2013). The complete attenuation in principal-by-school fixed effects models reinforces that this correlation is not driven by principal improvement.[23]

Extending our analysis to a different type of student outcome, we find no evidence that student attendance improves as principals gain experience. In Appendix Table A3, we show these results for TN and OR. In both states, there is weak evidence that attendance rates actually *decline* as principals gain more experience in the position, though these results are relatively small in magnitude (<0.5 days).

Given the indirect nature of principals' influence on student outcomes and the difficulty of establishing this link empirically, we do not interpret the results in Tables 1, A2 and A3 as clear evidence that principals do not improve with experience. Principals may improve in ways that do not clearly manifest through improvements in student achievement or attendance. Thus, we turn to measures that are perhaps more clearly tied to principal effectiveness. We first examine teacher hiring and retention. While these outcomes are muddier conceptually (e.g., higher staff turnover may be desirable in certain circumstances) and likely produce some of the same challenges as student test scores (namely, principals do not have complete control over hiring and retention decisions), they are more proximal to principals' leadership behaviors. Prior evidence also suggests that human capital management is a key channel through which principals affect school performance (Boyd et al., 2011; Branch et al., 2012).

Teacher Hiring and Retention

We find no evidence that principals improve at teacher retention or hiring as they gain experience, on average. Table 2 shows estimates from least squares models predicting

[23] As an additional piece of evidence, we show in Appendix Tables A5 and A6 that the correlation between principal experience and student achievement is largely driven by *school-specific* experience rather than total experience. This reinforces the selective attrition mechanism—principals are more likely to remain in the school when test scores are higher.

teacher turnover as a function of principal experience from our two key specifications.[24] Here, negative coefficients would indicate that teacher turnover rates are lower relative to the principal's first year in the school. In TN, we find precise null coefficients for each of the experience buckets and the interaction with having prior principal experience, demonstrating that teacher turnover rates are unchanged, on average, as principals remain in their school. In NYC and OR, we find positive coefficients, suggesting that turnover rates *increase* slightly as a principal gains experience. However, neither set of coefficients are jointly statistically significant. In NYC, the differences are statistically significant for the first several experience buckets (where statistical power is greater) and the interaction term is positive and significant. That is, the uptick in teacher turnover is somewhat larger for principals who have prior principal experience. This finding dovetails with the student achievement results, where principals with prior experience saw decreases in student test scores as they remained in a school. Again, however, these results are based off of a very small number of principals.[25]

As noted previously, teacher turnover may be difficult to interpret with respect to improvements in principal effectiveness. While there is clear evidence that high rates of teacher turnover harm student achievement *on average* (Ronfeldt et al., 2013), that may mask important heterogeneity with respect to *which* teachers are leaving. Adnot et al. (2017), for instance, show that student outcomes in the District of Columbia improved when lower-performing teachers were induced to leave under the district's high-stakes evaluation system. Relatedly, Grissom and Bartanen (2019b) show that while principals who were rated as more effective by their supervisors experienced lower rates of teacher turnover, on average, they actually saw *higher* rates of turnover among low-performing

[24] Here, we regress a binary indicator for teacher turnover on the principal experience buckets, a vector of time-varying school characteristics, and fixed effects for principal-by-school and year. Additionally, we include an indicator for whether the principal left their position following year t. This accounts for findings in prior work (e.g., Bartanen et al., 2019; Winters et al., 2023) showing that teacher turnover spikes following a principal transition. Because the turnover variable is constructed using yearly snapshots, we cannot pinpoint the exact timing of a teacher's departure. To avoid misattributing the turnover spike to principal experience (as opposed to the turnover event), we control for principal turnover in these models.

[25] In auxiliary regressions not shown here, we also find null effects for the relationship between principal experience and whether teachers move to a different school, change roles, or exit the public education system entirely.

teachers, suggesting that principals may target retention efforts at higher-performing teachers while seeking to push out lower-performing teachers. By similar logic, principals may improve with time at this type of strategic teacher retention, even if average turnover rates within the school are unchanged.

We investigate this possibility by modeling as the dependent variable the observable characteristics of teachers who leave in a particular year. Specifically, we examine teachers' years of experience, value-added, and observation scores (available in TN only). Given multiple outcome measures for each context, we focus on the school-specific experience specification for parsimony (results are effectively identical in the other specification). Table 3 shows that, on average, the characteristics of departing teachers are not changing as principals gain experience in their school. The one exception is for observation scores in TN, where we see a slight *increase* in the scores of departing teachers as principal experience increases. On the whole, however, Tables 2 and 3 demonstrate that both the amount of turnover and type of teachers who leave are not improving with principal experience.

Turning to hiring, we again find no evidence that principals improve with experience on this dimension. Table 4 shows results from models predicting the characteristics of newly hired teachers as a function of principal experience. We focus specifically on direct measures of prior performance (prior value-added and, in TN only, prior classroom observation scores) and teacher experience (both total years of experience and a binary indicator for first-year teacher). For new hires' years of experience, we observe a negative relationship with respect to principal experience. That is, principals tend to hire less experienced teachers, on average, as they remain in their school. This pattern is similar across all three contexts, though the evidence is strongest in NYC, where the sample size in largest. The coefficients in TN and OR, while similar is magnitude, are not statistically significant. In general, our hiring models struggle from low statistical power because of the collinearity of principal experience and year fixed effects, which is compounded by relatively few new hires in a school per year. That said, the preponderance of evidence suggests that principals do not hire teachers who improve student test scores or receive higher evaluation ratings as they gain experience.

Ratings From Teachers and Supervisors

Lastly, we turn to results for ratings of principal effectiveness from supervisors and teachers. In addition to being plausibly more direct measures of leadership behaviors, these outcomes may capture dimensions of a principal's performance over which they can exercise more direct control.

Table 5 demonstrates contrasting patterns of principal improvement based on the perceptions of supervisors versus teachers. Column 1 shows that first-time principals in TN earn substantially higher supervisor ratings as they gain experience, particularly in their first three years. Note that we employ a censored growth model here with a 5+ years bucket because there is substantial improvement in the first five years that subsequently levels off. Using the buckets from the prior tables leads to a downward bias in the coefficients (see Appendix Table A8 for a complete set of specifications).[26] To provide a sense of magnitude, the typical principal scores in the 37th percentile (3.62 on the 1 to 5 rating scale) in their first year in a school, compared to the 56th percentile (3.97) in their sixth year. The negative interaction term in column 1 indicates that this improvement in supervisor ratings is much smaller in magnitude for principals who have had prior principal experience. For example, a principal with any prior principal experience is expected to improve by 0.28 *SD less* (-0.055 $\times$ 5) over their first five years, which is roughly half of the improvement for first-time principals (0.56 *SD*). Thus, supervisors seem to perceive that principal improvement has both a general and a school-specific component. This result is confirmed in Appendix Table A8 using indicators for both total and school-specific experience.

[26] Specifically, the bias arises because of substantial improvement in supervisor ratings in the 2–3 and 4–6 years buckets. In the baseline specification, using 2–3 and 4–6 year buckets implicitly assumes that true ratings growth is zero within these ranges. However, we observe a pattern of sharp increases in these early years, suggesting that this assumption is violated. The result is that actual improvement is attributed to time trends captured by the year fixed effects, leading to downward bias in the estimated returns to experience (Papay & Kraft, 2015). This pattern further confirmed by a comparison of specifications using different buckets in Appendix Table A8, where we observe a flatter (albeit still positive and substantial) experience profile using the coarser buckets. For teacher ratings, we use the same buckets as supervisor ratings for parsimony, but the results are not particularly sensitive to the choice of buckets because ratings are more or less consistent after the first two years.

By contrast, in both TN and NYC (columns 2 and 4) we find that principals do not earn higher ratings from teachers as they remain in the school, on average. In fact, subjective ratings from teachers tend to *decrease* over the principal's first few years in the school, with the bulk of this dip occurring between the first and second year. While the contrast between perceptions of supervisors and teachers is potentially surprising, one hypothesis is that the decline in teacher ratings is driven by a "honeymoon period" that fades out over time, during which teachers may be relatively more positive about a new leader who brings a fresh perspective (or is simply a contrast from the prior principal). They may also give a new principal "the benefit of the doubt" early on. As the new principal becomes established, implements unwelcome changes, or fails to bring improvements to the school, they may meet resistance from some teachers.

In TN, where we can link individual teachers to their ratings, we have the ability to dig into this potential mechanism. Column 3 considers the extent to which the decline in teacher ratings is driven by teachers whom the principal inherits (as opposed to teachers hired by the principal). Here, we interact the principal experience buckets with an indicator for whether the principal hired the teacher. The results confirm that, at least in TN, the drop in teacher ratings is driven by "inherited" teachers rather than hired teachers. The main effect of being a hired teacher is 0.19 SD, which is essentially the same magnitude as the decline in ratings (roughly -0.20 SD). The interactions between hired teacher and principal experience show that, if anything, perceptions of principal effectiveness actually *improve* in the first few years among teachers whom the new principal hired. These results may demonstrate a challenging dynamic faced by new principals, whereby they must work to implement their vision for a school while balancing working with a teaching staff that is, at least initially, mostly hired by a prior principal.

Discussion

In this study, we use administrative data from Tennessee, New York City, and Oregon to estimate the returns to experience among principals. Although research shows that principals play a large part in supporting teaching and learning within their schools, our understanding of principals' skill development is limited. In particular, we know little about the extent to which principals—and the schools they lead—improve as they gain experience. Understanding the returns to principal experience helps to identify the potential benefits of policies to improve principal retention and provides insight about the nature of principal skill development.

Across all three contexts, we find no evidence that observable student and organizational outcomes improve as principals gain experience. While schools do tend to see better student performance and lower teacher turnover when their principal is more experienced, this pattern is driven by selective attrition rather than the returns to experience. That is, principals are more likely to leave their positions during periods of lower student achievement and higher teacher turnover, creating a positive correlation between principal experience and school performance. Using a within-principal design that accounts for bias from selective attrition, we estimate relatively precise null effects for principal experience on student outcomes.

However, there is one measure for which we find large and positive returns to experience: ratings from principal supervisors. Here, the typical principal in Tennessee improves by 0.56 *SD* over their first five years, moving from the moving from the 37^{th} to the 56^{th} percentile in the statewide distribution. Unfortunately, we have no such measures for principals in New York City or Oregon, though the similarity across contexts for our other findings suggests that these supervisor ratings results are potentially generalizable.

In considering these findings, it is important to emphasize the high level of principal turnover. The typical length of a principal's career is relatively short. Across the three contexts, the median principal leads a school for only 3–5 years and leaves the principalship after 6–7 years. While we find that even principals who stay in their schools for longer periods of time do not observably raise school outcomes, the short career of the typical principal suggests that many schools are in near-constant states of turbulence that may further curtail the possibility for principals to make meaningful contributions to school outcomes.

