De-Unionization and the Labor Market for Teachers: From School Boards to State Politics

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Abstract

How does the labor market for teachers react to a ban on collective bargaining? Tennessee teachers who lost bargaining rights in 2011 are compared to colleagues in the state whose districts never negotiated within a differences-in-differences framework. De-unionization reduced compensation and increased the demand for teachers. Salaries grew one percentage-point less, cumulatively over five years, while employer-paid health insurance premiums grew five percentage-points less. Instead of raising wages, administrators decreased the student-teacher ratio by half a student. Meanwhile, teachers' unions lost 25 percent of pre-prohibition revenue because contracts no longer stipulate automatic payroll deduction of union dues.

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1 Introduction

Once a prominent feature of public education in the United States, teachers' ability to collectively bargain is increasingly limited. Since 2011, seven state governments have passed legislation to reduce union leverage over local school boards.[1] For example, Utah prohibited paid leave for association activities, Illinois allowed school boards to cease negotiating over pension and health insurance benefits, and Tennessee banned collectively bargained contracts outright. In 2015, the Supreme Court of the United States considered a challenge to California's agency shop policy, which allows the California Education Association to collect dues from non-member teachers who are covered by union contracts (*Friedrichs v. California Teachers' Association*).[2] These recent events reinforce a longer-term trend toward the de-unionization of education. In 2015, 45 percent of K-12 professionals were covered by collectively bargained employment contracts, whereas 61 percent were covered in 1983 (Hirsch and Macpherson, 2016).

The literature has yet to reach consensus on the causal relationship between union contracts, teacher labor markets, and student achievement. Studies of unionization in the U.S. private sector often find wage premiums on the order of 15 percent.[3] Yet, union differentials in the education sector vary greatly depending on the research design and context. For example, recent observational studies find either no effect (Strunk, 2011) or a four-percent premium increasing with seniority (Lamm West and Mykerezi, 2011).[4] Quasi-experimental analyses typically focus on the passage of state laws, beginning in the 1960s, that permitted collective bargaining in school districts. Here again, conclusions diverge. Hoxby (1996) documents a five percentage-point salary premium from unionization, whereas Lovenheim (2009) and Frandsen (2016) see none. Hoxby shows a

[1] National Conference of State Legislatures (2016). Specifically: Idaho (H 261 of 2012), Illinois (S 1 of 2014), Indiana (S 575 of 2011), Michigan (H 4628 and S 158 of 2011, H 5387 of 2016), Tennessee (S 113 of 2011), Utah (H 183 of 2011), and Wisconsin (Act 10 of 2011).

[2] The case was affirmed by an equally divided court in 2016.

[3] Blanchflower and Bryson (2004) review the observational literature; DiNardo and Lee (2004) and Frandsen (2012) offer regression discontinuity estimates based on union certification elections.

[4] Strunk (2011) examines variation in union strength across districts in California. Lamm West and Mykerezi (2011) compare (large) districts that collectively bargain throughout the United States to those that do not.

two-student decrease in the student-teacher ratio and a three percentage-point increase in the dropout rate, while Lovenheim finds no change. Nevertheless, Lovenheim and Willén (2016) argue that collective bargaining hurts student achievement in the long run.

Even if the lessons from historical studies were clear, they need not apply to de-unionization today. Cutting existing benefits might be more difficult than granting new ones, as school boards risk a deterioration of teacher morale that undermines performance (Mas, 2006). National trends toward salary transparency, pension reform, and teacher evaluation based on high-stakes testing have changed the terms of labor negotiations.[5] Two recent studies examine Wisconsin's 2011 package of policies that simultaneously limited collective bargaining to wages, capped wage growth at cost-of-living, and reduced pension and retiree health insurance benefits, which are both set by the state. Litten (2016) documents an eight percentage-point reduction in compensation due to the law, while Biasi (2016) reveals that higher-quality teachers sorted into the districts that subsequently adopted performance pay. Yet, neither study shows how school boards react to de-unionization absent direct legislative control over wages and benefits. Thus, recent initiatives to curb collective bargaining serve as both the motivation for this essay and its research design.

I explore how a ban on collective bargaining in public-school districts impacts teacher compensation, student-teacher ratios, and student test scores. Specifically, I evaluate the effects of a 2011 law in Tennessee that replaced teachers' previously held right to collectively bargain with a "meet and confer" arrangement. The law allows teachers and administrators to formally discuss working conditions, but school districts are no longer required to negotiate contracts with the Tennessee Education Association. Importantly, not all school districts engaged in collective bargaining prior to 2011. In 2010, Tennessee hosted 136 traditional K-12 public-school districts, 91 of which collectively bargained, while 45 did not. Within-state variation in bargaining status allows for a differences-in-differences (DID) research design. I compare outcomes in districts that once bargained

[5]See Mas (2014), Munnell (2012), and National Council on Teacher Quality (2011) for a discussion of these developments.

– the "treated" districts – to outcomes in districts that never bargained – the "control" districts – before and after the policy change.

I draw on the personnel records of nearly 70,000 classroom teachers over a period of six years, combined with district-aggregate data from 2006 to 2015 on staffing, student test scores, and financial characteristics. I find that the ban on collective bargaining enhanced teacher employment at the expense of compensation, and had large effects on the unions themselves. Teacher salaries grew one percentage-point less, cumulatively over five years, while employer-paid health insurance premiums grew five percentage-points less over the same period. As school-district administrators slowed the growth of compensation, they also decreased student-teacher ratios by half a student. Whereas the effect on compensation had stabilized by 2015, student-teacher ratios are still on a downward trajectory. Student test scores appeared unchanged as of 2014, but the estimates are too imprecise to rule out small improvements. Meanwhile, Tennessee's teachers' unions suffered a rapid loss of revenue since they can no longer require school boards to automatically deduct union dues from teacher paychecks. If smaller coffers inhibit union lobbying, then the prohibition of bargaining may affect local school board elections and policies set by the State Legislature.

The remainder of this paper proceeds as follows. Section 2 sets the context for de-unionization in Tennessee. Section 3 outlines the conceptual framework underlying the analysis. Section 4 introduces the data and formalizes the differences-in-differences research design. Section 5 presents the main results: union revenue, teacher salaries, teacher health insurance premiums, and class size. Section 6 reports suggestive results: student test scores, total expenditure, and teacher turnover. Section 7 discusses how waning political influence could affect teachers in the future. Section 9 displays the main figures and tables referenced in the text. A separate, online appendix contains detailed summary statistics and supplementary analyses.

For ease of exposition, I refer to districts that collectively bargained in 2010 as "unionized." Tennessee is a right-to-work state where teachers elect to join the union irrespec-

tive of their employer. Most public-school data in Tennessee are reported over school years rather than calendar years. I indicate school years by the calendar year of the fall semester. Hence, the 2009-10 school year becomes 2009.

2 A Natural Experiment in Tennessee

For 32 years, teachers in Tennessee determined their own bargaining status with district-specific union certification elections (Education Professional Negotiations Act of 1978). Certification persisted until the local school board could demonstrate union membership below 50 percent. If Tennessee resembled Midwestern states, most districts would have held elections during the 1980s and 1990s, the results of which still determined collective bargaining status years later (Lovenheim, 2009). Indeed, certification data from the Tennessee School Boards' Association shows nearly constant bargaining status after 2007.[6] As a result, two-thirds of Tennessee's 136 traditional public-school districts collectively bargained in 2010, while the remaining one-third did not.[7] Figure 1 shows how the unionized and non-unionized districts were scattered across the state.

The 1978 collective bargaining law mandated a procedure for labor negotiations. District managers and union representatives each proposed an ideal contract and engaged in "reasonable efforts to reach agreement." Teachers were prohibited from going on strike. If compromise proved elusive, either side could request assistance from the Federal Mediation and Conciliation Service. After mediation, either side could ask the American Arbitration Association to designate a non-binding, fact-finding, advisory arbitrator. The arbitrator was permitted to publicly announce his/her recommendations. The law required district administrators to negotiate salaries and fringe benefits (with the exception

[6]Neither the Tennessee Department of Education nor the Tennessee School Boards' Association possess historical data on union certification. The Tennessee Education Association did not respond to my requests for assistance. The Tennessee School Boards' Association provided data on bargaining status from the 2007-08 school year to the 2010-11 school year. Two districts changed status between 2007-08 and 2008-09: Fayette County Schools de-certified (student enrollment around 3,500) and Rogersville City Schools unionized (student enrollment around 600). Changing the classification of these two districts does not affect the results.

[7]The district count excludes charter school districts and schools that exclusively serve children with disabilities.

of the Tennessee Consolidated Retirement System, a state-administered defined-benefit pension) working conditions, leaves of absence, student disciplinary procedures, grievance procedures, and payroll deduction of union dues. Union contracts remained in effect for a maximum of three years. I examined 15 union contracts that were still readily available online in the fall of 2016.[8] All stipulated that negotiations should recommence before the current expiration date. However, one also indicated that the current agreement hadn't been reached until after the prior contract had expired.

Teacher compensation and working conditions were still fairly rigid in the non-unionized districts, even absent negotiated contracts. In 2010, all school districts in Tennessee paid teachers according to salary schedules (matrices) that rewarded teaching experience and highest-degree earned.[9] Wage rigidity is partly due to a legislated, state-wide Minimum Salary Schedule set annually by the Tennessee State Board of Education. Similarly, the Tennessee Legislature determines pension benefits, tenure laws, minimum class sizes, and school performance benchmarks.

2.1 Collective Bargaining Replaced with Meet and Confer

In 2011, the Tennessee State Legislature prohibited collective bargaining in traditional K-12 public-school districts (Professional Educators' Collaborative Conferencing Act). As a result, school-district administrators became the sole arbiters of labor disputes. The prohibition of bargaining still provides a formal mechanism through which teachers and administrators meet to discus salaries and benefits. Teachers within each district decide by referendum to confer with administrators, electing a representative body that may include traditional union negotiators. However, teacher representatives are not allowed to discuss school staffing or payroll deduction of union dues. Existing union contracts

[8]Blount County (2009-11), Cumberland County (2010-13), Dickson County (2010-13), Franklin County (2010-13), Hawkins County (2010-13), Heywood County (2009-12), Macon County (2011-14), McMinn County (2010-13), Metropolitan Nashville (2009-10), Obion County (2010-13), Rhea County (2009-11), Sevier County (2005-09), Sullivan County (2010-11), Sumner County (2009-12), and Trenton SSD (2008-11). Contracts available from the author upon request.

[9]The Tennessee Education Association posts these schedules on its website. Historical schedules from 2005 through 2009 are recoverable through the Internet Archive (`https://archive.org/web/`).

persist until their scheduled expiration dates, with the exception of "re-opener" clauses, which faced legal dispute (White, 2011).[10] As of September 2015, the Tennessee School Boards' Association knew of collaborative conferencing in 16 districts.[11]

The Tennessee State Legislature introduced its ban on bargaining in January of 2011. Republicans had just gained control of the Governorship, State House and State Senate for the first time since the late 1800s, running on a platform of fiscal restraint (Santos, 2010). The new governor, Bill Haslam, prioritized implementation of First to the Top education reforms enacted under the previous administration (discussed in Section 2.2).[12] This environment emboldened the Tennessee School Boards' Association to suggest de-unionization – a long-standing desire – to state senators (Gibbons, 2012). Governor Haslam signed the law prohibiting bargaining in June of 2011, effective immediately.

