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How Much Do School Principals Matter When It Comes to Teacher Working Conditions?

Susan Burkhauser
RAND Corporation
Loyola Marymount University

Teacher turnover is a challenge for U.S. public schools. Research suggests that teachers' perceptions of their school working conditions influence their leaving decisions. Related research suggests that principals may be in the best position to influence school working conditions. Using 4 years of panel data constructed from the North Carolina Teacher Working Condition Survey, this study uses value-added modeling approaches to explore the relationship between teachers' perceptions of four measures of their working conditions and their principal. It finds that teacher ratings of the school environment depend on which principal is leading the school, independent of other school and district contextual factors, suggesting districts struggling with teacher turnover should assess climate and use that information to advise and support principals.

Keywords: *educational policy, leadership, policy analysis, principals, regression analyses, secondary data analysis, teacher context*

Teacher turnover has long been identified as a key challenge in meeting the demand for effective teachers in U.S. public schools. Nationally, 16% of public school teachers leave their schools annually (Goldring, Taie, & Riddles, 2014). Although turnover does not always have negative impacts (e.g., replacing an individual who is a poor fit could be beneficial), high levels of turnover, year after year, are harmful for districts, schools, and students. In addition to negatively affecting efforts to build a strong organizational culture and to maintain staff cohesion (Guin, 2004; Hanselman, Grigg, & Bruch, 2014), high rates of teacher turnover negatively affect student achievement outcomes (Ronfeldt, Loeb, & Wyckoff, 2013). Replacing teachers is also costly. Carroll (2007) reported that replacing an individual teacher costs US$4,400 to US$17,900, and Haynes (2014) reported that state expenditures on teacher turnover range from US$1 billion to US$2 billion annually. Moreover, the negative impacts of teacher turnover disproportionately affect schools with higher proportions of minority, low-income, or low-achieving students—that is, students most in need of a stable school culture (Borman & Dowling, 2008; Clotfelter, Ladd, Vigdor, & Wheeler, 2007; Hanushek, Kain, & Rivkin, 2004; Scafidi, Sjoquist, & Stinebrickner, 2007).

Given the severity of the problem, researchers have explored a number of factors that are potentially related to teacher turnover, including teacher demographic characteristics (e.g., gender, race, age), teacher qualifications (e.g., training, experience, ability), student body characteristics (e.g., race, socioeconomic composition, student achievement), and school contextual factors (e.g., average class size, teacher salary, school location, school working conditions; Borman & Dowling, 2008). Among these, school working conditions appear to have some of the strongest and most robust effects (Boyd et al., 2011; Johnson, Kraft, & Papay, 2012; Ladd, 2011). Measures of school working conditions typically include factors such as administrative support and communication, teacher empowerment and influence over school policy, opportunities for teacher professional development and advancement, level of teacher collaboration, use of teachers' time, student behavior, school

facilities, school resources, school culture, and community support (Boyd et al., 2011; Hirsch, Emerick, Church, & Fuller, 2007; Johnson et al., 2012). Johnson et al. (2012), for example, provided evidence that teachers' desire or decision to leave a school is mostly explained by their satisfaction with school working conditions, including measures of collegial relationships, school leadership, and school culture.

This research is promising and suggests a policy amenable solution to the problem of teacher turnover—improving school working conditions. But how might this be accomplished? Some research suggests that principals may be in the best position to influence school working conditions. Much of this existing literature is qualitative, focusing on case studies, observational analyses, and descriptive survey results (Dworkin, Haney, Dworkin, & Telschow, 1990; Fimian, Pierson, & McHardy, 1986; Griffith, 2004; Hipp, 1997; National Center for Education Statistics, 1997; Richardson, Cassanova, Placier, & Guilfoyle, 1989; Shann, 1998; Whaley, 1994). Some researchers have used quantitative methods including multivariate regression, multilevel modeling, and path analyses to study the relationship, but these are fewer in number (Anderman, Belzer, & Smith, 1991; Bogler, 2001; Cerit, 2009; Duyar, Gumus, & Bellibas, 2013; Dworkin, 1985; Fimian & Blanton, 1986; Singh & Billingsley, 1998).

The purpose of this study is to build on existing literature that examines the role of the principal in teachers' perceptions of their working conditions. Making use of a detailed working conditions survey fielded over multiple years, and employing a method of analysis new to this literature, this study uses value-added modeling approaches to explore the relationship between teachers' perceptions of four measures of their working conditions and their school's principal (teacher time use, physical environment, teacher empowerment/school leadership, professional development). Next, this study examines whether principal effects estimated by the models are correlated across these four measures to see if more effective principals, rather than being specialists who are skilled at leadership/management in one or a few domains, tend rather to be capable of enhancing perceptions across a wide range of domains simultaneously.

Specifically, the study explores the following research questions:

Research Question 1: How much of the school-to-school variation in teachers' ratings of their school working conditions can be attributed to principals?

Research Question 2: How correlated are the estimated principal effects?

Conceptual Framework

Teacher Mobility and Working Conditions

Researchers have consistently found that hard-to-staff schools have higher proportions of minority, low-income, or low-achieving students—students who are most likely in need of a supportive and stable school culture (Borman & Dowling, 2008; Clotfelter et al., 2007; Hanushek et al., 2004; Scafidi et al., 2007). One explanation for this phenomenon is that teachers leave because of the characteristics of their students. Another theory, however, is that schools with higher proportions of minority, low-income, or low-achieving students tend to have less desirable working environments for teachers (Allensworth, Ponisciak, & Mazzeo, 2009; Boyd et al., 2011; Johnson et al., 2012; Ladd, 2011). Johnson et al. (2012), for example, observed strong negative relationships between teacher satisfaction and higher proportions of minority and low-income students. In regressions that also included a measure of overall perceived working conditions, however, there was a significant decrease in the magnitude of the relationships between student race and income and teacher satisfaction. A similar result was found for teacher leaving decisions.

Papers by Ladd (2011) and Boyd et al. (2011) provided similar results. Ladd (2011) found that measures of leadership, expanded teacher roles, and teacher time use were negatively and significantly associated with teacher-stated leaving decisions. In addition, the inclusion of working conditions variables lessened the magnitude of the positive coefficient on percentage of Black students. Boyd et al. (2011) found that measures of teacher influence, administrative support, facilities, staff relations, and students were significantly and negatively associated with teacher leaving decisions. Including working conditions

in the models resulted in a decrease in the magnitude of the coefficients on percentage Black and percentage Hispanic students, even in some cases becoming statistically insignificant.

