Annenberg Institute
BROWN UNIVERSITY

EdWorkingPaper No. 26-1624

Empty Desks: Schools and Staffing after the Pandemic

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Sustained enrollment losses and other post-pandemic factors have placed budgetary pressures on many school districts and motivated difficult discussions about both closing under enrolled schools and staffing reductions. Using the most currently available national data, this brief provides descriptive evidence on trends in the number of operating schools and their teacher staffing and discusses their policy implications. We find that, in the post-pandemic period when public-school enrollment fell by over 1 million students, the number of operating schools is effectively unchanged while the number of teachers increased. This combination implies average enrollment per school and pupil-teacher ratios declined. One in four public schools currently has enrollment at least 15 percent below its pre-pandemic baseline. Over the same period, pupil teacher ratios fell by 4 percent. Where closures did occur, they were more common among schools in lower-income neighborhoods, those serving higher concentrations of Black students, and charter schools. These results indicate that how school districts adapt to their post-pandemic fiscal reality remains an unresolved and important education-policy challenge.

VERSION: October 2026

Suggested citation: Dee, Thomas S., and Jaymes Pyne. (2026). Empty Desks: Schools and Staffing after the Pandemic. (EdWorkingPaper: 26-1624). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/60a8-kk19

Introduction

A recent, nationally representative survey of school-district superintendents in the US found that concerns about budget shortfalls have grown sharply and become the "most pressing challenge" these leaders face (Clinton et al., 2026). Budgetary pressures are due in part to the sharp and sustained enrollment losses experienced by many school districts in the wake of the COVID-19 pandemic. Nationwide, public-school enrollment fell by 1.4 million students at its start (i.e., between the fall of 2019 and 2020) and has not meaningfully recovered since (National Center for Education Statistics, 2026).

Several other contemporaneous factors—the expiration of federal pandemic aid, price inflation, declining birth rates, and expanding school choice—have exacerbated the fiscal challenges faced by the districts that also experienced meaningful enrollment losses (Dee, 2023; Kaput et al., 2026). The difficult financial context has motivated broad and often contentious public discussions about school districts possibly closing and consolidating underenrolled schools as well as hiring freezes and potential layoffs (e.g., Merod, 2026a, 2026b).

This brief presents new, national data on how school districts have responded to these challenges by changing the number of schools they operate and teacher staffing levels. Drawing on a national census of public schools, we show that school districts have, in the aggregate, been largely unresponsive to enrollment and financial pressures. The number of operating schools and teacher staffing in the most current federal data are actually slightly higher than they were on the eve of the COVID-19 pandemic.

As a result, average school enrollment and pupil-teacher ratios have fallen considerably, particularly among elementary and middle schools. For example, we find that 1 in 4 public schools currently has enrollment that is 15 percent or more below their pre-pandemic level. Similarly, the national pupil-teacher ratio in public schools has fallen by 0.6 students per teacher, a 4 percent decline relative to its pre-pandemic baseline. We also find these post-pandemic changes exhibit notable geographic variation. We present additional descriptive results characterizing how these changes in school size and staffing vary by school and district traits (e.g., grade levels, urbanicity, etc.). We conclude by discussing the policy implications of these results by situating them in the research literatures on school closures, staffing reductions, and the political economy that shapes these district decisions.

Data

Our primary data source is the Common Core of Data (CCD), the annual survey of US public schools administered by the National Center for Education Statistics (NCES). We combine three CCD surveys for each of the 15 school years from 2010-11 through 2024-25. The directory file reports each school's identifiers, operating status, and grade span while the membership and staff files report enrollment counts and the full-time-equivalent (FTE) number of classroom teachers (i.e., excluding paraprofessionals and instructional aides; see Appendix for details). Together, these surveys cover 1,537,095 reported school-year observations across 125,178 unique schools. In addition, for the descriptive regressions, we add two measures from the NCES Education Demographic and Geographic Estimates (EDGE) program: each school's locale and its 2019-20 School Neighborhood Poverty Estimate, which is the income-to-poverty ratio of families with children in the neighborhood around the school building (1.0 = the federal poverty line).

We apply three notable restrictions to this sampling frame. First, we keep only public schools in the 50 states and the District of Columbia. Second, we measure enrollment as the NCES membership count, which includes students from pre-kindergarten through twelfth grade and those in "ungraded" and "grade 13" programs. We exclude adult-education enrollment counts from school totals and the 31 schools that the CCD labeled as having entirely ungraded enrollments. Third, we keep only those school-year observations that the NCES classifies as "regular schools" (i.e., traditional public, charter, and virtual schools). This excludes special-education, vocational, and alternative schools that often carry volatile or unreported enrollment. However, as a robustness check, we show in the appendix (e.g., Figure A1) that our main results are similar in a sample that also includes non-regular schools.

In using these school-year panel data to document trends over this period, we focus on three specific annual measures: the total number of operating schools, average enrollment per school, and the pupil-teacher ratio. Following the convention in NCES reporting, we construct annual pupil-teacher ratios as the ratio of total enrollment to total teacher FTEs by year. However, we show that our results are similar when instead averaging school-level observations of pupil-teacher ratios by year (see Figure A2).

In the appendix, we also detail several ways in which we examined the accuracy of the CCD data (and, in a small number of cases, corrected them). First, we identified schools as "in operation" based on both a CCD flag and the presence of positive enrollment. We resolve discrepancies between these two indicators of operating schools using several sources including other state and federal reporting and the school's own enrollment history. We also examined the school enrollment counts and teacher FTEs reported in the CCD for outliers that may reflect misreporting. For operating schools where the CCD had no usable enrollment value in a given year, we drew on data from the relevant state agency or the federal Civil Rights Data Collection (CRDC) when possible (and imputed enrollment from adjacent-year interpolations when no other source was available). We adopted a similar approach (i.e., external sources) when the teacher FTE counts for an operating school were unavailable. For the pupil-teacher ratio results, we also exclude schools in Arizona, Louisiana, and Tennessee entirely due to school-level teacher FTE data that cannot be defined on a consistent basis. See the Appendix for details on these data decisions.

These data issues imply that the results presented here are based on three slightly different analytic samples. The primary sample includes all in-operation schools with positive enrollments and contains 1,335,134 school-year observations across 105,181 unique schools. This sample is the basis for identifying trends in the number of operating schools and school size. A second sample used to identify pupil-teacher trends excludes schools in Arizona, Louisiana, and Tennessee, resulting in 1,256,836 school-year observations across 97,608 unique schools. Finally, our mapped presentation of these data necessarily excludes 9,432 schools that cannot be matched to a mapped school-district. Most of these mapping exclusions are charter schools that are not associated with a conventional school district or its geographic boundaries (see Appendix for details). This leaves 1,262,084 school-year observations across 95,749 unique schools.

Results

Figure 1 presents three time series from fall 2010 through fall 2024: the number of operating regular public schools, their average enrollment, and the pupil-teacher ratio. In the decade before the COVID-19 pandemic, the number of public schools grew modestly, increasing by 1,256 or 1.4

percent. After the pandemic (and the substantial decline in public-school enrollment), this modest growth in the number of public schools in the US largely continued. Specifically, the number of public schools in operation in fall 2024 was actually higher than in fall 2019 just prior to the pandemic (i.e., an additional 143 schools or 0.2 percent). This small increase combines a modest decrease in traditional public schools (i.e., n = 302) and a somewhat larger increase in charter and other non-traditional public schools (i.e., n = 445).

The second panel in Figure 1 illustrates the trend in average school enrollment. In the decade prior to the pandemic, enrollment per school grew modestly (i.e., by about 8 students). However, the post-pandemic combination of sustained enrollment loss and a small growth in the number of schools implies a sharp reduction in average school size (i.e., a decline of 18 students or roughly 3 percent). The trend in teacher staffing, illustrated in the third panel of Figure 1 is broadly similar. Prior to the pandemic, particularly after 2013, the number of teachers grew relative to enrollment resulting in a declining pupil-teacher ratio. After the pandemic (i.e., between fall 2019 and 2024), the number of teacher FTEs in public schools continued increasing (i.e., by 0.9 percent in total) as enrollment dropped. This combination implies the pupil-teacher ratio fell sharply in the first school year after the pandemic and continued declining. Specifically, between fall 2019 and 2024, the pupil-teacher ratio fell by 4 percent (i.e., from 15.952 to 15.318).

While these trends in the national data are striking, they also obscure several important sources of variation at the school level. For example, the 3-percent decline in average school enrollment reflects both the gains in the schools that may have grown due to pandemic-related migration and the more substantial declines in other schools. To illustrate this variation, we calculate that one out of every four public schools lost 15 percent or more of its enrollment between fall 2019 and 2024 (Table A1). Roughly 9 percent of open schools have post-pandemic enrollment losses of at least 25 percent. These post-pandemic declines in average school enrollment occurred at every grade level but were larger in schools serving younger students (i.e., middle-school grades and lower) than in high schools (Figures A3 and A4). This heterogeneity is consistent with the evidence that pandemic enrollment losses were concentrated among younger students (Dee et al., 2023). Given these enrollment losses, we also find, unsurprisingly, that the decline in pupil-teacher ratios was larger in schools serving earlier grades than in high schools (Figure A5).

The national trends in Figure 1 also mask the substantial amount of localized, geographic variation. Figure 2 illustrates this by presenting heat maps that represent the post-pandemic change (i.e., fall 2019 to 2024) in average school enrollment at both the high-school level and in schools serving students at the middle-school level or below. The figures illustrate that the decline in school enrollment has been larger at the lower grade levels. These figures also demonstrate that these declines vary substantially within as well as across states. Similarly, the pandemic declines in pupil-teacher ratios also vary across and within states (Figure A6). Closures varied far less nationally (Figure A7). Among mapped districts, 81.8 percent operated exactly as many schools at the end of the period as at the start, and only 9.4 percent operated fewer. Just 52 districts, 0.4 percent of the total, lost more than five schools and are concentrated in large urban systems, led by Chicago with 30 fewer schools and Los Angeles with 26 (Table A2; Figure A8).

To examine this post-pandemic variation more systematically, we estimated school-level descriptive regressions where the dependent variables represent school closure, the percent change in enrollment, and the change in the pupil-teacher ratio (i.e., all defined comparing 2024 to 2019). Table 1 reports the key results of these regressions, which condition on state fixed effects and

report robust standard errors clustered at the district level. Over this period, 3.2 percent of schools closed. However, the regression estimates indicate that these closures were substantially more common in schools serving early-childhood grade spans (e.g., pre-K through 1, pre-K and kindergarten, etc.) relative to high schools (i.e., 8.8 percentage points). Closures were also more common among elementary and middle schools than high schools (i.e., 1.2 and 1.8 percentage points, respectively). However, we note that school openings offset these closures in the counts of operating schools by grade band (Figure A3). Closures were also more common in schools serving towns relative to rural areas (i.e., 0.8 percentage points). These results also indicate that closures were more common in lower-income communities and among schools serving higher concentrations of Black students. For example, a reduction of one standard deviation in the ratio of income to poverty of a school's surrounding neighborhood predicts a 0.55 percentage-point increase in the probability of closing. -

The data in columns (2) and (3) of Table 1 also indicate that both enrollment losses and corresponding declines in pupil-teacher ratios were concentrated in schools serving younger students and in non-rural areas. Notably, other things being equal, the schools serving higher concentrations of Black students experienced both larger enrollment losses and a statistically significant increase in pupil-teacher ratios. This pattern is unlike what is observed in the national data and implies that schools serving these students were more likely to close and to undertake significant staffing reductions in response to enrollment losses. Schools serving higher concentrations of Hispanic students also experienced larger enrollment losses but without a commensurate loss of teacher staffing or an increased probability of a school closure. Charter schools were more likely to close over this period but actually experienced enrollment growth and a slight increase in pupil-teacher ratios after the pandemic.

