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SMALL DIFFERENCES THAT MATTER:  
MISTAKES IN APPLYING TO COLLEGE

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Small Differences that Matter: Mistakes in Applying to College

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### **ABSTRACT**

This paper estimates the sensitivity of students' college application decisions to a small change in the cost of sending standardized test scores to colleges. Using confidential ACT micro data, I find that when the ACT increased from three to four the number of free score reports that ACT-takers could send, the fraction of test-takers sending four reports rose substantially while the fraction sending three fell by an offsetting amount. Students simultaneously sent their scores to a wider range of colleges. Using micro data from the American Freshman Survey, two identification strategies show that ACT-takers sent more college applications and low-income ACT-takers attended more selective colleges after the cost change. The first strategy compares ACT-takers before and after the cost change, controlling for time trends and covariates, and the second estimates difference-in-difference regressions using SAT-takers as a control group. Back-of-the-envelope calculations suggest that by inducing low-income students to attend more selective colleges, the policy change significantly increased their expected earnings. Because the cost of sending an additional (non-free) ACT score was merely \$6 throughout, this sizable behavioral change is surprising and suggests that students may use simple heuristics in making their application decisions. In such a setting, small policy perturbations can have large effects on welfare.

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# 1 Introduction

Where a student applies to college greatly affects both whether she attends college and the type of college she attends. Yet, little is known about how students decide where to apply.

An expanding literature suggests that students' application decisions, particularly those of low-income students, may be suboptimal. Low-income students are less likely to attend college than are their higher-income peers, conditional on high school achievement (*e.g.*, Ellwood and Kane, 2000). Conditional on high school achievement, they are also less likely to attend selective colleges (*e.g.*, Hill *et al.*, 2005; Winston and Hill, 2005). This is troubling as Card (1995) finds that the return to a year of college is particularly large for disadvantaged students and the literature suggests that low-income students have larger returns to attending selective colleges.<sup>1</sup>

Much of this underrepresentation may result from low-income students' application choices. Low-income students are less likely to apply to selective colleges than are their higher-income peers, but, conditional on applying, are no less likely to be admitted or matriculate (Bowen *et al.*, 2005; Pallais and Turner, 2006; Spies, 2001; and Hoxby and Avery, 2012). Additionally, a number of recent papers find that providing students with information about colleges or assistance with the college application process change students' college matriculation outcomes, particularly those of low-income students. Bettinger *et al.* (2012) find that filling out financial aid forms for students increased their matriculation rates. Carrell and Sacerdote (2013) find that giving high school students college counseling guidance and application fee waivers increased college matriculation, particularly for students attending disadvantaged high schools. Hoxby and Turner (2013) find that sending high-achieving, low-income students application fee waivers and information about colleges and optimal application strategies induced them to attend more-selective colleges.

This paper shows that students are particularly responsive to a \$6 decrease in the cost of sending standardized test scores to colleges. Before the fall of 1997, students taking the ACT, a popular college entrance exam, could send their test scores to three colleges for free while each additional score report cost \$6. Afterwards, students could send four score reports for free with the same \$6 cost for each report beyond four. I find that, in response to this \$6

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<sup>1</sup>Many studies have found a large return to college quality for students of all income levels (*e.g.*, Hoxby, 1998; Zhang 2005; Brewer *et al.*, 1999; and Black and Smith, 2006). There is no consensus in this literature, however, because Dale and Krueger (2002) find there is no return to college selectivity for most students when they compare the earnings of students who were admitted to the same colleges, but chose to attend different ones. Yet, Dale and Krueger do find large returns to college selectivity for low-income students. Many other studies (*e.g.*, Saavedra, 2008; Monks, 2000; Behrman *et al.*, 1996; and Loury and Garman, 1995) find that low-income students and minorities receive particularly high returns from attending selective colleges.

cost change, both high- and low-income students sent substantially more score reports and applications and low-income students attended more selective colleges.

Figure 1 uses data from the ACT and SAT (a competing college entrance exam) to show the fraction of different high school classes that sent exactly three and exactly four score reports.<sup>2</sup> ACT-takers graduating high school before 1998 were eligible for three free score reports, those graduating after 1998 were eligible for four, and those in the class of 1998 received three if they took the ACT in their junior year and four if they took the test as seniors. SAT-takers received four free score reports throughout the period. The figure shows that between the classes of 1996 and 2000, the fraction of ACT-takers sending exactly four score reports jumped from 3% to 74%, while the fraction sending exactly three fell from 82% to 10%. In contrast, SAT-takers experienced relatively small changes in their score-sending patterns. Micro data from the ACT confirm that this large increase in score-sending was not driven by changes in the pool of test-takers.

