IS COLLECTIVE BARGAINING DETRIMENTAL TO STUDENT ACHIEVEMENT?: EVIDENCE FROM A NATIONAL STUDY

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ABSTRACT

The two largest teacher unions in the United States claim millions of members and wield substantial political influence over educational policy. In light of the often negative claims about the operation of teacher unions in public schools, it is puzzling why so few scholars have empirically scrutinized whether collective bargaining shapes the academic performance of students. I used data from the National Education Longitudinal Study to examine whether collective bargaining was related to student achievement or student educational expectations. I employed multivariate regression techniques whenever possible to isolate possible effects of bargaining from those of confounding variables. Findings suggest that bargaining was *not* associated with either lower student achievement (math, reading, science, or history) or lower educational expectations between the eighth and tenth grades.

INTRODUCTION

The two largest teacher unions in the United States, the American Federation of Teachers (AFT) and the National Education Association (NEA) together claim more than 4.6 million members [1, 2] and wield considerable influence over school policy. More than four of five public school teachers are members of either the AFT or the NEA [3]. Given the rapid spread of collective bargaining in education since the 1960s, teacher unions have likely increased their influence in

the daily operations of schools. Researchers have accumulated a small number of studies that investigate how bargaining shapes the social organization of schools [4-9].

Collective bargaining in education also represents a compelling topic due to the fact that scholars, policymakers, and the public alike are sharply divided on whether and how bargaining shapes student achievement and educational reform [10-15]. Critics contend that collective bargaining raises the costs of education and stymies its reform [8, 16]. Bargaining contracts may also constrain administrators' discretion [17, 18], make it difficult to remove incompetent teachers [19], reduce teacher incentives to perform their best work under salary schedules that neglect merit [8], and increase conflict levels within schools and the community more generally [20].

Supporters of unions often assume that what is good for teachers is ultimately beneficial for their students. Bargaining may increase teachers' classroom autonomy and input in policy decisions [3, 9], boost their job satisfaction, and reduce absenteeism and turnover [21]. The bargaining contract may "shock" schools into more effective organizations by holding teachers and principals more accountable through its many provisions [22]. Despite the rhetoric from both detractors and supporters, collective bargaining is seldom included as a predictor of academic outcomes in research—and, when it is treated, it is often presumed to wield negative effects.

Unfortunately, research evidence is thin on whether collective bargaining shapes student outcomes and, if so, exactly *how* it does so. Complicating matters is the fact that existing studies are of widely varying quality, for example, a number have been critiqued for their methodology [10, 23] or employ anti-union rhetoric, for example, references to "militant teacher unions" [24] and "Big Labor" [19]. Several of the more dubious studies are cited by policymakers as evidence that collective bargaining hampers student achievement. Our understanding would be enhanced with additional research by scholars who perform careful research and maintain a balanced view of the implications of bargaining.

RESEARCH QUESTIONS

Two questions guided this inquiry:

1. Do students at public schools with and without collective bargaining differ with respect to their achievement between the eighth and tenth grades, that is, as measured by math, reading, science, and history achievement tests?
2. Do students at schools with and without collective bargaining differ on educational expectations between the eighth and tenth grades?

COLLECTIVE BARGAINING AND STUDENT OUTCOMES

Social scientists have long debated whether unions are detrimental or beneficial to organizational outcomes. Economists have characterized unions as operating in a monopolistic situation wherein they bargain from a position of exclusionary strength on behalf of their members [25, 26]. Freed from competition, unions are characterized at worst as detrimental to educational outcome or, at best, inefficient vehicles to educational improvement. The ostensible reason for the existence of teacher unions is to bargain for higher salaries, greater benefits, more security, and increasingly, issues associated with professionalization. That unions tend to increase organizational costs is well established [5, 27-29]. Collective bargaining might then foster a zero-sum outcome-gains for teachers at the expense of students and their parents in the form of lowered achievement and higher costs, respectively. Opponents of bargaining argue further that the push by unions for seniority-based promotion systems protects less competent teachers from reprisals and fails to reward extra effort. A final argument against bargaining is that strikes, or their threat, depress student achievement [30].