One potentially important limitation of these results is that the most current federal data are only available through the 2024-25 school year, which may obscure more current actions to close underenrolled schools and right-size staffing levels. To examine this issue, we assembled state data for California, which is a useful test case given its size, the availability of data for the 2025-26 school year, and its substantial loss of enrollment after the pandemic. News accounts also suggest that California districts have begun to close schools in response to the financial pressures driven by enrollment losses (e.g., Allen & Xie, 2026).

We find that California operated 8,905 regular public schools in October 2019 and 8,833 in October 2025, the most recent fall for which the state's records are complete. That is a decline of only 72 schools, or 0.8 percent, against an enrollment decline of over 400,000 students (i.e., 7 percent). Over the same period of enrollment loss, teacher FTEs in California increased from roughly 273,000 to 281,000 (i.e., 3 percent). Together, these data indicate that pupil-teacher ratios in California fell by nearly 10 percent (i.e., 2.1) since the pandemic. Overall, these recent data are consistent with the patterns observed in the most current national data: little change (or increases) in the number of schools or teachers over a period of sustained enrollment losses.

Discussion and Policy Implications

In the immediate aftermath of the COVID-19 pandemic, commentators suggested that public-school enrollment losses and the resulting financial pressure on districts would trigger a new wave of school closures (e.g., Ewing & Green, 2022) and possible teacher layoffs. Contentious public discussions of possible school closures have indeed become commonplace in many school districts

as enrollment losses have endured and been exacerbated by other financial challenges (e.g., the expiration of federal pandemic aid to schools). However, the national data presented here show that school districts have largely not yet responded to these pressures. The number of operating public schools is effectively unchanged and their teacher staffing is instead *higher* now than on the eve of the pandemic. As a result, the average enrollment per school has fallen as has the pupil-teacher ratio. Public schools now have more teachers per student than at any other point over the last 15 years.

The general lack of alignment between schools, staffing, and enrollment losses likely reflects the political economy of decision-making in school districts. The prospect of school closures and layoffs constitutes a highly visible and consequential threat to parents and teachers who can readily lobby school-board members and district leadership. That pressure, coupled with the often brief and provisional nature of superintendent tenures, can forestall confronting difficult decisions.

In the absence of considered action by school districts, several other policy responses are possible. First, increases in tax-financed state and local support provide one way districts could maintain their post-pandemic status quo. However, financial and political considerations are likely to make this an unavailable option for school districts. Second, if school districts choose not to right-size the number of schools they operate and their staffing levels, spending cuts may occur on other functions that are less visible but still educationally consequential (e.g., building maintenance, support services for student learning and mental health, etc.). Third, districts that repeatedly fail to manage their finances effectively may be confronted by the prospect of a state takeover. The available evidence suggests these takeovers can be disruptive with no clear longer-run benefit for students (Schueler & Bleiberg, 2022).

Furthermore, if districts only undertake school closures and staffing reductions in a crisis context, their capacity to avoid the potential harm to students may be attenuated. Specifically, the prior literature on school closures indicates they can disrupt student learning and well-being but also have positive effects if students are matched to higher-performing schools (de la Torre & Gwynne, 2009; Engberg et al., 2012). It should also be noted that school closures may not result in cost savings, at least in the short term, as districts reconfigure receiving schools and transportation as well as undertake administrative and legal costs (Pearman, 2026). Teacher layoffs also create both risks and opportunities for students, depending on their design. In particular, layoffs are often based simply on seniority, though the available evidence indicates that discretionary teacher dismissals based on observed teacher effectiveness can drive student learning gains (Adnot et al., 2017; Kraft, 2015).

We also note that there are potentially compelling ways to support districts in managing enrollment losses that fall between simply allowing them to figure it out and an invasive state takeover under duress. These include financial training for school board members and district leaders, the appointment of a financial auditor, and the use of multi-year budgeting and minimum fiscal reserves (Roza & Cicco, 2024). The evidence that district operations and staffing have not yet clearly responded to the pandemic-era enrollment losses implies that there is an opportunity to do so in a way that most effectively supports student success.

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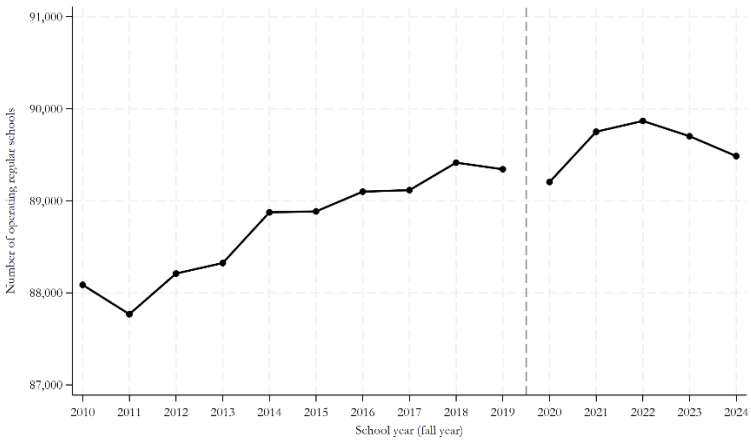
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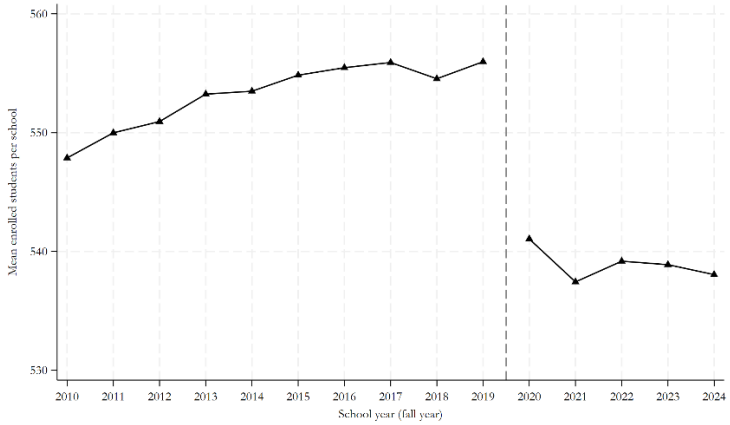
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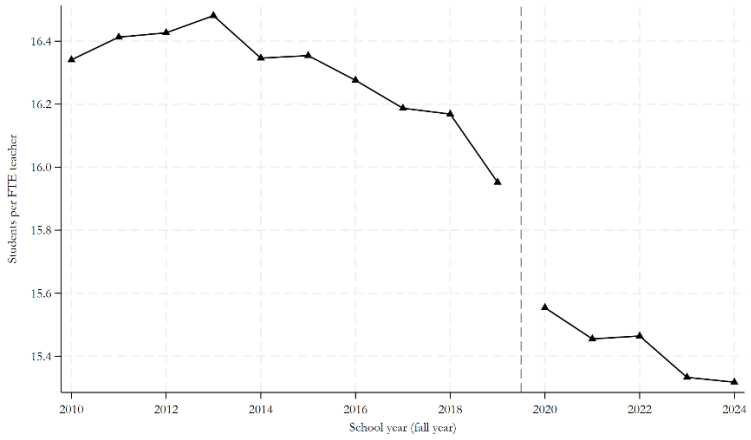
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(a) Total in-operation regular schools, by year



(b) Average enrollment per school by year



(c) Pupils per FTE teacher by year

Figure 1. Regular Public Schools: Operation, Enrollment, and Staffing, Fall 2010 to Fall 2024. Notes: The data reflect annual universe surveys of regular public schools (traditional, charter, and virtual) in operation serving grades pre-K through 12 in the 50 US states and DC. See the data appendix for further details.

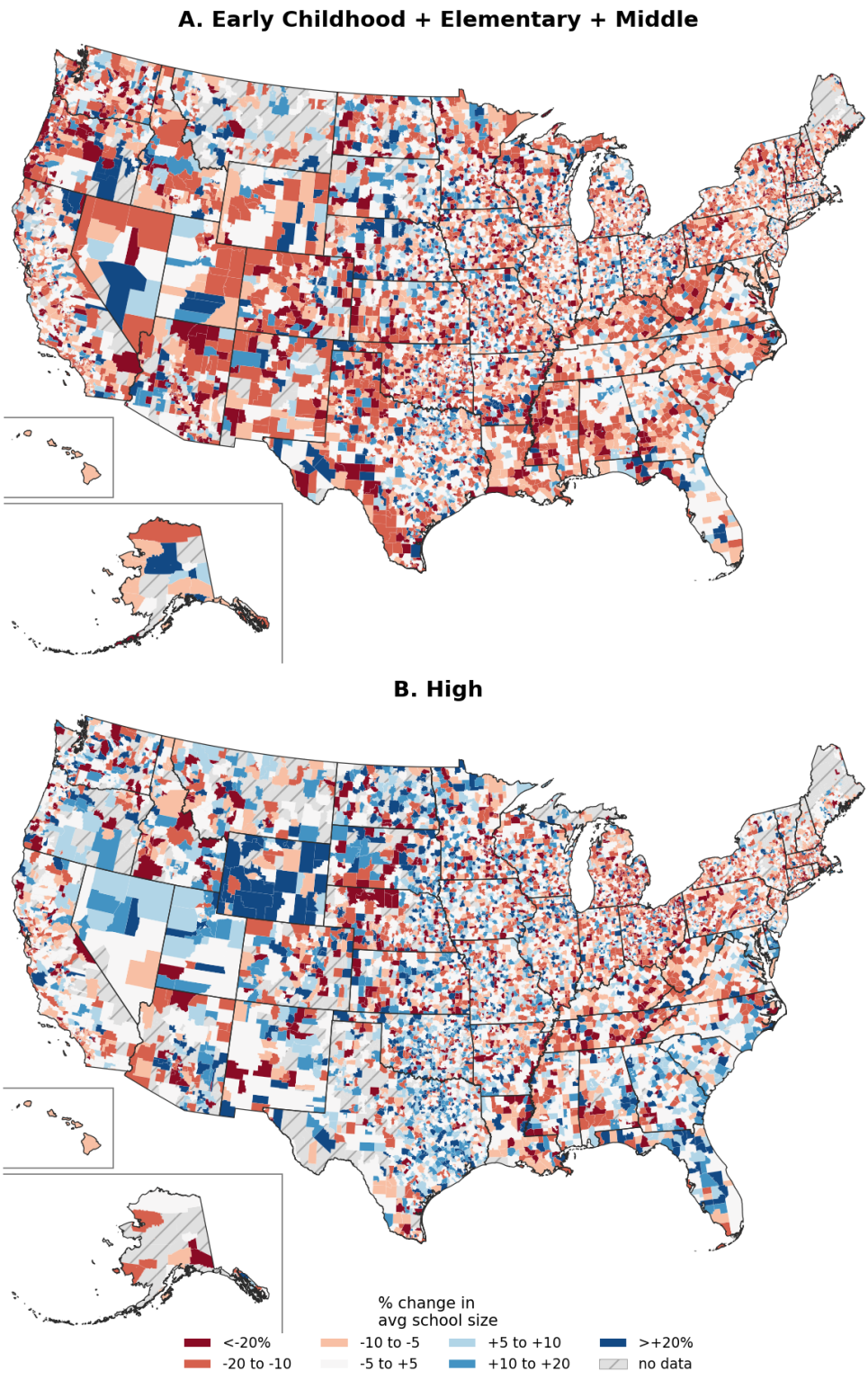


Figure 2. Percentage change in average school enrollment by district by grade band, Fall 2019 to Fall 2024.