While the question we set out to answer—to what extent do principals improve with experience?—appeared simple, our analysis does not yield a clear answer. Empirically, we are limited in our ability to explain the discordance between supervisor ratings and the other measures of leadership practices and school performance. That said, we advance several hypotheses that might allow us to make sense of these results, though we caution that each is speculative and would benefit from more careful research.

One hypothesis is that supervisors' ratings do accurately capture improvement in principal effectiveness, but principals face constraints that weaken the link between their practices and school outcomes. For example, constraints due to the mediating role of *malleable school conditions* could inhibit the manifestation of principal improvement on school outcomes. A principal may spend a significant amount of time observing and coaching teachers, but teachers may improve too slowly or too little to produce measurable changes in student achievement. This explanation seems particularly plausible in light of the relatively short tenures of principals in their schools.

A related hypothesis is that there exists a disconnect between aspects of leadership captured by supervisor ratings versus those driving changes in the other outcomes we observe. Conditions such as community violence, teacher labor market shortages, or limited financial resources could force principals to engage in reactive practices that do not lead to school improvement as measured by observable student outcomes. For instance, a principal may be skilled in observing and coaching teachers, but may instead be required to spend time responding to stakeholder concerns about curriculum content. Recalling that managerial returns to experience tend to be firm-specific (Crook et al., 2011), the knowledge and skills that principals acquire may be similarly school-specific. Indeed, descriptive studies suggest that effective principals develop skills specific to the unique context and needs of their schools (such as principals in turnaround settings [Meyers and Hambrick Hitt, 2017]) and their students (Khalifa et al., 2016). By contrast, the practices captured in the typical principal evaluation rubrics must be abstract enough to be applicable in all schools across a district or state, but are only very weakly predictive of improved student outcomes (Grissom et al., 2018).

Finally, principals' evaluation ratings may largely reflect a social process in which supervisors assign higher ratings as principals gain experience that do not reflect principals' actual leadership practices. This disconnect may stem from a self-serving bias, in which supervisors—who are often also responsible for supporting and coaching principals—inflate their ratings because principals' effectiveness suggests supervisor effectiveness. Studies have shown that such bias is common among raters who are charged with both evaluating and developing an individual, even when raters are not evaluated themselves (Greenberg, 1991; Jones et al., 2021). Supervisors may also be more lenient in their ratings as they develop rapport with principals over time, may compare them favorably against less experienced principals if they think experience is an important factor in principal effectiveness, or may artificially lower evaluation ratings when principals are new because they lack sufficient opportunities to observe their skills (Bol, 2011; Yeates et al., 2013).

Given the unanswered questions raised by our analysis, we aim to be appropriately circumspect in discussing implications. On their face, our results suggest that, in isolation, policy efforts to increase principal retention may not translate to improvements in school performance, on average. Embedded in some multi-dimensional proposals to improve principal retention are some seemingly straightforward retention strategies, including paying higher salaries or restructuring deferred compensation disbursements (e.g., Levin & Bradley, 2019). Policy makers may be tempted to start with such approaches given that these may be easier to implement than more complex strategies to improve working conditions or provide better professional development. Our findings serve as a caution that these sorts of quick fixes are unlikely to result in improved school and principal performance, even if they increase retention. Importantly, however, our results cannot speak to policies that seek to improve principal retention by facilitating the manifestation of principal leadership practices via broad changes to the supports principals receive or the contexts in which they work (e.g., Darling-Hammond et al., 2022; Gates et al., 2020; Levin & Bradley, 2019). Such policies might simultaneously increase retention and produce observable returns to experience, though this is ultimately an empirical question.[27]

[27] A critical determinant of the likely effects of such principal support practices on returns to experience is the quality with which they are implemented. In Davis et al. (2020)'s review of state-level policies on principal professional development, Oregon was a clear outlier in having state level policies in 2015 that required principal professional development based on performance data, was job-embedded and sustained, was collaborative, reflective and supported through ongoing coaching. Despite these policy requirements,

Perhaps the most warranted implication of our study is that the research and policy communities need more evidence on how and under what conditions principals improve. The discrepancy between our results for supervisor ratings and all other outcomes highlights the importance of understanding which dynamic is at play. Are principals improving their "skills and knowledge" but contextual constraints inhibit these human capital improvements from manifesting in improved outcomes *or* are the ratings invalid and principal skill does not improve over time? The answer to this question implies substantially different policy responses.

Given the prevalence and costliness (Tran et al., 2018; Weinstein et al., 2009) of principal turnover, understanding when and in what ways principals improve may be key to retaining them as well. "Retaining effective principals" is a ubiquitous goal in school districts, but the principal effects literature so far has had little to say about how principal effectiveness and principal retention relate to one another. Indeed, the factors that help principals improve their effectiveness may not necessarily be those that help retain them in the job, and the principals in our data did not become more effective (outside of supervisor ratings) as they stayed in the role. Future research should examine the extent to which determinants of principal effectiveness and principal retention overlap.

This study has some important limitations. First, estimating the returns to principal experience involves addressing several obstacles to causal identification using imperfect methods. As with any non-experimental analysis, there is no guarantee that all confounding factors have been addressed. Of particular note in this study is that isolating the returns to experience from unobserved time-varying productivity trends requires methodological choices that could affect the results. That said, we have taken care to demonstrate the robustness of our findings to these choices and establish consistency across three different contexts and datasets.

While the replication of results across three distinct contexts bolsters external validity, there remain limitations in this area. First, the majority of principals we observe

our analysis, covering an overlapping timeframe as the Davis et al. (2020) review, does not suggest that principal performance improved with years of experience at a faster rate in this state.

only worked in one school during the study period, and many are observed for a small number of years. While this is a reflection of the nature of the principal labor market, it has implications for our findings. Specifically, identification of the returns to experience come from principals who remain in the principalship for a given number of years. As principal experience increases, this subset of "stayers" becomes increasingly small, which raises the possibility that the estimates for these higher experience buckets are less representative of the full sample. More intuitively, few principals reach high levels of experience, which makes estimates based on this select group more likely to be idiosyncratic. Given the null results across most outcomes, however, this concern seems less salient.[28] Relatedly, censoring of experience measures in OR and TN means that our estimates in these contexts are driven by principals from more recent cohorts though, again, our results are similar in NYC where we have complete data.

Finally, and perhaps most critically, we do not observe independent, objective measures of principal skills and practices. Each of the measures we examine has shortcomings with respect to inferring changes in principal effectiveness or performance. While this limitation is common in returns to experience analyses (particularly in the education realm), the unique role of principals may amplify its importance. For example, studies of the returns to teacher experience commonly rely on changes in student achievement to infer changes in teacher effectiveness. Many find this exercise convincing because teachers interact with and provide direct instruction to students on a daily basis. However, principals' effects on student outcomes are indirect and likely spread across many school-level processes, which introduces issues related to the timing and expected magnitude of these effects. While we aim to address this limitation by examining a wide range of outcomes, some of which are more proximal to principals' leadership behaviors, we believe that measurement remains a substantial challenge for the quantitative school

[28] Further, Appendix Table A9 provides empirical evidence that the estimated returns to experience do not vary substantially according to the length of a principal's tenure. To show this, we interact the experience buckets with a time-invariant, binned variable for the length of a principal's tenure in a school. These interactions are nearly all small in magnitude and not statistically significant. The one exception is for principal's with very short (i.e., 2 years) tenures in New York City. Here, we observe a clear decline in test scores from the first to second year.

leadership literature.

In sum, the findings of this study suggest that the average principal does not become more successful over time at improving student achievement or attendance rates. As such, this study raises important questions about the nature of principal improvement. What are the actual skills that principals could (and should) build as they accumulate more experience as leaders? What are the links between changes in principal skillsets and changes in school conditions? What policy and practice interventions could strengthen the link between leadership practices and school and student outcomes? Answers to these questions will inform policies that might increase the quality of school leadership and by extension learning opportunities for children.

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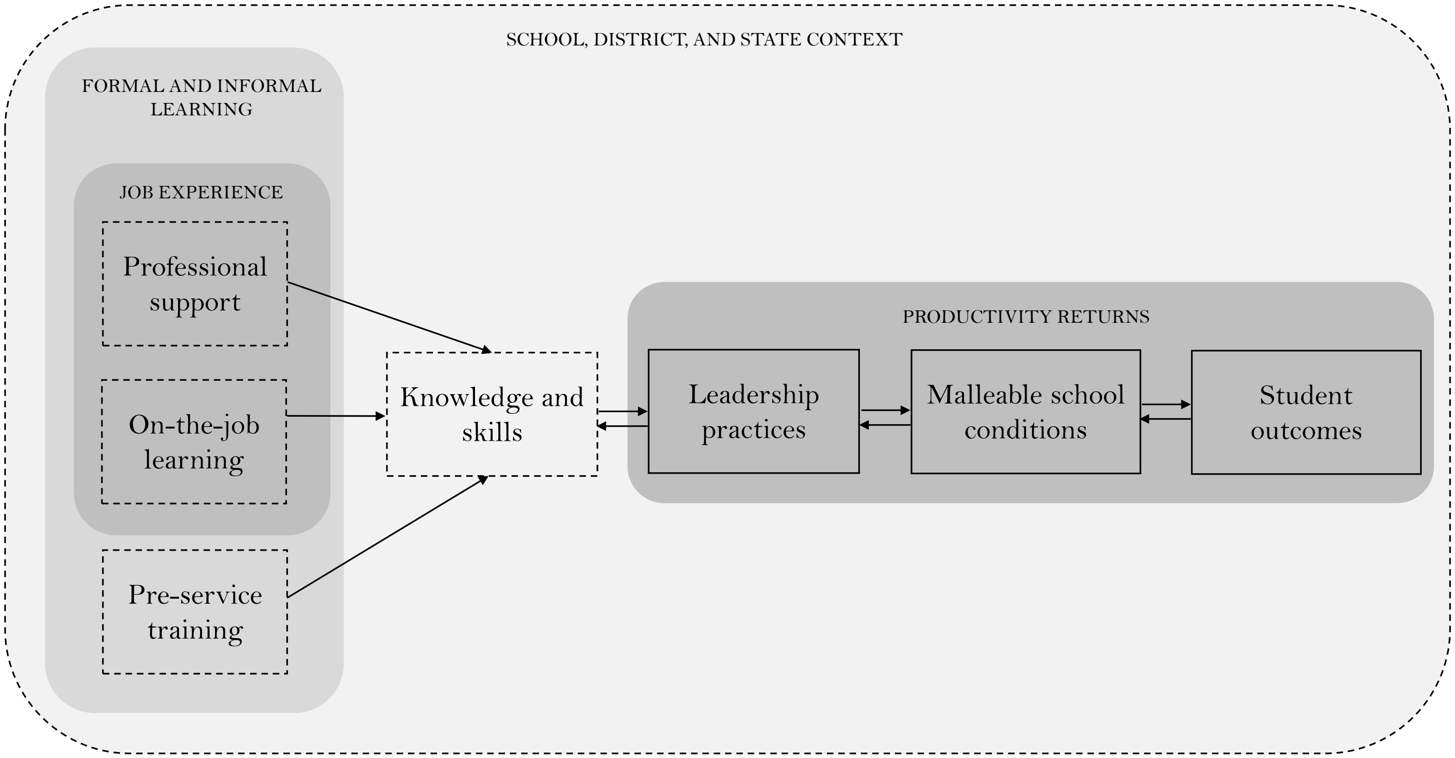
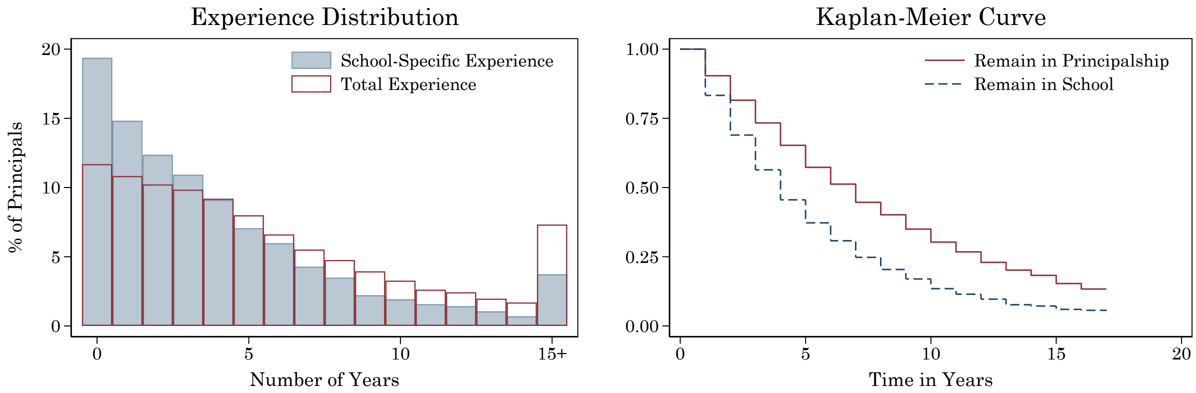