Sending additional score reports benefitted students only if they also sent additional applications. I use the American Freshman Survey (AFS), a survey of college freshmen, and two identification strategies to directly evaluate the effect of the cost change on the number of applications students sent. First, I look only at students who took the ACT before and after the cost change. Then, I use a difference-in-difference methodology, comparing ACT-takers to SAT-takers. Both identification strategies show that ACT-takers sent more applications after the cost change, though the increase in applications was much smaller than the increase in score-sending.

When students gained access to the fourth free report, they widened the range of colleges to which they sent scores. Some students sent scores to colleges that were more selective than any they would have sent scores to otherwise, giving the students an additional opportunity to attend a more-selective college. Other students sent scores to less-selective colleges with higher admission rates, giving them another chance to be admitted to any college. Using the AFS data (and both identification strategies), I find that, after the cost change, low-income students attended more-selective colleges, while higher-income students did not.

I do not observe how the cost change affected low-income students' earnings. However, a back-of-the-envelope calculation suggests that by increasing the probability that a low-income student attended a more-selective college, sending an additional score report increased her expected future earnings by over \$10,000. A similar calculation estimates that

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<sup>2</sup>The ACT data used here come from a database compiled by Jesse Rothstein for other projects. The dataset covers about half the years from 1991 to 2004. I did not choose these years; they were chosen for another project and the figure displays data from all the years to which I have access. The SAT data come from a similar dataset. Jesse Rothstein provided the tabulations for Figure 1b as I do not have access to the SAT micro data. Both graphs are limited to students sending at least one score report.

even if only one out of every 29,000 low-income ACT-takers who sent an additional score report was induced to attend two years of college, the benefits of sending an additional report for the average low-income student through this channel would exceed \$6.

In the paper’s conclusion I consider explanations for students’ large reaction to the cost change. It seems unlikely that it could be optimal for so many students to change their behavior as a result of so small a change. However, deciding on the optimal portfolio of colleges to apply to is a difficult problem, which depends on many parameters students may not know. Instead, many students use rules of thumb to determine which colleges to apply to. They may interpret the ACT’s providing three (or four) free score reports as an indication that sending that many reports is recommended. When the cost structure changed, so did their rule of thumb. In this way, this paper’s findings are complementary to the findings in Madrian and Shea (2001), Choi *et al.* (2002), and Thaler and Sunstein (2008) that individuals are strongly affected by default choices when choosing among savings and health insurance plans. If this is the case, providing students with information on optimal application strategies instead of having them deduce rules of thumb from external sources could induce low-income students to attend more-selective colleges, potentially facilitating better student-college matches.

The paper proceeds as follows: Section 2 discusses the policy change and the datasets used. Section 3 uses ACT micro data to determine the effect of the cost change on the number and selectivity of colleges to which students sent scores. Section 4 uses the AFS data to analyze the effect of the cost change on students’ application behavior and the selectivity of the colleges they attended. Section 5 benchmarks the benefits low-income students might receive from sending an additional score report, while Section 6 concludes and discusses why students’ behavior changed so much in response to a small cost change.

## 2 Background Information

### 2.1 Setting and Policy Change

The ACT is a nationwide college entrance exam that is particularly popular in the Midwest. At the time of the policy change, just under one million students took the ACT each year (ACT Corporation, 1999). During the period considered in the paper, the test consisted of English, math, reading, and science sections. Students’ scores on these four sections were averaged to create an overall ACT score, an integer ranging from one to 36.<sup>3</sup>

Throughout the period analyzed in this paper, when students registered for the ACT,

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<sup>3</sup>The ACT introduced an optional writing section in 2005, after the time period analyzed in this paper.

they provided their demographics, information about their high school experience, and up to six colleges they wanted their ACT scores sent to. Students could send additional score reports after they took the test, but this was relatively uncommon: only 8% of students did so in 2004 (the only year for which this information is available). Free score reports could be sent only at test registration.

