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The relationship between changes in the percentage of students passing and in the percentage testing advanced on state assessment tests in Kentucky and Virginia

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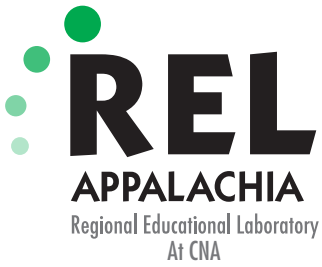

The relationship between changes in the percentage of students passing and in the percentage testing advanced on state assessment tests in Kentucky and Virginia

March 2010

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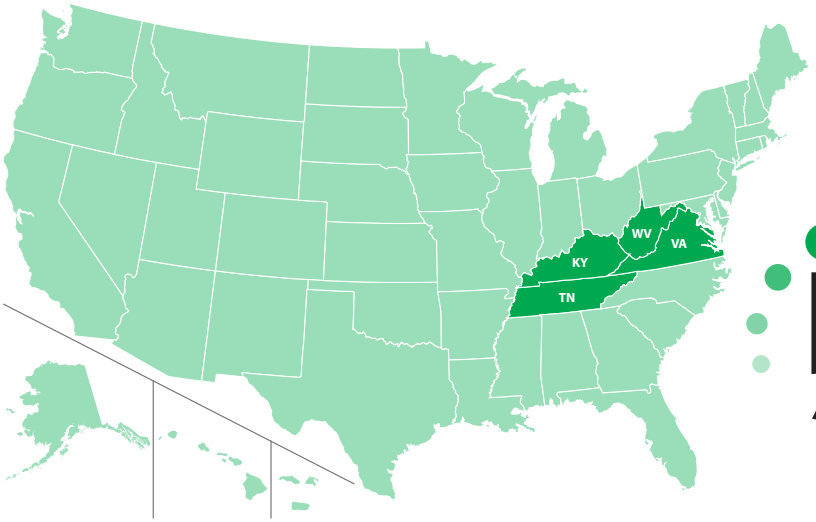

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March 2010

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Summary

REL 2010–No. 087

The relationship between changes in the percentage of students passing and in the percentage testing advanced on state assessment tests in Kentucky and Virginia

The No Child Left Behind Act of 2001 requires states to test students in reading and math and identify them as below proficient, proficient, or advanced. Schools are held accountable only for ensuring that students test proficient or better (both considered passing), leading to concerns that a focus on increasing the percentage of students testing proficient on state assessments may have an unintended consequence of reducing—or not increasing—the percentage of students testing advanced. Analysis of the data in Kentucky and Virginia finds that schools with the greatest increases in the percentage passing also have the greatest increases in the percentage testing advanced.

The No Child Left Behind (NCLB) Act of 2001 requires states to test all students in reading and math and identify them as below proficient, proficient, or advanced, but the law holds schools accountable only for ensuring that students test proficient or better. State officials, district and school leaders, and others have expressed concern that attention to proficiency alone might have unintended consequences if focusing on moving students from below proficient to proficient has negative consequences on moving students from proficient to advanced. An alternative view sees attention to below proficient students as possibly improving the performance of all students. Few empirical studies have examined how changes from proficient to advanced are affected by changes from below proficient to proficient.

This study examines the statistical association between changes in the percentage of students in a school testing below proficient, proficient, and advanced in Kentucky and Virginia in the early years of NCLB accountability. The study was designed to answer four questions:

1. What are the overall school-level trends in the percentage of students passing (testing proficient or advanced) and the percentage testing advanced on state assessment tests in Kentucky and Virginia?

2. What is the statistical association between annualized changes in the school-level percentage of students passing and annualized changes in the school-level percentage testing advanced?

3. Does this association vary when controlling for the percentage of students passing in 2001/02?

4. Does this association vary when controlling for characteristics of a school's students, such as level and change in the percentage of students eligible for free or reduced-price lunch, level and change in the percentage of racial/ethnic minority students, and the school's locale (urban, suburban, town, or rural)?

The study answered these questions using data on the percentages of students testing below proficient, proficient, and advanced provided by the Kentucky Department of Education and the Virginia Department of Education. In addition, the Common Core of Data (data sets maintained by the U.S. Department of Education's National Center for Education Statistics) was used for information on school characteristics. The data covered 2001/02–2005/06 in Kentucky and 2001/02–2004/05 in Virginia, so no pre- and post-NCLB comparisons can be made.

The findings of this report are:

1. Kentucky schools experienced upward trends in the percentage of students passing between 2001/02 and 2005/06, with increases in both the percentage testing proficient and the percentage testing advanced. Virginia schools also experienced upward trends in the percentage passing between 2001/02 and 2004/05, but in grade 5 reading and math and grade 3 math a greater share of students moved from proficient to advanced than from below proficient to proficient.

2. Positive associations were found between school-level changes in the percentage passing and changes in the percentage testing advanced in Kentucky and Virginia schools in both reading and math in all grades tested.

3. In most subjects and grades the positive association between school-level changes in the percentage passing and in the percentage testing advanced holds across schools regardless of whether the percentage of students passing in 2001/02 was above or below the 2004/05 annual measurable objective level. Even in schools where the 2001/02 percentage of students passing was below the 2004/05 annual measurable objective, schools whose percentage passing rate increased also saw an increase in the percentage testing advanced (with the exception of high school end of course reading exams in Virginia).

4. Controlling for school characteristics such as 2001/02 level and change in the percentage of students eligible for free or reduced-price lunch, 2001/02 level and change in percentage of racial/ethnic minority students, and locale accounts for some of the variation in changes in the percentage testing advanced but does not alter the association between changes in the percentage passing and changes in the percentage testing advanced in Kentucky schools and does not eliminate the association in Virginia schools.

It is not possible to infer from this report's findings any conclusions regarding the factors that brought about the observed relationships.

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WHY THIS STUDY?

The No Child Left Behind (NCLB) Act of 2001 requires states to test all students in reading and math and identify them as below proficient, proficient, or advanced, but the law holds schools accountable only for ensuring that students test proficient or better. Some researchers and commentators have suggested that because the NCLB Act focuses on schools that fail to meet standards for moving students from below proficient to proficient, schools may give more attention to students testing below proficient at the expense of those testing proficient or above (Booher-Jennings 2005; de Vise 2007).[1] A contrasting view holds that steps taken to improve the performance of students testing below proficient are likely to improve results for students testing proficient or advanced (see box 1 for definitions of key terms).

Concern about the impact on students testing proficient and above from the NCLB Act's focus on improving the performance of students testing below proficient has numerous implications. State officials, district and school leaders, and others have asked whether attention to proficiency alone might have unintended consequences for students testing proficient or advanced. Policymakers are interested in understanding how test scores move together. Some superintendents and principals in Kentucky and Virginia have identified a need for support in developing and interpreting statistics that provide a balanced, accurate, and multidimensional view of how well schools are serving students testing below proficient, proficient, and advanced (Sheekey, Bausch, and Peterson 2008a, 2008b). To better inform decisions about what kinds of performance measures and standards are needed, policymakers at the state level are interested in understanding how the distributions of students at each proficiency level vary over time.

A growing body of literature is examining assessments and the impact of high-stakes accountability systems (such as NCLB) on student achievement—especially trends in test results disaggregated by achievement level—as well as the association among them. Formal tests of the effect of accountability

BOX 1

Definitions of key terms

Not meeting the 2004/05 annual measurable objective in 2001/02. The No Child Left Behind (NCLB) Act was enacted in 2001/02, whereas 2004/05 was the first year in which the annual measurable objectives increased in Kentucky and Virginia. Schools whose percentage of students passing in 2001/02 was below the 2004/05 annual measurable objective would need to increase that percentage to meet the objective in 2004/05. In Kentucky the annual measurable objective varies by subject and school level: for elementary schools it is 53.86 in reading and 32.14 in math; for middle schools it is 52.40 in reading and 26.93 in math; for high schools it is 29.35 in reading and 29.79 in math. In Virginia the annual measurable objective for both reading and math in 2004/05 was 70.

Meeting the 2004/05 annual measurable objective in 2001/02. Schools with a percentage passing rate in 2001/02 equal to or greater than the 2004/05 annual measurable objective would need only to maintain that rate to meet the annual measurable objective in 2004/05.

Advanced. Under NCLB-mandated accountability, the highest level of student performance on the state assessment used for NCLB accountability. In Kentucky the "distinguished" level is synonymous with advanced.

Annual measurable objective. The state-set level for the percentage of students expected to test proficient or above under NCLB accountability in a given year. In all states the annual measurable objective must reach 100 percent by 2013/14.

Annualized change. The average year to year change in the percentage of students passing or the percentage testing advanced over the study period (2001/02–2005/06 in Kentucky and 2001/02–2004/05 in Virginia).

Below proficient. The level of student performance on the state test used for NCLB accountability below the proficient level. Kentucky uses the terms "novice" and "apprentice" levels instead of "below proficient"; both have been combined into the below proficient category for this study.

Passing. The level of student performance on the state test used for NCLB accountability at or above the state-defined proficient cutscore.

Proficient. Under NCLB-mandated accountability, the level of student performance required for achieving proficiency on the state assessment used for NCLB accountability, but not performance at the advanced level.

systems on the rate of improvement of test scores across levels of proficiency have provided mixed evidence (for example, Neal and Schanzenbach 2007; Springer 2008; Center on Education Policy 2008). Several studies have found that gains in achievement are highest for students at or below the passing cutscore, while more advanced students experience small or negative changes in achievement (Deere and Strayer 2001; Krieg 2008; Neal and Schanzenbach 2007; Reback 2008). Other studies have found that test score gains by low-performing students do not come at the expense of more advanced students (Ballou, Liu, and Rolle 2006; Ballou and Springer 2008; Springer 2008). Because previous studies focused on student-level changes in achievement, this study contributes to the literature by examining the changes in the percentage of students passing and percentage testing advanced at the school level. The report makes no claims about what is happening at the school or classroom level to drive those changes.

The intent of this study is to examine whether a statistical association exists between changes in the percentage of students passing and simultaneous changes in the percentage of students testing advanced. Four questions drive the analysis:

1. What are the overall school-level trends in the percentage of students passing (testing proficient or advanced) and the percentage testing advanced on state assessment tests in Kentucky and Virginia?

2. What is the statistical association between annualized changes in the school-level percentage of students passing and annualized changes in the school-level percentage testing advanced?

3. Does this association vary when controlling for the percent of students passing in 2001/02?

BOX 2

Methodology

The report examines overall school-level trends in the percentage of students passing (testing proficient or advanced) and the percentage testing advanced on state assessments used for No Child Left Behind (NCLB) accountability in Kentucky and Virginia, the statistical association between annualized changes in the percentage passing and in the percentage testing advanced, and the association controlling for the percentage passing in 2001/02.

Data sources. Three data sources were used:

- The Kentucky Department of Education (2007) provided school-level data on the number of students tested overall, the percentages of students testing below proficient (novice or apprentice), proficient, and above proficient (distinguished) for reading in grades 4, 7, and 10 and math in grades 5, 8, and 11 for 2001/02–2005/06. The percentage passing rate is calculated by adding the percentage testing proficient and the percentage testing advanced.
- The Virginia Department of Education (2007) provided school-level data, by grade tested, on the number of students tested overall, the percentages of students testing below proficient, proficient, and advanced in reading and math for 2001/02–2004/05. Grades 3, 5, and 8 were tested in elementary and middle schools, and end of course exams were given in high school reading and Algebra 2.
- The Common Core of Data (U.S. Department of Education 2007), which contains information on public school student demographic and socioeconomic characteristics by school, provided data on total enrollment, the percentage of students eligible for free or reduced-price lunch, the percentage of racial/ethnic minority students, and school locale for 2001/02 and 2005/06 for both Kentucky and Virginia.

Analysis. Analysis occurred in five stages. The overall statewide trends in the percentage of students passing and the percentage testing advanced were examined by state, subject, and grade. Schools were grouped into four categories by deviations from the mean change in percentage passing and compared for average change in percentage testing advanced. Changes in the percentage testing advanced were then regressed on changes in the percentage passing. The sample was split into two groups based on the percentage of students passing in 2001/02—schools whose 2001/02 percentage passing was above the 2004/05 annual measurable objective and schools whose 2001/02 percentage passing was below the 2004/05 objective—and the regression was run again to see whether schools threatened with NCLB sanctions showed a different association than other schools (see appendix B). Finally, a multivariate ordinary least squares regression was run to control for the percentage testing proficient in 2001/02, the 2001/02 level and subsequent change in percentage eligible for free or reduced-price lunch, the 2001/02 level and subsequent change in the percentage of racial/ethnic minority students, and school locale.

The sample was limited to schools that tested enough students in each grade in every year of the study period for NCLB accountability according to each state's accountability workbook. The minimum number is 10 in Kentucky and 50 in Virginia. Thus the sample includes schools in Kentucky that tested at least 10 students per grade tested every year during 2001/02–2004/05 (see appendix A for details about the sample schools and the excluded schools).

All analyses were conducted using school-level data by state, subject, and grade.

4. Does this association vary when controlling for characteristics of a school's students, such as level and change in the percentage of students eligible for free or reduced-price lunch, level and change in the percentage of racial/ethnic minority students, and the school's locale (urban, suburban, town, or rural)?

This study is descriptive and makes no claims about causality. It uses only post-NCLB data and therefore can make no claims about the effect of NCLB on changes in the distribution of proficiency at schools. Furthermore, the observed changes may have occurred in the absence of NCLB or may be associated with demographic or cultural change.

The study examines the association between changes in the percentage of students passing and the percentage testing advanced over a limited period of time. The study methodology is summarized in box 2 and described fully in appendix A.

KENTUCKY AND VIRGINIA SCHOOLS SHOW UPWARD TRENDS IN PERCENTAGE OF STUDENTS PASSING AND PERCENTAGE TESTING ADVANCED

This section describes the trend in average percentage of students passing disaggregated by the percentage testing proficient and the percentage testing advanced. The number of schools in the sample by state, grade, and subject are presented in table 1.

The results in this section are based on average school-level test results over a statewide sample. As a result, they may mask significant variation across schools. For example, it is possible that individual schools that show the largest increases in the percentage of students passing show no increase or a decrease in the percentage testing advanced.

TABLE 1
Number of schools in sample for Kentucky (2001/02–2005/06) and Virginia, by grade and subject (2001/02–2004/05)

State and grade	Reading	State and grade	Math
Kentucky			
Grade 4	616	Grade 5	604
Grade 7	202	Grade 8	202
Grade 10	197	Grade 11	197
Virginia			
Grade 3	710	Grade 3	723
Grade 5	737	Grade 5	739
Grade 8	323	Grade 8	321
High school reading (end of course exam)	279	High school Algebra 2 (end of course exam)	232

Source: Authors' calculations based on data from Kentucky Department of Education (2007) and Virginia Department of Education (2007).

Kentucky

A greater share of students tested at the proficient level than at the advanced level in both 2001/02 and 2005/06 (figure 1). In each subject and grade tested, a larger percentage of students tested at the proficient level in 2005/06 than in 2001/02. The same trend was observed for students at the advanced level.

In Kentucky a greater share of students tested at the proficient level than at the advanced level in both 2001/02 and 2005/06, and in Virginia the percentage of students passing both subjects increased in all grade levels between 2001/02 and 2004/05

The increase in the percentage of students passing ranges from 7 points in grade 7 reading to 21 points in grade 5 math. The increases in the percentage testing advanced are greater than the increases in the percentage testing proficient in reading for grades 4 and 10 and in math for grades 5 and 11 (in terms of both point increases and the share of the increase in the percentage of students passing). In grade 7 reading and grade 8 math more of the increase in the percentage of students passing comes from increases in the percentage testing proficient than in those testing advanced. Overall, schools in Kentucky experienced upward shifts in the percentage of students passing coming from increases in both the percentage testing proficient and the percentage testing advanced.

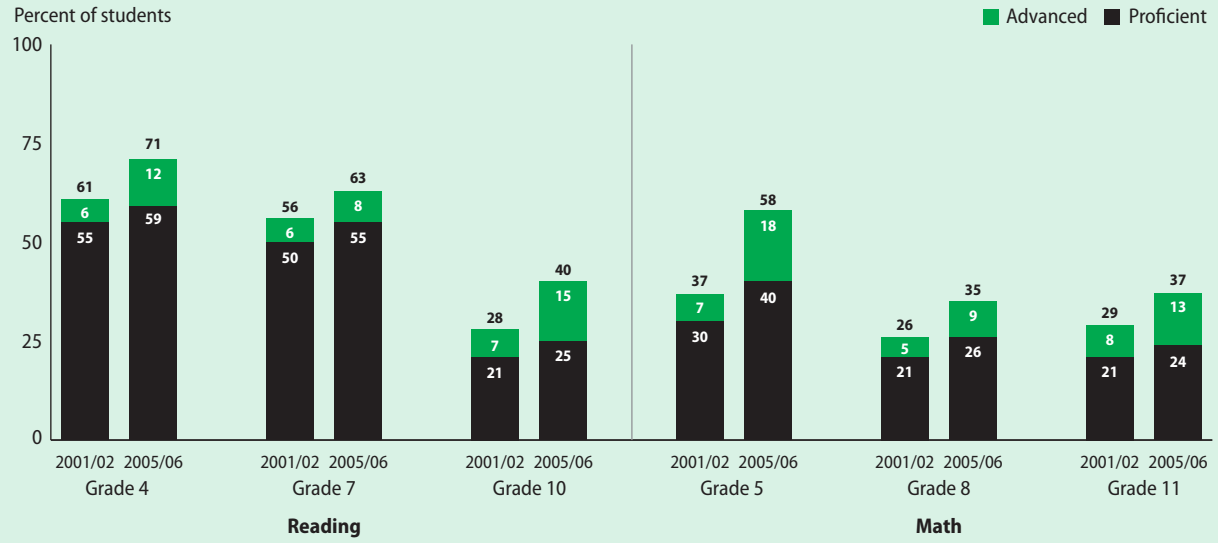
Virginia

Virginia schools show an increase in the percentage of students passing in all grade levels and both subjects between 2001/02 and 2004/05 (figure 2).[2] The increases range from a low of 4 points in grade 3 reading and high school reading end of course tests to a high of 13 points on the Algebra 2 end of course test.

