The impact of grading standards on student achievement, educational attainment, and entry-level earnings

by

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Abstract

Despite recent theoretical work, there is little empirical work on the effects of higher grading standards. In this paper we use data from the High School and Beyond survey to estimate the effects of grading standards on student achievement, educational attainment, and entry level earnings. We consider not only how grading standards affect average outcomes but also how they affect the distribution of educational gains by skill level and race/ethnicity. We find that higher standards raise test scores throughout the distribution of achievement, but that the increase is greatest toward the top of the test score distribution. Higher standards have no positive effect on educational attainment, however, and indeed have negative effects on high school graduation among blacks and Hispanics. We suggest a relative performance hypothesis to explain how higher standards may reduce educational attainment even as they increase educational achievement.

[JEL Classification: I2]

Keywords: Grading standards; educational incentives.

1. Introduction

Economists have produced a large body of empirical research that models student outputs in terms of school inputs. Most work has focused on readily measurable inputs, such as class sizes (Hanushek 1986; Betts 1996). Relatively little has focused on the incentives that schools create for their students. Considering economists' interests in incentives, this is surprising.

Incentives have been the focus of a small theoretical literature on educational standards.[1] A common finding is that higher standards may help some students at the expense of others. Whereas higher standards may lead more motivated students to increase effort, they may cause others to give up as the standard moves beyond their reach. Thus higher standards could potentially have adverse distributional consequences.

In this paper, we expand on the existing empirical work in two important ways. First, we analyze the effect of schools' grading standards on a number of educational outcomes. We estimate the effects of higher standards not only on test scores but also on high school graduation, college attendance, and entry-level earnings.

Second, we explicitly consider the distributional consequences of higher standards. We first use quantile regression methods to estimate their effects at different points in the achievement distribution. We then stratify the sample by race/ethnicity to analyze whether higher standards have adverse consequences for minorities.

2. Background

2.1 Theoretical framework

[1] See for instance Kang (1985), Becker and Rosen (1992), Costrell (1994), and Betts (1998).

Becker and Rosen (1992) and Betts (1995) analyze models in which students maximize utility functions defined over their achievement (or a related variable, subsequent income) and their effort. Greater effort reduces utility, although it may raise achievement. Both models predict that increases in grading standards may have ambiguous effects on achievement. More able students may increase effort in order to reach the new standard. Less able students, who must increase effort by a greater amount to increase their achievement, may give up instead. Inframarginal students at both ends of the distribution may be unaffected.

Differences in the effects of higher standards by ability level may manifest themselves as differences by race. Minority test scores generally fall below those of whites. To the extent that test scores reflect ability levels, increases in achievement due to higher standards could be concentrated disproportionately among whites, whereas decreases in could be concentrated disproportionately among minorities.

An interesting question not addressed in the literature concerns the role of parents and schools. Parents may choose their child's school to maximize his effort. Alternatively, parents concerned that their child may give up altogether may choose a school with less demanding standards. Furthermore, the school's choice of grading standard may be influenced by the skill level of its students.

The actions of parents and schools are unobservable, which causes problems for empirical analysis. How parents' choice of schools would affect our estimates is not clear, as the above examples suggest. School behavior could give rise to a reverse causation problem. That is, standards may be correlated with achievement not only because standards affect student effort, but because students' achievement influences the school's choice of standards. We attempt to deal with these problems by including in our regressions proxies for the decisions made by parents and schools. We discuss this in more detail below.

2.2. Previous empirical work

Betts (1995) provides some of the first evidence on the effects of higher grading standards. Using data from the Longitudinal Study of American Youth (LSAY), he has shown that higher grading standards improve average achievement. He finds that grading standards have greater effects among stronger students than among weaker students, but he is unable to estimate separate effects by race because of small sample sizes.

Lillard and DeCicca (2001) focus on the effects of higher graduation standards, defined as the number of courses that students must take in order to graduate, rather than grading standards. They find that raising graduation standards leads to moderate increases in the dropout rate.

3. Methods

3.1. Data

We analyze data from the Sophomore Cohort of the High School and Beyond (HSB) survey, which has many features that are useful for our analysis. First, it provides data from a national probability sample of roughly 15,000 students from 1000 schools. The HSB began tracking these students in 1980, when they were sophomores in high school, and followed them through 1992, when they were roughly 28 years old. The HSB provides data on students' educational achievement, attainment, and post-schooling earnings for the period 1989 to 1991.[2] Moreover, the HSB substantially oversamples blacks and Hispanics.