The Principal's Role in Teacher Working Conditions

The National Policy Board for Educational Administration (2015), informed by empirical research and the recommendations of researchers and school and district leadership, lists 10 standards that define "effective educational leadership" and embody a "holistic view of leadership." The standards include developing and supporting school curriculum and hiring, supporting, and retaining effective teachers. They also include engendering a shared commitment to the mission and vision of the school, maintaining a safe and healthy school environment, promoting professional development of teachers, empowering and entrusting teachers to perform, and effectively managing staff resources. Thus, while earlier conceptions of the principalship charged school leaders with more managerial duties like overseeing bus schedules and ensuring teachers arrived on time, current conceptions charge principals with shaping school vision, leading instruction, cultivating teacher leadership, managing people and processes, and ensuring a hospitable environment for students and staff (The Wallace Foundation, 2013).

That principals can affect how teachers feel about their schools is intuitive, but it is also supported by research. As Duyar et al. (2013) summarized, researchers have studied the principal's influence on teacher job satisfaction for some time. Early research provided evidence that practices such as managing student behavioral issues to ensure a safe school environment, providing support, insulating teachers from external forces, supporting teachers, and acknowledging teachers' accomplishments were associated with increased job satisfaction. Other researchers have found that instructional practices (e.g., managing curriculum and supervising teachers, etc.) and principal servant leadership (e.g., providing support, making teachers a priority, etc.) were associated with increased job satisfaction (Duyar et al., 2013; J. Murphy, 1988). Singh and Billingsley (1998) cited research showing principal support to be associated with teachers feeling less stress and burnout in addition to being associated with increased job satisfaction. Citing Rosenholtz (1989), they note that teachers are more likely to feel committed if they feel empowered.

The current study contributes to this literature in two ways. First, using panel data constructed from the biannual North Carolina Teacher Working Conditions Survey, linked to principal placement data, it employs models using principal fixed effects to estimate principal impacts on four school environment measures: teachers' ability to focus on teaching (teacher time use), the physical environment is well maintained and conducive to teaching (physical environment), teacher empowerment/school leadership, and teacher professional development. To the author's knowledge, the use of this value-added modeling approach is novel to this literature. This approach examines how much of the school-to-school variation in these measures can be explained by principals. In using principal fixed effects in combination with school-fixed effects, teachers' survey responses from within the same network of schools are compared for those schools that experienced a change in principal at any point over the years of the study (school years 2005–2006 through 2011–2012). The benefit of this design choice is that it allows for the estimation of principal effects beyond school effects. It may be, for example, that there is a highly involved and influential community of parents who greatly influence the teachers' overall happiness with their school environment. Not including school-fixed effects would attribute this factor to the principal and would overestimate the principal's influence over perceptions of school working conditions.

Second, the study examines whether the estimated principal effects are correlated across perceptions of working conditions. If principals, rather than being specialists who are skilled at leadership/management in one or a few domains, tend rather to be capable of enhancing performance across a wide range of domains simultaneously, this could shape how districts and principal preparation programs train principals to affect the school environment. If principal effects are correlated, this might suggest that targeting general principal leadership skills could

TABLE 1

Comparison of the North Carolina Public School Population With the U.S. Average, School Year 2011-2012

Characteristic	North Carolina	U.S. public school population average
Total number of schools	2,476	1,856
Total students	1,462,172	940,704
American Indian/Alaskan Native (%)	2	1
Asian/Pacific Islander (%)	3	5
Black (%)	26	15
Hispanic (%)	14	24
White (%)	52	52
Two or more races (%)	4	3
FRPL (%)	53	45
ELL (%)	7	9
Total teachers	94,397	58,354
Total staff	183,768	112,654
Pupil/teacher ratio	15.5	16.1

Source. U.S. Department of Education, National Center for Education Statistics, Common Core of Data, "Local Education Agency (School District) Universe Survey" and "Public Elementary/Secondary School Universe Survey."
Note. Analysis is limited to regular public school districts. U.S. public school population average is weighted by student population size. FRPL = free or reduced price lunch; ELL = English language learner.

be more useful than those targeting training on one of the measured dimensions of the school environment.

Data

Data for this study are from North Carolina public schools and span school years 2005–2006 through 2011–2012. This sampled population is useful when thinking about generalizability. As reported in Table 1, compared with the U.S. public school population average, North Carolina has a higher proportion of Black students, a lower proportion of Hispanic students, and a higher proportion of students who qualify for a free or reduced price lunch (FRPL). North Carolina also has a larger educational system than the U.S. average with more students, schools, faculty, and staff. Other demographics such as the percentage of English language learners (ELL) are similar to the U.S. public school population average. Although 85 of the 100 counties in North Carolina are considered rural, as of 2013, North Carolina was home to five of the nation's 100 largest school districts: Wake County Schools, Charlotte Mecklenburg Schools, Guilford County Schools, Forsyth County Schools, and Cumberland County Schools (American School & University, 2014; North Carolina Rural Economic Development Center, 2012).

Data on the school environment measures come from the biannual, anonymous North Carolina Teacher Working Conditions Survey provided by the North Carolina Education Research Data Center (NCERDC). Motivated in part by a high teacher turnover rate in North Carolina, and informed by focus groups of more than 500 teachers and a review of the literature on the relationship between working conditions and teacher satisfaction and mobility, the North Carolina Professional Teaching Standards Commission developed the survey (Hirsch, 2005; Moir, 2009). The survey is a reliable measure of teaching conditions with Cronbach's alpha values above .80 for all categories of working conditions (Moir, 2009).

The data used in this study are from the 2006 through 2012 surveys and include responses from teachers only. Earlier versions of the survey were too different from the later surveys to be comparable or had comparatively low response rates. Due to efforts in 2006 by the North Carolina business community to increase participation in the survey (including financial incentives), survey response rates improved

(38% in 2004 to 66% in 2006 to 86% in 2012; Clark, 2008; Halstead, 2012; Hirsch, Emerick, Church, & Fuller, 2006; Ladd, 2011; Press Release, 2008).

Exploring potential bias from low response rates across survey years, Table 2 provides comparisons of school-level average principal, school, and district characteristics from schools with teacher response rates of at least 20% to schools with 0% teacher response rates and to schools with 1% to 19% teacher response rates. The school-level observations vary depending on data availability. Although there are several significant differences, many are small practically speaking. It does appear, however, that schools with longer serving principals, more American Indian students, more Hispanic students, fewer Black students, and schools in districts with more school administrators were more likely to have higher teacher response rates especially when comparing schools with a 0% teacher response rate with schools with teacher response rates greater than 20%. The analyses presented in this study include schools with any amount of survey respondents; however, as a robustness check, the analyses were limited to schools with a teacher response rate of at least 20%. This did not significantly alter the findings.

