



## Teacher Localness, Early-Career Effectiveness, and Retention

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## Teacher Localness, Early-Career Effectiveness, and Retention

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### Abstract

Recruiting locally connected individuals has gained policy attention under recent “Grow-Your-Own” initiatives, yet evidence linking teacher localness to student achievement and retention is limited. Using statewide Maryland data on teachers’ high school enrollment, postsecondary training, prior school employment, and certification, we examine three dimensions of localness: growing up locally, engaging in local teacher training, and working locally before teaching (e.g., as an instructional assistant). Value-added models with student fixed effects show that certification and licensure pathway, not localness itself, is the strongest predictor of early-career effectiveness. Teachers with formal university-based preparation in Maryland outperform young conditionally certified teachers in math by 0.06 standard deviations—even though conditionally certified teachers are the most likely of any certification group to have grown up in-state. Local upbringing is only modestly and imprecisely associated with achievement gains, while high school teacher-preparation pathways show positive effects comparable to university-based preparation. Former aides, who have strong local ties and are more racially/ethnically diverse than other novices, perform similarly to peers. Retention analyses show a different pattern: local upbringing and local training most strongly predict remaining in the same school or district. Local recruitment complements, but does not substitute for, high-quality preparation.

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## Introduction

Localized teacher recruitment is a longstanding strategy that school systems have employed for addressing workforce shortages (Faust, 1950; Gelber, 2022) and has gained significant and widespread policy attention in recent years under “Grow-Your-Own” (GYO) programs and legislation (Garcia, 2024). These programs take varied forms, from high school career and technical education (CTE) pathways, to residency models that embed aspiring teachers in local schools, to aide-to-teacher pipelines (Gist et al., 2019; Edwards & Kraft, 2025). Advocates argue that locally recruited teachers are more likely to stay in their schools and communities (Reininger, 2012; Blaushild et al., 2026), make local workforces more reflective of the students they serve (Carver-Thomas, 2018; Blazar, Gao, et al., 2026), and improve student outcomes through shared community ties and local knowledge (Goldhaber et al., 2017; Gist et al., 2019). Yet the empirical evidence connecting teacher localness to student achievement and retention remains thin. Foundational work documents teachers’ preferences for working near their hometowns (Boyd et al., 2005; Reininger, 2012) and school systems’ preference for candidates with state and community ties (Hinrichs, 2021), but does not test whether these ties translate into benefits for students or schools. The few studies that link teacher localness, student achievement, and teacher retention focus on individual components—such as in-state versus out-of-state training (Henry et al., 2014) or prior aide experience (Fortner et al., 2015)—and no study we are aware of integrates multiple dimensions in a single analytic framework.

We contribute to this literature by examining three dimensions of localness in Maryland’s public-school teacher labor market: *growing up locally* (attending a Maryland public high school, teaching in one’s home district), being *trained locally* (participating in a high school CTE teacher pathway, completing a Maryland-approved university-based preparation program), and having *worked locally* (prior classroom aide experience in Maryland public schools). We link person-level

administrative records spanning teachers' own high school enrollment, postsecondary training, prior school employment, and certification to student test scores in grades 3 through 8 and to teacher retention, using econometric models with school and/or student fixed effects. Our primary outcome of interest is student achievement, as we view students as the primary and ultimate beneficiaries of policy reforms that emphasize localized teacher recruitment. Teacher retention can further strengthen achievement (Ronfeldt et al., 2013) and can reduce other costs to school systems (Sorensen & Ladd, 2020). However, in the case that one dimension of localness produces different effects on student achievement versus retention, we argue that school systems should prioritize more effective teachers who may be less likely to stay in their same role over less effective teachers who are more likely to stay—potential tradeoffs we return to in our Discussion and Conclusion.

Several patterns emerge from our achievement analyses. First, growing up locally is at most modestly and imprecisely associated with student outcomes: teachers who return to their home district show small positive associations (approximately 0.02 standard deviations [SD] in both math and English language arts [ELA]) that do not reach conventional levels of statistical significance, while those who attended a Maryland high school but taught in a different district show near-zero effects. To our knowledge, this is among the first studies to directly test this question. Second, pathways with a local training component—the high school Teacher Academy of Maryland (TAM) CTE program, Maryland-approved university-based preparation programs, and residency-based pathways—show consistent math advantages of 0.04 to 0.09 SD, with smaller and statistically insignificant effects in ELA. These findings complement evidence on in-state preparation (Henry et al., 2014; Goldhaber et al., 2017; Redding, 2022) and recent Maryland evidence that high school exposure to TAM increases entry into teaching a decade later (Blazar, Gao, et al., 2026). Third, prior aide experience is positively (approximately 0.03-0.04 SD) but not significantly associated with math

or ELA achievement. Notably, teachers who transition from aide roles are more racially and ethnically diverse than other novices.

Two patterns further complicate a simple “local-is-better” reading. First, out-of-state traditionally trained teachers post the largest math associations (upwards of 0.17 SD), which we interpret as a hiring-selection effect (Hinrichs, 2021). In-state graduates are hired at rates approaching the total of new licenses issued, while out-of-state candidates convert licenses to positions at far lower rates. Second, young conditionally certified teachers display the strongest ties to growing up locally of any licensure category—66% attended a Maryland public high school and 45% taught in the district they attended—yet every other pathway outperforms this group in math, consistent with evidence that teachers entering without formal preparation are less effective on average (Goldhaber & Brewer, 2000; Kane et al., 2008; Backes et al., 2024). That said, leave-one-out cohort analyses suggest this gap has narrowed in more recent cohorts, countering trends in other states (Backes et al., 2024; Chi et al., 2025).

We complement these achievement analyses with retention outcomes, long central to arguments for local recruitment (Boyd et al., 2005; Carver-Thomas, 2018; Edwards & Kraft, 2025; Gist et al., 2019). Growing up locally and being trained locally emerge as roughly parallel forces: teachers who attended a Maryland public high school in their current district are roughly 9 percentage points (pp) more likely to remain in the same school three years after hire and 16 pp more likely to remain in the same district at five years (relative gains of 15% and 28%). Maryland-prepared teachers show comparable advantages. Crucially, though, the pathways most strongly associated with achievement gains are not those most strongly associated with retention: out-of-state traditionally licensed teachers and those who enter through a residency program post large math advantages but little or no retention advantage.

By integrating three dimensions of localness in a single framework, our study documents that localness is multidimensional and intersects with licensure pathways in non-uniform ways. Because the dimensions most strongly associated with achievement are not those most strongly associated with retention, recruitment, preparation, and retention may require distinct policy levers. Local recruitment should be a complement to, not a substitute for, quality preparation.

## **Motivating Literature**

### **Teacher Preparation, Credentials, and Student Achievement**

A large body of research has sought to identify what factors influence teacher effectiveness, motivated by consistent evidence that teachers are the most important within-school resource for improving student outcomes (Nye et al., 2004; Rockoff, 2004; Chetty et al., 2014). Much of this work examines characteristics observable at the point of hire—certification and licensure pathway, the type and content of pre-service training, and academic credentials—and the overall picture is one of modest and often inconsistent associations with student outcomes. Effect sizes typically are small relative to the returns to on-the-job experience (Bacher-Hicks & Koedel, 2023; Harris & Sass, 2011; Rockoff, 2004).

Among the most extensively studied dimensions is the certification and licensure pathway through which individuals enter the classroom. A longstanding line of inquiry compares teachers who complete traditional university-based preparation programs with those who enter through alternative routes, including formalized programs that provide some pre-classroom training but emphasize on-the-job learning (e.g., Teach for America), and informal pathways with no formal training at all (e.g., emergency or conditional certificates). Goldhaber and Brewer (2000) document that students of teachers with standard certification in mathematics outperform those taught by teachers with emergency credentials, though differences in other subjects are more limited. Kane et al. (2008) find that initial differences in effectiveness across certification routes in New York City are

generally small, and that alternatively certified teachers perform comparably to traditionally certified peers in math after their first year. Boyd et al. (2007) similarly conclude that the relationship between certification and effectiveness depends on the specific pathway and context. Experimental evidence reinforces this nuance: Glazerman et al. (2006) find that Teach For America teachers produce modestly higher math gains than comparison teachers despite entering through a nontraditional route.

More recently, pandemic-era expansions of emergency licensure have renewed interest in these questions. Backes et al. (2024) find that emergency-licensed teachers in Massachusetts are initially less effective, with gaps that persist in some subjects, and Chi et al. (2025) document similar patterns while noting that the expansion did not produce the large-scale quality declines some had feared. Kirksey and Gottlieb (2024) document more pronounced negative effects in Texas, where emergency credentials do not require a bachelor's degree. These post-pandemic studies are relevant to contexts like Maryland, where substantial growth in conditional certification predates the pandemic and the pathway requires a bachelor's degree but no formal teacher training. Taken together, these studies suggest that formal preparation matters, but that the specific content and structure of training (e.g., opportunities for hands-on classroom experience), rather than the broad certification label, drives differences in effectiveness.

Beyond the certification pathway, studies of where teachers train suggest that alignment between preparation experiences and first teaching contexts matters for student outcomes. Goldhaber et al. (2017) find that teachers whose student teaching placements more closely match the demographics and achievement levels of their first classrooms produce higher test-score gains, extended in several other studies (for a review, see Ronfeldt, 2021). Henry et al. (2014) compare teachers trained in North Carolina with those prepared out of state and find that in-state trained teachers are generally more effective, a finding attributed in part to the alignment between

preparation and local school contexts. Other teacher credentials, including advanced degrees and licensure test scores, show more limited and inconsistent associations with student achievement (Clotfelter et al., 2007; Harris & Sass, 2011; Ladd & Sorensen, 2015).

A recurring pattern across this literature is that associations between teacher characteristics and achievement are larger and more consistently detected in math than in ELA (Clotfelter et al., 2007; Goldhaber & Brewer, 2000; Goldhaber et al., 2017; Kane et al., 2008), likely reflecting the greater sensitivity of math instruction to teacher-specific content knowledge. A similar math-ELA pattern emerges in our analyses.

### **Integrating Localness into the Teacher Workforce Literature**

The idea that schools benefit from hiring individuals with ties to the local community has deep roots in education policy dating at least to the mid-twentieth century (Faust, 1950; Gelber, 2022). In recent years, these efforts have gained renewed attention under “Grow-Your-Own” (GYO) programs, which take varied forms—high school CTE pathways, residency models, and aide-to-teacher pipelines—but share the premise that localness is a valuable attribute that can be cultivated through intentional recruitment and preparation (Garcia, 2024; Edwards & Kraft, 2025; Gist et al., 2019).

Despite this longstanding policy interest, the empirical research base on teacher localness and student outcomes remains thin. The foundational contribution linking geographic proximity to the teacher labor market is Boyd et al. (2005), who document that teachers exhibit strong preferences for working near their hometowns, with important implications for the distribution of teacher quality: districts in communities that produce fewer college graduates face structural disadvantages in attracting qualified candidates. Reininger (2012) shows that the strength of these hometown preferences varies across teacher characteristics and community types. On the demand side, Hinrichs (2021) provides experimental evidence that school principals prefer candidates with

state and community ties, even when other qualifications are held constant. While these studies establish that localness shapes both teacher preferences and hiring decisions, as well as retention (see below), they are primarily descriptive studies and do not link dimensions of localness to student and school-system outcomes.

A small number of studies examine related dimensions of localness and student achievement, though none frame their analyses under a unified localness concept. Redding (2022) finds that “homegrown” teachers who graduated from the same urban districts in which they teach are more racially diverse and no less effective than other novice teachers. Henry et al. (2014) document advantages for in-state trained teachers in North Carolina. To our knowledge, no study has examined whether participation in high school pathway programs that introduce students to teaching is associated with later classroom effectiveness, though there is growing interest in such programs as early entry points into GYO pipelines (Edwards & Kraft, 2025) and some evidence that they work (Blazar, Gao, et al., 2026).

On the dimension of local work experience, Fortner et al. (2015) provide the most direct evidence, documenting that former teaching assistants in North Carolina who transition into full-time teaching are at least as effective as other new teachers. Camp et al. (2024) document similar achievement patterns in Arkansas, though notably—unlike Fortner et al. (2015)—show that the individuals who transition from aide to full-time teaching positions are less likely to be Black or Hispanic than the broader aide pool. Descriptive research further documents the growing scale and diversity of this potential pipeline (Bisht et al., 2021; Kistler et al., 2024), and Edwards and Kraft (2025) situate aide-to-teacher pathways within the broader GYO framework as one of the most promising strategies for simultaneously addressing workforce shortages and increasing teacher diversity.

The connection between localness and workforce diversity deserves particular attention. Because locally recruited teachers are more likely to reflect the demographic composition of their communities, localized hiring has been proposed as one mechanism for increasing the representation of teachers of color (Bristol & Martin-Fernandez, 2019; Gershenson et al., 2021). This is supported by a robust, experimental literature documenting that Black students perform better when taught by Black teachers (Blazar, 2024; Dee, 2004; Gershenson et al., 2022; for a comprehensive review, see Redding, 2019). The connection is particularly relevant for programs that recruit from the existing school workforce, since paraeducators and instructional aides can be substantially more diverse than the teaching force as a whole (Bisht et al., 2021; Camp et al., 2024; Fortner et al., 2015).

### **Teacher Preparation, Localness, and Retention**

Alongside the extensive literature on teacher effectiveness, a parallel body of research has examined the correlates of teacher attrition and retention. Meta-analyses and systematic reviews consistently find that both personal characteristics (age, experience, subject, qualifications) and work contexts (organizational conditions, student composition, leadership, salaries) shape who stays (Borman & Dowling, 2008; Nguyen et al., 2020; Nguyen & Springer, 2023). Two patterns are particularly relevant here: novice teachers disproportionately leave in their earliest years, and contextual conditions are among the strongest policy-malleable predictors of persistence.