[2] For this reason, we use the HSB rather than the more recent NELS. At the most recent (1994) follow-up, the NELS students were only 20 years old, and many were full-time students. Thus the NELS is unsuitable for an analysis of post-schooling earnings.

Our dependent variables include 12th-grade test scores, dummy variables for high school graduation and college attendance, and entry-level earnings. The high school graduation dummy is equal to one if the student received a high school diploma, but not if she received a GED. The college attendance dummy is equal to one if the student attended a four-year college at any point during the first two years after leaving high school. Our earnings measure is the (logarithm of) average annual earnings, where the averaging is done over all years between 1989 and 1991 during which the student indicated that she worked at least nine months out of the year. Our dependent variables are summarized in panels A-C of Table 1.

[Table 1 here]

3.2. Measuring schools' grading standards

Theoretically, the school's grading standard is the achievement level needed for students to receive any given grade. It is a measure of how stringently the school grades its students, relative to an objective measure of student achievement obtained from standardized tests. In the simplest terms, if one school generally gives B's to students who score in the 75th percentile on the nationwide test, whereas a second school generally gives such students C's, then the latter school has higher grading standards.

Constructing grading standards requires two pieces of information: each student's standing relative to all students nationwide, as measured through test scores, and each student's standing relative to other students in his/her school, as measured through grades. In 1980 and 1982, HSB respondents took nationally standardized tests in fields such as mathematics, science and English. In 1984, the administrators of the HSB conducted a high school transcript survey, obtaining the complete high school transcripts for nearly all students in the cohort.

We estimate the grading standards by regressing math test scores on the student's math grade point average (GPA) and a vector of school dummies.[3] The coefficients on the school dummies serve as our estimated grading standards. To see this, consider the following regression of the Grade 12 math test score A_{ij} for person i in school j:

$$(1) \qquad A_{ij} \; ? \; \overset{n^{SCH}}{\underset{j?1}{?}} SCHOOL_{ij} ?_{j} \; ? \; \overset{n^{COR}}{\underset{m?1}{?}} ?_{ijm} ?_{m} \; ? \; GPA_{ij} ? \; ? \; ?_{ij}$$

where the $?$, $?$, and $?$ terms are parameters to be estimated, $?_{ij}$ is an error term, and n^{SCH} and n^{COR} equal the number of schools and the number of distinctly identified math courses within the data. The GPA variable indicates the student's average letter grade in math classes, the SCHOOL dummy variables represent separate intercepts for each school, and $?_{ijm}$ is the *number* of math courses of a given type m taken by the student. The latter are meant to control for the fact that if somebody takes a more difficult course, for instance algebra instead of business math, then we would expect him to obtain a higher test score, holding constant his GPA. Similarly, the total number of math courses taken should positively influence the test score, holding constant GPA. Ordinary least squares applied to equation (1) yields an estimated grading standard for each school in the sample, denoted by $\hat{?}_{j}$, where the hat symbol denotes a statistical estimate.[4]

If all schools graded in the same way, then the relation between test scores and letter grades would be identical across schools, and all schools would have the same intercept. If grading standards vary, a school with a higher $?_{j}$ has high grading standards. To see this, consider the case of two

[3] We focus on schools' grading standards for math courses in light of findings by Grogger and Eide (1995) and Murnane, Willett and Levy (1995) that the impact of mathematics achievement on earnings both is substantial and has grown over time.

[4] With the exception of the quantile regressions, all standard errors below are calculated in a manner that accounts for the presence of multiple students per school.

schools. If $?_1 > ?_2$, then students in school 1 receive higher standardized test scores, on average, than students in school 2 who earn the same grades. For example, students with a B average at school 1 score higher than students with a B average at school 2. Thus, school 1 has higher grading standards.[5]

The null hypothesis of similar intercepts was rejected resoundingly, with p-values well below $5?10^{-6}$. Among students with the same GPA who have completed similar coursework, achievement varies dramatically across American schools.[6] Panel D of Table 1 summarizes the estimated grading standard.