Before the fall of 1997, the ACT allowed students to send three free score reports. Starting in the fall of 1997, it provided four free reports. The marginal cost of an additional score report was constant at \$6 from the fall of 1995 to the fall of 2001. Before then (in the years analyzed in the paper) it ranged from \$4 to \$5.50, while afterwards, each additional score report cost \$7. While the monetary cost of sending four score reports decreased in the fall of 1997, the non-monetary cost did not. Because students chose the colleges they sent scores to when they registered for the test, they had to provide payment at that time regardless of the cost of sending score reports.<sup>4</sup> Both before and after the cost change, students were given six lines to record the colleges to which they wanted their scores sent.

Students who had not taken the ACT under the old cost structure may not have been aware that the ACT was changing its score-sending policy. It was not generally publicized nor even mentioned in the ACT's annual newsletter to guidance counselors. The ACT registration documents described the then-current cost structure, but never mentioned that there had been a change.

In comparison, the SAT provided students with four free score reports throughout the entire period analyzed in the paper. The marginal cost of sending an additional SAT score report was \$6 before the fall of 1994 and \$6.50 afterwards.

## 2.2 Data

This paper uses three datasets: a large database from the ACT Corporation, the American College Survey (ACS), and the AFS.

### 2.2.1 ACT Database

I use the ACT database, which contains administrative data from the ACT Corporation on test-takers, to analyze the change in ACT-takers' score-sending patterns after the cost change. The database includes information on students planning to graduate from high school in 1991, 1992, 1994, 1996, 1998, 2000, and 2004. In particular, it provides information on one out of every four Caucasians, one out of every two minorities, and every test-taker who

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<sup>4</sup>This is not necessarily true for low-income students who could waive only the testing, not the score-sending fee.

did not provide a race in these classes. This provides a large sample: 2,486,159 observations with over 287,000 in each year. I observe each student's ACT score, high school GPA, race, gender, family income, high school, courses taken, and extracurricular activities. I also observe up to six colleges to which each student sent her ACT scores at the time of registration.

In the analysis, I exclude students who sent no score reports at test registration. These students likely either took the ACT for reasons other than college admissions, sent score reports after viewing their scores, or sent SAT score reports instead. However, I show the effect of the cost change on score-sending using the entire sample in an appendix table.

### **2.2.2 American College Survey**

The ACS is a yearly survey of colleges and universities in which over 3,000 colleges provide data ranging from their courses of study and admissions statistics to their sports teams. I link the ACS to the ACT database to determine the selectivities of colleges the students sent scores to. My measure of college selectivity is based on the ACT scores of each college's entering freshman class. The ACS provides the 25th and 75th percentile ACT scores of the entering class.<sup>5</sup> I discuss only the results using only colleges' 25th percentile ACT scores because the results using the 75th percentiles are so similar.<sup>6</sup> I use test scores from freshmen matriculating in a base year, 1993, so that the analysis is not confounded by colleges becoming more competitive over time. Using test scores of matriculated students as a measure of selectivity is common in the literature (*e.g.*, Hoxby and Turner, 2013, Dale and Krueger, 2002, Loury and Garman, 1995) and the only measure available in the AFS. However, I show that other selectivity measures provide the same results in the ACT data.

### **2.2.3 American Freshman Survey**

The AFS is a yearly survey of first-time full-time (FTFT) freshmen at four-year colleges and universities. I use the survey to analyze the effect of the cost change on the number of applications students sent and the selectivities of the colleges they attended.

This paper uses data on the entering college cohorts of 1992 through 1999, the last cohort with publicly available data. It includes 1,886,245 total observations covering over 350 colleges and over 200,000 students in each year. Colleges come in and out of the survey such that only 18% of colleges (comprising 36% of student observations) are present in all

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<sup>5</sup>Many colleges do not provide both SAT and ACT scores of matriculating freshmen. For schools that only provide their freshman classes' 25th and 75th percentile SAT scores, I impute the corresponding ACT scores using a concordance produced by the College Board.