In contrast, supporters of unions argue that they raise output by providing employees with a collective voice to better air concerns with management [28, 31]. A collective voice may be particularly trenchant for certain social minorities, who may experience fewer formal channels to be heard. Further, unions may increase worker solidarity, morale, empowerment, provide a sense of dignity to work, and lower turnover rates [21, 32]. These psychosocial returns for teachers might ultimately enhance output through increased motivation and decreased absenteeism and turnover. Strikes may be disruptive to student achievement in the short term [33], but there is little evidence that strikes lower achievement over the school year [34, 35].

While there is disagreement about the direction of the bargaining-achievement link, a careful review of this thin body of research hints that bargaining exhibits small, but positive, effects for most students [10, 14]. The most comprehensive review turned up only 17 well-cited studies [10]. Several more are considered here: one recently released [19], two studies less often cited [36, 37], and one that addressed the influence of bargaining indirectly [38]. This meager body of work involves a variety of disciplines, data sources, levels of analysis, analytic methods, and grade levels. Studies that reported favorable effects outnumbered those that reported negative effects by more than a 2 to 1 ratio. Every study that reported negative patterns for bargaining was conducted with highly aggregated data, either at the district or state level. While highly aggregated studies are not without merit, their findings are more prone to spuriousness due to the ecological fallacy [39-41]. This study circumvents many of the problems with aggregated analyses by focusing on the effects of bargaining *within* public schools, where student learning actually occurs.

Bargaining Diminishes Outcomes

Kurth [24] examined factors that contributed to the decline of the then-named Scholastic Aptitude Test (SAT) scores from 1972 to 1983. Of the explanatory variables examined, teacher unionization wielded the largest negative effects on state scores. Nelson and Gould [42] replicated Kurth's study, but they concluded that unionization was associated with *higher* scores.

Peltzman [43, 44] completed two additional studies at the state level, both with somewhat negative findings for unionization. First, he linked changes in state proportions of NEA and AFT memberships to changes in SAT and American College Test (ACT) scores from 1972 to 1989 [43, 45]. Although this study is often cited as finding strongly negative effects, a closer examination of the results reveals a mixed pattern. Larger NEA memberships raised scores from 1972 to 1981, while larger AFT memberships lowered scores. Since the NEA had much larger memberships than the AFT, one might conclude that unionism exercised a positive effect overall. Yet over the period from 1981 to 1989, Peltzman found that increased NEA and AFT memberships were both associated with lower test scores.

The studies discussed so far treated high-achieving students, that is, those who entertained thoughts of college. To his credit, Peltzman [44] also studied those who completed the standardized Armed Forces Qualifying Test (AFQT), most of whom did not attend college. He concluded that increased state unionization led to decreased state AFQT performance in the 1980s. Yet even this study evinced inconsistent patterns; increased unionization had no effect on AFQT scores during the 1970s.

Other studies have relied on uncontrolled correlational relationships to link collective bargaining to lower achievement. Fuller et al. [20] claimed that the Milwaukee's Public School District's unionization was related to subsequently disappointing student achievement. Unfortunately, this study did not control for potentially confounding variable—in particular, the deindustrialization during the 1970s and 1980s that impinged on Milwaukee's economic prosperity [46] and that may have contributed to the lowered achievement. Also, Riley et al. [19] reported that unionized districts in California scored lower than nonunionized districts on standardized tests (SAT-9) in math and reading for fourth and tenth grade students. In discussing California's educational decline, the authors asserted, "A major reason for this plunge is the power of unions, through the collective bargaining process, to influence the details of classroom instruction in a way detrimental to student achievement" [19, p. 1].

In perhaps the most convincing study to report negative effects, Hoxby [25] found that unionized districts had drop-out rates that were 2.3% higher than nonunionized districts from 1970 to 1990. Yet even this study has been critiqued on methodological grounds [47, 48].

Bargaining Boosts Outcomes

Most studies that found favorable patterns for bargaining were conducted at the student level of analysis, for example, several studies tracked student gains on standardized test scores over time in both unionized and nonunionized schools. Eberts and Stone [17] reported that fourth graders under bargaining showed greater improvement on a standardized math test over the school year. Others found similar results for high school students [22, 37, 49, 50]. Researchers extended this pattern to vocabulary, reading, and writing [22, 37], science and civics [37], and economic literacy [51].

