

## The Impact of School Size on Student Achievement: Evidence from Four States

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### **Abstract**

Student achievement models in this paper draw on information from a large panel dataset provided by the Northwest Evaluation Association covering roughly one million students in four states representing diverse geographic zones across the United States. Estimates are obtained of how a student's achievement changes as he moves between schools of different sizes from grades 2-10 in the time period 2007 to 2011. We find significant negative effects of large schools on student math and reading achievement of  $-.043$  and  $-.023$  *SD* respectively, compared to the average sized school. The negative impacts of large schools are particularly salient in grades 6-10.

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### The Impact of School Size on Student Achievement: Evidence from Four States

Small school reforms were once a hot topic among politicians, foundations, educators, and parents, but have since faded from the public eye before sufficient, rigorous research was completed to assess the potential for small schools to significantly improve student achievement. For a time, organizations such as the Bill and Melinda Gates Foundation, the Annenberg Foundation, the Carnegie Corporation, and the Pew Charitable Trusts strongly argued that small schools could impact student outcomes through a variety of mediators, such as community building and increased accountability. By 2002, The Gates Foundation alone had invested over \$250 million in grants to facilitate the growth of small schools nationwide but have since retreated from this reform to focus on other reform strategies (Vander Ark, 2002).

This paper is the first of its kind to examine the impacts of school size in both elementary and secondary schools using a rigorous research design that focuses on individual changes in student achievement as a student moves between schools of varying sizes. As such, we are able to explore the validity of past claims regarding the relationship between small schools and learning outcomes on elementary students. Moreover, our large and representative dataset allows for a rigorous examination of the impact of school size on secondary school students which, until now, has yet to be conducted.

Two specific research questions are addressed:

1. Does school size have a significant impact on student achievement?
2. Do school size impacts vary between elementary and secondary school levels?

School consolidation efforts throughout the twentieth century have had a significant impact on average school size. In 1920, there were 271,000 public elementary and secondary schools in the U.S. By

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2009, that number had shrunk to 98,706.<sup>2</sup> While public schools have been closing and merging, the student population over this time period has more than doubled, growing from 21.6 million students to 49.3 million.<sup>3</sup> Policymakers pushing for consolidation of schools and increasing school size have put forth a number of theoretical reasons to favor large schools. The primary argument supporting more school consolidation rests on the notion of economies of scale. There are cost efficiencies associated with maintaining fewer buildings and sharing expensive resources among greater numbers of students (Guthrie, 1979; Michelson, 1972). Large schools permit the purchasing of facilities and instructional equipment in bulk. Second, large schools might be more likely to attract a more diverse population, exposing students to peers of different races, ethnicities, and cultural backgrounds (Smith & DeYoung, 1988). A third, related factor to having a more diverse student body is the increased likelihood of psychological benefits from being exposed to peers who share similar interests, feel comfortable together, and help develop social functioning skills. Finally, it might be the case that the division of labor among faculty enables teachers in large schools to specialize in areas of expertise, exposing students to a broader array of course options taught by teachers whose instructional strengths are uniquely suited to those subjects (Conant, 1959). However, not all of these assumed benefits have held up to empirical research, and even those that do come at a price. A number of important studies on the effects of school size can offer insights on these matters and are thoroughly reviewed in the next section.

School size reforms often occur as part of a portfolio of reforms to school policies, such as governance practices, curricular reforms, and human resource policies. Thus, an empirical challenge presents itself when trying to isolate the effects of just one dimension of a school reform package. A weakness of much of the existing studies on school size effects is that they are cross-sectional in nature, and thus they fail to clearly isolate the effects of variations in school size from other reforms occurring at the same time.

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<sup>2</sup> See Table 90 of the Digest of Education Statistics 2010: Number of Public School Districts and Public and Private Elementary and Secondary Schools: Selected Years, 1869-70 through 2008-09.

<sup>3</sup> See Table 3 of the Digest of Education Statistics 2011: Enrollment in educational institutions, by level and control of institution: Selected years, 1869-70 through fall 2020.

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Moreover, variation in school size is usually not exogenous, and often the observed variation in school size is correlated with other observable and unobservable traits that may affect student achievement, such as urban/rural status and ethnicity compositions. This paper addresses this potential weakness by employing a panel dataset that tracks individual students over time and estimates the effect of school size within students, as opposed to across students. Exploiting variation across time like this allows us to isolate the effect of school size from that of any unobserved student or temporal characteristics. As a result, this study uses unique data analysis procedures to address the central research questions at both the elementary and secondary levels, avoiding the biases of previous papers on the topic. Furthermore, the database we employ is larger and more geographically comprehensive than those used in previous analyses of school size impacts.