<sup>6</sup>The results for the 75th percentile are readily available upon request.

eight cohorts I use. However, survey weights are provided to make the sample representative of the national population of FTFT freshmen.<sup>7</sup>

In addition to background characteristics, the data provide information on whether students took the SAT or the ACT, the number of college applications they sent, and the selectivity of the colleges they enrolled in. The AFS asks students to provide their ACT and SAT scores. I define students as taking the ACT if they provided ACT scores and taking the SAT if they provided SAT scores. I limit the sample to students who took only one test. This eliminates students who took the ACT but were coded as taking neither test because they didn't want to provide their test scores and students who took both tests who could have sent either ACT or SAT scores.<sup>8</sup>

The AFS directly provides the "median" SAT score of incoming freshmen at each student's college.<sup>9</sup> I convert this SAT score to an ACT score using a concordance produced by the College Board. So that the analysis is not confounded by colleges changing selectivity over time, I average each college's yearly ACT scores to create one constant selectivity measure for each college.

#### 2.2.4 Summary Statistics

Appendix Table 1 displays descriptive statistics from the ACT and AFS databases. Appendix Table 2 shows that low-income students send fewer score reports and applications than students with higher family incomes even controlling for demographics, high school performance, and high school activities. Appendix Table 3 shows that low-income students send scores to and attend much less-selective colleges than their higher-income peers. These gaps decrease, but remain large and significant when control variables are included.

The ACT and AFS data have different income categories. In the ACT data, I define low-income students as those with family incomes below \$36,000, while in the AFS data I define them as students with family incomes below \$40,000. These are relatively high definitions of low-income: approximately 40% of ACT-takers in the data have family incomes below \$36,000. However, in 1998-1999, 9% of dependent Pell Grant recipients had family incomes above \$40,000, while 25% had family incomes above \$30,000 (Department of Education, 1999). In footnotes, I report results for "very low-income students:" students with family

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<sup>7</sup>The number of colleges included in the survey increases over my sample period. However, the characteristics of the average college are more stable and neither the average selectivity nor the average number of students at these colleges has a clear trend.

<sup>8</sup>The results using the entire sample are qualitatively similar, but slightly attenuated (as expected). These results are readily available upon request.

<sup>9</sup>In fact, this median is the average of the 25th and 75th percentile. While the data has a unique identifier for each college, this identifier purposely cannot be linked to other datasets, so no other college selectivity measures can be constructed.



incomes below \$18,000 in the ACT data and below \$20,000 in the AFS.

### 3 Changes in Score-Sending

#### 3.1 Number of Score Reports

When the ACT allowed students to send a fourth free score report, ACT-takers sent substantially more score reports. In particular, there was a dramatic increase in the fraction of ACT-takers sending exactly four score reports and corresponding decrease in the fraction sending exactly three. Figure 1 shows that in each class graduating before 1997 (in which all ACT-takers received only three free score reports) over 80% of ACT-takers sent exactly three score reports. Less than 5% sent exactly four. On the other hand, in the class of 2000 when test-takers received four free score reports, the fraction sending three score reports plummeted to 10% while the fraction sending four increased to just under 75%. The class of 1998, in which only some ACT-takers were eligible for four free score reports, represents an intermediate case where the fraction of ACT-takers sending three score reports had dropped to just under 40% and the fraction sending four had increased to just over 45%.<sup>10</sup>

While there were large changes in the fraction of ACT-takers sending exactly three and exactly four score reports, there were very small changes in the fraction of students sending other numbers of scores. Aside from the fraction of students sending one score report in 2004, over the 13 years spanned by these data, the fraction of students sending one, two, five, and six score reports each varied by fewer than one percentage point, remaining almost unchanged after 1997. The figure also shows that there was no similar increase in score-sending among SAT-takers. In fact, after the cost change, there was actually a small decrease in the fraction of SAT-takers sending four score reports and no change in the fraction of students sending three. This suggests that it was the change in the ACT's score-sending cost structure and not some general secular change that caused the dramatic increase in ACT score-sending.

Table 1 displays regression estimates of the effect of the cost change on the number of score reports ACT-takers sent. It presents estimates of the regression

$$y_i = \alpha + \beta_1 class1998_i + \beta_2 post1998_i + \beta_3 t + X_i \beta_4 + \varepsilon_i. \quad (1)$$

Here, the dependent variable,  $y_i$ , is the number of score reports student  $i$  sent. The variable  $class1998_i$  is an indicator for being in the high school class of 1998 and  $post1998_i$  is an

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<sup>10</sup>Appendix Figure 1 replicates Figure 1 including students who sent no score reports. The results are very similar although slightly attenuated due to the fact that over this period there was a 10 percentage point increase in the fraction of students who sent no score reports.