Table 1. Descriptive Regressions

	Closed by fall 2024	Enrollment change (%)	Pupil/teacher ratio change
Fall 2019 characteristic	(1)	(2)	(3)
Early childhood	0.088***	-4.187***	-0.909***
	(0.009)	(0.521)	(0.081)
Elementary	0.012***	-3.606***	-0.367***
	(0.002)	(0.161)	(0.028)
Middle	0.018***	-5.828***	-0.564***
	(0.002)	(0.185)	(0.027)
City	0.002	-1.971***	-0.227***
	(0.003)	(0.278)	(0.061)
Suburb	-0.001	-0.527***	-0.108***
	(0.002)	(0.193)	(0.032)
Town	0.008***	-0.409**	-0.022
	(0.003)	(0.189)	(0.030)
Neighborhood income-to-poverty ratio	-0.003***	0.117**	0.023**
	(0.001)	(0.054)	(0.009)
Share Black	0.049***	-4.649***	0.287**
	(0.007)	(0.513)	(0.114)
Share Hispanic	0.005	-4.217***	-0.249***
	(0.005)	(0.497)	(0.096)
Share Asian	-0.035***	-2.074*	0.104
	(0.008)	(1.087)	(0.209)
Charter school	0.046***	9.137***	0.141*
	(0.005)	(0.405)	(0.080)
Schools	89075	85514	80782
R^2	0.024	0.062	0.058
Mean of outcome	0.032	-4.541	-0.731
SD of outcome	0.177	15.000	2.092

Note: Column 1 is a linear probability model for closure (1/0) by fall 2024. Columns 2 and 3 cover only schools open in both years. Column 3 excludes Arizona, Louisiana, and Tennessee and also requires a usable teacher FTE in both years. All models include state fixed effects and controls for imputed inputs. Outcomes in columns 2 and 3 are winsorized at the 5th and 95th percentiles of their own estimation samples; Appendix Tables A3 and A4 report 1/99 winsorizing and the outcomes as observed. Race shares are proportions (0 to 1). Omitted categories are high schools and rural locale. Standard errors cluster on fall-2019 district. Results are robust to clustering at the state level instead of the district. * p<.10, ** p<.05, *** p<.01.

Appendix for "Empty Desks: Schools and Staffing after the Pandemic"

Sources

Our data primarily come from the annual surveys of all U.S. public schools reported in the Common Core of Data (CCD), administered by the National Center for Education Statistics (NCES). We combine three CCD surveys for each of 15 school years, 2010–11 through 2024–25: the School Universe (Directory) survey, which reports each school's identifiers, operational status, and grade span; the School Membership survey, which reports enrollment by grade, race, and sex; and the Staff survey, which reports full-time-equivalent classroom teacher counts (National Center for Education Statistics, n.d.-a, n.d.-b). These combined surveys include data on 1,537,095 unique school-year observations. As discussed below, we also complemented the base CCD variables in a small number of instances of missingness or logical inconsistencies with other state and federal sources.

Sample Restrictions

We implemented three selection rules to identify the analytic panel. First, we keep only schools in the 50 US states and the District of Columbia (DC), dropping the outlying territories and areas, the Department of Defense system, and the Bureau of Indian Education. Second, we include only what NCES classifies as "regular schools," which includes traditional public, charter, and virtual schools. We exclude "non-regular" special-education, vocational/technical, and alternative or other schools for several reasons. This focus on regular public schools excludes entities which often have volatile, or unreported, enrollment. For example, "shared time schools," such as vocational schools, count a regular school as a student's school of record (Glander, 2019), which results in zero or unreported enrollment counts at these shared time schools in 73% of cases. However, as a robustness check, we also replicate our key results in a sample that includes all non-regular schools and find patterns of results similar to those in the main analyses (see Figure A1).

Third, our analysis excludes adult-education enrollment, keeping student enrollments reported in grades PK-12, "ungraded", "grade 13," and "not specified." Ungraded students are enrolled in classes with no standard grade designation, whose students are often of different ages. Grade 13 enrollments are used rarely among a small subset of schools for early-college or postsecondary transition program enrollment (just 19,463 student enrollments across 1,145 school-year observations). "Not Specified" enrollments are derived values resulting from "the difference between the sum of reported grade values and the reported total" (6,371 student enrollments). Excluding adult-education enrollments in regular schools removes 8,016 student enrollments across the entire sample period. We also exclude information from 31 unique schools in which the grades served were entirely coded as "ungraded". All 31 schools are coded "regular schools" by CCD's own school-type field; however, upon inspection we found that they functionally serve special-education, dropout-recovery, hospital/homebound, or correctional populations.

Applying these three restrictions and addressing several issues of data-quality and availability (discussed below) results in three slightly different analytic samples. Our first and primary sample includes 1,335,134 school-year observations of in-operation schools (i.e., 105,181 unique schools over the 15-year period). We use this sample to identify the trends in the number of operating schools and average school size. The trends in pupil-teacher ratios are based on a second sample that excludes schools in Arizona, Louisiana, and Tennessee due to irreconcilable data issues in some years. This sample consists of 1,256,836 school-year observations across 97,608 unique schools. To map the geographic variation in school counts, size, and staffing, a third analytic sample retains 1,262,084 school-year observations across 95,749 unique schools in all 50

states and DC. This sample excludes 9,432 unique schools from the primary analytic sample that cannot be matched to a mapped school-district boundary (mostly charter schools). We discuss the mapping of these school-level data in more detail below.

Data Quality Control

NCES-Reported Comparisons

As a check on our sample construction, we compare our count of all operating public schools in the CCD to the NCES published universe across three benchmark years spanning the panel: SY2014-15, SY2019-20, and SY2022-23. This comparison uses the full CCD universe, before the regular-school and enrollment restrictions. We align both the operating definition and the geographic scope to the published tables: a school counts as operating if the CCD reports it open, newly opened, administratively added, or reopened at the start of the school year, and we restrict the comparison to the 50 states and the District of Columbia, the coverage the published totals report and the same jurisdictions our first sample restriction retains. Our counts match the published totals within 0.06 to 0.10 percent in every year: 98,248 against a published 98,176 in SY2014-15 (0.07 percent) and 98,370 against 98,469 in SY2019-20 (0.10 percent), and 99,352 against 99,409 in SY2022-23 (0.06 percent). The published series in Table 105.50 ends at SY2020-21, so the SY2022-23 benchmark comes from the CCD's own annual summary table. The corresponding comparison for enrollment matches the published national totals within 0.8 percent in every year: 49.95 million against a published 50.31 million in SY2014-15, 50.45 against 50.80 million in SY2019-20, and 49.30 against 49.62 million in SY2022-23.

Schools In Operation and Valid Enrollments

We identify whether and when a regular school is in operation using three largely different indicators: the school's reported operational status in the CCD, whether it continues to appear in the CCD at all, and its reported enrollment. Regarding the CCD-reported operational status, each school-year observation carries an NCES-assigned status code indicating whether the school is open, newly opened, administratively added, reopened, changed boundaries or agencies, closed, or inactive. We treat a school as *not-in-operation* when it is marked as closed or inactive and treat it as *in-operation* otherwise. Most of these closed or inactive cases eventually lead to a school's attrition from the CCD entirely in subsequent years and never reappearing in the data. A small number of schools attrit from the CCD entirely with no closed or inactive code ever recorded. We treat a school's final reported year as an attrition-based closure as of t+1 whenever it fails to reappear in a later year.

As part of our quality control, we examined school-year observations for logical inconsistencies. Specifically, we identified observations listed as *not-in-operation* but having positive enrollment (i.e., 4 school-year observations) and school-year observations labeled *in-operation* with zero or missing enrollment (i.e., 13,078 school-year observations). The latter group consists of 7,041 CCD observations in-operation but reporting zero enrollment (0.5 percent of all observations) and 6,037 observations in operation but with missing enrollment (0.4 percent of all observations). We examined these cases through their longitudinal histories of CCD data (i.e., being in the CCD, their operational statuses, their enrollment over time) as well as through external sources (i.e., school directory and enrollment data from state departments of education). Among the four regular *not-in-operation* school-year observations with positive enrollment, we found that two are Florida district "virtual instruction" administrative entities reporting negligible enrollment (5 and 3 students enrolled). Because these are not regular schools, we excluded them. The

remaining two appear to be regular schools (a Missouri early-childhood center and a New York intermediate school) reporting valid enrollment continuously before and after the flagged year and at levels consistent with adjacent years. This suggests their status codes of "closed" and "inactive" are erroneously applied to these schools. We include both observations as *in-operation*.

For some of the 13,078 regular in-operation school-year observations with zero or missing enrollment, we were able to recover enrollment data from other sources. Specifically, we use state enrollment data to obtain positive values for 669 school observations from the 2022-23 Los Angeles Unified School District state records and for 227 additional school-year observations across multiple states. We recovered positive enrollment data for 1,311 additional school-year observations from the Civil Rights Data Collection (CRDC). The remaining 10,871 regular in-operation school-year observations still listed with zero or missing enrollment appear among 3,922 unique schools (see Figure A9). For each case, we assess whether the school was in-operation during the year in question and, if so, how to impute enrollment for that school-year observation using other available information. We flag all observations with imputations to facilitate a robustness check on the empirical consequences of these decisions.

To begin, for each unique school we identified the number of years in which its enrollment was listed as zero or missing. The majority (2,193 of 3,922 schools, or 56%) had zero or missing enrollment in only a single year. We decomposed these 2,193 schools into three distinct groups. First, 512 unique schools appear in only one year across the whole panel period and are excluded from the sample. Second, 266 of these schools have a missing or zero enrollment count falling between two enrollment counts in t-1 and t+1. We code them as in operation and impute their enrollment as the sample average of enrollment reported for the school over these two periods.

Third, 1,415 of these schools have their single zero or missing enrollment in a year falling at either the beginning or end of a run of years with positive enrollment data. We code 1,123 of these schools as *not-in-operation* in the year with missing or zero enrollment because they either sit adjacent to a documented closure or the school's terminal attrition from the sample (i.e., presumed closed), or precede the school's first positive enrollment (i.e., assumed not-yet-open). We set aside the remaining 292 zero or missing school-year enrollments found at the edge of the panel (fall 2010 and fall 2024) and address them along with similar school-year cases below.

Of the remaining 1,729 unique schools listed as in operation in *more than* one year with zero or missing enrollment, we found that 1,149 of these schools had those years fall in a single consecutive run rather than scattered across the panel years. We categorized this group of 1,149 schools into four groups. First, 629 of these consecutive-run schools have *no* positive enrollment reported in any of their years in the panel (ranging from 2 to 15 years reported in the CCD) and are thus excluded from the sample. In a second group of 357 unique schools, positive enrollment data appeared before the sequence of zero or missing enrollment data began. We categorize these schools as not in operation (i.e., closed) when enrollment is reported as zero or missing. In a third group of 118 unique schools, a sequence of zero or missing enrollment appears in years before the school began reporting positive enrollment. We also categorize these schools as not in operation (i.e., not yet open) when enrollment is reported as zero or missing. In a fourth group of 45 unique schools, a sequence of zero or missing enrollment is followed by the report of positive enrollment (i.e., typically a gap of two years). We treat these instances as in operation school-years and impute enrollment by interpolating across the unreported gaps.

The remaining 580 unique schools have missing or zero enrollment in more than one year but not exclusively in a consecutive run. We decomposed this set of schools into three distinct groups. First, a group of 402 unique schools containing 2,395 zero or missing school-year cases

report positive enrollment in at least one year between their zero or missing enrollment years. When a zero or missing enrollment year falls between two positive years, we interpolate it and flag it as imputed (779 school-year cases). We code the remaining 1,616 school-year cases as not in operation because one or more positive years appear either only before it (i.e., presumed closed) or only after it (i.e., assumed not yet open). Second, a group of 81 schools have no positive enrollment counts in the years between those where the CCD lists them as in operation but also reports of zero or missing enrollment. This occurs in part because these schools are listed as closed or inactive in other years (or not reported at all in the CCD). We exclude the 478 school-year observations from these 81 schools that are listed as in operation but have zero or missing enrollment. Third, a final group of 97 unique schools contain 98 school-year instances of zero or missing enrollment in fall 2010 and/or fall 2024 that have positive adjacent enrollments in fall 2011 and/or fall 2023. We address these cases next along with the other "panel-edge" cases mentioned above.

