Bargaining for Success: Examining the Relationship Between Teacher Unions and Student Achievement[1]

Todd E. Vachon[2] and Josef (Kuo-Hsun) Ma[3]

While many previous studies have identified a positive relationship between teachers unions and student achievement on standardized tests, little research to date has explored the channels through which unions might actually affect achievement. Utilizing multilevel random intercept models, we examine the effects of two categories of items commonly negotiated in teacher contracts—"industrial union" items and "professional union" items—on individual student math scores. Further, we assess the ability of these two clusters of variables to explain the positive union effect found in previous research. The results confirm that teachers unions are positively associated with student achievement and suggest that the industrial model explains moderately more of the union effect than the professional model; however, only the combination of both models is capable of reducing the union effect to nonsignificance. These findings are also confirmed in a supplemental analysis utilizing instrumental variables to account for the possibility of endogeneity. Finally, a decomposition of the union effect suggests that teachers unions are most beneficial to middle- and high-achieving students. We conclude that through industrial and professional bargaining, teachers are able to secure higher salaries, credentialing, and greater autonomy which lead to improved student achievement.

KEY WORDS: bargaining styles; education; school reform; teacher autonomy; teacher unions; workers' voice.

INTRODUCTION

The role of workers' voice on the job raises questions that have long animated sociological research on the workplace. The manner in which decisions are made in the workplace can be more or less democratic depending upon the nature of institutional arrangements. Within the teaching profession the questions are even more salient because many of the otherwise routine decisions about workplace rules and practices take on new meaning when they also affect student outcomes. Whether workers' voice in this setting—in the form of teachers unions—can serve the best interests of students in addition to just the interests of teachers has been a topic of investigation since the 1980s. On at least one measure, standardized test scores, most empirical studies conducted to date have found that teachers unions positively

affect student performance.[4] Despite these findings, little research has explored the channels through which unions might actually improve student achievement (see Eberts and Stone [1984] and Zigarelli [1994] for exceptions)—a question of great sociological significance considering the strong relationship between educational achievement and many social outcomes.

To address this gap in the literature, the current study examines two broad categories of issues commonly negotiated in teacher contracts—economic and noneconomic items—and evaluates their effects on the relationship between teacher unionization and student achievement. On the one hand, economic items, which correspond with Peterson's (1999) "industrial" model of unionism, are believed to influence the *supply* of teachers. For example, greater compensation should attract and retain more highly qualified applicants; applicants who would otherwise seek better-paying jobs in the noneducational private sector. On the other hand, noneconomic items, which correspond with Kerchner and Koppich's (1993) and Peterson's (1999) "professional" model of unionism, are believed to affect the *ability* of skilled teachers to perform their jobs as educators—issues such as class size and teacher autonomy. Many have suggested that the industrial model of bargaining is preventing the implementation of necessary reforms to improve public education and that a more professionally oriented type of reform bargaining should be expanded as a possible means for improving schools through the collective bargaining process (Johnson and Kardos 2000). Building from this discussion of industrial versus professional models of teacher unionism, this study assesses the extent to which these two bargaining strategies affect student achievement—a question that has been discussed and debated but not tested empirically at the national level.

To test these two models, we utilize data from the first follow-up of the National Educational Longitudinal Study (NELS) in 1990. This particular data set, which is now over 20 years old, was selected for several reasons. First, and most importantly, the NELS is the most recent nationally representative educational study with a measure of teacher unionization and questions related to industrial and professional bargaining. Second, a series of national and state-level educational policies, including the No Child Left Behind Act of 2001 and the Common Core State Standards of 2009, have severely reduced teacher autonomy and have initiated a process of standardization of teaching practices in both union and nonunion schools over the past decade (Hyslop-Margison and Sears 2010; Ingersoll 2003). While this may not have affected existing contracts, it certainly restricted the ability of many industrial-style unions to pursue certain aspects of the professional model of bargaining and narrowed the realm of possible differences between union and nonunion environments. Third, the recent controversial changes in law related to collective bargaining in several Midwestern states, including the infamous Wisconsin Act 10 (or "Budget Repair

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[4] For positive effects, see Eberts and Stone 1987; Grimes and Register 1990; Kleiner and Petree 1988; Milkman 1997; Nelson, Rosen, and Powell 1996; Steelman, Powell, and Carini 2000; Zigarelli 1994. For mixed results, see Eberts 2007; Lindy 2011; Peltzman 1993. For negative effects, see Kurth 1987. For alternative educational outcomes, see Fuller, Mitchell, and Hartmann 2000; Hoxby 1996; Lovenheim 2009; Moe 2009; Riley et al. 2002; Zwerling and Thomason 1992. For a review of past research, see Carini 2008a (Appendix).

Bill of 2011"), have eroded the ability of many teachers unions to bargain for issues beyond wages. These changes have effectively outlawed professional bargaining in some states—an important factor that would need to be controlled for in a more current study (if data were available). Together, these changes make NELS an ideal data set because it was collected during a period when the differences between union and nonunion schools were more pronounced and easily discernible. Although the findings from these data may no longer be generalizable to all schools, they still offer important insight into the possibilities of professional bargaining for improving student achievement in states with favorable bargaining laws. Further, recent developments such as the Chicago teachers' strike in 2012 and the American Federation of Teachers' "Reclaim the Promise" campaign suggest a growing desire by many unions to reassert their ability to positively affect student outcomes through the collective bargaining process.

This study makes several contributions to the sociological literature on teacher unionism. First, it utilizes a nationally representative sample to provide a multilevel (hierarchical linear modeling [HLM]) analysis of the effect of unions, at the school level, on the achievement of students on standardized tests at the individual level. Second, it evaluates the effects of key industrial and professional bargaining items on student achievement. Third, it distinguishes itself from previous studies of the union effect which used similar data (see Argys and Rees 1995; Carini 2008a; Zwerling and Thomason 1992) by examining which, if either, of these bargaining strategies explains the effect of unions on student achievement. Finally, it addresses concerns of endogeneity (selection bias)—common to studies of collective bargaining—by performing instrumental variable analyses of the main models. In sum, our findings confirm the positive relationship between unionization and student achievement found in several earlier studies and suggest that the industrial model explains slightly more of the union effect than the professional model; however, only the combination of both models is capable of reducing the union effect to nonsignificance. Given the ongoing debate over public school reform and the role of teachers unions in that reform, a detailed consideration of these bargaining items is very timely.

TEACHER UNIONISM IN HISTORICAL PERSPECTIVE

Teacher associations, operating largely as professional organizations, began forming at the end of the nineteenth century, and by 1902 the first teachers "union," the Chicago Federation of Teachers, joined the American Federation of Labor (AFL). This was one of many local precursors to the nationwide American Federation of Teachers (AFT) which was chartered in 1916 (Slater 2004). Although union membership grew steadily during the first half of the twentieth century, collective bargaining was almost unanimously prohibited until the 1960s, when states such as Wisconsin began to pass legislation permitting bargaining by public employees. Once allowed to bargain, teachers organized *en masse* to address the often unprofessional and unfair ways they were treated by management (Murphy 1990). Between

1960 and 2010 teacher union membership increased from 65,000 to 4.7 million, but still not all teachers are covered by collectively bargained contracts.[5] Today there are 32 states that mandate collective bargaining, 5 that expressly prohibit it, and 13 that allow it (if both teachers and management agree to it).[6]

Prior to collective bargaining, teachers were poorly paid (with extreme gender disparities in compensation), regularly harassed by management, and often summarily dismissed. Murphy (1990) documents the numerous incidents of teachers being fired for being married (women), for being accused of being communists, or for being members of racially integrated organizations in the South. It was the nature of these abuses that led to the "industrial union" character of early teachers unions who often struck for job security and higher pay (Cole 1969). As teacher unionism matured, having won much from earlier struggles, a "professional union" model began to rise in the 1980s and 1990s (Johnson and Kardos 2000; Kerchner and Koppich 1993; Peterson 1999). The professional union model has built upon the earlier successes of the industrial approach and incorporated many issues that could explicitly affect the performance of students (Chase 1997; Goldschmidt and Stuart 1986).