Figure 1

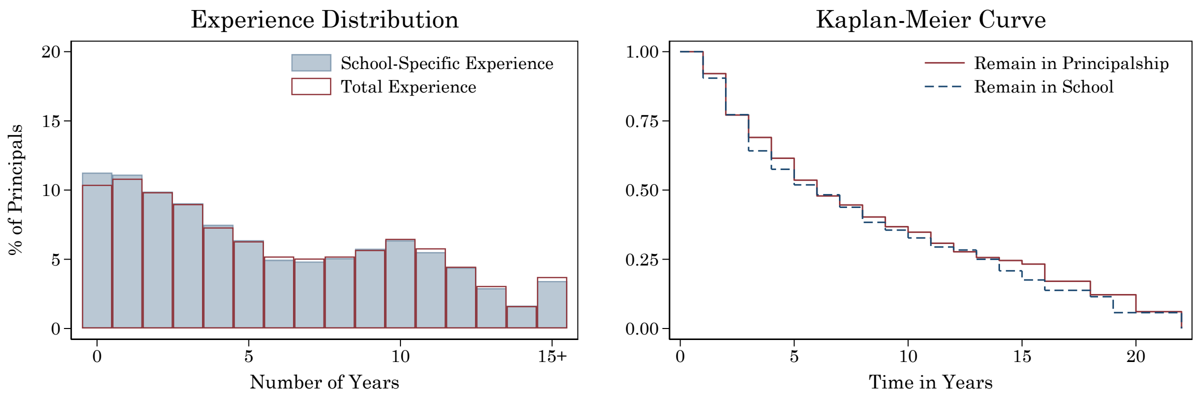
Conceptual Framework for the Returns to Principal Experience

Notes: Dashed boxes denote unmeasured constructs, while solid boxes are constructs for which we have one or more measures. Increased job experience (i.e., years of experience) offers increased opportunities for professional support and on-the-job learning, which may translate into improved knowledge and skills, ultimately manifesting in observable changes in leadership practices, malleable school conditions, and student outcomes.

(a) *Tennessee*



(b) *New York City*



(c) *Oregon*

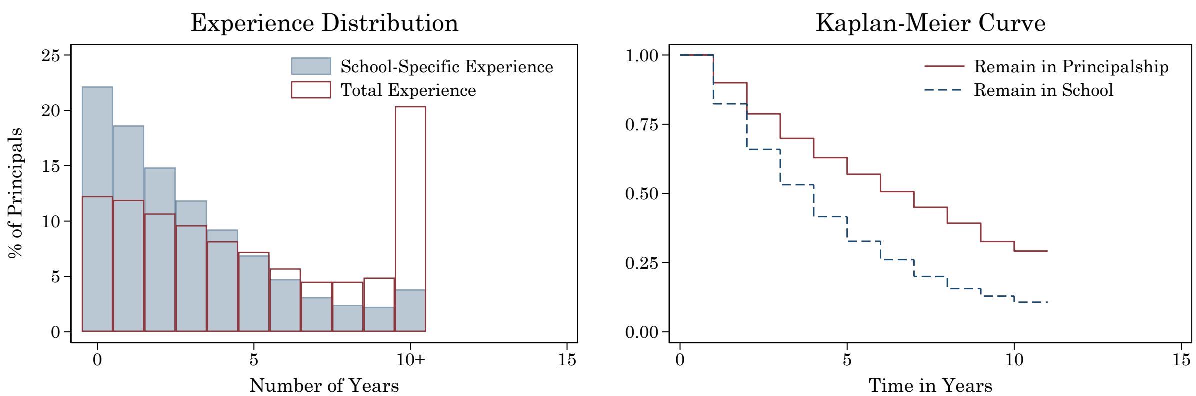


Figure 2

The Distribution of Principal Experience

Notes: Figures use the three most recent years of data in each setting. Left-hand plots show histograms for total and school-specific experience. Right-hand plots show Kaplan-Meier curves generated from unadjusted survival analyses estimated for survival in position in school and in the principalship.

Table 1

Principal Experience and Student Math Test Scores

	Tennessee		New York City		Oregon†	
Type of Experience =	Total (1)	School (2)	Total (3)	School (4)	Total (5)	School (6)
0 years (base)						
1 year	-0.001	-0.001	0.000	-0.001	0.003	-0.005
	(0.005)	(0.004)	(0.003)	(0.003)	(0.006)	(0.005)
2–3 years	0.002	0.002	0.004	0.002	0.012	-0.003
	(0.007)	(0.007)	(0.007)	(0.007)	(0.011)	(0.010)
4–6 years	0.005	0.004	0.014	0.009	0.029	0.007
	(0.012)	(0.012)	(0.013)	(0.013)	(0.017)	(0.015)
7–9 years / 7+ years†	-0.003	-0.003	0.009	0.003	0.030	0.003
	(0.016)	(0.018)	(0.019)	(0.020)	(0.024)	(0.023)
10+ years	-0.007	-0.002	-0.005	-0.005		
	(0.020)	(0.023)	(0.026)	(0.027)		
School Exp. × Any Prior Exp.		-0.001		-0.010**		-0.003
		(0.003)		(0.002)		(0.003)
Exp Joint Test (p)	0.697	0.821	0.023	0.184	0.348	0.432
R^2	0.319	0.319	0.366	0.366	0.307	0.310
N	4954018	5600963	7727635	7727635	1688603	2182834

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

† In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Table 2

Principal Experience and Teacher Turnover

	Tennessee		New York City		Oregon[†]	
Type of Experience =	Total (1)	School (2)	Total (3)	School (4)	Total (5)	School (6)
0 years (base)						
1 year	-0.002	-0.002	0.002	0.004	0.001	0.001
	(0.003)	(0.003)	(0.002)	(0.002)	(0.005)	(0.004)
2–3 years	-0.003	0.001	0.004	0.006*	0.006	0.006
	(0.004)	(0.004)	(0.003)	(0.003)	(0.007)	(0.007)
4–6 years	-0.006	-0.004	0.004	0.007*	0.010	0.016
	(0.006)	(0.006)	(0.004)	(0.004)	(0.011)	(0.012)
7–9 years / 7+ years[†]	-0.007	-0.001	0.006	0.007	0.029	0.030
	(0.009)	(0.009)	(0.005)	(0.005)	(0.016)	(0.018)
10+ years	-0.006	0.001	0.009	0.011		
	(0.013)	(0.014)	(0.007)	(0.007)		
School Exp. × Any Prior Exp.		0.000		0.002*		0.000
		(0.001)		(0.001)		(0.001)
Exp Joint Test (p-value)	0.800	0.343	0.780	0.312	0.156	0.386
R^2	0.079	0.077	0.072	0.072	0.079	0.088
N	599448	683378	930448	930448	159319	206588

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. Estimates are from linear probability models for a binary indicator of teacher turnover. N refers to the total number of teacher-by-year observations.

[†] In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Table 3

Principal Experience and Characteristics of Departing Teachers

	Tennessee			New York City		Oregon†	
	Yrs Exp (1)	VA (2)	Obs (3)	Yrs Exp (4)	VA (5)	Yrs Exp (6)	VA (7)
School-Specific Experience							
0 years (base)							
1 year	-0.194	-0.012	0.050*	-0.015	-0.042	0.104	-0.067
	(0.138)	(0.019)	(0.022)	(0.124)	(0.022)	(0.214)	(0.059)
2–3 years	-0.066	0.036	0.090**	0.013	-0.011	-0.040	-0.061
	(0.206)	(0.028)	(0.033)	(0.170)	(0.027)	(0.336)	(0.090)
4–6 years	-0.106	0.064	0.102	-0.137	-0.004	-0.501	-0.035
	(0.352)	(0.049)	(0.054)	(0.279)	(0.042)	(0.603)	(0.151)
7–9 years / 7+ years†	0.245	0.081	0.101	-0.114	0.007	-0.506	-0.075
	(0.551)	(0.077)	(0.082)	(0.433)	(0.063)	(0.953)	(0.234)
10+ years	0.076	0.091	0.079	-0.276	0.001		
	(0.788)	(0.106)	(0.108)	(0.609)	(0.086)		
School Exp. × Prior Exp.	0.031	0.010	0.009	0.140**	-0.011	-0.038	0.023
	(0.046)	(0.007)	(0.008)	(0.050)	(0.009)	(0.074)	(0.027)
Experience Joint Test (p)	0.282	0.209	0.026	0.900	0.379	0.470	0.716
R^2	0.111	0.179	0.235	0.155	0.270	0.139	0.298
N	120314	47247	63222	136213	30867	40467	7107

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. All regressions are at the teacher-year level and the sample includes newly hired teachers only. The dependent variable is the characteristic listed at the top of the column. Yrs Exp (years of experience) is a continuous measure of teachers' total years of experience. New Tch (new teacher) is a binary indicator for whether the teacher is in their first year of teaching. VA (value-added) is the teacher's average value-added estimate (math and reading), generated from all available years of data using the Chetty et al. (2014) drift-adjusted approach. Obs (observation scores) is the average of a teacher's classroom observation scores from all available prior years of data.