For grade 3 reading, high school reading, and grade 8 math, changes in the percentage testing proficient make up a greater share of the increase in the percentage of students passing than do changes in the percentage testing advanced. For grade 8 reading and the high school Algebra 2 end of course test, both the percentage testing proficient and percentage testing advanced increase,

FIGURE 1

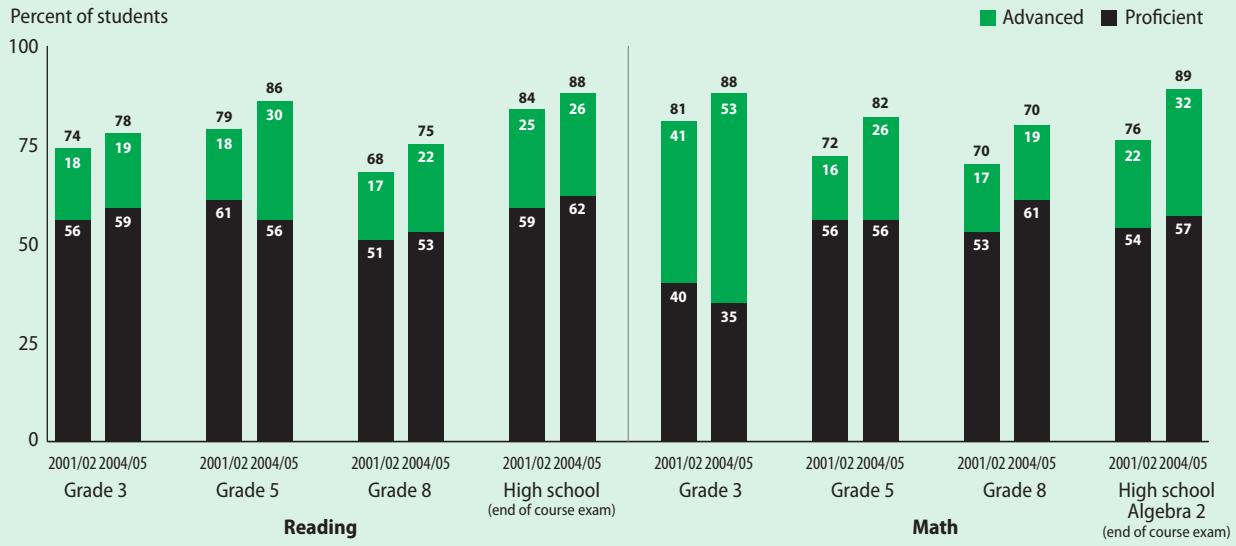
Percentage of students passing in Kentucky schools, by percentage testing proficient or advanced, 2001/02 and 2005/06



Source: Authors' calculations based on data from Kentucky Department of Education (2007).

FIGURE 2

Percentage of students passing in Virginia schools, by percentage testing proficient or advanced, 2001/02 and 2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

but a greater share of the increase in the percentage of students passing comes from the change in the percentage testing advanced.

Grade 5 reading and math and grade 3 math, however, show a different pattern. The increase in the percentage of students passing comes from an increase in the percentage testing advanced; there is no change (or a decrease) in the percentage testing proficient. For grade 5 reading and grade 3 math the percentage testing proficient declines by 5 points, but the percentage testing advanced increases by 12 points, for a 7-point net increase in percentage of students passing. For grade 5 math

all of the increase in the percentage of students passing comes from the 10-point increase in the percentage testing advanced with no change in the percentage testing proficient. Thus, for grade 5 reading and math and grade 3 math, the rise in the percentage of students passing reflects a greater share of students moving from proficient to advanced than from below proficient to proficient.

SCHOOLS WITH THE LARGEST INCREASES IN THE PERCENTAGE OF STUDENTS PASSING SHOW THE LARGEST INCREASES IN THE PERCENTAGE TESTING ADVANCED

This section takes a closer look at the relationship between annualized changes in the school-level percentage of students passing and annualized changes in the school-level percentage testing advanced by considering variation in the percentage of students passing. The analysis can show whether the same trend holds across all schools or whether the association differs across schools with different changes in the percentage of students passing.

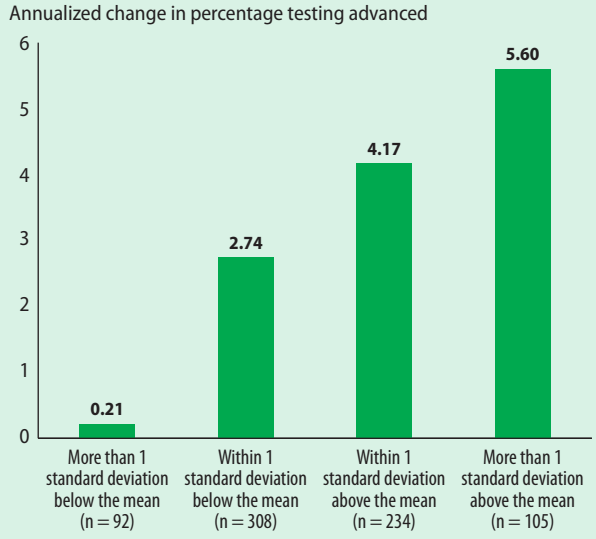
For this analysis, schools were split into four groups based on their average change in the percentage of students passing: schools with the smallest (and sometimes negative) changes, schools with below average increases, schools with above average increases, and schools with the largest increases. The average change in the percentage testing advanced was then compared across the four groups. (See appendix B for details of how the groups were constructed.)

The results produced a consistent finding: schools with the largest increases in the percentage of students passing also have the largest increases in the percentage testing advanced. Examination of each subject and grade for both states showed a consistent pattern of larger average annualized changes in the school-level percentage of students testing advanced as the change in the percentage passing grew larger (see figures B1–B6 and B9–B16 in appendix B).

Schools with the largest increases in the percentage of students passing also have the largest increases in the percentage testing advanced

FIGURE 3

Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 5 math in Virginia schools grouped by standard deviation, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

Figure 3 illustrates this trend. For each group for grade 5 math in Virginia, schools with the largest increase in the percentage of students passing show the largest annualized increase in the percentage testing advanced, and schools with the smallest increase (or a decrease) in the percentage passing show the smallest annualized change in the percentage testing advanced. The same pattern is found in reading and math at all grade levels in Kentucky and Virginia, with the exception of grade 5 reading in Virginia. In all cases schools with the smallest changes in the percentage of students passing (more than one standard deviation below the mean) show the smallest changes in the percentage testing advanced.

SCHOOL-LEVEL CHANGES IN THE PERCENTAGE OF STUDENTS TESTING ADVANCED ARE POSITIVELY ASSOCIATED WITH CHANGES IN THE PERCENTAGE PASSING

This section refines the previous estimates by calculating the statistical associations between

school-level changes in the percentage of students passing and changes in the percentage testing advanced. Bivariate regression analysis was used to further examine the association between annualized changes in the school-level percentage of students passing and annualized changes in the school-level percentage testing advanced (see appendix B for detailed scatterplots and results). In the regression analysis the school-level change in percentage testing advanced is modeled as a function of change in the percentage passing. The slope coefficient represents the direction of the relationship—how a 1 percentage point increase in the percentage of students passing is associated with a change in the percentage testing advanced. Positive slope coefficients mean that increases in the percentage of students passing are associated with increases in the percentage testing advanced. The strength of the relationship is represented by the r^2 value, with higher values indicating that the association accounts for a larger share of the variation in the percentage testing advanced.

A statistically significant positive association is found for all subjects and grades in both Kentucky and Virginia (table 2). In Kentucky the magnitude of change in the percentage of students testing advanced based on the change in the percentage passing is similar across grades, ranging from .28 to .52. That means that on average for every 1 percentage point increase in the percentage of students passing, the percentage of students testing advanced increases a third to a half a percentage point. In Virginia the variation in magnitude across schools is greater, ranging from 0.16 to 0.89.

The association is strongest in Kentucky for grade 10 reading, grade 8 math, and grade 11 math and in Virginia for grade 3 math. The association is weakest in Kentucky for grade 4 reading and in Virginia for grade 5 reading. The association is also weak in Virginia for grade 8 reading and math and the Algebra 2 end of course exam. As the slope coefficients and r^2 values show, the overall association between school-level changes in the percentage of students passing and changes in the percentage testing advanced is stronger in Kentucky than in Virginia (see table 2).

TABLE 2

Ordinary least squares regressions for the association between school-level changes in the percentage of students testing advanced and changes in the percentage passing in Kentucky (2001/02–2005/06) and Virginia (2001/02–2004/05)

State, subject, and grade	Number of schools	Slope coefficient	r^2
Kentucky			
Reading			
Grade 4	616	0.282***	.170
Grade 7	202	0.324***	.399
Grade 10	197	0.524***	.502
Math			
Grade 5	604	0.352***	.312
Grade 8	202	0.350***	.510
Grade 11	197	0.400***	.434
Virginia			
Reading			
Grade 3	710	0.404***	.280
Grade 5	737	0.162***	.035
Grade 8	323	0.323***	.109
High school reading (end of course exam)	270	0.793***	.273
Math			
Grade 3	723	0.887***	.420
Grade 5	739	0.364***	.223
Grade 8	321	0.260***	.167
High school Algebra 2 (end of course exam)	232	0.374***	.168

*** Significant at $p < .001$.

Source: Authors' calculations based on data from Kentucky Department of Education (2007) and Virginia Department of Education (2007).

ASSOCIATIONS REMAIN POSITIVE BUT ARE WEAKER IN SCHOOLS WHERE THE PERCENTAGE PASSING IN 2001/02 IS BELOW THE 2004/05 ANNUAL MEASURABLE OBJECTIVE

Under the NCLB Act each state defines its own annual measurable objective for test results by level, with the goal of achieving 100 percent proficiency by 2013/14. Each state established a starting annual measurable objective for each subject and grade in 2001/02. In both Kentucky and Virginia the annual measurable objectives remained the

Even among schools whose percentage of students passing in 2001/02 was below the 2004/05 annual measurable objective, the statistically significant positive association between changes in percentage passing and changes in percentage testing advanced holds

same for three years, then increased in 2004/05 and remained the same for three years.[3]

Schools whose percentage of students passing in 2001/02 is below the 2004/05 annual measurable objective might be more likely than schools whose percentage passing is above the 2004/05 objective to focus on moving students from below proficient to proficient than from proficient to advanced. Therefore, the association between changes in the percentage of students passing and the percentage testing advanced was compared for schools in the two groups.

In Kentucky relatively few schools (7–27 percent, depending on subject and grade) had a percentage of students passing in 2001/02 below the 2004/05 annual measurable objective. And in Virginia fewer than 5 percent of high schools had a percentage passing on the end of course reading test in 2001/02 below the 2004/05 annual measurable objective. But close to a quarter of Virginia schools were below the 2004/05 annual measurable objective for grade 5 reading and high school Algebra 2 (end of course test), and approximately 40–50 percent of schools were below the 2004/05 annual measurable objective for grades 3 and 8 reading and grades 5 and 8 math. Comparing the "below" and "above" groups tests whether the results hold after controlling for the school-level percentage of students passing in 2001/02. As in the preceding section, the analysis is based on regressions of the annualized change in the school-level percentage of students testing advanced on the annualized change in the school-level percentage passing (see appendix A for a discussion of the methods and variables, and appendix B for detailed results).

The analysis shows that even among schools whose percentage of students passing in 2001/02 was below the 2004/05 annual measurable objective, the statistically significant positive association between changes in percentage passing and changes in percentage testing advanced holds (table 3), with the exception of the high school end of course reading test in Virginia. In each case, however, the slope coefficients are lower for the "below" schools than for the "above" schools, meaning that in schools where the percentage of students passing in 2001/02 was below the 2004/05 annual measurable objective, the increases in the percentage testing advanced was smaller on average for a one percentage point increase in the percentage passing.

In Virginia for schools whose percentage of students passing in 2001/02 was below the 2004/05 annual measurable objective, the explained variance in the change in the percentage of students testing advanced is greater (as measured by the r^2 value) for elementary schools than for middle and high schools. As with the analysis of the full sample, the explained variation is greater in Kentucky schools than in Virginia schools.

POSITIVE ASSOCIATIONS HOLD AFTER CONTROLLING FOR SCHOOL-LEVEL CHARACTERISTICS

Other school factors, such as demographic composition, might account for the association between changes in the percentage of students passing and changes in the percentage testing advanced. A regression analysis of changes in the percentage of students testing advanced was conducted to control for multiple factors, including the percentage testing proficient[4] in 2001/02, the 2001/02 level and subsequent change in the percentage of students eligible for free or reduced-price lunch and in the percentage of racial/ethnic minority students, and the school's locale (urban, suburban, town, or rural).

The analysis shows that positive, statistically significant associations between changes in the percentage of students passing and in the percentage testing advanced remain after adding the controls. It also finds a positive, statistically significant association between the percentage of students testing proficient in 2001/02 and changes in the percentage testing advanced for grades 4 and 10 reading and grades 5 and 11 math in Kentucky and

TABLE 3

Ordinary least squares regressions of school-level changes in the percentage of students testing advanced on changes in the percentage passing for schools with the percentage passing in 2001/02 below and above the 2004/05 annual measurable objective

	Percentage passing in 2001/02 below the 2004/05 annual measurable objective			Percentage passing in 2001/02 above the 2004/05 annual measurable objective		
State, subject, and grade	Number of schools	Slope coefficient	r^2	Number of schools	Slope coefficient	r^2
Kentucky						
Reading						
Grade 4	45	0.208***	.344	571	0.327***	.192
Grade 7	25	0.235**	.300	177	0.343***	.417
Grade 10	55	0.429***	.577	142	0.633***	.610
Math						
Grade 5	65	0.346***	.426	539	0.378***	.328
Grade 8	55	0.235***	.344	147	0.388***	.584
Grade 11	49	0.379***	.494	148	0.573***	.536
Virginia						
Reading						
Grade 3	271	0.312***	.233	439	0.537***	.199
Grade 5	160	0.290***	.151	577	0.396***	.097
Grade 8	167	0.229***	.100	156	0.725***	.234
High school reading (end of course exam)	12	0.445	.086	258	0.826***	.240
Math						
Grade 3	114	0.806***	.452	609	1.062***	.362
Grade 5	298	0.366***	.275	441	0.658***	.261
Grade 8	145	0.235***	.231	176	0.649***	.262
High school Algebra 2 (end of course exam)	59	0.295*	.108	173	0.838***	.320

* Significant at $p < .05$; ** significant at $p < .01$; *** significant at $p < .001$.

Source: Authors' calculations based on data from Kentucky Department of Education (2007) and Virginia Department of Education (2007).

grades 3, 5, and 8 reading and grade 5 math in Virginia. Schools with a higher percentage of students testing proficient in 2001/02 are associated with larger increases in the percentage testing advanced. No consistent associations are found between the school demographic controls and the change in the percentage of students testing advanced. (See tables in appendix C for detailed results.)

LIMITATIONS OF THE STUDY

Drawing inferences from the analysis of trends in assessment data is complex and challenging. This section discusses several limitations that affected this study and informed the interpretation of the results.

- The analysis describes only the association at the school level between changes in the percentage of students passing and changes in the percentage testing advanced. It cannot identify what practices, if any, drive these changes at the schools. Furthermore, because the analysis is conducted at the school level, it does not follow cohorts of students over time and cannot answer how much improvement individual students show.

The analyses presented here indicate that increases in the percentage of students testing at proficient levels in math and reading is not associated with a decline in those achieving at advanced levels

- The study analyzed data over a fixed period in two states. The results cannot be extrapolated beyond the period studied or the states examined. As the state accountability systems change, the associations may change. Similarly, lack of data for the pre-NCLB period prevented comparison of trends before and after the NCLB Act was passed, which would have indicated whether there were changes associated with the inception of the NCLB Act.

- The analysis examined all students tested by state, subject, and grade. It did not disaggregate students by NCLB subgroup (racial/ethnic groups, students with disabilities, economically disadvantaged students, and English language learner students), and the patterns may differ for the subgroups.

- Demographic change within schools over the period studied could generate bias. The multivariate models controlled for the observable characteristics of the percentage of students eligible for free or reduced-price lunch and percentage of racial/ethnic minority students in the baseline year and changes in those characteristics over the study period and found no differences in the associations examined.

- The sample excluded small schools that did not test enough students to come under NCLB accountability, so the results may not be generalizable to small schools.

CONCLUSIONS

The picture that emerges from this study is that, in general, schools with the smallest increases in the percentage of students passing in reading and math have the smallest increases in the percentage testing advanced, and schools with the largest increases in the percentage passing have the largest increases in the percentage testing advanced.

There is a positive statistical association between changes in the percentage of students passing and changes in the percentage testing advanced, but the strength of the association varies somewhat depending on the subject, the grade, and whether the percentage of students passing in 2001/02 was below or above the 2004/05 annual measurable objective. The association is stronger in Kentucky than in Virginia, and stronger in elementary schools than in middle or high schools.