indicator for graduating after 1998 (being in the class of 2000 or 2004). I include separate indicators for the class of 1998 and classes after 1998 because I expect the policy to have larger effects in years when all test-takers received four free score reports. The vector  $X_i$  includes controls for student demographics and high school performance.<sup>11</sup> Adding these controls ensures that any change in score-sending behavior is not a result of changing demographics of ACT-takers. The variable  $t$  represents a linear time trend. The first column does not contain the time trend or any controls. The second column adds the time trend, the third adds the demographic controls, the fourth adds the high school performance controls, and the fifth adds high school fixed effects. Throughout the paper, standard errors calculated from the ACT data are clustered at the state level. Standard errors calculated from the AFS data are robust Huber-White errors (state is not included in the AFS data).

The regressions in Panel A include only middle- and high-income students (students with family incomes above \$36,000 per year). Before the time trend is added, the estimates indicate that students sent an additional 0.39 score reports in the class of 1998 and an additional 0.61 score reports in later classes. Including the time trends increases these coefficients as, on average, students sent 0.02 fewer score reports each year between 1991 and 2004. However, the other covariates and high school fixed effects have very little effect on the estimates. After these controls are included, the estimates show that on average, middle- and high-income students in the classes of 2000 and 2004 sent 0.78 more score reports than those in classes in which students only received three free score reports.

Panel B estimates the same regression on the sample of low-income students. The results are similar to the results for middle- and high-income students. Low-income students also substantially increased their score-sending when the fourth score report became free: sending on average an additional 0.80 score reports.<sup>12</sup> Appendix Table 4 replicates this table, including students who did not send any score reports. It shows a large increase in score-sending,

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<sup>11</sup>I use the same controls in regressions throughout the paper. The demographic controls are the same in the ACT and AFS data. They are race dummies, an indicator for being a U.S. citizen, an English language indicator, and gender. In the ACT data, the English language indicator is whether English is the primary language spoken in the home, while in the AFS data, the indicator is whether English is the student's native language. High school performance controls are as follows. In both datasets, I control for high school GPA, whether the student had college credit, and dummies for each ACT score. (For students in the AFS data who took only the SAT, I convert their SAT scores to ACT scores using the concordance produced by the College Board.) In the ACT data, I also control for the number of years of English and math classes the student took as well as indicators for taking honors English and math, attending a private high school, and being on a college preparatory track. I add indicators for ever having been elected to a student office, working on the staff of a school paper or yearbook, earning a varsity letter for sports participation, and holding a regular part-time job. In the AFS data, I do not have these additional controls, but do include controls for whether the student drank beer, smoked cigarettes, performed volunteer work, spent at least one hour per week on student clubs or groups, and spent more than five hours a week on homework in the last year.

<sup>12</sup>Very-low income students (students with family incomes below \$18,000 per year) also sent 0.80 additional score reports on average.

but one that is attenuated due to the increase in the number of students sending zero score reports over this period.

### 3.2 Selectivity of Score Reports

When students sent more score reports, they sent scores to a wider range of colleges: that is, those that were both more- and less-selective than any they would have sent scores to otherwise. Figure 2 shows the average selectivity of students' most- and least-selective colleges within each high school class. The figure shows that the range of colleges students sent scores to was relatively constant before the cost change. But, it widened for the class of 1998 and continued to widen for the class of 2000.

Tables 2 and 3 analyze these changes through regressions. They present results from estimating Equation (1) on the ACT database. Table 2 is limited to middle- and high-income students while Table 3 is limited to low-income students. In Panel A of both tables, the dependent variable is a student's range of colleges: the difference between the selectivities of the most- and least-selective colleges to which a student sent scores. In Panels B and C, the dependent variables are the selectivities of these most- and least-selective colleges, respectively. The controls are the same as in Table 1.