Principal placement data were provided by the NCERDC in the "Personnel Pay History file" for school years 1994–1995 to 2011–2012. This data provide a yearly snapshot of principal ID numbers and school placements. In accordance with Miller (2013), there were instances where more than one principal was listed in a given year at a given school (11% of the school-by-year placements over the 18-year time span). Following the methods of Miller, only instances where Principal A is listed in the prior year, Principals A and B are listed in the given year, and only Principal B is listed in the following year are kept. To ensure that teacher ratings in a given school in a given year are assigned to only one principal, and because the survey is administered in the spring of the given school year, these school-year ratings are allocated to Principal B in the year where two principals are listed. Using this rule, a sample of 1,863 multiple principal placements are retained comprising 5% of the final sample, and 6% of the potential sample is eliminated.

Method

Construction of the School Environment Variables

The surveys contain 34 items of interest asked in each survey year.[1] To determine if the items were measuring broader school environment constructs, and if these were consistent across survey years, a principal components factor analysis was implemented, followed by an orthogonal rotation of the factors separately for each survey year at the individual teacher response level. This resulted in four distinct measures of the school environment: teachers' ability to focus on teaching (teacher time use), the physical environment is well maintained and conducive to teaching (physical environment), teacher empowerment/school leadership, and teacher professional development.[2] The factors, their corresponding survey items, and the range of coefficient alpha (i.e., the measure of internal consistency) across survey years are listed in Table 3.[3] Each factor in each year has an alpha value that is greater than .70, generally thought of as an acceptable level of internal consistency (Nunnally, 1978). School- and year-level factor scales were created by averaging the teacher-level scales by school and year. Finally, these scales were standardized to have a mean zero and standard deviation of one for each school year.[4] Table 4 provides the means and standard deviations for the unstandardized factor scales by school year.

Measuring Principal Impacts

The following is the main equation estimated for each of the four measures of the school environment:

$$q_{mspy} = \beta_{m0} + \beta_{mpy}\mathrm{X}_{py} + \beta_{msy}\mathrm{X}_{sy} + \beta_{mdy}\mathrm{X}_{dy} + \theta_{mp} + \gamma_{ms} + \delta_{my} + \varepsilon_{mspy}, \quad (1)$$

where q_{mspy} is the standardized ~$N(0, 1)$ average score across teacher responses for a given measure of the school environment (m) in a given year (y) at a given school (s) with a given principal (p). A fixed effect for each principal, θ_{mp}, is generated for each measure of the school environment as well as a fixed effect for the school,

TABLE 2

Differences in Control Variable Mean Values by School-Level Teacher Response Rates

	≥20% response rate		1%–19% response rate		0% response rate	
Characteristic	Schools	*M*	Schools	*M*	Schools	*M*
Principal level						
Tenure as principal in North Carolina	8,519	5.6	73	4.8**	23	6.0
Tenure as principal at school	8,519	3.8	73	3.2**	23	2.5**
School level						
Minimum grade	9,553	2.5	112	1.7**	120	1.2**
Maximum grade	9,553	7.3	112	7.5	120	8.5**
Pupil/teacher ratio	9,506	14.8	109	15.3	119	15.7
Magnet school (%)	9,553	5.1	112	8.0	120	2.5
American Indian (%)	9,492	1.6	112	0.9**	119	0.9**
Asian (%)	9,515	2.1	112	1.7	119	1.2**
Hispanic (%)	9,537	10.7	112	9.9	119	4.6**
Black (%)	9,537	30.6	112	36.8	119	46.0**
White (%)	9,538	53.5	112	50.5	119	46.0
FRPL (%)	8,641	53.5	81	57.3	57	54.7
District level						
Per pupil spending (US$)[a]	9,338	8,392.3	80	7,586.5**	46	8,358.7
School administrators	9,514	115.7	107	145.9	112	46.7**
Rural (%)	9,589	53.2	113	45.1	144	39.6**
Suburb (%)	9,589	10.9	113	7.1	144	16.0
Town (%)	9,589	9.0	113	8.0	144	11.8
City (%)	9,589	27.0	113	39.8**	144	32.6
School year						
2005–2006	9,591	22.8	113	85.0**	145	42.1**
2007–2008	9,591	25.2	113	6.2**	145	24.8
2009–2010	9,591	26.2	113	4.4**	145	9.0**
2011–2012	9,591	25.8	113	4.4**	145	24.1

Note. There were 41 classroom teachers at the average school in North Carolina over the study period; therefore, a 20% response rate is on average eight teachers. Standard errors are adjusted to account for repeated observations of schools within the data. FRPL = free or reduced price lunch.

[a]Not adjusted to real dollars.

**$p < .05$.

γ_{ms}. A vector of year-specific principal tenure variables, X_{py}, is included. This vector contains a variable measuring tenure as principal at the school as well as a variable measuring tenure as principal in the state. A vector of year-specific school-level demographic characteristics, X_{sy}, and a vector of the year-specific district-level demographic characteristics, X_{dy}, are also included along with a vector of school-year fixed effects, δ_{my}. Finally, ε_{mspy} is an idiosyncratic error term.

This study employs principal fixed effects in the model because it is interested in the variance explained by the set of principal IDs, not principal-level variables (e.g., education level, gender, etc.). Fixed effects for school and school year are also employed, but serve in the more traditional sense (i.e., only within-school and within-school-year variation are being examined). Because this study is interested in an intuitive interpretation of the principal fixed effect estimates, a method of dropping one arbitrary principal fixed effect out of the regression and comparing all estimated principal fixed effects to this specific principal is not that informative. Instead, following the methods of Mihaly, McCaffrey, Lockwood, and Sass