Political actors describe the prohibition as a conflict between children's interests and politicians' careers. Proponents of de-unionization claim that rigid contracts prevented school boards from implementing performance-enhancing compensation and management practices: "Reform after reform has been refused or dismantled. The barrier that has prevented us from putting the best possible teacher in every classroom will soon be removed" (Tennessee Lt. Governor Ron Ramsey, 2011). Opponents argue that anti-union laws help election coffers rather than teachers and students: "Its sponsors only care that TEA endorsed legislators [...] who happen to be Democrats" (Al Mance, Executive Director of the Tennessee Education Association, 2011). Supporters and opponents alike rallied around the Tennessee State Capitol in 2011 amid significant local media coverage.

The prohibition of bargaining likely affected some outcomes with a time lag, while others could have changed in anticipation of the law. Compensation was relatively inflexible until existing collectively-bargained contracts expired. School boards could not reduce salaries below those specified in the union contract, but could freeze salaries by refusing to reopen grandfathered contracts. In contrast, teachers might have altered their pedagogy

[10] Re-opener clauses require annual renegotiation of a multi-year contract.
[11] Email communication with the Tennessee School Boards' Association (2015).
[12] "Bill's Priorities" official profile on `www.tn.gov`, archived by the Wayback Machine.

and turnover at the very threat of de-unionization. Anticipation effects could therefore appear as early as November, 2010, when the state political climate shifted against the Tennessee Education Association.

2.2 Concurrent Changes to State Education Policy

The prohibition of bargaining took effect in a newly high-stakes environment for teachers. In 2010, the Tennessee State Legislature enacted education reforms to comply with a Federal Race to the Top grant (Tennessee First to the Top Act). The reforms provide for State oversight of persistently low-achieving schools, and mandate annual teacher performance evaluations based on Teacher Value-Added Scores (35 percent), school-aggregate performance (15 percent), and qualitative classroom observations (50 percent).[13] Teacher tenure became contingent on these evaluations in 2011 (Chapter 70 of the Public Acts of 2011). To receive tenure, novice teachers must wait five years, rather than three, and earn positive evaluations in the last two years. Teachers granted tenure prior to 2011 enter probation if they receive negative evaluations for two consecutive years.

So as not to conflate the effects of First to the Top with de-unionization, I exclude districts at risk of State intervention from the analysis. Specifically, the Tennessee Department of Education designated "priority" schools in six districts between 2010 and 2014 – five bargaining districts and one non-bargaining.[14] Teacher evaluations are less of a concern because aggregate district performance was already well known, and few teachers lose tenure due to poor test scores. School- and district-aggregate Value-Added scores have been calculated by the Tennessee Department of Education since the late 1990s and are widely disseminated on *District Report Cards*. Meanwhile, district administrators use the qualitative portion of teacher evaluations to reduce disparities in the quantitative portion (Tennessee Department of Education 2012, 2014, and 2016). Kraft and Gilmour (2016)

[13]Teacher Value-Added measures student test-score gains over time, and ascribes systematic gains within a class to teacher quality. See Chetty et al. (2014a and 2014b) and Tennessee Department of Education (2015) for a detailed explanation.

[14]Hamilton County, Hardeman County, Knox County, Jackson-Madison County, Memphis City, and Nashville-Davidson County. "Priority" designations are posted on the website of the Tennessee Department of Education.

indicate that 11 percent of teachers received negative evaluations in 2014-15. This is an upper-bound during the period of my analysis because teacher evaluations have been worsening over time (Tennessee Department of Education, 2016).

The most recent change to State education policy occurred in 2013, when the Tennessee State Board of Education revised its State Minimum Salary Schedule to reduce salaries for senior teachers and those with graduate degrees. The State Legislature responded by allocating fewer equalization funds for teacher salaries. I will show in Section 5 that State funding dropped equally in unionized and non-unionized districts.

3 Conceptual Framework

What changes should we expect from a ban on collective bargaining? The Tennessee Education Association and its local affiliates once engaged in three primary activities. First, they negotiated labor contracts with local school boards. Second, they supported members with legal assistance in cases of contract dispute. And, third, they engaged in political activities to advance members' interests with local school boards and the State Legislature. In 2009, the four largest expenditures of the Tennessee Education Association were: compensation and travel for employees (77 percent, including negotiators, lobbyists, and the Association President), legal services (three percent), government relations (three percent), and activity by its Political Action Committee (two percent).[15]

By banning union contracts, de-unionization eliminates the first of these activities and largely obviates the second.[16] Prior studies typically expect union contracts to increase the monetary compensation of covered teachers, but disagree as to magnitude. Three quasi-experiments examine the passage of state laws permitting collective bargaining in school districts during the 1960s, 1970s, and 1980s. Hoxby (1996) finds that unionization increased teacher salaries by five percent; in contrast, Lovenheim (2009) and Frandsen

[15]Tennessee Education Association (2010).

[16]Of course, the union may still take legal action over non-contracted grievances. For example, the Tennessee Education Association recently lost a suit against the Knox County School Board over the use of Teacher Value-Added scores in evaluations (Sawchuk, 2016).

(2016) see no increase in teacher salaries.[17] Glaeser and Ponzetto (2014) expect union contracts to enhance pensions and health insurance because benefit costs are opaque to taxpayers. Lacking historical data, neither Hoxby, Lovenheim, nor Frandsen consider benefits. Similarly, studies of the private sector often assume that union negotiators cater to the preferences of the median voter in representation elections (Farber, 1978; Grossman, 1983; and Lee and Mas, 2012). This assumption implies that senior teachers capture the benefits of association. Unfortunately, the aggregate salary data employed by prior studies do not differentiate based on seniority.

Efforts to pin down the causal relationship between union contracts and employment protections face greater challenges. If teachers negotiate class size, then union contracts should increase the number of teachers and decrease the student-teacher ratio.[18] Yet, districts could also respond to elevated union salaries by hiring fewer teachers. Hoxby (1996) shows a nearly two-student *decrease* in the student-teacher ratio, while Lovenheim (2009) finds no change.[19] Union grievance procedures may prevent school boards from terminating low-productivity teachers, or force districts to rigorously screen novice, untenured teachers who are often less protected (Han, 2013).

The effect of union contracts on student achievement is also ambiguous, ex-ante. Rising compensation should attract talented teachers, but the effect may be mitigated if raises only accrue to senior colleagues (Nagler et al., 2015). Small classes improve student test scores and long-run outcomes, but protecting low-quality educators from termination hurts achievement (Chetty et al., 2014b; Angrist and Lavy, 1999; Chetty et al., 2011; Fredriksson et al., 2013). Collective bargaining leads to a three-percentage-point increase in the dropout rate in Hoxby's (1996) analysis, whereas Lovenheim (2009) reports no change. In subsequent work, Lovenheim and Willén (2016) argue that unionization reduces students' long-run earnings.

[17] However, the standard errors on both sets of estimates are too large to rule out very small increases.

[18] The 2010-13 Memorandum of Understanding negotiated between Cumberland County Schools and the Cumberland County Education Association is an example in Tennessee.

[19] Lovenheim (2009) estimates the percent change in the student-teacher ratio. The 95-percent confidence interval on his estimate ranges from a two-percent increase to a five-percent decrease.

Many studies document how teachers' unions attempt to sway education policy beyond the negotiating table. Local school boards and the State Legislature are all elected, prompting union campaign contributions, get-out-the-vote initiatives, and lobbying (Freeman, 1986; Hess and Leal, 2005; Moe, 2011; and Zax and Ichniowski, 1988). Political influence may be an important determinant of labor-market outcomes. For example, union contracts in California are more likely to restrict district management when the union is also involved in local politics (Strunk and Grissom, 2010). Participatory local budgeting favors civil servants because they are more likely to vote than private-sector taxpayers (Saiz, 2011). Police unions obtain larger wage increases than teachers, although the two professions negotiate in similar institutional environments (Frandsen, 2016). Lastly, teachers enjoy tenure and defined-benefit pensions even in southern states where bargaining has never been allowed.

The Tennessee Education Association could lose its largest source of revenue as negotiated contracts expire. De-unionization disincentivized membership and simultaneously increased the time cost of paying dues, since many union contracts provide for automatic payroll deduction.[20] I present evidence of a decline in union revenue that is consistent with a political role for negotiated contracts. Smaller, weaker unions may lose influence over local school boards and state legislators.

I seek to arbitrate between conflicting models of union influence in public schools. Of course, the research design has limitations. I only examine the short run, and the control group is not entirely isolated from de-unionization. In addition to experiencing political fallout, the non-unionized districts no longer face a union threat and may freeze compensation alongside unionized districts. Relatedly, all districts compete in a local labor market for teachers. Those located in the same region might set compensation in relation to each other so as to recruit and retain talented staff. As wages decline in unionized districts, non-unionized neighbors follow suit. For these reasons, I may underestimate the degree to which de-unionization affects teacher compensation and employment.

[20]Of the 15 collectively bargained agreements that I examined, all require employers to allow payroll deduction of union dues, and several default teachers into automatic deduction.

4 Data and Summary Statistics

4.1 Sample Selection and Data Sources

The analysis sample contains all traditional public-school districts in Tennessee that: 1) operated continuously between 2006 and 2014, and 2) did not contain any "priority" schools that could become subject to State oversight under First to the Top.[21] Since priority schools are more likely to be located in metropolitan areas, this sample restriction excludes the four largest cities in Tennessee – Nashville, Memphis, Knoxville, and Chattanooga. Ultimately, the analysis sample tracks 87 unionized and 42 non-unionized districts from 2006 to 2015.

The Tennessee Department of Education (TDE) provided most of the data for this study. Teacher personnel records follow 68,240 classroom teachers in the analysis districts from 2009 to 2014. These records contain: salary received in a given year (including base pay, supplements for extra duties, and bonus pay), years of full-time-equivalent teaching experience credited on the State teaching license, highest academic degree earned, grade assignment, and district where employed.[22] I supplement the personnel records with district-aggregate data from multiple sources, available from 2006 to 2015. The Tennessee State Board of Education (TSBE) publishes annual compensation data in *Basic Education Program Review Committee Annual Reports*. The TSBE collects official salary schedules from each district and calculates the average scheduled salary in that district, weighting the individual salary "cells" by the fraction of teachers across the entire state who have the requisite experience and education. Similarly, the TSBE calculates the average health insurance premium paid by a local school board, on behalf of its teachers, across three

[21] The main sample omits Davidson County Schools (Nashville), Hamilton County Schools (Chattanooga), Hardeman County Schools, Knox County Schools (Knoxville), Jackson-Madison County Schools, Memphis City Schools, and Shelby County Schools. I drop Carroll County Schools because the district enrolls between two and ten students over this period. The Tennessee Department of Education provides an annual list of "priority" schools on its website.