Other studies targeted samples of students who were less representative of their grade level, for example, those who planned to attend college and high school dropouts. Bargaining was linked to higher scores on college entrance exams and protection against high school dropout [52-55]. Appendix 1 presents a summary of the extant studies on bargaining and achievement.

Mediators of the Effect of Bargaining on Outcomes

Researchers have increasingly turned their attention to how bargaining may influence student outcomes. These mechanisms would serve as "process indicators" to better understand how bargaining shapes student outcomes [56, 57]. These processes would constitute "actionable" items that could be modified so as to practically affect learning. Researchers have focused on social organizational processes that differ at schools with and without collective bargaining.

Researchers have been more successful at identifying factors that fail to mediate the bargaining-achievement link than uncovering those that successfully mediate it. Scholars have considered whether the very elements that unions bargain for might shape achievement. One might think, for example, that higher teacher salaries associated with unionized schools may lead to better motivated, more effective teachers. However, higher teacher salaries [22, 52], greater per capita spending on education, and smaller class sizes [49, 52] do not appear to explain a substantial portion of the favorable union effects [54].

One promising explanation involves standardization. Several studies suggest that bargaining confers the greatest achievement benefits to students of middle-range abilities, for example, those who scored near the mean on a pretest [17, 37, 49, 50]. The effects of bargaining vanished or turned slightly negative for both extremely low- and extremely high-achieving students. Eberts and Stone [17] found that bargaining standardized math program and its instruction. Research may be funneled away from specialized programs toward programs that serve most students [17]. This increased standardization, in turn, should benefit middle-range students more [58], perhaps at the expense of very low- and high-achieving counterparts.

ANALYTIC APPROACH

Data Source

The study of the implications of teacher unions is hampered by a paucity of national data sources that include both measures of collective bargaining and student achievement. Researchers in this area often cobble together disparate data sources. Seen in this light, the National Education Longitudinal Study (NELS) is a particularly comprehensive source. NELS is a multi-stage, nationally-representative probability sample of schools and students in the United States. Data were analyzed from 1990 and 1988, when students were in the tenth and eighth grades, respectively. While these national data are more than a decade old, they are the most recent available linking bargaining to achievement at the student level. Analytical samples consisted of 5,016, 6,234, 4,390, and 2,956 students for analyses involving math, reading, science, and history achievement, respectively. Analyses involving educational expectations included responses from 10,799 students.

Measures

Achievement Test

Studies on bargaining often analyze only math gains, or de-emphasize reading gains on their own merit by combining math and reading gains into a composite score [22]. In contrast, this study tests whether student gains on standardized math, reading, science, and history tests differ for students in schools with and without collective bargaining. Cognitive pretests in each of the four subjects were administered to eighth graders. Posttests were administered to these same students in the tenth grade. To minimize ceiling and floor effects on the change in test scores over the two-year period, all scores were adjusted with item response theory (IRT). Psychometric properties of the standardized tests were detailed by the National Center for Education Statistics [59].

The dependent variables were the posttest scores in each subject. The inclusion of eighth-grade achievement levels as predictors served to statistically equalize initial achievement levels between students at schools with and without collective bargaining. Regressions including the pretests as predictors were conservative given the considerable correlations between posttests and pretests. Table 1 reports descriptive statistics for math, reading, science, and history achievement test scores. As expected, mean test scores between the eighth and tenth grades showed an average gain in each subject over the two years.

Educational Expectations

Greater educational expectations have been linked to greater tenacity in meeting goals such as higher educational attainment [60]. Educational expectations were

Table 1. Weighted Means and Standard Deviations for Achievement Test Scores in Four Subjects, Educational Expectations, and Collective Bargaining