School characteristics, such as the percentage of students testing proficient in 2001/02, the percentage of students eligible for free or reduced-price lunch, the percentage of racial/ethnic minority students, and school locale, improved the explanation of variation in changes in the percentage of students testing advanced. School characteristics did not, however, alter the fundamental positive relationship between changes in the percentage of students passing and changes in the percentage testing advanced.

While correlation and regression analyses show a consistently positive association between trends in students testing at different levels, some schools exhibit different behavior. What moves test scores—and whether different categories move together—is an extremely complex question. The analyses presented here indicate that increases in the percentage of students testing at proficient levels in math and reading is not associated with a decline in those achieving at advanced levels. In fact, it is more likely that increases in the passing and advanced levels move together.

NOTES

1. This report uses the National Assessment of Educational Progress classification terminology of "below proficient," "proficient," and "advanced." Virginia uses these terms, but Kentucky uses the term "distinguished" instead of "advanced." Kentucky also has two below proficient levels: "novice," the lowest level, and "apprentice." This report combines these two levels and refers to them as "below proficient."

2. While Virginia administers all tests at the end of the year, it refers to the high school tests as end of course tests. Students typically take the high school reading test in grade 10. End of course exams are given for both Geometry and Algebra 2 in high school, but only Algebra 2 is examined here for ease of presentation. (Results for Geometry are available from the authors on request.)

3. This pattern refers to the original Consolidated State Accountability Workbooks. Virginia revised its annual measaurable objectives in June 2005 so that instead of increasing then remaining the same for three years, the objectives would increase incrementally each year after 2004/05.

4. The analysis controlled for the percentage of students testing proficient in 2001/02 because schools with a high percentage of proficient students might be more likely to increase the percentage of students testing at the advanced level than either schools with many below proficient students or schools with many students already testing advanced. NCLB accountability systems compare successive cohorts of students entering each grade, not the same cohort of students over time. But because the test scores of students entering a given grade change slowly over time, in general, schools with many proficient students at one point find it "easier" to increase the percentage testing advanced over time because their students need smaller increases in their test scores to move into the advanced category.

APPENDIX A
DATA SOURCES AND METHODOLOGY

This report examines school-level associations between the changes in the percentage of students passing (testing proficient or advanced) and changes in the percentage testing advanced on state assessments used for No Child Left Behind (NCLB) accountability in Kentucky and Virginia. It describes:

- The average trends in percentage of students passing disaggregated by the percentage testing proficient and the percentage testing advanced over the early period of NCLB accountability in Kentucky (2001/02 to 2005/06) and Virginia (2001/02 to 2004/05).
- The statistical association between annualized changes in the percentage of students passing and annualized changes in the percentage testing advanced at the school level.
- The association for schools where the percentage of students passing in 2001/02 was below the 2004/05 annual measurable objective and the association for schools where the percentage of students passing in 2001/02 was above the 2004/05 objective (to account for schools likely to have difficulty achieving NCLB or state standards).
- The association controlling for school characteristics such as the 2001/02 level and subsequent changes in the percentage of students eligible for free or reduced-price lunch, the 2001/02 level and subsequent changes in the percentage of racial/ethnic minority students, and the school's locale (urban, suburban, town, or rural).

Percentage passing is defined as the percentage of students per grade in a school testing proficient or advanced. The annualized change in the school-level percentage of students passing is the average yearly change over the period studied. Positive changes in the percentage passing reflect movement from the percentage of students testing below proficient to the percentage testing proficient or above. The percentage of students testing advanced is defined as the percentage of students per grade in a school testing advanced. The annualized change in percentage testing advanced is the average yearly change over the period studied (average annualized changes are used to smooth out any large year to year fluctuations). Positive changes in the percentage testing advanced reflect movement from the percentage of students testing proficient to the percentage testing advanced. Because the analysis is conducted at the grade level within schools, it does not represent changes in individual students over time but rather it shows the overall performance of a school over time.

All the analyses are based on schools with enough test-takers per grade tested to count for schoolwide NCLB accountability in each year of the study period. The minimum was 10 test-takers a year in Kentucky and 50 in Virginia. The following section compares schools in the sample and schools excluded from the sample. On average, excluded schools had lower total enrollments and lower percentages of students eligible for free or reduced-price lunch than did sample schools. Assessment results were not reported for students in schools where fewer than 10 students were tested.

Data sources and sample

The report uses three publicly available data sources:

- The Kentucky Department of Education (2007) provided school-level data on the number of students tested overall, the percentage testing below proficient (novice or apprentice), the percentage testing proficient, and the percentage testing above proficient (distinguished) for reading and math for each year for 2001/02–2005/06. In the period studied, Kentucky tested reading in grades 4, 7, and 10 and math in grades 5, 8, and 11. This report treats grades 4 and 5 as elementary school, 7 and 8 as middle school, and 10 and 11 as high school. All percentages of students passing or

testing advanced for Kentucky in this study are based on these data. Data can be found online at ftp://ketsftp.k12.ky.us/OAA.

- The Virginia Department of Education (2007) provided school-level data, by grade tested, on the number of students tested overall, the percentage testing below proficient, the percentage testing proficient, and the percentage testing above proficient (advanced) in reading and math for each year for 2001/02–2004/05. In the period studied, Virginia tested students in both reading and math in grades 3, 5, and 8 and with end of course assessments in high school. End of course tests used in this report are reading and Algebra 2. The reading end of course test is typically taken at the end of grade 10. This report treats grades 3 and 5 as elementary school, 8 as middle school, and end of course reading and Algebra 2 as high school. All percentages of students passing or testing advanced for Virginia in this study are based on these data. Data can be found online at https://p1pe.doe.virginia.gov/datareports/assess_test_result.do.

- The Common Core of Data (U.S. Department of Education 2007), which contains information on public school student demographic and socioeconomic characteristics by school, provided data on total enrollment, the percentage of students eligible for free or reduced-price lunch, the percentage of racial/ethnic minority students, and school locale for 2001/02 and 2005/06 for both Kentucky and Virginia. Data can be found online at http://nces.ed.gov/ccd/bat.

Treatment of Kentucky data . Restricting the Kentucky sample to public schools with 10 or more test-takers in each year for 2001/02–2005/06 reduced the overall sample by 14 percent for elementary schools, less than 1 percent for middle schools, and 2 percent for high schools. Table A1 displays the total number of schools and those included in the sample.

The restricted sample includes schools with higher total enrollment and lower percentages of students eligible for free or reduced-price lunch. Results may not generalize to small schools or schools with lower rates of students eligible for free or reduced-price lunch. Tables A2, A3, and A4 display comparisons of the mean and standard deviations of schools included in and excluded from the sample. Although the means differ, the standard deviations are large enough to have some overlap.

Treatment of Virginia data. Virginia reports assessment data for schools with 10 or more test-takers, but only schools with 50 or more test-takers per school are held to NCLB accountability standards. Restricting the Virginia sample to public schools with 50 or more test-takers in each year for 2001/02–2004/05 resulted in retaining 78 percent of reporting schools for grade 3 reading, 76 percent for grade 3 math, 82 percent for grade 5 reading, 79 percent for grade 5 math, 87 percent for grade 8 reading, 78 percent for grade 8 math, 93 percent for the end of course assessments in reading, and 81 percent for the end of course assessments in Algebra 2. If the sample had included schools with 10–49 test-takers in each year for 2001/02–2004/05, it would have retained 99 percent of schools that reported reading assessments

TABLE A1

Number of excluded and sample schools in Kentucky by grade and subject, 2001/02–2005/06

School group	Grade 4 Reading	Grade 5 Math	Grade 7 Reading	Grade 8 Math	Grade 10 Reading	Grade 11 Math
Excluded schools (fewer than 10 test-takers in any year)	85	97	1	1	4	4
Sample schools (10 or more test-takers in each year)	616	604	202	202	197	197
Total	701	701	203	203	201	201

Source: Authors' calculations based on data from Kentucky Department of Education (2007).

TABLE A2

Comparison of excluded and sample elementary schools in Kentucky, 2001/02–2005/06

Grade, subject, and characteristic	Excluded schools (fewer than 10 test takers in any year)			Sample schools (10 or more test takers in each year)		
	Number of schools	Mean	Standard deviation	Number of schools	Mean	Standard deviation
Grade 4 reading						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	44	67	21	596	59	23
Percentage of racial/ethnic minority students, 2001/02 (school)	44	9	17	596	13	17
Total students at school, 2001/02	44	285	207	596	416	156
Percentage of students testing below proficient, 2001/02	39	50	26	616	39	16
Percentage of students testing proficient, 2001/02	39	46	23	616	55	13
Percentage of students testing advanced, 2001/02	39	4	6	616	6	7
Change in percentage testing below proficient, 2001/02–2005/06	9	–7	27	616	–10	14
Change in percentage testing proficient, 2001/02–2005/06	9	–2	36	616	4	13
Change in percentage testing advanced, 2001/02–2005/06	9	–3	7	616	5	10
Grade 5 math						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	56	67	21	584	59	23
Percentage of racial/ethnic minority students, 2001/02 (school)	56	9	17	584	13	17
Total students at school, 2001/02	56	285	207	584	416	156
Percentage of students testing below proficient, 2001/02	51	73	19	584	64	17
Percentage of students testing proficient, 2001/02	51	23	17	604	29	12
Percentage of students testing advanced, 2001/02	51	3	19	604	7	7
Change in percentage of students testing below proficient, 2001/02–2005/06	21	–8	19	604	–21	15
Change in percentage of students testing proficient, 2001/02–2005/06	21	4	14	604	10	13
Change in percentage of students testing advanced, 2001/02–2005/06	21	3	12	604	11	9

Source: Authors' calculations based on data from Kentucky Department of Education (2007) and National Center for Education Statistics (2007).

TABLE A3

Comparison of excluded and sample middle schools in Kentucky, 2001/02–2005/06

Grade, subject, and characteristic	Excluded schools (fewer than 10 test takers in any year)			Sample schools (10 or more test takers in each year)		
	Number of schools	Mean	Standard deviation	Number of schools	Mean	Standard deviation
Grade 7 reading						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	1	75	na	197	48	19
Percentage of racial/ethnic minority students, 2001/02 (school)	1	26	na	197	12	15
Total students at school, 2001/02	1	700	na	197	587	234
Percentage of students testing below proficient, 2001/02	1	67	na	202	44	13
Percentage of students testing proficient, 2001/02	1	30	na	202	50	10
Percentage of students testing advanced, 2001/02	1	33	na	202	6	5
Change in percentage testing below proficient, 2001/02–2005/06	0	na	na	202	–7	11
Change in percentage testing proficient, 2001/02–2005/06	0	na	na	202	5	8
Change in percentage testing advanced, 2001/02–2005/06	0	na	na	202	1	6
Grade 8 math						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	1	75	na	197	48	19
Percentage of racial/ethnic minority students, 2001/02 (school)	1	26	na	197	12	15
Total students at school, 2001/02	1	700	na	197	587	234
Percentage of students testing below proficient, 2001/02	1	92	na	202	74	12
Percentage of students testing proficient, 2001/02	1	7	na	202	21	8
Percentage of students testing advanced, 2001/02	1	8	na	202	5	12
Change in percentage testing below, 2001/02–2005/06	0	na	na	202	–9	9
Change in percentage testing proficient, 2001/02–2005/06	0	na	na	202	5	7
Change in percentage testing advanced, 2001/02–2005/06	0	na	na	202	4	9

na is not applicable.

Source: Authors' calculations based on data from Kentucky Department of Education (2007) and National Center for Education Statistics (2007).

TABLE A4

Comparison of excluded and sample high schools in Kentucky, 2001/02–2005/06

Grade, subject, and characteristic	Excluded schools (fewer than 10 test takers in any year)			Sample schools (10 or more test takers in each year)		
	Number of schools	Mean	Standard deviation	Number of schools	Mean	Standard deviation
Grade 10 reading						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	4	57	8	196	38	18
Percentage of racial/ethnic minority students, 2001/02 (school)	4	6	12	196	10	13
Total students at school, 2001/02	4	532	378	196	837	404
Percentage of students testing below proficient, 2001/02	4	82	7	197	72	11
Percentage of students testing proficient, 2001/02	4	14	5	197	21	7
Percentage of students testing advanced, 2001/02	4	5	2	197	7	5
Change in percentage testing below, 2001/02–2005/06	0	na	na	197	–13	9
Change in percentage testing proficient, 2001/02–2005/06	0	na	na	197	4	6
Change in percentage testing advanced, 2001/02–2005/06	0	na	na	197	9	7
Grade 11 math						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	4	57	8	196	38	18
Percentage of racial/ethnic minority students, 2001/02 (school)	4	6	12	196	10	13
Total students at school, 2001/02	4	532	378	196	837	404
Percentage of students testing below proficient, 2001/02	4	82	4	197	71	12
Percentage of students testing proficient, 2001/02	4	13	2	197	21	7
Percentage of students testing advanced, 2001/02	4	6	4	197	8	6
Change in percentage testing below proficient, 2001/02–2005/06	0	na	na	197	–8	8
Change in percentage testing proficient, 2001/02–2005/06	0	na	na	197	3	6
Change in percentage testing advanced, 2001/02–2005/06	0	na	na	197	5	5

na is not applicable.

Source: Authors' calculations based on data from Kentucky Department of Education (2007) and National Center for Education Statistics (2007).

TABLE A5

Number of schools reporting on test-takers in Virginia by grade and subject, 2001/02–2004/05

	Grade 3		Grade 5		Grade 8		High school end of course exams	
School group	Reading	Math	Reading	Math	Reading	Math	Reading	Algebra 2
Excluded schools								
9 or fewer test-takers in any year	11	48	12	50	46	79	5	13
10–49 test-takers in each year	191	179	152	151	3	9	16	41
Sample schools								
50 or more test-takers in each year	710	723	737	739	323	321	279	232
Total	912	950	901	940	372	409	300	286

Source: Authors' calculations based on data from Virginia Department of Education (2007).

TABLE A6

Comparison of excluded and sample elementary schools in Virginia, 2001/02–2004/05

	Excluded schools (10 49 test takers in any year)			Sample schools (50 or more test takers in each year)		
Grade, subject, and characteristic	Number of schools	Mean	Standard deviation	Number of schools	Mean	Standard deviation
Grade 3 reading						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	191	47	23	710	32	22
Percentage of racial/ethnic minority students, 2001/02 (school)	191	44	33	710	38	26
Total students at school, 2001/02	191	375	84	710	598	162
Percentage of students testing below proficient, 2001/02	191	32	16	710	27	14
Percentage of students testing proficient, 2001/02	191	54	11	710	56	9
Percentage of students testing advanced, 2001/02	191	14	10	710	17	11
Change in percentage testing below proficient, 2001/02–2004/05	191	–7	16	710	–5	12
Change in percentage testing proficient, 2001/02–2004/05	191	5	14	710	3	11
Change in percentage testing advanced, 2001/02–2004/05	191	3	10	710	2	9
Grade 3 math						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	179	47	23	723	32	22
Percentage of racial/ethnic minority students, 2001/02 (school)	179	42	32	723	38	27
Total students at school, 2001/02	179	372	86	723	596	163
Percentage of students testing below proficient, 2001/02	179	23	15	723	19	11
Percentage of students testing proficient, 2001/02	179	41	10	723	40	9
Percentage of students testing advanced, 2001/02	179	35	16	723	41	16
Change in percentage testing below proficient, 2001/02–2004/05	179	–10	14	723	–7	10
Change in percentage testing proficient, 2001/02–2004/05	179	–3	14	723	–5	10
Change in percentage testing advanced, 2001/02–2004/05	179	13	17	723	12	14

(CONTINUED)

TABLE A6 (CONTINUED)

Comparison of excluded and sample elementary schools in Virginia, 2001/02–2004/05

Grade, subject, and characteristic	Excluded schools (10 49 test takers in any year)			Sample schools (50 or more test takers in each year)		
	Number of schools	Mean	Standard deviation	Number of schools	Mean	Standard deviation
Grade 5 reading						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	152	45	23	737	32	22
Percentage of racial/ethnic minority students, 2001/02 (school)	152	43	32	737	37	26
Total students at school, 2001/02	152	364	79	737	588	162
Percentage of students testing below proficient, 2001/02	152	24	15	737	22	13
Percentage of students testing proficient, 2001/02	152	60	11	737	61	8
Percentage of students testing advanced, 2001/02	152	16	10	737	18	10
Change in percentage testing below proficient, 2001/02–2004/05	152	-9	14	737	-8	9
Change in percentage testing proficient, 2001/02–2004/05	152	–2	13	737	–4	12
Change in percentage testing advanced, 2001/02–2004/05	152	11	10	737	12	9
Grade 5 math						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	151	45	23	739	32	22
Percentage of racial/ethnic minority students, 2001/02 (school)	151	44	32	739	37	27
Total students at school, 2001/02	151	362	80	739	587	162
Percentage of students testing below proficient, 2001/02	151	31	19	739	28	16
Percentage of students testing proficient, 2001/02	151	56	14	739	56	11
Percentage of students testing advanced, 2001/02	151	14	11	739	16	12
Change in percentage testing below proficient, 2001/02–2004/05	151	–11	19	739	–10	13
Change in percentage testing proficient, 2001/02–2004/05	151	0	16	739	0	12
Change in percentage testing advanced, 2001/02–2004/05	151	10	12	739	10	10

Source: Authors' calculations based on data from Virginia Department of Education (2007) and National Center for Education Statistics (2007).

for grades 3 and 5 and 95 percent of schools that reported math assessments for grades 3 and 5. The sample would not have increased much for the grade 8 assessments, but would have increased to 98 percent of schools for end of course reading and 95 percent for Algebra 2. Table A5 displays the number of schools in each category.