The following two sections will explore some of the key bargaining provisions of the industrial and professional models of unionism and consider their relationship with student achievement. Three distinct lines of research related to the potential mediators of student achievement can be identified: (1) studies that test whether issues that are typically bargained over affect educational outcomes, (2) studies that perform content analyses of union contracts to assess their likely impact on the social organization of schools, and (3) studies that test whether unionized schools differ from their nonunionized counterparts on social organizational aspects. These previous studies have explored an array of potential mediators of achievement, including standardization of curricula and instructional methods, shock theory and tighter vertical coupling (Zigarelli, 1994), principals' discretion to manage the school (Goldschmidt and Stuart 1986), teachers' influence over school policy (Eberts and Stone 1984), and teachers' job satisfaction. In order to streamline the review, we focus our discussion on only those past studies that deal explicitly with the mediators directly related to our theoretical framework—industrial versus professional bargaining.

INDUSTRIAL UNIONISM: THE ECONOMIC ASPECTS OF COLLECTIVE BARGAINING

The economic aspects of collective bargaining are the most widely recognized and understood function of unions. Items such as salary and wage scales, working hours, credentials, and fringe benefits are commonly referred to as "bread and butter" items and fall under the category of industrial unionism. As for teacher unions,

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[5] The 1960 total includes only AFT locals as the National Education Association (NEA) acted largely as a professional educational organization at that time and most branches still allowed school principals to join. The figure for 2010 includes both AFT and NEA membership.

[6] Bargaining is prohibited in GA, NC, SC, TX, VA; permitted in AL, AR, AZ, CO, ID, KY, LA, MO, MS, OH, UT, WV, WY; and required in the remaining states.

these items are often the target of attack by critics who claim that unions are narrowly self-interested, "rent-seeking" organizations who place the betterment of their members over the education of students (Hoxby 1996). However, given the positive association between teachers unions and teacher pay (Hirsch, Macpherson, and Winters 2011; Johnson and Donaldson 2006; Morgan and Kearney 1977) and between teachers unions and student achievement on standardized tests found in much previous research (Nelson et al. 1996; Steelman et al. 2000), one must ask, "How well does the industrial model of unionism explain student achievement?" In this section we consider two key aspects of industrial union bargaining: compensation and credentialing.

Compensation

The implication of teacher salaries and benefits for student achievement can be explained in economic terms by the functions of supply and demand. If the teaching profession offers relatively low compensation compared to private sector jobs requiring the same level of education, then highly educated individuals will be more likely to pursue occupations other than teaching (Murnane and Steele 2007). However, if teachers' salaries are competitive with the salaries of the nonteaching private sector, then the profession will likely attract and retain better job candidates. Figlio (1997) finds support for this hypothesis with evidence at the metropolitan and district level where public schools paying higher salaries are able to attract more teachers who had attended selective undergraduate institutions and more teachers with significant subject-matter expertise. Further support comes from studies by Hartman (1994), Hirsch et al. (2011), Loeb and Page (2000), MacPhail-Wilcox and King (1986), and Turner et al. (1986) who all find a positive relationship between teacher salaries and student achievement. In a meta-analysis of previous studies on school expenditures, Verstegen and King (1998) find 76% of findings about teacher salary showed a positive and statistically significant effect on student achievement. Additionally, Hanushek, Kain, and Rivkin (2004) find evidence that differences in teacher salaries can influence the decision of teachers to relocate to different school districts, often drawing the most experienced teachers to the best-paying districts. Considering these findings, we expect the starting salaries of teachers, at the school level, to be positively associated with individual student achievement.

Credentialing

Credentialing is a process by which professionals signal their aptitude or ability to perform the tasks of a given profession. Occupational groups have long sought credentialing systems as a means to both ensure uniform quality of job performance as well as to restrict the pool of job applicants, thus increasing the value of specialized labor to be performed exclusively by licensed professionals (Kleiner 2006). In the case of teachers unions, the incentives are similar; however, the students may also benefit from the highly educated pool of teachers produced by credentialing systems. On the whole, the literature supports these claims, suggesting that

credentialing of teachers serves both to increase the salary and prestige of teachers as well as the achievement of students (Wayne and Youngs 2003). For example, Clotfelter, Ladd, and Vigdor (2007) find a strong positive effect of teacher licensure and possession of advanced degrees; Ferguson (1991) finds a strong positive effect for teachers having master's degrees; Goldhaber and Brewer (2000) find standard certification to have a positive impact; and Boyd et al. (2008) find that the percentage of teachers within poor schools in New York City that have certification and advanced degrees has a positive effect on student achievement. Less convinced of these benefits, Rivkin, Hanushek, and Kain (2005) suggest that teacher quality is indeed a strong predictor of variation in achievement, but find that teacher credentials play a very small part in explaining the differences in student outcomes across teachers. On the whole, considering these theoretical offerings and empirical findings, we hypothesize that the extent to which teachers have master's degrees and standard certification within a school will be positively associated with student achievement.

PROFESSIONAL UNIONISM: THE NONECONOMIC ASPECTS OF COLLECTIVE BARGAINING

Aside from increasing compensation, unions can serve as a democratic voice for workers within the workplace to address various other working conditions which can impact student achievement. These additional, noneconomic aspects of collective bargaining represent the professional model of teacher unionism (Kerchner and Koppich 1993). By bargaining over professional issues, such as restricting class sizes and protecting their own professional judgment, unionized teachers attempt to improve student learning in ways that they feel are effective. Johnson and Kardos (2000) suggest that industrial bargaining served the factory model of education, which was common during the 1960s and 1970s, and that the professional "reform" bargaining model arose during the 1980s in response to the decline of the factory model of schooling that resulted from various school reform efforts. McDonnell and Pascal (1988) note that professional bargaining was only possible once the industrial model had first secured the bread-and-butter issues which enabled unions to move on to questions of professional autonomy and full participation. In this section we examine two key aspects of professional union bargaining: the student–teacher ratio and teacher autonomy.

Student–Teacher Ratio

In smaller classes, teachers have a greater opportunity to adapt instruction to the needs of individual learners and students are more directly and personally involved in their education. Smaller classes can be better monitored by teachers to ensure that individual students are "staying on task" and not "getting lost in the crowd." Further, small classes may not only affect learning outcomes directly, but may also contribute indirectly by affecting student attitudes and teacher perceptions of their own work. The literature on the ratio of students to teachers finds, on

balance, a positive effect of decreased class sizes on student achievement. For example, in a comprehensive review of previous studies, Glass et al. (1982) found 60% of previous studies favored small class size. Comparing just classes of 18 to those of 28, they found 69% of previous studies favored small class size. Further, Hanushek's (1989) meta-analysis found the overall percentage of studies with statistically significant positive outcomes slightly exceeded the percentage with negative outcomes (42% versus 38%). Further support for the benefits of smaller classes comes from the Tennessee STAR (Student/Teacher Achievement Ratio) project, which found smaller classes produced "improved teaching conditions, improved student performance, and, after the experimental years, improved learning behaviors, fewer classroom disruptions and discipline problems, and fewer student retentions" (Finn and Achilles 1999:98). We thus hypothesize that the student–teacher ratio will be negatively associated with individual student achievement; that is, schools with fewer students per teacher, on average, will perform better than schools with more students per teacher.

Teacher Autonomy

Within the sociological literature on work and occupations, the importance of work autonomy has been well established (Breaugh 1999). Worker autonomy has been linked to increased productivity, job satisfaction, efficacy, and performance as well as to reduced turnover (Cummings and Molloy 1977; Fried, 1991; Lee, Dedrick, and Smith 1991; Spector 1986). For unions, workplace autonomy also represents an opportunity to challenge managerial prerogative, deploy site-specific knowledge, and seek "respect" within the workplace (Silver 1990; Stepan-Norris and Zeitlin 2002). Jessup (1978) found that the major factor contributing to teacher union participation in six New York school districts was a feeling of powerlessness in educational decision making. The teachers became involved in unionization efforts with the goal of establishing collective bargaining agreements that would institutionalize autonomy and ensure teachers a voice in decisions regarding education. Carini (2008b) suggests that teachers have successfully institutionalized some aspects of autonomy through negotiations. In a study of the Schools and Staffing Survey (1993–1994), he found teachers in unionized schools reported more autonomy in the classroom, greater influence over school policy, greater instructional efficacy, and less coordination of content across classrooms than their nonunion counterparts.

Like any skilled trade, the teaching profession imbues its practitioners with a distinct set of craft knowledge that can only be obtained by performing the job. Through increased levels of workplace autonomy teachers can employ this invaluable knowledge to increase student achievement. Some key areas in which teachers may exercise autonomy are professional development, curriculum design, the selection of teaching materials, and the choice of teaching methods. Each of these will be reviewed briefly.