The “draw of home” tradition establishes that teachers’ unusually strong preferences for working near where they grew up translate into retention behavior. Teachers who initially take positions near home are less likely to switch schools or leave teaching (Boyd et al., 2005; Reininger, 2012; Blaushild et al., 2026), and they are more responsive to nearby job openings than to higher-paying positions farther away (Engel, Jacob, & Curran, 2014). Broader work on early-career teacher turnover further suggests that match between a teacher and their school context—of which

geographic proximity is one dimension—is a central predictor of persistence (Ronfeldt et al., 2013; Papay et al., 2017).

A second strand of work links locally embedded preparation to retention. Goldhaber, Krieg, and Theobald (2014, 2017) and Krieg, Theobald, and Goldhaber (2016) show that prospective teachers placed in student-teaching positions demographically and geographically similar to their intended job markets are both more likely to be hired and more likely to remain in those settings. Evaluations of teacher residencies—where candidates train in the districts where they will eventually teach—report retention advantages of roughly 5 to 15 pp over comparable novices three to five years post entry, even when achievement effects are modest (Papay et al., 2012; Silva et al., 2014; Guha et al., 2017). Reviews of GYO programs broadly conclude that locally embedded preparation pathways consistently produce above-average retention, though most existing estimates are descriptive (Gist et al., 2019; Edwards & Kraft, 2025; Valenzuela, 2017).

A third literature focuses on pathways that recruit individuals already working locally in schools, particularly former instructional aides and paraprofessionals. Studies in North Carolina (Fortner et al., 2015) and Arkansas (Camp, Zamarro, & McGee, 2024) find that former paraprofessionals are substantially more likely to remain in teaching—and in their original school or district—than novices who entered through traditional university-based routes, though these candidates are also older and bring school-based work experience that may itself drive persistence. Across these three literatures, retention advantages associated with local ties are consistent in direction but vary in magnitude.

### **Gaps in the Literature**

Despite the breadth of research on teacher preparation, certification, and geographic proximity, several gaps remain. First, the strands above have developed largely in parallel, and no study we are aware of integrates them within a single framework. Second, while existing work shows

that local ties shape teacher preferences and hiring decisions, whether these are associated with student achievement remains an open empirical question. Third, the teacher labor market has changed substantially in recent years. For example, the expansion of conditional and emergency certification has introduced a large and growing share of teachers who lack formal preparation but may hold other local connections, and less attention has been paid to whether the relationship between certification pathways and student outcomes has evolved as these pathways have grown. If the quality of conditionally certified teachers has deteriorated as the pathway has expanded, the policy implications would differ considerably from a scenario in which effectiveness has remained stable.

## **Research Design**

### **Data and Sample Construction**

We leverage administrative data on teachers and students in Maryland public schools, accessed through the Maryland Longitudinal Data System (MLDS) Center. The data system allows us to link teachers to students through course roster data. Crucially for our analysis, it additionally allows us to link teachers' certification and experience to other K-12 staff positions prior to their first year hired as teachers, as well as to their own enrollment in and graduation from Maryland public high school and postsecondary education, which are key inputs to identify local ties. We include teacher-student links from the 2012–2013 through 2023–2024 academic years (referenced below by the spring year), starting with the first available year of this data and going up through the most recent year of data available at the time of writing.<sup>1</sup> The broader data system includes data elements going back to 2007-2008, allowing us to capture dimensions of localness before individuals became teachers.

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<sup>1</sup> Although student test scores and K-12 staff records are also available for the 2024-2025 academic year at the time of writing, we exclude it from our analytic sample. Initial license designations are updated with lag so this variable is missing for over 90% of teachers hired that year. We backfill license information using teachers' second and third years, but cannot do so for the most recent school years.

Our interest in how entry characteristics and local ties relate to early-career effectiveness and retention leads us to focus on novice teachers. We define novice (first-time) teachers as those with no prior teaching experience either in Maryland (public or private) or out of state, as determined by a recorded experience variable in the human resources data. This restriction applies specifically to experience as a teacher.<sup>2</sup> For descriptive and retention analyses, we include all novice teachers (N = 35,246). For achievement analyses, we focus on teachers in elementary and middle school classrooms (grades 3 to 8) because the state administers standardized math and ELA assessments in these grades. Consistent with prior work (e.g., Goldhaber et al., 2017), we further restrict our student achievement sample to only include classrooms with at least five students (N = 12,366 unique teachers, linked to approximately 1,581,000 student-year observations, drawn from a broader population of roughly 4,930,000 student-year observations in grades 3 through 8 statewide). In instances where students are connected to more than one math or ELA teacher in a given year, we start by identifying the primary teacher (i.e., non-remedial class with maximum number of credits) and then dropping student-subject observations when we cannot do so.<sup>3</sup>

### **Operationalizations of Localness**

We construct measures of localness along three dimensions. To capture whether teachers *grew up locally*, we use two variables. The first indicates whether the teacher graduated from a Maryland public high school, as identified from high school completion records.<sup>4</sup> The second indicates whether the teacher's first teaching position is in the same local education agency (LEA) as

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<sup>2</sup> Individuals who previously appeared in employment records in non-teaching roles (e.g. teaching aides) are not excluded. As an additional screen, we exclude teachers holding an advanced professional certificate the first time they appear in the employment records as teachers, since these can only be awarded after accumulated teaching experience.

<sup>3</sup> For reference, students matched to two or more non-remedial math and ELA courses with different teachers in the 2023-2024 academic year account for 5.5% and 21.4% of all students, respectively. Among students who are dropped for having more than one ELA teacher, 92.1% have exactly two. A random draw of these cases shows that the majority correspond to students having different classes for "Language Arts" and "Reading".

<sup>4</sup> Because these records begin in the 2008-2009 school year, this variable is left-censored for teachers born before approximately 1988: some teachers who did attend Maryland public high schools may be incorrectly coded as non-local, with this censoring disproportionately affecting earlier hire cohorts.

the high school they attended. To capture *local training*, we identify completion of the Teacher Academy of Maryland (TAM), a high school CTE program that provides early exposure to teaching, from certificate codes listed on high school completion records.<sup>5</sup> Additional dimensions of local training are captured through licensure categories, described below. Finally, to capture *local work experience*, we identify teachers who held classroom-based aide positions in Maryland public schools prior to becoming teachers, using position classification codes in K12 staff records. This measure includes “Teacher Aides/Assistants” (the vast majority of aide positions), “Library/Media Center Aides”, and “Other Aide” roles.

We further classify novice teachers into five licensure categories based on certification records at the time of entry into a teaching position in a Maryland public school. The first are teachers who earned a Standard Professional Certificate I (SPC) through a Maryland-approved teacher preparation program.<sup>6</sup> The second are teachers who earned an SPC through an equivalent out-of-state program. The remaining categories are teachers entering through residency pathways (e.g., Teach for America, Baltimore City Teacher Residency) and conditionally certified teachers (i.e., no formal training but requiring a bachelor’s degree). We split conditionally certified teachers into two groups by age at entry: those under 28 and those 28 and older. The age-28 threshold corresponds to the median age among novice teachers with conditional certificates, a median that has remained stable across the study period, and distinguishes individuals likely entering teaching shortly after completing their undergraduate education from mid-career switchers with prior work experience in other fields (including but not limited to school-based aide positions).<sup>7</sup>

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<sup>5</sup> This variable is subject to the same censoring as the other high school-based measures.

<sup>6</sup> For cohorts hired after 2018-2019, this classification draws on administrative records identifying completers of Maryland-approved programs; for earlier cohorts, we rely on matching postsecondary enrollment records to identify teachers who completed education programs at Maryland institutions prior to entering teaching.

<sup>7</sup> Approximately 12% of teachers in each hiring cohort from 2012-2013 through 2023-2024 have unknown or missing licensure information. This share is substantially higher for cohorts hired in 2022 and later, as MLDS allows years to backfill licensure records. Teachers with unknown or missing licensure information are included as a separate control category in our value-added models.

## Sample Descriptions

Table 1 presents a summary for all novice teachers hired between the 2012-2013 and 2023-2024 academic years in a Maryland public school, overall, by localness dimension, and initial license type.<sup>8</sup> The novice teacher workforce is predominantly female (76%) and white (67%), but the demographic composition varies substantially across certification and licensure pathways. Conditionally certified teachers, both under and over 28, are far more likely to be Black (42% and 43%, respectively) than teachers in any other category. Teachers with prior aide experience are also disproportionately more likely to be Black (28%) relative to the overall sample (20%). These patterns are consistent with research documenting that alternative certification pathways, which decrease barriers to entry, tend to attract a more racially diverse pool of candidates in Maryland and across the country (Blazar, Anthenelli, et al., 2026; Carver-Thomas, 2018; Redding, 2022). Age at hire further illustrates the distinct populations entering through different pathways: teachers with prior aide experience average 36.6 years old at entry, compared to 25.8 for traditionally certified in-state teachers, potentially reflecting the varied career trajectories that lead individuals into teaching.

Table 2 presents summary statistics for student-year observations in grades 3 through 8, overall and by characteristics of students' teachers. Students matched to a novice teacher have lower math (-0.04 SD vs. 0.04 SD) and ELA (-0.08 SD vs. -0.01 SD) scores, higher Title I rates (32% vs. 26%), and higher FARMS eligibility (50% vs. 46%) than the full population. These gaps widen across licensure pathways: students of conditionally certified teachers have prior math scores roughly 0.2 SD below the mean and are disproportionately Black and FARMS-eligible, and students of resident teachers have the lowest prior achievement of any group (-0.46 SD math, -0.49 SD ELA) and highest Title I (68%) and Black (68%) shares—reflecting residency placement in “hard-to-staff” schools concentrated in Baltimore City. By contrast, students of traditionally certified teachers have

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<sup>8</sup> Table A.6 in the Appendix shows an analog table for the sample of teachers hired in the same period and were linked as the primary math or ELA teacher to a grade 3 through 8 student. Overall teacher demographics remain largely similar.

prior achievement near or slightly above the statewide mean. This non-random sorting motivates the controls and fixed effects in our value-added models.

## Methods

We follow a large literature on teacher effectiveness (Rockoff, 2004; Chetty et al., 2014; Bacher-Hicks & Koedel, 2023) in specifying a student production function that models end-of-year student test scores as a function of teacher, student, and contextual inputs. Our primary interest is in how specific, time-invariant characteristics of teachers—namely their localness and licensure pathways—relate to student achievement. We estimate separate models for math and ELA, with the dependent variable being the student’s standardized test score within grade and year:

$$A_{it} = \alpha_i + \sum_j [\beta_f TCF^{(j)} + \beta_v TCV_t^{(j)}] \times D_{it}^{(j)} + \sum_s \pi_s S_{it}^{(s)} + \theta_g + \tau_t + \epsilon_{it} \quad (1)$$

where  $A_{it}$  is the test score for student  $i$  in year  $t$ ;  $\alpha_i$  are student fixed effects;  $TCF^{(j)}$  are time-invariant characteristics of teacher  $j$ , including localness indicators, initial license type, and demographic variables held fixed (gender, race, and age at first hire);  $TCV_t^{(j)}$  are time-varying teacher characteristics, specifically dummies for years of experience;  $D_{it}^{(j)}$  is an indicator for student  $i$  being matched to teacher  $j$  in year  $t$ ;  $S_{it}^{(s)}$  are school fixed effects;  $\theta_g$  are grade fixed effects; and  $\tau_t$  are year fixed effects. We cluster standard errors at the teacher level.

The central concern in this type of analysis involves two layers of non-random sorting: students to teachers and teachers to characteristics. Student fixed effects address the first by comparing the same student across years with and without a given teacher characteristic, accounting for all time-invariant student attributes—a stronger identification assumption than conditioning on prior-year test scores alone. However, student fixed effects do not resolve the second layer of sorting: teachers are not randomly assigned their background characteristics. For example, if

conditionally certified teachers disproportionately sort into schools or classrooms with unobserved features that independently depress achievement, student fixed effects will not eliminate this confound. Accordingly, we interpret our estimates as the effect of being assigned to a teacher with a given background profile, rather than the causal effect of the characteristic itself. That said, we simultaneously condition on multiple teacher characteristics in the same model, so each coefficient captures the conditional association with student achievement net of other observable teacher attributes and all fixed effects.

In our main analyses, the localness indicators described above—attended a Maryland public high school, teaches in the same district, participated in TAM, and prior aide experience—are estimated simultaneously in a single model alongside license-type indicators. For license-type comparisons, we include dummies for each category with young conditionally certified teachers (under 28) as the omitted group. This reference category is a natural baseline: these teachers entered the profession without formal pre-service training from a Maryland institution and most likely without the accumulated local experience of working as an aide prior to entering. Each license-type coefficient therefore captures the difference in student achievement associated with a given pathway relative to novice teachers who lack both formal teacher preparation and prior local workforce connections, conditional on localness measures and all fixed effects. We report results separately for math and ELA. Our main estimates focus on teachers in their first years in the classroom, with an experience indicator controlling for years of experience. We present results across progressively broader experience windows (first year only, first two years, and so on) to assess sensitivity to sample composition and career stage. Extending the window increases sample size but may change interpretation, as entry-characteristic differences can fade with experience.

In addition to estimating associations between teacher localness and student achievement, we examine whether the same dimensions of localness and licensure are associated with novice teachers'

retention in Maryland’s public school workforce. This analysis is far more straightforward, as we primarily focus on descriptive trends rather than causal relationships. That said, we aim to address correlates of both teacher localness and retention left unobserved in our analyses (e.g., school working conditions) by estimating the following high-dimensional fixed effects linear probability model:

$$R_j^h = \alpha + \beta_f TCF_j + \pi_s + \tau_t + \epsilon_j \quad (2)$$

where  $R_j^h$  is an indicator equal to one if novice teacher  $j$  is still observed in the Maryland workforce at retention horizon  $h$ ;  $TCF_j$  is a vector of time-invariant teacher characteristics that includes the same localness and licensure indicators used in equation (1);  $\pi_s$  are first-school-of-hire fixed effects; and  $\tau_t$  are hire-year fixed effects. School fixed effects compare teachers to other novices in the same school, accounting for non-random sorting of teachers across schools, while hire-year fixed effects account for differences in labor pools and conditions across time. We estimate this model separately for each of two retention time horizons—three and five years after hire—and four outcome definitions—remaining as teacher in the same school, same district, and the same state, as well as remaining in the state in any K-12 staff position. We cluster standard errors at the first-school-of-hire level.