*$p < 0.05$, **$p < 0.01$.

Table 4

Principal Experience and Teacher Hiring

	Tennessee				New York City			Oregon†		
	Yrs Exp (1)	New Tch (2)	VA (3)	Obs (4)	Yrs Exp (5)	New Tch (6)	VA (7)	Yrs Exp (8)	New Tch (9)	VA (10)
School-Specific Experience										
0 years (base)										
1 year	-0.142	0.011	-0.015	0.003	-0.359**	0.027**	-0.031	-0.145	0.004	0.018
	(0.098)	(0.007)	(0.028)	(0.025)	(0.075)	(0.006)	(0.029)	(0.175)	(0.011)	(0.034)
2–3 years	-0.259	0.015	-0.043	-0.033	-0.467**	0.041**	-0.012	-0.279	0.020	0.067
	(0.150)	(0.010)	(0.039)	(0.037)	(0.088)	(0.007)	(0.036)	(0.278)	(0.018)	(0.052)
4–6 years	-0.225	0.011	-0.093	-0.059	-0.534**	0.049**	0.001	-0.611	0.035	0.087
	(0.252)	(0.016)	(0.066)	(0.060)	(0.124)	(0.010)	(0.054)	(0.494)	(0.033)	(0.089)
7–9 years / 7+ years†	-0.131	0.006	-0.145	-0.083	-0.532**	0.051**	-0.006	-1.035	0.065	0.052
	(0.395)	(0.024)	(0.103)	(0.093)	(0.175)	(0.015)	(0.079)	(0.773)	(0.049)	(0.138)
10+ years	-0.632	0.031	-0.182	-0.129	-0.565*	0.049*	-0.058			
	(0.559)	(0.036)	(0.148)	(0.130)	(0.230)	(0.020)	(0.111)			
School Exp. × Prior Exp.	-0.096**	0.009**	-0.004	0.013	-0.022	0.003	0.013	-0.064	-0.001	0.006
	(0.034)	(0.002)	(0.009)	(0.010)	(0.036)	(0.003)	(0.010)	(0.065)	(0.004)	(0.016)
Experience Joint Test (p)	0.044	0.155	0.817	0.785	0.000	0.000	0.502	0.753	0.669	0.401
R^2	0.092	0.092	0.175	0.191	0.111	0.108	0.217	0.205	0.207	0.321
N	108554	108429	23553	32101	149828	149829	17240	35521	35521	6902

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. All regressions are at the teacher-year level and the sample includes newly hired teachers only. The dependent variable is the characteristic listed at the top of the column. Yrs Exp (years of experience) is a continuous measure of teachers' total years of experience. New Tch (new teacher) is a binary indicator for whether the teacher is in their first year of teaching. VA (value-added) is the teacher's average value-added estimate (math and reading), generated from all available years of data using the Chetty et al. (2014) drift-adjusted approach. Obs (observation scores) is the average of a teacher's classroom observation scores from all available prior years of data.
*$p < 0.05$, **$p < 0.01$.

Table 5
Ratings from Supervisors and Teachers

	Tennessee			New York City
	Supervisors	Teachers		Teachers
	(1)	(2)	(3)	(4)
School-Specific Experience				
0 years (base)				
1 year	0.232**	-0.091**	-0.125**	-0.151**
	(0.027)	(0.015)	(0.016)	(0.049)
2 years	0.359**	-0.123**	-0.170**	-0.172**
	(0.041)	(0.021)	(0.022)	(0.064)
3 years	0.457**	-0.152**	-0.210**	-0.208*
	(0.055)	(0.027)	(0.027)	(0.081)
4 years	0.507**	-0.163**	-0.215**	-0.186*
	(0.070)	(0.035)	(0.035)	(0.094)
5+ years	0.564**	-0.163**	-0.202**	-0.165
	(0.091)	(0.044)	(0.044)	(0.120)
School Exp. × Prior Exp.	-0.055**	0.017	0.018	-0.053
	(0.018)	(0.009)	(0.009)	(0.072)
Principal Hired Teacher (main effect)			0.189**	
			(0.017)	
Exp = 1 year x Hired			0.068**	
			(0.020)	
Exp = 2 years x Hired			0.061**	
			(0.021)	
Exp = 3 years x Hired			0.061**	
			(0.023)	
Exp = 4 years x Hired			0.034	
			(0.024)	
Exp = 5+ years x Hired			-0.005	
			(0.022)	
Experience Joint Test (p-value)	0.000	0.000	0.000	0.049
Interaction Joint Test (p-value)			0.000	
R^2	0.735	0.192	0.200	0.862
N	11319	151299	151299	4536

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. For supervisor ratings, the unit of observation is principal-year and ratings are standardized within year. For teacher ratings, the unit of observation is teacher-year and ratings are standardized at the teacher level within year.
$^*p < 0.05$, $^{**}p < 0.01$.

Appendix A
Supplementary Tables and Figures

Table A1

Missingness of Experience by Year

	Tennessee		Oregon	
	Total Exp.	School-Specific	Total Exp.	School-Specific
2007	0.515	0.378	0.826	0.709
2008	0.446	0.312	0.702	0.543
2009	0.371	0.247	0.623	0.421
2010	0.316	0.201	0.536	0.306
2011	0.275	0.164	0.444	0.210
2012	0.240	0.127	0.391	0.152
2013	0.199	0.101	0.315	0.097
2014	0.167	0.080	0.277	0.071
2015	0.144	0.064	0.213	0.039
2016	0.119	0.048	0.183	0.028
2017	0.110	0.040	0.151	0.023
2018	0.093	0.033	0.134	0.021
2019	0.080	0.022		

Notes: New York City has no missingness and is thus excluded from this table.

Table A2

Principal Experience and Student Test Scores (Preferred Specifications, Reading)

	Tennessee		New York City		Oregon†	
Type of Experience =	Total (1)	School (2)	Total (3)	School (4)	Total (5)	School (6)
0 years (base)						
1 year	-0.001	-0.003	-0.004	-0.006	-0.002	-0.006
	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)
2–3 years	0.000	-0.001	-0.004	-0.007	0.003	-0.007
	(0.005)	(0.004)	(0.006)	(0.006)	(0.010)	(0.009)
4–6 years	0.000	-0.005	0.005	0.001	0.019	-0.011
	(0.007)	(0.007)	(0.011)	(0.011)	(0.015)	(0.015)
7–9 years / 7+ years†	-0.010	-0.020	0.013	0.009	0.014	-0.018
	(0.011)	(0.010)	(0.016)	(0.017)	(0.022)	(0.022)
10+ years	-0.013	-0.018	0.015	0.015		
	(0.014)	(0.014)	(0.023)	(0.024)		
School Exp. × Any Prior Exp.		-0.001		-0.007**		-0.003
		(0.002)		(0.002)		(0.003)
Exp Joint Test (p-value)	0.408	0.043	0.018	0.005	0.149	0.690
R^2	0.324	0.324	0.368	0.368	0.327	0.328
N	5290205	6049240	7445426	7445426	1677903	2164625

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

† In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Table A3

Principal Experience and Student Attendance (Preferred Specifications)

	Tennessee		Oregon†	
Type of Experience =	Total (1)	School (2)	Total (3)	School (4)
0 years (base)				
1 year	0.00	0.02	-0.03	-0.02
	(0.05)	(0.04)	(0.05)	(0.04)
2–3 years	0.04	0.00	-0.06	-0.08
	(0.07)	(0.07)	(0.10)	(0.09)
4–6 years	-0.13	-0.12	-0.03	-0.08
	(0.12)	(0.11)	(0.13)	(0.13)
7–9 years / 7+ years†	-0.22	-0.09	-0.07	-0.18
	(0.16)	(0.16)	(0.18)	(0.22)
10+ years	-0.13	0.01		
	(0.21)	(0.22)		
School Exp. × Any Prior Exp.		-0.01		-0.03
		(0.02)		(0.02)
Exp Joint Test (p)	0.012	0.072	0.906	0.782
R^2	0.119	0.121	0.112	0.113
N	9983705	11437170	3203214	4161078

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student days of attendance (i.e., positive coefficients indicate more days attended). The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

† In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

$^*p < 0.05$, $^{**}p < 0.01$.

Table A4

Heterogeneity by Prior Experience as an Assistant Principal

	Tennessee		New York City		Oregon†	
	Math (1)	Read (2)	Math (3)	Read (4)	Math (5)	Read (6)
Total Experience						
0 years (base)						
1 year	0.004	-0.004	0.006	-0.000	0.008	0.004
	(0.011)	(0.006)	(0.006)	(0.006)	(0.008)	(0.007)
2–3 years	0.012	0.002	0.011	0.003	0.016	0.006
	(0.014)	(0.009)	(0.009)	(0.008)	(0.013)	(0.011)
4–6 years	0.001	0.006	0.011	0.012	0.042*	0.022
	(0.021)	(0.013)	(0.014)	(0.013)	(0.020)	(0.017)
7–9 years / 7+ years†	0.004	-0.004	0.006	0.005	0.033	-0.001
	(0.028)	(0.018)	(0.021)	(0.019)	(0.030)	(0.027)
10+ years	-0.032	-0.021	-0.009	0.001		
	(0.033)	(0.022)	(0.028)	(0.025)		
Interactions						
1 year x Any AP Exp	-0.006	0.004	-0.008	-0.007	-0.008	-0.009
	(0.012)	(0.007)	(0.006)	(0.006)	(0.009)	(0.008)
2–3 years x Any AP Exp	-0.012	-0.002	-0.010	-0.012	-0.006	-0.003
	(0.015)	(0.009)	(0.008)	(0.007)	(0.013)	(0.010)
4–6 years x Any AP Exp	0.005	-0.007	0.006	-0.009	-0.019	-0.004
	(0.021)	(0.012)	(0.011)	(0.010)	(0.018)	(0.014)
7–9 years / 7+ years† x Any AP Exp	-0.011	-0.007	0.010	0.017	-0.004	0.023
	(0.027)	(0.017)	(0.015)	(0.013)	(0.027)	(0.025)
10+ years x Any AP Exp	0.032	0.011	0.015	0.035*		
	(0.032)	(0.020)	(0.021)	(0.018)		
N	4954018	5290205	7727491	7445335	1688603	1677903
R^2	0.319	0.324	0.366	0.367	0.307	0.327

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

† In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

$^{*}p < 0.05$, $^{**}p < 0.01$.