TABLE 3

Survey Scales, Corresponding Items, and Coefficient Alpha Values

Scale	Item
Teacher Time Use (α = .79–.81)	Teachers have reasonable class sizes, affording them time to meet the educational needs of all students
	Teachers have time available to collaborate with their colleagues
	Teachers are protected from duties that interfere with their essential role of educating students
	School leadership tries to minimize the amount of routine administrative paperwork required of teachers
	The noninstructional time provided for teachers in my school is sufficient
Physical Environment (α = .83–.85)	Teachers have sufficient access to appropriate instructional materials and resources
	Teachers have sufficient access to instructional technology, including computers, printers, software, and Internet access
	Teachers have sufficient access to communications technology, including phones, faxes, email, and network drives
	Teachers have sufficient access to office equipment and supplies such as copy machines, paper, pens, etc.
	The reliability and speed of Internet connections in this school are sufficient to support instructional practices
	Teachers have adequate professional space to work productively
	Teachers and staff work in a school environment that is clean and well maintained
	Teachers and staff work in a school environment that is safe
Teacher Empowerment/ School Leadership (α = .95–.96)	Teachers are trusted to make sound professional decisions about instruction
	The faculty has an effective process for making group decisions and solving problems
	In this school, we take steps to solve problems
	There is an atmosphere of trust and mutual respect within the school
	The school leadership consistently enforces rules for student conduct
	The school leadership support teachers' efforts to maintain discipline in the classroom
	The school leadership consistently supports teachers
	The school improvement team provides effective leadership at this school
	The faculty and staff have a shared vision
	Teachers are held to high professional standards for delivering instruction
	The procedures for teacher performance evaluations are consistent
	Teachers receive feedback that can help them improve teaching
	The school leadership makes a sustained effort to address teacher concerns about: facilities and resources
	The school leadership makes a sustained effort to address teacher concerns about: the use of time in my school
	The school leadership makes a sustained effort to address teacher concerns about: professional development
	The school leadership makes a sustained effort to address teacher concerns about: leadership issues
	The school leadership makes a sustained effort to address teacher concerns about: new teacher support
	Overall, my school is a good place to teach and learn
Professional Development (α = .75–.80)	Sufficient funds and resources are available to allow teachers to take advantage of professional development activities
	Adequate time is provided for professional development
	Teachers have sufficient training to fully utilize instructional technology

Note. Possible responses to all items in 2006 and 2008 were (1) *strongly disagree*, (2) *somewhat disagree*, (3) *neither disagree or agree*, (4) *somewhat agree*, and (5) *strongly agree*; possible responses to all items in 2010 and 2012 were (1) *strongly disagree*, (2) *disagree*, (3) *agree*, and (4) *strongly agree*. For all items, a higher rating indicates a more favorable perception. Separate factor analyses are performed for each survey year; the alpha value ranges displayed in the table provide the range of internal consistency reliability across survey years.

(2010), principals and schools are clustered into connected networks, or groups. Each principal fixed effect is then estimated as the deviation of that principal's fixed effect from the mean fixed effect of all the principals in the principal's group. The statistical routine centers the group means at zero. This provides an intuitive interpretation of the principal fixed effects.

TABLE 4

School-Level Means and Standard Deviations of Survey Scales by School Year

	2005–2006		2007–2008		2009–2010		2011–2012	
n	2,079		2,194		2,261		2,058	
Scale	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Teacher Time Use	3.09	0.43	3.30	0.48	2.71	0.31	2.69	0.31
Physical Environment	3.70	0.38	3.94	0.41	3.14	0.27	3.11	0.26
Teacher Empowerment/School Leadership	3.63	0.43	3.79	0.48	3.03	0.29	3.01	0.28
Professional Development	3.30	0.39	3.51	0.45	2.91	0.26	2.91	0.24

Note. Possible responses to all items in 2006 and 2008 were (1) *strongly disagree*, (2) *somewhat disagree*, (3) *neither disagree or agree*, (4) *somewhat agree*, and (5) *strongly agree*; possible responses to all items in 2010 and 2012 were (1) *strongly disagree*, (2) *disagree*, (3) *agree*, and (4) *strongly agree*. Direct comparisons should not be made, therefore, between the mean values from the 2006 and 2008 surveys and the mean values from the 2010 and 2012 surveys.

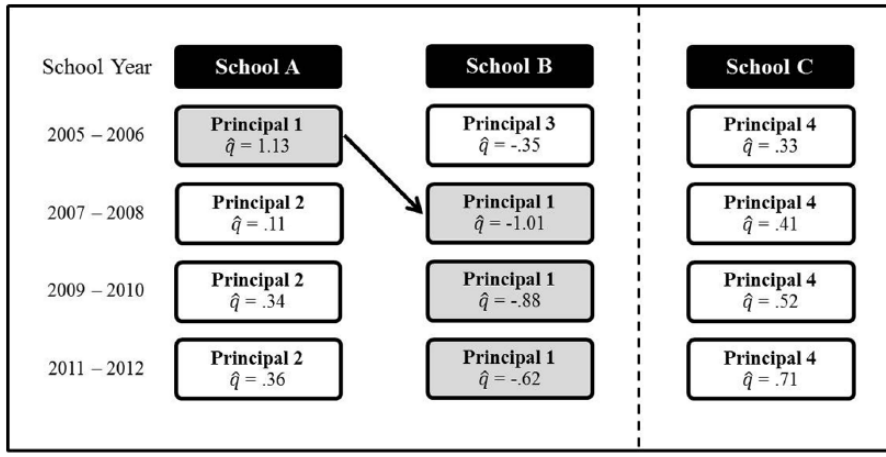

FIGURE 1. *Demonstration of a connected network.*
Source. Adapted from Chiang, Lipscomb, and Gill (2016).

This method allows a comparison of principals with other principals not serving in the same school, but depends on variation in principals in at least one network school. Figure 1, adapted from research by Chiang, Lipscomb, and Gill (2016), demonstrates a hypothetical group. During the 2005–2006 school year, Principal 1 works at School A and Principal 3 works at School B; then during the 2007–2008 school year, Principal 2 takes over at School A while Principal 1 takes over at School B. For the sake of simplicity, Principal 2 is new to the principalship in North Carolina during the 2007–2008 school year, and Principal 3 retires after the 2005–2006 school year. In this example, Principal 1, Principal 2, and Principal 3, and Schools A and B are all in the same group. In this same example, Principal 4 works at School C across the survey years (i.e., Principal 4 is not a mobile principal and School C is exposed to Principal 4 only). Principal 4 and School C do not belong to the same network as Principal 1, Principal 2, and Principal 3, and Schools A and B. Also, because Principal 4 does not change schools and School C only experiences one principal over the study period, this principal and school would not be included in the model with both principal and school-fixed effects. All groups are mutually exclusive; each principal and each school can belong to only one group. In the example provided in Figure 1, Principal 3 can be deemed superior to Principal 2 because Principal 3's

TABLE 5

Connectedness of Principals Included in the Main Model of Interest

Number of principals in the group	Principal-school groups		Principals	
	n	*n* (%)	*n*	*n* (%)
2	558	56.8	1,116	35.9
3	201	20.5	603	19.4
4	84	8.6	336	10.8
5	51	5.2	255	8.2
6	25	2.5	150	4.8
7	19	1.9	133	4.3
8	16	1.6	128	4.1
9	8	0.8	72	2.3
10 or more	20	2.0	318	10.2
Total	982	100.0	3,111	100.0

Note. The main model of interest includes both principal and school-fixed effects. To provide an intuitive interpretation of the principal fixed effects, principals and schools are clustered into groups. Each principal fixed effect is then estimated as the deviation of that principal's fixed effect from the mean fixed effect of all the principals in the principal's group. This table includes observations with nonmissing model covariates only. There are 3,111 unique principals and 1,842 unique schools included in this table, 629 additional principals and 635 schools belong to connected networks of only one principal.

estimated effect is greater than Principal 1 in School B, while Principal 1's estimated effect is higher than Principal 2 in School A.

