SPENDING, SIZE, AND GRADE SPAN IN K–8 SCHOOLS

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Abstract

Reorganizing primary school grade spans is a tractable and relatively inexpensive school reform. However, assessing the effects of reorganization requires also examining other organizational changes that may accompany grade span reforms. Using data on New York City public schools from 1996 to 2002 and exploiting within-school variations, we examine relationships among grade span, spending, and size. We find that school grade span is associated with differences in school size, class size, and grade size, though generally not with spending and other resources. In addition, we find class size and grade size differences in the same grade level at schools with different configurations, suggesting that school grade span affects not only school size but also class size and grade size. We find few relationships, though, between grade span and school-level performance, pointing to the need to augment these analyses with pupil-level data. We conclude with implications for research and practice.

1. INTRODUCTION

Despite the complexity of schools as institutions, school reform efforts often focus narrowly on changing a single organizational feature of a school—reducing class size is a classic example. A more recent reform, gaining interest in school districts around the United States, involves reorganizing the grade spans of elementary and middle schools, for example by creating K–8 schools or moving sixth grades into elementary schools in order to keep older children in schools with younger ones (Jellick 2005; Thevenot 2005; Herszenhorn 2004). Reorganizing grade spans has considerable appeal because the lever of change is clear, tractable, and relatively inexpensive. Nevertheless, the simplicity of grade span reform is easily overstated. Changing grade spans will likely require, or be accompanied by, other changes in the schools—in the number of classes in each grade, the school size, and/or physical plant—in much the same way that reducing class size creates an increased need for teachers and classrooms. Notice that the impact of these collateral changes can be counter to the intention of the reform, as vividly demonstrated by the unintended (and undesirable) impact of California's class size reduction initiative on the distribution of experienced teachers in urban schools (Jepsen and Rivkin 2002). Before we view grade span reform as an easy fix to problems of low student performance, it behooves us to take a broader look at the multiple dimensions of K–8 school organization to better understand the related changes in schools—their organization, resources, and so on.

This article seeks to take that broader view by analyzing public elementary and middle schools in New York City over the period 1996–2002, examining the relationships between three "Ss" of school organization: span, spending, and size. The key goal is to understand how grade span is related to other features of schools in order to avoid the kinds of unintended consequences experienced in previous reforms. In the end, understanding whether and why grade span reform works will depend on understanding what other organizational features change with it and disentangling specific contributions of each. At the same time, our results will prove useful to the broader effort to understand the relationship between academic outcomes and school resources. While production function–type analyses of student academic outcomes routinely include measures of class size, school size, or school spending, virtually none controls for variations in grade span. If grade span matters to student performance, excluding grade span from the analyses may bias statistical estimates and yield misleading results.

Before proceeding, we should acknowledge the challenge of disentangling the specific causal impact of grade span changes on other school resources due to the potential endogeneity of changes in grade span. Put simply, changes in grade span may be affected by a set of factors that simultaneously spur other

changes. As discussed in greater detail below, our investigations yielded little evidence that changes in span were caused by characteristics of the schools themselves. Nevertheless, our results should be interpreted carefully, providing at least descriptive evidence on the question of what varies with grade span and at most evidence on the impact of grade span changes on school characteristics and outcomes.

The article is organized as follows. We begin by defining the three Ss and providing brief background and a literature review of these school organizational attributes as they relate to the least-studied aspect, span. Based on this literature, we develop two important, unanswered questions about the effects of span change on other school features. Next we describe our unique data set and our analysis strategy. We follow with a discussion of results.

To preview the results, we find that school grade span is associated with differences in school size, class size, and grade size, though generally not with spending and other resources. In addition, we find that class size and grade size differences are not simply artifacts of averaging to the school level but are found in the same grade level at schools with different configurations, suggesting that school grade span affects not only the size of a student's school but also of his or her class and grade. Thus grade span matters. In analyses of school-level correlations between grade span and school-level performance, however, we find few relationships, pointing to the need to augment these analyses with microlevel data at a pupil level. We conclude with implications for research and practice.

2. THREE Ss OF SCHOOL ORGANIZATION

For our purposes, school grade span is defined by the number and level of grades served within a given school.[1] The United States offers tremendous diversity in school grade spans even within the broad categories of elementary and secondary schools. Nationally, the largest percentage of elementary schools in 2003 ended at fifth grade (36.2 percent), while the next largest group ended at sixth grade (21.3 percent) (Snyder, Tan, and Hoffman 2004).[2] Schools serving the middle grades typically include either grades 6–8 or grades 7, 8, and sometimes 9. In recent years, schools serving grades K–8 have become increasingly popular in urban areas (Gootman 2007; Bowie 2007), although they have long been common in rural districts. Nationally, 18.4 percent of elementary schools serve exclusively grades 4, 5, or 6 to grades 6, 7, or 8,

1. This definition in turn raises the question, "What is a school?" In this study we define schools based on programmatic structure, leadership, and autonomy rather than physical location. Thus multiple schools may be housed in the same building.
2. The lowest grade in these schools was either prekindergarten, kindergarten, or first grade.

while the remainder combine the middle grades with lower grades or other configurations. Over 28 percent of sixth graders in 2001 were not in separate schools but attended K–6 or K–8 schools (Bedard and Do 2005).

The grade span structure of schools has also undergone significant transformation over the past fifty years. Self-contained middle schools housing combinations of grades 6–8 have become increasingly popular around the country, spurred by concerns over meeting the unique needs of younger adolescents (see, for example, Carnegie Task Force 1989). In 1970–71, middle schools comprised 2.3 percent of elementary and secondary schools but had risen to almost 13 percent by 2001–2 (Snyder, Tan, and Hoffman 2004).[3] At the same time, junior high schools fell from 8.7 percent to 3.5 percent of elementary and secondary schools.[4]

Grade Span and Student Performance

Before turning to the relationship between grade span and school resources, it may be helpful to consider why and how grade span matters to student performance, both because it is important as a policy goal but also because it shapes costs. Grade span could affect student performance in a number of ways—both positive and negative. If, for example, shorter grade spans permit more classes in each grade, then there might be greater focus and specialization in each grade, better matching the needs of the student. At the same time, however, more classes per grade might provide greater opportunity for tracking and within-school segregation and their consequences. Longer grade spans could result in fewer school transitions, avoiding any costs that might occur due to switching schools, or could result in students being locked in for longer periods of time to schools that may not meet their needs. That is, shorter grade spans have the advantage of providing more opportunities for students to match to appropriate schools. Of course, longer grade spans allow schools to create greater vertical integration of curricula and instruction and may provide greater opportunity to strategically target resources at particular grades (which we return to below). Finally, grade span may matter to student behavior and safety because of the differences in the age ranges of the students attending school together. As an example, the behavior of twelve-year-olds may depend on whether their schoolmates are teenagers, as in a middle school, or ten-year-olds, as in an elementary school.

Analysts have noted, though, that the evidence base in this area is "seriously wanting" (Howley 2002, p. 25), with a "dearth of empirical research"

3. Middle schools are defined by the National Center for Education Statistics (NCES) as schools beginning at grade 4, 5, or 6 and ending at grade 6, 7, or 8.
4. Defined by the NCES as schools serving grades 7 through 8 or 9.