The remainder of the paper is organized as follows: Section II reviews the existing literature on school size and student achievement and situates our contribution in this literature. Section III describes the data for this study. Section IV describes the estimation strategy. Section V presents the results. Section VI concludes with a discussion of the policy relevance of our findings.

### **Literature Review**

As compared to other educational policies, the research base attempting to quantify the effects of school size on student achievement is relatively large and comprehensive (for thorough reviews, see Andrews, Duncombe & Yinger, 2002; Fox, 1981; Leithwood & Jantzi, 2009), yet much of the research relies upon cross sectional observations that fail to control for endogenous variation in the school size variable. Studies on this topic have analyzed a variety of outcomes, including extra-curricular participation (Coladarci & Cobb, 1996; Crosnoe et al., 2004; Feldman & Matjasko, 2007; McNeal, 1999), graduation and enrollment statistics (Darling-Hammond, Aness, & Ort 2002; Stiefel, Berne, Intarola, & Fruchter, 2000), standardized test scores (Kuziemko, 2006), equity of distribution of achievement (Bickel & Howley, 2000; Lee & Loeb, 2000; Lee, Smerdon, Alfeld-Liro, & Brown, 2000; Lee & Smith, 1993,

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1995, 1997), quality and variety of courses offered (Lee & Smith, 1995; Monk, 1987; Monk & Haller, 1993), attendance (Darling-Hammond, Anness, & Ort, 2002; Kuziemko, 2006), truancy, graduation (Darling-Hammond, Anness, & Ort, 2002), dropout rates (Bos, Ruijters, & Visscher, 1990; Funk & Bailey, 1999; Gardner, Ritblatt, & Beatty, 2000; Lee & Burkam, 2003; McNeal, 1997; Phillips, 1997; Rumberger, 1995; Rumberger & Palardy, 2005; Rumberger & Thomas, 2000; Witte & Walsh, 1990), school engagement (Lee & Smith, 1995; McNeely, Nonnemaker, & Blum, 2002; ), school attachment (Crosnoe, Johnson & Elder, 2004), student self-esteem (Coladarci & Cobb, 1996; Holland & Andre, 1994), student safety (Rubie-Davies & Townsend, 2007), student social behavior (Darling-Hammond et al., 2002; Ma, 2001), cost-efficiency (Barnett et al., 2002; Bickel et al., 2001; Bowles & Bosworth, 2002; Stiefel, Berne, Intarola, & Fruchter, 2000) teacher turnover (Adalsteinsdottir, 2004; Falch & Strom, 2005), and teacher attitudes (Barty et al., 2005; Eberts et al., 1990; Lee et al., 2000; Rosenblatt, 2001; Sturman, 2003).

For the purpose of this study, we narrow the focus to consider impacts on standardized achievement tests in math and reading. We analyze elementary and high school impacts separately and present results accordingly.

**Elementary schools.** Before 2006, much of the research on this topic was correlational in nature or used multivariate regression with cross-sectional data that failed to address issues of selection bias. Studies using this approach have found a negative effect of large school size on student academic achievement (Deller & Rudnicki, 1993; Walberg & Walberg, 1994). Kuziemko (2006) was the first researcher to use a sufficiently rigorous methodology to generate unbiased estimates of the effects of elementary school size on student achievement. In his analysis, he takes advantage of enrollment shocks provided by school openings, closings, and mergers to ensure that changes in school size are exogenous and to rule out the possibility of bias resulting from changes in student achievement that are being jointly determined with changes in enrollment size. Kuziemko's sample includes 3<sup>rd</sup> and 6<sup>th</sup> grade math and language outcomes for students in 96 schools in Indiana, which he tracks for 3 years and analyzes using a

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two-stage-least-squares instrumental variable approach. He finds that smaller schools have a positive impact on both math scores and attendance rates. Specifically, Kuziemko estimates that a one standard deviation increase in enrollment is associated with .15 standard deviation decrease in math scores.

Although Kuziemko was the first researcher to address this question with a rigorous research design that accounts for unobserved student ability, motivation, or other factors, the limited size and scope of his sample tells us little that is generalizable about differences in school size effects across elementary and secondary schools in diverse geographic areas.