Specifically, we combine the 292 panel-edge school-year cases we previously set aside from the single-year nonpositive enrollment group and the 98 cases from the scattered nonpositive enrollment group for a total of 390 zero or missing panel-edge cases at the beginning and end of our sample period (i.e., fall 2010 and fall 2024) that are adjacent to positive enrollments. We begin by addressing the 285 fall 2010 panel-edge cases by attempting to locate each within fall 2009 CCD enrollment files. We divide these left-edge cases into two groups. First, we identify 139 schools appearing in the fall 2009 data with positive enrollments; in these cases, we interpolate the fall 2010 enrollment value using fall 2009 and fall 2011 values. Second, we code the remaining 146 schools as not in operation in fall 2010 because they have zero/missing enrollment values in fall 2009 or are missing from the fall 2009 data entirely.

Next, for the remaining 105 in-operation schools with zero or missing enrollment at the end of the sample period in fall 2024, we manually verify the current operating status of all such schools against district/state rosters, school board minutes, and online closure notices. We distinguish two groups of schools. First, we code 52 schools as not in operation in fall 2024 if there is affirmative documentation of the school's closure in fall 2024 (34 schools); the school is absent from the district's current school list (as of August 2026; 15 schools); or the school is absent from its state's official enrollment files in both fall 2024 and fall 2025 (3 schools). Second, in the remaining 53 cases, we directly verify that 33 are still operating as of August 2026; another 14 are still present on the district's current school roster; and we defer to the CCD's in-operation status for a final 6 that we could not otherwise verify. We code all 53 as in operation and impute enrollment values by carrying forward the school's 2023 enrollment.

Teacher Full-Time Equivalency Counts

Teacher full-time-equivalent (FTE) counts come from CCD Staff data. The CCD counts classroom teachers in full-time-equivalent units as of October 1 of each school year. Under the federal staff-reporting specification, this count includes teachers of pre-kindergarten, kindergarten, elementary, secondary, and ungraded classes, either directly employed or contracted, and excludes vacant positions (U.S. Department of Education, 2019). Paraprofessionals and instructional aides, librarians, counselors, instructional coordinators, and administrators are reported in separate categories and are not included. Teachers with more than one assignment are counted proportionally (e.g., 0.5 FTE in each of two schools). Our quality-control efforts for teacher FTE data focus on four features of this series: inconsistent state-level reporting of teacher FTEs (in

Arizona, Louisiana, and Tennessee), entire states missing teacher FTE counts in only some years, implausible teacher FTE counts, and zero or missing teacher FTE data.

Inconsistent State Reporting. Arizona, Louisiana, and Tennessee teacher FTE values exhibit features that lead to their exclusion entirely. Arizona charter schools did not report a school-level teacher count to CCD in many years prior to 2024-25, including a complete gap from 2016-17 through 2023-24. We checked two substitutes (i.e., authorizer-district attribution; the state charter board); however, neither offered viable replacements. Due to Arizona's sizeable charter sector, a teacher FTE series built only from its traditional public schools would understate the state's actual school-level teacher FTE reality.

Louisiana's teacher FTE reporting changed beginning in 2023-24, when the state began reporting ungraded teachers, a category it had not reported in any prior year (8,136 FTE). The state describes these teachers in NCES's documentation as "special teachers not necessarily designated with grade" (National Center for Education Statistics, 2024). Consequently, Louisiana's school-level teacher FTE rose 19 percent that year while its enrollment fell 1.2 percent. The state's own workforce reports show 843 more teachers than the year before, a 1.6 percent increase (Louisiana Department of Education, 2024). Because the CCD's school-level file reports only each school's total teacher count, the change in counting cannot be subtracted for 2023-24 onward. Due to the mismatch in teacher FTE counting over time, we exclude Louisiana from these analyses in every year.

Tennessee's teacher FTE reporting changed over the study period. Specifically, the Tennessee Department of Education's own technical documentation states that, starting with the 2023-24 Report Card, its staff counts reflect only educators assigned a specific role at the school in which they spent most of their time as of December 1 (Tennessee Department of Education, 2025). This is a narrower population than its prior methodology counted. We investigated whether Tennessee's pre- and post-2023-24 staff counts could be reconciled into a single consistent series and found they could not. Under either methodology, Tennessee's own staff counts were never constructed on a basis comparable to CCD's FTE-weighted classroom-teacher definition. We thus exclude Tennessee from these analyses entirely because the terminal year cannot be identified consistently and a change in reporting would manufacture a 2023-24 data trend change.

Missing Counts Across State-Years. Several school years carry no usable school-level teacher count for one or more states, because those state education agencies did not submit the school-level Staff file in a particular cycle. We divide these nonreporting state-years by those with and without recoverable externally reported counts.

Externally Recovered Counts by State. State administrative data sources of teacher counts are available for several states and years: California in 2010-11 and 2019-20; Ohio and Wisconsin in 2014-15; Washington in 2013-14. These states publish a school- or building-level teacher-FTE file for each of these missing years. Utah is missing four years of teacher FTE counts; although no state-reported school-level teacher FTE data could be recovered, the federal Civil Rights Data Collection (CRDC) provides a school-level count for Utah in 2015-16, 2017-18, and 2020-21.

Interpolated Counts by State. We were unable to locate state or federal school-level alternatives for Wyoming in 2010-11 and 2012-13; Illinois in 2020-21; and Nevada in 2021-22. We address this limitation by interpolating school-level averages based on available adjacent t-1 and t+1 Common Core of Data records (5,176 imputed school-years). Additionally, no CRDC data exist in 2014-15 and we must interpolate Utah's 2014-15 missing counts by bracketing and averaging CRDC counts from 2013-14 and 2015-16 (970 imputed school-years).

Zero or Missing Counts. Among the 1,260,811 school-years that carry forward from the above restrictions, 13,405 (1.1 percent) report zero or missing teacher FTE counts. We address these nonpositive teacher FTE cases according to how many years affect a given school.

First, we identify 4,828 unique schools with a single missing teacher FTE year. Because closure status has already been resolved in the enrollment analysis, every one of these school-years belongs to a school we have confirmed as in-operation. We expect that a zero or missing case here reflects a reporting gap rather than a change in operating status and resolve these cases in one of three ways: interpolating between the t-1 and t+1 teacher FTE counts before and after the missing case (3,156 schools); carrying forward or backward the single adjacent teacher FTE count when data exist on only one side of a school's in-operation run (1,273 schools); or, in the remaining 399 cases, leaving the value unresolved because the school reports no usable teacher FTE count in any other year.

Second, the remaining 2,070 unique schools (8,577 school-years) have two or more years of zero or missing teacher FTE counts. We interpolate gap years bracketed by valid teacher FTE counts on both sides (2,023 school-years) and carry the nearest valid count forward or backward when data exist on only one side (2,996 school-years). The remaining 3,558 school-years are among 648 unique schools that never report a usable count in any year and are excluded from the sample.

Implausible Counts. In a small number of remaining cases, the CCD Staff data report teacher FTEs that appear implausible (e.g., a high school of about 2,600 students reporting 0.02 FTE teachers; a single record reporting nearly 1,800 teachers for about 1,200 students). To identify such cases systematically throughout the data, we identify outlier values for further examination. Specifically, we isolate school-year observations of pupil-teacher ratios where the given value exceeded 150 percent of the magnitude of the pupil-teacher ratio at the 95th percentile or was less than 50 percent of the pupil-teacher ratio at the 5th percentile (15,531 school-year observations, or 1.2 percent of the sample).

We compare these outlying values to the pupil-teacher ratios reported for the same school in other years and to the school's overall enrollment and find that most do not appear to reflect reporting errors. Fully virtual schools, which do not staff conventional classrooms, routinely post extreme ratios; they account for 1,573 (10%) of these flagged observations (a lower bound, because the CCD's fully-virtual indicator is populated only from 2016-17 onward). Of the remainder, 11,478 recur in the same school across two or more years, indicating a stable, if unusual, configuration rather than a one-time error (e.g., a school with 12 students and two teacher FTEs). A further 596 appear in a single year at very small schools (i.e., those with fewer than 50 students, in which a small staffing change swings the ratio sharply). In all of these cases, we leave the teacher FTE count as-is.

Another 188 cases are usable in only a single year of the panel (most often the school's first or last observed year), leaving no adjacent year for comparison. Most are small (i.e., a median of 32 students). The larger ones are typically schools with names implying virtual instruction (e.g., containing "Online", "Virtual", or "Distance" learning in the title) that is not captured by the CCD's "fully virtual" flag. Others, despite being classified as regular schools, are small and have names implying special-population programs (e.g., hospital and homebound instruction, schools for the visually impaired, special-education preschools), whose staffing would be unusual by design. We leave all 188 of these teacher FTE counts as-is.

This leaves 1,696 school-year observations, all at non-virtual schools enrolling at least 50 students, where an isolated extreme value appears to reflect a reporting error rather than a real

configuration (e.g., 1500 students with fewer than 10 teacher FTEs). Because each of these schools reports a usable teacher FTE count in at least one other year, we replace the flagged value using the same interpolation or carry-forward procedure applied to missing teacher FTE counts (Table A5). We flag all observations where our primary analysis used an imputation to assess its potential empirical relevance.

School Grade-Level Bands

We categorize each school's grade-level band according to the following rules differentiating high schools (9-12+), middle schools (6-8), elementary schools (1-5), and early childhood sites (Figure A10). Early childhood sites are pre-kindergarten (PK)-only, PK-kindergarten (KG), PK-grade 1, and KG-only spans. All other schools are classified by counting the number of grades in the school's span in elementary, middle, and high school. We assign the school to whichever range contains the most grades, with ties going to the higher grade-level band. High schools are defined as schools with as many or more high school grade levels compared to either middle or elementary school grade levels. Middle schools are schools with (a) as many or more middle school grade levels compared to elementary school grade levels and (b) more middle school grade levels than high school grade levels. Elementary schools are all remaining schools with at least one elementary grade level. For 16,427 school-year cases in which the low and/or high grade served is missing entirely, we fill both values from the school's nearest year with a reported grade span, carrying forward or backward as needed. The grade band tie rule favoring higher bands affects 2,139 schools, concentrated in grade 5–6, 3–8, and 8–9 spans. In robustness checks, we find that breaking ties toward the lower band instead shifts band-level averages by at most three students and open-school counts by no more than 3% in any year, and leaves the pre-to-post trend in every band effectively unchanged.

Finally, we note that some observed grade bands change suddenly in these data from year to year. We first restrict attention to school-years in which the change alters the school's grade-band classification and does not hold for at least two subsequent years — a band change that persists is treated as real and left uncorrected. Next, we document the remaining 967 events across 794 schools in the primary analytic sample, in which a changed grade span results in a grade-level band change. These schools exhibit a sudden shift in the lowest or highest grade served that changes the school's grade band, followed by either a return to the pre-shift level or a further change. In these cases, we treat this as a one-year data-coding error rather than a genuine grade-span change and apply a general correction for single-year coding errors in the reported grade span. Among the remainder, we treat a school-year's reported low or high grade as miscoded if it falls outside the range bounded by the preceding and following year's values and replace the low and high grade jointly with the following year's values.

Virtual Schools

We retain virtual schools in the analytic samples; they fall within NCES's regular-school classification and the CCD flag that identifies them is too inconsistently reported to support a clean exclusion (Glander, 2019). The fully-virtual indicator is populated beginning in SY2016-17 but unevenly, with several states omitting the flag entirely in some years. For example, California in SY2020-21 and SY2021-22, and Illinois, Utah, Connecticut, and Idaho in a single school year each omit virtual school status flags. Additionally, at least one state (Virginia) over-applies the virtual school label in pandemic years; in SY2020-21, Virginia coded 303 brick-and-mortar schools as fully virtual and immediately reverted them the following school year. These inconsistencies are

mostly trivial to our results; fully virtual schools comprise between 0.7% and 1.5% of all in-operation regular schools and between 0.6% and 1.6% of student enrollments from 2016-17 through 2024-25. These inconsistencies do not affect our counts of openings, closures, or "in operation" schools, which are measured from operational status and count a school regardless of whether its virtual status is recorded. However, virtual schools grew over the study period – particularly after 2020, during which the share of fully virtual regular in-operation schools roughly doubled from 0.90 to 1.50 percent and enrollment doubled from 0.78 to 1.48 percent (Table A6). Due to post-pandemic growth and these schools' higher pupil-teacher ratios compared to brick-and-mortar regular schools, retaining them results in conservative pupil-teacher ratio estimates. Even so, we find similar results when we exclude all schools described as virtual for in-operation pupil-teacher ratios.