Table A5

Principal Experience and Student Test Scores (School Fixed Effects, Math)

	Tennessee			New York City			Oregon†		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total Experience									
0 years (base)									
1 year	0.003		-0.002	0.005*		-0.009	0.005		0.007
	(0.004)		(0.007)	(0.003)		(0.007)	(0.005)		(0.008)
2–3 years	0.011*		0.002	0.019**		-0.017	0.010		0.005
	(0.005)		(0.009)	(0.003)		(0.011)	(0.006)		(0.011)
4–6 years	0.013*		-0.002	0.039**		-0.002	0.023**		0.004
	(0.006)		(0.011)	(0.005)		(0.016)	(0.008)		(0.011)
7–9 years / 7+ years†	0.010		-0.007	0.045**		0.027	0.019		-0.005
	(0.008)		(0.014)	(0.006)		(0.018)	(0.011)		(0.013)
10+ years	0.020		0.007	0.045**		0.022			
	(0.011)		(0.019)	(0.007)		(0.021)			
School-Specific Experience									
0 years (base)									
1 year		0.004	0.006		0.007**	0.014*		0.001	-0.003
		(0.003)	(0.006)		(0.002)	(0.007)		(0.004)	(0.007)
2–3 years		0.012**	0.009		0.023**	0.037**		0.007	0.007
		(0.004)	(0.008)		(0.003)	(0.011)		(0.005)	(0.009)
4–6 years		0.021**	0.020		0.044**	0.044**		0.023**	0.028*
		(0.006)	(0.010)		(0.005)	(0.016)		(0.007)	(0.012)
7–9 years / 7+ years†		0.022**	0.021		0.045**	0.017		0.028*	0.037*
		(0.009)	(0.015)		(0.006)	(0.018)		(0.012)	(0.018)
10+ years		0.032*	0.008		0.047**	0.023			
		(0.015)	(0.022)		(0.007)	(0.022)			
Total Exp Joint Test (p-value)	0.190		0.772	0.000		0.044	0.087		0.809
Sch Exp Joint Test (p-value)		0.008	0.459		0.000	0.007		0.017	0.045
R^2	0.311	0.310	0.311	0.358	0.358	0.358	0.302	0.303	0.302
N	4954018	5600963	4931048	7727635	7839062	7727635	1688603	2182834	1688603

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

† In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Table A6

Principal Experience and Student Test Scores (School Fixed Effects, Reading)

	Tennessee			New York City			Oregon[†]		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total Experience									
0 years (base)									
1 year	0.004		-0.001	-0.001		-0.006	0.003		0.004
	(0.003)		(0.005)	(0.002)		(0.007)	(0.004)		(0.007)
2–3 years	0.012**		0.001	0.004		-0.013	0.010		0.007
	(0.004)		(0.006)	(0.003)		(0.009)	(0.005)		(0.009)
4–6 years	0.016**		-0.003	0.019**		0.002	0.022**		0.014
	(0.004)		(0.007)	(0.004)		(0.013)	(0.007)		(0.010)
7–9 years / 7+ years[†]	0.012*		-0.007	0.030**		0.021	0.018		0.008
	(0.006)		(0.009)	(0.005)		(0.014)	(0.010)		(0.013)
10+ years	0.021*		-0.004	0.034**		0.022			
	(0.008)		(0.012)	(0.006)		(0.019)			
School-Specific Experience									
0 years (base)									
1 year		0.004	0.005		0.001	0.005		0.002	-0.001
		(0.002)	(0.004)		(0.002)	(0.007)		(0.003)	(0.006)
2–3 years		0.013**	0.013*		0.007*	0.018*		0.009*	0.003
		(0.003)	(0.005)		(0.003)	(0.009)		(0.004)	(0.008)
4–6 years		0.019**	0.023**		0.022**	0.018		0.020**	0.013
		(0.004)	(0.007)		(0.004)	(0.013)		(0.006)	(0.010)
7–9 years / 7+ years[†]		0.016**	0.022*		0.030**	0.009		0.031**	0.016
		(0.006)	(0.010)		(0.005)	(0.015)		(0.012)	(0.017)
10+ years		0.029**	0.031*		0.035**	0.012			
		(0.009)	(0.014)		(0.006)	(0.020)			
Total Exp Joint Test (p-value)	0.004		0.949	0.000		0.095	0.030		0.750
Sch Exp Joint Test (p-value)		0.000	0.044		0.000	0.332		0.007	0.724
R^2	0.320	0.320	0.320	0.362	0.362	0.362	0.322	0.323	0.322
N	5290205	6049240	5259831	7445426	7551488	7445426	1677903	2164625	1677903

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

[†] In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Table A7

Principal Experience and Teacher Turnover

	Tennessee	New York City	Oregon†
	(1)	(2)	(3)
School-Specific Experience			
0 years (base)			
1 year	-0.004	0.005	0.014
	(0.003)	(0.003)	(0.007)
2–3 years	0.000	0.006	0.010
	(0.005)	(0.004)	(0.011)
4–6 years	-0.003	0.009	0.022
	(0.008)	(0.005)	(0.019)
7–9 years / 7+ years†	-0.005	0.007	0.032
	(0.013)	(0.008)	(0.029)
10+ years	-0.005	0.011	
	(0.019)	(0.011)	
School Exp. × Prior Exp.	0.001	0.003	-0.006
	(0.001)	(0.002)	(0.003)
Teacher VA (main effect)	-0.011**	-0.007*	-0.014
	(0.002)	(0.004)	(0.007)
Interaction w/ Principal Experience			
× 1 year	-0.003	-0.015**	0.001
	(0.002)	(0.005)	(0.009)
× 2–3 years	-0.000	-0.013**	-0.003
	(0.002)	(0.004)	(0.009)
× 4–6 years	-0.003	-0.017**	0.006
	(0.002)	(0.004)	(0.009)
× 7–9 years / 7+ years†	-0.001	-0.016**	0.004
	(0.003)	(0.005)	(0.015)
× 10+ years	-0.004	-0.018**	
	(0.004)	(0.005)	
Experience Joint Test (p-value)	0.636	0.374	0.345
Interaction Joint Test (p-value)	0.606	0.002	0.901
R^2	0.091	0.081	0.092
N	290236	255543	45959

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. Estimates are from linear probability models for a binary indicator of teacher turnover. N refers to the total number of teacher-by-year observations.

† In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Table A8

Supervisor Ratings (Tennessee, All Models)

	(1)	(2)	(3)	(4)	(5)	(6)
Total Experience						
0 years (base)						
1 year	0.236**	0.130**				
	(0.030)	(0.047)				
2 years	0.370**	0.242**				
	(0.041)	(0.066)				
3 years	0.439**	0.249**				
	(0.052)	(0.078)				
4 years	0.509**	0.328**				
	(0.063)	(0.095)				
5+ years	0.560**	0.346**				
	(0.078)	(0.115)				
1 year				0.222**	0.141**	
				(0.031)	(0.049)	
2–3 years				0.366**	0.267**	
				(0.047)	(0.073)	
4–6 years				0.461**	0.375**	
				(0.070)	(0.103)	
7–9 years				0.452**	0.441**	
				(0.101)	(0.138)	
10+ years				0.403**	0.446*	
				(0.134)	(0.179)	
School-Specific Experience						
0 years (base)						
1 year		0.123**	0.232**			
		(0.041)	(0.027)			
2 years		0.148*	0.359**			
		(0.064)	(0.041)			
3 years		0.233**	0.457**			
		(0.081)	(0.055)			
4 years		0.219*	0.507**			
		(0.104)	(0.070)			
5+ years		0.266*	0.564**			
		(0.131)	(0.091)			
1 year					0.074	0.192**
					(0.042)	(0.026)
2–3 years					0.071	0.305**
					(0.068)	(0.043)
4–6 years					0.025	0.350**
					(0.102)	(0.068)
7–9 years					-0.132	0.239*
					(0.142)	(0.100)
10+ years					-0.243	0.145
					(0.187)	(0.131)
School Exp. × Prior Exp.			-0.055**			-0.050**
			(0.018)			(0.018)
N	10438	10414	11319	10438	10414	11319
R^2	0.734	0.734	0.735	0.734	0.734	0.734

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. For supervisor ratings, the unit of observation is principal-year and ratings are standardized within year. For teacher ratings, the unit of observation is teacher-year and ratings are standardized at the teacher level within year.
$^*p < 0.05$, $^{**}p < 0.01$.