As in Kentucky, the schools excluded in Virginia are smaller (based on total enrollments in 2002) than the sample schools and have larger percentages of students eligible for free or reduced-price lunch. Tables A6, A7, and A8 provide details on the school characteristics and key variables for excluded schools with 10–49 test-takers each year and the sample schools. Descriptive statistics are not presented for schools with 9 or fewer test-takers in any year 2001/02–2004/05 because the state did not report the data.

Methodology for the bivariate analysis

The bivariate analysis examines, in four steps, the relationship between the annualized changes in the school-level percentage of students passing and annualized changes in school-level percentage testing advanced over five years in Kentucky and four years in Virginia.

TABLE A7

Comparison of excluded and sample middle schools in Virginia, 2001/02–2004/05

Grade, subject, and characteristic	Excluded schools (10 49 test takers in any year)			Sample schools (50 or more test takers in each year)		
	Number of schools	Mean	Standard deviation	Number of schools	Mean	Standard deviation
Grade 8 reading						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	3	36	11	323	32	19
Percentage of racial/ethnic minority students, 2001/02 (school)	3	11	5	323	34	26
Total students at school, 2001/02	3	283	58	323	817	446
Percentage of students testing below proficient, 2001/02	3	30	12	323	31	12
Percentage of students testing proficient, 2001/02	3	59	10	323	51	7
Percentage of students testing advanced, 2001/02	3	11	3	323	18	9
Change in percentage testing below proficient, 2001/02–2004/05	3	–1	11	323	–7	8
Change in percentage testing proficient, 2001/02–2004/05	3	–8	12	323	2	9
Change in percentage testing advanced, 2001/02–2004/05	3	8	6	323	5	7
Grade 8 math						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	9	40	18	321	32	19
Percentage of racial/ethnic minority students, 2001/02 (school)	9	25	24	321	34	26
Total Students at School, 2001/02	9	385	178	321	819	445
Percentage of students testing below proficient, 2001/02	9	26	23	321	30	16
Percentage of students testing proficient, 2001/02	9	63	20	321	53	10
Percentage of students testing advanced, 2001/02	9	12	13	321	17	12
Change in percentage testing below proficient, 2001/02–2004/05	9	–1	13	321	–11	11
Change in percentage testing proficient, 2001/02–2004/05	9	2	15	321	8	11
Change in percentage testing advanced, 2001/02–2004/05	9	-2	8	321	3	7

Source: Authors' calculations based on data from Virginia Department of Education (2007) and National Center for Education Statistics (2007).

First, the average annualized change in school-level percentage of students testing advanced is compared across four groups of schools with increasingly greater changes in the percentage of students passing: schools where the change in percentage passing is more than one standard deviation below the mean, schools where it is within one standard deviation below the mean, schools where it is within one standard deviation above the mean, and schools where it is more than one standard deviation above the mean.

Second, the bivariate association is examined using scatterplots to display annualized changes in the school-level percentage of students passing by annualized changes in school-level percentage testing advanced.

Third, an ordinary least squares (OLS) regression is estimated and plotted with a 95 percent confidence interval. The model's dependent variable, the annualized change in the percentage of students testing advanced, is a function of the annualized change in the percentage passing, the independent variable, or,

Kentucky: $\Delta adv_{(t_4-t_0)/4} = \alpha + \beta_1[\Delta pass_{(t_4-t_0)/4}] + e$

Virginia: $\Delta adv_{(t_3-t_0)/3} = \alpha + \beta_1[\Delta pass_{(t_3-t_0)/3}] + e$

where: Δadv = change in the percentage testing advanced, t_0 = 2001/02, t_1 = 2002/03, t_3 = 2004/05, t_4 = 2005/06, and $\Delta pass$ = change in the percentage passing.

TABLE A8

Comparison of excluded and sample high schools in Virginia, 2001/02–2004/05

Grade, subject, and characteristics	Excluded schools (10 49 test takers in any year)			Sample schools (50 or more test takers in each year)		
	Number of schools	Mean	Standard deviation	Number of schools	Mean	Standard deviation
Reading (end of course exam)						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	16	25	20	279	22	17
Percentage of racial/ethnic minority students, 2001/02 (school)	16	33	37	279	31	24
Total students at school, 2001/02	16	305	85	279	1,228	665
Percentage of students testing below proficient, 2001/02	16	20	18	279	16	8
Percentage of students testing proficient, 2001/02	16	61	14	279	59	8
Percentage of students testing advanced, 2001/02	16	18	17	279	25	11
Change in percentage testing below proficient, 2001/02–2004/05	16	–8	11	279	–4	8
Change in percentage testing proficient, 2001/02–2004/05	16	7	13	279	3	7
Change in percentage testing advanced, 2001/02–2004/05	16	2	11	279	2	7
Algebra 2 (end of course exam)						
Percentage of students eligible for free or reduced-price lunch, 2001/02 (school)	41	39	22	232	19	14
Percentage of racial/ethnic minority students, 2001/02 (school)	41	28	31	232	32	23
Total students at school, 2001/02	41	482	218	232	1,346	639
Percentage of students testing below proficient, 2001/02	41	27	18	232	24	14
Percentage of students testing proficient, 2001/02	41	56	12	232	54	10
Percentage of students testing advanced, 2001/02	41	17	15	232	22	12
Change in percentage testing below proficient, 2001/02–2004/05	41	–18	20	232	–13	12
Change in percentage testing proficient, 2001/02–2004/05	41	7	19	232	2	12
Change in percentage testing advanced, 2001/02–2004/05	41	11	17	232	10	11

Source: Authors' calculations based on data from Virginia Department of Education (2007) and National Center for Education Statistics (2007).

The analysis compares the slope coefficients and the r^2 values to test the direction, magnitude, and strength of any relationships.

Fourth, the sample was split into two groups: schools with the percentage of students passing in 2001/02 below the 2004/05 annual measurable objective and schools with the percentage passing above the 2004/05 objective. Splitting the sample in this way enables testing for whether schools with different levels of proficiency in 2001/02 show the same pattern.

Methodology for the multivariate analysis

Three separate OLS regressions were conducted in which the dependent variable is the annualized change in the school-level percentage of students testing advanced (over 2002/03–2005/06 in Kentucky and 2002/03–2004/05 in Virginia) and the independent variable is the annualized change in the school-level percentage passing. This change was made so that the percentage testing proficient in 2001/02 could be used as a control. The models were estimated controlling for no covariates,

controlling for the percentage of students testing proficient in 2001/02, and controlling for school-level characteristics (percentage of students eligible for free or reduced-price lunch [*FRL*] and changes in that percentage, percentage of racial/ethnic minority students and changes in that percentage, and changes in school locale—city, suburb, town, or rural area):

(1a) Kentucky: $\Delta adv_{(t_4-t_1)/3} = \alpha + \beta_1[\Delta pass_{(t_4-t_1)/3}] + e$

(1b) Kentucky: $\Delta adv_{(t_4-t_1)/3} = \alpha + \beta_1[\Delta pass_{(t_4-t_1)/3}] + \beta_2(\%\ proficient_{t_0}) + e$

(1c) Kentucky: $\Delta adv_{(t_4-t_1)/3} = \alpha + \beta_1[\Delta pass_{(t_4-t_1)/3}] + \beta_2(\%\ proficient_{t_0}) + \beta_3(\%\ FRL\ eligible_{t_0}) + \beta_4[\Delta\ \%\ FRL_{(t_4-t_0)}] + \beta_5(\%\ racial/ethnic\ minority_{t_0}) + \beta_6(\Delta\ \%\ racial/ethnic\ minority_{(t_4-t_0)}) + \beta_7(city_{t_0}) + \beta_8(suburb_{t_0}) + \beta_9(town_{t_0}) + e$

(2a) Virginia: $\Delta adv_{(t_3-t_1)/2} = \alpha + \beta_1[\Delta pass_{(t_3-t_1)/2}] + e$

(2b) Virginia: $\Delta adv_{(t_3-t_1)/2} = \alpha + \beta_1[\Delta pass_{(t_3-t_1)/2}] + \beta_2(\%\ proficient_{t_0}) + e$

(2c) Virginia: $\Delta adv_{(t_3-t_1)/2} = \alpha + \beta_1[\Delta pass_{(t_3-t_1)/2}] + \beta_2(\%\ proficient_{t_0}) + \beta_3(\%\ FRL\ eligible_{t_0}) + \beta_4[\Delta\ \%\ FRL_{(t_4-t_0)}] + \beta_5(\%\ racial/ethnic\ minority_{t_0}) + \beta_6[\Delta\ \%\ racial/ethnic\ minority_{(t_4-t_0)}] + \beta_7(city_{t_0}) + \beta_8(suburb_{t_0}) + \beta_9(town_{t_0}) + e$

where Δadv = change in the percentage testing advanced, t_0 = 2001/02, t_1 = 2002/03, t_3 = 2004/05, t_4 = 2005/06, and $\Delta pass$ = change in the percentage passing.

The annualized change in the school-level percentage of students testing advanced is assumed to be linearly related to the independent variables, defined as follows:

- $\%\ proficient_{t_0}$ is the percentage of students at the school in the grade tested testing at the proficient level in 2001/02, as reported by the Kentucky Department of Education (2007) or the Virginia Department of Education (2007).
- $\%\ FRL\ eligible_{t_0}$ is the percentage of students at the school eligible for free or reduced-price lunch in 2001/02, as reported in the Common Core of Data for 2001/02 (U.S. Department of Education 2007).
- $\Delta\ \%\ FRL\ eligible_{t_4-t_0}$ is the difference in the percentage of students at the school eligible for free or reduced-price lunch in 2005/06 and 2001/02, as reported in the Common Core of Data for 2001/02 and for 2005/06 (U.S. Department of Education 2007).
- $\%\ racial/ethnic\ minority_{t_0}$ is the percentage of racial/ethnic minority students at the school, as reported in the Common Core of Data for 2001/02 (U.S. Department of Education 2007).
- $\Delta\ \%\ racial/ethnic\ minority_{t_4-t_0}$ is the difference in the percentage of students of a racial/ethnic minority at the school in 2005/06 and 2001/02, as reported in the Common Core of Data for 2001/02 and for 2005/06 (U.S. Department of Education 2007).
- $City_{t_0}$ is a zero-one indicator, equal to one if a school has urban-centric locale codes 11, 12, or 13, as reported in the Common Core of Data for 2001/02 (U.S. Department of Education 2007).
- $Suburb_{t_0}$ is a zero-one indicator, equal to one if a school has urban-centric locale codes 21, 22, or 23, as reported in the Common Core of Data for 2001/02 (U.S. Department of Education 2007).
- $Town_{t_0}$ is a zero-one indicator, equal to one if a school has urban-centric locale codes 31, 32, or 33, as reported in the Common Core of Data for 2001/02 (U.S. Department of Education 2007).

The slope coefficients measure the degree of association between the dependent and independent variables, holding constant other factors included in the model. (The coefficients for each covariate are reported in appendix C.)

APPENDIX B
DETAILED RESULTS OF THE BIVARIATE ANALYSIS

The report analyzes annualized changes at the school level in the percentage of students testing advanced as a function of annualized changes in the percentage passing (testing proficient or advanced) in reading and math by grade in Kentucky and Virginia. The bivariate results examine changes in Kentucky over the five years 2001/02 –2005/06 and in Virginia over the four years 2001/02–2004/05. Descriptive statistics for these annualized changes are presented in tables B1 and B2.

TABLE B1

Descriptive statistics for bivariate analysis of the association between annualized changes in the percentage of students testing advanced and in the percentage passing in Kentucky, 2001/02–2005/06

Subject, grade, and variable	Number of schools	Mean	Standard deviation
Reading			
Grade 4			
Annualized change in percentage passing	616	2.39	3.52
Annualized change in percentage testing advanced	616	1.31	2.40
Grade 7			
Annualized change in percentage passing	202	1.72	2.72
Annualized change in percentage testing advanced	202	0.37	1.40
Grade 10			
Annualized change in percentage passing	197	3.15	2.26
Annualized change in percentage testing advanced	197	2.18	1.67
Math			
Grade 5			
Annualized change in percentage passing	604	5.24	3.75
Annualized change in percentage testing advanced	604	2.69	2.36
Grade 8			
Annualized change in percentage passing	202	2.16	2.30
Annualized change in percentage testing advanced	202	0.97	1.13
Grade 11			
Annualized change in percentage passing	197	2.05	2.01
Annualized change in percentage testing advanced	197	1.19	1.22

Source: Authors' calculations based on data from Kentucky Department of Education (2007).

TABLE B2

Descriptive statistics for bivariate analysis of association between annualized changes in the percentage of students testing advanced and in the percentage passing in Virginia, 2001/002–2004/05

Subject, grade, and variable	Number of schools	Mean	Standard deviation
Reading			
Grade 3			
Annualized change in percentage passing	710	1.59	4.00
Annualized change in percentage testing advanced	710	0.55	3.07
Grade 5			
Annualized change in percentage passing	737	2.57	3.15
Annualized change in percentage testing advanced	737	4.02	2.87
Grade 8			
Annualized change in percentage passing	323	2.28	2.57
Annualized change in percentage testing advanced	323	4.02	2.38
High school reading (end of course exam)			
Annualized change in percentage passing	279	1.43	2.51
Annualized change in percentage testing advanced	279	0.78	3.75
Math			
Grade 3			
Annualized change in percentage passing	723	2.40	3.31
Annualized change in percentage testing advanced	723	4.02	4.53
Grade 5			
Annualized change in percentage passing	739	3.31	4.41
Annualized change in percentage testing advanced	739	3.28	3.40
Grade 8			
Annualized change in percentage passing	321	3.60	3.75
Annualized change in percentage testing advanced	321	0.84	2.39
High school Algebra 2 (end of course exam)			
Annualized change in percentage passing	232	4.16	3.92
Annualized change in percentage testing advanced	232	3.43	3.59

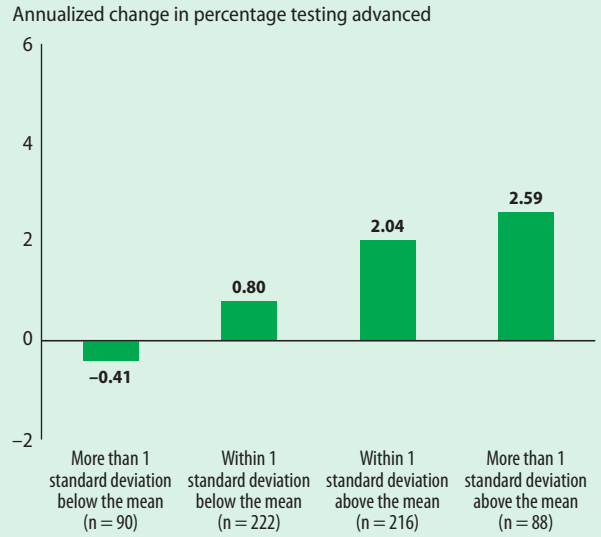
Source: Authors' calculations based on data from Virginia Department of Education (2007).

Average changes in the school-level percentage of students testing advanced for schools grouped by the deviation from the mean change in the percentage of students passing for Kentucky

The average annualized changes in the percentage of students testing advanced was analyzed by schools grouped by standard deviation based on annualized changes in the percentage of students passing. The resulting figures show that schools with the largest changes in the percentage of students passing (those with changes more than one standard deviation above the mean) also have the highest average annualized changes in the percentage testing advanced. This positive relationship holds whether schools are grouped by standard deviations from the mean or percentage point changes from the mean. Figures B1–B6 display these changes for schools in Kentucky. See table B1 for the means and standard deviations used to set cutpoints for each group, by grade and by subject.

FIGURE B1

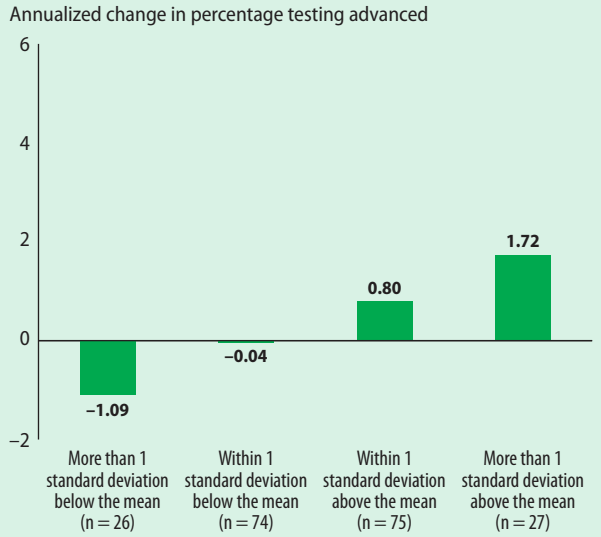
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 4 reading in Kentucky schools grouped by standard deviation, 2001/02–2005/06



Source: Authors' calculations based on data from Kentucky Department of Education (2007).

FIGURE B2

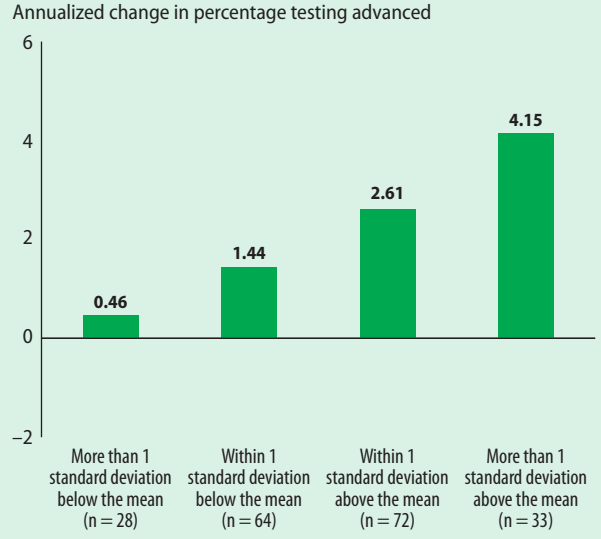
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 7 reading in Kentucky schools grouped by standard deviation, 2001/02–2005/06



Source: Authors' calculations based on data from Kentucky Department of Education (2007).