3.3. Estimating the effects of grading standards on educational outcomes

Using the estimated grading standards, we estimate their effects on students' educational success by fitting regression models of the form:

$$(3) \qquad y_{ij} \; ? \; ??\hat{?}_j \; ? \; X_{ij}? \; ? \; Z_j? \; ? \; u_{ij}$$

where y_{ij} is the outcome measure for the *i*th student in the *j*th school, X_{ij} is a vector of student background characteristics, Z_j is a vector of school characteristics, and u_{ij} is a disturbance term. The terms ?, ?, and ? are parameters to be estimated, where ? gives the effect of a unit change in the grading standard on the educational outcome.

[5] In preliminary analyses we experimented with a number of different measures of grading standards. First, we added controls for the student's race, to guard against the possibility that the HSB test battery may be racially biased. Second, we added the square of GPA to control for possible non-linearities. Third, we added both the race controls and GPA squared. Fourth, we repeated each of these variants after substituting an omnibus measure of test scores for math test scores as the dependent variable in equation (1), while at the same time replacing the student's math GPA with his overall GPA and likewise replacing the number of math courses with the total number of courses. We found very high correlations between the models that controlled for race and the square of GPA and the models that did not. More to the point, the estimated effects of grading standards on student outcomes were generally similar regardless of how we estimated the grading standard. Likewise, the results were similar whether we used the math grading standard or the overall grading standard. In the analysis below, we focus on the math grading standards estimated without terms for race or GPA squared.

[6] Further details on the construction of the grading standards appear in Appendix 1 of an earlier working paper draft. See Betts and Grogger, National Bureau of Economic Research Working Paper 7875, September 2000.

The vector X_{ij} includes the student's race/ethnicity, sex, family size, family structure, parental income, and parental education.[7] In some specifications, it also includes the student's 10th-grade test score. This provides a measure of the student's achievement at the beginning of our sample period. Presumably, it incorporates the results of all prior decisions aimed at influencing the student's academic success, including the parent's choice of school. We use it as a proxy for otherwise unobservable parental behavior.

The term Z_j includes the average 10th-grade test score of students in the school. Including average achievement scores in the regression provides a means of controlling for reverse causation, that is, the possibility that the school's choice of grading standards may depend on students' initial skill levels.

4. Results

4.1. Effects of grading standards on 12th-grade test scores

One problem with 12th-grade test scores is that only some of the high school dropouts in the HSB actually took the 12th-grade tests. To the extent that dropouts who took the test differ from their counterparts who did not, this may give rise to a sample selection problem. We attempt to deal with this problem using an approach that is similar to that adopted by Grogger and Neal (2000). The idea is to use the information at our disposal to predict what the non-test takers would have scored if they had taken the test. To do this we assume that the students who did not take the 12th-grade test would have achieved the same relative score on their 12th-grade test as they achieved on their 10th-grade test. In other words, we compute the student's 10th grade percentile rank based on her 10th-grade test score,

[7] We could have controlled for these variables in the regression used to construct the grading standards, but chose to control for them here instead. Partitioned regression theory tells us that both approaches would have yielded the same coefficients for the grading standard if the unit of observation were the same for the grading standards and the test scores (Greene, 1993, p. 179).

then impute to her a 12th-grade test score corresponding to that percentile rank in the distribution of 12th-grade test scores.

As discussed by Grogger and Neal (2000), when the imputed scores are included in a quantile regression, the assumption under which the approach yields consistent estimates is simply that the imputation places the student on the correct side of the conditional quantile being estimated. This seems plausible, since we are in effect assuming that dropouts do not learn at a sufficient rate so as to advance their relative position in the distribution of test scores.[8]

Table 2 reports regression estimates of the effects of grading standards on students' 12th-grade math scores. In addition to the variables shown, all three specifications include an extensive set of controls for the student's race, sex, family structure, family size, parental occupation, family income, and residence in an urban, suburban, or rural location, as listed in the note to Table 2. Linear regression estimates appear in panel A.

[Table 2 here]

Comparing specification (1) to specification (2) reveals a pattern that appears in nearly all the regressions that we present. In the models that omit controls for the student's ex ante achievement, grading standards appear to have positive and significant effects on educational outcomes. Including the student’s 10th-grade test score greatly reduces this effect, however. In panel A, the coefficient on the grading standard falls by more than half, from 0.506 to 0.225. In specification (3), although the coefficient on the school's mean 10th-grade test score is positive and significant, its inclusion reduces the

[8] Grogger and Neal (2000) take a somewhat different approach, imputing zero test scores to dropouts, which are guaranteed to be below the conditional quantile in question. In practice, the approach we take here yields estimates that are similar both to those based on the Grogger-Neal approach and to those that ignore the sample-selection problem altogether.

grading standard coefficient only slightly. All of the estimates in panel A suggest that higher grading standards are associated with higher 12th-grade test scores, on average.