**Secondary schools.** Small school reforms at the secondary level have received substantial support from philanthropic and public sources. The research challenge of evaluating such policies is that they are rarely enacted in isolation from other reforms, making it difficult to capture valid estimates of the effect. This can be particularly problematic in studies relying upon cross-sectional data that fail to account for endogenous variation in school size. In light of this problem, it is not surprising that many of the findings on school size impacts at the secondary school level are contradictory. On the one hand, many of the cross-sectional studies of secondary schools find negative effects of increasing school size on student academic outcomes (Fowler & Walberg, 1991; Lee & Smith, 1993; Lee & Smith, 1995). For instance, using data for 11,794 students in 830 high schools, Lee & Smith (1993) find that students learn more in math, reading, history, and science in small schools than in large schools. This effect is particularly pronounced for disadvantaged students. Similarly, examining data for 293 New Jersey secondary schools, Fowler & Walberg (1991) find that school size is negatively related to student outcomes. On the other hand, at least three studies, Sander (1993) and Schreiber (2002) find a positive effect of school size on student academic outcomes. In order to reconcile these conflicting findings, it is of primary importance to turn to studies with stronger methodological approaches.

A rigorous evaluation by Bloom, Thompson, & Unterman (2010) uses the gold standard approach to examine small high schools of choice in New York City. Findings from the 105 schools that were over-subscribed and facilitated a randomized enrollment lottery reveal sustained positive effects of small

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schools on graduation rates. Updates to this study in 2012 reveal that the positive average effect of small schools of choice on four-year graduation rates was sustained through the second cohort. This positive average effect holds across student subgroups such as family income, race/ethnicity, gender, and various levels of prior achievement. The estimated effect on four-year graduation rates is equivalent in magnitude to about 43 percent of the gap in graduation rates between white students and students of color in New York City.

Similarly, Schwartz, Stiefel, and Wiswall (2011) use an instrumental variable approach to provide a rigorous, causal evaluation of school size reforms in New York City. Instrumenting for small school attendance by using student residence, the authors find that newly established small high schools have strong positive effects on student performance whereas older (pre-2002) small high schools have no effect.

### **Data**

In order to overcome many of the issues that have plagued previous research on school size, we use a rich dataset provided by the Northwest Evaluation Association (NWEA) that reports student math and reading achievement on the NWEA Measures of Academic Progress (MAP) assessment in grades 2 through 10. This student-level dataset contains observable characteristics for over one million students in 2,715 unique schools from 2007 through 2011. Data come from four diverse states representing different regions of the United States: the Pacific Northwest, New England, the Rocky Mountains, and the Southeast.

In addition to student demographic information, the dataset includes student-level test scores on the math and reading MAP assessments. A unique student identifier allows us to track students as they switch between schools. NWEA's untimed, computerized, adaptive assessments are designed specifically to measure student academic growth. Scores were recorded in Rasch units (RIT), an equal-interval

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measurement scale that results in stable, consistent longitudinal data. Scores have been standardized by grade/year to ease interpretation of analyses.

The data also include unique school identification codes, merged with data from the National Center for Education Statistic's Common Core of Data. This allows us to match students to specific schools over time. The relevant summary statistics for the merged data files appear in Table 1.

<< TABLE ONE ABOUT HERE >>

There are 2,715 unique schools in our database (Figure 1). School size has a positively skewed distribution. There are a few very large schools (with more than 2,000 students), several very small schools (enrolling fewer than 300 students), with the median school size around 535. Secondary schools have a much higher standard deviation (435 students, as compared to 158).

<< FIGURE ONE ABOUT HERE >>

### Empirical Strategy

Our primary approach uses student fixed effects to account for unobserved individual heterogeneity at the student level. Model (i) estimates the effect of school size (treated as a continuous variable) on students' math and reading outcomes on the MAP assessment in a given year, while accounting for other potentially confounding student characteristics. This approach implicitly compares single students to themselves at different points in time, as each student experiences schools of varying sizes. Our initial approach estimates OLS regressions, taking the form:

$$Y_{ist} = \beta_0 + \beta_1 Z_{st} + \beta_2 SchEnrollment_{ist} + \beta_3 SchEnrollment_{ist}^2 + \phi_t + \tau + \lambda_i + \epsilon_{ist} \quad (i)$$