Measure	Description	Metric	Mean	SD	N	Source
Math achievement						
Posttest	Standardized test administered in tenth grade	IRT-adjusted units	43.51	13.71	5,016	Student
Pretest	Standardized test administered in eighth grade	IRT-adjusted units	36.30	11.66	5,016	Student
Square root of pretest	Square root of eighth grade pretest	Square root units	595.96	.96	5,016	Student
Reading achievement						
Posttest	Standardized test administered in tenth grade	IRT-adjusted units	29.91	9.87	6,234	Student
Pretest	Standardized test administered in eighth grade	IRT-adjusted units	26.60	8.46	6,234	Student
Square root of pretest	Square root of eighth grade pretest	Square root units	5.09	.83	6,234	Student
Science achievement						
Posttest	Standardized test administered in tenth grade	IRT-adjusted units	21.43	5.98	4,390	Student
Pretest	Standardized test administered in eighth grade	IRT-adjusted units	18.82	4.83	4,390	Student
History achievement						
Posttest	Standardized test administered in tenth grade	IRT-adjusted units	31.85	5.27	2,956	Student
Pretest	Standardized test administered in eighth grade	IRT-adjusted units	29.68	4.52	2,956	Student
Educational expectations						
Tenth grade	How far in school expect to go?	1 = Less than high school degree to 5 = advanced degree	3.74	.98	10,799	Student
Eighth grade	How far in school expect to go?	1 = Less than high school degree to 5 = advanced degree	3.79	.92	10,799	Student
Key independent variable						
Collective bargaining[a]	Whether the school's regular staff was covered by a collective bargaining agreement	1 = collective bargaining 0 = otherwise	.66	.47	5,016	Principal

[a] Descriptive statistics on bargaining are for models involving math achievement.

measured with "How far in school do you think you will get?" To this researcher's knowledge, no study on teacher unionism has yet analyzed educational expectations. As shown in Table 1, mean values for educational expectations during the eighth and tenth grades were stable at 3.79 and 3.74, respectively.

Collective Bargaining

The presence or absence of bargaining was measured by whether the school's regular teaching staff was covered by a bargaining agreement. Collective bargaining was coded as "1" if a student was from a school with bargaining, and "0" if the student was not.[1] Table 1 reports descriptive statistics on collective bargaining for analyses involving math achievement.

Controls

Control variables were included in models that predicted student achievement, for example, family background, student and teacher characteristics, and school characteristics. Controls for family background included the educational attainment of the most educated parent and total family income. Family income was logged to prevent a small number of cases with extremely high family incomes, for example, greater than $200,000, from exerting an undue influence. Student controls included sex, race/ethnicity, whether the student had a learning disability that affected her/his progress in the particular subject, whether the student suffered an illness that left her/him behind in the subject, and whether the student was grouped into an honors, academic, or general level ability class in the subject. Controls for the student's paired teacher in the subject included sex, total teaching experience, whether or not the teacher had a degree in the subject, highest degree held, and to what extent the teacher felt prepared to teach the subject.

School controls included the percentage of students who received free lunch, mean parental socioeconomic status, attendance rate, enrollment, and urbanicity. School SES and free lunch were included as contextual SES effects over and above parent(s) educational attainment and family income. School SES was measured by computing the mean parental SES of student respondents. Free lunch was included as a proxy for school resources, but it was aggregated into

[1] The precedent of Argys and Rees [49] was followed for the measurement of bargaining status. In most cases, students reported in the tenth grade that their family had not moved during the prior two years. It was assumed that the bargaining status of the school remained constant over the period for these non-movers. If a student reported that she had moved, her school identifier for that year was checked against a school identifier reported by a non-mover; if it matched, the bargaining status of the non-mover's school was used. Conversely, if a mover's school identifier did not match any non-mover's school identifier, the student was dropped from the analysis.

quartiles in NELS. Both mean school SES and free lunch were included to compensate for the measurement weakness of each. Descriptive statistics for all controls are available from the author upon request.

ANALYSES

A series of ordinary least squares (OLS) regressions were conducted at the individual-level. To control for initial achievement levels in each of the four subjects, the student's eighth grade test score (pretest) was entered into each model as a predictor. Since it was possible that increasing pretest scores were associated with increasingly smaller gains on the posttest, several nonlinear functional forms were investigated for model fit, for example, curvilinear, natural log, 1-1/X, square root, and 1 + square root. Ultimately, both the pretest and the square root of the pretest were included as control variables for math, the square root of the pretest for reading, and linear specifications for science and history. This strategy of including a pretest function represents a stringent test—one that confined the possible effects of bargaining to only the ninth and tenth grades, as well as a small portion of eighth grade after the pretest was administered in the spring. This strategy cannot inform whether bargaining was associated with lower or higher achievement prior to the eighth grade. Similarly, educational expectations in tenth grade were regressed on bargaining while controlling for eighth grade expectations.