(Renchler 2000, p. 1), and an appeal that "researchers must continue to disentangle grade span from its corollaries" (Coladarci and Hancock 2002, p. 2). Much research has focused on the middle school grades, specifically grades 5–8, and suggests that student performance in the middle grades may suffer when these grades are housed in a separate school or when they are included in secondary schools rather than elementary schools. As an example, Franklin and Glascock (1998) selected a random sample of Louisiana schools with different grade configurations and found higher achievement and better behavior for sixth- and seventh-grade students attending elementary or unit schools as compared with those attending middle schools and for tenth graders in unit schools as compared with secondary schools. Their cross-sectional ANOVA analyses did not control for prior achievement or selection into schools and districts, however. Wihry, Coladarci, and Meadow (1992) used a production function approach and found significantly higher scores for eighth graders housed in elementary schools rather than middle schools or junior/senior high schools, after controlling for community socioeconomic characteristics and some school resource variables but not district or school effects. Bedard and Do (2005), using national district-level data for 1987–1994 with district fixed effects, estimated the impact of grade span reconfiguration, specifically districts moving sixth graders into self-contained middle schools. They concluded that changing to an all–middle school (grades 6–8) structure could reduce on-time graduation rates by up to 3 percent. Mac Iver and Mac Iver (2006) examined growth in student achievement between fifth and eighth grades in Philadelphia, controlling for a variety of student and school characteristics (such as private management), and found mixed results for K–8 schools, with higher performance in older K–8 schools but not in schools recently converted to the K–8 structure.

Other studies of grade organization have examined a range of nonacademic outcomes, including behavior, perceptions of school safety, and students' self-esteem. Like Mac Iver and Mac Iver, Weiss and Kipnes (2006) used multilevel models to examine K–8 school effects in Philadelphia and found higher self-reported self-esteem and perceived school safety among students attending K–8 schools as compared with middle schools, but no academic performance differences. Cook et al. (2008) used data from North Carolina to examine the effects of placing sixth grade in a middle school rather than an elementary school. They found significantly greater student infractions and noted that this difference persisted into high school for black students. Jovonen et al. (2004) reviewed available evidence on issues including student academic achievement, school climate, parental involvement, and teacher training in middle schools and offered a succinct summary of the available research: "Not only is evidence showing that young teens benefit from a separate three years of

schooling weak, there is strong evidence suggesting that transitions (especially if they involve several changes in the school environment and instruction) have at least temporarily negative effects on some youth" (p. 113).

Grade Span and School Spending

Why might grade span be related to school spending? While much previous research has found that the level of spending by school *districts* depends on factors such as local fiscal capacity, state aid, and the community demand for public education, it is less clear what determines the level of spending in any given *school*. A growing (but small) research literature identifies factors that include student educational characteristics and needs, school organizational characteristics, and the sorting of teachers across schools. In principle, grade span might be related to school resources for several reasons. Most important is that school districts may have resource allocation policies that direct different levels of resources to schools based on the grades they serve, such as policies that support smaller class sizes for early elementary grades. Alternatively, districts might provide guidance counselors or other support personnel based on the grade span served—say, to help with placement of graduating students. In another vein, different grade span configurations may be viewed by teachers as particularly attractive (or unattractive), making it easier (or more difficult) for schools to attract and retain more experienced and highly educated teachers. To the extent that school districts allocate positions, rather than dollars as is typical, this will lead to differences in spending across schools. Finally, schools with different grade spans might attract different types of students, which can translate into different resources, if spending depends on the characteristics of the student body. As an example, if schools with longer grade spans attract more students with special needs, perhaps drawn by the greater stability, then school resources will vary with grade span. Thus analyses aimed at disentangling the specific impact of grade span per se on resources must control for differences in the student body, as we do below.

The research examining the relationship between grade span and school resources is thin, though two studies are worth noting. Respondents to teacher and administrator surveys administered in one Alaska district reported higher levels of resources for young learners, greater parental involvement, and increased collaboration between school staff in the K–2 schools in one Alaska district as compared with schools with other grade spans (Norwood 2002). Bickel et al. (2000) used cross-sectional Texas high school data to examine the effect of school size and grade span on per pupil expenditures. Ordinary least squares (OLS) regression estimates suggested that for Texas schools with equal achievement and student characteristics, per pupil expenditures were lower in schools serving more grades, particularly K–12, possibly due to cost savings

from reduced articulation between schools serving different grade levels. These analyses do not control for unobserved school or district effects, however.

Grade Span and the Size of Schools, Grades, and Classes

In principle, grade span and school size need not be related because longer grade spans can be offset by smaller grade size (decreases in students per grade). In fact, existing school buildings may mean that school size may be difficult to change. Despite this restriction, it seems unlikely that increases in span will be fully offset by decreases in grade size, suggesting that longer grade spans may be associated with larger schools and a smaller number of students in each grade.

As for class size for any grade, class size may be completely unrelated to grade span—both long and short grade spans can be formed with large and small class sizes—and it is possible that the size of a class of a particular grade is determined entirely by a district-wide formula or policy. Thus the size of a third-grade class would be the same in a K–5 school as in a K–8 or K–3 school. As mentioned earlier, it is also possible that while resources are allocated to the school according to this type of formula, resources may not be allocated accordingly within the school. Instead, resources may be allocated to achieve equity in class size across grades, or the size of the class may be determined by the size of the entering class with few new entrants (or exits) across grades. The implication is that for any grade, class size may depend on the grade span of the school, with smaller class sizes in upper grades in schools including lower grades and/or larger class sizes in lower grades in schools also serving upper grades.

There is, to our knowledge, no existing literature examining the relationship between grade span and the size of schools, grades, or classes. There is, however, a significant (and growing) body of literature on both class size and school size, and their relationship to student outcomes and costs. In their review of the school size literature, Andrews, Duncombe, and Yinger (2003) concluded that most studies suggest decreasing returns (increasing costs) in elementary schools larger than six hundred students and high schools larger than one thousand students. Stiefel et al. (2000) included student performance and found that, despite higher per pupil spending in small high schools, their better than average achievement resulted in equivalent costs per graduate. Kuziemko (2006) used a first difference approach as well as exogenous enrollment changes caused by school mergers and closings to instrument for school enrollment. She estimated that a 50 percent decrease in elementary school size leads to a roughly 20 percent increase in costs. Other studies have looked at the relationship between school size and outcomes—and there is a long literature examining whether small schools are better or worse than large

schools, perhaps due to greater intimacy in smaller settings, more opportunities to play leadership roles, and so on. Among the quantitative analyses, many have reported an inverse relationship between school size and outcomes (see Fowler 1995; Lee and Smith 1997), although recently this finding has been challenged (Schneider, Wyse, and Keesler 2007).

A large research base on class size effects has developed, spurred in part by several influential meta-analyses (Glass and Smith 1979; Hanushek 1989; Greenwald, Hedges, and Laine 1996) and particularly by the Tennessee Student–Teacher Achievement Ratio (STAR) experiment (see, for example, Finn and Achilles 1999; Nye, Hedges, and Konstantopoulos 1999). Class size reduction is occasionally cited as a cost-effective intervention to raise student achievement, particularly among low-income students (Krueger 1999).

While the relationship between class size and student performance has been studied extensively in the literature, common class size measures often fail to accurately measure the number of students typically present in a given classroom. For example, aggregating average class size to the school level may fail to accurately measure significant intra-school class size variations (Boozer and Rouse 2001). If class sizes vary systematically across grades, intra-school variation is likely to increase as grade span expands. Additionally, if class sizes differ by grade depending on grade span, then student performance may be affected indirectly by the span of the school attended.