Professional development, when done correctly, has been shown to improve student achievement (Kennedy 1998; Wayne et al. 2008; Yoon et al. 2007). When teachers are empowered to develop their own professional growth, they are more

likely to self-identify their weaknesses and seek out ways to address them. Conversely, top-down, mandated professional development is often demoralizing and unrelated to what teachers are actually doing in their classrooms. If students are expected to think critically, craft innovative solutions, and solve problems, then teachers must be afforded the opportunity to approach their work in the same way (Sparks 2004). Peckover et al. (2006:137) argue that ongoing professional development involving "shared visioning, dialogue, collaboration, context sensitive inquiry, and shared learning for a common goal" develops the ability and passion of teachers to increase student achievement.

In an assessment of a teacher-directed professional development program in California, Colbert et al. (2008) report two main conclusions. First, teachers embraced their needs and took steps to address those needs. Being the creators of their own development program, teachers were more likely to acknowledge and address their personal weaknesses. Second, teachers pursued authentic professional development to increase their content knowledge. Rather than engaging in generic pedagogical exercises, secondary teachers were able to sharpen their skills within their subject area by creating their own professional development. Further support comes from a review by Yoon et al. (2007) which demonstrates that carefully constructed professional development, delivered by its creators, can have a positive effect on student achievement; however, Desimone (2009) urges us to use caution when interpreting the findings of professional development studies because methodological decisions can greatly alter the findings of otherwise similar studies.

As for curricular design, public schools often face a barrage of "mandates for change" in the form of prewritten curriculums that are passed down from central offices and state boards. Weaver, Coble, and Mattheis (1993) find that these curricular mandates are often not enthusiastically embraced at the administration level within schools, thus making it even less likely that they will be received with excitement by teachers. These prescribed curriculums view teachers merely as passive implementers of programs designed by others who are removed from the local environment, leaving little to no room for teachers to incorporate their own personal skills and knowledge into the planned learning environment (Tobin 1991). Unfortunately, when teachers do not understand the intent of curriculum designed by others, or when they feel pressured to make changes but have no voice in them, they tend to remold the new curriculum to fit their past practices (Apple 1990; Ball and Cohen 1996; Clark and Peterson 1986; Powell 1985). This on-the-fly transformation of curriculum serves neither the intent of the mandated curriculum nor what might have been the curriculum had the teacher been involved in its design.

In an experiment involving middle school science teachers who developed their own curriculum, Park and Coble (1997) found positive effects compared to classes that implemented the state-designed curriculum. In responses to survey questions, 67% of students in the experimental classrooms said science class was "interesting," compared to just 43% in the control group; 80% said they learned "useful" things in science class, as opposed to 47% in the control group; and 44% said they collaborated with fellow students "every day," compared to just 3% in the control group. The experimental teachers reported that they worked collaboratively with fellow teachers more often, were able to link daily lessons to real-world experiences more

often, and were more likely to try new things in the classroom that they had not tried before.

In addition to curriculum, but closely related, are the selection of teaching materials and the choice of teaching method—both key indicators of teacher autonomy. Through these forms of pedagogical autonomy, teachers are better able to adapt to the unique needs and unexpected situations that may arise in a given classroom during a given school year. Autonomous teachers in their individual classrooms are free to institute their own changes in methods or materials as students change or as new approaches become available (Deal and Celotti 1977). Alternatively, teachers who are tied to prescribed materials and teaching methods have little or no room to adapt to their unique and changing classroom environments. Further, pedagogical autonomy allows teachers to maximize the use of their own personal strengths and skills in the classroom to enhance the education of students. Considering these findings, we hypothesize that the degree of teacher autonomy within schools will be positively associated with student achievement.

DATA AND METHODS

Data

This study utilizes the NELS of 1988. The NELS public-use data set is a nationally representative sample of eighth-graders who were first surveyed in spring 1988 and then resurveyed through four follow-ups in 1990, 1992, 1994, and 2000. Student, teacher, and school data from the first follow-up in 1990—when the students were in tenth grade—are used for this analysis.[7] The sample includes 6,791 students nested within 799 public schools (private schools were excluded from this study). The NELS was selected over more current data sets (such as the Educational Longitudinal Survey) because it is the most recent nationally representative study conducted prior to several changes that reduced teacher autonomy in the early 2000s and it includes both a measure of unionization as well as key indicators of industrial and professional bargaining.

Level 1 Dependent Variable

Previous research has demonstrated that math skills are a better indicator of school effects than reading skills because math is learned almost exclusively at school while reading is more likely to be supplemented at home and varied by socioeconomic status (Bryk and Raudenbush 1988). Thus, to measure student achievement, we utilize *math score*, the NELS-administered, tenth-grade mathematics exam score as our dependent variable. This is a student-level measure.

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[7] It is possible that students may have moved into or out of unionized schools between eighth and tenth grade. Being unable to identify the direction of moves, we tried dropping all cases of students who had moved and reran our models. The findings were substantively unchanged.

Level 2 Independent Variables

To evaluate the effect of unions, a dichotomous measure of whether teachers within a school are covered by a collective bargaining agreement is included; this variable is named *union*. The union variable is taken from the base year survey in 1988, two years prior to the dependent and remaining independent variables. To capture the industrial union aspects of collective bargaining, one measure of teacher compensation and one measures of credentialing are included. *Teacher salary* represents the starting salary for new teachers with bachelor's degrees, measured in tens of thousands of dollars. To control for regional differences in pay due to cost-of-living differences, this variable is centered on the regional mean starting salary and constructed as follows: salary (centered) = salary – regional mean salary. This construction allows for a robust comparison of the effect of teacher salary on student achievement within schools across the entire country. *Teacher credentials* is a measure of the percentage of full-time teachers that hold both a standard teacher certificate and a master's degree within the school.

Two school-level variables are identified to represent the professional union model of collective bargaining. To examine the effects of class size, we follow previous research by using the *student–teacher ratio* as a proxy, created by dividing the total number of students within a school by the total number of full-time teachers. To be clear, this variable does not directly measure the number of students within each math classroom. Four school-level measures are identified to capture the effects of teacher autonomy: influence over professional development, curriculum design, textbook selection, and teaching methods. Each measure ranges from 1 for "no influence" to 5 for "a great deal of influence," with 3 representing "moderate influence." We sum these four measures to construct the *teacher autonomy index*. The four measures load onto one factor and the index has a Cronbach's alpha value of .71.

Control Variables

Following previous educational research, we control for prior academic achievement, socioeconomic status, and demographic factors at the individual level. To account for previous math achievement as well as any innate skills that may exist at the individual level, we control for student's *previous math grades* by including a five-category ordinal self-assessment of previous math grades, ranging from 1 (mostly Fs) to 5 (mostly As).[8] To control for social class, we include a measure of *parent's education*, operationalized as the highest number of school years completed

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[8] Alternatively, we considered controlling for previous test scores. However, we opted to use previous grades instead because previous scores were highly correlated with the dependent variable (r = 0.88); a problem encountered by Carini (2008a). In addition to high correlation, there are three other concerns with controlling for previous scores: (1) the presence of a union is likely to affect both the eighth-grade and the tenth-grade test scores, which would overcontrol for the union effect; (2) controlling for previous scores on the same assessment would effectively transform the study from a cross-sectional analysis of the effects of unions on achievement to a study of improvement over time; and (3) evaluations of test score improvement are problematic due to the presence of a ceiling effect (e.g., lower performing students have more room to improve because there is a maximum possible score).

by the parent with the highest level of education, and a measure of *family income*, operationalized as total family income in tens of thousands of dollars. The family income variable is centered on the mean. To control for student's race, we include a simple dummy variable for *minority*, which is coded as 1 for nonwhite students. At the school level (level 2), we include a control for the racial composition of the school, *percent minority students in the school*, and a control for the socioeconomic composition of the school, *percent students receiving free lunch*. The complete descriptive statistics and coding are presented in Table I.