Models that incorporate school-fixed effects rely on principal mobility to identify principal impacts. As stated previously, hypothetical Principal 4 who serves as principal in School C from 2005–2006 to 2011–2012 will not be in the model that includes school-fixed effects because there is no way to differentiate the effect of Principal 4 from the effect of School C. The results of the group generating analysis are reported in Table 5. There are 982 connected networks representing 3,111 principals and 1,842 schools. In addition, there are 629 principals and 635 schools that belong to groups with only one principal. As discussed above, these principals and schools will not be included in the main model. Of the connected networks that are included in the main model, 558 (57%) are networks with only two principals. Therefore, a large number of principals are compared with only one other principal. In cases like this, the estimated fixed effects for the two principals will be of the same magnitude but with opposite signs. Because a large proportion of the groups are small, this may decrease the face-validity of the estimates.

For each measure of the school environment, following the estimation of the model, the principal fixed effects are ranked from lowest estimated fixed effect to highest estimated fixed effect, and the distribution of these principal fixed effects is computed. Following the methods of Dhuey and Smith (2012), this study looks at the standard deviation of the principal fixed effects to quantify the estimated impact of improving principal quality (i.e., hiring a better principal, or investing in the current principal's human capital).

As discussed in Dhuey and Smith (2012) and Aaronson, Barrow, and Sander (2007), there is most likely measurement error in the principal fixed effect estimates. It may be that the principal effects are upwardly biased due to random differences in the groups of teachers rating the principals and not due to the principals themselves. Where principals have only a few ratings each, this can be especially problematic and the standard deviation of the principal effects will more than likely be biased. Following the methods of Dhuey and Smith and Aaronson et al., the standard deviation of the principal effects is therefore adjusted for sampling error by subtracting the squared average of the standard errors of the estimated principal fixed effects; for more details on

this method, see Aaronson et al. (2007). The resulting adjusted standard deviations for the distributions of the principal fixed effects are reported in the results.

As a sensitivity check, in addition to Model 1, two additional models are specified. In Model 2, q_{mspy} is the standardized ~$N(0, 1)$ average score across teacher responses for a given measure of the school environment (m) in a given year (y) at a given school (s) with a given principal (p). A fixed effect for each principal, π_{mp}, is generated for each measure of the school environment, but this model does not include a fixed effect for the school. In not including a school-fixed effect, the model is not limited by principal mobility, so all principals are included in this model. A vector of year-specific principal tenure variables, X_{py}, is included along with a vector of year-specific school-level demographic characteristics, X_{sy}; a vector of the year-specific district-level demographic characteristics, X_{dy}; and a vector of year fixed effects, τ_{my}. Finally, μ_{mspy} is an idiosyncratic error term.

$$q_{mspy} = \alpha_{m0} + \alpha_{mpy}X_{py} + \alpha_{msy}X_{sy} + \alpha_{mdy}X_{dy} + \pi_{mp} + \tau_{my} + \mu_{mspy}. \quad (2)$$

The methods of Mihaly et al. (2010) are once again followed, but in this model, the statistical routine centers the mean of all principal fixed effects at zero, and the fixed effects are interpretable as deviations from the average of all principal fixed effects. Model 3 is specified in the same way as Model 2, except that the sample is limited to the population of principals eligible to be included in the school-fixed effects model. That is, the mobility restriction is imposed in Model 3. The purpose of estimating Model 2 and Model 3 across the four school environment measures is to see if dropping the observations that are excluded from the model which includes school-fixed effects results in different outcomes. If the results of these two models are different, it would provide evidence that the populations of principals are different and that the results are not generalizable to all principals.

Correlating Principal Impacts

After running the models above and estimating principal fixed effects for each of the four measures of the school environment, pairwise correlations across these estimated fixed effects are computed.

Results

Table 6 provides the results of Models 1, 2, and 3 for each measure of the school environment. This table shows the distribution of principal fixed effects, the number of unique principals in each model, the number of unique schools, the control variables used, and p values from an F test with the null hypothesis that all principal fixed effects are equal to zero. This test is important because if the principal fixed effects are not distinguishable from zero, it means that the principals are not significantly associated with how teachers view these school environment measures. A p value of .05 or less will allow for a rejection of the null hypothesis and will provide evidence that principals are associated with teachers' perceptions of these school environment measures. In addition to producing the p value of the F test for each model, Holm–Bonferroni corrections were applied across the 12 models to account for multiple comparisons (Holm, 1979).

The results for Model 1, the preferred model, which includes school-fixed effects, indicate that there is evidence to reject the null hypothesis that all principal fixed effects are equal to zero for each measure of the school environment. These remain significant after Holm–Bonferroni corrections. In addition, the results suggest that improving principal quality by one adjusted standard deviation results in an increase in the range of .24 to .60 standard deviations in the school-level average rating of the four measures of the school environment.

To offer some context for the magnitude of the estimates, they can be compared with the coefficient on pupil/teacher ratio from the full model (see Appendix Table A1, for full model results). Using the model of teacher time use as an example, the model estimates that the coefficient on pupil/teacher ratio is −.040, highly significant at alpha level .01. Using a movement of one adjusted standard deviation (an estimated increase of .28 standard deviations for the measure of teacher time use), all else equal, the model estimates that the pupil/teacher ratio would have

TABLE 6

Distribution of Principal Fixed Effect Estimates

	Teacher time use			Physical environment			Teacher empowerment/school leadership			Professional development		
Model	[1]	[2]	[3]	[1]	[2]	[3]	[1]	[2]	[3]	[1]	[2]	[3]
SD	.76	.92	.92	.77	.89	.89	.91	.92	.92	.80	.92	.91
Adjusted *SD*	.28	.70	.65	.37	.68	.64	.60	.71	.66	.24	.68	.63
10th percentile	−0.90	−1.09	−1.10	−0.89	−1.12	−1.12	−1.05	−1.13	−1.15	−0.93	−1.11	−1.12
25th percentile	−0.42	−0.61	−0.60	−0.42	−0.55	−0.56	−0.50	−0.57	−0.57	−0.45	−0.58	−0.58
50th percentile	0.01	−0.04	−0.05	0.01	0.01	0.02	0.02	0.01	0.04	0.01	0.00	0.02
75th percentile	0.43	0.53	0.54	0.44	0.58	0.58	0.52	0.59	0.60	0.45	0.56	0.58
90th percentile	0.89	1.14	1.14	0.89	1.14	1.12	1.02	1.12	1.12	0.93	1.11	1.10
Number of principals	3,111	3,740	3,111	3,111	3,740	3,111	3,111	3,740	3,111	3,111	3,740	3,111
Number of schools	1,842	2,477	1,842	1,842	2,477	1,842	1,842	2,477	1,842	1,842	2,477	1,842
F test *p* value	.000	.000	.002	.000	.000	.000	.000	.000	.000	.000	.000	.002
Model variations												
Includes school-fixed effects	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No
Restricted to principals in connected networks of more than one principal	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes

Note. Models control for principal tenure; minimum and maximum grade; pupil/teacher ratio; magnet status; percentages of students who are FRPL, American Indian, Asian, Black, and Hispanic; district per-pupil spending; school administrators in the district; district location; and school year fixed effects. The row "*F* test *p* value" contains the *p* value for each model of the *F* test that all principal fixed effects are equal to zero. FRPL = free or reduced price lunch.

to decrease by seven students to achieve the same effect on the perception of teacher time use.[5] Using the average pupil/teacher ratio of 15 for the entire sample (see Appendix Table A2), this would result in a decrease to eight students per teacher for the average school.

Model 2, which does not include school-fixed effects and as a result includes an additional 629 principals, also provides evidence to reject the null hypothesis that all principal fixed effects are equal to zero for each measure of the school environment.[6] These remain significant after Holm–Bonferroni corrections. In this model, the estimated range of increases in the measures of the school environment resulting from improving principal quality by one adjusted standard deviation (.68–.71) are larger in all cases. This is not surprising as it is expected that the principal fixed effects in these models are picking up some variation attributable to the schools where the principals are placed. Comparing the standard deviations with the adjusted standard deviations in Models 1 and 2, the results indicate that the estimated fixed effects in Model 1 suffer more from sampling error than the fixed effects from Model 2 (i.e., the differences between the standard deviation and the adjusted standard deviation are larger). Model 3 replicates Model 2 except that it limits the observations to those included in the model which uses school-fixed effects. The estimates for Model 2 and Model 3 across the four measures of the school environment are similar.

To further explore possible selection bias resulting from the exclusion of nonmobile principals, Table 7 provides means across the school-level and district-level control variables for principals excluded and included in Model 1. Although there are some statistically significant differences between the two sets of principals, many of these differences are small practically speaking. The most substantial difference is that principals excluded from the main model have more school administrators in their districts on average. In addition, principals excluded from the model have 2.4 additional years of tenure as principal at their school on average. This is not surprising given principal mobility is necessary for inclusion in the main model.

Taking the results from Model 1 a step further, Figure 2 presents the results of the correlations of the principal fixed effect estimates from Model 1, pairwise for each of the four dimension of the school environment. Except for the lowest value of .49, between teacher time use and professional development, each correlation coefficient is greater than .50 which is considered a large effect size (Cohen, 1988).

Discussion

Teacher turnover presents a major challenge to U.S. public schools. A growing body of research suggests that teachers' perceptions of their school working conditions greatly influence their decisions to leave their schools. A related body of research suggests that principals may be in the best position to influence school working conditions. This study builds on this later literature. Making use of a longitudinal panel of working conditions survey data, it employs a method of analysis new to this literature. It uses value-added modeling approaches to explore the relationship between teachers' perceptions of four measures of their working conditions and their school's principal. It goes on to examine whether principal fixed effects estimated by the models are correlated across these four measures.

Evidence presented in this article suggests that the individual principal matters when it comes to a teacher's perception of his or her work environment. For example, the estimated effect of increasing principal quality by one adjusted standard deviation in perceptions of teacher time use has the equivalent estimated effect of a decrease in seven students per teacher or a movement to a pupil/teacher ratio of 8-to-1 in the average classroom. In addition, nearly all of the estimated principal effects are highly correlated across the four dimensions of the school environment. This may provide some evidence that principals associated with favorable perceptions on one area of the school environment tend to be associated with favorable perceptions across all areas of the school environment; however, further research into what may be driving this correlation is needed to make any definitive conclusion here. One alternative view of this result is that teachers either like or do not like their school environment and thus tend to rate responses across the

TABLE 7

Differences in Control Variable Mean Values by Model Inclusion

Characteristic	Included in Model 2 only	Included in all models	Difference
n	1,803	5,958	
Principal level			
Tenure as principal in North Carolina	7.03	5.23	1.80**
Tenure as principal at school	5.73	3.34	2.38**
School level			
Minimum grade	2.28	2.58	−0.29
Maximum grade	7.06	7.19	−0.13
Pupil/teacher ratio	14.69	14.96	−0.26
Magnet school (%)	0.07	0.04	0.03**
American Indian (%)	1.21	1.39	−0.18
Asian (%)	2.09	1.94	0.15
Hispanic (%)	11.13	10.73	0.40
Black (%)	28.65	29.65	−1.00
White (%)	55.15	54.66	0.49
FRPL (%)	51.51	53.68	−2.16**
District level			
Per pupil spending (US$)[a]	8,342.00	8,378.67	−36.68
School administrators	122.26	106.91	15.35**
Rural (%)	0.53	0.56	−0.04
Suburb (%)	0.12	0.12	0.00
Town (%)	0.09	0.09	−0.01
City (%)	0.26	0.22	0.04**
School year			
2005–2006	0.24	0.26	−0.02**
2007–2008	0.19	0.20	0.00
2009–2010	0.31	0.28	0.03**
2011–2012	0.26	0.26	−0.01

Note. Standard errors are adjusted to account for repeated observations of schools within the data. FRPL = free or reduced price lunch.

[a]Not adjusted to real dollars.

**$p < .05$.

survey similarly. If this is the case, it may be that the findings suggest that the principal has an impact, but that it is not possible to differentiate the impact across the various dimensions.

The results from this study have important policy implications. Districts struggling with high teacher turnover either across the board or at specific schools might think about assessing teachers' perceptions of their working environments. If school environment ratings are low, districts should look to the principal as an important player in improving the conditions at the school. District resources could be used to establish a professional development plan for principals in schools with low school environment ratings. These may include things like teaching principals how to communicate effectively with teachers, or helping them to improve their adult leadership skills. Similarly, these findings suggest that principal preparation programs may want to focus on adult leadership skills and how to provide effective teacher feedback as they train future school leaders. Districts might also look for or recruit principals with a proven track record of improvements in teacher working conditions when hiring at schools that struggle to maintain their teaching force.