[22] I collapse the data to observe each teacher only once within a district in a given year. Teachers filling multiple positions within a district in a given year (administrative or teaching) are assigned their total salary across all positions, but are categorized by the position that contributes most to their total salary. In the analysis sample, only 619 teachers fill multiple positions within a district in the same year.

plan types: PPO, POS, and HMO. The individual premiums are weighted by the fraction of teachers who participate in each plan type among all teachers in the state.

The Tennessee School Boards' Association supplied a list of the districts that collectively bargained in 2010. The TDE publishes *Annual Statistical Reports* with basic financial, demographic, and staffing information for each school district. I rely particularly on average daily membership (ADM), which measures the average number of students enrolled in the district over the school year. I also frequently reference the number of full-time-equivalent classroom teachers, which sums total teaching hours in a district and divides by the number of teaching hours clocked by a typical full-time teacher, as determined by the State. Full-time-equivalent teacher counts correlate quite strongly with a simple count of teaching staff in the personnel records.[23] Likewise, the TDE provided aggregate student test scores from 2006 to 2014.[24] These data record mean and median scores on the standardized Tennessee Comprehensive Achievement Program by district, grade, and subject. The Tennessee Comptroller of the Treasury publishes *Tax Aggregate Reports of Tennessee* that list total appraised residential property value in each district. Lastly, the U.S. Census Bureau tabulates school-district-level demographic information for all residents of Tennessee based on the decennial Census. To judge the level of urban development in a school district, I divide total population by land area measured in 2010.

Large non-profit organizations, including labor unions, report revenues and expenditures to the Internal Revenue Service on Form 990. Non-profits with fewer than $50,000 in gross receipts may also choose to file. I gathered information on unions in Tennessee from Form 990 Reports published online by the National Center for Charitable Statistics at the Urban Institute. My sample includes public-sector unions that filed Form 990 every year between 2006 and 2013 (the last year of data available): 12 affiliates of the National Education Association or American Federation of Teachers (bargaining teachers' unions); 9 professional associations for K-12 management; 17 police unions, and 12 fire-

[23]The correlation is 0.999. I replace Fayetteville City's full-time-equivalent count in 2010 with personnel records because of an error in the *Annual Statistical Report*.

[24]Unfortunately, Tennessee did not administer the exam in 2015.

fighter unions.

4.2 Summary Statistics

Table 1 compares mean characteristics of the unionized and non-unionized districts – weighted by size – while Online Appendix A presents detailed summary statistics. The two groups appear to be similar with a few notable exceptions. The unionized districts enrolled substantially more students, but are located in less urban areas. Unionized districts are more likely to serve an entire county, whereas non-unionized districts mostly serve individual cities or special service areas within a county. The unionized districts enjoyed slightly fewer financial resources, largely due to Tennessee's tax structure, which allows cities to levy property taxes on top of county-wide taxes. Aggregate student test scores were also slightly lower in the unionized districts. I convert the raw exam results to z-scores by subtracting the state-wide mean in 2010 from the district-aggregate score, within each grade and subject, and then dividing by the state-wide standard deviation in 2010.

My DID design assumes that outcomes in unionized and non-unionized districts would have trended similarly absent the ban on bargaining. Of particular concern in this context, large urban districts and small rural districts may experience the financial crisis of 2008 differently. To illustrate, Online Appendix Figure A1 highlights the positive relationship between 10-year growth in student enrollment (2005-15) and average daily membership in 2000. Districts in the top third of the enrollment distribution grew by two percent, on average, while those in the bottom third contracted by two percent. Migration from small to large school districts could produce a spurious correlation between unionization and student enrollment. For this reason, all of the analyses control flexibly for average daily membership in 2000. I test the sensitivity of the DID estimates to these controls and show that the results do not change if I also control for district population density. As a further robustness check, I replicate the analysis on a "small" robustness sample that excludes all districts enrolling more than 6,500 students in 2000 – the largest non-

unionized enrollment. Online Appendix Tables A1-A5 display summary statistics for this smaller sample; small unionized districts are increasingly rural.

Table 1 reveals that teachers in the unionized districts had one fewer year of licensed teaching experience in 2009, on average, and earned slightly lower salaries. School districts in Tennessee receive annual equalization funds from state appropriations.[25] The formula to fund teacher salaries is based on the State Minimum Salary Schedule. Most school districts pay teachers with a combination of state equalization revenue and local property taxes. In 2009, districts supplemented each teacher's state-paid salary with \$5,000-\$6,000 of local funds, on average (Online Appendix Table A3). Online Appendix Figure A2 shows that most teachers earned at least \$30,000 in 2009, but that some received significantly less. Since a first-time teacher holding a Bachelor's degree was entitled to a legislated minimum salary of \$29,215 in 2009, I infer that teachers earning below this amount work part-time or part-year. Online Appendix Figure A3 supports this supposition: teachers who earn less than the State Minimum Salary tend to be novices or seniors preparing for retirement.

Turnover is high among novice teachers, decreasing notably around 10 years of experience, and rising again as teachers gradually become eligible for retirement (Online Appendix Figure A5). Teachers participate in the Tennessee Consolidated Retirement System, a State-administered defined-benefit pension that permits retirement at age 60 with 10 years of tenure, or at any age with 30 years of tenure (Tennessee Consolidated Retirement System, 2009-15). Benefit levels and pension contributions (both employer and employee) are mandated by the State Legislature. Districts, however, choose health insurance plans for currently employed teachers.

[25] The Basic Education Program.

4.3 Dynamic Differences-in-Differences Model

Equation (1) below serves as a baseline specification for my empirical analysis.

$$Y_{i,d,t} = \alpha + \boldsymbol{Year_t} + \boldsymbol{District_d} + \boldsymbol{\beta}(\boldsymbol{Year_t} Union_d) + \boldsymbol{Year_t} ADM_d + \epsilon_{i,d,t} \qquad (1)$$

$Y_{i,d,t}$ is the outcome of interest for teacher i in district d in year t. $\boldsymbol{Year_t}$ denotes a vector of year fixed effects that includes 2006 through 2014, with 2010 as the omitted year. $\boldsymbol{District_d}$ represents a vector of district fixed effects; I identify the impact of de-unionization from within-district changes in outcomes over time. To this end, define $Union_d$ as a dichotomous indicator for bargaining status pre-2011; it varies across districts, but not over time. The interaction of $\boldsymbol{Year_t}$ and $Union_d$ allows for a union premium (or penalty) that changes over time. I label these DID estimators $\boldsymbol{\beta}$. As discussed above, the interaction of average daily membership in 2000, ADM_d, with the year fixed effects controls flexibly for urbanization.[26] I estimate Equation (1) using Ordinary Least Squares; all regressions report robust standard errors clustered at the district level.

I periodically examine how the effect of de-unionization varies by subgroup. In these instances, I introduce an additional set of multiplicative terms to Equation (1), multiplying an indicator variable for subgroup participation with the DID estimators and year fixed effects. Linear combinations of $\boldsymbol{\beta}$ and the resulting differences-in-differences-in-differences (DDD) estimators test for an effect of prohibition among unionized subgroup teachers relative to their non-unionized subgroup peers. Results Section 5 explains each of these subgroup regressions in detail.

[26] The results are unchanged if I control instead for the log of average daily membership.

5 Main Results

5.1 Union Revenue

A sharp reduction in union revenue signals that the prohibition of bargaining took effect as intended. As discussed in Section 4.1, union revenue in Tennessee is reported to the Internal Revenue Service on Form 990. For ease of interpretation, I adjust revenue to account for different fiscal year-ends across the sample of unions – year-ends occur in nearly every month. I put all unions on a similar timeline by creating a weighted average of current and prior-year revenue, where the weights reflect the number of months that the union's fiscal year exceeds March (the earliest fiscal year-end in the data). For example, a union whose fiscal year ends in May receives 10/12 of current-year revenue and 2/12 of prior-year revenue. Table 2 summarizes the size of the unions in my sample.

Figure 2 plots total revenue across different sectors, as a fraction of total revenue earned by the sector in 2010. Teachers' unions steadily increased revenue collection until 2011, when receipts began to decline. By 2013, teachers' unions collected approximately 25 percent less revenue than they received in 2010. The prohibition of collective bargaining probably caused this sharp decline, since other sectors experienced 10 to 20 percent growth in total revenue over the same period. The Tennessee Education Association and its affiliates charged approximately $250 per year in dues between 2010 and 2016 (Tennessee Education Association, 2010-16). A 25 percent drop in revenue implies that more than 10,000 teachers quit union membership between 2010 and 2014.

Figure 3 replicates the analysis for two teachers' unions whose last collectively bargained contracts I was able to find online.[27] Both unions experienced a substantial reduction in real revenue after 2011, but contract expiration dates alone do not fully explain the setback. The union whose contract expired on June 30, 2013 lost 20 percent of real revenue by March, 2014. The union whose contract expired on June 30, 2012 lost 80 percent of real revenue by March, 2013. Union funding appears to be influenced by

[27] Union names are withheld at the request of the National Center for Charitable Statistics.

union-employer relations. For example, the union whose contract expired in 2012 was engaged in legal conflict with the local school board.[28]

5.2 Teacher Salaries

This section examines the generosity of teacher salaries. I estimate Equation (1) with log of annual salary as the dependent variable. Recall that salary includes not only base pay, but also supplements and bonuses. The district's salary schedule is typically announced during the spring or summer before the school year begins, so that de-unionization should gradually affect outcomes beginning in 2011. I focus on full-time classroom teachers by removing those earning below the State Minimum Salary.[29] Experience dummy variables and highest-degree-earned dummy variables removes bias from changes in demographic composition. I drop teachers with more than 30 years of experience since Online Appendix Figure A4 shows that so few persist beyond this point.[30]

Figure 4 displays cumulative salary growth as predicted by Equation (1), controlling for teacher demographics and district size. By 2014, nominal salaries in the non-unionized districts had risen by six percent, whereas salaries in the unionized districts had risen by five percent. DID estimates of the difference in growth are presented in the first column of Table 3. The one-percentage-point difference in cumulative growth is both statistically significant and economically small. Ninety-five percent confidence intervals rule out even a three-percentage-point difference in cumulative growth. Replacing district with teacher fixed effects in column 2 does not change the story, but columns 3 and 4 show that the effect of de-unionization depends on district size. Removing the enrollment controls or limiting the sample to districts with 6,500 or fewer students in 2000 substantially attenuates my estimate.

[28]References withheld to protect confidentiality, but available from the author upon request.

[29]I exclude principals, supervisors of instruction, vocational teachers, substitute teachers, and home/hospital instructors.

[30]Teaching experience is occasionally unreliable in the data. A few teachers are credited zero years of experience in the year that they are hired, only to receive more than one the following year. Additionally, experience is missing for 2,835 teacher-year observations. I infer the correct experience from years prior or post. I also exclude teachers whose highest degree I cannot determine or who do not hold a Bachelor's degree – less than half of a percent of all teacher-year observations.