Where  $Y_{ijst}$  is the standardized test score of student  $i$ , in school  $s$ , during year  $t$ ;  $Z$  is a vector of observable school characteristics including urban/ rural status, charter status, school level proportion of minority



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students, school level proportion of students in poverty, and type of school (eg. Vocational school);

*SchEnrollment* is a continuous variable for school enrollment size and  $SchEnrollment^2$  is that term

squared, which allows the distribution to have a quadratic form in case changes in school size do not have

a uniform impact across the distribution;  $\phi$  is a fixed effect for school year;  $\tau$  is a state indicator;  $\lambda$  is a

student fixed-effect that eliminates bias that may result if school size is related to unobservable time

invariant student characteristics; and  $\epsilon$  is a stochastic error term.  $\beta_2$  is the parameter of interest.

**Defining a “small” school.** In order to dig deeper into the policy ramifications of school size, our second approach creates indicators for school size. There is no consensus in the literature on how to define a “small” school. Lee & Loeb (2000), for example, define small schools as those with fewer than 400 students and large schools as those with greater than 750 students. The Gates Foundation recommends no more than 100 students per grade level, corresponding to 400 students for a typical grade 9-12 high school (Vander Ark, 2002). The U.S. Department of Education set a limit of 300 students through its *Small Schools Initiative* (U.S. Department of Education, 2006). Finally, Lee & Smith (1997) recommend that the ideal small high school should enroll between 600-900 students. For the purposes of this study, we divide school size into quintiles. This regression equation takes the form:

$$Y_{ist} = \delta_0 + \delta_1 Z_{st} + \delta_2 SizeQuintile_{ist} + \phi_t + \tau + \lambda_i + \mu_{ist} \quad (ii)$$

This model is identical to the previous model, except that in this case, *SizeQuintile* is a series of indicator variables for each school size quintile (the third quintile is the omitted category).  $\delta_2$  is the parameter of interest. Model (ii) is our preferred model. Table 2 presents mean school enrollment sizes by quintile.

<< TABLE TWO ABOUT HERE >>

## Results

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In this section we discuss the results from each of our model specifications. Our results reveal two key findings, which point to the importance of school size as a contributing factor to student achievement growth. First, school size has a significant impact on student achievement in both math and reading. Large schools with enrollments greater than 590 students have significant negative impacts on student academic achievement. Second, these impacts vary by grade level. In grades 6-10, school size has the greatest effect with student achievement significantly declining in schools that enroll more than 638 students.

Tables 3 and 4 present the results of model (i), where school enrollment size is included as a continuous independent variable. These tables have been scaled so that a 1 unit change in the coefficient represents an increase of 100 students. In Table 3, we see small, negative impacts on math achievement associated with increases in secondary school size. Across all grade levels, this equates to a -.011 of a standard deviation (*SD*) drop in student math achievement for every 100-student-increase in school size. Breaking results apart by grade levels, we see there are no significant impacts in the elementary grades but in grades 6 through 10, an increase of 100 students is associated with -.009 *SD* drop in student math outcomes.

<< TABLE THREE ABOUT HERE >>

Table 4 presents model (i) results for reading achievement. If we aggregate our results across all grade levels, there is a small negative impact on reading achievement of -.006 *SD*. If we break out our findings by grade level, once again we see no significant impacts in the elementary grades but significant negative impacts of school size on student reading outcomes in grades 6 through 10 of -.007 *SD*.

<< TABLE FOUR ABOUT HERE >>

Tables 5 and 6 report the results from model (ii), which five indicators of school size are used in place of the continuous measure. We present three sets of estimates, varying by grade level studied. The first

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column displays results from models incorporating all grade levels in the sample; the second column displays results from elementary school models that only include estimates from grades 2 through 5. The third column displays results from middle/ high school models that include grades 6 through 10.

<< TABLE FIVE ABOUT HERE >>

Looking at the first column, we see significant negative achievement effects for students in schools in the largest quintiles of school enrollment size, with an effect size of  $-.043 SD$  for the largest schools. None of the coefficients are significant in the elementary grades. Looking at the secondary grades, we see large negative effects for the two largest school size quintiles with estimates of  $-.017 SD$  and  $-.044 SD$ , respectively. Clearly, the negative effects observed in the full sample are being driven by large high schools.