Method

This study uses random intercept models to estimate a series of multilevel, cross-sectional models (Raudenbush and Byrk 2002) that examine the effects of unionization and each of the two clusters of test variables (industrial unionism and professional unionism) on individual student math achievement.[9] The study will also explore the moderating effects of industrial and professional bargaining on the union-achievement relationship. For this analysis, level 1 represents student-level attributes and level 2 represents school-level factors. Our analytic approach involves seven models, estimated via restricted maximum likelihood regression. Model 1 will serve as the level-1 baseline model and point of reference for level-2 error variance. Model 2 will include the level-2 controls and the level-2 measure of unionization; this model will be used as a point of reference for the moderating effect of industrial and professional bargaining on the union parameter. Models 3 and 4 will introduce each cluster of level-2 variables separately, allowing for an examination of the hypothesized effects of the industrial and professional bargaining items on student achievement, independent of unionization. Models 5 through 7 reinsert the level-2 measure of unionization and introduce the industrial and professional union models separately and then together to facilitate a comparison of their influence on the union parameter from model 2. Pseudo R^2 measures are computed for each model by subtracting the level-2 error variance component of the focal model from that of the baseline model and dividing the difference by the level-2 error of the baseline model. This value represents the proportional reduction in error variance of each model compared to the baseline model. Significance for all variables will be measured at the $p < .10$, $p < .05$, $p < .01$, and $p < .001$ levels using two-tailed tests. In addition to the primary analyses, a set of supplemental analyses are conducted utilizing instrumental variables. This approach will be elaborated further when the results are considered below.

RESULTS

Descriptive Analysis

Descriptive statistics for all variables are presented in Table I. At level 1, the NELS standardized math scores range from a low of 31.7 to a high of 71.9, with an

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[9] The only other study we could find that utilized hierarchical linear modeling to examine the union-achievement effect was by Carini (2008a) in a supplemental analysis.

Table I. Descriptive statistics for all variables in the analysis

Variable Name	All Public Schools				Nonunion Schools		Union Schools[a]		Description/Coding
	Mean	SD	Min	Max	Mean	SD	Mean	SD	
Standardized Math Score	51.5	9.8	31.7	71.9	50.7	9.7	51.9	9.8	Student's score on 10th grade mathematics exam
Previous Math Grades	4.0	1.0	1.0	5.0	4.1	1.0	4.0	1.0	Student's overall math grades in Jr. High; 5 = mostly As
Parent's Education	14.1	2.5	10.0	22.0	14.0	2.5	14.2	2.5	Total years of education for parent with highest attainment
Family Income	3.8	3.1	0.0	25.0	3.6	3.2	3.8	3.1	Total family income in tens of thousands of dollars, 1990
Racial Minority	0.3	0.5	0.0	1.0	0.3	0.5	0.3	0.5	Student is not white = 1
Pct. Minority Students in School	22.2	27.1	0.0	95.5	26.3	27.3	19.7	26.6	Percent of students who are not white
Pct. Students Receive Free Lunch	24.0	21.1	0.0	88.0	26.8	22.0	22.4	20.3	Percent of students who receive free lunch
Teacher Starting Salary	17.7	2.5	11.0	23.0	16.9	2.7	18.1	2.3	Starting salary for new teachers in thousands of dollars, 1990
Teacher Credentials	49.6	31.9	0.0	100.0	43.6	32.0	53.0	31.3	Percent of teachers who have a standard certification and a master's degree
Student-Teacher Ratio	16.9	6.1	5.3	72.0	16.7	5.6	17.0	6.3	Ratio of students to teachers
Teacher Autonomy Index	15.8	2.1	8.0	20.0	15.3	1.9	16.2	2.1	Sum of five items: teacher control over textbooks + teacher control over their teaching + teacher influence over professional development + teacher influence over curriculum. Responses range from 0-5 for each item; 5 = a great deal of influence
N	6,791				2505		4286		

[a]The difference in means for all variables (union vs. nonunion) are statistically significant at the .05 level using two-tailed tests.

average test score of 50.7 for nonunion schools and 51.9 for unionized schools. This difference represents a 3% advantage for students in unionized schools compared to their nonunion counterparts. Looking at prior math ability, students on average report previous math grades to be "mostly Bs," with a standard deviation of about one letter grade. The sociodemographic measures reveal that parental education ranges from 10 to 22 years, with a mean of 14 years and that total family income in 1988 ranges from $0 to $250,000, with a mean of $38,000. Approximately 30% of all students in the sample are racial minorities. At the school level, on average, 22% of students are racial minorities and about 24% of all students within schools receive free lunch. Comparing the Ns for union versus nonunion schools we can see that approximately 63% of students in this sample attend unionized schools. The first industrial union variable—starting salary for teachers with a bachelor's degree —has a mean of $16,900 for nonunion schools and $18,100 for unionized schools. Looking at teacher credentials, we see that, on average, 43.6% of nonunion and 53% of unionized teachers hold a standard certification and a master's degree. Looking next at the professional union items, we find that the student–teacher ratio ranges from a low of 5 to a high of 72 students per teacher, with a mean of about 17 and a standard deviation of 6. Looking next at the teacher autonomy index, we see that, on average, nonunion teachers report having 15.3 out of 20 and unionized teachers 16.2 out of 20 on the autonomy index, which suggests moderate influence over professional development, curriculum design, textbook selection, and teaching methods, with union teachers having modestly greater autonomy. The differences in means between all variables in nonunion versus union schools are significant at the .05 level or better.

Multilevel Analysis

Table II contains the results from the multilevel analyses of student achievement for tenth-grade standardized math exams in the NELS. The intraclass correlation coefficient (ICC) indicates that approximately 22% of the variation in test scores exists between schools. Model 1 introduces the level-1 control variables. As in previous research, the coefficients for previous grades, parent's education and family income are positive. Minority status of the student is negatively associated with test scores and is statistically significant at the .001 level.

In Model 2 we add the school-level controls along with the union variable, which together reduce the level-2 error term by 19% (in a model not shown, we find the union variable alone explains 4% of the level-2 error variance). The percent of minority students within a school and the percent of students receiving free lunch are both negatively related to test scores and are statistically significant. Having a teachers union at the school level is positively related to student test scores, which corroborates findings of previous studies on teacher unions at the state and the student level. Students within unionized schools score, on average, 2% higher on the standardized math exam than students in nonunion schools when controlling for individual characteristics and school-level racial and economic composition.

Table II. Multilevel random intercept models predicting student mathematics exam scores

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Level 1-Student Variables							
Controls							
Previous Math Grades	3.904***	3.908***	3.907***	3.896***	3.911***	3.902***	3.905***
	[0.103]	[0.102]	[0.102]	[0.103]	[0.102]	[0.103]	[0.103]
Parent's Education	0.961***	0.924***	0.921***	0.928***	0.92***	0.928***	0.924***
	[0.045]	[0.045]	[0.045]	[0.045]	[0.045]	[0.045]	[0.045]
Family Income	0.201***	0.168***	0.158***	0.158***	0.160***	0.160***	0.151***
	[0.036]	[0.036]	[0.036]	[0.036]	[0.036]	[0.036]	[0.036]
Racial Minority	−2.632***	−2.056***	−2.083***	−2.020***	−2.083***	−2.028***	−2.057***
	[0.229]	[0.249]	[0.249]	[0.250]	[0.249]	[0.250]	[0.250]
Level 2-School Variables							
Controls							
Pct. Minority Students in School		−0.011†	−0.015*	−0.005	−0.013*	−0.005	−0.008
		[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Pct. Students Receive Free Lunch		−0.053***	−0.052***	−0.055***	−0.052***	−0.055***	−0.053***
		[0.008]	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]
Unionization							
Union		0.776**			0.574*	0.658*	0.435
		[0.275]			[0.285]	[0.279]	[0.290]
Industrial Union Model							
Teacher Starting Salary			0.140**		0.114*		0.130*
			[0.054]		[0.055]		[0.056]
Teacher Credentials			0.009*		0.008†		0.007†
			[0.004]		[0.004]		[0.004]
Professional Union Model							
Student-Teacher Ratio				−0.005		−0.009	−0.005
				[0.022]		[0.022]	[0.022]
Teacher Autonomy Index				0.252***		0.222***	0.235***
				[0.065]		[0.066]	[0.066]
Constant	22.919***	24.331***	24.493***	20.860***	24.138***	20.929***	20.518***
	[0.730]	[0.779]	[0.779]	[1.366]	[0.798]	[1.363]	[1.384]
Error Variances							
Level 1	58.943	58.792	58.749	58.712	58.762	58.718	58.687
Level 2 (intercept)	7.201	5.810	5.852	5.677	5.773	5.587	5.538
Pseudo R²		0.19	0.19	0.21	0.20	0.22	0.23

Notes: N = 6,791 students nested within 799 public schools. †p < .10, *p < .05, **p < .01, ***p < .001. Standard errors in brackets. ICC = .219. The Pseudo R² represents the proportion reduction in level 2 error variance relative to Model 1.