To better understand the relationship between de-unionization and district size, define an indicator variable – $Subgroup_{d,t}$ – equal to one if the district enrolled fewer than 4,000 students in 2000. In the main sample, 43 of 87 unionized districts enrolled so few students, while 36 of 42 non-unionized districts did so. In the "small" robustness sample, 43 of 62 unionized districts enrolled 4,000 or fewer. Equation (2) interacts the small-district indicator variable with the year dummy variables and DID estimators in Equation (1):[31]

$$\begin{aligned} Y_{i,d,t} =& \alpha + \boldsymbol{Year_t} + \boldsymbol{District_d} + Subgroup_{d,t} + \boldsymbol{Year_t} Subgroup_{d,t} \\ &+ Union_d Subgroup_{d,t} + \boldsymbol{\beta}(\boldsymbol{Year_t} Union_d) + \boldsymbol{\gamma}(\boldsymbol{Year_t} Union_d Subgroup_{d,t}) \\ &+ \boldsymbol{Year_t} ADM_d + \epsilon_{i,d,t} \end{aligned} \quad (2)$$

The vector of DID coefficients $\boldsymbol{\beta}$ compares large unionized districts to their large non-unionized counterparts, while the linear combination of $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ contrasts outcomes among small unionized and non-unionized districts.

Figure 5 shows clearly that de-unionization had a larger effect on salaries in the large districts. Salaries in the large non-unionized districts increased by seven percent between 2010 and 2014, whereas salaries only increased by five percent in the large unionized districts. Meanwhile, salaries in the small districts grew by five percent over this period, regardless of unionization (Figure 6). Columns 1 and 2 of Table 4 confirm that the two-percentage-point penalty among large districts is both statistically significant and statistically different from the effect of de-unionization on small districts. This result persists in the "small" robustness sample, suggesting that the relationship between de-unionization and size is not driven entirely by the very largest districts. Online Appendix Table B1 reveals similar results if I replace the level enrollment controls with either log enrollment, level or log district population density, or a combination of enrollment and density. The results are also similar if I remove the enrollment controls altogether.

[31] The regression drops $Subgroup_{d,t}$ and $Union_d Subgroup_{d,t}$ because they are co-linear with the district fixed effects. I leave them in the written version of Equation (2) for consistency with later subgroup regressions.

Small average effects could mask a larger penalty among senior teachers. I test this hypothesis with two variants of Equation (2). In the first, I change the subgroup indicator, $Subgroup_{i,d,t}$, to equal one if the teacher has no more than 10 years of teaching experience – the median level of experience in the data. The results are displayed in columns 3 and 4 of Table 4. I find that senior teachers fare similarly to their junior colleagues in both the main sample and the "small" robustness sample. While one might worry about bias due to the selection of senior (or junior) teachers into urban school districts, Online Appendix Figure A7 reveals no substantial experience differences across large and small districts.

As an additional test of the seniority hypothesis, I redefine the subgroup indicator to equal one if the teacher's current salary falls in the bottom half of her district's annual distribution of salaries. Equation (2) now compares the effect of de-unionization at different points of the district's wage distribution. Results in columns 5 and 6 of Table 4 are similar to those by absolute seniority. I find no systematic evidence that teachers whose salaries fall in the top half of their district's wage distribution fare worse from de-unionization than teachers whose salaries fall in the bottom half of the annual distribution. Rather, de-unionization seems to penalize most teachers in large districts.

The remainder of this section reports the results of two placebo tests. First, I confirm that the seeming "de-unionization penalty" is not a preexisting trend toward lower salaries in districts that once bargained. Instead of personnel records, I analyze district-level data on average scheduled salaries published by the Tennessee State Board of Education. Each year, the TSBE collects official salary schedules from every district and calculates an average scheduled salary. The individual salary "steps" that contribute to the district mean are weighted by the percent of teachers in the entire state who have the requisite teaching experience and education. I estimate Equation (1) at the district level, with log of average scheduled salary as the dependent variable. For comparability with the teacher-level analysis, I weight the regressions by the number of full-time-equivalent teachers currently in the district. Online Appendix Table B2 is reassuring: scheduled salaries trend similarly before 2011, DID estimates from 2009 through 2014 are similar to those found

using personnel records, and the difference in relative wages appears to have stabilized by 2015.

As a second placebo test, I look for an effect of de-unionization on the portion of teacher salaries that is paid by state equalization funds. The loss of union contracts could have an effect on state-paid salaries, since, with minor exceptions, equalization funds are not strictly earmarked. However, the state does suggest uses for the funds it allocates, and I hypothesize that the state-funded portion of teacher salaries is much less sensitive to collective negotiation. I set the log of state-paid salary as the dependent variable in a teacher-level version of Equation (1). As before, I control for the experience and education of teachers, since these characteristics determine the level of state funding. The placebo DID estimates in Online Appendix Table B3 are economically small and statistically insignificant regardless of sample or controls for district size.

5.3 Employer Cost of Teachers' Health Insurance

Many observers of collective bargaining contend that teachers' unions enhance fringe benefits more effectively than salaries. Data limitations compel me to focus on health insurance premiums as a measure of benefit generosity; specifically, I consider the weighted average premium paid by local school boards on behalf of teachers. If school boards decrease the employer cost, then teachers must either pay more for the same benefits or receive reduced benefits. Figure 7 displays the average effects estimated by Equation (1). For comparability with the salary regressions reported in Section 5.2, I weight the insurance regressions by the number of full-time-equivalent teachers employed by the district in each year.[32]

Employer premiums were rising rapidly in the non-unionized districts until 2014, when they began a steady decline. However, premiums in the unionized districts stabilized earlier, so that by 2015, de-unionization had reduced employer costs by five percentage

[32]The employer premiums are missing in 2010 because the Tennessee State Board of Education did not published updated data.

points relative to the non-unionized districts. Since the average employer paid $6,308 for health insurance in 2009, a five-percentage-point reduction implies that employers saved around $300 per teacher. Although the small number of districts prevents me from estimating separate DID coefficients by district size, I infer differential effects by re-estimating Equation (1) with each district granted equal weight. Column 2 of Table 5 reveals that small districts again reacted much less to de-unionization. However, we should note that the very largest unionized districts drive much of this result, and these districts have no clear non-unionized counterparts for comparison. Restricting the sample to districts with 6,500 or fewer students in 2000 weakens the estimated effect considerably, even with teacher weights (column 3).

5.4 Staffing Levels and Student Enrollment

Since teachers' unions can enhance the size of the workforce by contracting on student-teacher ratios, we might expect school boards to cut back on teacher employment after union contracts expire. Alternately, local school boards might respond to lower salaries with increased demand for teachers. I define the student-teacher ratio as the average daily membership divided by the number of full-time-equivalent classroom teachers. In order to examine trends prior to 2009, I rely on district-aggregate data published in the *Annual Statistical Report of the Department of Education*. I estimate Equation (1) at the district level, setting student-teacher ratio as the dependent variable. Again, I weight the regressions to determine whether large and small districts reacted differently. Weighting by the average daily student membership in 2000 estimates how an average pupil experienced de-unionization, instead of an average school board.

By 2015, most pupils in the unionized districts enjoyed classes that were half a student smaller, on average, relative to counterparts in the non-unionized districts (Figure 8). Unlike teacher compensation, class sizes were still reacting to de-unionization in 2015 and may decrease further. Unsurprisingly, the very largest districts appear to drive this result. The district-weighted regression in column 2 of Table 6 and its neighbor in column

3, which restricts the sample to districts with fewer than 6,500 pupils in 2000, both show limited effects of de-unionization.

One can decompose trends in the student-teacher ratio into trends in student enrollment and trends in teacher hiring. Since staffing strongly depends on the number of students, I first examine whether enrollment reacts to de-unionization. Conclusions should be considered suggestive because the DID estimates are imprecisely estimated. I re-estimate Equation (1) with the log of average daily membership as the dependent variable. Unlike the analysis of student-teacher ratio, my preferred specification grants each district equal weight. Columns 1 and 2 of Online Appendix Table B4 reveal a two percentage-point decline in student enrollment, relative to the non-unionized districts, that is statistically indistinguishable from zero. In a few years, we may observe a five-percent decrease corresponding to Lovenheim (2009), or the trend may reverse if parents react positively to smaller class sizes.[33] Conversely, large districts appear to have maintained the number of full-time equivalent teachers despite the dip in enrollment (columns 3 and 4).

6 Supplemental Analyses

The results presented above raise two questions that I attempt to answer in this section. First, does de-unionization allow districts to improve student achievement without additional expenditure? And second, do teachers separate at a higher rate after the loss of bargaining rights? Claims to follow are only suggestive since the regression results are either less precise than earlier estimates or limited to the very short run.

[33] If parents did withdraw their children from unionized districts, then we could see a corresponding increase in private-school enrollment. Unfortunately, the *Private School Universe Survey* administered by the National Center for Education Statistics has not been updated beyond the 2011-12 school year. To my knowledge, this is the only comprehensive database on private schools in Tennessee.

6.1 Student Test Scores

I examine student performance on a standardized exam as a proxy for achievement. Specifically, I consider math and reading scores of children in grades three through eight on the Tennessee Comprehensive Assessment Program. The Tennessee Department of Education aggregates individual scores to the level of district, grade, subject, and year. For ease of interpretation, I normalize the raw scores by subtracting the mean of the state-wide distribution in 2010 and dividing by the standard deviation of the state-wide distribution in 2010, for each grade and subject. Thus, the unit of analysis is a standard deviation of the 2010 student distribution of scores. Note that the exam was graded on a different scale prior to 2009. We may be wary of comparing 2008 with 2009, but we may still assess trends from 2006 to 2008 and from 2009 to 2014.

I re-estimate Equation (1) including grade-by-year fixed effects for grades six through eight, since not all districts offer the higher grades. Table 7 compares the vector of DID estimates from three specifications, each of which aggregates the individual student scores differently. Column 1 considers mean scores, by district-grade-subject-year, with each observation receiving equal weight. Column 2 switches the dependent variable to median score, while column 3 reverts to mean scores, but weights the regression by the number of students in each district-grade-year. For ease of interpretation, panels (a) through (c) of Figure 9 depict the DID estimates graphically.

All three specifications suggest that de-unionization did not alter student achievement in the short run. (Columns 4 through 6 of Table 7 repeat this exercise on the "small" robustness sample of districts, with similar results). However, the point estimates are insufficiently precise to rule out small improvements. As a benchmark, consider the Tennessee STAR experiment that ran between 1985 and 1989. This project randomly assigned young students in Tennessee to classes with seven fewer students than normal. Participation in a small class for one year increased student test scores by approximately 0.2 standard deviations (Krueger, 1999; and Mosteller, 1995). Based on these results, we might expect test scores to improve by 0.01 to 0.02 standard deviations after de-

unionization, since class sizes decreased by half a student, on average. Effects of this magnitude are within the confidence intervals depicted in Figure 9, particularly when the DID estimates are weighted by the number of students taking the exam.