The tables show that both middle- and high-income students and low-income students increased the range of colleges they sent scores to. Low-income students experienced a slightly larger increase (0.93 points) than did higher-income students (0.88 points) off of a slightly lower base. (Low-income students had an average range of 2.82 points in 1996, relative to 3.11 for higher-income students.) For both higher- and low-income students, about 60% of this increase resulted from students applying to more-selective colleges than they otherwise would have. Overall, after the cost change, students of all income groups sent their scores to more-selective colleges on average.<sup>13</sup>

However, some students sent scores to less-selective schools as a result of the cost change. Low-income students experienced approximately the same change in the selectivity of their least-selective colleges as did higher-income students (0.36 and 0.37 ACT points, respec-

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<sup>13</sup>The fact that students sent scores to more-selective colleges does not depend on the selectivity metric. The fraction of students sending scores to a college in one of the top three Barron's selectivity categories (most competitive, highly competitive plus, and highly competitive) increased by 7.3 percentage points for middle- and high-income students and 6.6 percentage points for low-income students. The number of colleges in the top three Barron's categories students applied to increased by 0.18 and 0.13 for higher- and low-income students, respectively. The admissions rate of the most-selective college students applied to decreased by 3.0 and 2.5 percentage points for higher- and low-income students respectively. (So that my results are not confounded by colleges becoming more competitive over time, I use consistent measures of colleges' Barron's ratings and admissions standards for each college across the different cohorts.)

tively).<sup>14</sup> When students sent scores to less-selective colleges, they sent scores to colleges with higher admissions rates. The highest admissions rate of the colleges students sent scores to increased by 1.5 percentage points for all students and by 1.7 percentage points for low-income students. This could increase college matriculation by increasing the probability that a student was admitted to any college.

## 4 Changes in Applications and College Selectivity

### 4.1 Number of Applications

The AFS data show that the increase in score reports translated into a substantial increase in applications, but one that was much smaller than the increase in score-sending. I use two identification strategies to determine the change in applications. First, I estimate regressions similar to the ones in the previous section using only ACT-takers. Second, I estimate difference-in-difference regressions, utilizing students who took only the SAT as controls.

The first four columns of results in Table 4 present the results of estimating Equation (1) on students who took only the ACT. Panel A considers middle- and high-income students while Panel B considers low-income students. The dependent variable is the number of applications sent. In the AFS data,  $post1998_i$  indicates that the student was in the high school class of 1999. As with the score-sending results, the estimates increase when time trends are added as ACT-takers are estimated to send 0.01 fewer applications every year, but are robust to the addition of controls. When the time trend and all the controls are added, the estimates indicate that higher-income students in the class of 1999 sent an additional 0.19 applications and students in the class of 1998 sent an additional 0.11 applications than students in previous cohorts.

Panel B shows that low-income students also sent more applications when the fourth score report became free. As with the increase in score reports, their response was similar in magnitude to that of their higher-income peers. Conditional on all the controls, I estimate that low-income students sent an additional 0.14 applications in the class of 1999 and 0.11 additional applications in the class of 1998, close to 20% of the increase in score-sending.

The final four columns of Table 4 present estimates from the second identification strategy.

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<sup>14</sup>Students with very low family incomes experienced a slightly larger changes in the range of colleges they sent scores to (1.00 points) and the selectivity of the most-selective college they sent scores to (0.63 points) than did low-income students. They experienced about the same decrease in selectivity of their least-selective college (0.37 points).

Specifically, it displays results from estimating the equation

$$y_i = \alpha + \beta_1(class1998_i \times ACT_i) + \beta_2(post1998_i \times ACT_i) + \beta_3class1998_i + \beta_5post1998_i + \beta_6ACT_i + \beta_7t + \beta_8(t \times ACT_i) + X_i\beta_9 + \varepsilon_i \quad (2)$$

where  $y_i$  is the number of applications sent and  $ACT_i$  is an indicator for taking the ACT. The estimates also suggest that ACT-takers sent significantly more applications as a result of the cost change. Once the time trends and all the controls are added, the increase in applications measured for the average higher-income student in the class of 1998 (0.13) is the same as in the other identification strategy. The effect for students graduating after 1998 (0.07) is about 40% the size of the effect measured with the other identification strategy. The results suggest that low-income students increased the number of applications they sent by 0.08 in both the class of 1998 and later classes, approximately 70% and 55%, respectively, of the estimates using only ACT-takers.<sup>15</sup>