Models 3 and 4 introduce the two clusters of bargaining items—industrial and professional unionism—separately to assess their relationship with student achievement. Beginning with industrial bargaining items in Model 3, we find teachers' starting salaries to be positively related to test scores and statistically significant. For a $10,000 increase above the regional average starting pay at the school level, individual student test scores will increase by 3%. Teacher credentials are also positively associated with test scores and significant. Students in schools where 100% of teachers have standard certification and a master's degree can be expected to score about 1.1% higher on the math test than students in schools with the mean level of credentials (49.6% of teachers). The industrial union cluster as a whole represents a 19% reduction in error variance compared to Model 1.

Model 4 examines the cluster of bargaining items associated with professional unionism. The first predictor, student–teacher ratio, shows a negative, but not significant effect on student math scores. The teacher autonomy index has a positive and significant effect on student achievement. Students in schools where teachers report having "a great deal of influence" over all four items (20/20 on the index) can be expected to perform 2.5% better on math tests than students in schools with the mean level of influence (15.8/20 on the index). Overall, the professional union cluster accounts for a 21% reduction in error variance compared to Model 1.

Models 5 through 7 reintroduce the level-2 measure of unionization, thus allowing a comparison of the ability of each bargaining model, separately, as well as together, to explain the positive effect of unions found in Model 2. Beginning with Model 5, we find the inclusion of industrial variables reduces the union coefficient by 26% (from .776 to .574) and reduces its significance. In Model 6 we find professional bargaining reduces the union coefficient by 15% (from .776 to .658) and reduces its significance. Comparing the two models, we see that industrial unionism explains a greater proportion of the union effect. Model 7 combines all of the bargaining items into one analysis. The inclusion of both the industrial and the professional bargaining items reduces the union effect by 44%, from .776 to .435, and it is no longer statistically significant. Looking at the pseudo R^2, we see that inclusion of all six bargaining items and the measure of unionization has reduced the intercept variance at school level by 23% compared to Model 1.

Identifying the Channels of Influence

Figure 1 displays the standardized coefficients for the channels of influence of unionization on student achievement.[10] On the left side of the diagram, the direct effect of unionization on each of the bargaining items displays the expected sign, with unions positively affecting salaries, credentialing, and autonomy, and

[10] This path diagram differs slightly from the diagram and tables in previous research by Eberts and Stone (1984:6–7) on the channels of influence of collective bargaining on student achievement. The primary difference stems from our focus on the theorized "industrial" and "professional" bargaining items considered in this research whereas Eberts and Stone were concerned with a wider variety of issues, including school resources, teaching time, and administrative leadership.

Industrial Unionism
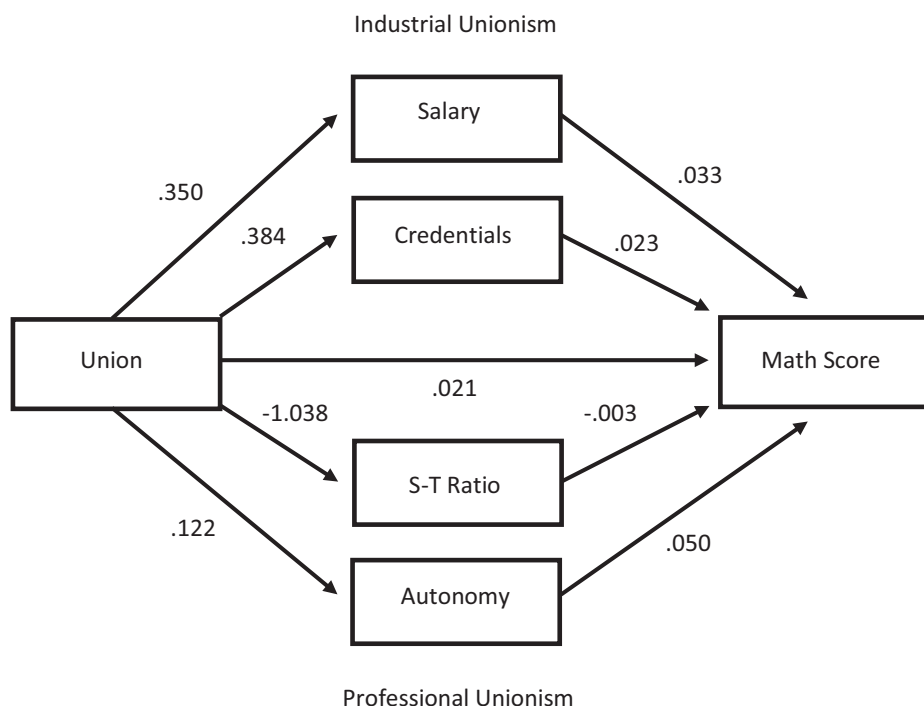
Fig. 1. Standardized direct and indirect effects of teacher unions on student achievement.

negatively affecting (reducing) the student-teacher ratio. Of these four measures, unions have the greatest standardized effect on student–teacher ratios. In real terms, having a union reduces the student–teacher ratio by 1.038 standard deviations, or approximately six students, holding all else equal. On the right side of the diagram we see similar results for the variables: salaries, credentialing, and autonomy have a positive direct effect on math scores, while the student–teacher ratio has a negative effect. Among the four bargaining items examined here, teacher autonomy has the single largest effect on test scores. For each standard deviation increase in the autonomy index, math scores are expected to increase by .05 standard deviations, or approximately half a point, holding all else equal. In the middle of the diagram we can see that the remaining direct effect of unionization after accounting for the bargaining items is .021 standard deviations, or about .21 points on the test score.

To explore the indirect effects of unions on achievement, we simply multiply the direct effect of unionization on each bargaining item by the direct effect of that bargaining item on test scores. For example, the indirect effect of unions on test scores through starting salary is .350 x .033 = .012 standard deviations. The remaining indirect effects are as follows: .009 for credentials, .003 for the student–teacher ratio, and .006 for autonomy. Overall, this diagram illustrates the channels of influence through which the industrial and professional models of unionism affect math scores and contribute to modestly greater student achievement.

Supplemental Analyses: Instrumental Variable Analysis

Recent literature on teacher unionization has raised concerns about the possible endogeneity of union dummy variables in cross-sectional analyses like ours (Hoxby 1996; Lindy 2011; Lovenheim 2009; Moe 2009). Endogeneity occurs when an independent variable is correlated with the error term in a regression model, leading to biased regression coefficients. The source of concern with our union measure is due to the potential for selection bias; that is, the types of parents who cluster into certain school districts may have preferences for both greater school spending and teacher unionization. There are many statistical methods for overcoming endogeneity, including instrumental variable regression and Heckman selection correction. Following previous research on teachers unions (Hoxby 1996) we conduct an instrumental variable analysis using two instruments for unionization—state collective bargaining laws, 1985 (Freeman and Ichniowski 1988) and state-level union density, 1985 (Hirsch and Macpherson 2013).[11]

The results of the instrumental analyses (not shown) are similar to those presented in the main analysis with two differences. First, the union effect is considerably larger in the instrumental analysis (coef = 2.722 in model 2). Second, the mediating effects of industrial and professional bargaining are both greater. Looking at Fig. 2, panel A, we see that the explanatory power of the industrial model is stronger, reducing the union effect by 28% compared to 26% in the main analysis. The professional model is also stronger, reducing the union effect by 24% compared to just 15% in the main analysis. Again, only the combination of both models of unionism together reduces the union effect to nonsignificance (coef = 1.26, p = .209) with a total reduction of 54% (compared to 44% in the main analysis). In sum, the findings of the instrumental regression allow us to view the results from the main analysis with confidence that they are not biased by problems of endogeneity. Complete results from the instrumental analysis are available from the authors upon request (pending approval from the National Center for Educational Statistics as they utilize restricted data).