How big are the estimated effects of higher grading standards? We can answer this in two ways. First, because one goal of imposing rigorous educational standards might be to reduce within-cohort variation in achievement, we interpret the predicted effects in terms of the variation in achievement within a grade. Table 1 shows that the standard deviation of 12th-grade test scores is 10.08. The estimate in specification (2) of Table 2 indicates that a one-standard deviation increase in grading standards would raise twelfth-grade test scores by 0.79 points, or less than one-tenth of a standard deviation. Thus, compared to the variance of test scores, the effects are quite small. Even a large increase in standards at low-performing schools would be unlikely to reduce the within-cohort variation in achievement by very much.

A second way to gauge the impact of raising standards is to compare the predicted gains with average gains in students' test scores between grades 10 and 12. For the subsample with valid test scores in both grades 10 and 12, the average achievement gain between 10th and 12th grades is about 2 points.[9] A gain in grade-12 test scores of 0.79 amounts to a 40 percent gain in the mean increase between grades 10 and 12. The predicted effects of higher grading standards are small in terms of variation in achievement *among* students, but substantial in terms of the mean gain in student achievement.

Because the theory predicts that higher standards may reduce the achievement of some students, even while increasing the achievement of others, we report quantile regression estimates of the

[9] As mentioned earlier, the mean test score in grade 10 that is shown in table 1 includes values set to zero for missing cases. Among students with non-missing test scores in both grade 10 and grade 12, the mean gain in test scores was about 2 points.

effects of grading standards for the 25th, 50th, and 75th percentiles of the 12th-grade test score distribution in panel B of table 2. Given the high significance of the students' 10th-grade test score in these regressions, we focus our discussion on the estimates from specifications (2) and (3).

Sub-panels 1 and 2 show that grading standards have similar effects at both the first quartile and the median of the 12th-grade conditional test score distribution. It matters little whether we include the school's mean 10th-grade test score. The estimate from specification (3) shows that a one-standard deviation increase in the grading standard leads to an increase 0.33 to 0.35 points on the 12th-grade test score at the 25th and 50th percentiles. Although these improvements would do little to equalize achievement among students, a 0.34 point gain amounts to a 17 percent gain in the average rate of learning between grades 10 and 12.[10]

At the third quartile, grading standards have somewhat greater effects on student achievement. The estimate in specification (3) indicates that a one-standard deviation increase in grading standards increases 12th-grade test scores at the 75th percentile by 0.79 points. Since grading standards have greater effects on students higher in the achievement distribution, higher grading standards may contribute to greater inequality in the distribution of educational achievement. However, they do not appear to decrease the achievement of students in the lower tail, but rather to increase their achievement by less than those in the upper tail.

4.2. Effects of grading standards on educational attainment

Although test scores provide one measure of educational success, educational attainment provides another that is arguably more important. In table 3, we present estimates of the effects of higher grading standards on these two important measures of educational attainment.

[Table 3 here]

The estimate in specification (2) in panel A suggests that a one-standard deviation increase in grading standards would have no significant effect on high school graduation. When we add the school's mean 10th-grade test score to the model in column (3), the grading standard coefficient becomes negative, although it remains small and insignificant. The college attendance results are similar.

Thus, although we find higher grading standards to raise test scores, we find them to have no significant effect on educational attainment. This apparent puzzle may be due to the fact that grading standards have their greatest effect among the students who are the most likely to graduate. With a graduation rate of 80 percent, the 75th percentile student is already likely graduate, so the large test score effects at the 75th percentile may have little effect on graduation rates. At the bottom quartile, one might imagine that large effects on test scores could lead to increases in graduation rates. However, the effects of grading standards at the bottom quartile are relatively small, which may explain why they have little effect on graduation rates.

4.3. Estimated effects of grading standards on earnings

Ideally, we would like to measure how higher grading standards in school affect the student's lifetime utility. An important component of utility is earnings. In table 4 we present estimates of the effects of grading standards on (the logarithm of) earnings.