FIGURE B3

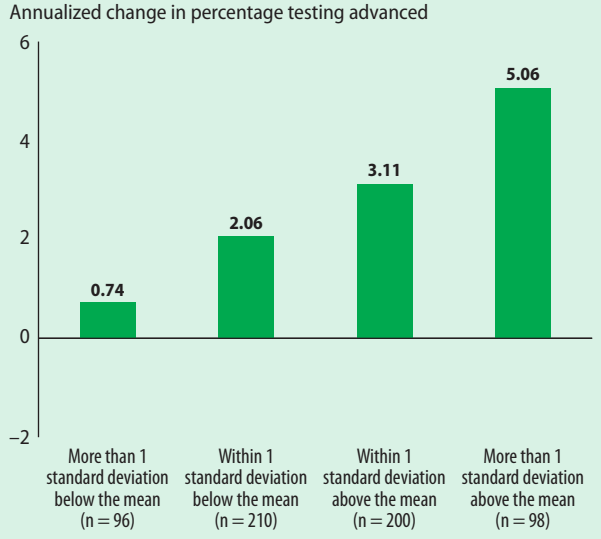
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 10 reading in Kentucky schools grouped by standard deviation, 2001/02–2005/06



Source: Authors' calculations based on data from Kentucky Department of Education (2007).

FIGURE B4

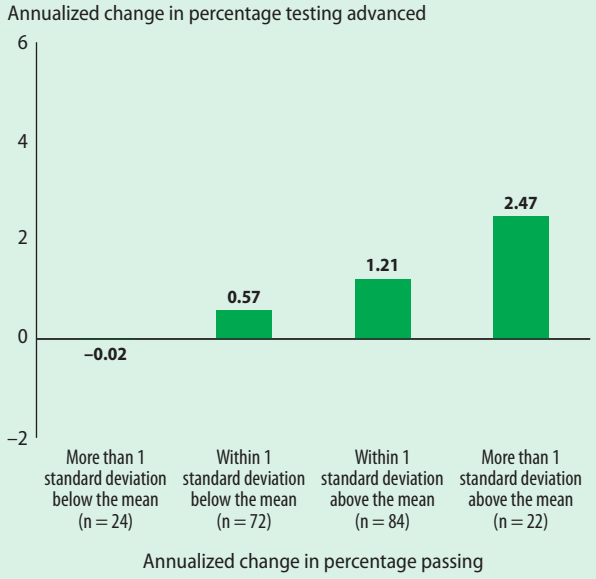
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 5 math in Kentucky schools grouped by standard deviation, 2001/02–2005/06



Source: Authors' calculations based on data from Kentucky Department of Education (2007).

FIGURE B5

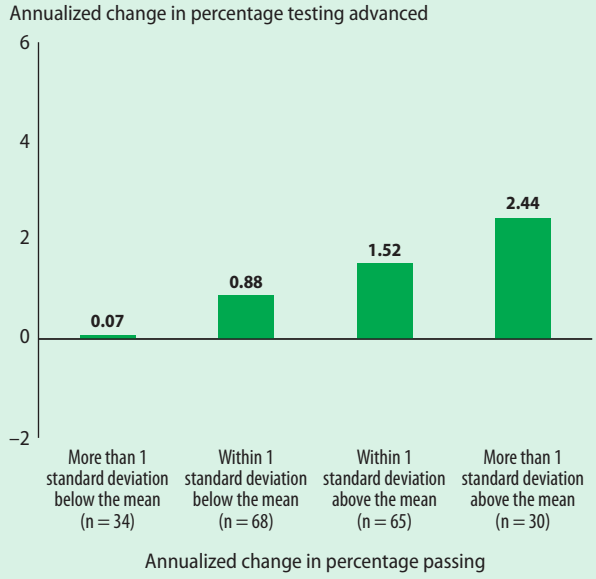
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 7 math in Kentucky schools grouped by standard deviation, 2001/02–2005/06



Source: Authors' calculations based on data from Kentucky Department of Education (2007).

FIGURE B6

Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 11 math in Kentucky schools grouped by standard deviation, 2001/02–2005/06



Source: Authors' calculations based on data from Kentucky Department of Education (2007).

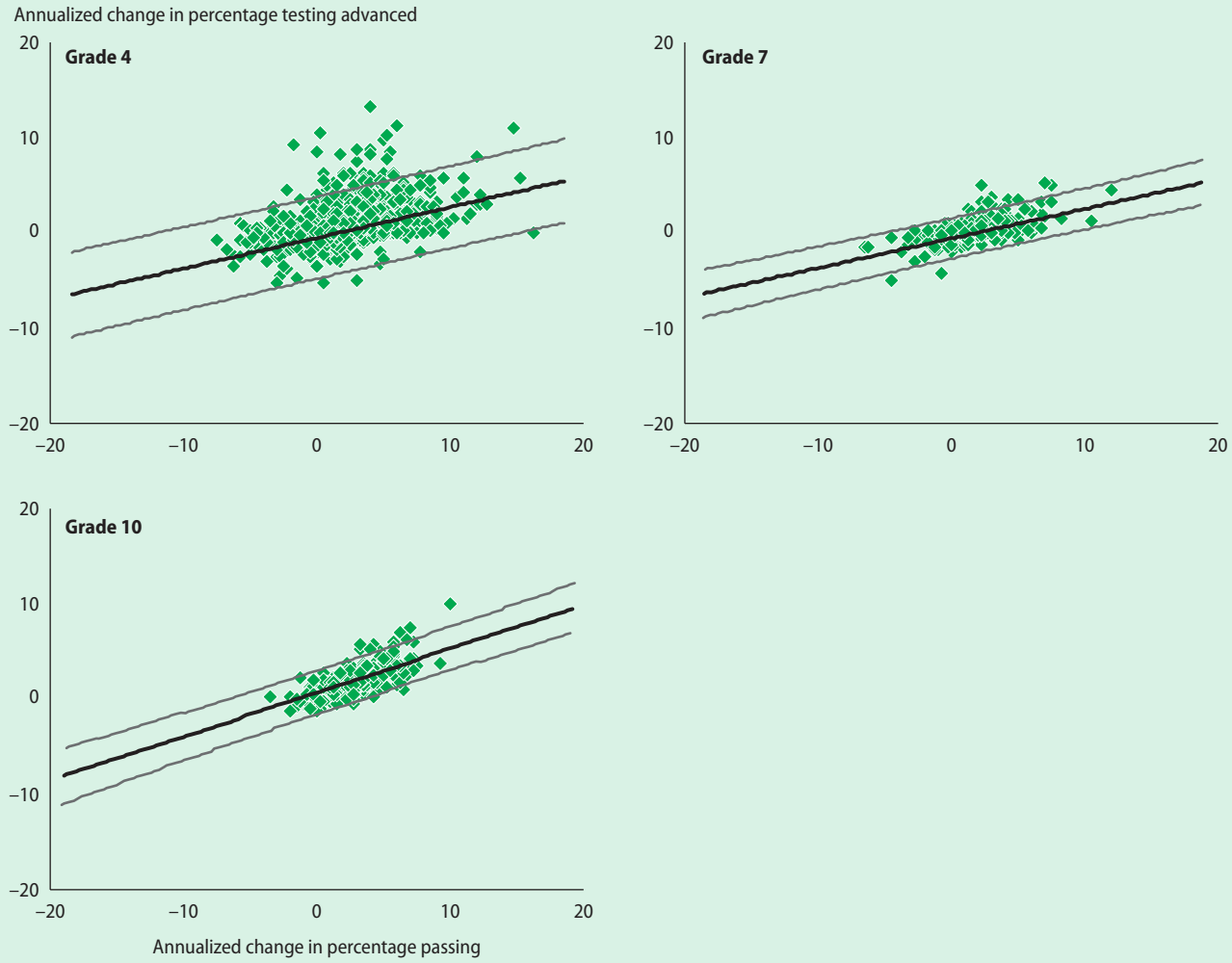
Regression results for the association between annualized changes in the percentage of students testing advanced and in the percentage passing in Kentucky schools

Scatterplot diagrams illustrate the regression results for the association between annualized school-level changes in the percentage of students testing advanced and annualized changes in the percentage passing for reading and math in Kentucky schools (figures B7 and B8). Each scatterplot includes a linear regression line and lines designating a 95 percent confidence interval. In each case the trend is positive, meaning that schools with positive changes in the percentage of students passing also have positive changes in the percentage testing advanced.

Each scatterplot can be divided into four quadrants: positive changes in percentage of students passing and percentage testing advanced (top right); positive change in percentage of students passing but negative change in percentage testing advanced (bottom right); negative change in percentage of students passing and percentage testing advanced (bottom left); and negative change in percentage of students passing but positive change in percentage testing advanced (top left). Table B3 shows the percentage of schools in each quadrant. Table B4 displays the corresponding regression coefficients, correlation coefficients, and r^2 values.

FIGURE B7

Regression results for the association between annualized changes in the percentage of students testing advanced and in the percentage passing in reading in Kentucky schools, 2001/02–2005/06



Source: Authors' calculations based on data from Kentucky Department of Education (2007).

TABLE B3

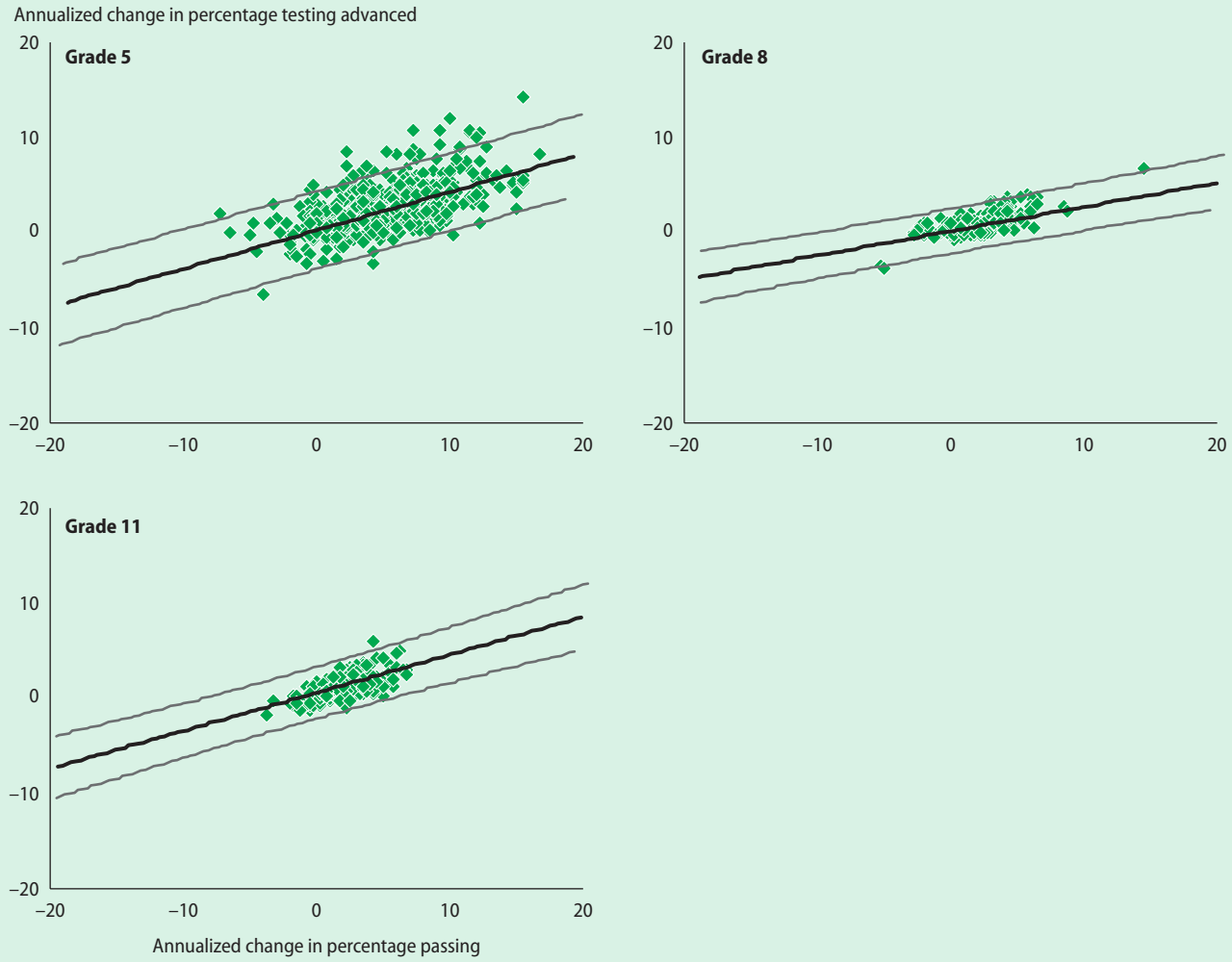
Percentage of Kentucky schools in each quadrant of figures B7 and B8 by subject and grade, 2001/02–2005/06

Subject and grade	Positive passing, positive advanced	Positive passing, negative advanced	Negative passing, negative advanced	Negative passing, positive advanced
Reading				
Grade 4	67.7	11.0	10.7	10.6
Grade 7	58.4	19.3	15.3	6.9
Grade 10	87.8	4.1	2.5	5.6
Math				
Grade 5	87.9	4.8	2.8	4.5
Grade 8	81.2	6.9	2.5	9.4
Grade 11	80.2	4.6	6.6	8.6

Source: Authors' calculations based on data from Kentucky Department of Education (2007).

FIGURE B8

Regression results for the association between the annualized changes in the percentage of students testing advanced and in the percentage passing in math in Kentucky schools, 2001/02–2005/06



Source: Authors' calculations based on data from Kentucky Department of Education (2007).

TABLE B4

Ordinary least squares regressions for the association between changes in the percentage of students testing advanced and in the percentage passing in Kentucky by subject and grade, 2001/02–2005/06

Subject and grade	Number of schools	Intercept coefficient	Slope coefficient	r^2	Correlation coefficient
Reading					
Grade 4	616	0.640***	0.282***	.170	0.412
Grade 7	202	–0.186*	0.324***	.399	0.632
Grade 10	197	0.536***	0.524***	.502	0.709
Math					
Grade 5	604	0.824***	0.352***	.312	0.559
Grade 8	202	0.214**	0.350***	.510	0.714
Grade 11	197	0.368***	0.400***	.434	0.659

* Significant at $p < .05$; **significant at $p < .01$; ***significant at $p < .001$.

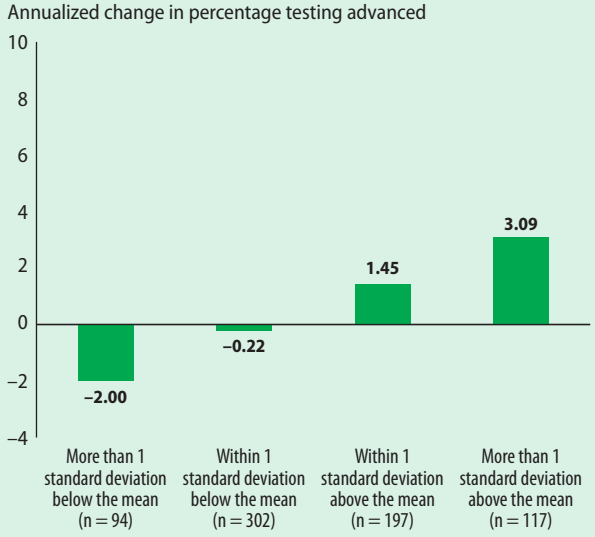
Source: Authors' calculations based on data from Kentucky Department of Education (2007).

Average changes in the school-level percentage of students testing advanced for schools grouped by the deviation from the mean change in the percentage of students passing for Virginia

Schools with the largest changes in the percentage of students passing (those with changes more than one standard deviation above the mean) have a higher annualized change in the percentage testing advanced than schools with the lowest changes in the percentage passing (those more than one standard deviation below the mean, figures B9–B16).