Table A9

Heterogeneity by Tenure Length

	Tennessee		New York City		Oregon[†]	
	Math (1)	Read (2)	Math (3)	Read (4)	Math (5)	Read (6)
School-Specific Experience						
0 years (base)						
1 year	-0.009	0.001	0.011	0.009	-0.023	0.014
	(0.018)	(0.012)	(0.010)	(0.010)	(0.018)	(0.015)
2–3 years	0.023	0.017	0.018	0.011	0.012	0.028
	(0.024)	(0.015)	(0.015)	(0.013)	(0.027)	(0.021)
4–6 years	0.036	0.022	0.028	0.027	0.030	0.033
	(0.028)	(0.017)	(0.023)	(0.019)	(0.041)	(0.029)
7–9 years / 7+ years[†]	0.038	0.015	0.021	0.038	0.022	-0.001
	(0.034)	(0.020)	(0.030)	(0.026)	(0.047)	(0.038)
10+ years	0.040	0.016	0.016	0.045		
	(0.036)	(0.022)	(0.034)	(0.030)		
Interactions						
1 year x Tot Tenure = 1 Year	0.015	0.002	-0.040**	-0.036**	0.012	-0.024
	(0.019)	(0.013)	(0.013)	(0.013)	(0.020)	(0.016)
1 year x Tot Tenure = 2–3 Years	-0.002	-0.008	-0.007	-0.011	0.025	-0.018
	(0.019)	(0.013)	(0.011)	(0.010)	(0.021)	(0.016)
2–3 Years x Tot Tenure = 2–3 Years	-0.040	-0.028	-0.020	-0.014	-0.000	-0.036
	(0.023)	(0.015)	(0.015)	(0.013)	(0.026)	(0.019)
1 year x Tot Tenure = 4–6 Years	0.013	-0.005	-0.012	-0.007	0.030	-0.012
	(0.019)	(0.013)	(0.011)	(0.011)	(0.019)	(0.015)
2–3 Years x Tot Tenure = 4–6 Years	-0.011	-0.015	-0.012	-0.006	-0.008	-0.033
	(0.024)	(0.015)	(0.015)	(0.013)	(0.025)	(0.019)
4–6 Years x Tot Tenure = 4–6 Years	-0.027	-0.027	-0.016	-0.013	-0.033	-0.048*
	(0.026)	(0.017)	(0.020)	(0.017)	(0.034)	(0.022)
1 year x Tot Tenure = 7–9 Years	0.027	0.010	-0.003	-0.013		
	(0.020)	(0.013)	(0.013)	(0.013)		
2–3 Years x Tot Tenure = 7–9 Years	0.018	0.004	-0.008	-0.017		
	(0.025)	(0.016)	(0.017)	(0.015)		
4–6 Years x Tot Tenure = 7–9 Years	0.009	-0.003	-0.006	-0.018		
	(0.027)	(0.018)	(0.023)	(0.019)		
7–9 Years x Tot Tenure = 7–9 Years	-0.005	-0.017	-0.004	-0.024		
	(0.030)	(0.019)	(0.025)	(0.022)		
N	5600963	6049240	4933211	4686633	1311356	1291712
R^2	0.319	0.324	0.355	0.351	0.303	0.325

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

[†] In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Appendix B
Descriptive Statistics

Table B1

Descriptive Statistics (Tennessee)

	Math Sample		Reading Sample		Attend Sample	
	Mean	SD	Mean	SD	Mean	SD
Students						
Asian	0.02		0.02		0.02	
American Indian	0.00		0.00		0.00	
Black	0.24		0.24		0.26	
Hispanic	0.08		0.07		0.08	
Pacific Islander	0.00		0.00		0.00	
White	0.66		0.66		0.64	
Qualifies for FRPL	0.49		0.49		0.52	
Enrolled in Special Education	0.11		0.11		0.14	
English Learner Classification	0.03		0.02		0.04	
Standardized Math Score	0.01	1.00	0.00	1.00		
Standardized Reading Score	-0.02	1.00	0.00	1.00		
Proportion Days Absent	0.05	0.05	0.05	0.05	0.06	0.09
Standardized Math Score (prior-year)	0.04	0.98	0.04	0.98		
Standardized Reading Score (prior-year)	0.02	0.97	0.02	0.98		
Proportion Days Absent (prior-year)	0.05	0.05	0.05	0.05	0.05	0.06
Missing Prior-year Math Score	0.24		0.23			
Missing Prior-year Reading Score	0.23		0.22			
Missing Prior-year Absence Rate	0.09		0.09		0.15	
Sample Size (Student-by-Year)	5,600,963		6,049,240		11,437,170	
Unique Students	1,512,094		1,570,369		2,157,138	
Principals						
Female	0.55		0.55		0.56	
Black	0.18		0.18		0.18	
White	0.81		0.81		0.81	
Other Race/Ethnicity	0.00		0.00		0.00	
Age	49.77	8.96	49.77	8.96	49.70	9.01
Years of Experience (total)	22.37	9.24	22.37	9.25	22.26	9.29
Years of Experience (principal)	4.83	3.80	4.83	3.80	4.86	3.85
Years in Current School (principal)	3.67	3.42	3.67	3.42	3.69	3.48
Elementary School	0.57		0.57		0.59	
Middle School	0.19		0.19		0.19	
High School	0.19		0.19		0.18	
Other Level School	0.04		0.04		0.04	
Sample Size (Principal-by-Year)	17,553		17,577		19,867	
Unique Principals	3,925		3,925		4,095	

Table B2

Descriptive Statistics (New York City)

	Math Sample		Reading Sample	
	Mean	SD	Mean	SD
Students				
Female	0.49		0.49	
Asian	0.14		0.14	
Black	0.31		0.31	
Hispanic/Latino	0.40		0.39	
White				
Other Race/Ethnicity	0.01		0.01	
English Learner Classification	0.12		0.09	
Qualifies for FRPL	0.82		0.82	
Enrolled in Special Education	0.16		0.16	
Standardized Math Score	0.00	1.00	0.03	0.99
Standardized Reading Score	0.00	1.00	0.00	1.00
Standardized Math Score (prior-year)	0.04	0.97	0.06	0.97
Standardized Reading Score (prior-year)	0.04	0.97	0.05	0.97
Missing Prior-year Math Score	0.28		0.26	
Missing Prior-year Reading Score	0.31		0.29	
Sample Size (Student-by-Year)	7,839,508		7,551,978	
Unique Students	2,039,158		1,966,690	
Principals				
Female	0.74		0.74	
Black	0.28		0.28	
White	0.46		0.46	
Hispanic/Latino	0.06		0.06	
Other Race/Ethnicity	0.03		0.03	
Missing Race/Ethnicity	0.17		0.17	
Age	49.50	8.51	49.50	8.51
Years of Experience (total)	25.17		25.17	
Years of Experience (principal)	3.92	3.46	3.92	3.46
Years in Current School (principal)	3.73	3.41	3.73	3.41
Sample Size (Principal-by-Year)	18,350		18,337	
Unique Principals	3,215		3,216	

Table B3

Descriptive Statistics (Oregon)

	Math Sample		Reading Sample		Attend Sample	
	Mean	SD	Mean	SD	Mean	SD
Students						
Asian/Pacific Islander	0.07		0.07		0.07	
American Indian/Alaska Native	0.01		0.01		0.01	
Black	0.02		0.02		0.03	
Hispanic/Latino	0.23		0.23		0.22	
White	0.64		0.64		0.64	
Other Race/Ethnicity	0.03		0.03		0.03	
Qualifies for FRPL	0.53		0.53		0.52	
Enrolled in Special Education	0.13		0.13		0.14	
Limited English Proficiency	0.07		0.07		0.09	
504 Plan Designation	0.02		0.02		0.02	
Migrant Designation	0.02		0.02		0.02	
Indian Education Designation	0.01		0.01		0.01	
Standardized Math Score	0.03	0.99				
Standardized Reading Score			0.03	0.99		
Proportion Days Absent					0.06	0.07
Standardized Math Score (prior-year)	0.02	0.98	0.03	0.98		
Standardized Reading Score (prior-year)	0.02	0.99	0.02	0.99		
Proportion Days Absent (prior-year)	0.05	0.06	0.05	0.06	0.06	0.06
Missing Prior-year Math Score	0.06		0.08			
Missing Prior-year Reading Score	0.09		0.06			
Missing Prior-year Absence Rate	0.02		0.02		0.03	
Sample Size (Student-by-Year)	2,182,834		2,164,625		4,161,078	
Unique Students	731,053		728,045		981,527	
Principals						
Female	0.50		0.50		0.50	
American Indian	0.01		0.01		0.01	
Asian/Pacific Islander	0.02		0.02		0.02	
Black	0.02		0.02		0.02	
Hispanic/Latino	0.05		0.05		0.05	
Multi-Racial	0.01		0.01		0.02	
White	0.87		0.87		0.87	
Other Race/Ethnicity	0.01		0.01		0.01	
Age	46.86	7.94	46.86	7.94	46.94	8.02
Years of Experience (total)	18.20	8.21	18.20	8.22	18.19	8.28
Years of Experience (principal)	2.83	2.63	2.82	2.63	2.81	2.63
Years in Current School (principal)	2.02	2.12	2.02	2.12	2.00	2.12
Elementary School	0.50		0.50		0.50	
Middle School	0.18		0.18		0.17	
High School	0.16		0.16		0.16	
Other Level School	0.17		0.17		0.17	
Sample Size (Principal-by-Year)	9,189		9,192		9,723	
Unique Principals	2,177		2,180		2,289	

Appendix C
Modeling Details

We apply the general models described by Equations 2 and 3 to various outcome variables, including: student test scores, student attendance, teacher turnover, teacher hiring, ratings from supervisors, and ratings from teachers. While each of these specifications follows the general framework in terms of the parameterization of experience and the inclusion of fixed effects for principal-by-school and year, the unit of observation and included covariates differ. We describe these differences in the text below and provide a tabular summary of the primary characteristics of the data across contexts (Appendix Table C1). For parsimony, we describe each specification according to Equation 2, as there are no differences between Equations 2 and 3 beyond how experience is parameterized.

For each model, we also describe and justify the control variables. Generally speaking, inclusion of control variables is to reduce bias from confounding in estimating the returns to experience in principal-by-school fixed effects models. Because principal-by-school fixed effects already account for time-invariant school-level heterogeneity, the control variables aim to account for time-varying factors.

Student Achievement

For student achievement, we predict via least squares regression student test scores in math and reading (standardized within grade and year), respectively, using the following model:

$$Y_{aist} = \beta ExpTotal_{ist} + \mu_{i,s} + \tau_t + \phi \mathbb{X}_{aist} + \epsilon_{aist} \tag{C1}$$

where Y is the achievement outcomes for student a with principal i in school s in year t. $\mu_{i,s}$ and τ_t are principal-by-school and year fixed effects. The vector of covariates $\mathbb{X}$ includes: gender, race/ethnicity, special education status, gifted status (TN only), free/reduced-price lunch eligibility, grade repetition (TN only), limited English proficiency, section 504 designated students (OR only), migrant education program participation (OR only), Indian education program participation (OR only). We also include school-by-year means of each of these student characteristics. Finally, we include an indicator variable for each grade (OR and NYC) or grade-by-exam (TN). The inclusion of these control variables accounts for potential shifts in the student population served by a school over a principal's tenure. See Appendix Tables D1 and D2 for a comparison of results with and without these covariates.

Student Attendance

Models for student attendance mirror those for student achievement. We operationalize attendance using each student's attendance rate expressed as a percentage between 0 and 100. In TN, we shift from grade-by-exam FE to grade FE.