[Table 4 here]

As desirable as it is to consider earnings effects, the earnings data in the HSB have a number of shortcomings that must be acknowledged. First, the earnings data pertain to the period 1989 to 1991, at which time the HSB respondents were typically 25 to 27 years old. Since entry-level earnings data

[10] In principle, one could compare the effects of grading standards not only with the mean gain in test scores, but

are quite noisy, we average each student's earnings over all years in which she satisfied our sample inclusion criteria. Since our interest is in earnings on career-track jobs, we include only earnings data from years when the student reported working full-time for at least nine months out of the year.[11] Finally, our earnings samples are quite a bit smaller than the test score and educational attainment samples. Part of the sample size reduction stems from our sample inclusion criteria, but part of it stems high levels of item non-response.

Our earnings equation does not control for the student's post-secondary schooling, occupational choices, or mobility, which affects the interpretation of our estimates. In principle, higher standards may affect a student's ultimate educational attainment, occupation, or mobility, and each of these factors may in turn affect earnings. In addition to these indirect effects on earnings, higher standards may exert an independent direct effect, raising the student's earnings even controlling for these other factors. By excluding these factors from the regression equation, we obtain "reduced form" estimates of the total effect of grading standards on earnings, that is, the sum of the direct and indirect effects.[12]

Results from the earnings regressions for the full sample are shown in Table 4. The estimate of the grading standards coefficient in specification (2) is marginally significant with a t-statistic of 1.63. It implies that a one-standard deviation increase in grading standards would increase earnings by nine-tenths of one percent. The estimate in specification (3), which includes the school's mean 10th-grade

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also with the gain in scores at the 25th percentile. However, because the 25th percentile fell slightly between the 10th and 12th grades, this comparison is not very meaningful.

[11] Restricting the sample to full-time workers may cause us to omit those who are rationed out of the labor market. If such rationing is correlated with grading standards, it may bias our results. However, part-time jobs held by workers in the transition from school to work may have little to do with the earnings those workers experience once they have completed the transition and are employed full time. Including those workers may also bias our results.

[12] Grogger (1996) discusses this issue in greater detail.

test score, is insignificant, but the grading standards coefficient itself does not vary that much between the two specifications.[13]

4.4. Race/ethnicity-specific estimates of the effects of grading standards

Above we noted that differences by ability in the effects of higher standards may manifest themselves in the form of differences by race. In table 5 we present race/ethnicity-specific estimates. In this table, each coefficient comes from a separate regression that contains all of the variables included in specification (3) in the tables above.

[Table 5 here]

Panel A presents estimates by race/ethnicity of the effects of grading standards on mean test scores. Grading standards have similar effects on whites and Hispanics. They also have positive and significant effects on blacks, but the estimated coefficient is smaller. The difference between the estimates for whites and blacks is significant, but because of the small sample sizes, the difference between blacks and Hispanics is not.

Grading standards have no effect on white graduation rates, as seen in panel B. For both blacks and Hispanics, however, grading standards have negative and significant effects on high school graduation. An explanation that is consistent with these results is based on the relative performance hypothesis. Because higher standards lead to higher gains for students near the top of the distribution than for students near the bottom, students near the bottom could perceive themselves as falling behind on a relative basis, despite their absolute gains. If minority test scores are concentrated toward the bottom of the distribution, and students judge their likely success by comparing their performance with

[13] In subsample regressions, these estimate coefficients were slightly greater among non-college workers than among workers who had gone to college. This is consistent with models from Farber and Gibbons (1996) and Betts (1998), both of which predict larger returns to achievement among workers with more experience. None of the subsample regression results were significant, however.

others rather than by evaluating their performance in absolute terms, then higher grading standards could lead minority students to quit school. Loury and Garman (1995) find evidence for a similar “relative performance” effect in their analysis of the impact of college selectivity and earnings. They find that college students whose own Scholastic Aptitude Test (SAT) scores are significantly below the median at their college are more likely than average to drop out of college.

In contrast to the graduation effects, the effects of grading standards on college attendance are insignificant for all three groups. The presence of insignificant college attendance effects despite significantly negative graduation effects suggests that those blacks and Hispanics who were dissuaded from graduating by higher grading standards would have been unlikely to attend college even if their grading standards had been lower.