Online Appendix Table B5 performs an additional series of sensitivity tests. As before, the first three columns report on the main analysis sample, while the last three limit the sample to districts with 6,500 or fewer students in 2000. Columns 1, 2, 4, and 5 examine math and reading scores separately to check for differential trends by subject matter. Columns 3 and 6 control for the annual percent change in the number of test takers, lest trends in enrollment subtly alter the socioeconomic composition of union districts. None of these alternate specifications contradict the main finding.

6.2 Total Expenditure

Overall, de-unionization appears to shift expenditure from compensation to employment. Do school administrators cut other types of spending? I use Equation (1) to examine the log of total current operating expenditure per-pupil, weighting each observation by the average daily membership in that year. Figure 10 shows that per-pupil expenditure has either remained constant or increased after de-unionization (detailed results presented in Online Appendix Table B6). Since this result is insensitive to both the weighting of the regression and the sample of districts, I conclude that de-unionization probably had no effect on per-pupil expenditure in the short run.

6.3 Teacher Turnover

Several factors suggest that de-unionization should increase teacher turnover in Tennessee. Teachers in unionized districts may seek alternate uses for their time as salaries decline relative to non-unionized districts. Additionally, with termination and grievance procedures no longer subject to union oversight, district managers can more easily remove low-productivity staff. I create a binary, teacher-level indicator for leaving one's current

district at the end of the school year, and estimate Equation (1) as a linear probability model using Ordinary Least Squares.

I find no short-run effect of de-unionization on the probability of separation. The DID estimates in column 1 of Table 8 never exceed one percentage point, are precisely estimated, and are quite stable across specifications. Column 2 of Table 8 removes the student enrollment controls while column 3 limits the sample to districts with 6,500 or fewer students in 2000. Neither of these sensitivity tests contradict the null finding.

7 Discussion

Political efforts to de-unionize education are gaining momentum in many states. Yet, the effect of union activity on K-12 public schools remains poorly understood. In this paper, I examine how teacher labor markets in Tennessee reacted to a 2011 ban on collective bargaining. I employ a differences-in-differences research design, comparing districts that once bargained to those that never did, before and after the policy change.

The loss of union contracts reduced compensation and school administrators responded with increased demand for teachers. Between 2011 and 2015, salaries in unionized districts grew one percentage-point less, cumulatively, while employer contributions for health insurance premiums grew five percentage-points less, cumulatively. Student-teacher ratios fell simultaneously by half a student, relative to those in non-unionized districts. Student test scores have yet to show a response, either positive or negative, although the results are insufficiently precise to rule out small effects.

What explains such modest changes? Working conditions may adjust over a long time horizon, with correspondingly slow effects on student achievement. The ban on collective bargaining took effect during the 2011-12 school year, with grandfathered contracts expiring as late as 2013. Although salaries and health insurance premiums had stabilized by 2015, student-teacher ratios may continue to decline today. Additionally, I assume that districts were unaffected by de-unionization if they were not bargaining prior to 2011.

Yet, school districts in Tennessee might all interact in equilibrium, competing for workers and students by enacting similar compensation and workforce policies.

Alternately, state politics may be an important mechanism through which public unions influence the civil service. Tennessee's teachers' unions lost at least 30 percent of their annual pre-prohibition revenue. While much of this revenue is no longer needed to support collective bargaining, some of it funds political activism at the state and local levels. Recall the official statement of the Tennessee Education Association regarding the prohibition of bargaining: "Its sponsors only care that TEA endorsed legislators [...] who happen to be Democrats" (Mance, 2011). With fewer resources in 2016, the TEA is in an undoubtedly weaker position to lobby legislative committees and donate to friendly campaigns.

Actions by the State Legislature contribute significantly to teacher salaries and working conditions across all districts in Tennessee. State appropriations fund approximately 50 percent of public-school budgets each year. The Legislature mandates teacher tenure laws and evaluation policies, along with maximum class sizes, teacher certification requirements, and performance targets on standardized exams. Assume that the prohibition of collective bargaining reduced union influence over the State Legislature by removing the funds needed to lobby. The resulting changes to State policy impact all teachers, regardless of their district's bargaining status. Yet, my differences-in-differences research design misses these effects. Political changes often phase in gradually, so that it is still too early to judge outcomes in Tennessee. There is much scope for future research on the political role of union contracts in the public sector.

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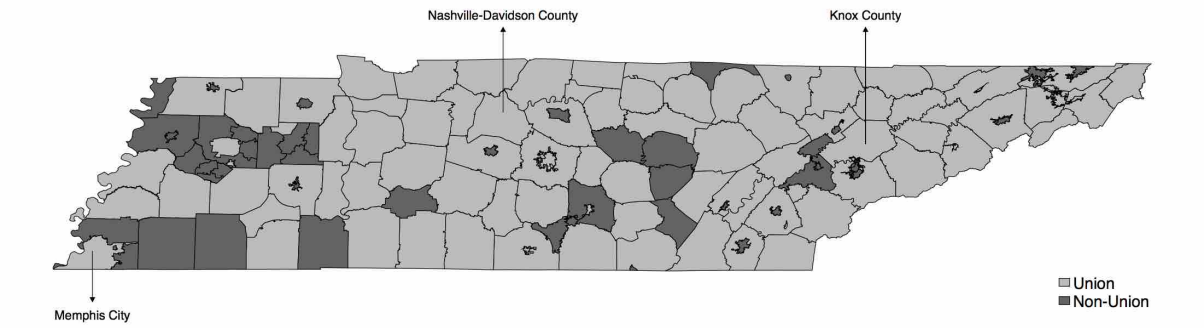
9 Figures and Tables

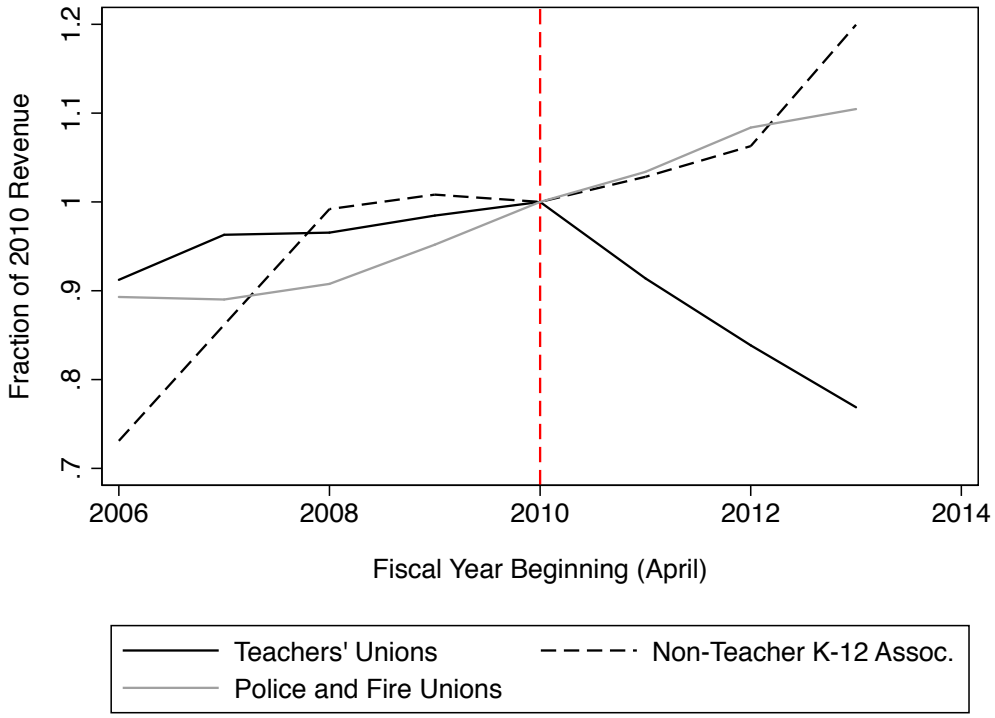
Figure 1: Location of School Districts by Bargaining Status, 2010



Source: data provided by the Tennessee School Boards' Association.

Figure 2: Total Revenue as a Fraction of Total 2010 Revenue

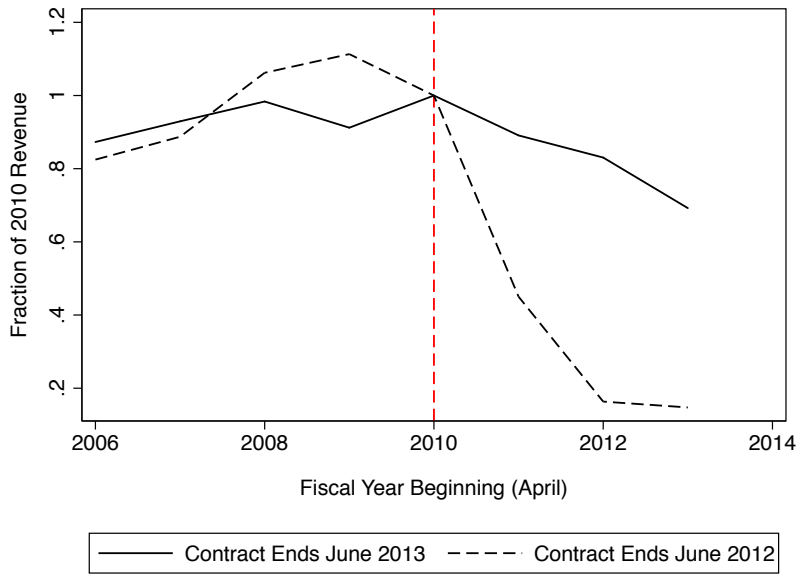
Large Public Unions in Tennessee



Source: author's calculations from IRS Form 990 data provided by the National Center for Charitable Statistics.
Notes: totals sum over 12 teachers' unions, 39 police and fire unions, and nine associations for K-12 management.

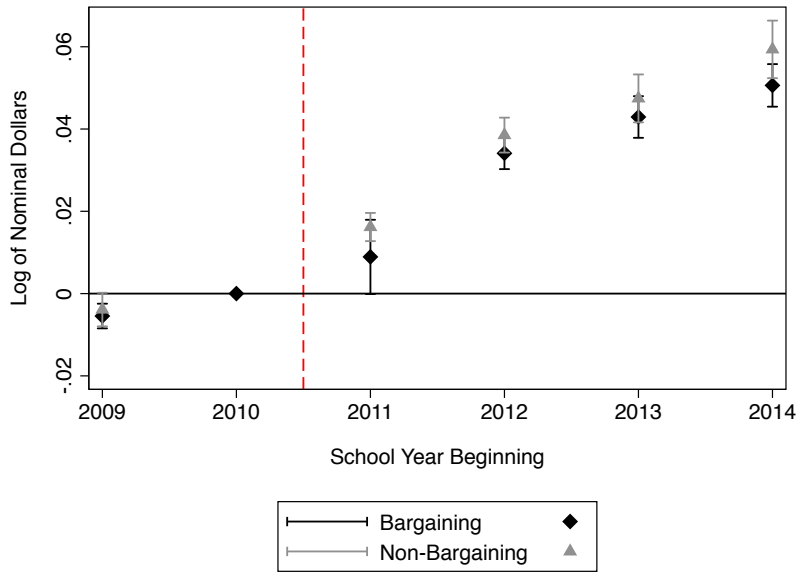
Figure 3: Total Revenue as a Fraction of Total 2010 Revenue

Two Large Teachers' Unions in Tennessee



Source: author's calculations from IRS Form 990 data provided by the National Center for Charitable Statistics.