School District Maps and Geographic Boundaries

The US district-level maps are derived from the analytic sample. We aggregate the school-level records to the school district, then compare two endpoint years rather than multi-year windows: the last pre-pandemic enrollment report (fall 2019, SY2019-20) and the most recent year available (fall 2024, SY2024-25). District polygons come from the 2023 Census cartographic boundary files at 1:500,000 scale. We use all three school-district layers — unified, elementary, and secondary — together with the state boundary file (U.S. Census Bureau, 2023).

Polygons are matched to the panel on the NCES district identifier. After the crosswalk, we omit 5,656 schools (6.3 percent of schools open in fall 2024) enrolling 2,952,113 students (6.1 percent of that year's enrollment) that sit in agencies with no mappable boundary in the most recent year. Nearly all are not associated with a conventional school district or its geographic boundaries, in which a charter school or network is its own local education agency and holds no territory (e.g., charters that operate as their own LEA). Roughly 95 percent of the omitted schools are charters; over this window, the omitted charter agencies grew—a net gain of 409 schools (7.8 percent) and 430,577 students (17.1 percent)—even as the mapped, geographically-assignable districts contracted (a net loss of 266 schools and 1.96 million students). The maps therefore depict the change among *territorial* geographic public-school districts and understate the charter sector's continued expansion.

We project the contiguous states to the USA Contiguous Albers Equal Area Conic projection. Alaska and Hawaii are each reprojected to their own equal-area projection, which avoids the shear the contiguous projection introduces at those latitudes. Both are then scaled into boxed insets below the map, and Hawaii is clipped to its main islands. Districts are shaded on a diverging red-to-blue scale, red for loss and blue for gain, except Figure A6, where red marks a rising pupil-teacher ratio and blue a falling ratio. Bins are symmetric around zero on the percentage-change map and centered on a no-change class on the net-count map. Districts without a value are shaded gray. We build the maps in Python using the geopandas and matplotlib libraries.

Two rules follow from the measures themselves. Since average school size is a ratio, maps omit districts in which pre-pandemic average school size is below 50 students (where a percentage change carries more noise than signal). Additionally, some layers overlap, requiring a drawing rule. Elementary and secondary school districts cover the same ground as each other wherever both exist: about 84 percent of elementary-district area falls inside a secondary district, while neither overlaps a unified district. Two agencies with different values therefore compete for the same area on the map. On the all-levels map and the combined Early Childhood/ Elementary/Middle map, we draw the elementary school district, because the capacity decline we

document is concentrated at the elementary and middle levels. In every case, a district with no value at that level is drawn beneath any district that has one, so an empty polygon never hides a filled one.

New York City School District Mapping

New York City is the one district on these maps in which CCD records and Census geography do not line up. The CCD files every New York City school under one of the 32 New York City geographic districts, while the Census school-district boundary files draw none of those 32 agencies. The only New York City polygon Census publishes is the citywide agency, and in the CCD that agency has no schools attached to it. We correct this by rolling the 32 geographic districts up to the citywide polygon. This choice for correction leaves New York City on a different standing from every other district shown. Elsewhere on these maps, one shaded polygon is one CCD agency. For New York City, one shaded polygon is 32 agencies aggregated into a citywide average across the five boroughs. Within-city variation is therefore invisible, and it is precisely within-city variation that the New York closure debate would hinge upon. The net-school-change compounds this: the city's figure of +9 schools nets closures against openings citywide, so concentrated school closure events remain hidden. However, NCES's documentation of the Census Bureau's boundary files affirms this choice, stating that New York City's five boroughs are drawn as a single Unified school district, the same treatment given to the state of Hawaii, and for the same reason (i.e., administrative sub-units that do not correspond to separate territory; see Geverdt, 2019).

State Takeovers and Receiverships

A further institutional margin, beyond the school-level closures documented above, is the state takeover of an entire district's governance — arguably the end-stage outcome for a district in which enrollment losses have left its financial position untenable. Systematic evidence on this margin is considerably thinner than on closures themselves, however. There are no federal data that track state takeovers or receiverships, though several researchers have done their own independent tracking. The most systematically constructed tracking effort, Schueler and Bleiberg (2022), identifies 124 takeover episodes across 111 districts and 25 states plus the District of Columbia between 1988 and 2016. However, this series stops before the pandemic-era enrollment declines that motivate the present study even begin, and it therefore cannot speak to whether takeovers became more common afterward. Additionally, Morel (2018) documents roughly 1,000 districts subject to some form of state intervention, but this study's focus is on how takeovers follow a district's Black political representation at least as strongly as its academic performance. Recent journalistic accounts suggest modest takeover activity in the US since. In 2026, Chalkbeat counted at least 21 new state takeovers since 2023, concentrated in a handful of states (mostly red states like TX, TN, MS, IN). Notably, these takeovers are framed more explicitly around political control than an academic-performance rationale. Whether this recent wave represents a genuine increase in rate rather than an increase in visibility is an open question that current available data cannot resolve – because no series currently bridges the pre-2018 academic tracking and the post-2023 journalistic count (Altavena, 2026).

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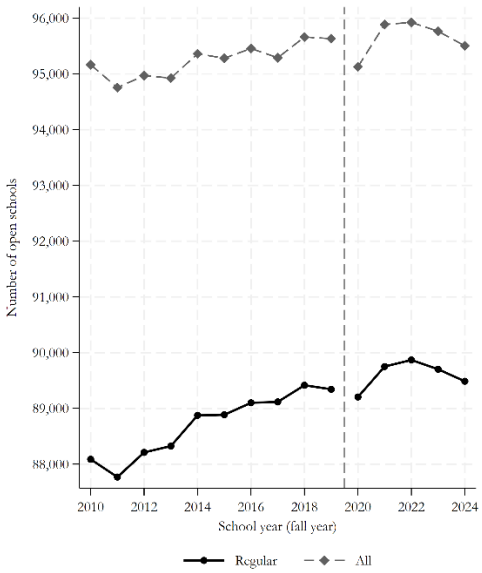
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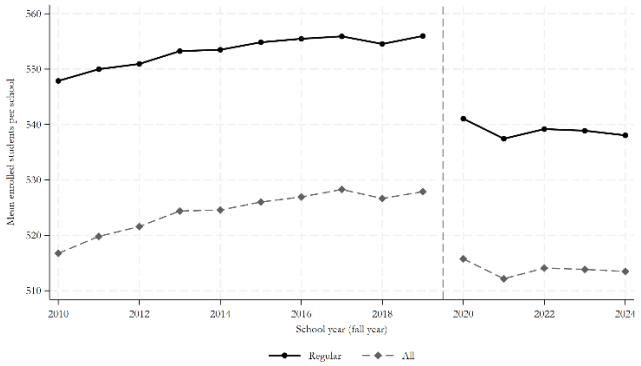
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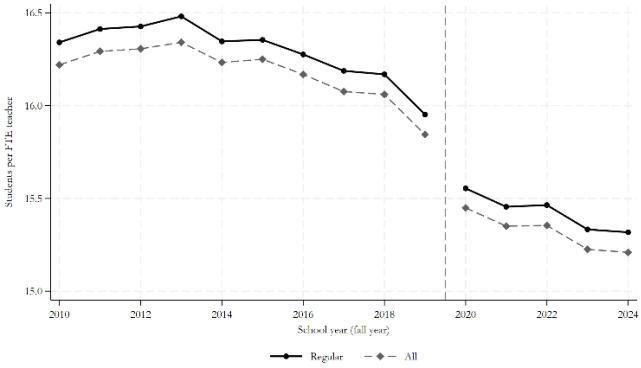
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(a) Total in-operation regular schools, by year



(b) Average enrollment per school by year



(c) Pupils per FTE teacher by year

Figure A1. Regular vs. all in-operation school counts, Fall 2010 through Fall 2024. Notes: The data reflect annual universe surveys of regular public schools (traditional, charter, and virtual) in operation and all in-operation public schools serving grades pre-K through 12 in the 50 US states and DC.

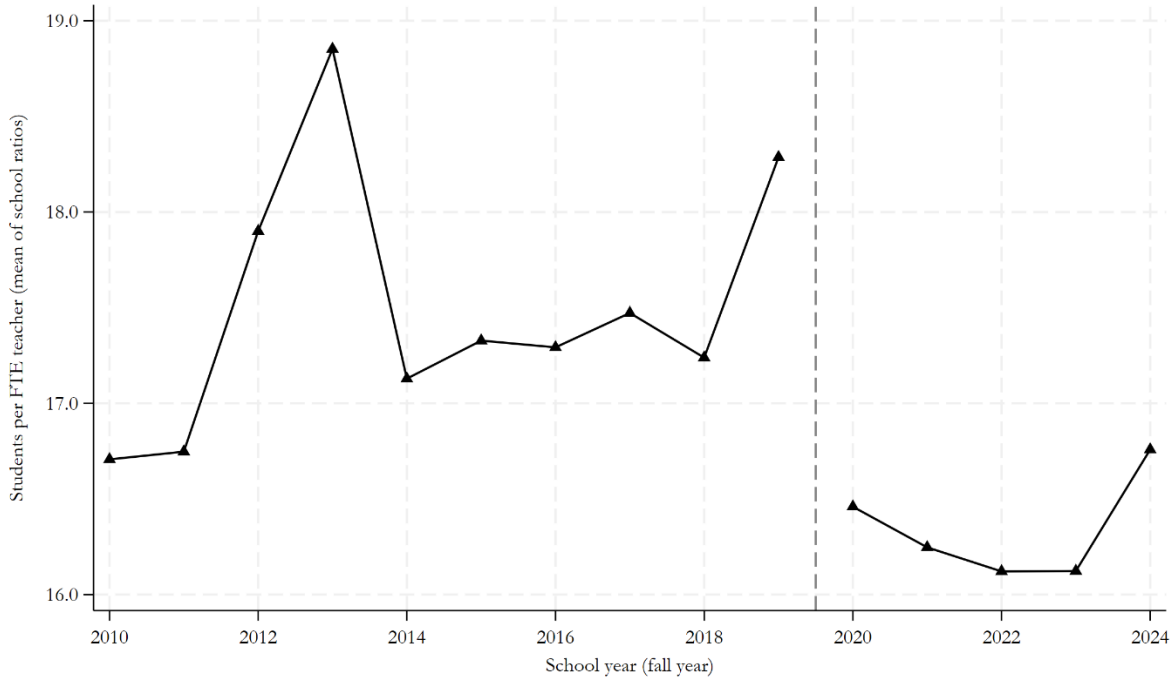


Figure A2. Mean of school-level pupil-teacher ratios, Fall 2010 through Fall 2024.
Notes: Each point is the unweighted average of school enrollment divided by full-time-equivalent teachers across regular public schools with usable teacher counts (excluding Arizona, Louisiana, and Tennessee). Figure 1(c) instead divides total enrollment by total FTE teachers, following the NCES definition. A small number of schools reporting extreme ratios moves this series noticeably in some years (e.g., fall 2013 and fall 2019).