To summarize, while research investigating various aspects of grade configuration has begun to accumulate, much of it has suffered from data limitations, such as the use of aggregate data and nonrandom selection of school organizational structures. In particular, very little previous research has examined other critical correlates of grade span and student performance—school- and grade-level resources and other school organizational features. Drawing on the literature, then, we identify two important, unanswered questions. First, does grade span affect resources (spending, salaries, and teacher characteristics)? Second, does grade span affect organizational features of schools (enrollment, class, and grade size)? In addition, we report correlational analyses between student performance and grade span at a school level and discuss future needed work in this area.

3. DATA, SAMPLE, AND VARIATION IN GRADE SPAN

To examine changes in school organization, we use a unique data set that includes all schools serving students in grades 1–8 in the New York City public schools between 1995–96 and 2001–2 (hereafter 1996–2002). Thus we focus strictly on elementary and middle grades, not secondary grades. As the largest school system in the United States, New York City provides an excellent laboratory for this study. There are a large number of elementary and middle

schools (over nine hundred in each year in our data set), serving a diverse set of students in schools configured in myriad ways. While there is much variation in the size, spending, and other features of the schools, since all are located in one district, they share a common set of institutions, policy changes, and macroeconomic and social environmental conditions.

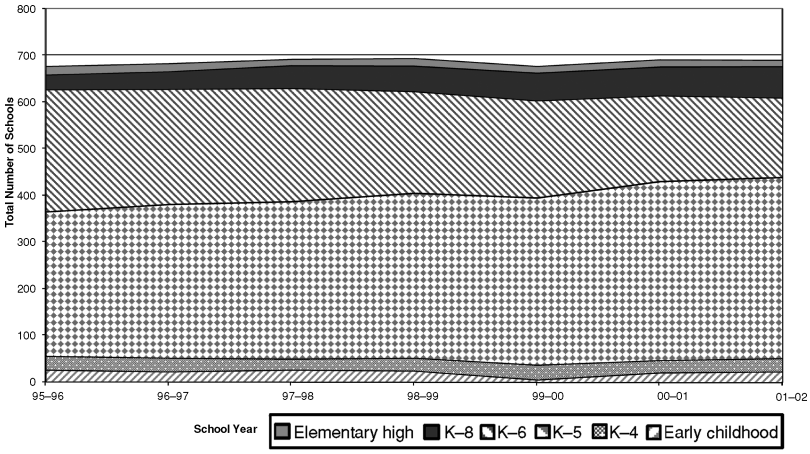
The data include detailed information on school-level resources (expenditures and the number and selected characteristics of teachers, such as experience and salary), enrollment by grade, number of classes per grade, class sizes, race, free lunch eligibility, and other student characteristics. Data on individual student socioeconomic and educational characteristics, test scores, and other variables were provided by the New York City Department of Education (NYCDOE) and were aggregated to the grade and school level. Much of our data on student and teacher characteristics come from annual school reports (ASR) and detailed data on school-level expenditures come from school-based expenditure reports (SBER).

Identifying the grade spans served in each school presented a number of unexpected complications. In some cases, schools were recorded as serving grades in which we found no students enrolled. In other cases, we found students enrolled in grades that were not recorded as being served by the school they apparently attended. As a general rule we characterized a school's grade span based on the enrollment patterns of the students and not by the grades they may have been "authorized" to serve.[5]

Given the large number of schools in the New York City system (1,100 appear at least once in our seven years of data), it is possible to find almost thirty different grade span configurations serving grades 1–8. To facilitate interpretation, our analyses use the most common grade span classifications for elementary and middle grades and collapse several uncommon configurations into our own categories with the labels "elementary high" and "middle low." These classifications denote ranges of grade span rather than specific grades served and result in a total of eleven grade span categories.

Schools that switch grade spans are important in our empirical work because they identify the effects of grade span on resources and other organizational characteristics of schools. In order to switch grade spans, a school must be present in the data for two or more years; 1,041 out of the total of 1,100 schools meet this two-year criterion. For these 1,041 schools, we define a switch in grade span as a change in low grade or high grade between school

5. We removed all schools that served primarily students in special education, as well as schools showing no students enrolled and schools with only prekindergarten and kindergarten students. While the data were largely consistent across data sets, there were instances in which we found no students in the student-level data set enrolled in certain grades, although the school served this grade according to the ASR.



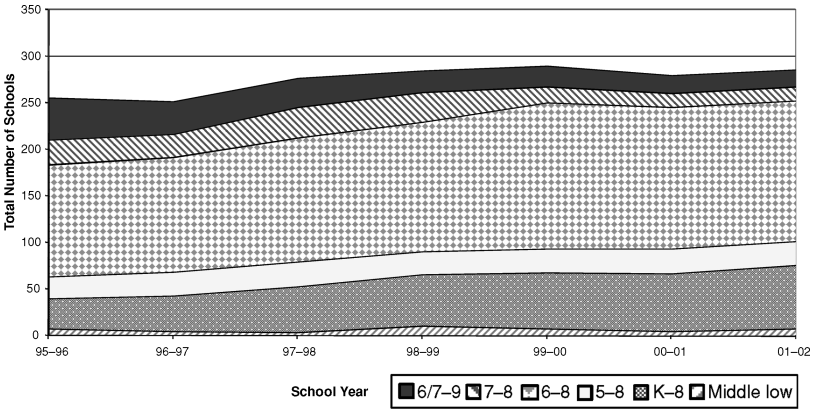
Sample is all New York City public elementary schools with students enrolled in grades 1–8. Sample excludes schools in District 75, any observations missing all ASR or all SBER data, any observations that show enrollment in only a single grade, and schools serving only nongraded special education students. Early childhood schools begin in grades K–2 and end in grades 1–3. Elementary-high schools begin in grades 2–3 and end in grades 4–8 or begin in grades 4–5 and end in grades 5–6. K–8 includes 37 schools that are K–7 and one school that is K–9.

Figure 1. The Composition of New York City Public Elementary Schools, 1996–2002

years and find that 752 schools keep the same span for all seven years of data, while 289 schools (over 25 percent) change their grade span at least once.[6] In addition, these 289 schools switch a total of 471 times.[7]

Figures 1 and 2 display the distribution of grade spans served by New York City elementary and middle schools between 1996 and 2002. As shown, K–5s and K–6s dominate the elementary schools, while 6–8s are the largest group among the middle schools.[8] Further, while the total number of elementary schools has increased slightly, the number of K–6s has declined steadily, accompanied by an increase in the number of K–5 and K–8 schools. Correspondingly, the total number of schools serving the middle grades has increased, with a shift from 6/7–9 schools toward 6–8s and smaller increases in other grade spans. Taken together, these results suggest that grade 6 has been moved out of many elementary schools and into middle schools and schools serving all elementary and middle grades. It appears, though, that the changes in grade span organization have also been complex and varied.[9]

6. This grade span switch variable can be calculated only when both current year and following year grade span data are available. In a small number of cases, there is missing data for inframarginal years. In these cases, grade span changes are defined based on the next year the school is observed.
7. Schools can switch their low grade, their high grade, or both. Overall, 77 switch low grade at least once and 242 switch high grade at least once. Grade span changes can involve the expansion or contraction in the number of grades. Grade span expansions occurred 273 times, grade span contractions occurred 190 times, and only 8 switches involved offsetting changes at the high and low end, preserving the number of grades.
8. Note that these figures do not show the distribution of students across these grade spans. Figures displaying student weighted numbers are available from the authors.
9. The changes in these tables reflect new schools in addition to schools that change grade span.



Sample is all New York City public middle schools with students enrolled in grades 1–8. Sample excludes schools in District 75, any observations missing all ASR or all SBER data, any observations that show enrollment in only a single grade, and schools serving only nongraded special education students. Middle-low schools begin in grades 4–5 and end in grades 6–8. K–8 includes 37 schools that are K–7 and one school that is K–9.