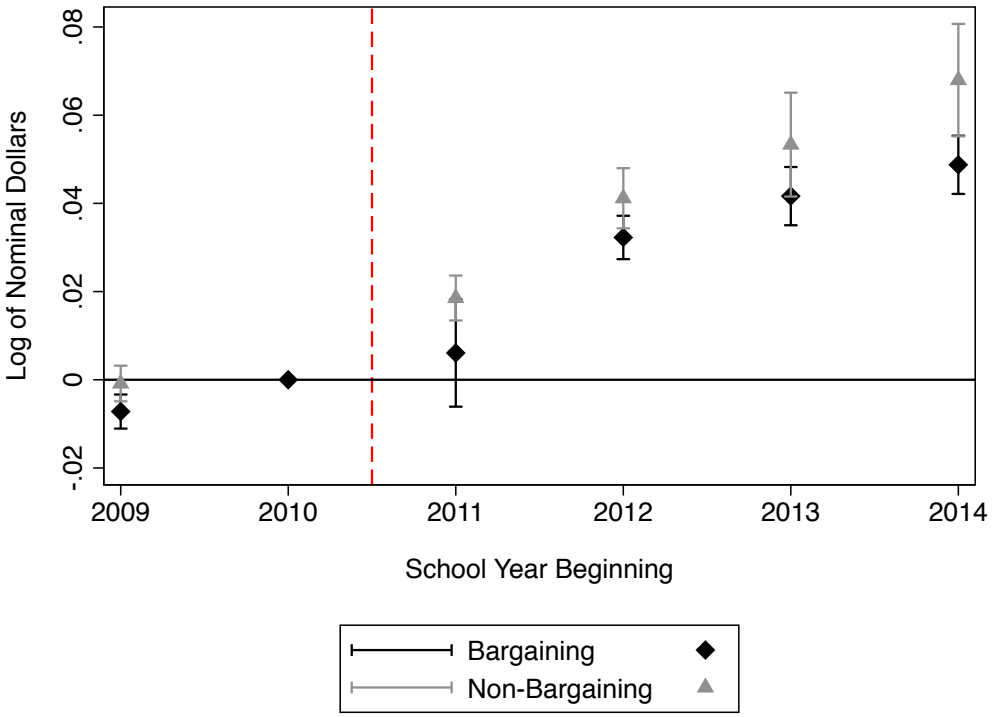
Figure 4: Teacher Salaries Relative to 2010, by Pre-Prohibition Bargaining Status



Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: sample excludes districts with "priority" schools, Shelby County Schools, and Carroll County Schools. Salaries are paid during the school year indicated. The regression controls for licensed teaching experience, highest degree achieved, and average daily student membership in 2000 interacted with year dummies. Non-classroom teachers and those with more than 30 years of experience are excluded from the analysis. Standard errors are clustered at the district level.

Figure 5: Teacher Salaries Relative to 2010, by Pre-Prohibition Bargaining Status

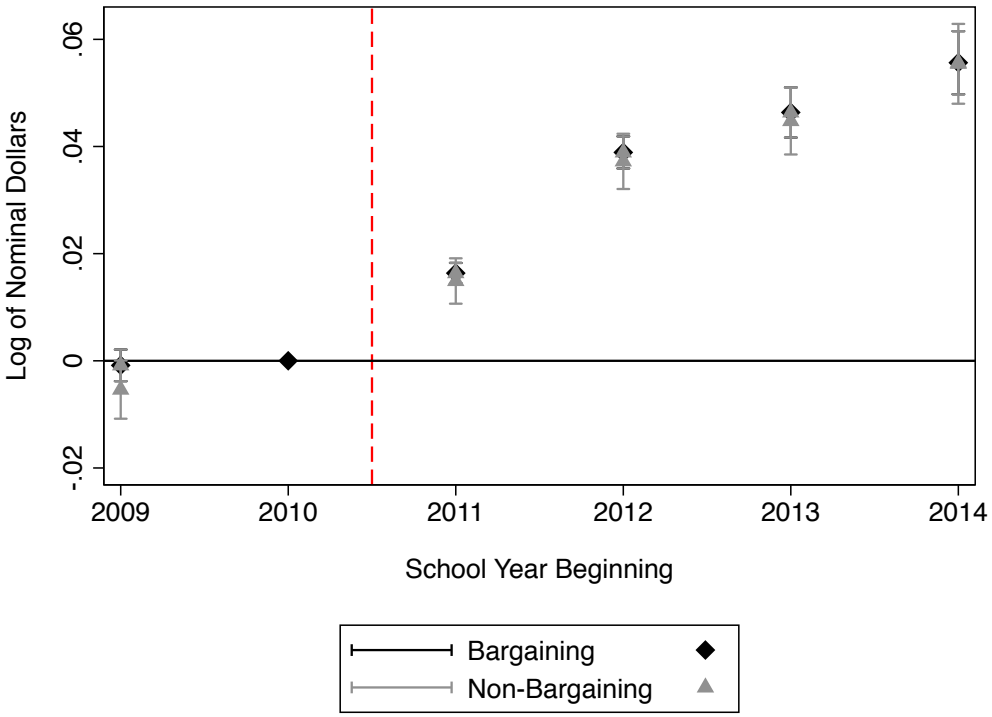
Districts with 4,000 or More Students in 2000



Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: sample excludes districts with "priority" schools, Shelby County Schools, and Carroll County Schools. Salaries are paid during the school year indicated. The regression controls for licensed teaching experience, highest degree achieved, and average daily student membership in 2000 interacted with year dummies. Non-classroom teachers and those with more than 30 years of experience are excluded from the analysis. Standard errors are clustered at the district level.

Figure 6: Teacher Salaries Relative to 2010, by Pre-Prohibition Bargaining Status

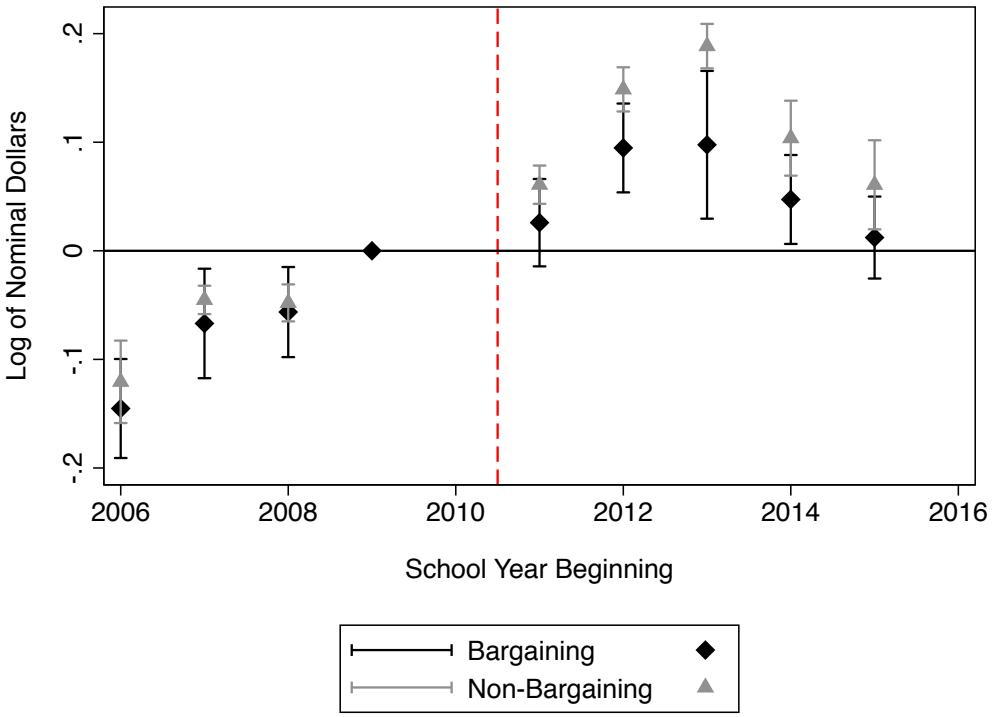
Districts with Fewer than 4,000 Students in 2000



Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: sample excludes districts with "priority" schools, Shelby County Schools, and Carroll County Schools. Salaries are paid during the school year indicated. The regression controls for licensed teaching experience, highest degree achieved, and average daily student membership in 2000 interacted with year dummies. Non-classroom teachers and those with more than 30 years of experience are excluded from the analysis. Standard errors are clustered at the district level.

Figure 7: Employer-Paid Premiums for Teachers' Health Insurance

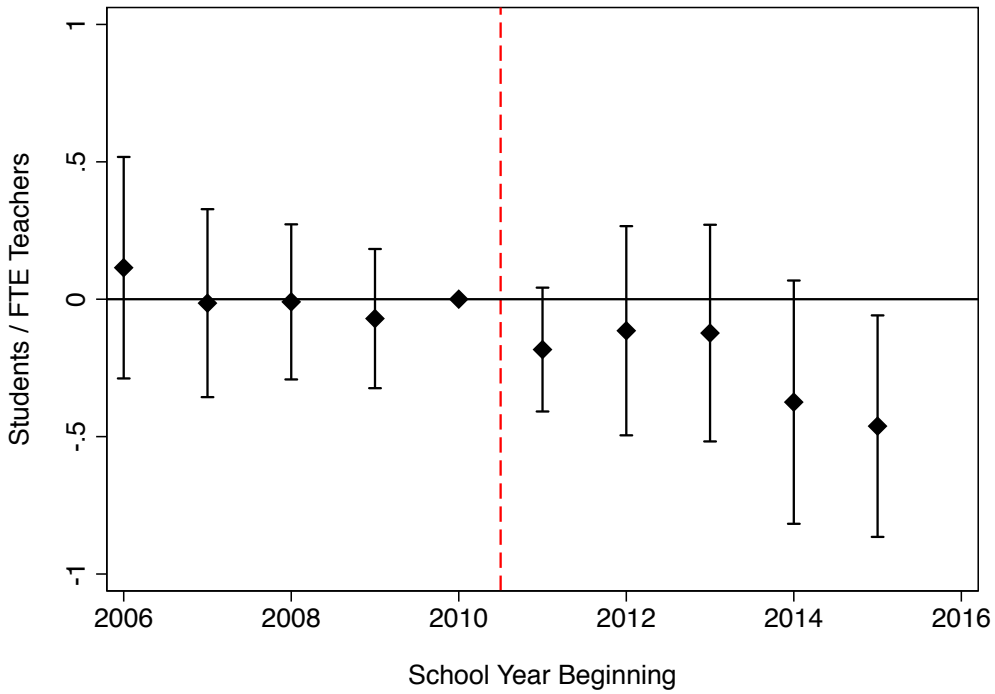
Relative to 2009, by Pre-Prohibition Bargaining Status



Source: author's estimates from data provided by the Tennessee Department of Education and the Tennessee State Board of Education.
Notes: sample excludes districts with "priority" schools, Shelby County Schools, and Carroll County Schools. The regression controls for average daily student membership in 2000 interacted with year dummies. Observations are weighted by the number of full-time-equivalent teachers in the district that year. Standard errors are clustered at the district level.