Teacher Turnover

For teacher turnover models, we predict via least squares regression a binary indicator for teacher turnover that takes a value of 1 if teacher a in school s in year t is no longer a teacher in school s in year $t+1$, and 0 otherwise:

$$Turnover_{ist} = \beta ExpTotal_{ist} + \mu_{i,s} + \tau_t + \phi \mathbb{X}_{aist} + \epsilon_{st} \tag{C2}$$

The vector of covariates $\mathbb{X}$ includes the vector of school-by-year aggregated characteristics described above for the student achievement. Note that we do not control for teacher characteristics because they are likely endogenous; principals may shape the teaching staff by hiring teachers whose characteristics are associated with lower turnover. Nonetheless, our results are essentially identical if we control for observable teacher characteristics. Finally, we include a binary indicator for whether the school's principal left their position between year t and $t+1$. This is important because of the timing of principal turnover and how our administrative data are captured. We receive yearly snapshot data for school personnel, such that we cannot pinpoint the exact timing for when a teacher or principal leaves their position. Most turnover, however, will occur in the summer between year t and $t+1$. When a principal leaves their position following year t, there is a spike in teacher turnover at the same time (Bartanen et al., 2019) as teachers subsequently respond to the principal transition. We control for principal turnover, then, to avoid attributing this disruptive event to the principal when it is likely that they are not making the same efforts to retain teachers after they have resigned their position.

Characteristics of Leavers

We supplement our teacher turnover models with an analysis of the types of teachers who leave the school. Here, the outcome is a particular teacher characteristic (years of experience, measured performance). The sample is restricted to include only teachers who leave the school between year t and year $t+1$ (i.e., those for whom the binary turnover flag described above takes a value of 1). We estimate via least squares regression:

$$Y_{aist} = \beta ExpTotal_{ist} + \mu_{i,s} + \tau_t + \phi\mathbb{X}_{st} + \epsilon_{aist} \tag{C3}$$

Here, $\mathbb{X}$ only includes the vector of time-varying school characteristics. We do not control for any teacher characteristics, as these would be endogenous.

Characteristics of New Hires

For teacher hiring, the outcome is a particular teacher characteristic (years of experience, prior performance). We model prior performance rather than current or future performance to avoid endogeneity (the principal may help a teacher improve after hiring them and our goal in these models is to isolate the compositional change via hiring only). The sample is restricted to include only teachers who first appear in a school in year t (this is how we classify new hires). We estimate via least squares regression:

$$Y_{aist} = \beta ExpTotal_{ist} + \mu_{i,s} + \tau_t + \phi\mathbb{X}_{st} + \epsilon_{aist} \tag{C4}$$

Here, $\mathbb{X}$ only includes the vector of time-varying school characteristics. We do not control for any teacher characteristics, as these would be endogenous.

Supervisor Ratings

Supervisor ratings are only available in Tennessee from 2012–2019. We use the average score across all rubric items (this is the measure used for the administrator evaluation system), which we subsequently standardize by year. We estimate via least squares regression:

$$Y_{ist} = \beta ExpTotal_{ist} + \mu_{i,s} + \tau_t + \phi\mathbb{X}_{ist} + \epsilon_{ist} \tag{C5}$$

Here, $\mathbb{X}$ only includes the vector of time-varying school characteristics.

Teacher Ratings

Teacher ratings are available in Tennessee (2012–2019) and New York City (2013–2016), but the unit of observation differs. In Tennessee, we have this measure at the individual teacher-by-year level. New York City only has a school-by-year aggregate measure. For TN, the model is the same as for teacher turnover model except that we do not include the indicator for principal turnover (since survey ratings are captured prior to the end of the school year, rather than an inference based on a yearly snapshot). The outcome is standardized at the teacher-by-year level. We estimate via least squares regression:

$$Y_{aist} = \beta ExpTotal_{ist} + \mu_{i,s} + \tau_t + \phi\mathbb{X}_{st} + \epsilon_{aist} \tag{C6}$$

For NYC, we estimate the model at the school-by-year level and include time-varying school characteristics. The outcome is standardized by year. We estimate via least squares regression:

$$Y_{ist} = \beta ExpTotal_{ist} + \mu_{i,s} + \tau_t + \phi\mathbb{X}_{ist} + \epsilon_{st} \tag{C7}$$

Table C1

Data Characteristics and Availability Across Contexts

	Tennessee	New York City	Oregon
Years of data	2006–07 – 2018–19	1998–99 – 2016–17	2006–07 – 2018–19
Available student outcomes	Grade 3–8 math & reading tests Attendance HS end-of-course tests	Grade 3–8 math & reading tests	Grade 3–8 math & reading tests Attendance
Teacher survey ratings	Yes Available at teacher-year level Standardized by teacher-year	Yes Available at school-year level Standardized by year	No
Supervisor ratings	Yes. Average of all rubric items	No	No
Variables in covariate vector	Gender Race/ethnicity Special education status FRPL-eligibility Limited English Proficiency Gifted status Prior grade repetition School-year avg of covariates	Gender Race/ethnicity Special education status FRPL-eligibility Limited English Proficiency School-year avg of covariates	Gender Race/ethnicity Special education status FRPL-eligibility Limited English Proficiency Sec. 504 designation Migrant education status Indian education status School-year avg of covariates
Covariates for turnover/hiring	School-year avg of covariates Principal turnover in t+1	School-year avg of covariates Principal turnover in t+1	School-year avg of covariates Principal turnover in t+1
Prior outcomes (Table D4)	Cubic in prior math & read score	Cubic in prior math & read score	Cubic in prior math & read score

Appendix D
Robustness Checks for Student Achievement Results

Table D1

Selection on Observables Test (Math)

	Tennessee				New York City				Oregon†			
Type of Experience =	Total		School		Total		School		Total		School	
Covariates =	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0 years (base)												
1 year	-0.003	-0.001	-0.002	-0.001	-0.002	0.000	-0.003	-0.001	-0.000	0.003	-0.008	-0.005
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.007)	(0.006)	(0.005)	(0.005)
2–3 years	-0.001	0.002	0.001	0.002	0.001	0.004	-0.001	0.002	0.005	0.012	-0.008	-0.003
	(0.008)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.012)	(0.011)	(0.010)	(0.010)
4–6 years	0.002	0.005	0.001	0.004	0.010	0.014	0.006	0.009	0.018	0.029	-0.001	0.007
	(0.012)	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.018)	(0.017)	(0.016)	(0.015)
7–9 years / 7+ years†	-0.006	-0.003	-0.010	-0.003	0.007	0.009	0.000	0.003	0.016	0.030	-0.001	0.003
	(0.017)	(0.016)	(0.019)	(0.018)	(0.020)	(0.019)	(0.020)	(0.020)	(0.025)	(0.024)	(0.025)	(0.023)
10+ years	-0.010	-0.007	-0.006	-0.002	-0.009	-0.005	-0.013	-0.005				
	(0.021)	(0.020)	(0.025)	(0.023)	(0.026)	(0.026)	(0.027)	(0.027)				
School Exp. × Any Prior Exp.			-0.002	-0.001			-0.007**	-0.010**			-0.004	-0.003
			(0.003)	(0.003)			(0.003)	(0.002)			(0.003)	(0.003)
R^2	0.190	0.319	0.191	0.319	0.209	0.366	0.209	0.366	0.116	0.307	0.122	0.310
N	4954018	4954018	5600963	5600963	7727635	7727635	7727635	7727635	1688603	1688603	2182834	2182834

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). Even-numbered columns include student characteristics and time-varying school characteristics; odd-numbered columns include only grade- and year-fixed effects. N refers to the total number of student-by-year observations.

† In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Table D2

Selection on Observables Test (Reading)

	Tennessee				New York City				Oregon[†]			
Type of Experience =	Total		School		Total		School		Total		School	
Covariates =	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0 years (base)												
1 year	-0.002	-0.001	-0.004	-0.003	-0.007*	-0.004	-0.008**	-0.006	-0.005	-0.002	-0.009	-0.006
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.005)	(0.005)	(0.005)
2–3 years	-0.003	0.000	-0.002	-0.001	-0.009	-0.004	-0.011*	-0.007	-0.002	0.003	-0.012	-0.007
	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.006)	(0.005)	(0.006)	(0.010)	(0.010)	(0.009)	(0.009)
4–6 years	-0.004	0.000	-0.007	-0.005	0.000	0.005	-0.003	0.001	0.013	0.019	-0.016	-0.011
	(0.008)	(0.007)	(0.008)	(0.007)	(0.009)	(0.011)	(0.009)	(0.011)	(0.016)	(0.015)	(0.015)	(0.015)
7–9 years / 7+ years[†]	-0.017	-0.010	-0.025*	-0.020	0.011	0.013	0.007	0.009	0.007	0.014	-0.019	-0.018
	(0.012)	(0.011)	(0.012)	(0.010)	(0.014)	(0.016)	(0.014)	(0.017)	(0.022)	(0.022)	(0.022)	(0.022)
10+ years	-0.019	-0.013	-0.018	-0.018	0.011	0.015	0.008	0.015				
	(0.015)	(0.014)	(0.016)	(0.014)	(0.020)	(0.023)	(0.020)	(0.024)				
School Exp. × Any Prior Exp.			-0.002	-0.001			-0.004	-0.007**			-0.004	-0.003
			(0.002)	(0.002)			(0.003)	(0.002)			(0.003)	(0.003)
R^2	0.155	0.324	0.157	0.324	0.189	0.368	0.189	0.368	0.103	0.327	0.108	0.328
N	5290205	5290205	6049240	6049240	7445426	7445426	7445426	7445426	1677903	1677903	2164625	2164625

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). Even-numbered columns include student characteristics and time-varying school characteristics; odd-numbered columns include only grade- and year-fixed effects. N refers to the total number of student-by-year observations.