Figure 2. The Composition of New York City Public Middle Schools, 1996–2002

4. METHODS AND MODELS OF SCHOOL ORGANIZATION

In this article we examine whether resources (spending, salaries, and teacher characteristics) and organizational features (school size, class size, grade size, and number of classes) vary by grade span type. Our analyses center on a series of equations that model these resource and organizational features as a function of school environmental variables and our variable of interest—grade span organization.

Two sets of analyses are based on a model of school-level resources:

$$Y_{it} = B_o + B_1 Socio_{it} + B_2 Span_{it} + S_i + T_t + e_{it} \quad (1)$$

and a model of grade-level resources:

$$Y_{igt} = B_o + B_1 Socio_{igt} + B_2 Span_{igt} + S_i + T_t + e_{igt}, \quad (2)$$

where i indexes schools, g indexes grade levels, and t indexes years. To be more specific, we use equation 1 to analyze patterns of two groups of dependent variables that are measured at the school level—school resources and school size. We use equation 2 to analyze patterns of three dependent variables that are measured at the grade level—class size, grade size, and number of classes per grade.[10] Note that only two of these latter three variables are independently measured. We use data on classes per grade and enrollment per grade to calculate class size per grade. Socio is a vector of variables capturing the socioeconomic characteristics of students that have been associated with

10. Class sizes for students in departmentalized school settings (primarily middle schools) reflect homeroom class sizes.

higher or lower education costs at the district level, such as the percentage of students who are poor, the racial/ethnic composition of the student body, and the percentage of students who are immigrants; Span is a series of dichotomous variables representing the grade span served; S is a school fixed effect; T is a time effect; and e is an error term with the usual properties. The primary variables of interest in our models are those measuring school grade span served in a given year.

School effects are included in both models to capture unobserved time-invariant characteristics of schools such as unobserved administrative factors related to leadership or political savvy that affect measures of school size and spending. By including the school fixed effects, the grade span coefficients capture the direct effect of grade span, holding these unobserved time-invariant school characteristics fixed. This implies that these coefficients are more accurate measures of the causal impacts of changes in grade span on the output variables.[11]

In addition, the inclusion of school fixed effects entails that the identification of grade span impacts is based only on the 471 switches in 289 (out of 1,041) schools. In order for these results to be generalized to all schools in the sample, the schools that switch grade spans must be a random sample of all schools. In order to investigate further the determinants of grade span change, we estimate a set of linear probability models (LPMs) to explain the likelihood that a school changes grade span.[12] The results for the LPMs are shown in table 1, where the dependent variable takes on a value of one if grade span changes between two years and zero otherwise. The results for a parsimonious specification that includes only school variables describing the student body are given in column 1. The results for a second specification include teacher characteristics and school fixed effects and are included in column 2. In both cases, few variables are shown to be significant predictors of switching, although school size seems to matter—enrollment is negative and significant in both specifications. The second regression suggests that some of the demographic variables may matter, but these effects are substantively

11. Some or all of these unobserved factors may well be due to the grade span itself, and we might wish to include the impact of these factors in our estimates of the impact of grade span on the output measures. That is, we might want the grade span coefficients to include the indirect effects as well as the direct effects. This can be accomplished using the random effects (versus fixed effects) estimator. The results from the two estimators are qualitatively and substantively similar, so we report only the fixed effects estimates. This similarity provides evidence that the indirect effects of grade span appear to be minimal.

12. Note that in this regression and all others that use data from 1996–2002, the maximum number of schools included in the estimation is 1,041 (the number present for two or more years). The number of observations is larger than 1,041 because observations correspond to school years, hence there are multiple observations for each school. The probit estimator produces similar results, so we present only the LPM estimates because they are easier to interpret.

Table 1. Linear Probability Regression Results of Schools that Switch Grade Span, School and Year Effects, 1996–2002

	(1)	(2)
Math z-score	−0.078*	0.018
	(0.044)	(0.058)
Reading z-score	0.069	−0.086
	(0.046)	(0.061)
% immigrant	−0.001	0.001
	(0.001)	(0.003)
% special education	−0.001	0.001
	(0.001)	(0.002)
% resource room	−0.004	−0.007
	(0.003)	(0.004)
% free lunch eligible	0.000	0.000
	(0.000)	(0.001)
% LEP	−0.000	0.001
	(0.001)	(0.001)
% Asian plus	0.001	0.001
	(0.000)	(0.003)
% black	−0.000	0.004*
	(0.000)	(0.002)
% Hispanic	0.000	0.005*
	(0.000)	(0.003)
% female	−0.003	−0.006**
	(0.002)	(0.003)
Attendance rate	−0.004	0.003
	(0.003)	(0.005)
Enrollment	−0.000***	−0.000***
	(0.000)	(0.000)
Missing data	0.096***	0.069**
	(0.020)	(0.031)
% teachers ≥2 years at school		−0.001
		(0.001)
% teachers ≥5 years experience		0.000
		(0.001)
% teachers licensed and permanently assigned		−0.000
		(0.001)
% teachers with master's		0.000
		(0.000)
Teacher–pupil ratio		0.008
		(0.009)
Constant	0.625**	0.003
	(0.267)	(0.540)
Observations	5,273	5,273
Schools	1,041	1,041
R^2	0.05	0.44
School fixed effects	No	Yes

Notes: Robust standard errors corrected for clustering at the school level in parentheses. Missing data dummy indicates that observation is missing values for one or more of the control variables. Models exclude schools in District 75, any observations missing all ASR or all SBER data, any observations that show enrollment in only a single grade, and schools serving only nongraded special education students. Math and reading test scores measured as z-scores with mean zero and standard deviation one; grade scores averaged to school level.
* significant at 10%; ** significant at 5%; *** significant at 1%

small. Taken together, the results suggest that while school size matters, other variables provide little predictive power. Controlling for size in subsequent regressions may be warranted, but there appear to be few observable factors related to school grade span changes. This exercise provides support for the view that the schools that switch are not significantly different from the schools that do not switch; hence our results based on the fixed effects estimator apply to all schools in our data set.[13]

5. EMPIRICAL RESULTS

Table 2 presents mean characteristics by grade span for 2002. As might be expected, schools serving primarily middle grades tend to be larger than those serving elementary grades. Schools serving grades 7–8 only are a notable exception, with average enrollments of only 514 students. The dominant middle grade configurations (5–8 and 6–8) average approximately one thousand students, while the dominant elementary configurations (K–5 and K–6) average approximately eight hundred students.

Disaggregating total enrollment into students per grade, average class size, and number of classes shows that middle schools tend to have more students and more classes in each grade, and larger average class sizes, as compared with elementary schools, though again 7–8 schools are outliers. For example, 6–8 schools, the predominant middle grade configuration, average twenty-eight students per class, as compared with twenty-four students per class in K–5 schools, the predominant elementary school configuration. Note that in middle school, the data for class and grade size are for homeroom only and do not necessarily reflect the class size in any instructional class in a specific subject area.

Turning to resources, per pupil spending in middle schools is generally lower than in elementary schools, though most grade spans have similar spending per pupil overall.[14] Several of the less-common configurations, though, such as the early childhood spans (K/1/2–1/2/3), middle-low, and 7–8 schools have substantially higher per pupil spending, while 6/7–9 schools have much lower spending. For example, total spending in 7–8 schools and in middle-low schools averages over $12,000 per pupil, while total spending per pupil in K–5 and 6–8 schools averages under $11,000 per pupil. Differences in teacher characteristics also emerge. Schools with the most common elementary school grade spans exhibit the highest observable qualifications among elementary

13. Because the random effects estimates of the grade span effects are based on all schools, the similarity of the fixed effects and random effects results provides further evidence that the schools that change grade span are representative of our full sample of schools.
14. All spending variables are adjusted to hundreds of 2001–2 dollars using the New York–Northern New Jersey–Long Island consumer price index (CPI).