Figure 8: Effect of De-Unionization on the Student-Teacher Ratio

Differences-in-Differences Estimates

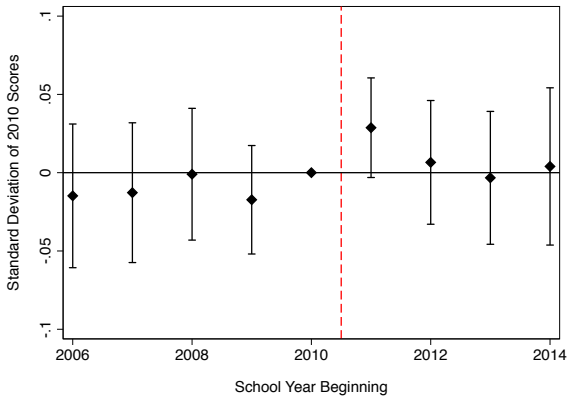


Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: sample excludes districts with "priority" schools, Shelby County Schools, and Carroll County Schools. The regression controls for average daily student membership in 2000 interacted with year dummies. Observations are weighted by the average daily student membership in 2000 and standard errors are clustered at the district level.

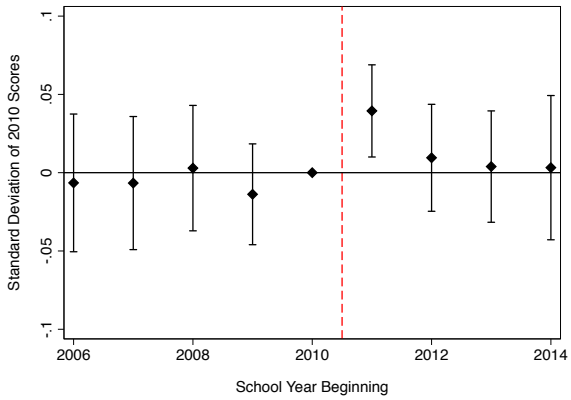
Figure 9: Effect of De-Unionization on District-Aggregate Standardized Test Scores

Math and Reading in Grades 3-8

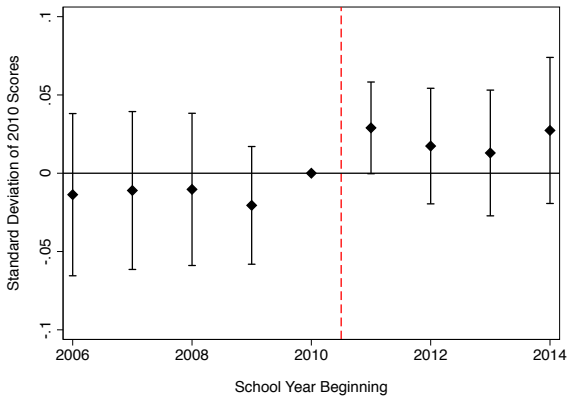
(a) Mean Score within Grade and Subject



(b) Median Score within Grade and Subject

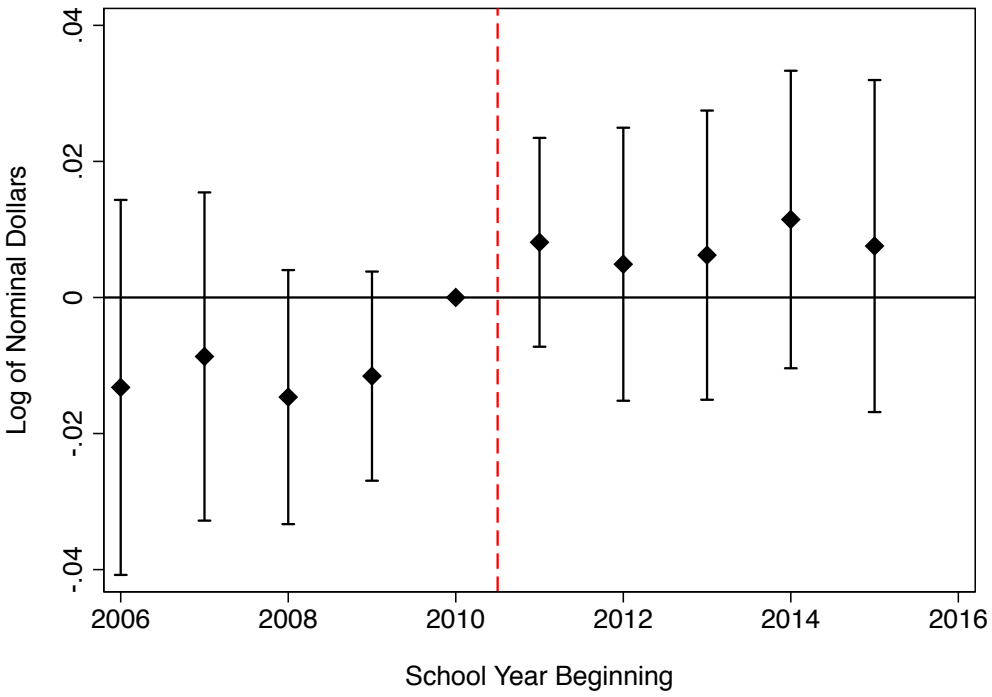


(c) Mean Weighted by Number of Students



Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: sample excludes districts with "priority" schools, Shelby County Schools, and Carroll County Schools. Individual student scores are aggregated within each combination of district, grade, and subject. Z-scores subtract the mean score across the entire state, within grade and subject, from the district-aggregate score and divide by the state-wide standard deviation within grade and subject. Regressions control for grade dummies and average daily student membership in 2000, both interacted with year dummies. Standard errors are clustered at the district level.

Figure 10: Effect of De-Unionization on Per-Pupil Operating Expenditure



Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: per-pupil expenditure divides total current operating expenditure by the average daily student membership in that year. The sample excludes districts with "priority" schools, Shelby County Schools, and Carroll County Schools. The regression controls for average daily student membership in 2000 interacted with year dummies. Observations are weighted by the average daily membership in the district that year. Standard errors are clustered at the district level.

Table 1: Mean Characteristics in 2009, Main Analysis Sample

VARIABLES	Unionized	Non-Unionized
District Characteristics, Identically Weighted		
Average Daily Student Membership (ADM)	6,715	2,321
Full-Time-Equivalent Teachers	454	164
District Characteristics, Student-Weighted		
District Serves Entire County	0.952	0.370
Fraction Students White	0.788	0.816
Frac. Students Eligible for Fed. Title I Funds	0.539	0.666
Per-Student Operating Expenditure	7,929	8,490
Fraction Expenditure State-Funded	0.502	0.493
Per-ADM Residential Property Value*	344,971	334,845
District Population Per Square Mile*	316	515
ADM / Full-Time-Equivalent Teachers	14.87	14.25
Average Employer Health Premium	7,071	6,256
Student-Mean Math Score (Z-Score)	-0.177	-0.069
Student-Mean RLA Score (Z-Score)	-0.064	0.009
Teacher Characteristics, Teacher-Weighted		
Total Annual Salary	43,373	44,591
Years of Licensed Teaching Experience	13.01	13.96
Fraction Highest Degree Bachelor's	0.455	0.432
Fraction Highest Degree Master's	0.394	0.422
Fraction Highest Degree Master's +30 Hours	0.078	0.060
Fraction Highest Degree Education Specialist	0.065	0.079
Fraction Leave District At End of Year	0.083	0.087
Number of Districts	87	42

* property value measured over the calendar year and district population from 2010 U.S. Census.
Source: author's calculations from data provided by the Tennessee Department of Education and the Tennessee State Board of Education.
Note: see Online Appendix Section A1 for variable definitions.

Table 2: Union Revenue in Tennessee, Fiscal-Year 2009-10

Union	N	Mean	SD	Min	Max
Teachers' Unions	12	1.591e+06	3.488e+06	45,194	1.251e+07
Other K-12 Professional Associations	9	354,392	608,571	18,184	1.909e+06
Police and Fire Unions	29	548,180	930,738	13,858	4.811e+06

Source: author's calculations from IRS Form 990 data provided by the National Center for Charitable Statistics.

Table 3: Effect of De-Unionization on Nominal Teacher Salaries

VARIABLES	(1) Log Salary	(2) Log Salary	(3) Log Salary	(4) Log Salary
Year 2009	-0.0039	-0.0099	-0.0035	-0.0019
	(0.0021)	(0.0029)	(0.0021)	(0.0029)
Year 2011	0.0162	0.0228	0.0167	0.0304
	(0.0017)	(0.0024)	(0.0017)	(0.0132)
Year 2012	0.0385	0.0515	0.0392	0.0389
	(0.0021)	(0.0038)	(0.0022)	(0.0033)
Year 2013	0.0474	0.0659	0.0478	0.0479
	(0.0029)	(0.0058)	(0.0030)	(0.0037)
Year 2014	0.0594	0.0853	0.0603	0.0633
	(0.0035)	(0.0072)	(0.0036)	(0.0043)
Union * Year 2009	-0.0016	-0.0009	0.0001	0.0013
	(0.0025)	(0.0031)	(0.0027)	(0.0024)
Union * Year 2011	-0.0073	-0.0083	-0.0050	-0.0064
	(0.0047)	(0.0053)	(0.0037)	(0.0060)
Union * Year 2012	-0.0044	-0.0057	-0.0011	-0.0005
	(0.0028)	(0.0032)	(0.0034)	(0.0026)
Union * Year 2013	-0.0045	-0.0054	-0.0028	-0.0015
	(0.0039)	(0.0049)	(0.0039)	(0.0036)
Union * Year 2014	-0.0088	-0.0116	-0.0043	-0.0054
	(0.0043)	(0.0053)	(0.0046)	(0.0045)
Observations	294,151	294,151	294,151	126,709
R-squared	0.793	0.969	0.793	0.798
Number of Districts	129	129	129	104
District FE	X		X	X
Experience Dummies	X	X	X	X
Education Dummies	X	X	X	X
ADM * Year Dummies	X	X		X
Teacher FE		X		

Robust standard errors in parentheses

Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: columns 1-3 exclude districts with "priority" schools, Shelby County Schools, and Carroll County Schools. Column 4 also excludes districts with an average daily student membership greater than 6,500 in 2000. Salaries are paid during the school year indicated. "Experience" refers to years of teaching experience on the State teaching license, earned in Tennessee or elsewhere. "Education" denotes highest degree earned. "ADM" controls for average daily student membership in 2000. Non-classroom teachers and those with more than 30 years of experience are excluded from the analysis. Standard errors are clustered at the district level.