The results from race/ethnicity-specific earnings regressions are presented in panel D. Of all the race/ethnicity-specific analyses, these are the most limited by small sample sizes. Although all of the coefficients are positive, none are statistically significant.

5. Conclusions

Our results provide mixed evidence on the effects of higher grading standards. The achievement results suggest that students respond favorably to the incentives provided by higher standards. Test scores rise in schools with higher standards, although they rise more for students near the top of the achievement distribution than for students near the bottom. These findings are similar to those of Betts (1995).

However, there is no evidence that higher standards raise either high school graduation or college attendance. For minorities, in fact, there is evidence that higher standards actually reduce graduation rates. There is some evidence that higher standards raise students' post-schooling earnings, although the estimates are only marginally significant. Moreover, the earnings analysis generally is limited by small sample sizes.

The notion that higher standards could result in both winners and losers is consistent with previous theoretical work. The potential puzzle in our results is that higher standards could lead to lower graduation rates despite their positive effect on test scores throughout the achievement distribution. We note that this finding is consistent with a relative performance hypothesis, whereby students judge their success not in absolute terms, but relative to their classmates. Because higher standards lead to greater increases in test scores at the top of the distribution than at the bottom, students near the bottom may perceive themselves as losing ground and give up on graduating as a result.

Whatever the ultimate explanation for our findings, they are consistent with theory in terms of their complexity. Theory predicts that different students may react differently to higher standards, and that as a result, policies based on higher standards may have both winners and losers. Our results suggest that the complexity of students' responses to higher standards needs to be better understood by policymakers before they become the cornerstone of educational reform.

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Table 1
Summary statistics for various outcomes and key explanatory variables

A. 12th-grade test score (*n*=9,543)		C. Log earnings	
Mean	14.46 (10.08)	Full sample (*n*=6,694)	9.93 (0.39)
25th percentile	5.34	College attendees (*n*=2,403)	10.04 (0.39)
50th percentile	13.46	Non-college attendees (*n*=4,072)	9.86 (0.37)
75th percentile	22.28		
B. Educational attainment		**D. Key explanatory variables**	
High school graduation (*n*=10,124)	0.80	Math grading standard	2.78 (3.49)
College attendance (*n*=9,831)	0.32	Student's 10th-grade test score	11.36 (9.67)
		School's mean 10th-grade test score	13.26 (4.35)

Note: Figures in parentheses are standard deviations. Sample for the statistics in panel D is the same as that for the statistics in panel A. Statistics corresponding to other samples are similar.

Table 2
Estimated effects of grading standards on test scores

A. Ordinary least squares (mean) regression estimates

Variable	(1)	(2)	(3)
Math grading standard	0.506	0.225	0.197
	(0.037)	(0.024)	(0.025)
Student's 10th-grade math score		0.891	0.883
		(0.007)	(0.008)
School's mean 10th-grade math score			0.061
			(0.022)
R-square	0.24	0.71	0.71

B. Quantile regression estimates

1. *25th percentile*

Variable	(1)	(2)	(3)
Math grading standard	0.436	0.102	0.094
	(0.029)	(0.018)	(0.018)
Student's 10th-grade math score		0.911	0.909
		(0.008)	(0.007)
School's mean 10th-grade math score			0.020
			(0.018)
R-square	0.12	0.49	0.49

2. *50th percentile*

Variable	(1)	(2)	(3)
Math grading standard	0.651	0.108	0.099
	(0.045)	(0.014)	(0.016)
Student's 10th-grade math score		1.003	0.995
		(0.006)	(0.006)
School's mean 10th-grade math score			0.029
			(0.015)
R-square	0.16	0.54	0.54

3. *75th percentile*

Variable	(1)	(2)	(3)
Math grading standard	0.713	0.243	0.227
	(0.043)	(0.022)	(0.024)
Student's 10th-grade math score		0.952	0.947
		(0.009)	(0.009)
School's mean 10th-grade math score			0.037
			(0.021)
R-square	0.14	0.51	0.54

Notes: Sample size is 9,543. Figures in parentheses are standard errors. In addition to the variables shown, all regressions include race dummies, a sex dummy, urban and rural dummies, parental occupation dummies, parental education dummies, family income dummies, a two-parent family dummy, and dummies for the number of siblings in the household. Specifications (2) and (3) include a dummy indicating whether the student’s 10th-grade test score was missing.