## Findings

### Dimensions of Localness

Our descriptive results reveal that novice (first-time) teachers entering Maryland public schools increasingly display prior ties to the local communities in which they work. We organize these findings around our three dimensions of localness—growing up locally, being trained locally, and having worked locally—beginning with measures that directly capture each dimension before turning to indirect measures related to certification and licensure pathways.

Two measures in our data directly capture whether teachers grew up locally: graduating from a Maryland public high school and teaching in the same LEA. Figure 1 Panel A shows that among all novices hired 2013-2024, about 40% attended a Maryland public high school and just under a quarter taught in the same LEA; Panel B shows both have been increasing over time. Because high school graduation records begin in 2007, these variables are censored for teachers born before approximately 1988, so estimates for hire years prior to 2018 likely understate the true prevalence of local ties.<sup>9</sup> Focusing on the more reliable post-2018 period, we observe substantial growth: by 2024, approximately 50% of novice teachers had graduated from a Maryland high school, and nearly 35% taught in the same district they attended high school. These patterns underscore the growing importance of local, geographic roots in shaping who enters the teaching profession in Maryland.

Next, we capture local training through three direct measures. First, participation in TAM—a high school program providing early exposure to teaching—accounts for at least 1.3% of novices overall and around 2.4% in the years where data are most reliable (Figure 1), subject to the same censoring as our other high-school-based measures. Second, teachers entering through a residency program and license represent a stable ~10% of novices across the study period (Figure 2 Panel C). Third, teachers earning a traditional certificate through a Maryland-approved preparation program comprise the largest group, but their share has fallen from roughly half of novices in 2013 to approximately 35% by 2021, as other pathways—particularly conditional certification—expanded. Finally, we measure local work experience via prior classroom-based aide positions in Maryland public schools. Figure 1 Panel A shows 3.6% of novices have such prior experience, and Panel B reveals notable growth—from 2% in 2013 to 3.5% by 2020 and 5.3% by 2024—suggesting aide-to-teacher pipelines play an increasingly important role.

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<sup>9</sup> Specifically, teachers born before 1988 who did attend Maryland public high schools may be incorrectly coded as non-local in our data. This censoring disproportionately affects earlier hire cohorts.

Beyond these direct measures, we also examine how licensure pathways correlate with local ties. Figure 2 Panel A reveals notable differences in local ties across licensure types. Traditionally certified teachers who completed Maryland-approved preparation programs are substantially more likely to have grown up in the state: 55% attended a Maryland public high school, and 31% taught in the same district they attended. By comparison, teachers who obtained their traditional certification through out-of-state programs exhibit lower but still non-trivial connections to Maryland: approximately 24% graduated from a Maryland public high school, and 15% later worked in the same district where they attended school. This suggests that even among teachers trained elsewhere, a meaningful share returns to teach in their home state or community.

Young conditionally certified teachers under age 28 at time of hire display the strongest ties to growing up locally among all licensure categories. As shown in Figure 2 Panel A, 66% of these young conditionally certified novice teachers attended a Maryland public high school—exceeding the rate for traditionally certified in-state teachers (55%)—and 45% taught in the same district they attended, compared to 31% of traditionally certified teachers trained in state. These patterns suggest that conditional licensure serves as an important pathway for young Marylanders who wish to enter teaching in their home communities but have not completed traditional preparation programs.

In contrast, older conditionally certified teachers and resident teachers show weaker ties to having grown up locally (8% and 14.5% attended a Maryland high school, respectively), though we interpret this in light of censoring for older novices. These groups instead connect to localness through other dimensions: residents by definition receive Maryland-based training, while older conditionally certified teachers are far more likely to have prior work experience in Maryland schools (Figure 2 Panel B shows they account for roughly 30% of novices with prior aide experience), often representing career changers with established local roots through non-teaching roles.

## Effects on Student Test Scores

Each column in Tables 3 and 4—for math and ELA test scores, respectively—represents a different sample restriction by years of experience (columns 1–6 progressively widen from first-year only to all available years). Because entry characteristics are most likely to manifest early, we focus on columns 2 and 3 and report coefficient ranges. Consistent with prior work (Clotfelter et al., 2007; Kane et al., 2008), associations are larger and more precisely estimated for math than ELA.

***Growing Up Locally.*** We first examine whether growing up locally is associated with student achievement. The birth year indicator (i.e., born after 1988)—which accounts for data constraints in the number of years we can look back in novice teachers’ educational records—is small and not statistically significant in either subject across columns 2 and 3 (math: 0.01 to 0.02 SD; ELA: 0.00 to -0.01 SD). Teachers who attended a Maryland public high school in the same district as their current assignment show modest positive associations with achievement in both math (approximately 0.02 SD) and ELA (0.01 to 0.03 SD), though neither estimate reaches conventional significance thresholds. Teachers who attended a Maryland high school but taught in a different district show near-zero associations in math and small negative but insignificant associations in ELA. These point estimates are relatively stable across columns, suggesting the patterns are not sensitive to how many career years are included. Overall, growing up locally shows, on average, at most a modest, imprecisely estimated positive association with student achievement, concentrated among teachers who return to teach in their home district.

***Local Training and Broader Preparation Pathways.*** We next examine how licensure pathways relate to student achievement, with all coefficients interpreted relative to young conditionally certified teachers. At least two forces are at play: the type and rigor of preparation a teacher receives, and the degree of local connection embedded in each pathway. We begin with pathways that incorporate local training by design. Teachers who earned a certificate from the high

school TAM CTE program—who, by definition, grew up in the state and received early training through a high school instructional sequence aligned to the state’s teaching standards—show a positive and statistically significant association with math achievement in column 2 (0.09 SD), with a smaller but still positive estimate in column 3 (0.04 SD). In ELA, the estimates are small but positive (0.01 SD) across both columns. Teachers who earned a Standard Professional Certificate through a Maryland-approved preparation program—the modal pathway into teaching—show positive and statistically significant associations with math achievement in column 2 (0.06 SD), with a similar point estimate in column 3 that is marginally significant. In ELA, these teachers show small positive but not statistically significant associations (approximately 0.02 SD). Teachers entering through the residency-based pathway—who receive their training through Maryland-based programs while working in schools—show the largest advantages among locally trained pathways: approximately 0.12 SD in column 2 and 0.08 SD in column 3 in math, both statistically significant. In ELA, the estimates are positive (0.02 to 0.03 SD) but not statistically significant. Across these three pathways, the pattern is consistent: formal preparation with a local training component is associated with meaningful math advantages over young conditionally certified teachers who lack such preparation.

Teachers who earned their certification through out-of-state programs show the largest positive coefficients in math among all license types: approximately 0.12 SD in column 2 and 0.10 SD in column 3, both statistically significant. In ELA, the associations are positive but smaller and not statistically significant (approximately 0.04 SD). Because these teachers were not trained in Maryland, their advantage cannot stem from local training or familiarity with the state’s curriculum and institutional context. We interpret this pattern as differential hiring selection rather than program differences. As shown in Appendix Figure A.4.1, in-state graduates are hired at rates approaching or exceeding the total of new licenses issued, while out-of-state candidates convert

licenses to positions at far lower rates, consistent with experimental evidence of strong preferences for in-state candidates (Hinrichs, 2021).

Older conditionally certified teachers (over 28) also outperformed their younger counterparts in math, with estimates of approximately 0.10 SD in column 2 and 0.08 SD in column 3, both statistically significant. In ELA, relationships are near-zero and not statistically significant. Despite also lacking formal pre-service training, these teachers may benefit from prior professional experience or unobserved community ties; in our models, we partial out the contribution of prior aide experience specifically.

***Local Aide Work Experience.*** We next examine whether prior local work experience, measured as having held a classroom-based aide position in a Maryland public school before becoming a teacher, is associated with student achievement. In math, the estimates are positive but not statistically significant across columns 2 and 3 (approximately 0.03 to 0.04 SD); as we include additional years of experience, the coefficient remains in a similar range (0.03 to 0.05 SD) but gains statistical significance, suggesting that the positive association is stable and becomes more precisely estimated with larger samples. The first-year ELA estimate is notably larger and statistically significant (0.19 SD), but this result attenuates quickly across broader experience windows and the first-year sample is small, so we do not place substantial weight on it. The central finding here is the absence of a negative association: teachers who transitioned from aide roles perform at least as well as comparable novice teachers who entered without prior aide experience.

***Robustness and Extensions.*** Because our three dimensions of localness are empirically correlated, each coefficient in the unified specification reflects variation orthogonal to the others. Table A.1 presents three companion math models that re-estimate each cluster of predictors separately: growing-up-locally together with TAM (i.e., characteristics measured from high school records; Panel A), license type (Panel B), and prior aide experience (Panel C). The sign, magnitude,

and significance of the main-text license-pathway coefficients are preserved across all three, indicating that the math advantages are not artifacts of correlation with our localness measures. The growing-up-locally coefficients attenuate modestly when estimated without license indicators, consistent with the small effect sizes in the unified model. We limit A.1 to math because main-text ELA estimates are largely null.

To examine whether the estimated associations are stable over time or driven by specific hire cohorts, we conduct a leave-one-out analysis that progressively drops the earliest cohorts from the sample, focusing on two license types of particular interest given the earlier findings: in-state traditionally certified teachers, who outperform young conditionally certified teachers but underperform out-of-state-trained teachers, and young conditionally certified teachers, whose share in the Maryland teacher pool has increased substantially over time. Because this analysis requires estimating separate effects for individual license types across multiple sample restrictions, we use a slightly different specification from the main models in Tables 3 and 4. Each coefficient comes from a separate regression comparing teachers with the focal license type to all other novice teachers with known licensure (with a dummy for missing licensure information), restricting to teachers in their first two years.

Appendix Figure A.2.1 presents the results for math achievement. For in-state traditionally certified teachers (Panel A), the point estimates are broadly stable across cohort groups, hovering between -0.03 and -0.06 SD. However, as earlier cohorts are progressively removed, the standard errors increase and the estimates lose statistical significance, suggesting that more recent cohorts may be introducing additional heterogeneity, to the point where in-state traditionally certified teachers may not be distinguishable from other license types in the most recent hire years. For young conditionally certified teachers (Panel B), the pattern is more dynamic. Earlier cohorts show negative associations of approximately -0.07 to -0.09 SD. But, as we shift to more recent hire years, the

estimated disadvantage diminishes: those hired between 2018 and 2023 show a smaller and not statistically significant estimate of -0.02 SD. This improving trend could reflect changes in who selects into conditional certification, improvements in the support systems available to these teachers, or growing institutional capacity to integrate conditionally certified novice teachers into schools. Notably, the estimates for more recent cohorts are not smaller (i.e., more negative) than earlier cohorts, suggesting that expansion of the incoming pool of conditionally certified teachers is not leading to comparable worse quality, on average. As we describe in more detail in the appendix, patterns in more recent years are unlikely to be driven by larger shares of missing licensure data in the most recent cohorts (see footnote 7).

Finally, we explore whether associations between licensure pathways and student math achievement vary by teacher's local ties—specifically, whether they attend a Maryland high school in the same district, a different district, or have no Maryland high school record. These interaction models are underpowered, so we interpret the results with caution and present them in Appendix Figures A.3.1 and A.3.2. The most suggestive patterns involve out-of-state traditionally certified teachers. Their math achievement advantage over young conditionally certified teachers appears to increase with local ties, from approximately 0.12 SD among those without a Maryland high school record to 0.22 SD among those teaching in their home district. This pattern is consistent with the hypothesis that the combination of rigorous external selection and local community knowledge may be especially beneficial. For other license types, the interaction effects are small, inconsistent, or imprecisely estimated, which limits our ability to draw strong conclusions about whether local ties amplify the association between specific preparation pathways and student achievement.

### **Differences in Teacher Retention**

As a complement to our achievement analyses, we examine whether the same dimensions of localness and licensure are associated with novice teachers' retention in Maryland's workforce. Table

5 shows estimates that make within-school, within hire-year comparisons three or five years after hire, and across four progressively broader contexts: the same school, the same district, the state as a teacher, and the state in any K-12 staff position. As in the achievement models, localness indicators are estimated against their respective absent-trait reference groups (e.g., did not attend a Maryland public high school, did not participate in TAM, no prior aide experience), and license-type indicators are estimated against young conditionally certified teachers.

***Growing Up Locally.*** Growing up locally is strongly and consistently associated with increased retention. Teachers who attended a Maryland public high school in the same district they later taught in, relative to those who did not attend a Maryland public high school, are 9.3 pp more likely to remain in the same school at three years and 10 pp more likely at five years. On base rates of 57% and 37%, respectively, these gaps correspond to relative increases of roughly 16% at three years and 27% at five years; both are statistically significant. The retained-in-district coefficients are larger still—11.6 pp at three years and 16.6 pp at five years—indicating that teachers who return to their home district stay not only in their initial school but in the broader local system. Associations with state-level retention, both as a teacher and in any K-12 role, are of similar magnitude (9 to 14 pp) and all statistically significant. In contrast, teachers who attended a Maryland public high school but initially taught in a different district show a distinctive asymmetry: they are just slightly more likely than non-Maryland-educated peers to remain in their initial school or district (2 to 3.1 pp), yet substantially more likely to remain in Maryland K-12: 7.9 to 13 pp at three and five years across the two state-level outcomes. One plausible reading, consistent with the draw-of-home literature (Boyd et al., 2005; Blaushild et al., 2026), is that teachers who leave their initial district assignment over time but remain in the state workforce eventually return to teach in their home districts, as we observe for 53% and 55% of these teachers in three and five years after hire, respectively.