Table 4: Effect of De-Unionization on Nominal Teacher Salaries, by Subgroup

	Subgroup: Small		Subgroup: Junior		Subgroup: Low-Paid	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Log Sal.	Log Sal.	Log Sal.	Log Sal.	Log Sal.	Log Sal.
Union * Year 2009	-0.006	-0.004	-0.002	0.002	-0.003	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Union * Year 2011	-0.012	-0.020	-0.008	-0.007	-0.007	-0.007
	(0.006)	(0.015)	(0.005)	(0.007)	(0.005)	(0.007)
Union * Year 2012	-0.009	-0.005	-0.007	-0.001	-0.005	0.002
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)
Union * Year 2013	-0.012	-0.008	-0.007	-0.002	-0.006	-0.000
	(0.007)	(0.007)	(0.005)	(0.004)	(0.005)	(0.004)
Union * Year 2014	-0.019	-0.017	-0.012	-0.005	-0.009	-0.003
	(0.007)	(0.008)	(0.005)	(0.005)	(0.005)	(0.005)
Subgroup * Union * 2009	0.011	0.009	0.001	-0.002	0.001	-0.001
	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)
Subgroup * Union * 2011	0.014	0.022	0.001	0.001	0.001	0.002
	(0.007)	(0.015)	(0.002)	(0.002)	(0.002)	(0.003)
Subgroup * Union * 2012	0.011	0.007	0.006	0.001	0.004	0.001
	(0.005)	(0.005)	(0.004)	(0.003)	(0.004)	(0.003)
Subgroup * Union * 2013	0.013	0.010	0.005	0.001	0.003	0.001
	(0.008)	(0.008)	(0.004)	(0.003)	(0.004)	(0.003)
Subgroup * Union * 2014	0.019	0.018	0.006	-0.002	0.003	-0.001
	(0.009)	(0.009)	(0.005)	(0.003)	(0.005)	(0.003)
Observations	294,151	126,709	294,151	126,709	294,151	126,709
R-squared	0.793	0.798	0.793	0.799	0.810	0.814
Number of Districts	129	104	129	104	129	104
District FE	X	X	X	X	X	X
Subgroup * Year Dummies	X	X	X	X	X	X
Experience Dummies	X	X	X	X	X	X
Education Dummies	X	X	X	X	X	X
ADM * Year Dummies	X	X	X	X	X	X

Robust standard errors in parentheses

Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: in columns 1-2, "subgroup" refers to districts enrolling fewer than 4,000 students in 2000; in columns 3-4, "subgroup" refers to teachers with fewer than 11 years of licensed experience; in columns 5-6, "subgroup" refers to teachers who earn salaries in the bottom half of their district's annual distribution. Columns 1, 3, and 5 exclude districts with "priority" schools, Shelby County Schools, and Carroll County Schools. Columns 2, 4, and 6 also exclude districts with an average daily student membership greater than 6,500 in 2000. Salaries are paid during the school year indicated. "Experience" refers to years of teaching experience on the State teaching license, earned in Tennessee or elsewhere. "Education" denotes highest degree earned. "ADM" controls for average daily student membership in 2000. Non-classroom teachers and those with more than 30 years of experience are excluded from the analysis. Standard errors are clustered at the district level.

Table 5: Effect of De-Unionization on Nominal Employer Health Insurance Premiums

VARIABLES	(1) Log Prem.	(2) Log Prem.	(3) Log Prem.
Union * Year 2006	-0.025	0.008	0.012
	(0.029)	(0.017)	(0.024)
Union * Year 2007	-0.022	0.017	0.019
	(0.025)	(0.012)	(0.012)
Union * Year 2008	-0.008	0.023	0.033
	(0.022)	(0.013)	(0.015)
Union * Year 2011	-0.035	0.010	0.009
	(0.021)	(0.012)	(0.012)
Union * Year 2012	-0.054	0.003	0.006
	(0.022)	(0.016)	(0.014)
Union * Year 2013	-0.091	-0.009	0.002
	(0.034)	(0.017)	(0.015)
Union * Year 2014	-0.056	-0.011	-0.014
	(0.026)	(0.023)	(0.026)
Union * Year 2015	-0.049	-0.015	-0.012
	(0.028)	(0.025)	(0.031)
Observations	1,161	1,161	936
R-squared	0.873	0.904	0.887
Number of Districts	129	129	104
Teacher Weighted	X		X
District FE	X	X	X
Year Dummies	X	X	X
ADM * Year Dummies	X	X	X

Robust standard errors in parentheses

Source: author's estimates from data provided by the Tennessee Department of Education and the Tennessee State Board of Education.

Notes: columns 1 and 2 exclude districts with "priority" schools, Shelby County Schools, and Carroll County Schools. Column 3 also excludes districts with an average daily student membership greater than 6,500 in 2000. "ADM" controls for average daily student membership in 2000. Standard errors are clustered at the district level.

Table 6: Effect of De-Unionization on the Student-Teacher Ratio

VARIABLES	(1) Student-Teacher Ratio	(2) Student-Teacher Ratio	(3) Student-Teacher Ratio
Union * Year 2006	0.115	0.186	0.253
	(0.204)	(0.196)	(0.215)
Union * Year 2007	-0.014	0.191	0.173
	(0.173)	(0.181)	(0.174)
Union * Year 2008	-0.010	0.154	0.129
	(0.143)	(0.129)	(0.145)
Union * Year 2009	-0.070	0.070	0.067
	(0.128)	(0.124)	(0.126)
Union * Year 2011	-0.183	-0.183	0.001
	(0.114)	(0.154)	(0.180)
Union * Year 2012	-0.115	0.049	0.082
	(0.192)	(0.258)	(0.326)
Union * Year 2013	-0.123	0.177	0.176
	(0.199)	(0.249)	(0.300)
Union * Year 2014	-0.375	-0.060	-0.156
	(0.224)	(0.220)	(0.260)
Union * Year 2015	-0.462	-0.185	-0.251
	(0.204)	(0.189)	(0.212)
Observations	1,290	1,290	1,040
R-squared	0.766	0.742	0.715
Number of Districts	129	129	104
ADM Weighted	X		X
District FE	X	X	X
Year Dummies	X	X	X
ADM * Year Dummies	X	X	X

Robust standard errors in parentheses

Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: columns 1 and 2 exclude districts with "priority" schools, Shelby County Schools, and Carroll County Schools. Column 3 also excludes districts with an average daily student membership greater than 6,500 in 2000. "ADM" controls for average daily student membership in 2000. Standard errors are clustered at the district level.

Table 7: Effect of De-Unionization on District-Aggregate Math and Reading Scores in Grades 3-8

VARIABLES	(1) Z-Score (Mean)	(2) Z-Score (Median)	(3) Z-Score (Mean)	(4) Z-Score (Mean)	(5) Z-Score (Median)	(6) Z-Score (Mean)
Union * Year 2006	-0.015	-0.007	-0.014	-0.008	0.004	-0.001
	(0.023)	(0.022)	(0.026)	(0.025)	(0.025)	(0.027)
Union * Year 2007	-0.013	-0.007	-0.011	-0.008	0.001	-0.002
	(0.023)	(0.021)	(0.025)	(0.025)	(0.024)	(0.027)
Union * Year 2008	-0.001	0.003	-0.010	0.007	0.012	0.001
	(0.021)	(0.020)	(0.025)	(0.024)	(0.023)	(0.027)
Union * Year 2009	-0.017	-0.014	-0.021	-0.015	-0.010	-0.020
	(0.018)	(0.016)	(0.019)	(0.019)	(0.018)	(0.021)
Union * Year 2011	0.029	0.039	0.029	0.027	0.042	0.021
	(0.016)	(0.015)	(0.015)	(0.018)	(0.017)	(0.016)
Union * Year 2012	0.007	0.010	0.017	0.016	0.019	0.019
	(0.020)	(0.017)	(0.019)	(0.023)	(0.020)	(0.021)
Union * Year 2013	-0.003	0.004	0.013	0.007	0.014	0.022
	(0.021)	(0.018)	(0.020)	(0.025)	(0.021)	(0.022)
Union * Year 2014	0.004	0.003	0.027	0.005	0.008	0.020
	(0.025)	(0.023)	(0.024)	(0.029)	(0.026)	(0.024)
Observations	13,770	13,770	13,770	11,070	11,070	11,070
R-squared	0.993	0.993	0.995	0.993	0.993	0.994
Number of Districts	129	129	129	104	104	104
District FE	X	X	X	X	X	X
Year Dummies	X	X	X	X	X	X
Grade Dummies * Year Dummies	X	X	X	X	X	X
ADM * Year Dummies	X	X	X	X	X	X
Student-Weighted			X			X

Robust standard errors in parentheses

Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: sample excludes districts with "priority" schools, Shelby County Schools, and Carroll County Schools. Individual student scores are aggregated within each combination of district, grade, and subject. Z-scores subtract the mean score across the entire state, within grade and subject, from the district-aggregate score, and divide by the state-wide standard deviation within grade and subject. Exams are scored on a different scale beginning in 2009, so that year dummies absorb most of the variation in the data. "ADM" controls for average daily student membership in 2000. Standard errors are clustered at the district level.

Table 8: Effect of De-Unionization on the Probability of Leaving Employment

VARIABLES	(1) Pr(Leave)	(2) Pr(Leave)	(3) Pr(Leave)
Year 2009	-0.019	-0.020	-0.027
	(0.008)	(0.008)	(0.011)
Year 2011	-0.005	-0.004	-0.018
	(0.006)	(0.006)	(0.010)
Year 2012	0.004	0.004	-0.008
	(0.008)	(0.008)	(0.010)
Year 2013	0.005	0.005	-0.007
	(0.008)	(0.008)	(0.010)
Union * Year 2009	0.007	0.002	-0.004
	(0.010)	(0.010)	(0.010)
Union * Year 2011	-0.007	-0.002	-0.014
	(0.007)	(0.007)	(0.008)
Union * Year 2012	-0.007	-0.003	-0.008
	(0.008)	(0.008)	(0.009)
Union * Year 2013	-0.003	0.001	-0.006
	(0.009)	(0.009)	(0.010)
Observations	252,949	252,949	109,554
R-squared	0.030	0.030	0.031
Number of Districts	129	129	104
District FE	X	X	X
Experience Dummies	X	X	X
Education Dummies	X	X	X
ADM * Year Dummies	X		X

Robust standard errors in parentheses

Source: author's estimates from data provided by the Tennessee Department of Education.
Notes: teachers separate at the end of the current school year by transferring to another district or exiting the dataset. Columns 1-2 exclude districts with "priority" schools, Shelby County Schools, and Carroll County Schools. Column 3 also excludes districts with an average daily student membership greater than 6,500 in 2000. "Experience" refers to years of teaching experience on the State teaching license, earned in Tennessee or elsewhere. "Education" denotes highest degree earned. "ADM" controls for average daily student membership in 2000. Non-classroom teachers and those with more than 30 years of experience are excluded from the analysis. Standard errors are clustered at the district level.