Mean substitution was used to replace missing values on control variables, with the inclusion of dummy variables as indicators of substitution in all regressions. Performing analyses without design weights, with listwise deletion, or with pairwise deletion did not alter the patterns reported here.

RESULTS

Table 2 summarizes the effects of collective bargaining on the four achievement tests and educational expectations. Standardized coefficients are provided to gauge whether these effects are substantively important as well as statistically significant. Y-standardized coefficients were computed by dividing the coefficient for collective bargaining by the pooled standard deviation on the dependent variable [61-63]. As suggested by some researchers [64, 65], effect sizes of less than .10 were treated as substantively trivial and not worthy of elaboration.

Collective bargaining was associated with higher tenth grade achievement in math, reading, science, and history before the introduction of pretests or controls in Model 1 of Table 2. For instance, Model 1 depicts a positive and statistically significant coefficient of .179 for bargaining on math achievement. Specifically, students under bargaining had math achievement gains that were nearly .18 standard deviations greater than counterparts in schools without bargaining. The proportion of variance in math achievement explained by bargaining alone was

Table 2. Summary of Y-Standardized Coefficients from OLS Regressions for Tenth Grade Student Achievement and Educational Expectations on Collective Bargaining,[a] Eighth Grade Level, and Controls[b,c]

Measure	Model 1 No controls	Model 2 with 8th grade level	Model 3 Student controls added to Model 2	Model 4 Teacher controls added to Model 3	Model 5 School controls added to Model 4
Achievement					
Math	.179***	.008	.001	.001	.007
Reading	.126***	.013	−.011	−.012	−.010
Science	.202***	.068**	.042*	.016	.005
History	.227***	.026	.019	.012	−.002
Educational expectations	.059**	.021	−.015	NA	−.039*

* = α at .05, ** = α at .01, *** = α at .001 (two-tailed tests)

[a]Coded 1 if the student attended a school covered by collective bargaining, else coded 0.

[b]Ns ranged from 2,956 to 10,799.

[c]Student controls included parent(s) education, logged income, sex, race/ethnicity, whether had a learning disability, whether behind due to health, class ability grouping; teacher controls included sex, experience, whether out-of-field teaching, educational attainment, prepared to teach; school controls consisted of free lunch, school SES, attendance rate, enrollment, and urbanicity.

0.7% (not shown in tabular format). When both collective bargaining and the pretest function were added in Model 2 for math, the effect of bargaining was reduced to .008, which was no longer statistically significant. Once the pretest was added, the proportion of variance explained on math achievement vaulted to nearly 77% (not shown in tabular format). Measuring the math gain in this fashion left only a modest amount of variance that could be explained by predictors such as bargaining, here about 23%. When student-level controls were added in Model 3, the effect of bargaining attenuated further to .001. Teacher and school controls were added in Models 4 and 5, but their inclusion did little to alter the coefficient for bargaining on math.

The pattern for bargaining on math achievement was generally repeated for the other subjects. Once eighth grade achievement was introduced in Model 2, the salubrious effects of bargaining attenuated to nonsignificance for all subjects but science. Even then, the significant association between bargaining and science achievement evaporated once student and teacher controls were added (Model 4). The introduction of school controls in Model 5 did not appreciably change the patterns for bargaining in any subject. All told, bargaining was *not* associated with lower gains in achievement between the eighth and tenth grades, as many have argued.

It is intriguing that collective bargaining was associated with greater tenth grade achievement in all four subjects before the eighth grade functions were entered. Perhaps model specifications that included the pretest from two years prior were too draconian in that there was comparatively little variance left to explain. In supplementary analyses not shown here in tabular format, OLS regressions were performed for tenth grade achievement scores without incorporating eighth grade achievement. After student, teacher, and school characteristics were controlled, bargaining wielded a statistically significant (positive) relationship only for history.