Table 2. Selected Means of School Characteristics, Student Characteristics, and Resource Variables by School Organization, 2002

	K–4	K–5	K–6	K–8	EH	ML	EC	5–8	6–8	7–8	6/7–9
Enrollment	809.69	810.44	728.54	858.79	580.54	315.63	429.91	1081.85	988.75	514.20	1129.67
Students/grade	162.95	129.91	100.65	99.92	145.60	143.06	133.13	271.91	319.86	237.75	362.02
Standard classes/grade	6.50	5.26	4.13	3.80	6.11	5.80	5.88	9.16	11.15	9.50	11.38
Standard class size	24.19	23.92	23.78	24.90	24.23	25.57	21.89	27.50	27.90	24.94	30.52
Total spending/pupil	114.28	108.91	113.24	113.48	107.10	128.63	118.66	106.10	103.19	122.40	95.00
% tch. lic. & perm assigned	79.14	86.80	84.45	80.11	86.14	60.71	84.43	71.43	74.14	70.14	82.06
% teachers ≥5 yrs experience	48.84	54.26	53.61	45.72	46.28	39.99	46.00	47.17	48.12	46.63	63.15
% teachers with master's	68.29	76.63	73.67	68.93	69.32	55.53	71.30	62.22	65.66	61.26	75.45
% special education	4.56	4.38	4.93	5.96	4.35	5.23	3.30	7.44	6.19	8.13	5.33
% resource room	5.17	5.14	5.57	6.12	5.87	12.56	3.00	6.04	7.06	8.13	7.03
% LEP	17.27	12.89	10.01	11.78	11.20	12.81	19.76	15.61	11.82	8.83	14.45
% free lunch	74.83	84.79	71.75	75.04	76.60	78.66	84.79	81.52	69.88	72.93	52.98
% white	2.06	20.35	10.29	14.79	7.87	6.24	4.44	4.63	16.30	2.07	24.33
% black	32.90	30.79	40.31	37.69	44.88	31.55	31.33	36.74	38.13	51.21	13.83
% Hispanic	60.61	36.69	35.47	40.11	38.78	59.49	48.93	53.43	35.69	40.40	30.86
% Asian plus	4.44	12.17	13.93	7.42	8.46	2.74	15.28	5.20	9.87	6.30	30.98
% female	48.80	48.83	48.88	49.62	51.15	50.51	49.34	50.15	49.48	49.53	48.66
% recent immigrant	5.21	7.27	6.48	5.09	6.47	4.04	8.21	4.52	6.77	3.79	9.58
N	29	388	170	68	13	8	23	26	151	15	18

Notes: Sample excludes schools in District 75, any observations missing all ASR or all SBER data, any observations that show enrollment in only a single grade, and schools serving only nongraded special education students. Total spending/pupil is reported in 100s of 2002 dollars, adjusted by the New York City Metropolitan Area CPI. Early childhood (EC) schools begin in grades K–2 and end in grades 1–3. Elementary-high (EH) schools begin in grades 2–3 and end in grades 4–8 or begin in grades 4–5 and end in grades 5–6. Middle-low (ML) schools begin in grades 4–5 and end in grades 6–8. Students/grade, classes/grade, and class size are aggregated from New York City public school student-level data. Classrooms with fewer than 15 or more than 40 students are excluded from their calculation. Asian plus indicates Asian, Native American, Pacific Islander, or unknown. K–8 includes three schools that are K–7.

schools, while fewer differences appear between middle schools. Schools serving K–4 and K–8 have the lowest proportions of teachers with full licenses, over five years of experience, and advanced degrees among schools serving elementary grades. The lower experience and education for teachers in these schools is particularly surprising given the higher average spending in these schools.

To the extent that resources and staffing patterns are related to student race and poverty (Rubenstein, Schwartz, and Stiefel 2006), differences in student characteristics may shed light on these patterns across grade span. In the elementary schools, the percentage of black students is relatively consistent across grade span configurations (approximately one-third of students), but K–4 schools have much higher percentages of Hispanic students (60 percent) and lower percentages of white and Asian students (less than 7 percent), particularly compared with K–5 schools. Schools serving grades K–5 have the highest poverty levels (as measured by eligibility for free lunch programs) and higher percentages of recent immigrants.[15]

Given the concentration of Hispanic students in K–4 schools, it is not surprising that they are also overrepresented in 5–8 schools (53 percent). We see a similar pattern for white and Asian students, who are more likely to attend K–5 and upper-level schools beginning in sixth grade. Asian students and recent immigrants, in particular, are heavily concentrated in 6/7–9 schools, which also tend to have much lower poverty levels than other configurations. Unlike in the elementary schools, which had relatively equal percentages of black students, over 50 percent of the students in 7–8 schools are black.

How Is Grade Span Related to School-Level Resources?

Table 3 presents the results of the regression analyses examining a grade span's relationship to spending and teacher characteristics, controlling for observable school factors, as well as school and time effects (see equation 1). Note that all grade span coefficients are relative to the omitted group—the K–8 grade span—and that for these regressions, data for the dependent variables are available from 1997 (not 1996) through 2002.[16] Examining teacher characteristics first, we find that once we control for student characteristics and unobserved time-invariant factors there appears to be little systematic relationship between grade span and teacher resources (see columns 1 and 4 of table 3). We do find a significant relationship between average teacher salaries and grade span for

15. In part, these patterns appear to be related to geographic differences across New York City's boroughs. For example, K–4 schools are most prevalent in the Bronx, a borough with a large Hispanic population. Schools serving K–5 are more common in Staten Island, a borough with an above-average white population, than in the other boroughs.

16. The maximum number of schools is now 1,036 rather than 1,041 because five fewer schools are in the data two years or more from 1997–2002.

Table 3. Resource Regression Results, School and Year Effects, 1997–2002

	(1) Average Teacher Salary	(2) Teachers per 100 Pupils	(3) Total Spending per Pupil	(4) % of Teachers with 5 Years Experience	(5) School Enrollment
EC	−1.512	−0.381	−5.668	0.389	−253.463***
	(18.941)	(0.601)	(5.509)	(4.574)	(54.700)
K–4	2.981	−0.124	−1.317	−2.829	−215.861***
	(10.240)	(0.334)	(3.894)	(4.016)	(42.414)
K–5	0.244	0.336**	5.213***	0.912	−156.447***
	(4.944)	(0.168)	(1.924)	(1.967)	(29.177)
K–6	7.702*	0.014	1.959	0.642	−103.838***
	(4.677)	(0.167)	(1.898)	(1.909)	(26.834)
EH	−13.939	0.125	−1.312	0.984	−240.047***
	(11.903)	(0.287)	(3.917)	(2.809)	(65.601)
ML	12.405	−0.027	−3.264	3.103	−295.422***
	(12.366)	(0.513)	(7.288)	(4.844)	(88.195)
5–8	8.338	−0.954	−16.675	−3.537	12.146
	(13.068)	(0.769)	(11.633)	(5.978)	(106.593)
6–8	14.018	−0.464	−5.124	2.732	−119.247
	(12.680)	(0.593)	(8.792)	(5.479)	(87.091)
7–8	19.388	0.497	14.866	3.970	−289.695***
	(13.648)	(0.622)	(10.085)	(6.124)	(91.170)
6/7–9	26.235*	−0.348	−3.548	6.625	−190.205**
	(15.068)	(0.614)	(9.270)	(5.654)	(80.151)
% recent immigrant	−0.225	−0.014	−0.298**	−0.329***	3.336**
	(0.357)	(0.009)	(0.140)	(0.086)	(1.400)
% special education	−0.141	0.000	0.290***	0.069	−1.404**
	(0.166)	(0.006)	(0.085)	(0.044)	(0.623)
% resource room	0.672	0.006	0.466**	0.049	−6.412***
	(0.438)	(0.013)	(0.182)	(0.121)	(1.413)
% free lunch	−0.090	0.006**	0.039	0.005	−0.510
	(0.088)	(0.003)	(0.030)	(0.029)	(0.323)
% LEP	−0.404	0.008*	0.075	−0.039	−0.039
	(0.247)	(0.004)	(0.052)	(0.066)	(0.469)
Constant	437.757***	8.620***	116.639***	56.265***	843.900***
	(13.533)	(0.644)	(6.482)	(5.232)	(70.910)
Observations	5,428	5,428	5,429	5,221	5,429
Schools	1,036	1,036	1,036	1,036	1,036
R^2	0.79	0.88	0.90	0.82	0.97