Decomposition of Effects by Level of Achievement

In addition to the instrumental variable analysis, we follow previous research by addressing the possibility that the union effect may vary for students of different abilities (Argys and Rees 1995; Eberts 2007; Eberts and Stone 1987; Lindy 2011; Zwerling and Thomason 1992). We test this possibility by examining the predicted test scores of students in union versus nonunion schools by their self-reported grades in mathematics from middle school. In panel B of Fig. 2 we see that students who reported earning mostly As or Bs in math appear to benefit the most from unionization with the lowest performers trailing close behind. The group that does

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[11] Teacher collective bargaining laws are coded "1" for states that allow or mandate bargaining and "0" for states that outlaw it or have no law on record. Union density represents the percentage of the workforce that belongs to unions. The Sargan test statistic for these instruments was .10 with a chi-square p-value of .75, which confirms the instruments are not endogenous. The restricted-use NELS data set was utilized to match state-level data with students and schools.
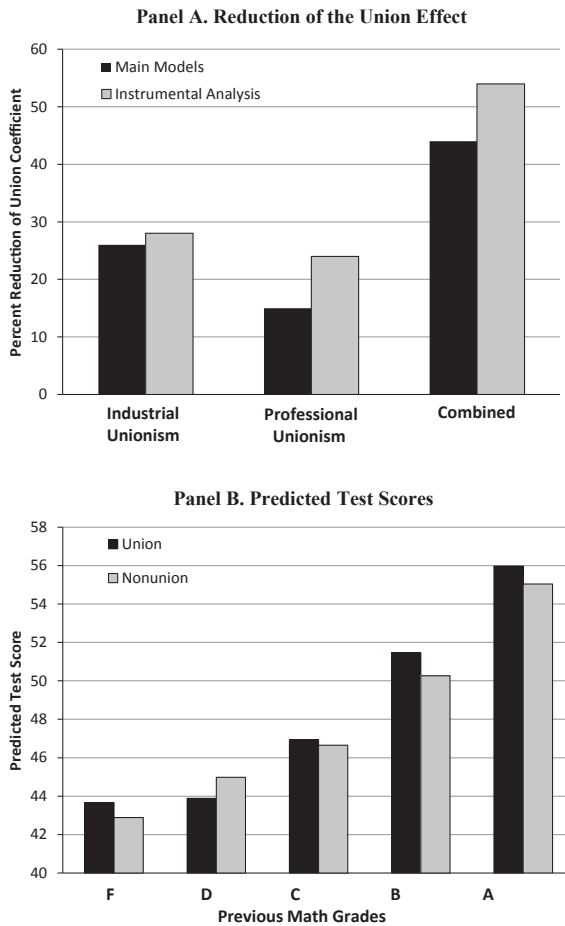
Panel A. Reduction of the Union Effect

Panel B. Predicted Test Scores

Fig. 2. Supplemental analyses.

not appear to benefit from unionization is comprised of the low, but not failing, performers (mostly Ds). This finding is somewhat different from Eberts and Stone (1987) and Eberts (2007), who found unions to be most beneficial for middle-level students, but it supports the findings of Lindy (2011) who found unions to be most beneficial for high-achieving students. Taken together, these findings suggest a generally positive effect of unions for students across the achievement spectrum, with students in four of the five categories scoring higher in unionized schools.

DISCUSSION AND CONCLUSION

The relationship between teachers unions and student achievement on standardized tests has been shown in most previous research to be positive; however, very little research to date has attempted to explain the mechanisms by which

unions facilitate greater achievement. This study assesses the extent to which two models of unionism—industrial unionism and professional unionism—explain both student achievement and the union effect on student achievement. We begin with a reassessment of the relationship between teachers unions and student achievement by fitting a multilevel model of individual students nested within public schools. We then explore and compare the relationship between the two models of unionism and the effect of unions on student achievement. This article has several key findings.

First, further support is found for the positive relationship between teachers unions and student achievement on standardized tests that has been demonstrated in previous studies (Eberts and Stone 1987; Grimes and Register 1990; Kleiner and Petree 1988; Milkman 1997; Nelson et al. 1996; Steelman et al. 2000; Zigarelli 1994). The multilevel design yields similar results to previous state- and student-level studies. Second, the industrial model of unionism is positively associated with student performance. This relationship operates mostly through the salary scale, a factor that can affect the supply of teachers by making teaching a more (or less) attractive profession for highly educated workers on the job market. Thus, bargaining for higher wages appears to go beyond mere "rent seeking" by having positive effects on the supply and performance of teachers which in turn fosters greater student achievement. This finding supports previous research on the relationship between teacher salaries and student achievement (Verstegen and King 1998) and extends the logic to help explain in part the positive union effect on student achievement. Teacher credentialing, in the form of standard teacher certification and master's degrees, also contributes to student achievement by restricting the teacher labor market to an adequately trained pool of would-be teachers.

Third, the professional model of unionism is also positively associated with student achievement. Professional unionism focuses on noneconomic items that can affect teachers' abilities to teach their students. The effect of professional unionism in this analysis is driven by the positive association between teacher autonomy and student achievement. When teachers have more voice in their professional development programs, development of curriculum, selection of teaching materials, and choice of teaching methods to be employed in their classrooms, they have a better understanding of the intended goals of the curriculum and materials and they are better able to deploy the appropriate methods for its successful implementation. This finding contributes to a long line of sociological research on worker autonomy and lends support to the hypothesis that more autonomous workers are often more productive (Cummings and Molloy 1977; Fried 1991; Lee et al. 1991; Spector 1986). Finally, the bargaining items associated with the industrial and professional models of unionism help to explain the overall positive effect of unions on student achievement; explaining nearly half of the union effect (44%). When compared, the industrial model explains more of the union effect (26%) than the professional model (15%); however, when examining the supplemental instrumental analyses, the professional model performs slightly better than the industrial model. In sum, these two models of unionization do a relatively good job of explaining both student achievement as well as the positive effect of unionization on student achievement.

Although this study employs a reasonably comprehensive set of variables, we acknowledge several limitations to this analysis. First, the application of these findings from 1990 to the current political-legal climate of 2014 is no longer logical in many places. Considering the implementation of the No Child Left Behind Act—which has triggered a wave of state-level restrictions on teacher autonomy—and the erosion of bargaining rights in many states, these period-based findings cannot be universally translated into practice, but they still offer important insight into the possibilities of professional bargaining for improving student achievement in states with favorable bargaining laws and suggest that such laws could be beneficial for students in other states. In particular, we find teacher autonomy in the form of influencing curriculum, professional development, textbook selection, and teaching methods is positively related to student test scores. These findings take on more significance when considering recent developments such as the Chicago teachers' strike in 2012 and the AFT's "Reclaim the Promise" campaign, both actions that suggest a desire by many unions to address, via professional bargaining, many of the non-economic issues that affect student achievement. If more current data become available, future research should consider the effects of No Child Left Behind, Race to the Top, and various changes in collective bargaining laws on the relationships between different types of unionism and student performance. In particular, future studies with new data could compare the union effect in states that have reduced their collective bargaining rights to states that have not as well as compare how the reduction in bargaining rights has affected the union effect within states over time. Despite its data limitations, this study suggests that educational reform and workers' voice are compatible, but only in a legal environment that permits workers to participate in decisions about issues beyond just wages.

A second limitation of this study involves the operationalization of teacher salary. There are likely several school-, state-, and regional-level variables that are correlated with teacher salary and for logistical reasons were not incorporated in this analysis. For example, local cost of living and local tax base—both of which are not available in the public-use data set. We have partially addressed this issue by centering teacher salary on the regional average salary, but a locally standardized measure of pay would be superior. A third limitation involves the student–teacher ratio, which had null findings in this study. Student–teacher ratio is a weak proxy for actual class size, which would be a more accurate measure to capture the theoretical insights brought forth in the literature review. The null findings in our study could be due to the difference between school's offerings of various specials such as art and music—classes that would require additional staff and thus affect the student–teacher ratio without directly affecting the number of students in math classes. Finally, the dependent variable in this analysis—a standardized test score—is not without problems and deficiencies as an indicator of student ability. Although testing in recent years has become the default measuring stick for school performance, there are many compelling arguments against its ability to accurately represent student learning (Kohn 2000).