FIGURE B9

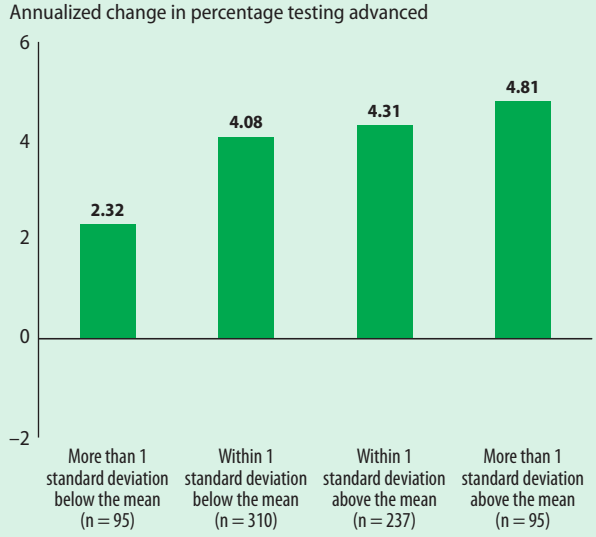
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 3 reading in Virginia schools grouped by standard deviation, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

FIGURE B10

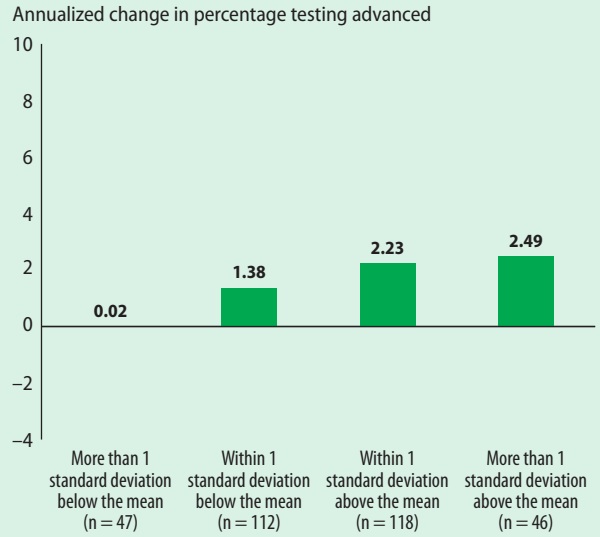
Association between annualized changes in the percentage of student testing advanced and in the percentage passing in grade 5 reading in Virginia schools grouped by standard deviation, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

FIGURE B11

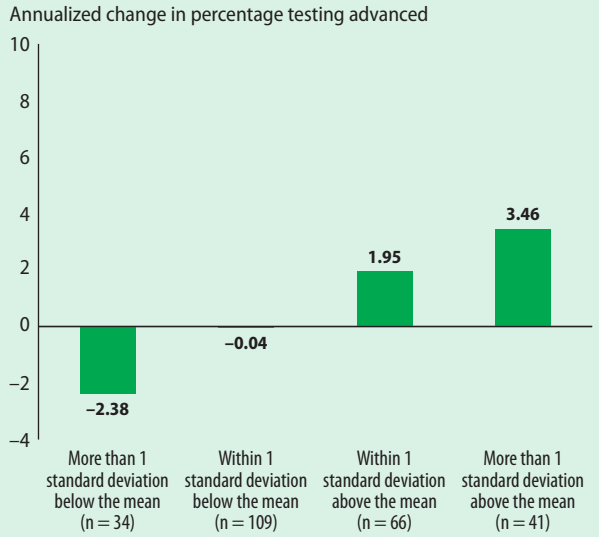
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 8 reading in Virginia schools grouped by standard deviation, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

FIGURE B12

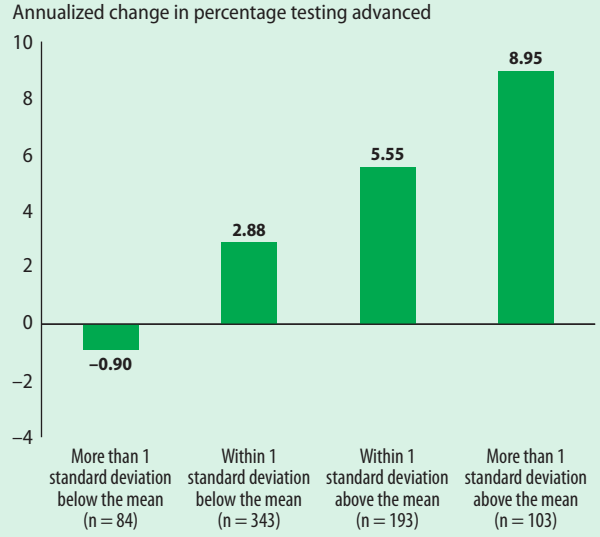
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in high school reading (end of course exams) in Virginia schools grouped by standard deviation, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

FIGURE B13

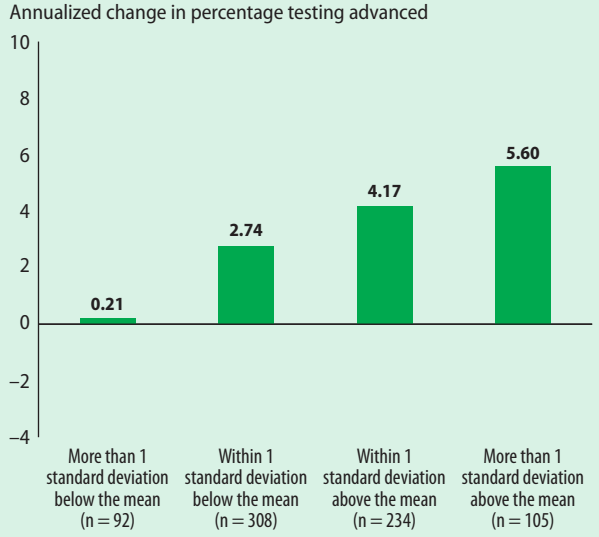
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 3 math in Virginia schools grouped by standard deviation, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

FIGURE B14

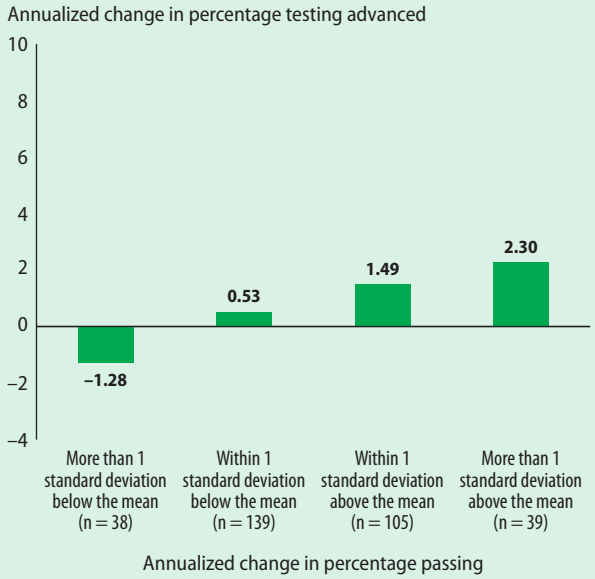
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 5 math in Virginia schools grouped by standard deviation, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

FIGURE B15

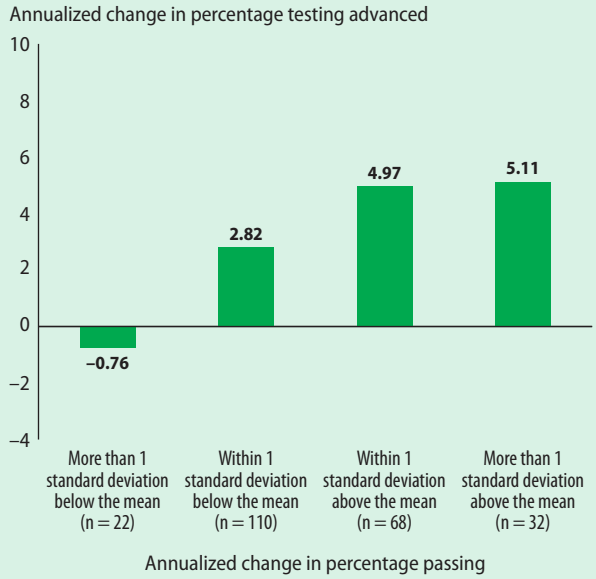
Association between annualized changes in the percentage of students testing advanced and in the percentage passing in grade 8 math in Virginia schools grouped by standard deviation, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

FIGURE B16

Association between annualized changes in the percentage of students testing advanced and in the percentage passing in high school Algebra 2 (end of course exam) in Virginia schools grouped by standard deviation, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

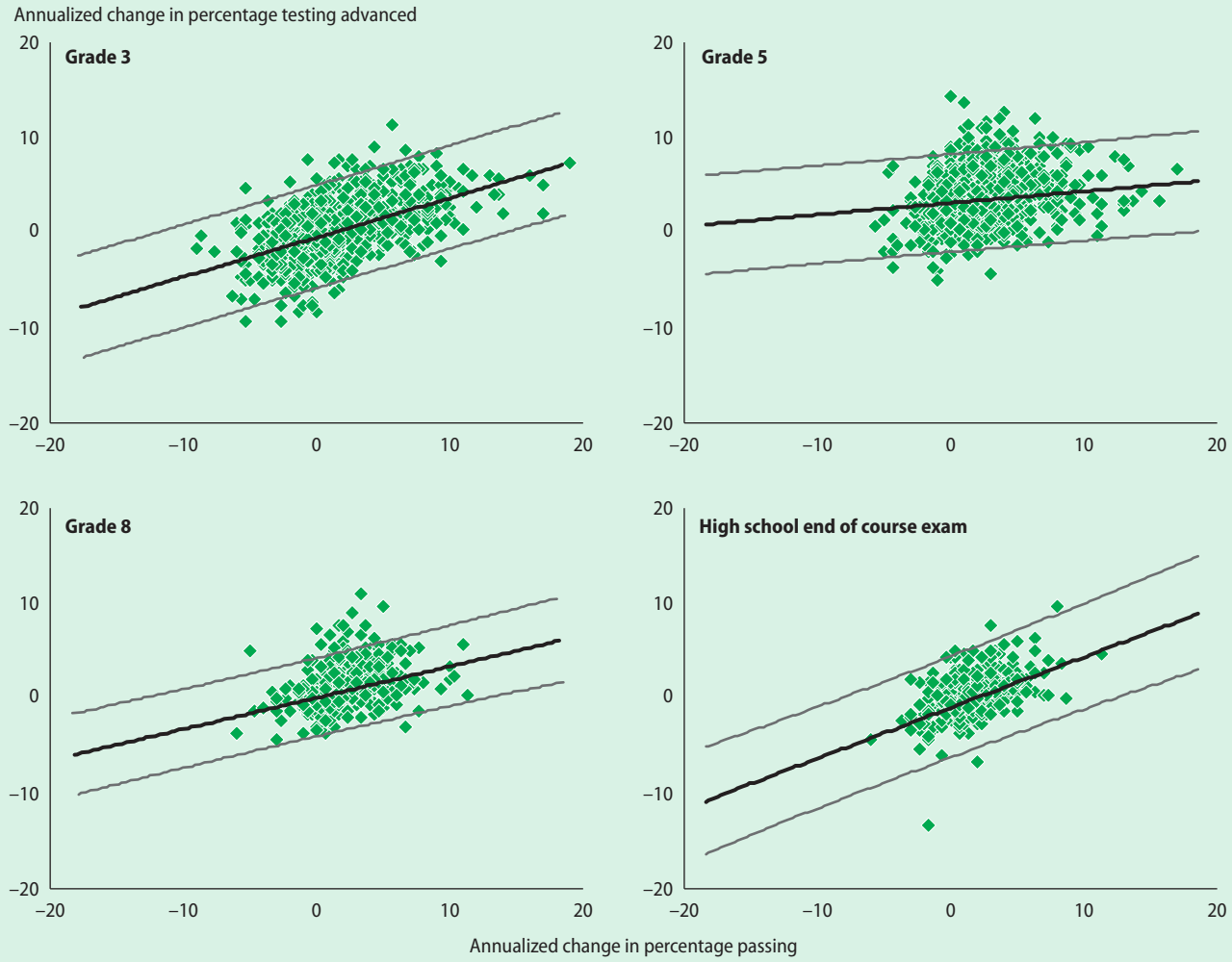
Regression results for the association between annualized changes in the percentage of students testing advanced and in the percentage passing in Virginia schools

Scatterplot diagrams illustrate the regression results for the association between annualized school-level changes in the percentage of students testing advanced and the annualized changes in the percentage passing for reading and math in Virginia schools (figures B17 and B18).

Each scatterplot can be divided into four quadrants: positive changes in percentage of students passing and percentage testing advanced (top right); positive change in percentage of students passing but negative change in percentage testing advanced (bottom right); negative change in percentage of students passing and percentage testing advanced (bottom left); and negative change in percentage of students passing but positive change in percentage testing advanced (top left). Table B5 shows the percentage of schools in each quadrant. Table B6 displays the corresponding regression coefficients, correlation coefficients, and r^2 values.

FIGURE B17

Regression results for the association between annualized changes in the percentage of students testing advanced and in the percentage passing in reading in Virginia schools, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

TABLE B5

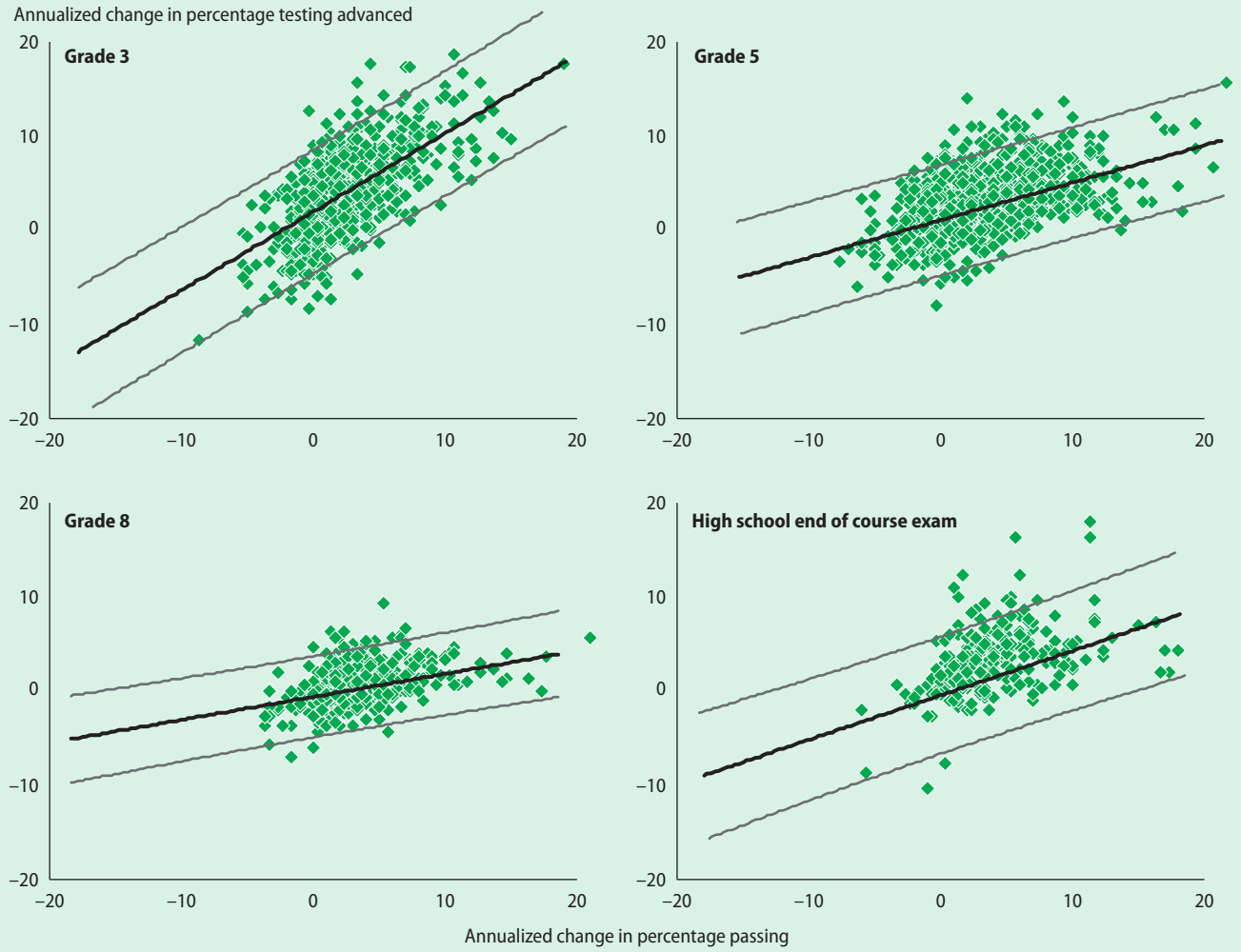
Percentage of Virginia schools in each quadrant of figures B17 and B18 by subject and grade

Subject and grade	Positive passing, positive advanced	Positive passing, negative advanced	Negative passing, negative advanced	Negative passing, positive advanced
Reading				
Grade 3	47.7	16.8	22.5	13.0
Grade 5	53.1	31.6	7.2	8.2
Grade 8	72.1	16.3	7.1	4.6
High school reading (end of course exam)	52.4	20.0	18.0	9.6
Math				
Grade 3	73.9	8.3	9.4	8.4
Grade 5	71.7	7.0	7.4	13.8
Grade 8	60.7	27.4	8.7	3.1
High school Algebra 2 (end of course exam)	84.5	7.3	4.7	3.4

Source: Authors' calculations based on data from Virginia Department of Education (2007).

FIGURE B18

Regression results for the association between annualized changes in the percentage of students testing advanced and in the percentage passing in math in Virginia schools, 2001/02–2004/05



Source: Authors' calculations based on data from Virginia Department of Education (2007).

TABLE B6

Ordinary least squares regressions for the association between changes in the percentage of students testing advanced and in the percentage passing in Virginia by subject and grade, 2001/02–2004/05

Subject and grade	Number of schools	Intercept coefficient	Slope coefficient	r^2	Correlation coefficient
Reading					
Grade 3	710	−0.186	0.404***	.280	0.529
Grade 5	737	3.520***	0.162***	.035	0.187
Grade 8	323	0.874***	0.323***	.109	0.330
High school reading (end of course exam)	270	−0.383	0.793***	.273	0.522
Math					
Grade 3	723	1.894***	0.887***	.420	0.648
Grade 5	739	2.076***	0.364***	.223	0.472
Grade 8	321	−0.094	0.260***	.167	0.409
High school Algebra 2 (end of course exam)	232	1.868***	0.374***	.168	0.410

*** Significant at $p < .001$.

Source: Authors' calculations based on data from Virginia Department of Education (2007).