Notes: Robust standard errors corrected for clustering at the school level in parentheses. Regression also includes dummies to indicate missing values (not shown). Sample excludes schools in District 75, any observations missing all ASR or all SBER data, any observations that show enrollment in only a single grade, and schools serving only nongraded special education students. Early childhood (EC) schools begin in grades K–2 and end in grades 1–3. Elementary high (EH) schools begin in grades 2–3 and end in grades 4–8 or begin in grades 4–5 and end in grades 5–6. Middle-low (ML) schools begin in grades 4–5 and end in grades 6–8. K–8 is the omitted category and includes 37 schools that are K–7 and one school that is K–9. Dollar figures measured in 100s of 2002 dollars. Using 1997–2002 data rather than 1996–2002 data results in 1,036 schools rather than 1,041 schools that appear two years or more. Missing dependent variables result in observation numbers that differ slightly across specifications.

* significant at 10%; ** significant at 5%; *** significant at 1%

K–6 and 6/7–9 schools, with higher salaries of $770 and $2,624, respectively, but no relationship between teacher experience and grade span.[17] With the exception of lower teacher experience in schools with more recent immigrants, we also find no significant relationships between teacher characteristics and our control variables.

Turning to the number of teachers and average spending, we find more teachers (approximately three per one thousand students) and higher spending ($521) in K–5 schools, but no significant relationships for other grade spans (see columns 2 and 3 of table 3). Not surprisingly, higher percentages of full-time and part-time special education students are associated with higher spending, while recent immigrants are associated with lower spending. While schools with higher percentages of low-income and limited English proficient students do not have higher spending, they do tend to have more teachers than do schools with fewer students with special needs, though the differences are quite small in magnitude.

To summarize, we find that spending and teacher resources vary little with grade span. There is some evidence that K–5 schools receive more resources, both in the form of more overall spending and greater teacher quality. There is also evidence that K–6 schools have significantly greater teacher quality and 7–8 schools receive significantly greater funding. Taken together, however, this evidence suggests that differences in grade span across schools carry little weight in determining the numbers of teachers, the average salaries of those teachers, and/or the overall spending level. Of course, these might reflect offsetting changes or deliberate policy interventions that create inertia in resource allocation (hold harmless provisions). Future work might explore this in greater depth.

How Is Grade Span Related to Other School Organizational Features?

School Size

The descriptive statistics presented earlier suggested that schools with different grade spans also differ in other organizational features, including school size. The fixed effects results for the enrollment model are presented in column 5 of table 3, with the other school-level variables. Not surprisingly, school size varies significantly with grade span—schools with longer grade spans are larger, other things equal, at both the elementary and middle grade levels. Compared with K–8 schools, for example, K–4 schools average 216 fewer students, K–5 schools have 156 fewer, and 7–8 schools have 290 fewer students. Thus adding a grade typically means increases in the number of students.

17. The standard deviation in teacher salaries is $5,248, so these impacts represent increases of 0.15 and 0.50 standard deviations in teacher salaries.

Class Size

Given that class size reduction and state aid programs often explicitly target the early grades for lower class sizes, it is important to carry out this analysis at the grade level and not the school level. Otherwise any impacts of grade span on class size may simply be the result of the difference in grade composition rather than the actual organization structure of the grade span itself.[18] To more fully understand class size differences, we need to examine the differences at the grade level to determine whether, for example, first-grade class sizes differ across grade spans.

Table 4 shows regression results for class size, classes per grade, and students per grade (see equation 2). This table presents three different regressions (one for each dependent variable), with each regression based on all grades pooled (grades 1–8) over seven years of data (1996–2002). Appropriate grade spans are matched to each grade level. Thus, for example, span 5–8 is matched to grades 5, 6, 7, and 8 but is not matched to grades 1, 2, 3, or 4. Coefficients reported in the table are obtained from interactions between the grade level (in the row) and the grade span (in the column). For example, in the upper left corner, 0.745 is the coefficient on the grade one dummy interacted with the early childhood span where class size is the dependent variable. Each regression includes a constant and a set of control variables listed in the table notes, as well as school and year fixed effects. The control variables are constrained to have identical coefficients across all grades in each regression. The omitted category in these models is grade 1 in the K–4 schools. Reading coefficients across a row for class size is a comparison of class size differentials (compared with K–4 schools) across all grade spans that include the (same) grade as indicated by the row grouping (i.e., grade 1, grade 2 . . .). The same holds for rows corresponding to classes per grade and students per grade. Reading coefficients down a column for the rows that correspond to class size is a comparison of class size differentials across different grades included in the (same) grade span, indicated by the column heading. Note that for grades 6–8, class size and classes per grade are calculated for homeroom classes only and should be interpreted with caution.

The class size regression results (first rows for each grade level in table 4) reflect meaningful differences in class size across grade spans. As an example, the average fifth grade in a K–5 school has 2.8 more students than the average first grade in a K–4 school. In addition, and more unexpectedly, there are differences in class size within the *same* grades across grade spans. That is, grade span matters to class size. For first grade, the biggest difference in class sizes

18. That is, if first grade typically has a lower class size than fourth grade and if first grade represents a larger share of enrollment in K–4 schools as compared with K–8 schools, these relationships may reflect the averaging of class size at the school level.