Table 3
Linear probability estimates of the effects of grading standards on educational attainment

A. High school graduation			
Variable	(1)	(2)	(3)
Math grading standard	0.0047	0.0011	-0.0023
	(0.0014)	(0.0014)	(0.0015)
Student's 10th-grade math score		0.0095	0.0086
		(0.0005)	(0.0005)
School's mean 10th-grade math score			0.0072
			(0.015)
R-square	0.085	0.13	0.14

B. College attendance			
Variable	(1)	(2)	(3)
Math grading standard	0.0068	0.0008	-0.0013
	(0.0018)	(0.0017)	(0.0018)
Student's 10th-grade math score		0.019	0.018
		(0.0006)	(0.0006)
School's mean 10th-grade math score			0.0044
			(0.0015)
R-square	0.16	0.26	0.26

Notes: Sample size is 10,124 in panel A and 9,831 in panel B. Figures in parentheses are standard errors. In addition to the variables shown, all regressions include race dummies, a sex dummy, urban and rural dummies, parental occupation dummies, parental education dummies, family income dummies, a two-parent family dummy, and dummies for the number of siblings in the household. Specifications (2) and (3) include a dummy indicating whether the student’s 10th-grade test score was missing.

Table 4
Ordinary least squares estimates of the effects of grading standards on log earnings

A. Full sample			
Variable	(1)	(2)	(3)
Math grading standard	0.0053	0.0026	0.0019
	(0.0016)	(0.0016)	(0.0018)
Student's 10th-grade math score		0.0078	0.0076
		(0.0006)	(0.0006)
School's mean 10th-grade math score			0.0014
			(0.0015)
R-square	0.12	0.14	0.14

B. College attendees			
Variable	(1)	(2)	(3)
Math grading standard	0.0026	0.0006	-0.0008
	(0.0025)	(0.0017)	(0.0025)
Student's 10th-grade math score		0.0070	0.0066
		(0.0010)	(0.0010)
School's mean 10th-grade math score			0.0034
			(0.0022)
R-square	0.11	0.13	0.13

C. Non-college attendees			
Variable	(1)	(2)	(3)
Math grading standard	0.0055	0.0039	0.0043
	(0.0020)	(0.0020)	(0.0023)
Student's 10th-grade math score		0.0050	0.0051
		(0.0008)	(0.0009)
School's mean 10th-grade math score			-0.0007
			(0.0019)
R-square	0.12	0.13	0.13

Notes: Sample size is 6,694 in panel A, 2,403 in panel B, and 4,072 in panel B. Figures in parentheses are standard errors. In addition to the variables shown, all regressions include race dummies, a sex dummy, urban and rural dummies, parental occupation dummies, parental education dummies, family income dummies, a two-parent family dummy, and dummies for the number of siblings in the household.

Specifications (2) and (3) include a dummy indicating whether the student's 10th-grade test score was missing.

Table 5
Estimated effects of grading standards on various outcomes, by race/ethnicity

A. Test scores: ordinary least squares (mean) regression estimates			
Variable	White	Black	Hispanic
Math grading standard	0.220	0.108	0.198
	(0.030)	(0.049)	(0.057)
	[6,487]	[1,342]	[1,425]
B. High school graduation			
Variable	White	Black	Hispanic
Math grading standard	0.0007	-0.0091	-0.0074
	(0.0016)	(0.0037)	(0.0037)
	[6,688]	[1,499]	[1,583]
C. College attendance			
Variable	White	Black	Hispanic
Math grading standard	-0.0014	-0.0060	0.0013
	(0.0021)	(0.0041)	(0.0040)
	[6,530]	[1,442]	[1,518]
D. Log earnings, full sample			
Variable	White	Black	Hispanic
Math grading standard	0.0011	0.0043	0.0023
	(0.0020)	(0.0053)	(0.0041)
	[4,733]	[807]	[966]

Notes: Figures in parentheses are standard errors. Figures in brackets are sample sizes. In addition to the variables shown, all regressions include the student's 10th-grade test score, the school mean 10th-grade test score, a dummy indicating whether the student's 10th-grade test score was missing, a sex dummy, urban and rural dummies, parental occupation dummies, parental education dummies, family income dummies, a two-parent family dummy, and dummies for the number of siblings in the household.