Overall, the findings of this study suggest that future debates concerning school reform should consider the collective voice of teachers. Given the well-established relationship between education and various social outcomes, further

studies of workers' voice within school systems can only provide more information for policy makers interested in improving schools. Policies like No Child Left Behind, Race to the Top, and the Common Core State Standards, championed by many state- and national-level policy makers, involve the standardization of curriculum development, the centralization of decision making, and often lead to outright attacks on teachers who stand up for competitive wages, autonomy, and smaller class sizes. The findings of this study suggest that policy makers would do well to consider the important role that these bargained working conditions play in affecting the achievement of students. When teachers achieve self-actualization, their work fulfills a broader human need—beyond mere remuneration—and their commitment to self-improvement and student achievement increase. The industrial and professional models of unionism examined in this study demonstrate the ways in which, through collective bargaining, teachers unions can improve student achievement, thus suggesting an active role for teachers in the improvement of public education. Through the collective bargaining process, teachers can ensure that their voices are heard and their expertise is taken into consideration in any future reforms of public schools in the United States.

REFERENCES

Apple, Michael W. 1990. "Is There a Curriculum Voice to Reclaim?" *Phi Delta Kappan* 71: 7: 526–531.

Argys, Laura M., and Daniel I. Rees. 1995. "Unionization and School Productivity: A Reexamination." In S. Polacheck (ed.), *Research in Labor Economics*, Volume 14: pp. 49–68. Greenwich, CT: JAI Press.

Ball, Deborah L., and David K. Cohen. 1996. "Reform by the Book: What Is—or Might Be—the Role of Curriculum Materials in Teacher Learning and Instructional Reform?" *Educational Researcher* 25: 9: 6–14.

Boyd, Donald, Hamilton Lankford, Susanna Loeb, Jonah Rockoff, and James Wyckoff. 2008. "The Narrowing Gap in New York City Teacher Qualifications and Its Implications for Student Achievement in High-Poverty Schools." *Journal of Policy Analysis and Management* 27: 4: 793–818.

Breaugh, James A. 1999. "Further Investigation of the Work Autonomy Scales: Two Studies." *Journal of Business and Psychology* 13: 3: 357–373.

Bryk, Anthony S., and Stephen W. Raudenbush. 1988. "Toward a More Appropriate Conceptualization of Research on School Effects: A Three-Level Hierarchical Linear Model." *American Journal of Education* 97: 1: 65–108.

Carini, Robert M. 2008a. "Is Collective Bargaining Detrimental to Student Achievement? Evidence From a National Study." *Journal of Collective Negotiations* 32: 3: 215–235.

Carini, Robert M. 2008b. "Teacher Unions and the Social Organization of Public Schools." In P. R. Weigart (ed.), *Teaching and Education: 21st Century Issues and Challenges*: pp. 73–106. New York: Nova Science.

Chase, Robert. 1997. "The New NEA: Reinventing Teachers Unions for a New Era." Remarks by the NEA president before the National Press Club, Washington, DC, February 5.

Clark, Christopher, and Penelope L. Peterson. 1986. "Teachers' Thought Processes." In M. C. Wittrock (ed.), *Handbook of Research on Teaching*: pp. 255–296. New York: Macmillan.

Clotfelter, Charles T., Helen F. Ladd, and Jacob L. Vigdor. 2007. "How and Why Do Teacher Credentials Matter for Student Achievement?" NBER Working Paper Series, Working Paper 12828. Cambridge, MA: National Bureau of Economic Research.

Colbert, Joel A., Richard S. Brown, SunHee Choi, and Steven Thomas. 2008. "An Investigation of the Impacts of Teacher-Driven Professional Development on Pedagogy and Student Learning." *Teacher Education Quarterly* 35: 2: 135–154.

Cole, Stephen. 1969. *The Unionization of Teachers: A Case Study of the UFT*. New York: Praeger.

Cummings, Thomas G., and Edmund S. Molloy. 1977. *Improving Productivity and the Quality of Work Life*. New York: Praeger.

Deal, Terence E., and Lynn D. Celotti. 1977. *"Loose Coupling" and the School Administrator: Some Recent Research Findings*. Stanford, CA: Center for Educational Research.

Desimone, Laura M. 2009. "Improving Impact Studies of Teachers' Professional Development: Toward Better Conceptualizations and Measures." *Educational Researcher* 38: 3: 181–199.

Eberts, Randall W. 2007. "Teachers Unions and Student Performance: Help or Hindrance?" *The Future of Children* 17: 1: 175–200.

Eberts, Randall W., and Joe A. Stone. 1984. *Unions and Public Schools: The Effect of Collective Bargaining on American Education*. Lexington, MA: Lexington Books.

Eberts, Randall W., and Joe A. Stone. 1987. "Teacher Unions and the Productivity of Public Schools." *Industrial and Labor Relations Review* 40: 3: 354–363.

Ferguson, Ronald F. 1991. "Paying for Public Education: New Evidence on How and Why Money Matters." *Harvard Journal on Legislation* 28: 1: 465–479.

Figlio, David. 1997. "Teacher Salaries and Teacher Quality." *Economics Letters* 55: 2: 267–271.

Finn, Jeremy D., and Charles M. Achilles. 1999. "Tennessee's Class Size Study: Findings, Implications, Misconceptions." *Educational Evaluation and Policy Analysis* 21: 2: 97–109.

Freeman, Richard B., and Casey Ichniowski (eds.). 1988. *When Public Sector Workers Unionize*. Chicago, IL: University of Chicago Press.

Fried, Yitzhak. 1991. "Meta-Analytic Comparison of the Job Diagnostic Survey and Job Characteristics Inventory as Correlates of Work Satisfaction and Performance." *Journal of Applied Psychology* 76: 5: 690–697.

Fuller, Howard L., George A. Mitchell, and Michael E. Hartmann. 2000. "Collective Bargaining in Milwaukee Public Schools." In T. Loveless (ed.), *Conflicting Missions? Teachers Unions and Educational Reform*: pp. 110–149. Washington, DC: Brookings Institution Press.

Glass, Gene V., Leonhard Cahen, Mary L. Smith, and Nikola Filby. 1982. *School Class Size*. Beverly Hills, CA: Sage.

Goldhaber, Dan, and Dominic J. Brewer. 2000. "Does Teacher Certification Matter? High School Teacher Certification Status and Student Achievement." *Educational Evaluation and Policy Analysis* 22: 2: 129–145.

Goldschmidt, Steven M., and Leland E. Stuart. 1986. "The Extent and Impact of Educational Policy Bargaining." *Industrial and Labor Relations Review* 39: 3: 350–360.

Grimes, Paul W., and Charles A. Register. 1990. "Teachers' Unions and Student Achievement in High School Economics." *Journal of Economic Education* 21: 3: 297–306.

Grimes, Paul W., and Charles A. Register. 1991. "Collective Bargaining, Teachers, and Student Achievement." *Journal of Labor Research* 12: 2: 99–109.

Hanushek, Eric A. 1989. "The Impact of Differential Expenditures on School Performance." *Educational Researcher* 18: : 45–62.

Hanushek, Eric, John Kain, and Steven Rivkin. 2004. "Why Public Schools Lose Teachers." *Journal of Human Resources* 39: 2: 326–354.

Hartman, William T. 1994. "District Spending Disparities Revised." *Journal of Education Finance* 20: 1: 88–106.

Hirsch, Barry T., and David A. Macpherson. 2013. "Union Membership and Coverage Database From the CPS." Retrieved October 10, 2013 (www.unionstats.com)

Hirsch, Barry T., David A. Macpherson, and Jon V. Winters. 2011. "Teacher Salaries, State Collective Bargaining Laws, and Union Coverage." Association for Education Finance and Policy (AEFP), Seattle, WA, March.

Hoxby, Caroline M. 1996. "How Teachers Unions Affect Education Production." *The Quarterly Journal of Economics* 111: 3: 671–718.

Hyslop-Margison, Emery J., and Alan M. Sears. 2010. "Enhancing Teacher Performance: The Role of Professional Autonomy." *Interchange* 41: 1: 1–15.

Ingersoll, Richard M. 2003. *Who Controls Teachers' Work? Power and Accountability in America's Schools*. Cambridge, MA: Harvard University Press.

Jessup, Dorothy K. 1978. "Teacher Unionization: A Reassessment of Rank and File Motivations." *Sociology of Education* 51: 1: 44–55.

Johnson, Susan M., and Morgaen Donaldson. 2006. "The Effects of Collective Bargaining on Teacher Quality." In J. Hannaway and A. J. Rotherham (eds.), *Collective Bargaining in Education: Negotiating Change in Today's Schools*: pp. 111–140. Cambridge, MA: Harvard Education Press.