*Local Training and Broader Preparation Pathways.* Local training is likewise positively associated with retention, with a pattern that largely parallels the teaching in the same district findings. Teachers who entered the profession through a Maryland-approved preparation program, relative to young conditionally certified teachers, are 12.7 pp more likely to remain in their initial school at three years and 11.2 pp more likely at five years—relative increases of 22% and 31% on the underlying base rates. These advantages extend to the three broader outcomes at both horizons, with coefficients ranging from 12.1 to 17.0 pp, all statistically significant. The magnitudes are comparable to, and slightly higher than, those for teachers who grew up in the same district they later taught in, suggesting that formal local preparation and local upbringing operate as roughly parallel forces on early-career retention.

By contrast, the other licensure pathways that demonstrated notable math achievement advantages in Tables 3 and 4 show heterogeneous retention advantages. Teachers who entered through an out-of-state preparation program are modestly more likely to remain in all four retention outcomes at both horizons—between 4.7 and 6.8 pp, all statistically significant. Resident teachers show small to null advantages on school- or district-level retention and are meaningfully less likely to remain in Maryland K-12 at five years across the two state-level outcomes, between 3.8 and 5.3 pp less, both statistically significant. These patterns are consistent with requirements of some residency-based training programs like Teach for America. TAM-certified teachers show no distinguishable retention patterns, though the small number of observations warrants caution in interpretation. TAM-certified teachers primarily enter teaching through an in-state, Maryland-approved traditional training program; therefore, while this route on its own does not have a retention advantage, we infer that TAM-certified teachers are more likely to be retained overall. Older conditionally certified teachers show a modest, marginally significant retention advantage in their broader retention at three years but null associations elsewhere, indicating that the achievement

advantage this group displays over their younger counterparts does not carry a comparable retention signal.

***Local Aide Work Experience.*** Relative to novice teachers without prior aide experience, those who transitioned from an aide role are no more or less likely to remain in their initial school or district at three or five year horizons. At the state level, the associations are positive and grow with horizon: teachers with prior aide experience are 5.9 pp more likely to remain as a teacher anywhere in Maryland and 10.1 pp more likely to remain in any Maryland K-12 role at five years—a relative increase of about 9% and 15% on the underlying base rate, respectively.

***Robustness and Extensions.*** As with the achievement analysis, Table A.5 presents three companion retention tables, one for each cluster of predictors (Panels A through C). Signs and significance of the main-text estimates are preserved across specifications, but magnitudes are generally larger in the subgroup models (e.g., same-district teaching on state-level retention rises from 9-16.6 pp to 11-18.6 pp; negative coefficients for resident teachers grow from 1.8-5.3 pp to 4.0-8.3 pp). The main-text estimates therefore understate, rather than overstate, the unconditional associations. In Table A.7, we further report retention results for the achievement-analysis subsample. Patterns remain similar in sign but with more modest magnitudes—in some cases losing significance for those teaching in a different district (school and district outcomes), out-of-state-trained teachers (overall retention), and those with prior aide experience (overall retention).

## **Discussion and Conclusion**

Bringing together three strands of literature—on teacher preparation and credentials, on teachers’ geographic ties to the labor market, and on teacher retention—our study makes three contributions to inform policy and practice around localized teacher recruitment, as well as future academic research.

First, by operationalizing local ties along three distinct dimensions, we show that localness is not a single construct: its dimensions intersect with licensure pathways in non-uniform ways and yield non-monotonic associations with student outcomes. In doing so, we provide what is, to our knowledge, among the first direct test of whether growing up locally—measured by attending a state public high school and teaching in one’s home district—results in improved early-career student achievement gains; the answer is the relationship is modest at best and concentrated among teachers who return to their home district (rather than the state more generally). Further, by separating upbringing from preparation pathway, our results show that young conditionally certified teachers’ unusually strong local ties do not overturn a consistent finding across the teacher effectiveness literature: lack of formal preparation generally results in worse student outcomes (Goldhaber & Brewer, 2000; Kane et al., 2008; Boyd et al., 2007; Backes et al., 2024). On their own, both findings push back on the strongest forms of the “draw of home” rationale (Boyd et al., 2005): that localness in itself will produce stronger teacher quality.

However, the full story is more complicated. Older conditionally certified teachers outperform their younger counterparts by 0.05 to 0.10 SD in math, suggesting that prior professional experience or other attributes accumulated before entry partially substitute for formal preparation in ways that growing up locally does not. Modestly positive effects for novice teachers with prior aide experience reinforce this pattern and are similar to estimates in two other states (Camp et al., 2024; Fortner et al., 2015). Our finding that locally embedded preparation pathways—the TAM CTE program, Maryland-approved university-based programs, and residency models—generate consistent math advantages adds to evidence linking program-context alignment to teacher effectiveness (Goldhaber et al., 2017; Krieg et al., 2016; Henry et al., 2014; Redding, 2022). At the same time, the strong performance of out-of-state traditionally trained teachers complicates a purely “local-is-better” reading and most clearly distinguishes our findings from prior

work (Henry et al., 2014; Redding, 2022). We interpret this as reflecting differential hiring selection rather than program quality. Exploratory analyses tentatively suggest that out-of-state preparation and local upbringing may be additive, implying that local knowledge alone is insufficient—but when paired with selective hiring may serve as a complementary input.

Second, our retention analyses both reinforce and complicate the achievement story. Teaching in one’s hometown district and entering through a Maryland-approved university-based program emerge as the strongest predictors of staying, with retention advantages on the order of 9 to 16 pp across three- and five-year horizons and across same-school, same-district, and in-state retention outcomes. These patterns are consistent with the GYO logic that deep community ties anchor teachers in place (Carver-Thomas, 2018; Edwards & Kraft, 2025; Boyd et al., 2005) and add to a small but growing empirical base on locally embedded preparation and persistence (Blaushild et al., 2026; Goldhaber et al., 2017; Krieg et al., 2016; Papay et al., 2012). The novel and more difficult pattern is that the pathways most strongly associated with early-career student achievement gains—out-of-state traditional preparation and residency programs—are not the pathways most strongly associated with retention.

This misalignment forces a prioritization that policy discussions often pass over. When forced to choose, we view student achievement as the primary outcome. The harms of low effectiveness accumulate over every year of instruction, whereas turnover is a one-time disruption that mentoring and induction infrastructure can partially absorb (Ronfeldt et al., 2013; Sorensen & Ladd, 2020). A “stable” workforce of underprepared teachers is not the desirable equilibrium. The strongest GYO investments likely combine effective preparation with anchoring to community—Maryland-approved in-state preparation being the clearest example in our setting.

Third, although workforce diversity is not the primary focus of this study, the demographic composition of pathways linked to localness has implications for GYO program design, which often

set workforce diversity as a central aim (Carver-Thomas, 2018; Edwards & Kraft, 2025; Valenzuela, 2017). Complicating interpretation further, Maryland-approved in-state preparation combines strong test-score effects and retention—yet entrants through this pathway are substantially less likely to be Black or Hispanic than entrants through every other pathway we examine (roughly 80% white, compared to 61% for prior-aide entrants, 55% for residents, and 42–44% for conditionally certified teachers). Because our achievement and retention models include teacher race/ethnicity as a control, pathway estimates hold demographics constant and do not speak to whether teachers of color are more or less effective—a separate question with positive evidence elsewhere (Blazar, 2024; Dee, 2004; Gershenson et al., 2022; Redding, 2019).

Aide-to-teacher pipelines and residency programs combine strong diversity with at-least-as-effective achievement results, supporting their continued investment as both diversity and quality strategies. Conditional certification, by contrast, draws disproportionately from Black and other communities of color but is associated with weaker early-career achievement on average. Notably, though, we show that more recent cohorts of young, conditionally certified teachers are equally effective as their peers who enter through another route. And the increased share of conditionally certified teachers over time roughly parallels the increase in the share of Black teachers: the share of novices who enter as young, conditionally certified teachers increased roughly linearly from less than 5% in 2013 to roughly 25% in 2024, while the share of novices who were Black also increased roughly linearly from roughly 15% to over 30% over the same time period. While purely descriptive, these patterns suggest that conditional certification may be functioning—whether by design or by default—as the de facto GYO diversity pipeline, drawing localized Black and other candidates of color into teaching whom Maryland’s more selective routes have not.

Four implications follow for policy and practice. First, GYO programs should be evaluated on their full design—who they attract, how they prepare them, and what supports surround

them—rather than on local roots alone. Second, when achievement and retention diverge, achievement should take priority: stable underperformance is not a workforce goal worth optimizing for. Third, hiring infrastructure is an underused lever: the strong performance of out-of-state teachers appears to reflect tighter selection, suggesting that investing in screening and matching can complement local recruitment. Fourth, programs that combine diverse recruitment with structured preparation—particularly aide-to-teacher and residency pathways—offer the most promising route for systems pursuing achievement, retention, and diversity goals jointly.

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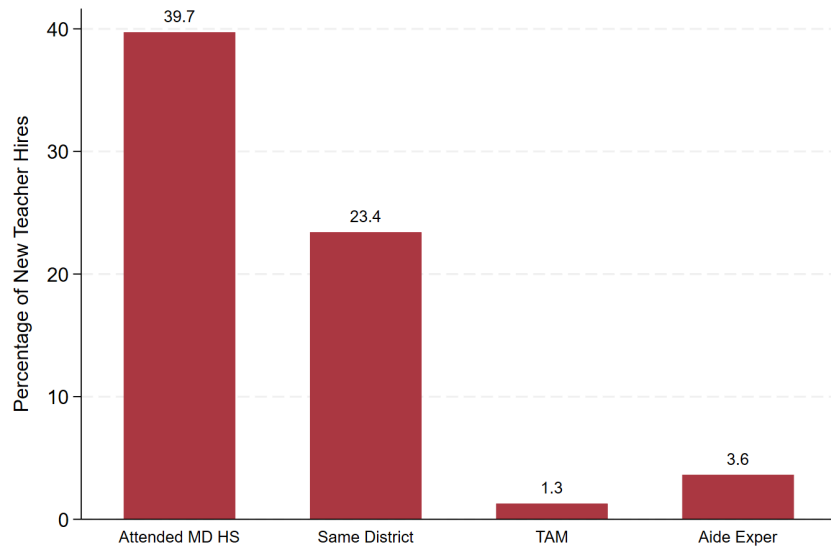
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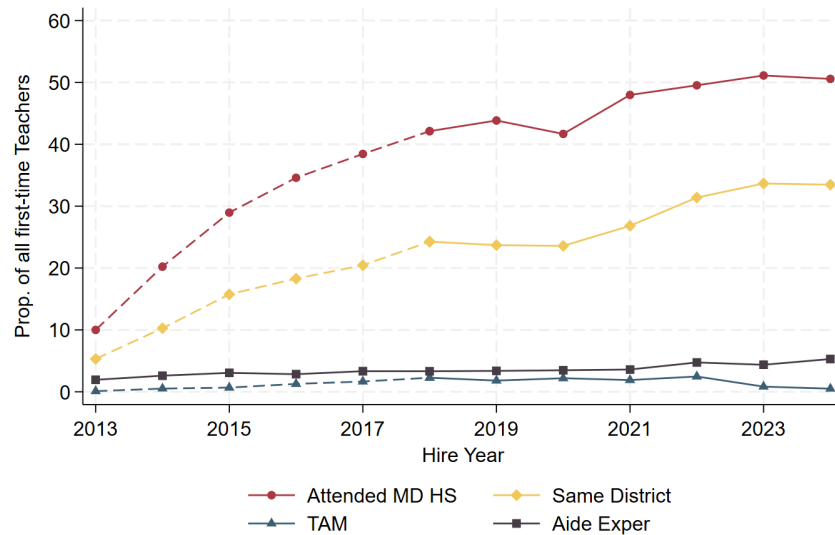
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## Figures and Tables

**Figure 1. Measures of Localness Dimensions for Novice Teachers**  
**(a) Pooled across years**



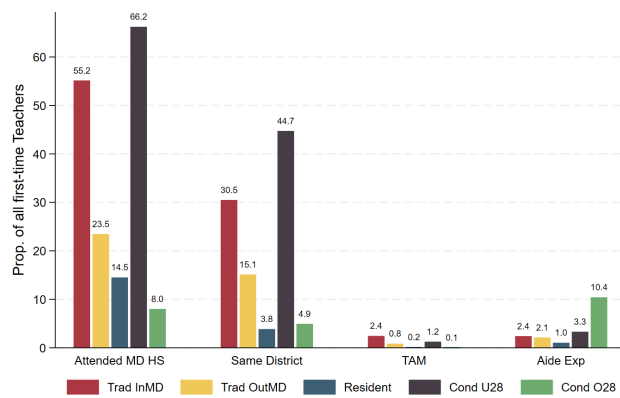
**(b) By year**



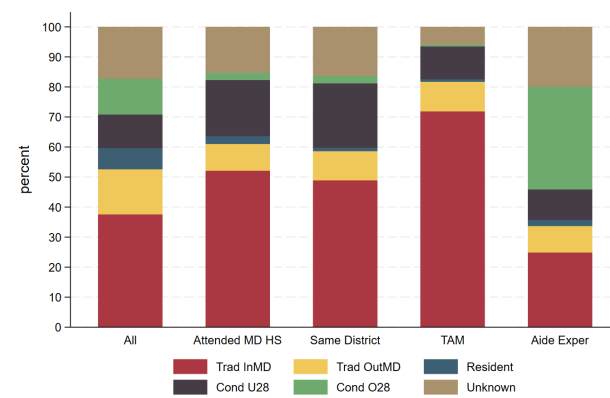
Note: The sample includes all novice (first-time) teachers hired in Maryland public schools between the 2012-2013 and 2023-2024 school years ( $N = 35,246$  unique teachers). Panel (a) shows the overall proportion of novice teachers displaying each localness measure across the full study period. Panel (b) shows trends in these proportions by hire year. “Attended MD HS” indicates teachers who graduated from a Maryland public high school, as identified from high school completion records in MLDS. “Same District” indicates teachers whose first teaching position is in the same local education agency (LEA) as the high school they attended. “TAM” indicates teachers who earned a Teacher Academy of Maryland certificate during high school, identified from certificate codes on high school completion records. “Aide Exper” indicates teachers who held a classroom-based aide position (e.g., Teacher Aide/Assistant, Library/Media Center Aide) in a Maryland public school prior to their first year as a teacher, identified from staff position classification codes. Because high school completion records in MLDS begin approximately in 2008, the Attended MD HS, Same District, and TAM measures are censored for teachers born before roughly 1988; proportions for hire years prior to 2018 likely understate the true prevalence of local ties.