TABLE B7

Ordinary least squares regressions for the association between changes in the percentage of students testing advanced and in the percentage passing for schools whose percentage passing in 2001/02 was below the 2004/05 annual measurable objective in Kentucky (2001/02–2005/06) and Virginia (2001/02–2004/05)

State, subject, and grade	Number of schools	Intercept coefficient	Slope coefficient	r^2	Correlation coefficient
Kentucky					
Reading					
Grade 4	45	−0.186	0.208***	.344	.587**
Grade 7	25	−0.272	0.235**	.300	.548**
Grade 10	55	0.126	0.429***	.577	.760**
Math					
Grade 5	65	−0.206	0.346***	.426	.680**
Grade 8	55	0.152	0.235***	.344	.586**
Grade 11	49	0.573*	0.379***	.494	.703**
Virginia					
Reading					
Grade 3	271	0.274	0.312***	.233	.483**
Grade 5	160	1.594***	0.290***	.151	.389**
Grade 8	167	0.861***	0.229***	.100	.316**
High school reading (end of course exam)	12	0.750	0.445	.086	.293
Math					
Grade 3	114	1.603*	0.806***	.452	.672**
Grade 5	298	1.452***	0.366***	.275	.524**
Grade 8	145	−0.355	0.235***	.231	.480**
High school Algebra 2 (end of course exam)	59	1.424	0.295*	.108	.328**

*Significant at $p < .05$; **significant at $p < .01$; ***significant at $p < .001$.

Source: Authors' calculations based on data from Kentucky Department of Education (2007) and Virginia Department of Education (2007).

Detailed analysis of schools with the percentage of students passing in 2001/02 below or above the 2004/05 annual measurable objective

The NCLB Act sanctions schools only if insufficient numbers of students fail to test at the proficient level or above on standardized tests. Thus the study considered schools where the 2001/02 percentage of students passing was below the 2004/05 annual measurable objective as having the strongest incentives to shift resources to below proficient students. Those schools needed to increase the percentage of students testing proficient to meet the annual measurable objective in 2004/05, the year the objective was increased for the first time.

To test whether schools with the percentage of student passing in 2001/02 below the 2004/05 annual measurable objective display the same trends as the sample as a whole, the sample was split into two groups: schools with the percentage of students passing in 2001/02 below the 2004/05 annual measurable objective and those with the percentage passing in 2001/02 above the 2004/05 objective.

In Kentucky the annual measurable objectives varied by subject and school level (for elementary schools, it was 53.86 in reading and 32.14 in math; for middle schools it was 52.40 in reading and 26.93 in math; for high schools it was 29.35 in

TABLE B8

Ordinary least squares regressions for the association between changes in the percentage of students testing advanced and in the percentage passing for schools whose percentage passing in 2001/02 was above the 2004/05 annual measurable objective in Kentucky (2001/02–2005/06) and Virginia (2001/02–2004/05)

State, subject, and grade	Number of schools	Intercept coefficient	Slope coefficient	r^2	Correlation coefficient
Kentucky					
Reading					
Grade 4	571	0.645***	0.327***	.192	.438**
Grade 7	177	−0.160	0.343***	.417	.646**
Grade 10	142	0.545***	0.633***	.610	.781**
Math					
Grade 5	539	0.842***	0.378***	.328	.573**
Grade 8	147	0.279***	0.388***	.584	.764**
Grade 11	148	0.532**	0.573***	.536	.732**
Virginia					
Reading					
Grade 3	439	−0.005	0.537***	.199	.446**
Grade 5	577	3.574***	0.396***	.097	.311*
Grade 8	156	0.778***	0.725***	.234	.484**
High school reading (end of course exam)	258	−0.333	0.826***	.240	.490**
Math					
Grade 3	609	1.786***	1.062***	.362	.602**
Grade 5	441	2.163***	0.658***	.261	.511**
Grade 8	176	−0.413	0.649***	.262	.512**
High school Algebra 2 (end of course exam)	173	1.063**	0.838***	.320	.566**

* Significant at $p < .05$; ** significant at $p < .01$; *** significant at $p < .001$.

Source: Authors' calculations based on data from Kentucky Department of Education (2007) and Virginia Department of Education (2007).

reading and 29.79 in math). Virginia had the same original annual measurable objective for both reading and math in 2004/05 (70). (Virginia later revised its annual measurable objectives to 65 in reading and 63 in math.)

The regression results for the association between annualized changes in the percentage of students passing and annualized changes in the percentage testing advanced for Kentucky and Virginia schools with percentage passing rates in 2001/02 below the 2004/05 annual measurable objective and those with percentage passing rates in 2001/02 above the 2004/05 annual measurable objective are shown in tables B7 and B8. In nearly all cases the slope (which tells the direction and magnitude of the association) is positive and statistically significant at the .05 level, indicating that changes in the percentage of students passing are positively associated with the changes in the percentage of students testing advanced. Among the schools with the percentage passing in 2001/02 below the 2004/05 annual measurable objective, the one exception is the Virginia high school reading (end of course exams), but this could be because only 12 schools were in the "below" category. The slope coefficients of the schools in the "above" category are larger than those of the schools in the "below" category. This means that in schools where the percentage of students passing in 2001/02 was higher than the 2004/05 annual measurable objective, the change in percentage of students testing advanced made up a greater proportion of the increase in the percentage passing than it did in schools where the percentage passing in 2001/02 was below the 2004/05 annual measurable objective. For both groups, the association was positive.

In both Kentucky and Virginia the r^2 values (a measure of the model's goodness of fit or explained variance) of the regressions for the schools in the "below" category are greater than those of the schools in the "above" category for elementary schools but lower than those for the schools in the "above" category for middle and high schools. These results suggest that for schools in the "below" category, the relationship between changes in the percentage of students passing and changes in the percentage testing advanced is positive, but less steep than for schools in the "above" category. Also noteworthy is that the model fits the Kentucky data better than it does the Virginia data—the Kentucky r^2 values average about twice those of Virginia.

APPENDIX C
DETAILED RESULTS OF THE MULTIVARIATE ANALYSIS

Analyzing the association between changes in the percentage of students testing advanced as a function of the changes in the percentage testing proficient or above while controlling for the percentage testing proficient in 2001/02 and other school characteristics required switching to a four-year period in Kentucky and a three-year period in Virginia. The models are specified so that the percentage testing proficient in 2001/02 is not included among the independent or dependent variables. Descriptive statistics for reading and for math in Kentucky are in tables C1 and C2.

The results of models 1a, 1b, and 1c (specified in appendix A, "Methodology for the multivariate analysis") are presented in tables C3 and C4. In all cases the association between changes in the percentage of students passing and changes in the percentage testing advanced is statistically significant (model 1a). The positive and statistically significant slope coefficients suggest that schools with the largest increases in the percentage of students passing also show the largest increases in the percentage testing advanced, and also that those with the smallest increases in the percentage of students passing also show the smallest increases in the percentage testing advanced. When controls for the percentage of students testing proficient in 2001/02 are added (model 1b), the association holds and the amount of variance explained. Model 1c adds when school-level characteristics are added (model 1c), and the association continues to hold.

Descriptive statistics for reading and math in Virginia are in tables C5 and table C6.

The results for models 2a, 2b, and 2c (as specified in appendix A) are presented in tables C7 and C8. The results are weaker for Virginia than for Kentucky (with the exception of grade 3 reading and math), as shown by the R^2 values, but the statistically significant positive relationship between the changes in the percentage of students passing and changes in the percentage testing advanced holds. Across the models the association holds regardless of controls added. The percentage proficient in 2001/02 and school-level variables reinforce the relationship. The amount of variance explained increases with each model, but the underlying relationship between the key independent variable and changes in the percentage testing advanced remains the same.

The results of models 2a, 2b, and 2c (specified in appendix A, "Methodology for the multivariate analysis") are presented in tables C7 and C8.

TABLE C1

Descriptive statistics for multivariate analysis for reading in Kentucky, 2002/03–2005/06

Grade and variable	Number of schools	Mean	Standard deviation
Grade 4			
Change in percentage testing advanced, 2002/03–2005/06	591	1.57	3.17
Change in percentage passing, 2002/03–2005/06	591	2.54	4.30
Percentage testing proficient, 2001/02	591	54.38	12.77
Percentage of students eligible for free or reduced-price lunch	591	59.07	23.02
Change in percentage of students eligible for free or reduced-price lunch	591	3.27	13.31
Percentage of racial/ethnic minority students	591	13.07	17.13
Change in percentage of racial/ethnic minority students	591	1.41	3.88
City	591	0.21	0.41
Suburb	591	0.13	0.34
Town	591	0.18	0.38
Rural (comparison)	591	0.48	0.50
Grade 7			
Change in percentage testing advanced, 2002/03–2005/06	194	0.12	1.74
Change in percentage passing, 2002/03–2005/06	194	1.89	3.33
Percentage testing proficient, 2001/02	194	49.84	9.84
Percentage of students eligible for free or reduced-price lunch	194	47.51	19.40
Change in percentage of students eligible for free or reduced-price lunch	194	4.60	11.69
Percentage of racial/ethnic minority students	194	11.22	14.13
Change in percentage of racial/ethnic minority students	194	1.57	3.98
City	194	0.19	0.39
Suburb	194	0.12	0.32
Town	194	0.29	0.46
Rural (comparison)	194	0.40	0.49
Grade 10			
Change in percentage testing advanced, 2002/03–2005/06	194	2.53	1.97
Change in percentage passing, 2002/03–2005/06	194	3.31	2.56
Percentage testing proficient, 2001/02	194	21.01	7.06
Percentage of students eligible for free or reduced-price lunch	194	37.89	18.00
Change in percentage of students eligible for free or reduced-price lunch	194	4.75	10.44
Percentage of racial/ethnic minority students	194	9.43	12.40
Change in percentage of racial/ethnic minority students	194	1.40	2.94
City	194	0.13	0.34
Suburb	194	0.09	0.29
Town	194	0.29	0.45
Rural (comparison)	194	0.48	0.50

Source: Authors' calculations based on data from Kentucky Department of Education (2007); U.S. Department of Education, National Center for Education Statistics (2007).

TABLE C2

Descriptive statistics for multivariate analysis for math in Kentucky, 2002/03–2005/06

Grade and variable	Number of schools	Mean	Standard deviation
Grade 5			
Change in percentage testing advanced, 2002/03–2005/06	579	3.28	3.20
Change in percentage passing, 2002/03–2005/06	579	6.48	4.99
Percentage testing proficient, 2001/02	579	29.84	11.37
Percentage of students eligible for free or reduced-price lunch	579	59.01	23.10
Change in percentage of students eligible for free or reduced-price lunch	579	3.19	13.45
Percentage of racial/ethnic minority students	579	13.17	17.22
Change in percentage of racial/ethnic minority students	579	1.43	3.93
City	579	0.21	0.41
Suburb	579	0.14	0.34
Town	579	0.17	0.38
Rural (comparison)	579	0.48	0.50
Grade 8			
Change in percentage testing advanced, 2002/03–2005/06	194	0.44	1.36
Change in passing, 2002/03–2005/06	194	1.21	2.73
Percentage testing proficient, 2001/02	194	21.09	8.12
Percentage of students eligible for free or reduced-price lunch	194	47.51	19.40
Change in percentage of students eligible for free or reduced-price lunch	194	4.60	11.69
Percentage of racial/ethnic minority students	194	11.22	14.13
Change in percentage of racial/ethnic minority students	194	1.57	3.98
City	194	0.19	0.39
Suburb	194	0.12	0.32
Town	194	0.29	0.46
Rural (comparison)	194	0.40	0.49
Grade 11			
Change in percentage testing advanced, 2002/03–2005/06	194	1. 32	1.51
Change in passing, 2002/03–2005/06	194	1.82	2.52
Percentage testing proficient, 2001/02	194	20.62	7.18
Percentage of students eligible for free or reduced-price lunch	194	37.89	18.01
Change in percentage of students eligible for free or reduced-price lunch	194	4.75	10.44
Percentage of racial/ethnic minority students	194	9.43	12.40
Change in percentage of racial/ethnic minority students	194	1.40	2.94
City	194	0.13	0.34
Suburb	194	0.09	0.29
Town	194	0.29	0.45
Rural (comparison)	194	0.48	0.50

Source: Authors' calculations based on data from Kentucky Department of Education (2007); U.S. Department of Education, National Center for Education Statistics (2007).

TABLE C3

Ordinary least squares multivariate regressions for reading in Kentucky, 2002/03–2005/06

	Model 1a		Model 1b		Model 1c	
Grade and variable	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Grade 4						
Constant	0.82***	0.14	–1.06*	0.54	–0.10	0.91
Change in percentage passing, 2002/03–2005/06	0.30***	0.03	0.31***	0.03	0.31***	0.03
Percentage testing proficient, 2001/02			0.03***	0.01	0.03**	0.01
Percentage of students eligible for free or reduced-price lunch					–0.01	0.01
Change in percentage of students eligible for free or reduced-price lunch					–0.02	0.01
Percentage of racial/ethnic minority students					0.00	0.01
Change in percentage of racial/ethnic minority students					–0.01	0.03
City					0.16	0.44
Suburb					–0.17	0.41
Town					–0.18	0.34
Rural (comparison)						
R^2	0.160		0.179		0.185	
Number of schools	591		591		591	
Grade 7						
Constant	–0.44***	0.10	–0.64	0.55	–1.83	1.12
Change in percentage passing, 2002/03–2005/06	0.30***	0.03	0.30***	0.03	0.30***	0.03
Percentage testing proficient, 2001/02			0.00	0.01	0.02	0.02
Percentage of students eligible for free or reduced-price lunch					0.01	0.01
Change in percentage of students eligible for free or reduced-price lunch					0.01	0.01
Percentage of racial/ethnic minority students					0.01	0.01
Change in percentage of racial/ethnic minority students					–0.01	0.03
City					–0.21	0.43
Suburb					–0.17	0.37
Town					0.19	0.26
Rural (comparison)						
R^2	0.327		0.327		0.338	
Number of schools	194		194		194	

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TABLE C3 (CONTINUED)

Ordinary least squares multivariate regressions for reading in Kentucky, 2002/03–2005/06

	Model 1a		Model 1b		Model 1c	
Grade and variable	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Grade 10						
Constant	0.82***	0.17	–1.00**	0.33	0.01	0.68
Change in percentage passing, 2002/03–2005/06	0.52***	0.04	0.53***	0.04	0.53***	0.04
Percentage testing proficient, 2001/02			0.09***	0.01	0.07***	0.02
Percentage of students eligible for free or reduced-price lunch					–0.01	0.01
Change in percentage of students eligible for free or reduced-price lunch					–0.02	0.01
Percentage of racial/ethnic minority students					–0.01	0.01
Change in percentage of racial/ethnic minority students					–0.01	0.04
City					0.34	0.43
Suburb					–0.08	0.40
Town					–0.16	0.25
Rural (comparison)						
R^2	0.453		0.545		0.557	
Number of schools	194		194		194	

* Significant at $p < .05$; ** significant at $p < .01$; *** significant at $p < .001$.

Source: Authors' calculations based on data from Kentucky Department of Education (2007); U.S. Department of Education, National Center for Education Statistics (2007).

TABLE C4

Ordinary least squares multivariate regressions for math in Kentucky, 2002/03–2005/06

	Model 1a		Model 1b		Model 1c	
Grade and variable	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Grade 5						
Constant	0.96***	(0.18)	–1.27***	(0.35)	0.66	(0.63)
Change in percentage passing, 2002/03–2005/06	0.36***	(0.02)	0.38***	(0.02)	0.39***	(0.02)
Percentage testing proficient, 2001/02			0.07***	(0.01)	0.05***	(0.01)
Percentage of students eligible for free or reduced-price lunch					–0.02***	(0.01)
Change in percentage of students eligible for free or reduced-price lunch					–0.01	(0.01)
Percentage of racial/ethnic minority students					–0.00	(0.01)
Change in percentage of racial/ethnic minority students					0.01	(0.03)
City					0.18	(0.39)
Suburb					–0.34	(0.36)
Town					–0.59	(0.31)
Rural (comparison)						
R^2	0.313		0.371		0.391	
Number of schools	591		591		591	
Grade 8						
Constant	0.04	(0.08)	0.05	(0.21)	0.77	(0.57)
Change in percentage passing, 2002/03–2005/06	0.33***	(0.03)	0.33***	(0.03)	0.32***	(0.03)
Percentage testing proficient, 2001/02			–0.00	(0.01)	–0.01	(0.01)
Percentage of students eligible for free or reduced-price lunch					–0.01	(0.01)
Change in percentage of students eligible for free or reduced-price lunch					–0.00	(0.01)
Percentage of racial/ethnic minority students					0.01	(0.01)
Change in percentage of racial/ethnic minority students					–0.01	(0.02)
City					–0.61	(0.30)
Suburb					–0.22	(0.26)
Town					–0.36	(0.18)
Rural (comparison)						
R^2	0.442		0.442		0.466	
Number of schools	194		194		194	

(CONTINUED)

TABLE C4 (CONTINUED)

Ordinary least squares multivariate regressions for math in Kentucky, 2002/03–2005/06

	Model 1a		Model 1b		Model 1c	
Grade and variable	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Grade 11						
Constant	0.64***	(0.10)	−0.17	(0.26)	0.06	(0.57)
Change in percentage passing, 2002/03–2005/06	0.38***	(0.03)	0.39***	(0.03)	0.39***	(0.03)
Percentage testing proficient, 2001/02			0.04***	(0.01)	0.04*	(0.02)
Percentage of students eligible for free or reduced-price lunch					−0.00	(0.01)
Change in percentage of students eligible for free or reduced-price lunch					−0.00	(0.01)
Percentage of racial/ethnic minority students					0.00	(0.01)
Change in percentage of racial/ethnic minority students					−0.02	(0.03)
City					−0.03	(0.35)
Suburb					−0.25	(0.32)
Town					0.09	(0.21)
Rural (comparison)						
R^2	0.401		0.434		0.442	
Number of schools	194		194		194	

* Significant at $p < .05$; ** significant at $p < .01$; *** significant at $p < .001$.