Johnson, Susan M., and Susan M. Kardos. 2000. "Reform Bargaining and Its Promise for School Improvement." In T. Loveless (ed.), *Conflicting Missions? Teachers Unions and Educational Reform*: pp. 7–46. Washington, DC: Brookings Institution.

Kennedy, Mary. 1998. *Form and Substance in Inservice Teacher Education*. Research Monograph No.13. Madison, WI: National Institute for Science Education.

Kerchner, Charles T., and Julia E. Koppich. 1993. *A Union of Professionals: Labor Relations and Education Reform*. New York: Teachers College Press.

Kleiner, Morris M. 2006. *Licensing Occupations: Ensuring Quality or Restricting Competition?*. Kalamazoo, MI: W. E. Upjohn Institute.

Kleiner, Morris M., and Daniel L. Petree. 1988. "Unionism and Licensing of Public School Teachers: Impact on Wages and Educational Output." In Richard Freeman and Casey Ichniowski (eds.), *When Public Sector Workers Unionize*: pp. 30–319. Chicago, IL: University of Chicago Press.

Kohn, Alfie. 2000. *The Case Against Standardized Testing: Raising the Scores, Ruining the Schools*. Portsmouth, NH: Heinemann.

Kurth, Michael M. 1987. "Teachers' Unions and Excellence in Education: An Analysis of the Decline in SAT Scores." *Journal of Labor Research* 8: 4: 351–367.

Lee, Valerie, Robert Dedrick, and Julia B. Smith. 1991. "The Effect of the Social Organization of Schools on Teachers' Efficacy and Satisfaction." *Sociology of Education* 64: 3: 190–208.

Lindy, Benjamin A. 2011. "The Impact of Teacher Collective Bargaining Laws on Student Achievement: Evidence From a New Mexico Natural Experiment." *Yale Law Journal* 120: 5: 1130–1191.

Loeb, Susanna, and Marianne Page. 2000. "Examining the Link Between Teacher Wages and Student Outcomes: The Importance of Alternative Labor Market Opportunities and Non Pecuniary Variation." *Review of Economics and Statistics* 82: 3: 393–408.

Lovenheim, Michael. 2009. "The Effect of Teachers' Unions on Education Production: Evidence From Union Election Certifications in Three Midwestern States." *Journal of Labor Economics* 27: 4: 525–587.

MacPhail-Wilcox, Bettye, and Richard A. King. 1986. "Production Functions Revisited in the Context of Educational Reform." *Journal of Education Finance* 12: 2: 191–222.

McDonnell, Lorraine, and Anthony Pascal. 1988. *Teacher Unions and Educational Reform*. Santa Monica, CA: Rand.

Milkman, Martin. 1997. "Teachers' Unions, Productivity, and Minority Student Achievement." *Journal of Labor Research* 18: 1: 137–150.

Moe, Terry M. 2009. "Collective Bargaining and the Performance of the Public Schools." *American Journal of Political Science* 53: 1: 156–174.

Morgan, David R., and Richard C. Kearney. 1977. "Collective Bargaining and Faculty Compensation: A Comparative Analysis." *Sociology of Education* 50: 1: 28–39.

Murnane, Richard J., and Jennifer L. Steele. 2007. "What Is the Problem? The Challenge of Providing Effective Teachers for All Children." *The Future of Children* 17: 1: 15–43.

Murphy, Marjorie. 1990. *Blackboard Unions: The AFT and the NEA, 1900–1980*. Ithaca, NY: Cornell University Press.

Nelson, F. Howard, Michael Rosen, and Brian Powell. 1996. *Are Teachers' Unions Hurting American Education? A State-by-State Analysis of the Impact of Collective Bargaining Among Teachers on Student Performance*. Milwaukee: Institute for Wisconsin's Future.

Park, Helen M., and Charles R. Coble. 1997. "Teachers Designing Curriculum as Professional Development: A Model for Transformational Science Teaching." *Journal of Research in Science Teaching* 34: 8: 773–789.

Peckover, Roger B., Suzanne Peterson, Pat Christiansen, and Louise Covert. 2006. "A Constructivist Pathway to Teacher Leadership." *Academic Exchange Quarterly* 10: 2: 136–143.

Peltzman, Sam. 1993. "The Political Economy of the Decline of American Public Education." *Journal of Law and Economics* 36: 1: 331–370.

Peterson, Bob. 1999. "Survival and Justice: Rethinking Teacher Union Strategy." In *Bob Peterson and Michael Charney* (eds.), *Transforming Teacher Unions*: pp. 11–19. Milwaukee, WI: Rethinking Schools.

Powell, Arthur G. 1985. "The Shopping Mall High School: Winners and Losers in the Educational Marketplace." *NASSP Bulletin* 69: 483: 40–51.

Raudenbush, Stephen W., and Anthony S. Bryk. 2002. *Hierarchical Linear Models: Applications and Data Analysis Methods*, 2nd edition. Thousand Oaks: Sage.

Riley, Pamela A., Rosemarie Fusano, LaRae Munk, and Reuben Peterson. 2002. *Contract for Failure: The Impact of Teacher Union Contracts on the Quality of California Schools*. San Francisco, CA: Pacific Research Institute for Public Policy.

Rivkin, Steven, Eric Hanushek, and John Kain. 2005. "Teachers, Schools, and Academic Achievement." *Econometrica* 73: 2: 417–458.

Silver, Marc. 1990. "Rethinking Craft Administration: Managerial Position, Work Autonomy, and Employment Security in the Building Trades." *Sociological Forum* 5: 2: 241–260.

Slater, Joseph E. 2004. *Public Workers: Government Employee Unions, the Law, and the State, 1900–1962.* Ithaca, NY: Cornell University Press.

Sparks, Dennis. 2004. "The Looming Danger of a Two-Tiered Professional Development System." *Phi Delta Kappan* 86: 4: 304–306.

Spector, Paul E. 1986. "Perceived Control by Employees: A Meta-Analysis of Studies Concerning Autonomy and Participation at Work." *Human Relations* 39: 11: 1005–1016.

Steelman, Lala Carr, Brian Powell, and Robert M. Carini. 2000. "Do Teacher Unions Hinder Educational Performance? Lessons Learned From State SAT and ACT Scores." *Harvard Educational Review* 70: 4: 437–466.

Stepan-Norris, Judith, and Maurice Zeitlin. 2002. *Left Out: Reds and America's Industrial Unions.* New York: Cambridge University Press.

Tobin, Kenneth. 1991. "Anthropological Perspectives on Science Classrooms: Teachers' Role Perceptions." *Florida Science Teachers Journal* 7: 1: 9–19.

Turner, Richard, Gregory Camilli, Richard Kroc, and John Hoover. 1986. "Policy Strategies, Teacher Salary Incentive and Student Achievement: An Explanatory Model." *Educational Researcher* 15: 3: 5–11.

Verstegen, Deborah A., and Richard A. King. 1998. "The Relationship Between School Spending and Student Achievement: A Review and Analysis of 35 Years of Production Function Research." *Journal of Education Finance* 24: 3: 243–262.

Wayne, Andrew, Kwang Suk Yoon, Pei Zhu, Stephanie Cronen, and Michael S. Garet. 2008. "Experimenting With Teacher Professional Development: Motives and Methods." *Educational Researcher* 37: 8: 469–479.

Wayne, Andrew, and Peter Youngs. 2003. "Teacher Characteristics and Student Gains: A Review." *Review of Educational Research* 73: 1: 89–122.

Weaver, Heather, Charles R. Coble, and Floyd Mattheis. 1993. "A Model for Integrating Science Curriculum, Instruction, and Assessment for the Middle School." National Association for Research in Science Teaching, Atlanta, GA, August.

Yoon, Kwang Suk, Teresa Duncan, Sylvia Lee, Beth Scarloss, and Kathy L. Shapley. 2007. *Reviewing the Evidence on How Teacher Professional Development Affects Student Achievement.* Washington, DC: *National Center for Education Evaluation and Regional Assistance.*

Zigarelli, Michael A. 1994. "The Linkages Between Teacher Unions and Student Achievement." *Journal of Collective Negotiations* 23: 4: 299–319.

Zwerling, Harris L., and Terry Thomason. 1992. *The Effects of Teacher Unions and Collective Bargaining Laws on Educational Performance.* Working Paper QPIR 1992-2. Kingston, ON: Industrial Relations Centre, Queen's University.