**Figure 2. Teacher Initial Certificate and Measures of Localness**

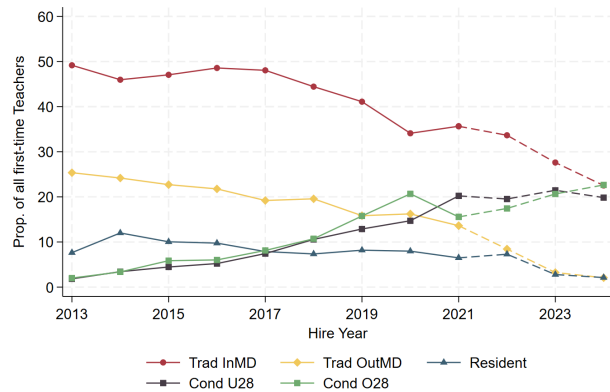
**(a) Localness Measure over Teacher Certificate**



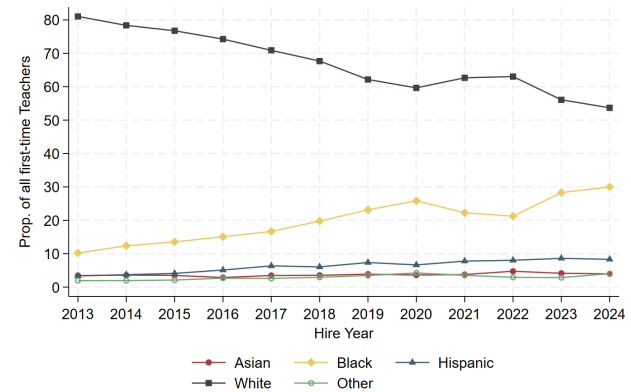
**(b) Teacher Certificate over Localness Measure**



**(c) Trends on Teacher Certificate**



**(d) Trends on Teacher Race/Ethnicity**



Note: The sample includes all novice (first-time) teachers hired in Maryland public schools between the 2012-2013 and 2023-2024 school years (N = 35,246 unique teachers). Panel (a) shows the proportion of novice teachers holding each localness category within each license type. Panel (b) shows the distribution of license types within each localness category, with bars summing to 100% within each group. Panel (c) shows trends in the share of novice teachers holding each license type by hire year. Panel (d) shows trends in the share of novice teachers holding each race/ethnicity by hire year. License types are: Trad-InMD (Standard Professional Certificate earned through a Maryland-approved teacher preparation program), Trad-OutMD (Standard Professional Certificate earned through an out-of-state program), Resident (teachers entering through Maryland’s Resident license pathway), Cond U28 (conditionally certified teachers under 28 years old at entry), and Cond O28 (conditionally certified teachers 28 years old or older at entry). Panel (b) additionally includes teachers with unknown or missing licensure information. Certificate data become less reliable for cohorts hired in the 2022–2023 school year and later due to lags in how quickly the MLDS data system updates licensure records; trends in Panel (c) for these years should be interpreted with caution.

**Table 1. Teacher Summary Statistics**

	All (1)	Same District (2)	TAM (3)	Prior Aide Exper. (4)	First teacher license type				
					Trad. In MD (5)	Trad. Out of MD (6)	Resident (7)	Conditional U28 (8)	Conditional O28 (9)
<b>Demographics</b>									
Female	0.764	0.802	0.923	0.756	0.818	0.786	0.707	0.707	0.683
Black	0.199	0.203	0.147	0.273	0.080	0.084	0.254	0.420	0.427
White	0.672	0.660	0.783	0.611	0.795	0.844	0.547	0.440	0.419
Hispanic	0.063	0.075	0.034	0.046	0.057	0.034	0.080	0.074	0.090
Asian	0.037	0.039	--	0.027	0.042	0.019	0.059	0.028	0.036
Other	0.029	0.023	0.023	0.043	0.026	0.018	0.059	0.038	0.027
Age at hire	28.342	23.897	23.141	36.662	25.828	26.014	27.300	24.611	40.588
<b>Localness measures</b>									
Attended MD HS	0.381	1.000	1.000	0.213	0.529	0.234	0.145	0.661	0.079
Same District	0.222	1.000	0.525	0.133	0.292	0.151	0.038	0.447	0.049
TAM	0.013	0.031	1.000	0.009	0.024	0.008	--	0.013	--
Prior Aide Exper.	0.035	0.021	0.023	1.000	0.024	0.021	0.010	0.033	0.104
<b>First license type</b>									
Trad. In MD	0.420	0.552	0.742	0.291	1.000	0.000	0.000	0.000	0.000
Trad. Out of MD	0.160	0.108	0.100	0.097	0.000	1.000	0.000	0.000	0.000
Resident	0.075	0.013	--	0.022	0.000	0.000	1.000	0.000	0.000
Conditional U28	0.117	0.236	0.111	0.111	0.000	0.000	0.000	1.000	0.000
Conditional O28	0.124	0.027	--	0.369	0.000	0.000	0.000	0.000	1.000
Missing	0.104	0.064	--	0.110	0.000	0.000	0.000	0.000	0.000
Observations	35,246	7,839	469	1,238	14,788	5,624	2,626	4,135	4,386

Notes: The sample includes all first-time teachers hired in Maryland public schools between the 2012-13 and 2023-24 school years. Column 1 includes all novice teachers. Columns 2 through 4 further subset column 1 by localness measures, which are not mutually exclusive. Columns 5 through 9 subset column 1 by the teacher's initial license type, which are mutually exclusive; teachers with unknown or missing license type are included in column 1 but not shown separately. Because localness measures and license types are defined along different dimensions, a given teacher may appear in multiple columns. Values are suppressed (--) when computed from fewer than 10 observations.

**Table 2. Student Summary Statistics**

	State-Wide (1)	All Novice Primary (2)	Same District (3)	TAM (4)	Prior Aide Exper. (5)	First teacher license type				
						Trad. In MD (6)	Trad. Out of MD (7)	Resident (8)	Conditional U28 (9)	Conditional O28 (10)
<b>Demographics</b>										
Female	0.489	0.495	0.493	0.493	0.483	0.494	0.496	0.501	0.497	0.497
White	0.364	0.315	0.361	0.408	0.339	0.359	0.373	0.089	0.191	0.202
Black	0.337	0.376	0.316	0.309	0.359	0.314	0.326	0.677	0.523	0.509
Hispanic	0.184	0.197	0.195	0.151	0.201	0.196	0.188	0.194	0.205	0.209
Asian	0.066	0.061	0.070	0.073	0.042	0.074	0.057	0.020	0.039	0.036
Other	0.049	0.051	0.057	0.059	0.059	0.056	0.056	0.019	0.042	0.044
FARMS	0.461	0.496	0.457	0.443	0.527	0.463	0.468	0.661	0.564	0.567
Title I	0.264	0.320	0.260	0.299	0.294	0.282	0.252	0.681	0.345	0.308
ELL	0.090	0.092	0.093	0.068	0.095	0.092	0.074	0.087	0.093	0.095
Special Ed.	0.165	0.160	0.158	0.162	0.196	0.158	0.154	0.168	0.157	0.160
<b>Same Year Test scores</b>										
Math score	0.037	-0.038	0.056	0.069	-0.139	0.044	0.042	-0.462	-0.214	-0.218
ELA score	-0.011	-0.077	0.014	0.001	-0.186	0.005	-0.016	-0.492	-0.213	-0.251
Observations	4,930,179	1,581,079	369,275	32,461	39,721	922,279	301,786	147,274	129,625	119,663

Notes: The sample includes all student-subject-year observations in grades 3 through 8 between the 2012-2013 and 2023-2024 school years. Column 1 includes all student-year observations statewide. Column 2 restricts to observations where the student's primary teacher in Math or ELA is a novice teacher. Columns 3 through 5 further subset column 2 by localness measures, which are not mutually exclusive. Columns 6 through 10 subset column 2 by the primary first-time teacher's initial license type, which are mutually exclusive; observations with unknown or missing license type are included in column 2 but not shown separately. Because localness measures and license types are defined along different dimensions, a given student-year observation may appear in multiple columns (e.g., a student whose teacher is conditionally certified under 28 and attended a Maryland high school would appear in both columns 3 and 9). Math and ELA scores are standardized within grade and year (mean zero, standard deviation one) for the statewide population. FARMS = Free and Reduced-Price Meals. ELL = English Language Learner.

**Table 3. Associations between Teacher Localness Characteristics and Student Math Achievement**

	First 1yr (1)	First 2yrs (2)	First 3yrs (3)	First 4yrs (4)	First 5yrs (5)	Full (6)
Birth Year > 1988	0.016 (0.041)	0.009 (0.028)	0.024 (0.022)	0.024 (0.021)	0.025 (0.020)	0.005 (0.014)
MD HS Diff District	0.004 (0.036)	-0.000 (0.021)	0.002 (0.017)	-0.004 (0.015)	-0.003 (0.015)	-0.006 (0.012)
MD HS Same District	0.029 (0.041)	0.018 (0.024)	0.021 (0.018)	0.009 (0.017)	0.015 (0.016)	0.019 (0.013)
TAM	0.072 (0.068)	0.089** (0.039)	0.041 (0.031)	0.054* (0.030)	0.042 (0.031)	0.019 (0.030)
Traditional In MD	0.098 (0.062)	0.063** (0.032)	0.055* (0.030)	0.063* (0.033)	0.054 (0.036)	0.017 (0.022)
Traditional Out of MD	0.168*** (0.061)	0.123*** (0.034)	0.097*** (0.032)	0.103*** (0.036)	0.101** (0.039)	0.049** (0.022)
Resident	0.125** (0.057)	0.120*** (0.034)	0.082** (0.033)	0.084** (0.035)	0.072* (0.037)	0.028 (0.023)
Conditional O28	0.113* (0.065)	0.095** (0.038)	0.077** (0.035)	0.078** (0.037)	0.080** (0.039)	0.020 (0.024)
Prior Aide Exper.	0.051 (0.081)	0.042 (0.039)	0.030 (0.027)	0.034 (0.023)	0.038* (0.022)	0.054*** (0.018)
Student FE	Yes	Yes	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes	Yes	Yes
R sqr.	0.886	0.889	0.888	0.888	0.887	0.887
N. of observations	18,960	59,148	95,680	126,593	153,210	213,557

Notes: Each column reports estimates from a separate value-added model in which the dependent variable is the student's standardized (within grade and year) Math test score. All license-type coefficients are relative to conditionally certified teachers under 28 (the omitted category). Column headers indicate the sample restriction by teachers' years of experience: column 1 includes only teachers in their first year, column 2 includes teachers in their first two years, and so on, with column 6 including all available years. "Birth Year > 1988" indicates that the teacher was born after 1988, the approximate threshold above which high school completion records are available in MLDS. "MD HS Diff District" and "MD HS Same District" indicate teachers who attended a Maryland public high school in a different or same district they are teaching in, respectively, relative to teachers who did not attend a Maryland public high school. All specifications include student, school, grade, and year fixed effects, as well as controls for student prior-year test scores, student time-varying characteristics, classroom time-varying controls, and school time-varying controls. Standard errors clustered at the teacher level are in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

**Table 4. Associations between Teacher Localness Characteristics and Student ELA Achievement**

	First 1yr (1)	First 2yrs (2)	First 3yrs (3)	First 4yrs (4)	First 5yrs (5)	Full (6)
Birth Year > 1988	-0.010 (0.043)	0.000 (0.021)	-0.005 (0.018)	-0.002 (0.015)	-0.006 (0.014)	-0.015 (0.012)
MD HS Diff District	-0.016 (0.034)	-0.019 (0.018)	-0.011 (0.013)	-0.006 (0.012)	-0.006 (0.010)	-0.010 (0.009)
MD HS Same District	-0.005 (0.030)	0.026 (0.019)	0.012 (0.013)	0.003 (0.011)	0.005 (0.010)	0.009 (0.009)
TAM	0.011 (0.065)	0.011 (0.044)	0.007 (0.037)	-0.001 (0.037)	-0.001 (0.031)	-0.004 (0.023)
Traditional In MD	-0.001 (0.052)	0.017 (0.026)	0.020 (0.023)	0.021 (0.022)	0.016 (0.020)	0.011 (0.017)
Traditional Out of MD	0.000 (0.053)	0.035 (0.027)	0.039 (0.024)	0.038* (0.023)	0.030 (0.021)	0.020 (0.018)
Resident	-0.024 (0.057)	0.023 (0.032)	0.034 (0.031)	0.025 (0.030)	0.029 (0.028)	0.032 (0.024)
Conditional O28	0.026 (0.055)	-0.026 (0.034)	0.002 (0.032)	-0.017 (0.030)	-0.022 (0.028)	-0.018 (0.023)
Prior Aide Exper.	0.187*** (0.065)	0.044 (0.039)	0.025 (0.032)	0.027 (0.026)	0.017 (0.024)	-0.001 (0.022)
Student FE	Yes	Yes	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes	Yes	Yes
R sqr.	0.903	0.895	0.898	0.899	0.900	0.901
N. of observations	13,283	47,202	76,485	99,722	118,115	156,053