Table 2 also displays results from OLS regressions of tenth grade educational expectations on collective bargaining, expectations in eighth grade, and controls. Model 1 shows that bargaining was associated with statistically significant but trivially higher student expectations. Model 2 introduced eighth grade expectations as a predictor, which explained nearly 29% of the variance in tenth grade expectations (not shown in tabular format). Once eighth grade expectations were included in Model 2, the effect of collective bargaining was reduced to nonsignificance. The effect of bargaining turned slightly negative in Models 3 and 5 after student and school controls were added, but the effects sizes were trivial.

Multilevel modeling (MLM) techniques were employed as a check on the robustness of the OLS regression findings [66]. Since student and teacher controls did little to influence the effects of bargaining in Models 3 and 4, student/teacher and school characteristics were modeled over two levels, but the error terms for the slopes involving student and teacher controls were made nonrandomly varying at the school level. The use of MLM did not substantially alter the patterns already reported.

DISCUSSION

Collective bargaining was not negatively related to student achievement in this national study as opponents of unions argue. Further, students in schools with and without collective bargaining evinced comparable changes in educational expectations between the eighth and tenth grades. This study comports with the only other study that used NELS to study unionism's effects; Argys and Rees [49] reported that, though positive, the bargaining coefficient for math achievement failed to reach statistical significance ($p = .13$). At a minimum, this study finds that bargaining was not associated with lower student achievement in four subject areas between the eighth and tenth grades. Other studies suggest that bargaining is, in fact, related to higher achievement for most students.

It is possible that modeling student gains is not the optimal way to analyze the potentially cumulative effects of bargaining. The pretest was employed to isolate differences in achievement between the two grade levels, but this is theoretically limiting. The use of gain scores between eighth and tenth grades does not speak to the total difference attributed to bargaining between pre-kindergarten and the eighth grade or to the trajectory of the differences as grade level increases. The tacit assumption of most researchers is that the effects of bargaining, if they exist, should be of equal increments for each additional year as students pass through a set of repeated measures. However, it is possible that critical junctures exist wherein effects of bargaining dramatically accelerate or decelerate. If so, one would have to capture a critical juncture within a pretest-posttest window in order to detect it.

CONCLUSION

Teacher unions are not without dubious outcomes in the United States as they increase the costs of education and raise the specter of a strike when bargaining breaks down. Although there is mounting evidence that bargaining shapes the social organization of schools, these effects taken together do not appear to depress student achievement. There is evidence that teacher unions are more willing to be at the vanguard of reform than in the past [67, 68], yet the degree to which unions oppose and effectively block reforms counter to their interests is still open to debate [8, 68]. Notably, unions do not hamper what is ostensibly the most import charter of public schools—student learning—and provide material benefits and collegial support for millions of teachers and staff.

ACKNOWLEDGMENT

APPENDIX 1. Research on Collective Bargaining and Student Outcomes

Author(s)	Data	Level	Method(s)	Key finding(s)
Bargaining Diminishes Outcomes[a]				
Riley, Fusano, Munk, and Peterson [19]	California Dept. of Education local union contracts	District	Mean difference	Unionized districts scored lower than nonunion districts on the SAT-9 test for 4th and 10th grade students in math and reading.
Fuller, Mitchell, and Hartmann [20]	Bargaining contract	District	Qualitative/ Temporal correlation	Achievement test scores fell after the Milwaukee Public Schools adopted collective bargaining.
Hoxby [25]	Census of Governments	District	Instrumental variable regression	Unionized schools had drop-out rates that were about 2% higher.
Peltzman [44]	Various government and union documents; AFQT, 1971-1995	State	OLS regression	1) Stronger unionization during the 1970s was not linked with lower AFQT scores. 2) Increased unionization in the 1980s was linked to lower scores for some measures.
Peltzman [43]	Various government and union documents	State	OLS regression	1) Greater NEA strength from 1972 to 1981 led to higher SAT and ACT scores, while greater AFT strength had a negative effect. 2) From 1981 to 1989, both NEA and AFT unionization were linked to lower scores.

APPENDIX 1. (Cont'd.)