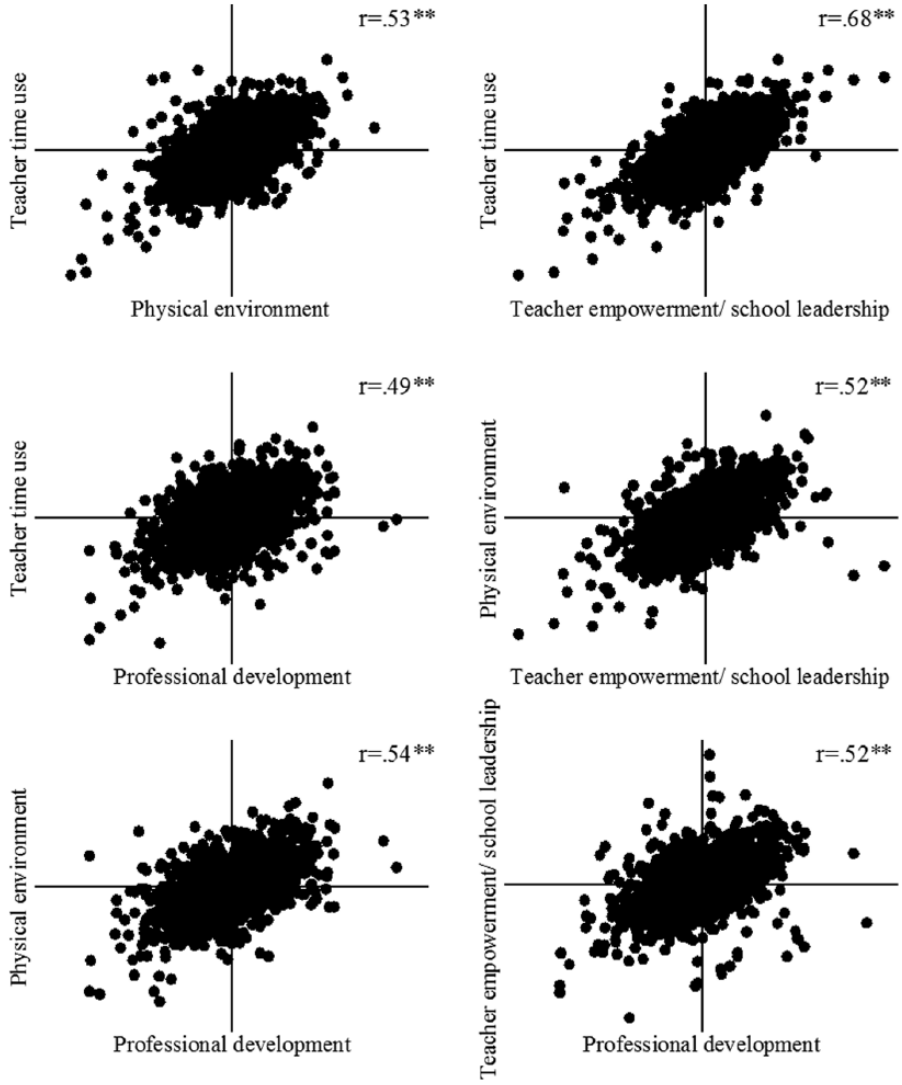

FIGURE 2. *Correlations of principal fixed effects, results from Model 1.*
Note. r = represents the correlation coefficient.
**$p < .05$.

One concern that can be raised with this study is that some of the survey scales measure aspects of the school working environment that are most likely not under the control of the school principal. For example, class size or classroom materials and resources are often determined by district policies. The Teacher Empowerment/School Leadership scale is arguably the one that best measures conditions for which principals are responsible. Therefore, the expectation would be to see the biggest principal effects on this scale, and, indeed, that is the case. Even limiting the results of this study to that one measure still allows for the conclusion that principals are important to teachers' perceptions of their working conditions. Either improving a principal's skill set in addressing teacher concerns, providing useful feedback, or establishing a feeling of mutual respect and trust at the school might enhance teachers' perceptions of the working environment in a meaningful way. It is also important to note that researchers linking teacher mobility to teacher perceptions of their working conditions find that ratings of school leadership

are significantly associated to teacher leaving decisions (Boyd et al., 2011; Johnson et al., 2012; Ladd, 2011).

Another concern is that the data used in this study do not reveal the actions principals have taken that may have affected the school environment. This raises at least two questions for future research. First, are principals associated with positive ratings engaged in leadership behaviors related to the school environment factors (e.g., for physical environment, are they actually figuring out how to provide more access to instructional materials), or do teachers ratings reflect a more positive perception of their working environment in general? Second, this study does not have the ability to consider actual measures of the efforts that different principals undertook for a given school. It simply observes that different principals served at a given school at different points in time. The added ability to incorporate data on principal efforts could inform on leadership actions which result in higher teacher perceptions.

There are also limitations to this study. The data are limited to North Carolina, which has been a leader in pursuing principal and teacher accountability initiatives. This might affect the labor market in the state by discouraging applicants for principalships (Gates et al., 2006). This may especially affect lower performing schools as suggested by Clotfelter et al. (2007) who found that principal attrition increased in North Carolina at lower performing schools following the implementation of an improvement program which tracks and provides public reports on student academic achievement and growth at the school level. In addition, North Carolina does not have collective bargaining agreements for teachers. These results may not be generalizable to strong union states where labor agreements determine the authority, autonomy, and job of the principal and where uniformity is enforced by the district (M. J. Murphy, 1985).

Another limitation is that the North Carolina Teacher Working Condition Survey can be used by a principal to demonstrate his or her impact on a school during the North Carolina principal evaluation process. This may threaten the validity of the survey as it may result in principals exerting pressure on teachers to inflate their ratings due to the high-stakes nature of the results. A principal, however, does not have to use the survey to demonstrate impact, it is one of several options (Mid-Continent Research for Education and Learning, 2009). The main purpose of the survey is not principal evaluation. In fact, the guidelines for appropriate use of the survey indicate that results of the survey should not be attributed one person, but are reflective of the school as a whole (Hirsch & Sioberg, n.d.). Finally, the high survey response rate lessens the concern that results are only being drawn from schools with the strongest principals or principals who are strong in pressuring teachers to inflate their ratings.

Another limitation is that the preferred model narrows, somewhat, the generalizability of the findings to schools exposed to mobile principals over the 7-year period. However, three quarters of North Carolina public schools meet this condition, lessening this concern. In addition, the estimates for Model 2 and Model 3 across the four measures of the school environment are similar providing some evidence that the selection bias from including school-fixed effects in the preferred model does not affect the external validity of these results.