Notes: Each column reports estimates from a separate value-added model in which the dependent variable is the student's standardized (within grade and year) ELA test score. All license-type coefficients are relative to conditionally certified teachers under 28 (the omitted category). Column headers indicate the sample restriction by teachers' years of experience: column 1 includes only teachers in their first year, column 2 includes teachers in their first two years, and so on, with column 6 including all available years. "Birth Year > 1988" indicates that the teacher was born after 1988, the approximate threshold above which high school completion records are available in MLDS. "MD HS Diff District" and "MD HS Same District" indicate teachers who attended a Maryland public high school in a different or same district they are teaching in, respectively, relative to teachers who did not attend a Maryland public high school. All specifications include student, school, grade, and year fixed effects, as well as controls for student prior-year test scores, student time-varying characteristics, classroom time-varying controls, and school time-varying controls. Standard errors clustered at the teacher level are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

**Table 5. Associations between Teacher Localness Characteristics and Teacher Retention**

	School		District		State		State Any	
	(1) 3yrs	(2) 5yrs	(3) 3yrs	(4) 5yrs	(5) 3yrs	(6) 5yrs	(7) 3yrs	(8) 5yrs
Birth Year > 1988	-0.005 (0.014)	-0.017 (0.015)	-0.005 (0.013)	-0.031** (0.015)	-0.002 (0.012)	-0.034** (0.015)	-0.000 (0.012)	-0.031** (0.014)
MD HS Diff District	0.026*** (0.009)	0.031*** (0.010)	0.020** (0.009)	0.028** (0.011)	0.079*** (0.008)	0.125*** (0.011)	0.080*** (0.008)	0.130*** (0.010)
MD HS Same District	0.093*** (0.009)	0.100*** (0.010)	0.116*** (0.008)	0.166*** (0.011)	0.092*** (0.008)	0.139*** (0.010)	0.097*** (0.008)	0.143*** (0.010)
TAM	0.025 (0.025)	0.033 (0.030)	0.020 (0.021)	0.015 (0.029)	0.023 (0.021)	-0.005 (0.028)	0.023 (0.021)	-0.017 (0.027)
Trad. In MD	0.127*** (0.012)	0.112*** (0.014)	0.121*** (0.012)	0.132*** (0.015)	0.141*** (0.010)	0.166*** (0.014)	0.135*** (0.010)	0.170*** (0.014)
Trad. Out of MD	0.068*** (0.013)	0.064*** (0.015)	0.056*** (0.013)	0.047*** (0.016)	0.059*** (0.011)	0.053*** (0.015)	0.055*** (0.011)	0.057*** (0.015)
Resident	0.038** (0.018)	-0.005 (0.017)	0.035** (0.017)	-0.010 (0.020)	-0.018 (0.014)	-0.053*** (0.018)	-0.022 (0.014)	-0.038** (0.018)
Conditional O28	0.028* (0.016)	0.017 (0.018)	0.039** (0.015)	0.023 (0.019)	0.017 (0.013)	0.006 (0.017)	0.022* (0.013)	0.031* (0.017)
Prior Aide Exper.	-0.017 (0.018)	0.015 (0.021)	0.008 (0.017)	0.025 (0.022)	0.021 (0.015)	0.059*** (0.020)	0.053*** (0.015)	0.101*** (0.019)
Dep Var mean	0.571	0.366	0.704	0.549	0.765	0.640	0.777	0.665
R sqr.	0.136	0.157	0.132	0.164	0.140	0.169	0.138	0.168
N. of observations	25,946	20,663	25,946	20,663	25,946	20,663	25,946	20,663

Notes: Each column reports estimates from a high-dimensional fixed effects linear probability model in which the dependent variable is an indicator for whether a novice teacher hired in year  $t$  is still observed in the Maryland K–12 workforce in year  $t+3$  (odd columns) or  $t+5$  (even columns). The four retention outcomes vary along two dimensions—geographic scope and role. Columns 1–6 hold the role fixed (still employed as a public school teacher) and progressively widen the geographic scope: the same school (columns 1–2), the same district (columns 3–4), or anywhere in the state (columns 5–6). Columns 7–8 hold the geographic scope at the state level but broaden the role to any K–12 staff position (teacher, aide, administrator, or other instructional role). All license-type coefficients are relative to young conditionally certified teachers (the omitted category). "Birth Year > 1988" indicates that the teacher was born after 1988, the approximate threshold above which high school completion records are available in MLDS. "MD HS Diff District" and "MD HS Same District" indicate teachers who attended a Maryland public high school in a different or same district they are teaching in, respectively, relative to teachers who did not attend a Maryland public high school. All specifications include school and year fixed effects, as well as teacher demographic controls (gender, race, age). We report the dependent variable sample mean of each retention outcome. Standard errors clustered at the school level are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

## Appendix

### A.1. Alternative specification: Associations between each Teacher Localness Dimension and Student Math Achievement

**Table A.1. Separate models for Associations between Teacher Characteristics and Student Math Achievement**

	First 1yr (1)	First 2yrs (2)	First 3yrs (3)	First 4yrs (4)	First 5yrs (5)	Full (6)
<b>Panel A. Model with High-School Characteristics</b>						
Birth Year > 1988	0.002 (0.043)	0.011 (0.029)	0.023 (0.023)	0.023 (0.022)	0.024 (0.022)	0.007 (0.014)
MD HS Diff District	-0.010 (0.039)	-0.022 (0.024)	-0.012 (0.018)	-0.014 (0.016)	-0.013 (0.016)	-0.011 (0.013)
MD HS Same District	0.011 (0.040)	-0.002 (0.024)	0.009 (0.017)	-0.002 (0.016)	0.005 (0.015)	0.015 (0.013)
TAM	0.075 (0.070)	0.094** (0.041)	0.041 (0.034)	0.051 (0.035)	0.038 (0.035)	0.017 (0.031)
<b>Panel B. Model with Initial License Characteristics</b>						
Traditional In MD	0.087 (0.062)	0.061* (0.033)	0.051* (0.031)	0.060* (0.033)	0.050 (0.037)	0.012 (0.022)
Traditional Out of MD	0.155*** (0.057)	0.119*** (0.034)	0.092*** (0.032)	0.099*** (0.036)	0.096** (0.040)	0.044** (0.022)
Resident	0.112** (0.054)	0.114*** (0.034)	0.075** (0.033)	0.078** (0.035)	0.064* (0.037)	0.021 (0.023)
Conditional O28	0.101 (0.062)	0.093** (0.038)	0.070** (0.035)	0.071** (0.036)	0.073* (0.038)	0.017 (0.024)
<b>Panel C. Model with “Worked Locally” Characteristics</b>						
Prior Aide Exper.	0.016 (0.066)	0.035 (0.035)	0.023 (0.025)	0.027 (0.021)	0.031 (0.020)	0.053*** (0.017)
Student FE	Yes	Yes	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes	Yes	Yes
N. of observations	18,960	59,148	95,680	126,593	153,210	213,557

Notes: Each column reports estimates from a separate value-added model in which the dependent variable is the student's standardized (within grade and year) Math test score. All license-type coefficients are relative to conditionally certified teachers under 28 (the omitted category). Column headers indicate the sample restriction by teachers' years of experience: column 1 includes only teachers in their first year, column 2 includes teachers in their first two years, and so on, with column 6 including all available years. "Birth Year > 1988" indicates that the teacher was born after 1988, the approximate threshold above which high school completion records are available in MLDS. "MD HS Diff District" and "MD HS Same District" indicate teachers who attended a Maryland public high school in a different or same district they are teaching in, respectively, relative to teachers who did not attend a Maryland public high school. All specifications include student, school, grade, and year fixed effects, as well as controls for student prior-year test scores, student time-varying characteristics, classroom time-varying controls, and school time-varying controls. Standard errors clustered at the teacher level are in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

## A.2. Cohort specific teacher effects

To examine whether achievement patterns are consistent over time or driven by specific hire cohorts, Appendix Figure A.2.1 presents math achievement estimates for two license types, in-state traditionally certified teachers and young conditionally certified teachers, separately by groups of hire years. We focus on math because this is where most of the positive effects are concentrated. Unlike the main specification in Tables 3 and 4, each estimate comes from a separate regression comparing teachers with the focal license type to all other novice teachers with known licensure, restricting to teachers in their first two years. The x-axis labels indicate which cohorts are included: “2013-2023” includes all teachers hired between 2012-2013 and 2022-2023 school years, while “2014-2023” excludes teachers hired in the (spring) academic year 2013, and so on. This approach allows us to observe whether estimated effects change as we progressively focus on more recent cohorts.

For in-state traditionally certified teachers, Panel A shows that the small negative effect relative to other license types is relatively stable across cohorts, hovering between -0.03 and -0.06 SD throughout. This consistency suggests that the pattern is not an artifact of any single cohort but rather reflects a persistent feature of how in-state traditionally trained teachers compare to those entering through other licensure pathways. For young conditionally certified teachers, Panel B reveals a more encouraging pattern. Earlier cohorts show larger negative associations: teachers hired between 2012-2013 and 2022-2023 school years (the full sample of teachers with at least their first two years since hire) show an estimate of approximately -0.09 SD relative to other license types. However, as we focus on more recent hire cohorts, the estimated association diminishes. Teachers in the 2018-2023 cohort show a smaller negative effect (-0.02 SD, not statistically significant), and the most recent cohort (2019-2023) shows a positive point estimate (0.06 SD), though confidence intervals remain wide. This improving trend could reflect changes in who selects into conditional

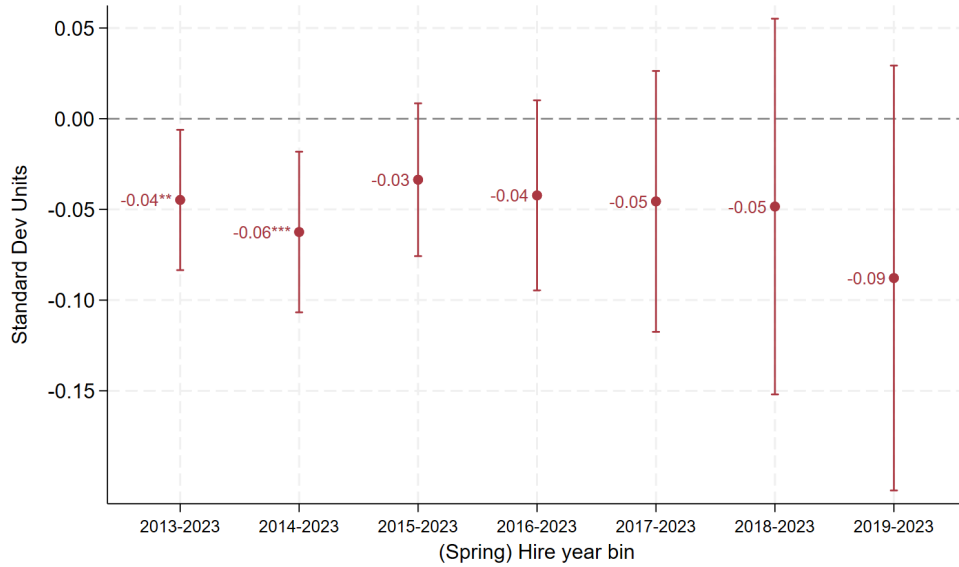
certification, improvements in the support systems available to teachers, or growing institutional capacity to integrate conditionally certified teachers into schools.

Because this leave-one-out design progressively concentrates the sample on more recent hire cohorts, it is worth addressing whether the patterns below could reflect incomplete licensure records rather than genuine change over time. As noted in the main text, initial license information is backfilled with a lag, so recent hire cohorts carry more missing licensure records than older cohorts. We examined how these records are filled in over the years following hire and found that no license category is more likely than another to be backfilled with a lag. Because missingness is not differential across categories, the distribution of known license types within each cohort closely approximates the distribution we would expect once records are complete, and the estimates reported below should therefore be insensitive to subsequent backfilling.

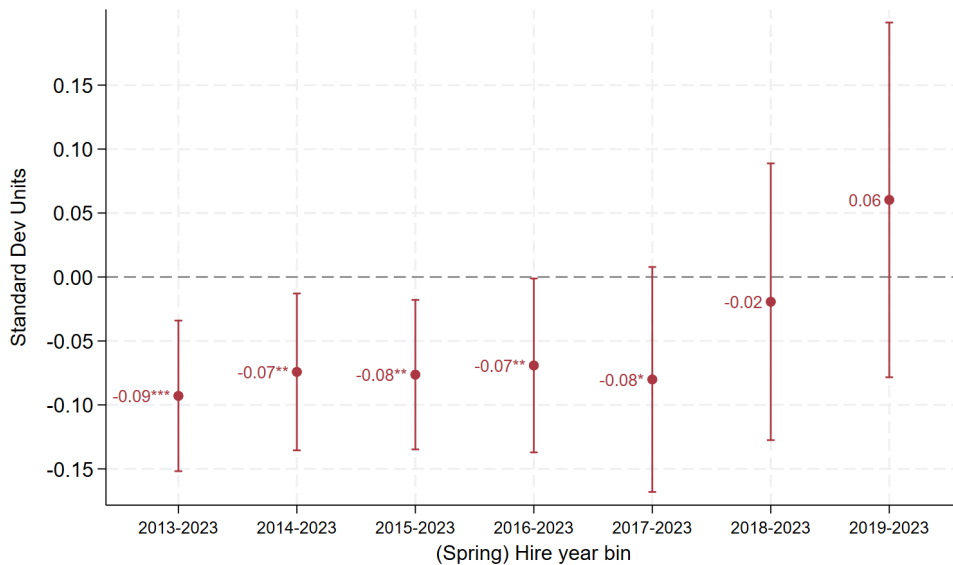
A more conservative reading asks what would happen to the trend for young conditionally certified teachers if the higher rate of missing licensure records in recent cohorts were resolved in a less favorable way. The regressions underlying Figure A.2.1 include a coefficient for the missing-license category (not shown). This coefficient is near zero and statistically insignificant in the full sample, and it grows only slightly more negative as earlier cohorts are progressively excluded, while remaining insignificant and imprecisely estimated throughout. Even under the extreme assumption that every teacher with a missing record turns out to be a young conditionally certified teacher, reassigning those observations would amount to combining a small negative coefficient with the positive estimate observed for young conditionally certified teachers in recent cohorts. The improving pattern for young conditionally certified teachers is therefore robust even to this worst-case scenario.