Author(s)	Data	Level	Method(s)	Key finding(s)
Kurth [24]	College Entrance Examination Board; government publications	State	OLS regression	Unionization had the strongest negative effect on change in SAT scores from 1972 to 1983 of any explanatory variable.
Bargaining Boosts Outcomes[a]				
Steelman, Powell, and Carini [54]	Schools and Staffing Survey, 1993-94; College Bound Seniors, 1993; Census of Governments	State	OLS regression	1) Positive relationships between unionization and SAT, ACT, and 8th-grade math NAEP scores. 2) Greater unionization linked to lower high school drop-out rates.
Milkman [21]	High School and Beyond, 1980-82	Student/ School	OLS regression	1) Students gained more on standardized math tests in unionized schools between their sophomore and senior years in high school. 2) Unionism benefited minority students less than white students. 3) Union effects for minority students were conditional on the racial composition of the school.
Nelson and Rosen [53]	Schools and Staffing Survey, 1994; Educational Testing Services, 1995	State	OLS regression	Positive relationships between unionization and SAT and 4th grade NAEP reading scores.

Study	Data Source	Level	Method	Findings
Zwerling and Thomason [55]	High School and Beyond, 1980-82	Student/School	OLS regression	Male students were less likely to drop out of unionized schools.
Zigarelli [22]	High School and Beyond, 1980-84	Student/School	OLS regression	1) Students in unionized schools improved approximately 3.5% more on math between their sophomore and senior years. 2) Increased school expenditures on nonsalary items and tighter school coupling reduced the effect to nonsignificance.
Zwerling and Thomason [37]	High School and Beyond, 1980-82	Student/School	OLS and Probit regressions	1) Test scores increased more from sophomore to senior year in unionized schools on math, civics, reading, science, vocabulary, and writing. 2) Union benefits diminished but did not become negative as student pretest scores moved away from the overall mean. 3) Students in unionized schools had lower drop-out rates.
Grimes and Register [69]	National Assessment of Economic Education Survey, 1987; telephone survey, 1988	Student/School	OLS regression	1) Students in unionized schools scored 3% higher on the SAT. 2) Black students in unionized schools scored 13% higher.

APPENDIX 1. (Cont'd.)

Author(s)	Data	Level	Method(s)	Key finding(s)
Register and Grimes [36]	National Assessment of Economic Education Survey, 1987; telephone survey, 1988	Student/ School	OLS regression	Students in unionized schools scored 4.7% higher on SAT and ACT.
Grimes and Register [51]	National Assessment of Economic Education Survey, 1987; telephone survey, 1988	Student/ School	OLS regression	High school seniors in unionized schools scored higher on a test of economic literacy.
Milkman [50]	High School and Beyond, 1980-82	Student/ School	OLS and Probit regressions	1) Students in unionized schools realized greater gains on standardized math tests from the sophomore to senior year. 2) Union benefit diminished as student pretest scores moved away from the overall mean.
Kleiner and Petree [52]	Educational Testing Service; American College Testing Service; U.S. Statistical Abstract; AFT documents; Census of Governments; state statutes	State	OLS regression	Greater unionization associated with higher ACT scores and graduation rates. Effects on SAT scores were positive or not significant, depending on the measure of unionization.

Nelson and Gould [42]	College Entrance Examination Board; government publications	State	OLS regression	States with more extensive unionization had higher SAT scores.
Eberts and Stone [17]	Sustaining Effects Survey, late 1970s	Student/ School	OLS regression	1) Students in unionized schools had 3% higher gains on math test scores. 2) Students with pretest scores near the mean had math gains that were 7% higher. 3) Students with extremely high or low pretest scores had math gains that were 7% lower.

Bargaining Does Not Affect Outcomes[a]

Argys and Rees [49]	NELS 1988-90	Student/ School	OLS regression	1) Positive but nonsignificant effects (p = .13) on standardized math tests from the 8th grade to sophomore year in schools with bargaining. 2) Union benefits diminished as student pretest scores moved away from the overall mean—negative union effects for extremely low- and high-scoring students.
Borland and Howsen [38]	KY Department of Education, 1989-90	District	OLS regression	Positive but nonsignificant effects on combined reading, language, and math standardized test scores for Kentucky third graders.

[a]Studies are listed in reverse chronological order.

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