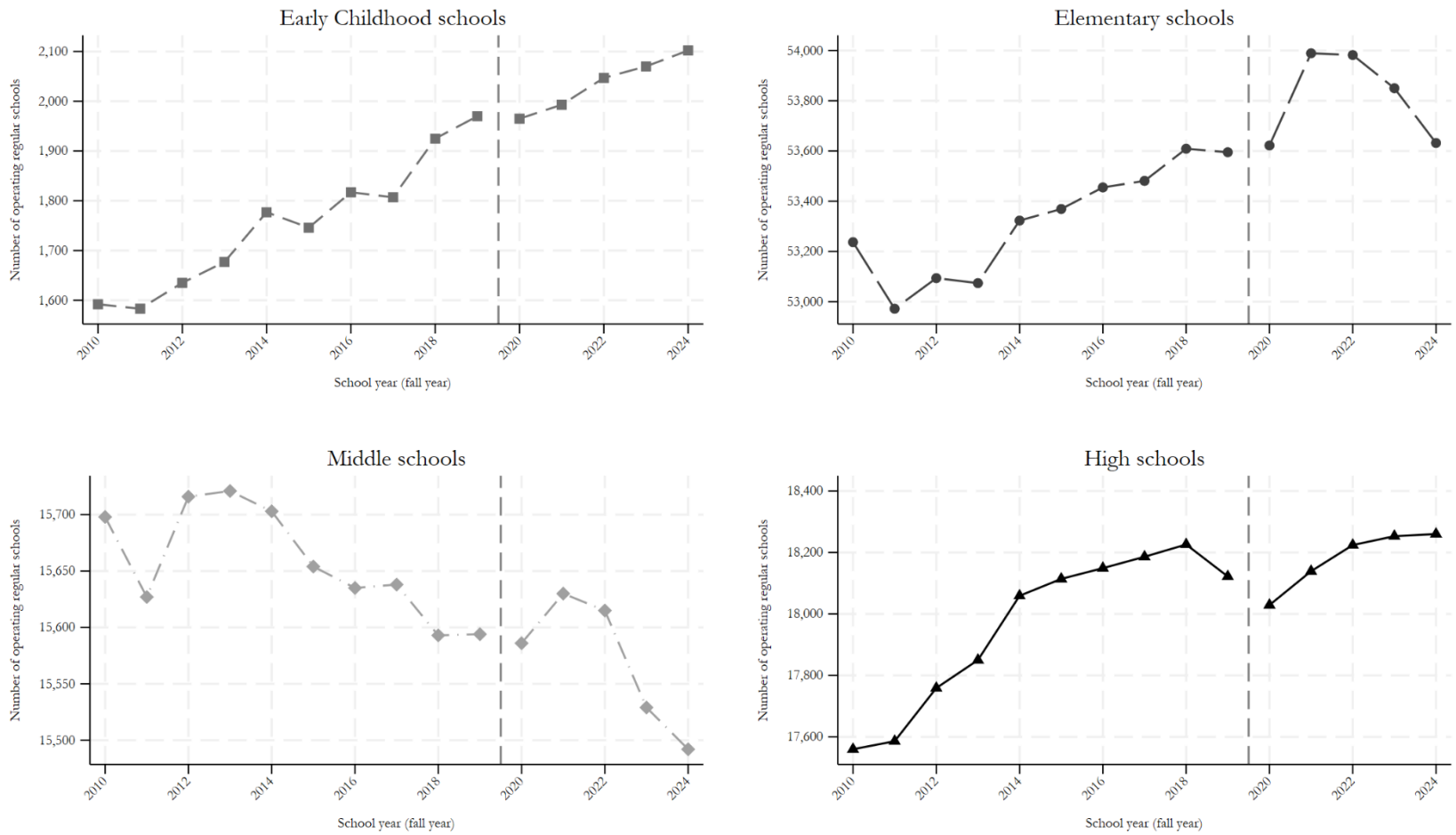


Figure A3. Operating public schools by grade band, Fall 2010 through Fall 2024.
Notes: See the data appendix for details on categorizing each school by grade span.

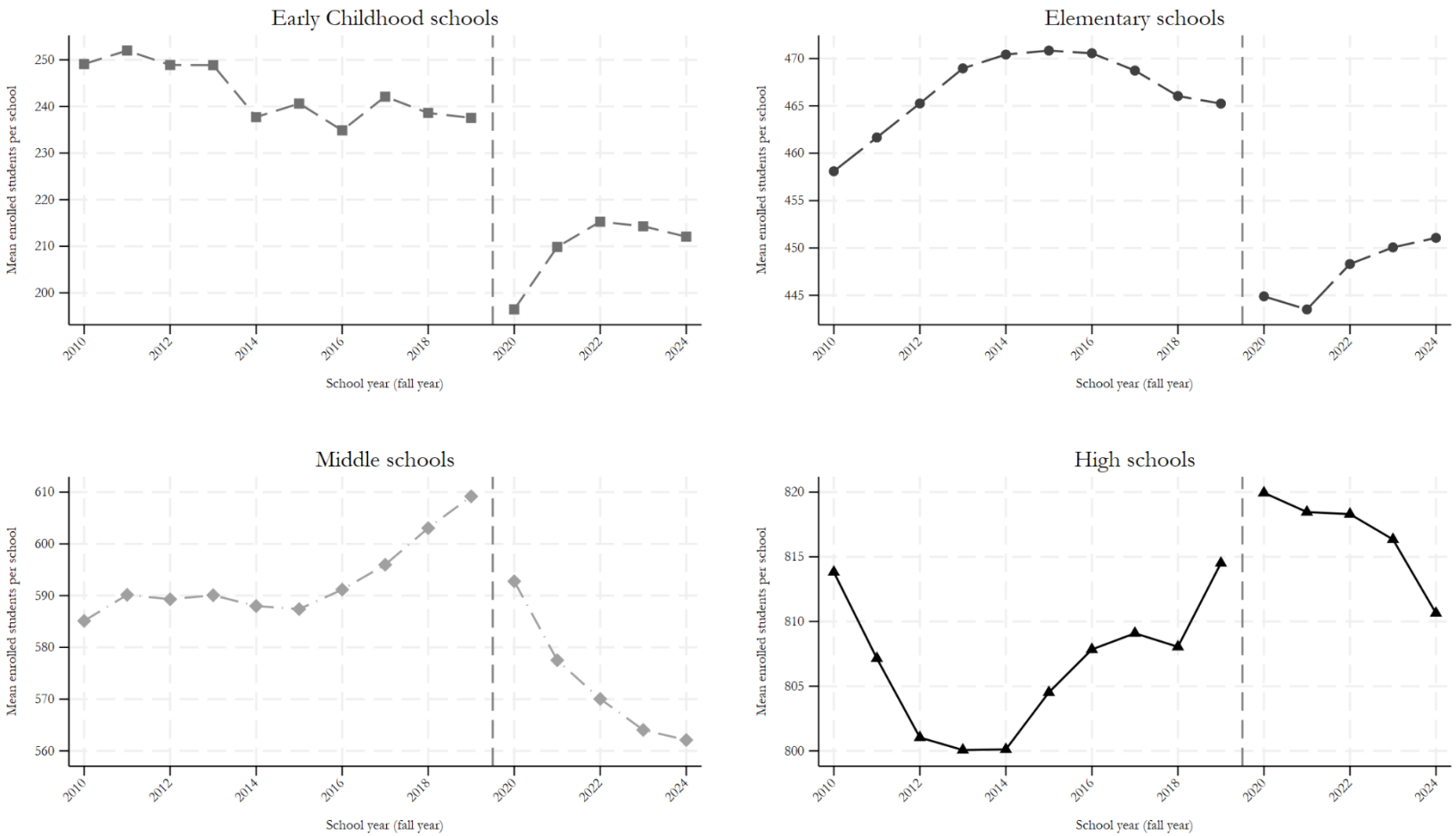


Figure A4. Average school size by grade band, Fall 2010 through Fall 2024.
Notes: See the data appendix for details on categorizing each school by grade span.

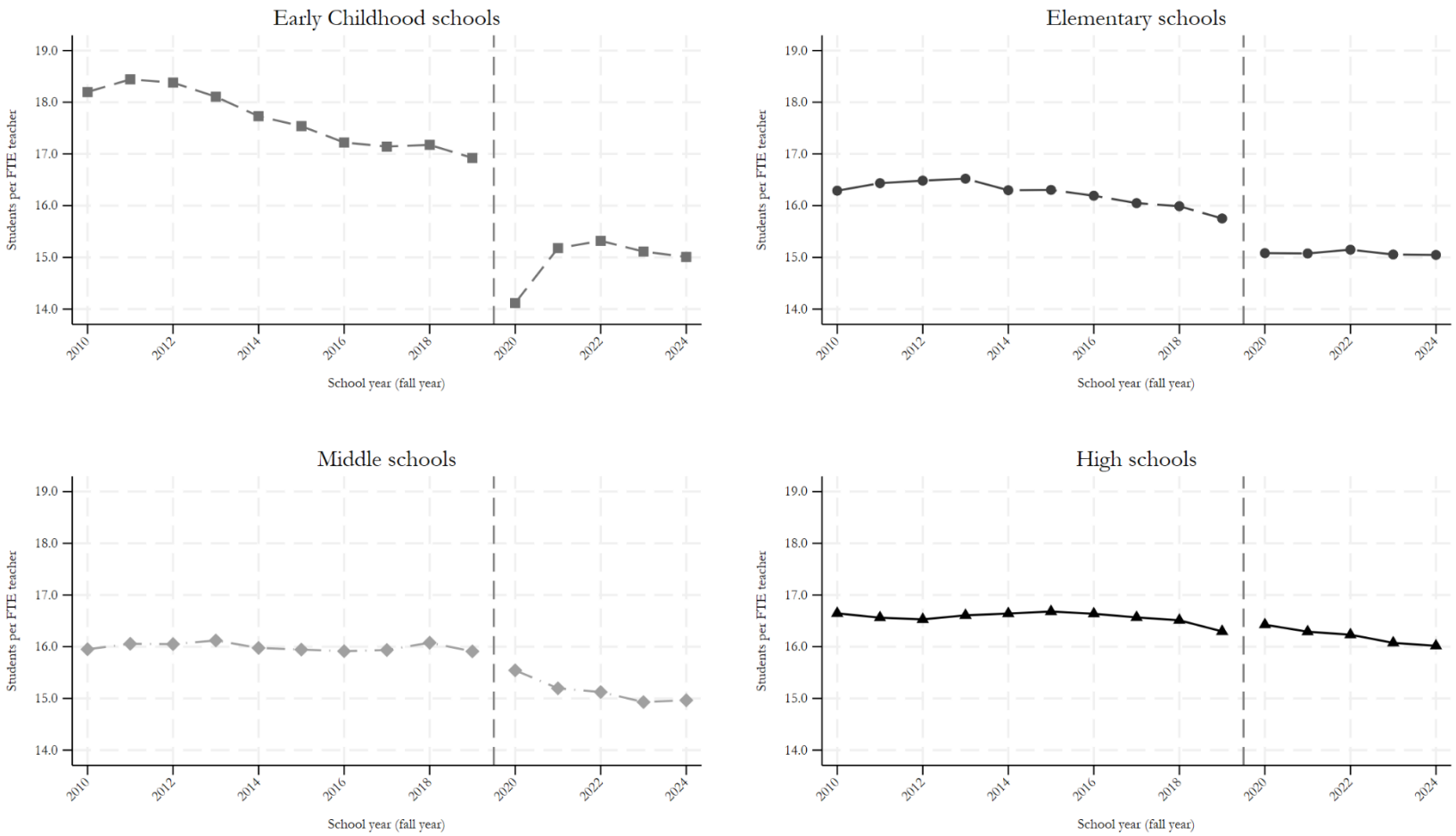


Figure A5. Pupil-teacher (FTE) ratio per school by grade band, Fall 2010 through Fall 2024.
Notes: See the data appendix for details on categorizing each school by grade span.