**Figure A.2.1. Math Estimates for Measures of Localness in the Teacher’s First Two Years, by Leave-One-Out Hire-Year Groups**

**(a) Traditionally certified teachers trained in-state vs all other known licenses**



**(b) Conditionally certified teachers under 28 vs all other known licenses**



Notes. Each panel reports math achievement estimates from a value-added model restricting teachers to their first two years. Unlike the main specification in Tables 3 and 4, each coefficient here is estimated from a separate regression in which the focal license type is compared to all other novice teachers with known licensure; teachers with missing license information are separated out with a unique dummy. The x-axis labels indicate which hire cohorts are included: "2013–2023" uses the full sample of teachers with at least their first two years since hire, while each subsequent label drops the earliest cohort (e.g., "2014–2023" excludes teachers hired in the 2013 [Spring] academic year). All specifications include student, school, grade, and year fixed effects, as well as the full set of controls described in Table 3. Bars represent 95% confidence intervals based on standard errors clustered at the teacher level.

### A.3. Exploratory Heterogeneity Analyses

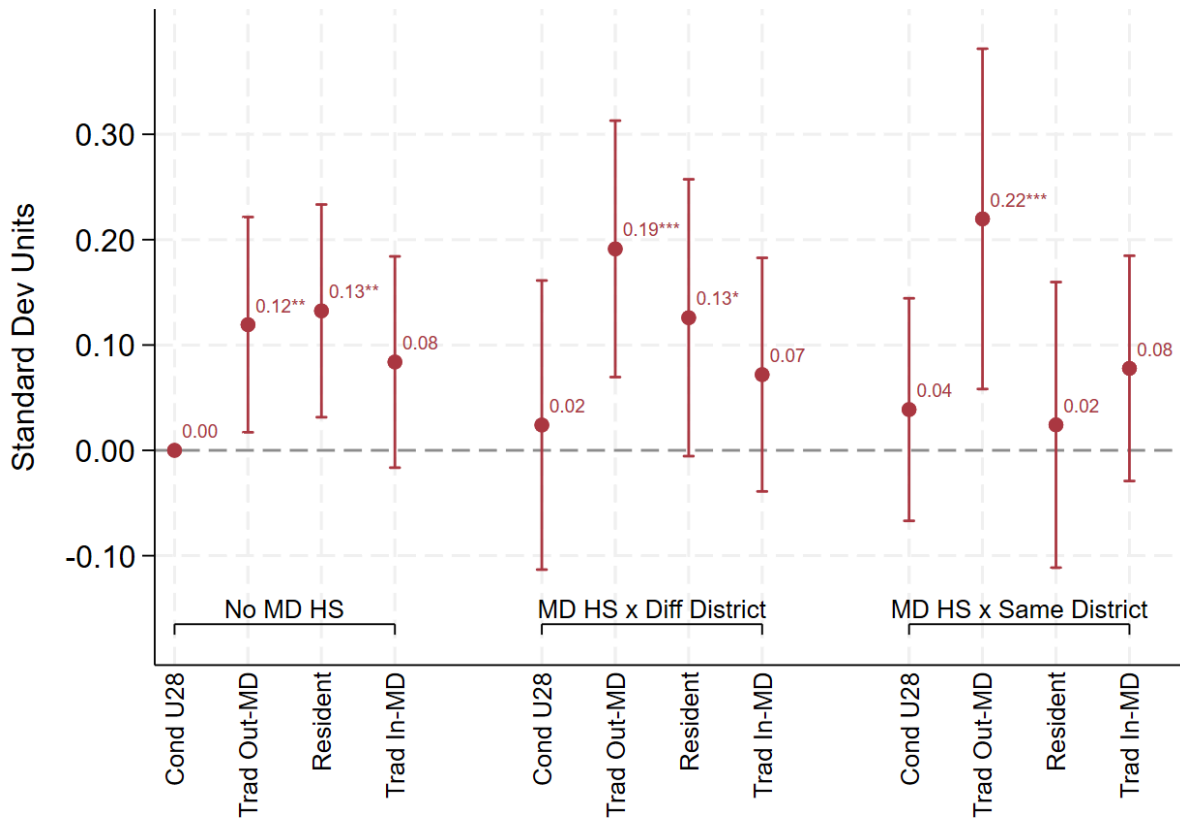
As an exploratory extension to the main achievement results, we examine whether the associations between licensure pathways and student math achievement differ depending on teachers' local ties. We estimate a single model that interacts license-type indicators with indicators for whether teachers attended a Maryland public high school in the same district as their current teaching assignment, in a different district, or have no Maryland high school record, restricting to teachers in their first two years and including the full set of controls and fixed effects described in Table 3. Because many of the resulting cells contain relatively few observations, particularly for the resident license category, these analyses are underpowered and the estimates should be interpreted as suggestive rather than definitive.

Appendix Figure A.3.1 presents the estimated association between each license type-localness combination and student math achievement, relative to young conditionally certified teachers without a Maryland high school record (normalized to zero). The most notable pattern involves out-of-state traditionally certified teachers, whose advantage increases with local ties: approximately 0.12 SD among those without a Maryland high school record, 0.19 SD among those who attended a Maryland high school in a different district, and 0.22 SD among those teaching in their home district. For resident teachers, the estimates are positive and statistically significant among those without a Maryland high school record (0.13 SD) and those in a different district (0.13 SD), but drop to near zero among those in the same district, a pattern likely driven by small cell sizes rather than a substantive reversal. For in-state traditionally certified teachers, the estimates are positive (approximately 0.07 to 0.08 SD) but stable across all three localness categories and not statistically significant. For young conditionally certified teachers, local ties are associated with only modest and not statistically significant increases (from 0.00 to 0.04 SD).

Appendix Figure A.3.2 presents a complementary view, showing the marginal association of attending a Maryland public high school, in the same or a different district, with math achievement separately within each license type. Among out-of-state traditionally certified teachers, the marginal effects are positive and suggestive (0.07 SD for a different district, 0.10 SD for the same district) though not individually statistically significant. For young conditionally certified teachers, the margins are similarly small and positive (0.02 to 0.04 SD). For in-state traditionally certified teachers, the margins are essentially zero. For Resident teachers, the same-district margin is negative and statistically significant (-0.11 SD), but given the small number of resident teachers with Maryland high school records teaching in their home district, we do not place substantial weight on this isolated result.

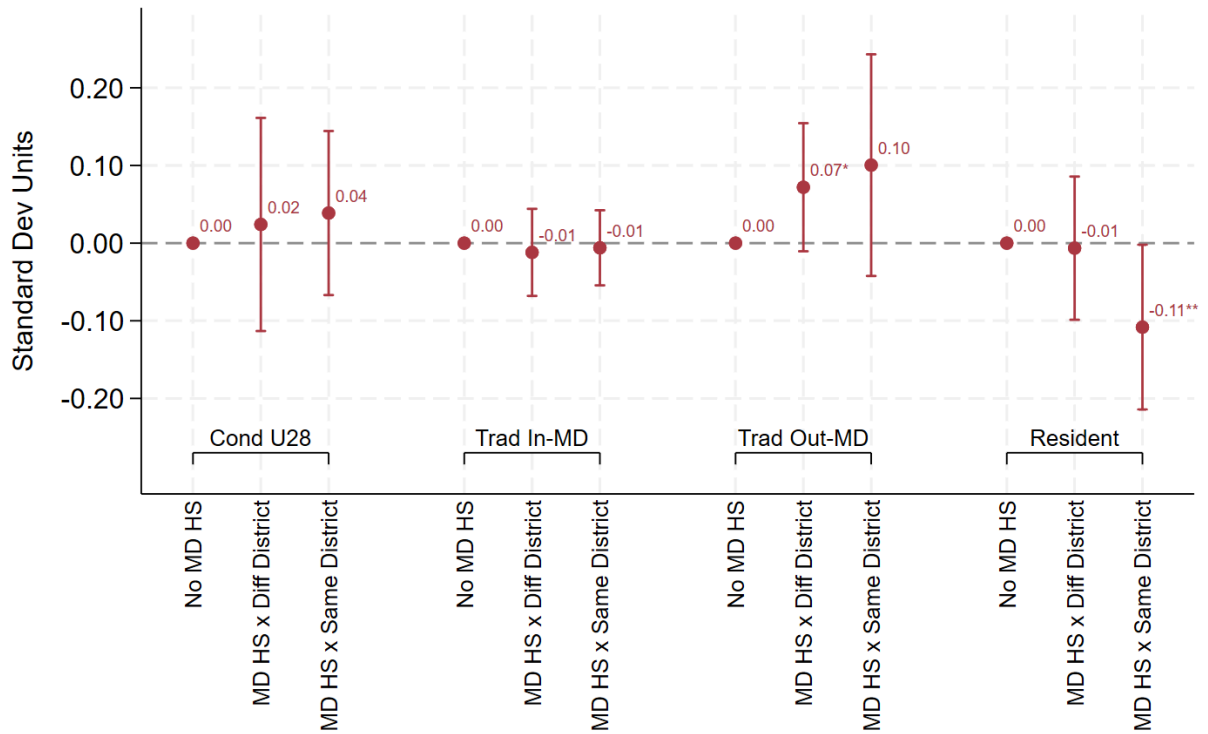
Taken together, these exploratory analyses suggest that local ties may amplify the effectiveness of some licensure pathways, particularly for out-of-state traditionally certified teachers, but the evidence is tentative and the interactions are not well-powered. Further research with larger samples would be needed to establish whether these patterns are robust.

**Figure A.3.1. Exploratory Estimates of Math Achievement Effects by License Type and Localness Category, Teachers' First Two Years**



Notes. Each coefficient reports the estimated association between a license type–localness combination and student standardized Math achievement, relative to conditionally certified teachers under 28 without a Maryland high school record (the omitted category, normalized to zero in the "No MD HS" group). Localness categories are: "No MD HS" (teacher did not attend a Maryland public high school or record is unavailable), "MD HS × Diff District" (attended a Maryland public high school in a different district), and "MD HS × Same District" (attended a Maryland public high school in the same district as their first teaching assignment). Estimates come from a single value-added model restricting teachers to their first two years and including the full set of controls and fixed effects described in Table 3. Bars represent 95% confidence intervals. These interactions are exploratory; many cells have limited observations, and estimates should be interpreted with caution. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

**Figure A.3.2. Marginal Associations of Maryland High School Attendance with Math Achievement, by License Type, Teachers' First Two Years**



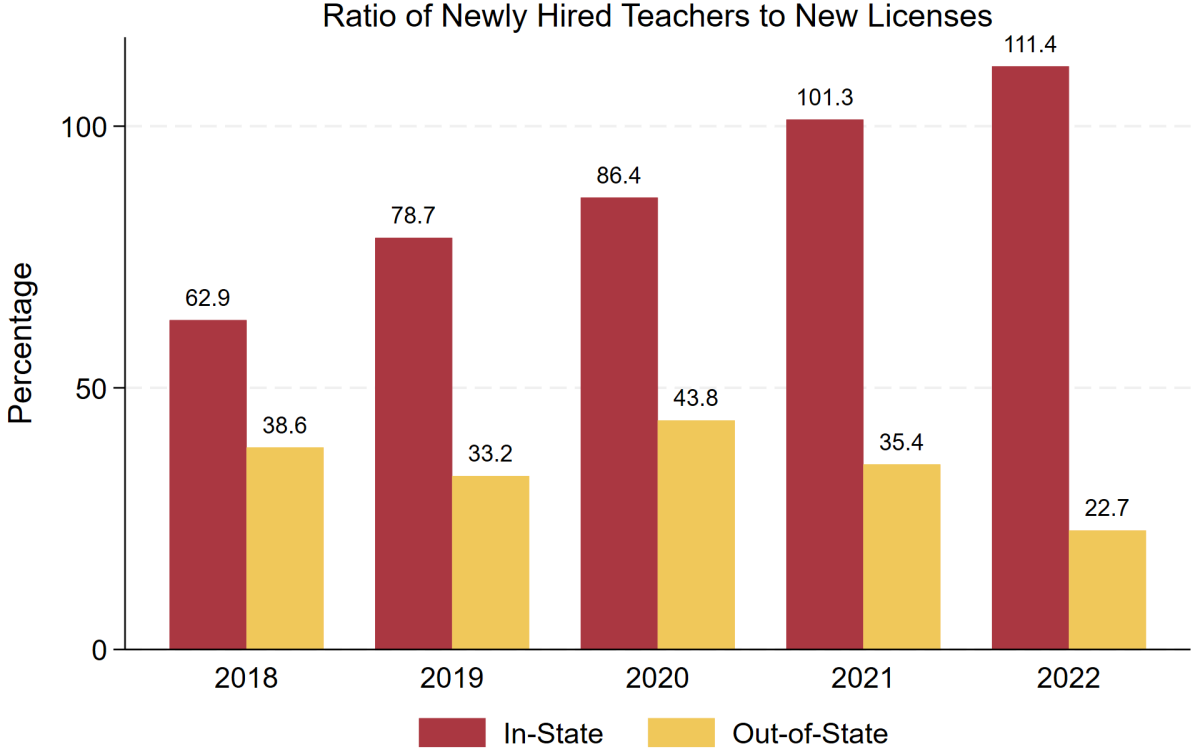
Notes. Each coefficient reports the estimated marginal association of attending a Maryland public high school—in a different district or the same district as the teacher's first assignment—with student Math achievement, separately within each license type. The omitted category within each license type is teachers without a Maryland high school record. Estimates come from a single value-added model with the full set of controls and fixed effects described in Table 3, restricting teachers to their first two years. Bars represent 95% confidence intervals. These interactions are exploratory and many cells have limited observations. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

#### **A.4. Hiring Selectivity by Preparation Location**

To provide suggestive evidence on differential selection in the hiring process, Appendix Figure A.4.1 presents the ratio of newly hired novice teachers to the number of new teaching licenses issued in the same year, separately for in-state and out-of-state prepared teachers. We construct this measure by comparing person-level hiring records from MLDS with publicly available new teaching licenses issued by the Maryland State Department of Education (2024). The latter data are only available from 2018 to 2022.