Table 6 displays the results of the same model for reading achievement. The impact estimates of school size on reading achievement show significant negative effects of  $-.023 SD$  in the largest schools in the aggregate model. In the elementary grades, we actually see a positive coefficient on the second largest category of schools but this fades to insignificant in the largest schools. Finally, in the secondary grades (6 through 10), large schools have significant negative effects of  $-.036 SD$ .

In attempting to interpret these results, it is worth considering reasons why school size has a more powerful impact at the secondary school level. It is possible that the self-contained nature of many elementary school classrooms where students spend the majority of their time with just one teacher and the same peers makes school size a less important factor. In a typical secondary school, on the other hand, students are constantly interacting with different teachers and different peers, which may present problems academically and socially as the size of that school increases. Additionally, it may simply be the case that there is a tipping point at which school size begins to have a negative effect on student achievement, and elementary schools rarely pass this threshold. High schools, which are on average

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larger than elementary schools, are more likely to reach the point at which their size has a negative and policy relevant effect on student achievement.

<< TABLE SIX ABOUT HERE >>

### **Limitations**

There are several limitations that should be taken into consideration when interpreting these findings. First, if trends in school enrollment size and student achievement are jointly determined, such as in the case of high achieving schools that grow in enrollment as parents and families see test scores improving, then a fixed effects approach inadequately addresses this potential bias—though such a bias should show that larger schools are better.<sup>4</sup> On the other hand, if changes in school enrollment occur randomly over time, then the specifications followed in this paper will provide valid estimates of the effect of school size on student achievement outcomes. Kuziemko (2006) tested the exogeneity of school enrollment changes by using “shocks” of mergers, school openings, and school closures with a two-stage-least squares (2SLS) instrumental variables regression model. The results from his conventional regressions are actually smaller in magnitude than the results from the 2SLS regressions, suggesting that even if a conventional regression approach is a biased estimator, it might actually underestimate the impact of school size on student achievement outcomes. On a final note, given the size and scale of this dataset, we might expect that the geographic and cultural diversity of the area under study would minimize the probability of such trends happening systematically throughout the data.

Second, our data do not allow us to identify when large schools divide into smaller units for instructional and organization purposes. It remains to be seen whether such schools can overcome the

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<sup>4</sup> In our second model, however, we mostly remove this potential bias by coding school size as a series of categorical quintiles instead of treating it as continuous. As a result, variations in school size for a particular student are generally estimated when a student changes schools, and not when a single school changes size.

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negative achievement effect of enrollment in a large school. In cases where the data are available to test this hypothesis, researchers should measure achievement impacts for this unique category of schools.

### **Conclusion**

We find consistent negative effects of large school size on student math and reading outcomes in our aggregate models. The results for the oldest grades in our sample, grades 6 through 10, are highly statistically significant, with math achievement declining by  $-.043 SD$  and reading achievement declining by  $-.023 SD$ . These estimates indicate that school size has a meaningful impact on student achievement.

Two key takeaways are apparent for policymakers deliberating over the efficacy of school size reforms. The first is that school size clearly matters. Conditional on average achievement and time invariant characteristics of a student, math and reading outcomes are impacted by the size of a school a student attends. The second key takeaway is that school size matters most in the oldest grades where schools are typically larger and students are not confined to a self-contained classroom for most of the day.

Future research should build upon this work by using a similarly rigorous approach to investigate whether the effects of school size vary among students with different ethnicities and socioeconomic levels, as well as investigate how school size affects students at different points in the achievement distribution. It would also be interesting to investigate whether learning gains are more or less equitably distributed between students within schools of various sizes. Finally, it would be especially informative to look at outcomes other than math or reading achievement. It is possible that some of the proposed benefits of larger schools— such as exposing students to a broader array of course options—are concentrated in other subjects.

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## SCHOOL SIZE AND STUDENT ACHIEVEMENT

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## SCHOOL SIZE AND STUDENT ACHIEVEMENT

Table 1.

*Summary Statistics*

<b>Variable</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>Minimum Value</b>	<b>Maximum Value</b>
Average RIT math score	214.90	22.39	101.42	318.35
Average RIT reading score	207.72	20.06	106.88	283.87
School enrollment	614.91	354.29	51	3792
Average school enrollment share of White students	0.62	0.27	0	1.00
Average school enrollment share of Black students	0.06	0.09	0	0.81
Average school enrollment share of Hispanic students	0.24	0.26	0	1.00
Average school enrollment share receiving federally subsidized lunch	0.51	0.24	0	1.00

*Note.* N= 2,715 schools. Data come from the Northwest Evaluation Association.