[†] In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Table D3

No Year Fixed Effects

	Tennessee				New York City				Oregon†			
Type of Experience =	Total		School		Total		School		Total		School	
Subject =	Math	Read	Math	Read	Math	Read	Math	Read	Math	Read	Math	Read
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0 years (base)												
1 year	-0.003	0.001	-0.003	-0.001	0.001	-0.002	0.002	-0.001	0.002	-0.002	-0.001	-0.000
	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.005)	(0.004)	(0.004)	(0.003)
2–3 years	-0.002	0.003	-0.003	0.004	0.006	0.005	0.007	0.005	0.003	-0.001	0.002	0.005
	(0.006)	(0.004)	(0.005)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.007)	(0.006)	(0.006)	(0.005)
4–6 years	-0.004	0.005	-0.007	0.005	0.014*	0.020**	0.014*	0.018**	0.010	0.010	0.012	0.012
	(0.008)	(0.005)	(0.008)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.010)	(0.008)	(0.010)	(0.008)
7–9 years / 7+ years†	-0.020	-0.005	-0.023	-0.007	-0.001	0.025**	-0.004	0.022**	0.002	0.000	0.013	0.020
	(0.011)	(0.007)	(0.012)	(0.007)	(0.008)	(0.007)	(0.009)	(0.007)	(0.014)	(0.012)	(0.016)	(0.014)
10+ years	-0.015	0.011	-0.018	0.014	-0.019	0.030**	-0.016	0.029**				
	(0.015)	(0.010)	(0.019)	(0.011)	(0.011)	(0.009)	(0.012)	(0.010)				
School Exp. × Any Prior Exp.			-0.001	-0.001			-0.002	0.000			-0.003	-0.002
			(0.003)	(0.002)			(0.002)	(0.002)			(0.003)	(0.003)
Exp Joint Test (p)	0.273	0.078	0.393	0.012	0.000	0.000	0.001	0.000	0.804	0.262	0.630	0.471
R^2	0.319	0.324	0.319	0.324	0.366	0.367	0.366	0.367	0.307	0.327	0.310	0.328
N	4954018	5290205	5600963	6049240	7727635	7445426	7727635	7445426	1688603	1677903	2182834	2164625

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

† In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Table D4

Control for Prior-Year Test Scores

	Tennessee				New York City				Oregon†			
Type of Experience =	Total		School		Total		School		Total		School	
Subject =	Math (1)	Read (2)	Math (3)	Read (4)	Math (5)	Read (6)	Math (7)	Read (8)	Math (9)	Read (10)	Math (11)	Read (12)
0 years (base)												
1 year	0.003	0.002	0.005	-0.000	0.007*	0.003	0.008*	0.003	0.010	0.005	0.004	0.003
	(0.005)	(0.003)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.005)	(0.005)	(0.004)
2–3 years	0.003	0.003	0.006	0.002	0.014**	0.005	0.014**	0.004	0.015	0.009	0.006	0.005
	(0.007)	(0.004)	(0.007)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.009)	(0.009)	(0.008)	(0.008)
4–6 years	-0.001	-0.001	0.005	-0.005	0.017*	0.006	0.015*	0.005	0.019	0.013	0.009	0.003
	(0.011)	(0.007)	(0.011)	(0.008)	(0.007)	(0.006)	(0.007)	(0.006)	(0.014)	(0.013)	(0.014)	(0.013)
7–9 years / 7+ years†	-0.009	-0.008	0.002	-0.019	0.008	0.006	0.005	0.004	0.023	0.016	0.002	0.002
	(0.016)	(0.011)	(0.016)	(0.012)	(0.011)	(0.008)	(0.011)	(0.009)	(0.022)	(0.021)	(0.023)	(0.021)
10+ years	-0.006	-0.004	0.006	-0.013	-0.003	0.006	-0.003	0.007				
	(0.021)	(0.015)	(0.024)	(0.017)	(0.014)	(0.011)	(0.014)	(0.012)				
School Exp. × Any Prior Exp.			-0.000	0.000			-0.004**	-0.002			-0.002	-0.003
			(0.002)	(0.001)			(0.001)	(0.002)			(0.002)	(0.002)
Exp Joint Test (p)	0.724	0.357	0.827	0.012	0.000	0.805	0.000	0.835	0.430	0.849	0.735	0.766
R^2	0.630	0.660	0.629	0.659	0.669	0.636	0.669	0.636	0.681	0.665	0.678	0.662
N	3798370	4101077	4267340	4659988	5293406	5281868	5293406	5281868	1688603	1677903	2182834	2164625

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics, time-varying school characteristics and cubic polynomials of students' math and reading prior-year scores (interacted with grade). N refers to the total number of student-by-year observations.

† In Oregon, 7–9 and 10+ years are combined into a single 7+ years category.

*$p < 0.05$, **$p < 0.01$.

Table D5

Alternative Bins (Censored Growth at 5 years)

	Tennessee				New York City				Oregon†			
Type of Experience =	Total		School		Total		School		Total		School	
Subject =	Math	Read	Math	Read	Math	Read	Math	Read	Math	Read	Math	Read
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0 years (base)												
1 year	0.001	0.001	-0.001	-0.001	0.003	-0.005	0.001	-0.006*	0.003	0.000	-0.005	-0.005
	(0.005)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.005)	(0.005)	(0.005)
2 years	0.003	0.003	0.002	0.002	0.006	-0.006	0.002	-0.010*	0.011	0.005	-0.001	-0.004
	(0.007)	(0.004)	(0.007)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.010)	(0.009)	(0.009)	(0.009)
3 years	0.009	0.007	0.002	0.004	0.016*	-0.005	0.011	-0.009	0.014	0.012	-0.008	-0.005
	(0.009)	(0.006)	(0.010)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.014)	(0.012)	(0.013)	(0.013)
4 years / 4+ years†	0.014	0.009	0.008	0.005	0.024**	-0.001	0.016*	-0.006	0.030	0.028	0.004	-0.006
	(0.011)	(0.007)	(0.013)	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)	(0.018)	(0.016)	(0.018)	(0.018)
5+ years	0.010	0.007	-0.002	-0.002	0.027*	0.007	0.018	0.001				
	(0.014)	(0.009)	(0.017)	(0.009)	(0.012)	(0.009)	(0.012)	(0.010)				
School Exp. × Any Prior Exp.			-0.001	-0.001			-0.010**	-0.006**			-0.003	-0.003
			(0.003)	(0.002)			(0.002)	(0.002)			(0.003)	(0.003)
Exp Joint Test (p)	0.576	0.721	0.334	0.251	0.014	0.016	0.041	0.005	0.338	0.148	0.128	0.751
R^2	0.319	0.324	0.319	0.324	0.366	0.368	0.366	0.368	0.307	0.327	0.310	0.328
N	4954018	5290205	5600963	6049240	7727635	7445426	7727635	7445426	1688603	1677903	2182834	2164625

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

† In Oregon, 4 years and 5+ years are combined into a single 4+ years category.

*$p < 0.05$, **$p < 0.01$.

Table D6

Alternative Bins (0–1, 2–4, 5+ bins)

	Tennessee				New York City				Oregon			
Type of Experience =	Total		School		Total		School		Total		School	
Subject =	Math (1)	Read (2)	Math (3)	Read (4)	Math (5)	Read (6)	Math (7)	Read (8)	Math (9)	Read (10)	Math (11)	Read (12)
0–1 years (base)												
2–4 years	0.006	0.004	0.003	0.004	0.010*	-0.002	0.007	-0.005	0.011	0.008	0.005	0.001
	(0.005)	(0.004)	(0.006)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)	(0.006)	(0.006)	(0.006)
5+ years	0.004	0.003	-0.005	-0.002	0.019*	0.008	0.012	0.004	0.029*	0.021	0.022*	0.004
	(0.010)	(0.007)	(0.011)	(0.006)	(0.009)	(0.008)	(0.009)	(0.008)	(0.014)	(0.012)	(0.011)	(0.012)
School Exp. × Any Prior Exp.			-0.001	-0.001			-0.011**	-0.006**			-0.003	-0.003
			(0.002)	(0.002)			(0.002)	(0.002)			(0.003)	(0.003)
Exp Joint Test (p)	0.447	0.445	0.263	0.082	0.056	0.016	0.296	0.006	0.113	0.226	0.121	0.919
R^2	0.319	0.324	0.319	0.324	0.366	0.368	0.366	0.368	0.310	0.328	0.310	0.328
N	4954018	5290205	5600963	6049240	7727635	7445426	7727635	7445426	1329568	1321398	2182834	2164625

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have 0 or 1 years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

$^*p < 0.05$, $^{**}p < 0.01$.

Table D7

Alternative Bins (0, 1, 2, 3, 4, 5–7, 8–10, 11+ bins)

	Tennessee				New York City				Oregon†			
Type of Experience =	Total		School		Total		School		Total		School	
Subject =	Math (1)	Read (2)	Math (3)	Read (4)	Math (5)	Read (6)	Math (7)	Read (8)	Math (9)	Read (10)	Math (11)	Read (12)
0 years (base)												
1 year	-0.002	0.001	-0.001	0.000	0.001	-0.003	-0.001	-0.005	0.003	0.000	-0.008	-0.005
	(0.005)	(0.003)	(0.005)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.007)	(0.006)	(0.006)	(0.006)
2 years	-0.001	0.002	0.001	0.006	0.002	-0.004	-0.001	-0.007	0.011	0.005	-0.006	-0.004
	(0.008)	(0.005)	(0.008)	(0.005)	(0.007)	(0.006)	(0.007)	(0.006)	(0.012)	(0.011)	(0.012)	(0.012)
3 years	0.003	0.006	0.001	0.009	0.010	-0.001	0.007	-0.004	0.014	0.012	-0.015	-0.005
	(0.010)	(0.007)	(0.011)	(0.007)	(0.010)	(0.009)	(0.010)	(0.009)	(0.016)	(0.015)	(0.017)	(0.017)
4 years	0.005	0.007	0.007	0.012	0.015	0.005	0.010	-0.000	0.024	0.024	-0.009	-0.006
	(0.013)	(0.009)	(0.014)	(0.010)	(0.013)	(0.011)	(0.014)	(0.012)	(0.021)	(0.020)	(0.023)	(0.022)
5–7 years	-0.002	0.005	-0.003	0.009	0.015	0.013	0.009	0.008	0.038	0.035	-0.004	-0.006
	(0.017)	(0.011)	(0.018)	(0.012)	(0.019)	(0.016)	(0.019)	(0.017)	(0.027)	(0.025)	(0.030)	(0.029)
8–10 years / 8+ years†	-0.008	0.002	-0.010	0.011	0.008	0.021	0.004	0.016	0.024	0.025	-0.029	-0.006
	(0.023)	(0.015)	(0.026)	(0.018)	(0.027)	(0.023)	(0.028)	(0.024)	(0.034)	(0.033)	(0.040)	(0.039)
11+ years	-0.019	0.001	-0.000	0.028	-0.003	0.025	-0.005	0.020				
	(0.029)	(0.021)	(0.036)	(0.025)	(0.036)	(0.031)	(0.037)	(0.033)				
School Exp. × Any Prior Exp.			-0.001	-0.001			-0.010**	-0.007**			-0.003	-0.003
			(0.003)	(0.002)			(0.002)	(0.002)			(0.003)	(0.003)
Exp Joint Test (p)	0.612	0.877	0.505	0.331	0.017	0.053	0.077	0.018	0.368	0.238	0.118	0.924
R^2	0.319	0.324	0.319	0.324	0.366	0.368	0.366	0.368	0.307	0.327	0.310	0.328
N	4954018	5290205	5600963	6049240	7727635	7445426	7727635	7445426	1688603	1677903	2182834	2164625

Notes: Coefficients and standard errors clustered by principal-school shown in parentheses. The dependent variables are standardized student achievement scores. The omitted category is principals who have zero years of experience (in the principalship or in the school). All models include student characteristics and time-varying school characteristics. N refers to the total number of student-by-year observations.

† In Oregon, 8–10 and 11+ years are combined into a single 8+ years category.

*$p < 0.05$, **$p < 0.01$.