Table 4. Regression Results, Three School Organizational Features, Grades 1–8, School and Year Effects, 1996–2002

	EC	K–4	K–5	K–6	K–8	EH	ML	5–8	6–8	7–8	6/7–9
Grade 1											
Class size	0.745	–	−0.571*	−0.082	0.165	–	–	–	–	–	–
Class/grd	0.702***	–	−0.239**	−0.485***	−0.907***	–	–	–	–	–	–
Stud/grd	24.330***	–	−7.595**	−10.064***	−19.192***	–	–	–	–	–	–
Grade 2											
Class size	0.129	0.057	−0.568*	−0.197	0.395	−0.129	–	–	–	–	–
Class/grd	0.018	−0.175*	−0.331***	−0.467***	−0.873***	−0.887**	–	–	–	–	–
Stud/grd	3.666	−4.350*	−9.675***	−9.870***	−17.111***	−21.538**	–	–	–	–	–
Grade 3											
Class size	−0.566	−0.014	−0.412	−0.301	0.293	0.093	–	–	–	–	–
Class/grd	−0.490**	−0.540***	−0.526***	−0.559***	−0.943***	0.203	–	–	–	–	–
Stud/grd	−13.642***	−14.230***	−14.000***	−12.695***	−19.710***	6.196	–	–	–	–	–
Grade 4											
Class size	–	2.015***	2.172***	2.189***	2.156***	1.689***	0.768	–	–	–	–
Class/grd	–	−1.463***	−1.206***	−1.165***	−1.409***	−0.445*	−1.400**	–	–	–	–
Stud/grd	–	−26.292***	−18.328***	−18.077***	−22.988***	1.194	−21.855	–	–	–	–
Grade 5											
Class size	–	–	2.815***	2.852***	3.000***	2.246***	1.262	3.278***	–	–	–
Class/grd	–	–	−1.558***	−1.387***	−1.585***	−0.624**	−0.395	−3.398***	–	–	–
Stud/grd	–	–	−24.791***	−21.443***	−24.287***	−0.747	0.689	−77.188***	–	–	–

Table 4. Continued.

	EC	K–4	K–5	K–6	K–8	EH	ML	5–8	6–8	7–8	6/7–9
Grade 6											
Class size	–	–	–	2.932***	3.203***	2.789***	2.948***	3.969***	3.697***	–	1.337
Class/grd	–	–	–	−1.757***	−1.864***	−0.956***	−0.030	−0.146	−0.660	–	−2.223***
Stud/grd	–	–	–	−31.352***	−32.133***	−7.662	14.540	17.775	−1.409	–	−57.710**
Grade 7											
Class size	–	–	–	–	2.904***	2.220**	2.098**	4.606***	4.552***	3.633***	3.092***
Class/grd	–	–	–	–	−2.039***	−1.079***	−0.750	0.527	0.664	1.747**	0.986
Stud/grd	–	–	–	–	−37.827***	−15.798*	−7.566	40.619**	42.380*	67.185***	42.416*
Grade 8											
Class size	–	–	–	–	2.640***	1.933**	2.965	4.675***	4.649***	4.089***	3.534***
Class/grd	–	–	–	–	−2.248***	−1.075***	−0.336	−0.026	0.435	1.810**	0.866
Stud/grd	–	–	–	–	−44.183***	−15.462	4.253	26.680	37.944*	73.598***	43.096**

Notes: Robust standard errors corrected for clustering at the school level (not shown). There are three separate regressions (dependent variables: class size, classes/grade, and students/grade). Each grade was interacted with the spans covered by that grade. R^2 is 0.25 for class size, 0.23 for classes/grade, and 0.15 for student/grade. Each of the three regressions has 1,041 schools and 29,918 observations. A set of control variables is included in each of the three regressions. These variables are percent recent immigrants, percent full-time special education students, percent resource room (part-time special education) students, percent eligible for free lunch program, and percent limited English proficient. Sample excludes schools in District 75, any observations missing all ASR or all SBER data, any observations that show enrollment in only a single grade, and schools serving only nongraded special education students. Early childhood (EC) schools begin in grades K–2 and end in grades 1–3. Elementary-high (EH) schools begin in grades 2–3 and end in grades 4–8 or begin in grades 4–5 and end in grades 5–6. Middle-low (ML) schools begin in grades 4–5 and end in grades 6–8. K–8 is the omitted category and includes 37 schools that are K–7 and one school that is K–9.

* significant at 10%; ** significant at 5%; *** significant at 1%

is for early childhood and K–5 schools. The difference, 1.32 students (0.745 − (−0.571)), is approximately one-third of a standard deviation in class size, and this difference is statistically significant. Given that early childhood schools are often presumed to have the most resources for younger children, it is surprising to find that they actually have the largest class size in first grade, although they do have the smallest in third grade. Thus the early childhood schools may be aiming greater resources at their graduating class of third graders, or they may be using their additional resources for other school personnel.

In the second grade, the biggest difference is for K–5 and K–8 grade spans, with smaller classes in K–5. The difference, 0.96 students (−0.568 − 0.395), is approximately one-quarter of a standard deviation in class size, and it is statistically significant. For third grade, the biggest difference is for early childhood and K–8 grade spans, with K–8 again having larger class sizes. The difference, 0.86 students, is approximately one-quarter of a standard deviation in class size, but it is significant only at the 11 percent level. For fourth grade, the biggest difference is for K–6 (largest) and middle-low (smallest) grade spans. The difference, 1.42 students, though not statistically significant, is still approximately one-third of a standard deviation in class size. For fifth grade, the biggest difference is for 5–8 (largest) and middle-low (smallest) grade spans. The difference is 2.02 students; it is significant at the 1.5 percent level, and it corresponds to more than one-half of a standard deviation difference in class size. There is also significant variation in class size across grade spans for sixth through eighth grades, although again classes typically are for homerooms, so it is less clear how to interpret these results.

The joint tests for the equality of class size at the same grade level across grade spans are rejected at the 5 percent significance level for grades 1–3 but are not rejected for grades 4 and 5. Despite the lack of significance for the latter two grades, the differences between the grade spans with the smallest and largest average class sizes are still large in an economic sense (as discussed above).

Overall, the evidence supports the hypothesis that class sizes are significantly different across grade spans within grades. Generally schools serving K–8 grades tend to have the largest class sizes for grades 1–5. K–5 schools tend to have among the smallest class sizes for grades 1–3. For fourth and fifth grades, middle-low schools have the smallest class sizes, followed by elementary-high schools.[19]

19. We also tested for the equality of class size across grades within the same grade span and found that they are not equal. This is not surprising, given the large differences evident between the early grades (1–3) and the later grades (4–8). We found that there is no significant difference in class sizes within grade spans for grades 1–3, whereas there are significant within–grade span differences in class sizes between grades 3 and 4 and grades 4 and 5.

Classes per Grade (Grade Size)

Turning to the grade size results as reported in the second row of each grade grouping of table 4, an interesting pattern emerges—schools with relatively small class sizes typically have more classes per grade. In fact, for grades 1–5, the correlation between the estimated coefficients for class size and classes per grade is −0.79. This relationship is most apparent for the K–8 schools, which have the largest classes but the fewest classes per grade. One exception is the early childhood schools for first grade, which appear to have both relatively large class sizes and number of classes per grade. Interestingly, the correlation between the estimated coefficients for class size and classes per grade for grades 6–8 is 0.54; schools with large class sizes also tend to have a larger number of classes per grade. The 7–8 schools appear to have the largest number of classes per grade—approximately four more, on average, compared with K–8 in both seventh and eighth grades.[20]

Students per Grade

The last set of regression results, as reported in row 3 of each grade grouping in table 4, corresponds to the number of students in each grade. Mirroring the classes per grade results, we find that grade span matters. The K–8 schools tend to have among the smallest number of students per grade across all grades 1–8. The early childhood and K–4 schools have the largest grades for grades 1 and 2, while the 7–8 schools have the largest seventh and eighth grades; the differences in average size between the 7–8 schools and the K–8 schools are 105 and 118 students in grades 7 and 8, respectively. Given that the standard deviation for students per grade is a little more than 100, these represent 1.03 and 1.16 standard deviation differences in grade size. Put simply, then, schools with longer grade spans on average have smaller grade sizes.