## SCHOOL SIZE AND STUDENT ACHIEVEMENT

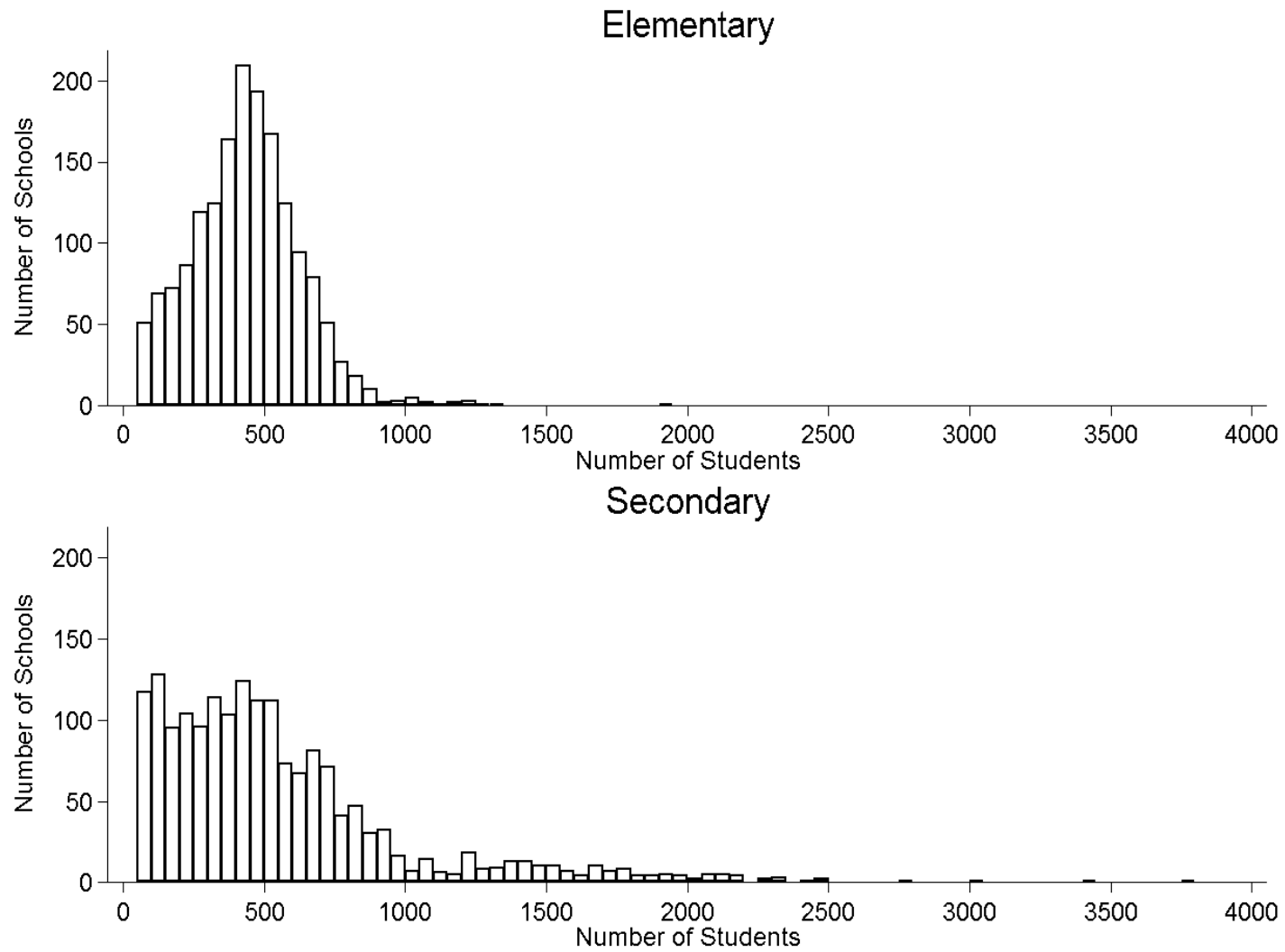


Figure 1. Histogram of the size distribution for all schools (n = 2,715)

Table 2.