Source: Authors' calculations based on data from Kentucky Department of Education (2007); U.S. Department of Education, National Center for Education Statistics (2007).

TABLE C5

Descriptive statistics for multivariate analysis for reading in Virginia, 2002/03–2004/05

Grade and variable	Number of schools	Mean	Standard deviation
Grade 3			
Change in percentage testing advanced, 2001/02–2004/05	708	–0.22	4.31
Change in percentage passing, 2002/03–2004/05	708	2.12	5.15
Percentage testing proficient, 2001/02	708	55.61	8.90
Percentage of students eligible for free or reduced-price lunch	708	32.19	22.26
Change in percentage of students eligible for free or reduced-price lunch	708	2.97	6.99
Percentage of racial/ethnic minority students	708	37.62	26.26
Change in percentage of racial/ethnic minority students	708	5.72	7.20
City	708	0.25	0.43
Suburb	708	0.40	0.49
Town	708	0.05	0.21
Rural	708	0.19	0.39
Grade 5			
Change in percentage testing advanced, 2001/02–2004/05	734	4.98	4.24
Change in percentage passing, 2002/03–2004/05	734	1.38	4.10
Percentage testing proficient, 2001/02	734	60.74	8.42
Percentage of students eligible for free or reduced-price lunch	734	32.35	22.15
Change in percentage of students eligible for free or reduced-price lunch	734	2.98	7.17
Percentage of racial/ethnic minority students	734	37.49	26.52
Change in percentage of racial/ethnic minority students	734	5.58	7.15
City	734	0.24	0.43
Suburb	734	0.40	0.49
Town	734	0.05	0.21
Rural	734	0.20	0.40
Grade 8			
Change in percentage testing advanced, 2002/03–2004/05	280	3.60	3.70
Change in percentage passing, 2002/03–2004/05	280	3.07	3.33
Percentage testing proficient, 2001/02	280	51.32	6.62
Percentage of students eligible for free or reduced-price lunch	280	31.44	19.68
Change in percentage of students eligible for free or reduced-price lunch	280	4.57	9.69
Percentage of racial/ethnic minority students	280	36.02	25.67
Change in percentage of racial/ethnic minority students	280	4.73	5.47
City	280	0.25	0.44
Suburb	280	0.31	0.46
Town	280	0.06	0.25
Rural	280	0.25	0.43

(CONTINUED)

TABLE C5 (CONTINUED)

Descriptive statistics for multivariate analysis for reading in Virginia, 2002/03–2004/05

Grade and variable	Number of schools	Mean	Standard deviation
High school reading (end of course exam)			
Change in percentage testing advanced, 2002/03–2004/05	248	–2.17	4.11
Change in percentage passing, 2002/03–2004/05	248	–1.95	3.09
Percentage testing proficient, 2001/02	248	59.34	7.92
Percentage of students eligible for free or reduced-price lunch	248	23.57	15.95
Change in percentage of students eligible for free or reduced-price lunch	248	5.10	9.08
Percentage of racial/ethnic minority students	248	31.41	24.51
Change in percentage of racial/ethnic minority students	248	3.39	4.27
City	248	0.17	0.38
Suburb	248	0.23	0.42
Town	248	0.09	0.30
Rural	248	0.36	0.47

Source: Authors' calculations based on data from Virginia Department of Education (2007); U.S. Department of Education, National Center for Education Statistics (2007).

TABLE C6

Descriptive statistics for multivariate analysis for math in Virginia, 2002/03–2004/05

Grade and variable	Number of schools	Mean	Standard deviation
Grade 3			
Change in percentage testing advanced, 2002/03–2004/05	716	2.16	6.13
Change in percentage passing, 2002/03–2004/05	716	2.17	4.09
Percentage testing proficient, 2001/02	716	40.48	8.74
Percentage of students eligible for free or reduced-price lunch	716	32.43	22.30
Change in percentage of students eligible for free or reduced-price lunch	716	3.02	6.99
Percentage of racial/ethnic minority students	716	38.07	26.61
Change in percentage of racial/ethnic minority students	716	5.66	7.21
City	716	0.25	0.44
Suburb	716	0.40	0.49
Town	716	0.04	0.21
Rural	716	0.19	0.39
Grade 5			
Change in percentage testing advanced, 2002/03–2004/05	736	3.87	4.75
Change in percentage passing, 2002/03–2004/05	736	3.21	5.51
Percentage testing proficient, 2001/02	736	55.59	10.59
Percentage of students eligible for free or reduced-price lunch	736	32.49	22.19
Change in percentage of students eligible for free or reduced-price lunch	736	2.99	7.17
Percentage of racial/ethnic minority students	736	37.42	26.61
Change in percentage of racial/ethnic minority students	736	5.60	7.17
City	736	0.24	0.43
Suburb	736	0.40	0.49
Town	736	0.05	0.21
Rural	736	0.20	0.40
Grade 8			
Change in percentage testing advanced, 2002/03–2004/05	318	1.37	3.29
Change in percentage passing, 2002/03–2004/05	318	2.57	4.26
Percentage testing proficient, 2001/02	318	52.86	9.91
Percentage of students eligible for free or reduced-price lunch	318	31.82	19.43
Change in percentage of students eligible for free or reduced-price lunch	318	4.71	9.37
Percentage of racial/ethnic minority students	318	33.70	25.79
Change in percentage of racial/ethnic minority students	318	4.42	5.40
City	318	0.23	0.42
Suburb	318	0.29	0.45
Town	318	0.08	0.26
Rural	318	0.28	0.45

(CONTINUED)

TABLE C6 (CONTINUED)

Descriptive statistics for multivariate analysis for math in Virginia, 2002/03–2004/05

Grade and variable	Number of schools	Mean	Standard deviation
High school Algebra 2 (end of course exam)			
Change in percentage testing advanced, 2002/03–2004/05	210	2.11	3.32
Change in percentage passing, 2002/03–2004/05	210	3.71	4.71
Percentage testing proficient, 2001/02	210	54.18	9.96
Percentage of students eligible for free or reduced-price lunch	210	20.98	13.25
Change in percentage of students eligible for free or reduced-price lunch	210	5.25	6.74
Percentage of racial/ethnic minority students	210	31.71	23.16
Change in percentage of racial/ethnic minority students	210	3.87	4.33
City	210	0.20	0.40
Suburb	210	0.26	0.44
Town	210	0.10	0.30
Rural	210	0.34	0.45

Source: Authors' calculations based on data from Virginia Department of Education (2007); U.S. Department of Education, National Center for Education Statistics (2007).

TABLE C7

Ordinary least squares multivariate regressions for reading in Virginia, 2002/03–2004/05

	Model 2a		Model 2b		Model 2c	
Grade and variable	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Grade 3						
Constant	–1.09***	(0.15)	–2.89**	(0.95)	–3.55***	(1.02)
Change in percentage passing 2002/03–2004/05	0.41***	(0.03)	0.42***	(0.03)	0.42***	(0.03)
Percentage testing proficient, 2001/02			0.03	(0.02)	0.04*	(0.02)
Percentage of students eligible for free or reduced-price lunch					–0.02	(0.01)
Change in percentage of students eligible for free or reduced-price lunch					–0.02	
Percentage of racial/ethnic minority students					0.03**	(0.01)
Change in percentage of racial/ethnic minority students					–0.00	
City					0.38	(0.38)
Suburb					–0.87*	(0.32)
Town					0.50	(0.63)
Rural (comparison)						
R^2	0.237		0.240		0.258	
Number of schools	708		708		708	
Grade 5						
Constant	4.60***	(0.16)	1.90	(1.13)	6.81***	(1.19)
Change in percentage passing 2002/03–2004/05	0.28***	(0.04)	0.30***	(0.04)	0.35***	(0.04)
Percentage testing proficient, 2001/02			0.04*	(0.02)	–0.00	(0.02)
Percentage of students eligible for free or reduced-price lunch					–0.08***	(0.01)
Change in percentage of students eligible for free or reduced-price lunch					–0.06**	(0.02)
Percentage of racial/ethnic minority students					0.01	(0.01)
Change in percentage of racial/ethnic minority students					0.02	(0.02)
City					0.92*	(0.45)
Suburb					–0.04	(0.40)
Town					0.86	(0.73)
Rural (comparison)						
R^2	0.073		0.078		0.184	
Number of schools	734		734		734	

(CONTINUED)

TABLE C7 (CONTINUED)

Ordinary least squares multivariate regressions for reading in Virginia, 2002/03–2004/05

Grade and variable	Model 2a		Model 2b		Model 2c	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Grade 8						
Constant	2.70***	(0.29)	–0.487	(1.76)	5.79**	(1.87)
Change in percentage passing 2002/03–2004/05	0.31***	(0.06)	0.33***	(0.07)	0.43***	(0.06)
Percentage testing proficient, 2001/02			0.06	(0.03)	–0.01	(0.03)
Percentage of students eligible for free or reduced-price lunch					–0.08***	(0.02)
Change in percentage of students eligible for free or reduced-price lunch					–0.07**	(0.02)
Percentage of racial/ethnic minority students					–0.01	(0.01)
Change in percentage of racial/ethnic minority students					–0.10***	(0.04)
City					2.35***	(0.62)
Suburb					–0.02	(0.55)
Town					0.18	(0.87)
Rural (comparison)						
R^2	0.072		0.080		0.223	
Number of schools	280		280		280	
High school reading (end of course exam)						
Constant	–1.18***	(0.28)	–5.80***	(1.79)	–3.829*	(1.91)
Change in percentage passing 2002/03–2004/05	0.54***	(0.08)	0.56***	(0.08)	0.58***	(0.08)
Percentage testing proficient, 2001/02			0.08**	(0.03)	0.06	(0.03)
Percentage of students eligible for free or reduced-price lunch					0.01	(0.02)
Change in percentage of students eligible for free or reduced-price lunch					–0.07*	(0.03)
Percentage of racial/ethnic minority students					–0.01	(0.01)
Change in percentage of racial/ethnic minority students					–0.10	(0.06)
City					0.89	(3.76)
Suburb					–0.28	(0.69)
Town					–0.03	(0.80)
Rural (comparison)						
R^2	0.165		0.189		0.239	
Number of schools	248		248		248	

* Significant at $p < .05$; ** significant at $p < .01$; *** significant at $p < .001$.

Source: Authors' calculations based on data from Virginia Department of Education (2007); U.S. Department of Education, National Center for Education Statistics (2007).

TABLE C8

Ordinary least squares multivariate regression for math in Virginia, 2002/03–2004/05

	Model 2a		Model 2b		Model 2c	
Grade and variable	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Grade 3						
Constant	0.09	(0.20)	1.27	(0.84)	2.05	(0.91)
Change in percentage passing, 2002/03–2004/05	0.95***	(0.04)	0.96***	(0.04)	0.98***	(0.05)
Percentage testing proficient, 2001/02			−0.03	(0.02)	−0.01	(0.02)
Percentage of students eligible for free or reduced-price lunch					−0.03	(0.01)
Change in percentage of students eligible for free or reduced-price lunch					0.05	(0.03)
Percentage of racial/ethnic minority students					0.00	(0.01)
Change in percentage of racial/ethnic minority students					−0.06*	(0.03)
City					−0.82	(0.56)
Suburb					−0.63	(0.50)
Town					−1.52	(0.93)
Rural (comparison)						
R^2	0.401		0.402		0.418	
Number of schools	716		716		716	
Grade 5						
Constant	2.43***	(0.17)	−0.10	(0.84)	2.86**	(0.99)
Change in percentage passing, 2002/03–2004/05	0.45***	(0.03)	0.47***	(0.03)	0.50***	(0.03)
Percentage testing proficient, 2001/02			0.04**	(0.01)	0.01	(0.02)
Percentage of students eligible for free or reduced-price lunch					−0.02	(0.01)
Change in percentage of students eligible for free or reduced-price lunch					−0.00	(0.02)
Percentage of racial/ethnic minority students					−0.03***	(0.01)
Change in percentage of racial/ethnic minority students					−0.03	(0.03)
City					1.25**	(0.46)
Suburb					0.71	(0.41)
Town					0.41	(0.75)
Rural (comparison)						
R^2	0.274		0.283		0.323	
Number of schools	736		736		736	

(CONTINUED)

TABLE C8 (CONTINUED)

Ordinary least squares multivariate regression for math in Virginia, 2002/03–2004/05

	Model 2a		Model 2b		Model 2c	
Grade and variable	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Grade 8						
Constant	0.60**	(0.20)	–2.48*	(0.99)	–0.548	(1.16)
Change in percentage passing, 2002/03–2004/05	0.30***	(0.04)	0.34***	(0.04)	0.36***	(0.04)
Percentage testing proficient, 2001/02			0.06**	(0.02)	0.03	(0.02)
Percentage of students eligible for free or reduced-price lunch					–0.04***	(0.01)
Change in percentage of students eligible for free or reduced-price lunch					–0.04*	(0.02)
Percentage of racial/ethnic minority students					0.03***	(0.01)
Change in percentage of racial/ethnic minority students					–0.00	(0.03)
City					–1.27*	(0.53)
Suburb					0.65	(0.46)
Town					–0.56	(0.65)
Rural (comparison)						
R^2	0.150		0.176		0.265	
Number of schools	318		318		318	
High school Algebra 2 (end of course exam)						
Constant	0.93***	(0.26)	–2.51*	(1.17)	–2.83	(1.24)
Change in percentage passing, 2002/03–2004/05	0.32***	(0.04)	0.34***	(0.04)	0.35***	(0.04)
Percentage testing proficient, 2001/02			0.06**	(0.02)	0.07**	(0.02)
Percentage of students eligible for free or reduced-price lunch					–0.01	(0.02)
Change in percentage of students eligible for free or reduced-price lunch					–0.03	(0.03)
Percentage of racial/ethnic minority students					0.00	(0.01)
Change in percentage of racial/ethnic minority students					0.05	(0.05)
City					–0.78	(0.64)
Suburb					0.63	(0.56)
Town					1.99**	(0.72)
Rural (comparison)						
R^2	0.199		0.233		0.291	
Number of schools	210		210		210	

* Significant at $p < .05$; ** significant at $p < .01$; *** significant at $p < .001$.

Source: Authors' calculations based on data from Virginia Department of Education (2007); U.S. Department of Education, National Center for Education Statistics (2007).

REFERENCES

Ballou, D., Liu, K., and Rolle, E. (2006). *Response to No Child Left Behind among Tennessee schools.* Working paper. Nashville, TN: Vanderbilt University, Peabody College.

Ballou, D., and Springer, M.G. (2008). *Achievement tradeoffs and No Child Left Behind.* Working paper. Nashville, TN: Vanderbilt University.

Booher-Jennings, J. (2005). Below the bubble: "educational triage" and the Texas accountability system. *American Educational Research Journal*, *42*(2), 231–68.

Center on Education Policy. (2007). *Answering the question that matters most: has student achievement increased since No Child Left Behind?* Washington, DC: Center on Education Policy.

Center on Education Policy. (2008). *Has student achievement increased since 2002? State test score trends through 2006–07.* Washington, DC: Center on Education Policy.

de Vise, D. (2007, March 4). A concentrated approach to exams. *Washington Post*.

Deere, D., and Strayer, W. (2001). Putting schools to the test: school accountability, incentives, and behavior. College Station, TX: Working paper. Texas A&M University, Department of Economics.

Jacobson, L. (2007). *Assessing the likelihood that Virginia schools will meet the proficiency goals of the No Child Left Behind Act.* Issues & Answers Report, REL 2007-No. 012. Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Education Laboratory Appalachia. Retrieved June 2008, from http://ies.ed.gov/ncee/edlabs.

Kentucky Department of Education. (2007). Research data. Retrieved June 2007, from ftp://ketsftp.k12.ky.us/OAA.

Krieg, J.M. (2008). Are students left behind? The distributional effects of the No Child Left Behind Act. *Education Finance and Policy, 3*(3), 250–81.

Neal, D., and Schanzenbach, D. (2007). *Left behind by design: proficiency counts and test-based accountability.* NBER Working Paper W13293. Cambridge, MA: National Bureau of Economic Research.

Reback, R. (2008). Teaching to the rating. *Journal of Public Economics, 92*(5), 1394–1415.

Sheekey, A., Bausch, S., and Peterson, A. (2008a). *Reactions of school principals to education challenges presented by NCLB: minutes of discussion occurring 2006–2007.* Unpublished manuscript. Alexandria, VA: CNA Corporation.

Sheekey, A., Bausch, S., and Peterson, A. (2008b). *Reactions of school superintendents to education challenges presented by NCLB: minutes of discussion occurring 2006–2007.* Unpublished manuscript. Alexandria, VA: CNA Corporation.

Springer, M. (2008). The influence of an NCLB accountability plan on the distribution of student test score gains. *Economics of Education Review, 27*(5), 556–63.

U.S. Department of Education, National Center for Education Statistics (2007). Common Core of Data, Build a table, School Years 2001–02, 2004–05, and 2005–06. Retrieved October 2008, from http://nces.ed.gov/ccd/bat.

Virginia Department of Education. (2007). Virginia assessment results. Retrieved June 2008, from https://p1pe.doe.virginia.gov/datareports/assess_test_result.do.