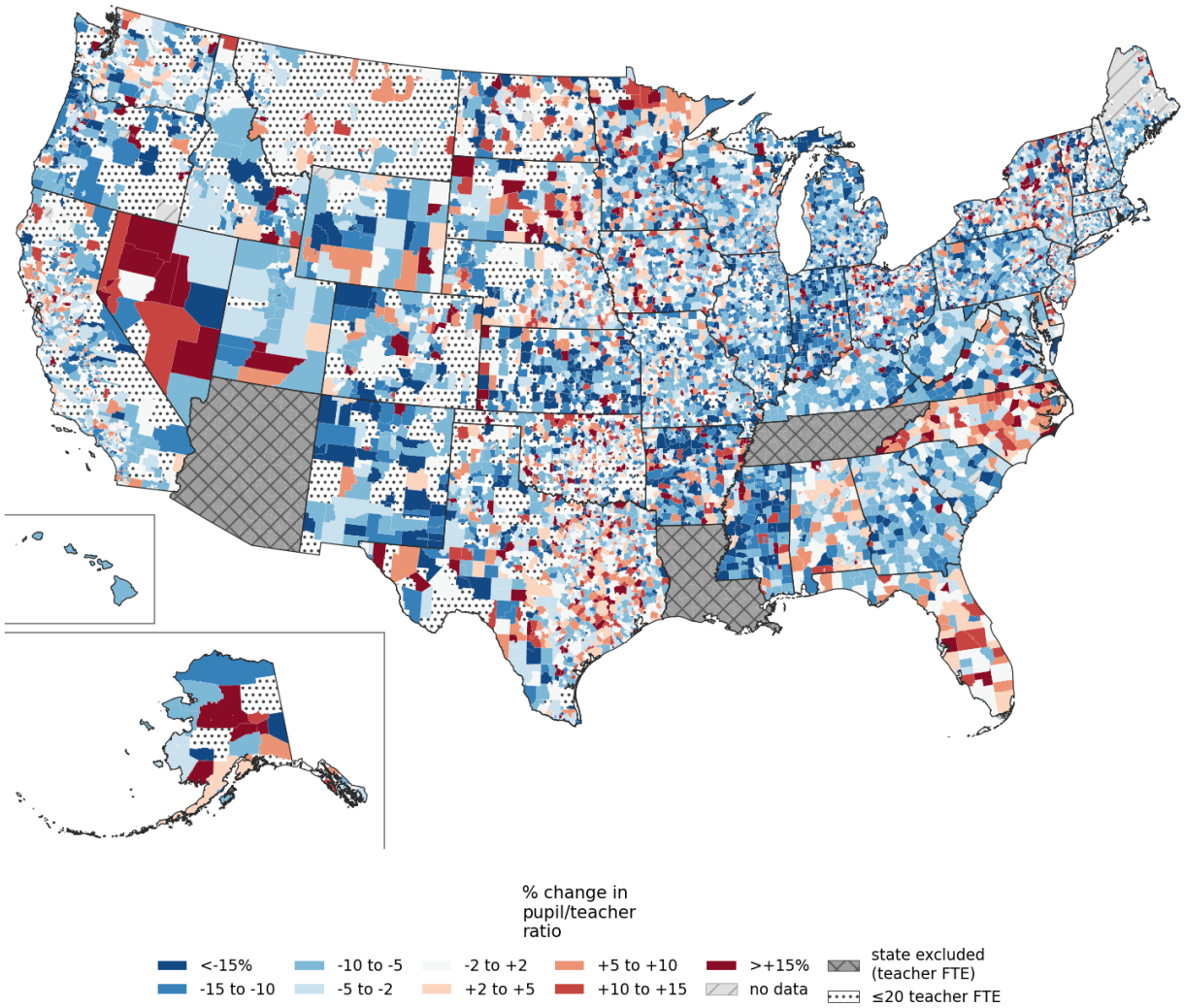


Figure A6. Percentage change in the pupil-teacher ratio by district, Fall 2019 to Fall 2024. Notes: District ratio is total enrollment divided by total teacher FTE across regular public schools in the district with usable teacher counts. Red indicates the pupil-teacher ratio rose; blue indicates the ratio fell. Districts with 20 or fewer teacher FTEs in either year are dotted rather than colored. Arizona, Louisiana, and Tennessee data are excluded.

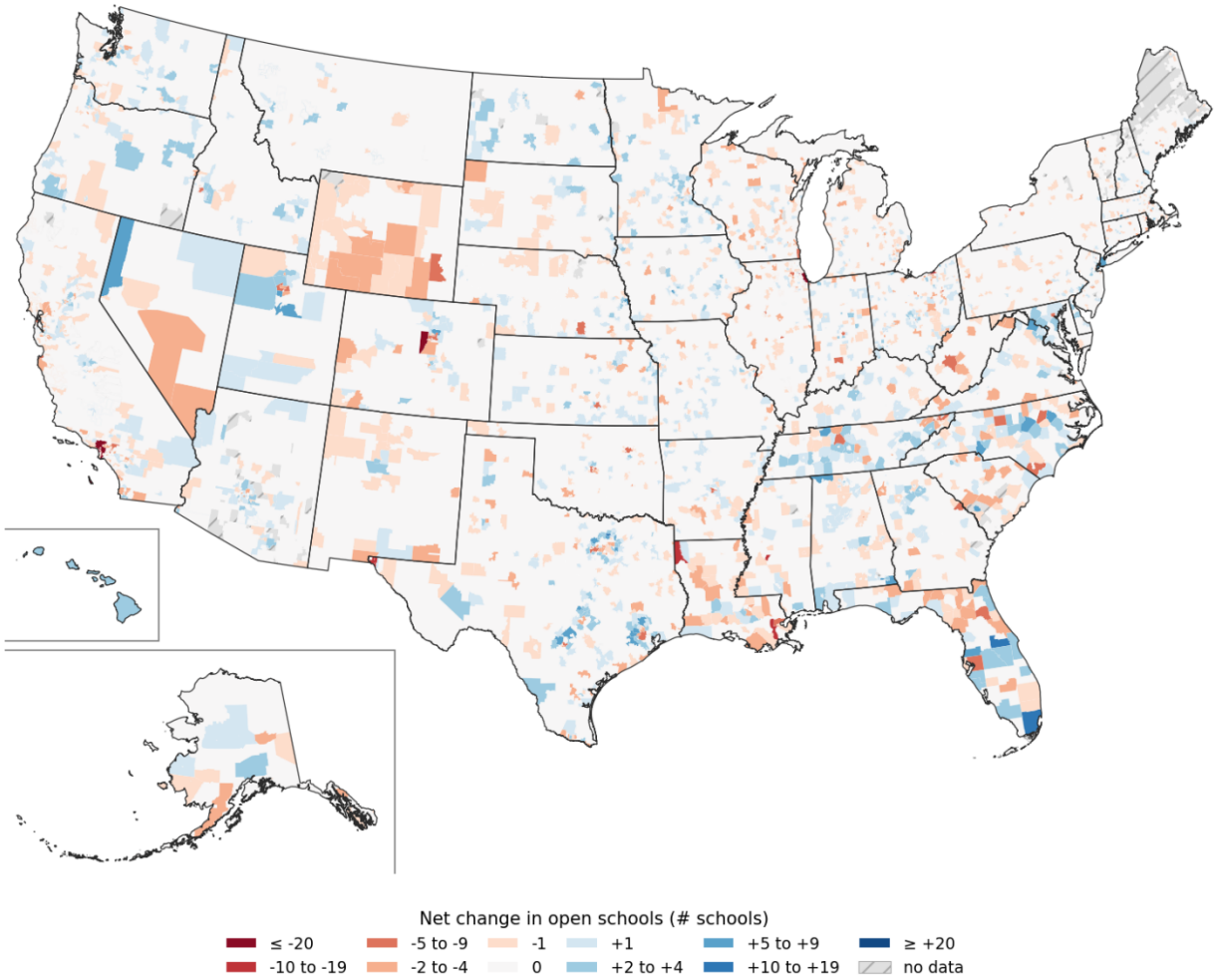


Figure A7. Net change in the number of open schools by district, Fall 2019 to Fall 2024.

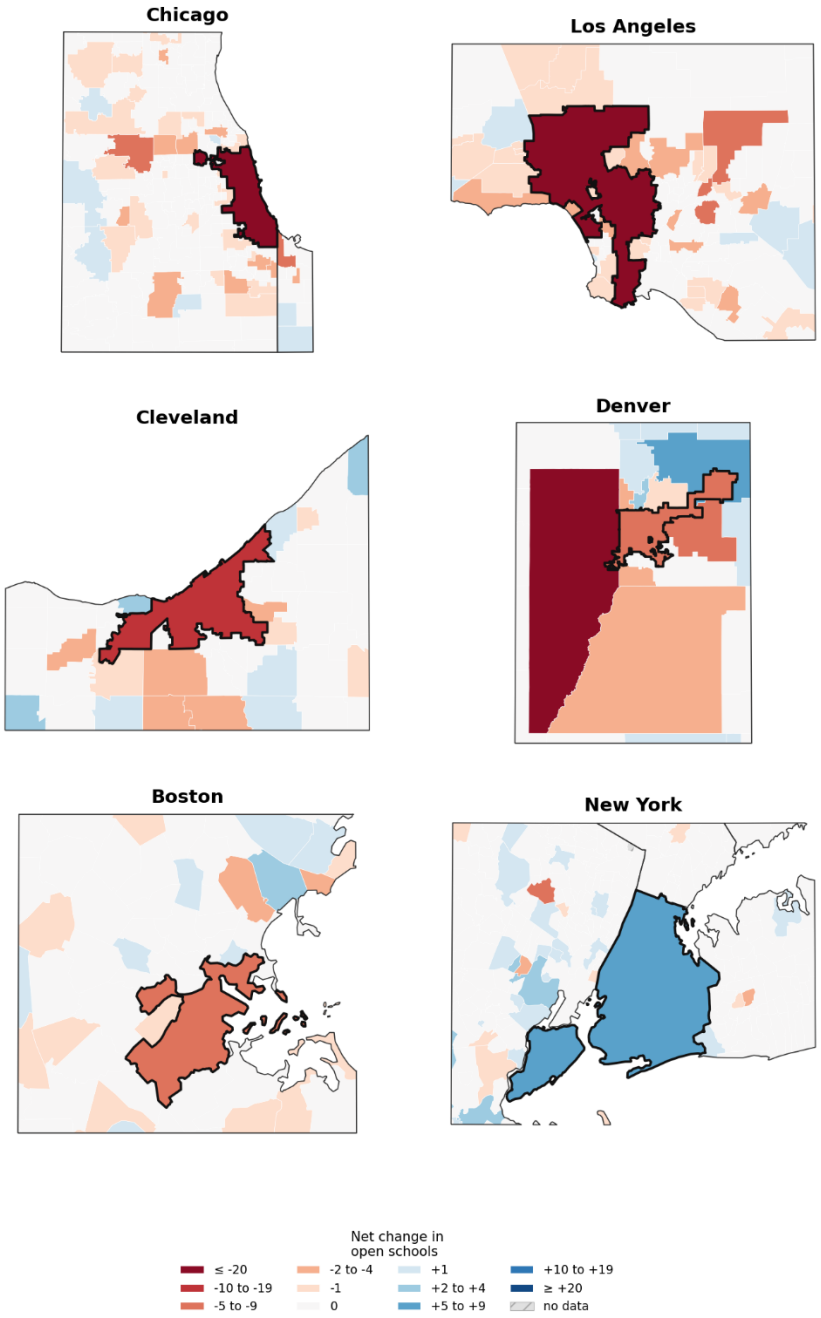


Figure A8. Net change in open regular schools by district, six large cities, FA2019 to FA2024. Graphs contain the same sample, measure, endpoints, and color scale as the national net-change map: regular, open schools, 50 states plus DC, with charter and virtual schools included. Each panel is projected on an equal-area cone centered on that city, keeping it square and north-up. Each central city district is outlined in black to distinguish it from the surrounding districts. Cities are ordered by the size of their net loss.