A final limitation is that this study does not attempt to control for principal sorting effects. In other words, each principal is assigned the same fixed effect no matter what school the principal works at. It may be that a principal's effect depends on certain aspects of a school such as location or the level of autonomy afforded by the school or district. This matters for policy because, if true, it might mean that a principal associated with favorable perceptions of the school environment at one school would not necessarily be associated with favorable perceptions at any school.

Conclusion

Public school districts in the United States, especially those serving the poorest and lowest performing students, struggle with teacher retention. As such, a critical question is what policies can be implemented to incentivize teachers to stay. This study provides evidence that school principals can play a key role in improving teachers' perceptions of their school environment which have been shown to affect their leaving decisions.

Appendix

TABLE A1

Full Regression Results From Model 1 by School Environment Measure

Variable	Teacher time use	Physical environment	Teacher empowerment/ school leadership	Professional development
Principal tenure				
North Carolina	.0434	−.0441	.0948	.0513
	(.0932)	(.0879)	(.0902)	(.1001)
School	−.0067	.0329	−.0695***	−.0218
	(.0229)	(.0216)	(.0222)	(.0246)
School				
Minimum grade	.0805**	.1014***	.0801**	.0704*
	(.0364)	(.0344)	(.0353)	(.0391)
Maximum grade	−.0437	−.0947**	−.1000**	−.1482***
	(.0418)	(.0394)	(.0404)	(.0448)
Pupil/teacher ratio	−.0403***	−.0251***	−.0114*	−.0174**
	(.0066)	(.0062)	(.0064)	(.0071)
Magnet school	−.3043**	−.2808**	−.1602	−.3192**
	(.1388)	(.1309)	(.1342)	(.149)
American Indian (%)	.0091	.0045	.0053	.0108
	(.0192)	(.0181)	(.0186)	(.0207)
Asian (%)	.0083	.0125	−.0017	.0108
	(.0119)	(.0112)	(.0115)	(.0127)
Hispanic (%)	.0118**	.0015	−.0034	.0037
	(.0052)	(.0049)	(.0051)	(.0056)
Black (%)	.0008	.0002	−.0045	.0051
	(.0034)	(.0032)	(.0033)	(.0037)
FRPL (%)	.0019	−.0001	−.0003	.0017
	(.0014)	(.0013)	(.0013)	(.0015)
District				
Per pupil spending (US$)[a]	.0001**	.0002***	.0000	.0000
	(.0001)	(.0000)	(.0000)	(.0001)
School administrators	.0031***	.0012	.0010	−.0009
	(.0009)	(.0008)	(.0008)	(.0009)
Rural	.0518	−.2233***	.0311	.1718**
	(.0693)	(.0653)	(.067)	(.0744)
Suburb	−.0054	−.1147*	.0723	.0682
	(.0731)	(.0689)	(.0707)	(.0785)
Town	−.0695	−.2161***	−.0170	.0846
	(.0863)	(.0814)	(.0835)	(.0927)
School year				
2007–2008	−.2007	−.1561	−.0192	−.0966
	(.187)	(.1763)	(.1809)	(.2008)
2009–2010	−.2408	−.1205	−.0459	−.1202
	(.3611)	(.3405)	(.3493)	(.3877)
2011–2012	−.2943	−.0555	−.1357	−.1637
	(.538)	(.5073)	(.5204)	(.5776)

Note. Omitted variables are district: city and school year: 2005–2006; models also include individual principal; and school-fixed effects not shown. Standard errors are in parenthesis. FRPL = free or reduced price lunch.

[a]Not adjusted to real dollars.

*$p < .1$. **$p < .05$. ***$p < .01$.

TABLE A2

Distribution of School and District Control Variables

Variable	*M*	*SD*
Principal level		
Tenure as principal in North Carolina	5.6	3.9
Tenure as principal at school	3.9	2.9
School level		
Minimum grade	2.5	4.2
Maximum grade	7.2	2.9
Pupil/teacher ratio	14.9	3.5
Magnet school (%)	0.0	0.2
American Indian (%)	1.3	6.3
Asian (%)	2.0	3.3
Hispanic (%)	10.8	10.5
Black (%)	29.4	24.3
FRPL (%)	53.2	21.4
District level		
Per pupil spending (US$)[a]	8,370.2	1,053.0
School administrators	110.5	127.3
Rural (%)	0.6	0.5
Suburb (%)	0.1	0.3
Town (%)	0.1	0.3
City (%)	0.2	0.4

Note. There are 7,761 schools by year observations represented in this table. FRPL = free or reduced price lunch.
[a]Not adjusted to real dollars.

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Notes

1. There were some minor wording changes across the survey years. In addition, starting in 2010, item response options changed from (1) *strongly disagree*, (2) *somewhat disagree*, (3) *neither disagree or agree*, (4) *somewhat agree*, and (5) *strongly agree*, to (1) *strongly disagree*, (2) *disagree*, (3) *agree*, and (4) *strongly agree*. It is possible that the removal of the neutral option in the 2010 and 2012 surveys may have influenced teacher responses in a substantive way, but the effect is most likely minor.

2. Ladd (2011) performed a factor analysis on the 2006 survey data to create her working conditions scales. The factor analyses in this study differ somewhat. This study includes different items (e.g., she included items related to the role of teachers in various capacities—these are not included in this study), her analysis was limited to one survey year, while this study uses 4 years of the survey data, and she performed her analysis separately by school level. Despite these differences, the factor scales in each study are similar.

3. If a respondent was missing any values for an item within a factor scale, the respondent's score for that item was imputed as the average value for all nonmissing scale items. As a robustness check, the analyses were performed with versions of the factor scales that used responses from teachers who responded to all items in a given factor scale only. This did not significantly alter the findings.

4. Because survey item response options changed between the 2008 and 2010 surveys (i.e., the neutral option was removed), it was necessary to standardize each measure by school year.

5. The models for the other three measures of the school environment estimate that increasing principal quality by one adjusted standard deviation has the equivalent effect of decreasing the pupil teacher ratio by 15 students (physical environment), 53 students (teacher empowerment/school leadership), and 14 students (professional development).

6. Model 1 includes 3,111 unique principals and 1,842 unique schools. This is 83% of principals included in Model 2 (3,740 unique principals) and 74% of schools included in Model 2 (2,477 unique schools).

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Author

SUSAN BURKHAUSER's research focuses on school leadership, higher education, and education policy. She is an institutional research and business intelligence associate at Loyola Marymount University and an adjunct assistant policy analyst at the RAND Corporation.

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