*Mean school enrollment sizes, by quintile and school level*

	All Grade Levels (Grades 2-10)			Elementary (Grades 2-5)			Secondary (Grades 6-10)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Quintile 1	153	51	254	178	51	279	125	51	206
Quintile 2	332	255	401	342	280	395	292	208	369
Quintile 3	457	402	515	438	396	477	452	370	527
Quintile 4	590	516	684	528	478	587	638	528	757
Quintile 5	1,075	685	3,792	711	588	1930	1,250	759	3,792

*Note.* N= 2, 715 schools. Data come from the Northwest Evaluation Association.

Table 3.

*Effect of School Size on Student Math Achievement, using a continuous size variable*

	All Grade Levels	Elementary Grades (2-5)	Secondary Grades (6-10)
<b>School Size</b>	-.011*** (.002)	-.003 (.010)	-.009*** (.002)
<b>School Size Squared</b>	.000*** (.000)	.000 (.000)	.000*** (.000)
<b>Adj. R-squared</b>	.788	.720	.861
<b>Observations</b>	5,574,137	2,741,026	2,833,111
<b>Students</b>	1,095,077	603,496	683,552

*Note.* Dependent variable is the student's standardized score on the NWEA MAP math test. Models include controls for year, state, grade, school percent Black, school percent Hispanic, and school percent eligible for free and reduced lunch. Robust standard errors in parentheses. \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$ , (two-tailed tests)

Table 4.

*Effect of School Size on Student Reading Achievement, using a continuous size variable*

	All Grade Levels	Elementary Grades (2-5)	Secondary Grades (6-10)
<b>School Size</b>	-.006** (.002)	.000 (.010)	-.007** (.003)
<b>School Size Squared</b>	.000** (.000)	.000 (.000)	.000** (.000)
<b>Adj. R-squared</b>	.777	.758	.806
<b>Observations</b>	5,485,907	2,702,191	2,783,716
<b>Students</b>	1,083,688	593,804	677,674

*Note.* Dependent variable is the student's standardized score on the NWEA MAP reading test. Models include controls for year, state, grade, school percent Black, school percent Hispanic, and school percent eligible for free and reduced lunch. Robust standard errors in parentheses. \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$ , (two-tailed tests).

Table 5.

*Effect of School Size on Student Math Achievement, using school size quintile indicators*

	All Grade Levels	Elementary Grades (2-5)	Secondary Grades (6-10)
<b>Quintile 1</b>	.003 (.011)	-.012 (.015)	.007 (.015)
<b>Quintile 2</b>	.002 (.007)	-.007 (.012)	.004 (.009)
<b>Quintile 3</b>	(omitted)	(omitted)	(omitted)
<b>Quintile 4</b>	-.017*** (.006)	-.015 (.011)	-.017** (.007)
<b>Quintile 5</b>	-.043*** (.007)	.004 (.012)	-.044*** (.009)
<b>Adj. R-squared</b>	.788	.720	.861
<b>Observations</b>	5,574,137	2,741,026	2,833,111
<b>Students</b>	1,095,077	603,496	683,552

*Note.* Dependent variable is the student's standardized score on the NWEA MAP math test. Models include controls for year, state, grade, school percent Black, school percent Hispanic, and school percent eligible for free and reduced lunch. Robust standard errors in parentheses. \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$ , (two-tailed tests).



Table 6.

*Effect of School Size on Student Reading Achievement, using school size quintile indicators*

	All Grade Levels	Elementary Grades (2-5)	Secondary Grades (6-10)
<b>Quintile 1</b>	.014 (.012)	-.008 (.011)	.013 (.017)
<b>Quintile 2</b>	.004 (.007)	.016 (.011)	.018* (.011)
<b>Quintile 3</b>	(omitted)	(omitted)	(omitted)
<b>Quintile 4</b>	-.004 (.006)	.024*** (.009)	-.015* (.009)
<b>Quintile 5</b>	-.023*** (.007)	.006 (.010)	-.036*** (.011)
<b>Adj. R-squared</b>	.777	.758	.806
<b>Observations</b>	5,485,907	2,702,191	2,783,716
<b>Students</b>	1,083,688	593,804	677,674

*Note.* Dependent variable is the student's standardized score on the NWEA MAP reading test. Models include controls for year, state, grade, school percent Black, school percent Hispanic, and school percent eligible for free and reduced lunch. Robust standard errors in parentheses. \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$ , (two-tailed tests)