Outcomes

In order to obtain some evidence on how grade span relates to grade-specific math and reading test score performance, we estimated four regressions whose results are presented in table 5. These regressions, like those in table 4, pool grades over all seven years, 1996–2002. The grades begin in third because that is the first time tests are administered. Columns 1 and 3, for reading and math test scores, are estimated using OLS, and columns 2 and 4 add school fixed effects. Note that all test scores are measured as grade-specific z-scores.[21]

20. We test and reject the equality of classes per grade across grade spans within each grade for all grades 1–8.
21. Each student's test score is calculated by taking the reported score, subtracting the grade-specific mean score, and dividing by the grade-specific standard deviation so that the overall mean for each grade is zero and the standard deviation is one.

Table 5. Reading and Math Scores, Grades 3–8, School and Year Effects, Pooled Data, 1996–2002

	(1) Reading	(2) Reading	(3) Math	(4) Math
EC	0.208***	0.189*	0.173**	0.063
	(0.061)	(0.102)	(0.070)	(0.098)
K–4	0.060	−0.042	0.049	−0.082
	(0.038)	(0.050)	(0.041)	(0.060)
K–5	0.029	0.036	0.015	−0.002
	(0.027)	(0.032)	(0.027)	(0.037)
K–6	−0.027	−0.014	−0.050*	−0.035
	(0.027)	(0.029)	(0.027)	(0.032)
EH	−0.038	0.023	−0.114***	−0.041
	(0.042)	(0.045)	(0.044)	(0.046)
ML	−0.064	−0.014	−0.103	−0.068
	(0.078)	(0.053)	(0.094)	(0.061)
5–8	−0.052	0.017	−0.064	−0.028
	(0.047)	(0.064)	(0.044)	(0.065)
6–8	−0.072*	0.006	−0.104***	−0.060
	(0.038)	(0.066)	(0.038)	(0.068)
7–8	−0.044	0.020	−0.063	−0.100
	(0.051)	(0.070)	(0.056)	(0.077)
6/7–9	−0.015	0.035	−0.049	−0.002
	(0.048)	(0.068)	(0.049)	(0.077)
Observations	20,583	20,583	20,838	20,838
Schools	1,041	1,041	1,041	1,041
R^2	0.68	0.83	0.70	0.85
School effects	No	Yes	No	Yes

Notes: Robust standard errors corrected for clustering at the school level in parentheses. Regressions include controls for percent recent immigrant, percent full-time special education, percent resource room (part-time special education), percent free lunch program eligible, percent limited English proficient, race, gender, attendance rate, enrollment, percent of teachers with two or more years at the same school, percent of teachers with at least five years of experience, percent of teachers licensed and permanently assigned, percent of teachers with a master's degree, and grade dummies. Missing dummy controls for missing values of control variables. Sample excludes schools in District 75, any observations missing all ASR or all SBER data, any observations that show enrollment in only a single grade, and schools serving only nongraded special education students. Early childhood (EC) schools begin in grades K–2 and end in grades 1–3. Elementary-high (EH) schools begin in grades 2–3 and end in grades 4–8 or begin in grades 4–5 and end in grades 5–6. Middle-low (ML) schools begin in grades 4–5 and end in grades 6–8. K–8 is the omitted category and includes 37 schools that are K–7 and one school that is K–9.
* significant at 10%; ** significant at 5%; *** significant at 1%

Although there are few statistically significant coefficients, where there are some, the results seem to indicate that in grade 3, early childhood organization outperforms others, while in math at least, there is some indication that K–6, 6–8, and elementary-high organizations perform worse than K–8 (the omitted category). We present these as indicative and suggest that in the future student-level data would be more appropriate to explore these relationships.

Summary of Results

These results have a number of implications for researchers and for students. First, it is clear that the grade span of a child's school affects the typical schooling environment and organization of the school. Not surprisingly, as school grade span widens, school size grows, which could carry with it implications for educational outcomes (Stiefel et al. 2000; Lee and Loeb 2000; Fowler 1995). In contrast, grade size tends to be smaller. Thus while K–8 schools are the largest overall, each grade has fewer students than most other grade span configurations. Second, certain types of schools are organized very differently from the typical school. For example, a child who attends fifth grade in a middle-low school (defined here as fourth, fifth, or sixth grade through seventh or eighth grade) is likely to attend a smaller school, with more classes per grade but smaller class sizes than a student who attends fifth grade in a more traditionally organized K–5 or K–6 school.

Third, research examining the effect of school inputs such as class size could produce biased results if class size is reported as a school average and the analyses do not control for grade span. We find large and significant differences in average class size both across different grades within schools and across the same grade in schools with different spans. Because class sizes may be significantly larger in the upper grades, schoolwide average class sizes may reflect the grades served within the school as much as the number of students in a typical class. Ideally, analyses should include data measuring actual class sizes at the grade level. Given that such data are rarely available, though, including a variable measuring school grade span may improve the precision of estimates of class size effects on student performance.

Finally, although estimation of the relationship between grade span and test scores undertaken at the school level produces few significant results, there is some indication that K–8 schools could produce better results in math in the higher elementary and middle school grades.

6. CONCLUSIONS

Given the interest of U.S. school districts in reorganizing schools to promote higher student achievement, it is surprising how little evidence is available examining the potential implications of these decisions. An obstacle in much of the available research is that it covers multiple school districts, making it difficult to disentangle the effects of district location and demographics from the effects of grade span. This article is one of the first to examine the relationships among several popular school organizational characteristics and reforms: school resources, class and school size, and grade span configuration. By examining resource and other differences over time and across schools

within a single urban school district (New York City), we exploit the unusual level of within-district variation in grade spans.

Several patterns emerge from the analyses. First, we find that a great deal of diversity exists in grade spans in New York City and that grade span configurations are not static over the time period 1996–2002. While schools serving grades K–5 and 6–8 are the dominant structures, we find substantial numbers of schools with other grade spans, including K–6, 5–8, and K–8.

Second, the fixed effects results provide the most accurate measures of possible causal relationships but are only identified by schools that switch grade spans. We find that changes in grade span are not related to observable factors, except perhaps enrollment, and thus the fixed effects results apply to the full set of schools in our data set (not just to the switchers).

Third, school grade span is often related to other important school organizational characteristics, including school size and class size. In the elementary grades, students in schools serving primarily earlier grades are likely to attend smaller schools with larger average class sizes than schools that also include higher grades. At the same time, it appears that a school's grade span has few implications for the characteristics of teachers a student will encounter.

Finally, grade span is an important, but typically omitted, variable in school-level production functions. Schools serving different grade spans appear to have different organizational patterns, particularly class sizes, even at the same grade levels. School-level teacher-pupil ratios or average class sizes may not accurately capture the grade-specific class size and may obscure possible effects of class size differences on student performance. Because school grade span is typically more readily observable than grade-specific class size, it may serve as a useful proxy in school-level analyses.

This article adds to the literature on school organization in general in several ways. First, in terms of common measurable attributes of schools, it illustrates the important relationships among the multiple dimensions of school organization. Second, it demonstrates the need to include several organizational factors in studies of school outcomes. Third, it emphasizes the need to avoid one-dimensional reform strategies focusing on only a single policy variable. While no "magic bullet" exists to improve student performance, it is critical that we identify the most cost-effective ways to organize schools to benefit students and that we understand the many-faceted effects of varying school organizational structures. Some evidence points to the possibility that K–8 schools produce better performance in the upper elementary and middle grades. This article provides a first look at the implications and trade-offs among the 3 "Ss" of school organization—size, spending, and span—and a starting point for examining their effects on student performance.

We thank Charles Parekh for excellent research assistance, participants at a session of the American Education Finance Association 2006 meetings for helpful comments, and the U.S. Department of Education, Institute for Education Sciences, for support that funded this work. All analyses and conclusions are our own.

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