This ratio is an imperfect proxy for hiring selectivity: it does not track individuals from licensure to employment, and teachers hired in a given year may have obtained their license in a prior year, which is why the ratio can exceed 100%. Nonetheless, the patterns are striking. In-state trained teachers are hired at rates that approach or exceed the total number of new licenses issued, rising from roughly 63% in 2018 to over 111% by 2022. In contrast, out-of-state trained teachers are hired at far lower rates relative to new licenses, with the ratio declining from approximately 39% in 2018 to 23% by 2022. These diverging trends suggest that in-state trained graduates enter Maryland classrooms at very high rates, consistent with strong mutual preferences between local candidates and hiring districts (Hinrichs, 2021; Boyd et al., 2005), while out-of-state candidates face a substantially more competitive hiring process. If preparation programs in and out of state produce graduates of broadly similar quality, then this differential filtering implies that the pool of out-of-state teachers who are ultimately hired in Maryland is drawn disproportionately from the upper end of the quality distribution, which could account for their stronger performance in our value-added estimates.

**Figure A.4.1. Ratio of Newly Hired Teachers to New Teaching Licenses Issued, by In-State and Out-of-State Preparation, 2018-2022**



Note: Each bar reports the ratio of the number of newly hired novice teachers observed in MLDS data to the number of new teaching licenses issued in that year from publicly available records (Maryland State Department of Education, 2024), separately for in-state and out-of-state prepared teachers. Ratios above 100% indicate that more teachers were hired in a given year than new licenses were issued, which can occur because some newly hired teachers obtained their license in a prior year. This ratio is an approximate measure of hiring selectivity: lower ratios suggest that a smaller share of licensed individuals are ultimately hired, consistent with more selective screening. The figure is limited to 2018-2022, the years for which both data sources can be reliably linked.

## A.5. Alternative Specification: Teacher Retention

**Table A.5.1. Separate models for Associations between Teacher Characteristics and Teacher Retention, Restricting to Grades 3 to 8**

	School		District		State		State Any	
	(1) 3yrs	(2) 5yrs	(3) 3yrs	(4) 5yrs	(5) 3yrs	(6) 5yrs	(7) 3yrs	(8) 5yrs
<b>Panel A. Model with "Grew Up Locally" and TAM characteristics</b>								
Birth Year > 1988	-0.012 (0.014)	-0.022 (0.015)	-0.012 (0.013)	-0.037*** (0.015)	-0.010 (0.012)	-0.040*** (0.015)	-0.008 (0.012)	-0.039*** (0.015)
MD HS Diff District	0.048*** (0.009)	0.049*** (0.010)	0.045*** (0.009)	0.057*** (0.011)	0.113*** (0.008)	0.166*** (0.010)	0.113*** (0.008)	0.170*** (0.010)
MD HS Same District	0.109*** (0.009)	0.111*** (0.010)	0.135*** (0.008)	0.186*** (0.010)	0.119*** (0.008)	0.169*** (0.010)	0.123*** (0.008)	0.171*** (0.010)
TAM	0.038 (0.025)	0.042 (0.030)	0.032 (0.021)	0.026 (0.029)	0.037* (0.021)	0.010 (0.028)	0.036* (0.021)	-0.003 (0.028)
<b>Panel B. Model with Initial License characteristics</b>								
Traditional In MD	0.127*** (0.012)	0.112*** (0.014)	0.121*** (0.012)	0.132*** (0.015)	0.141*** (0.010)	0.166*** (0.014)	0.135*** (0.010)	0.170*** (0.014)
Traditional Out of MD	0.068*** (0.013)	0.064*** (0.015)	0.056*** (0.013)	0.047*** (0.016)	0.059*** (0.011)	0.053*** (0.015)	0.055*** (0.011)	0.057*** (0.015)
Resident	0.038** (0.018)	-0.005 (0.017)	0.035** (0.017)	-0.010 (0.020)	-0.018 (0.014)	-0.053*** (0.018)	-0.022 (0.014)	-0.038** (0.018)
Conditional O28	0.028* (0.016)	0.017 (0.018)	0.039** (0.015)	0.023 (0.019)	0.017 (0.013)	0.006 (0.017)	0.022* (0.013)	0.031* (0.017)
<b>Panel C. Model with "Worked Locally" characteristics</b>								
Prior Aide Exper.	-0.017 (0.018)	0.015 (0.021)	0.008 (0.017)	0.025 (0.022)	0.021 (0.015)	0.059*** (0.020)	0.053*** (0.015)	0.101*** (0.019)
Dep Var mean	0.571	0.366	0.704	0.549	0.765	0.640	0.777	0.665
N. of observations	25,946	20,663	25,946	20,663	25,946	20,663	25,946	20,663

Notes: Each column reports estimates from a high-dimensional fixed effects linear probability model in which the dependent variable is an indicator for whether a novice teacher hired in year  $t$  is still observed in the Maryland K-12 workforce in year  $t+3$  (odd columns) or  $t+5$  (even columns). The four retention outcomes vary along two dimensions—geographic scope and role. Columns 1–6 hold the role fixed (still employed as a public school teacher) and progressively widen the geographic scope: the same school (columns 1–2), the same district (columns 3–4), or anywhere in the state (columns 5–6). Columns 7–8 hold the geographic scope at the state level but broaden the role to any K–12 staff position (teacher, aide, administrator, or other instructional role). "Birth Year > 1988" indicates that the teacher was born after 1988, the approximate threshold above which high school completion records are available in MLDS. "MD HS Diff District" and "MD HS Same District" indicate teachers who attended a Maryland public high school in a different or same district they are teaching in, respectively, relative to teachers who did not attend a Maryland public high school. All license-type coefficients are relative to young conditionally certified teachers (the omitted category). All specifications include school and year fixed effects, as well as teacher demographic controls (gender, race, age). We report the dependent variable sample mean of each retention outcome. Standard errors clustered at the school level are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

## A.6. Summary Statistics for the sub sample of teachers who are Math and/or ELA novice primary teachers

**Table A.6. Summary Statistics. Math and ELA primary novice teachers by teacher characteristic in grades 3 to 8**

	All (1)	Same District (2)	TAM (3)	Prior Aide Exper. (4)	First teacher license type				
					Trad. In MD (5)	Trad. Out of MD (6)	Resident (7)	Conditional U28 (8)	Conditional O28 (9)
<b>Demographics</b>									
Female	0.834	0.868	0.963	0.807	0.880	0.858	0.719	0.767	0.764
Black	0.206	0.191	0.154	0.282	0.098	0.112	0.304	0.490	0.538
White	0.679	0.676	0.776	0.626	0.788	0.822	0.528	0.367	0.349
Hispanic	0.050	0.070	--	0.035	0.050	0.031	0.058	0.077	0.053
Asian	0.036	0.043	--	--	0.042	0.018	0.052	0.022	0.032
Other	0.028	0.019	--	0.045	0.024	0.017	0.059	0.045	0.027
Age at hire	27.4	23.6	22.9	36.3	25.5	26.4	27.2	24.5	40.4
<b>Localness measures</b>									
Attended MD HS	0.398	1.000	1.000	0.193	0.526	0.261	0.150	0.647	0.078
Same District	0.225	1.000	0.556	0.115	0.289	0.171	0.040	0.417	0.050
TAM	0.017	0.043	1.000	--	0.027	0.010	--	0.020	--
Prior Aide Exper.	0.034	0.018	--	1.000	0.024	0.025	0.011	0.040	0.125
<b>First license type</b>									
Trad. In MD	0.496	0.636	0.762	0.348	1.000	0.000	0.000	0.000	0.000
Trad. Out of MD	0.163	0.124	0.098	0.118	0.000	1.000	0.000	0.000	0.000
Resident	0.092	0.017	--	0.031	0.000	0.000	1.000	0.000	0.000
Conditional U28	0.090	0.166	0.103	0.104	0.000	0.000	0.000	1.000	0.000
Conditional O28	0.086	0.019	--	0.313	0.000	0.000	0.000	0.000	1.000
Missing	0.073	0.038	--	0.086	0.000	0.000	0.000	0.000	0.000
Observations	12,366	2,782	214	425	6,129	2,017	1,142	1,109	1,068

Notes: The sample includes all first-time teachers hired in Maryland public schools between the 2012-2013 and 2023-2024 school years who can be matched to students as their primary instructor in Math or ELA in grades 3 through 8. Column 1 includes all novice primary teachers. Columns 2 through 4 further subset column 1 by localness measures, which are not mutually exclusive. Columns 5 through 9 subset column 1 by the teacher's initial license type, which are mutually exclusive; teachers with unknown or missing license type are included in column 1 but not shown separately. Because localness measures and license types are defined along different dimensions, a given teacher may appear in multiple columns. Values are suppressed (--) when computed from fewer than 10 observations.

**A.7. Teacher Retention Outcomes for all Novice Teachers who were a Math or ELA primary for Grades 3 through 8**

**Table A.7. Associations between Teacher Localness Characteristics and Teacher Retention for Novice Primary Math or ELA**

	School		District		State		State Any	
	(1) 3yrs	(2) 5yrs	(3) 3yrs	(4) 5yrs	(5) 3yrs	(6) 5yrs	(7) 3yrs	(8) 5yrs
Birth Year > 1988	-0.025 (0.024)	-0.018 (0.026)	-0.024 (0.023)	-0.012 (0.027)	-0.029 (0.019)	-0.035 (0.025)	-0.027 (0.019)	-0.047* (0.024)
MD HS Diff District	0.021 (0.015)	0.029* (0.016)	0.019 (0.014)	0.010 (0.018)	0.086*** (0.012)	0.119*** (0.016)	0.092*** (0.012)	0.123*** (0.016)
MD HS Same District	0.088*** (0.016)	0.088*** (0.017)	0.120*** (0.013)	0.163*** (0.017)	0.092*** (0.012)	0.128*** (0.016)	0.097*** (0.012)	0.134*** (0.016)
TAM	-0.027 (0.039)	-0.037 (0.041)	0.008 (0.031)	0.019 (0.043)	-0.013 (0.029)	-0.022 (0.040)	-0.009 (0.029)	-0.032 (0.039)
Trad. In MD	0.091*** (0.023)	0.070** (0.028)	0.064*** (0.020)	0.084*** (0.030)	0.091*** (0.017)	0.129*** (0.026)	0.089*** (0.017)	0.134*** (0.026)
Trad. Out of MD	0.049** (0.025)	0.046 (0.028)	0.025 (0.022)	0.022 (0.031)	0.027 (0.019)	0.027 (0.028)	0.028 (0.018)	0.031 (0.027)
Resident	0.012 (0.030)	-0.031 (0.032)	0.027 (0.028)	-0.011 (0.038)	-0.046** (0.022)	-0.070** (0.032)	-0.046** (0.022)	-0.056* (0.031)
Conditional O28	0.049* (0.029)	-0.000 (0.036)	0.035 (0.026)	0.021 (0.037)	-0.005 (0.023)	-0.018 (0.033)	0.014 (0.022)	-0.005 (0.032)
Prior Aide Exper.	-0.063** (0.032)	0.003 (0.037)	-0.003 (0.029)	0.049 (0.037)	0.006 (0.024)	0.059* (0.033)	0.025 (0.023)	0.071** (0.032)
Dep Var mean	0.600	0.370	0.748	0.592	0.825	0.704	0.836	0.733
R sqr.	0.203	0.240	0.186	0.230	0.183	0.220	0.182	0.218
N. of observations	9,440	7,695	9,440	7,695	9,440	7,695	9,440	7,695

Notes: Each column reports estimates from a high-dimensional fixed effects linear probability model in which the dependent variable is an indicator for whether a novice primary teacher hired in year t is still observed in the Maryland K-12 workforce in year t+3 (odd columns) or t+5 (even columns). The four retention outcomes vary along two dimensions—geographic scope and role. Columns 1–6 hold the role fixed (still employed as a public school teacher) and progressively widen the geographic scope: the same school (columns 1–2), the same district (columns 3–4), or anywhere in the state (columns 5–6). Columns 7–8 hold the geographic scope at the state level but broaden the role to any K–12 staff position (teacher, aide, administrator, or other instructional role). All license-type coefficients are relative to young conditionally certified teachers (the omitted category). "Birth Year > 1988" indicates that the teacher was born after 1988, the approximate threshold above which high school completion records are available in MLDS. "MD HS Diff District" and "MD HS Same District" indicate teachers who attended a Maryland public high school in a different or same district they are teaching in, respectively, relative to teachers who did not attend a Maryland public high school. All specifications include school and year fixed effects, as well as teacher demographic controls (gender, race, age). We report the dependent variable sample mean of each retention outcome. Standard errors clustered at the school level are in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.