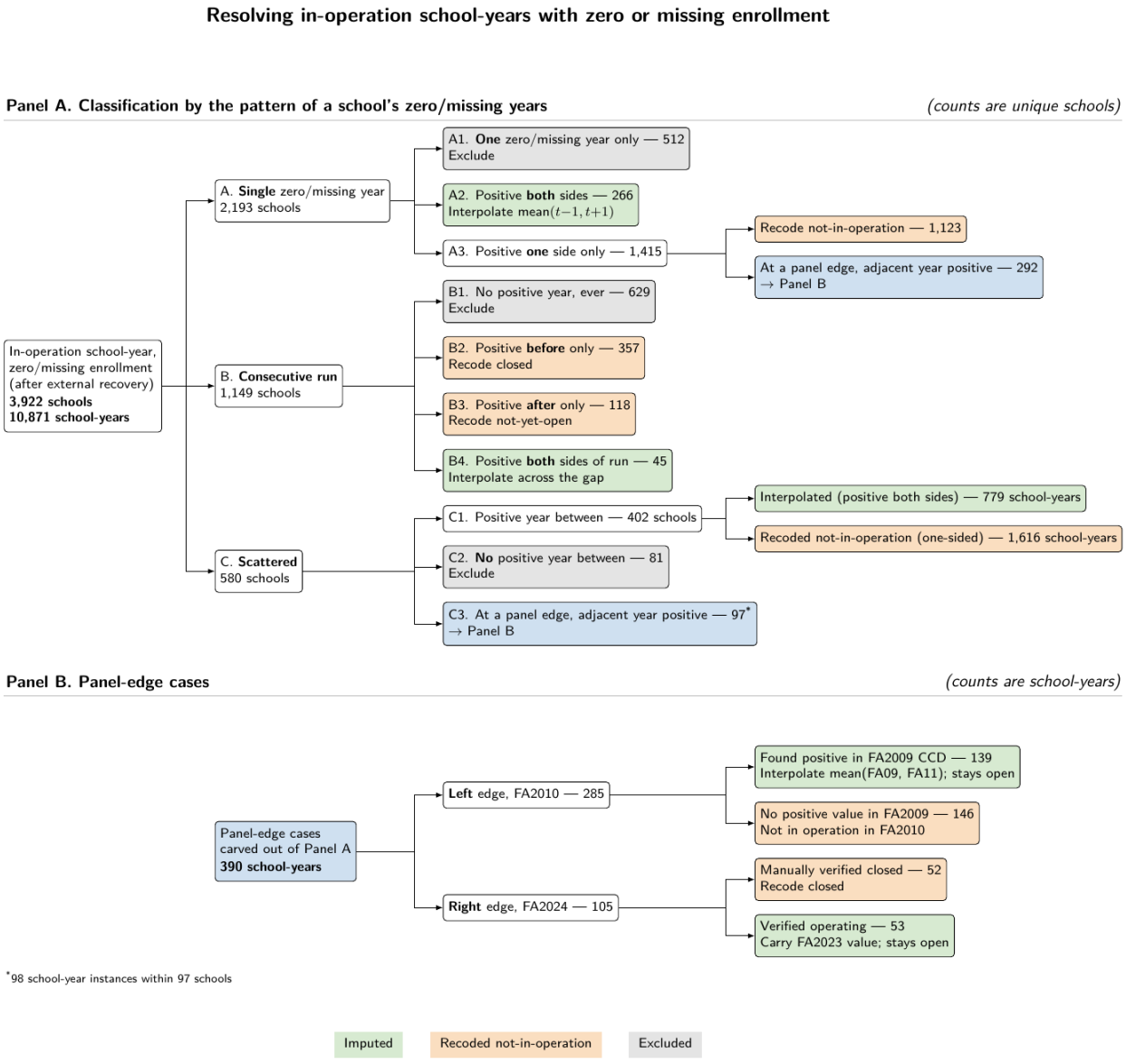


Figure A9. Resolving in-operation school years with zero or missing enrollment.

Lowest grade level	Highest grade level: PK	KG	01	02	03	04	05	06	07	08	09	10	11	12+
PK	EC	EC	EC	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
KG		EC	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
01			ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
02				ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	HS
03					ES	ES	ES	ES	ES	MS	MS	MS	HS	HS
04						ES	ES	ES	MS	MS	MS	MS	HS	HS
05							ES	MS	MS	MS	MS	MS	HS	HS
06								MS	MS	MS	MS	MS	HS	HS
07									MS	MS	MS	HS	HS	HS
08										MS	HS	HS	HS	HS
09											HS	HS	HS	HS
10												HS	HS	HS
11													HS	HS
12														HS

Figure A10. Grade band categorization by lowest and highest grade served in a school. EC = early childhood (pre-kindergarten, kindergarten); ES = elementary school (1-5); MS = middle school (6-8); HS = high school (9-12+).

Table A1. Schools by Enrollment-Change Threshold, Fall 2019 to Fall 2024

Threshold	Lost (N)	Lost (%)	Gained (N)	Gained (%)
10% or more	31,643	36.9	13,159	15.4
15% or more	20,717	24.2	9,214	10.8
20% or more	12,758	14.9	6,796	7.9
25% or more	7,654	8.9	5,287	6.2

Note: Sample includes all regular public schools (any grade band, excluding adult-education enrollment), 50 states plus DC, open and validly reporting enrollment in both fall 2019 (SY2019-20) and fall 2024 (SY2024-25). Percent change compares these two single-year snapshots only, with no multi-year window averaging.

Table A2. Selected Large-City School Districts Losing More Than 5 Schools (Fall 2019 to Fall 2024)

District	Schools Fall 2019	Schools Fall 2024	Net change	% change
Chicago, IL	651	621	-30	-4.6
Los Angeles, CA	695	669	-26	-3.7
Jackson, MS	52	36	-16	-30.8
Rochester, NY	49	38	-11	-22.4
Cleveland, OH	103	93	-10	-9.7
El Paso, TX	81	72	-9	-11.1
San Antonio, TX	88	79	-9	-10.2
Baltimore, MD	147	138	-9	-6.1
Denver, CO	185	176	-9	-4.9
Indianapolis, IN	57	49	-8	-14.0
St. Louis, MO	68	60	-8	-11.8
Boston, MA	107	99	-8	-7.5
Wichita, KS	88	81	-7	-8.0
New Orleans, LA	11	5	-6	-54.5
Providence, RI	42	36	-6	-14.3
Little Rock, AR	43	37	-6	-14.0
Greensboro, NC	118	112	-6	-5.1
Nashville, TN	160	154	-6	-3.8

Note: Net change in the count of regular, open-validated (SY_STATUS Open/New/Added/ Reopened/Changed Boundary-Agency AND positive, non-missing enrollment), 50+DC schools, FA2019 (SY2019-20) to SY2024-25; virtual schools included. Cities are purposively selected to a set of well-known, large urban districts (chosen for salience and size).

Table A3. Descriptive Regressions with Outcomes Winsorized at 1/99

Fall 2019 characteristic	Closed by fall 2024 (1)	Enrollment change (%) (2)	Pupil/teacher ratio change (3)
Early childhood	0.088***	-2.963***	-1.374***
	(0.009)	(0.845)	(0.126)
Elementary	0.012***	-4.117***	-0.401***
	(0.002)	(0.216)	(0.035)
Middle	0.018***	-6.428***	-0.641***
	(0.002)	(0.288)	(0.033)
City	0.002	-2.312***	-0.262***
	(0.003)	(0.355)	(0.077)
Suburb	-0.001	-0.762***	-0.122***
	(0.002)	(0.250)	(0.040)
Town	0.008***	-0.698***	-0.026
	(0.003)	(0.254)	(0.037)
School-neighborhood income-to-poverty ratio	-0.003***	0.053	0.025*
	(0.001)	(0.067)	(0.013)
Share Black	0.049***	-5.165***	0.343**
	(0.007)	(0.665)	(0.156)
Share Hispanic	0.005	-5.218***	-0.285**
	(0.005)	(0.606)	(0.115)
Share Asian	-0.035***	-2.641**	0.134
	(0.008)	(1.316)	(0.239)
Charter school	0.046***	15.670***	0.177
	(0.005)	(0.735)	(0.115)
Schools	89075	85514	80782
R-squared	0.024	0.061	0.051
Mean of outcome	0.032	-3.411	-0.730
SD of outcome	0.177	20.742	2.609

Note: Same model as Table 1, but with the two continuous outcomes winsorized at the 1st and 99th percentiles of their own estimation samples. * p<.10, ** p<.05, *** p<.01.

Table A4. Descriptive Regressions without Winsorizing

Fall 2019 characteristic	Closed by fall 2024 (1)	Enrollment change (%) (2)	Pupil/teacher ratio change (3)
Early childhood	0.088***	18.734	-1.254
	(0.009)	(16.729)	(2.615)
Elementary	0.012***	-6.440***	0.079
	(0.002)	(0.730)	(0.403)
Middle	0.018***	-8.329***	-1.123*
	(0.002)	(0.844)	(0.628)
City	0.002	-1.467	-0.436
	(0.003)	(1.140)	(0.482)
Suburb	-0.001	0.481	0.353
	(0.002)	(0.737)	(0.335)
Town	0.008***	-1.074*	1.502*
	(0.003)	(0.641)	(0.791)
School-neighborhood income-to-poverty ratio	-0.003***	0.790	0.130
	(0.001)	(1.194)	(0.094)
Share Black	0.049***	-6.834***	0.421
	(0.007)	(2.265)	(0.684)
Share Hispanic	0.005	-4.201	1.369
	(0.005)	(2.842)	(1.297)
Share Asian	-0.035***	-3.123	0.796
	(0.008)	(11.112)	(1.021)
Charter school	0.046***	28.420***	-0.147
	(0.005)	(2.302)	(0.888)
Schools	89075	85514	80782
R-squared	0.024	0.007	0.003
Mean of outcome	0.032	-1.275	-0.703
SD of outcome	0.177	109.292	42.372

Note: Same model as Table 1 but with the two continuous outcomes left as observed. * p<.10, ** p<.05, *** p<.01.

Table A5. Sensitivity of Main Results to Imputations and Replacements

Exhibit metric	With imputations	CCD values without imputations	With imputations and without fully virtual schools
Open schools, Fall 2019	89,343	89,076	88,803
Open schools, Fall 2024	89,486	89,433	88,530
Average school size, Fall 2019	556.0	557.2	555.9
Average school size, Fall 2024	538.0	538.3	537.3
Pupil/teacher ratio, Fall 2019	15.95	15.25	15.92
Pupil/teacher ratio, Fall 2024	15.32	15.31	15.27
Share losing >=15% enrollment	24.20%	24.17%	24.24%
Share losing >=25% enrollment	8.94%	8.91%	8.93%

Note: The 'without imputations' column reverts every enrollment and teacher-FTE value to what the CCD reported, undoing external recovery, interpolation, and outlier replacement. Regular schools, 50 states + DC (pupil/teacher ratio excludes Arizona, Louisiana, and Tennessee). CCD published no school-level teacher FTE for California in SY2019-20, largely accounting for the 0.70 difference. The third column applies every imputation but removes schools CCD classifies as exclusively virtual in fall 2019 or fall 2024, though Texas reports no virtual status in either year, Connecticut none in fall 2019, and Idaho none in fall 2024.

Table A6. Virtual School Footprint by Year

School year	Fully-virtual schools (N)	Fully-virtual enrollment (N)	% of all students
2016-2017	650	297,723	0.601
2017-2018	744	338,029	0.682
2018-2019	807	384,427	0.775
2019-2020	807	386,956	0.779
2020-2021	1,140	783,122	1.621
2021-2022	1,155	616,133	1.276
2022-2023	1,392	625,222	1.290
2023-2024	1,352	661,973	1.369
2024-2025	1,340	713,378	1.481

Note: Fully-virtual = a school in operation with the CCD virtual flag set to fully or primarily virtual. Column 1 counts in-operation fully-virtual schools; columns 2 is sum enrollment over in-operation schools; column 3 is fully-virtual enrollment as a share of all in-operation regular-school enrollment that year. Analytic sample includes "regular schools" in 50 US states plus DC. The CCD virtual flag is available only from SY2016-17 and is reported inconsistently in several state-years. See the data appendix on virtual-reporting inconsistency.