## 4.2 Selectivity of Attended College

I use the same two identification strategies to examine the change in the selectivity of the colleges attended by ACT-takers after the cost change. Table 5 replicates Table 4 where the dependent variable is the selectivity of the college attended instead of number of applications sent. I consider Panel B, which shows the effect of the cost change on the college selectivity of low-income students, first. The first identification strategy (using only ACT-takers) finds that the average low-income ACT-taker in the classes of 1998 and 1999 attended more-selective colleges (colleges that were 0.26 ACT points and 0.24 ACT points more selective, respectively). These changes are approximately half the difference in the selectivities of colleges attended by observationally equivalent low- and high-income students and 40% of the increase in the average selectivity of the most-selective colleges low-income students sent scores to.<sup>16</sup> The second identification strategy also finds that low-income students attended more-selective colleges as a result of the cost change. The estimated magnitudes of the effect for low-income students are similar to the estimates using the other identification strategy (0.14 and 0.31 ACT points for the classes of 1998 and 1999, respectively). However, these

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<sup>15</sup>Students with very low family incomes experienced relatively similar increases the number of applications they sent as low-income students in general: 0.13 in the class of 1999 using only ACT-takers and 0.10 using the difference-in-difference strategy.

<sup>16</sup>This does not necessarily imply that score reports sent to more-selective colleges translated into applications at a higher-than-average rate. Consider a student who would have applied to three colleges before the cost change: a very selective college from which she was rejected and two unselective colleges. The cost change induced her to apply to a moderately selective college to which she could gain admission. Thus, it could induce her to attend a more selective college without affecting the range of colleges she applied to.

estimates do not appear to be as robust as the ones using the first identification strategy.

There are two potential threats to the validity of these results. The first is that the supply of college slots may not be perfectly elastic. If low-income ACT-takers displaced SAT-takers from selective colleges, the difference-in-difference results in the final columns of Table 5 would overestimate the effect of the cost change. The estimates in the first columns of the table would not suffer from this bias. The second potential threat is that I observe only matriculated students in the AFS. Sending an additional application may have induced some ACT-takers to attend college. If these new matriculants were unobservably different from other matriculated ACT-takers, then the results from both identification strategies would be biased. However, this effect would have to be implausibly large (and in a counterintuitive direction) to drive these results.<sup>17</sup> Moreover, if the results were being driven by increased matriculation, this would suggest that some low-income students benefitted from the cost change (see the next section).

Panel A shows the results for middle- and high-income students. Despite the fact that higher-income students changed their score-sending and application behavior similarly to low-income students, the estimates using ACT-takers only suggest that they did not attend more-selective colleges as a result of the cost change. In fact, when all the controls are added, middle- and high-income students are estimated to attend less-selective colleges as a result of the cost change. This estimate is relatively small (about one fourth of the effect for low-income students), but suggests that some higher-income students may have been crowded out of selective colleges by lower-income students. The second identification strategy also indicates that higher-income students attended less-selective colleges after the cost change, though this is not robust to the exclusion of controls.<sup>18</sup>

## 5 Assessing Benefits to Students

Sending an additional application may benefit a student by increasing the probability she is admitted to any college, allowing her to attend a more-selective college, or allowing her to attend a college with a better financial aid package. But, it also has costs. It costs

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<sup>17</sup>For selection to drive the results for low-income students in Table 5, the new matriculants would have to have attended more-selective colleges than the students who did not need an additional free score report to induce them to attend college. Even if, conditional on observables, the new matriculants would have attended colleges that were one standard deviation more selective than the existing matriculants conditional on observables, the number of matriculants would have had to increase by approximately 9% to cause the 0.24 ACT point change in college selectivity. This seems implausibly large relative to the 14% of test-takers who sent an additional application.

<sup>18</sup>Despite having relatively similar changes in score-sending and application behavior, very low-income students experienced increases in the selectivity of the colleges they attended almost twice as large as low-income students: 0.48 points using only ACT-takers and 0.53 points using the difference-in-difference strategy.

the student time to complete the application and the admissions officer time to read it. Higher-income students often have to pay application fees. Moreover, students induced to attend college or more-selective colleges may have crowded out other students. Bound and Turner (2007) find that college slots are partially elastic, suggesting full crowdout is unlikely. However, even if there were perfect crowdout, given that low-income students are estimated to have particularly large returns from attending college and selective colleges, increasing the number of low-income students may increase efficiency. The fact that many selective colleges have recently attempted to attract more low-income students suggests they also value economically diverse student bodies.

In this section, I benchmark the benefits low-income ACT-takers received from sending another score report through (1) attending more-selective colleges and (2) increased college matriculation. I do not calculate the costs to potentially displaced higher-income students,<sup>19</sup> the direct costs students or colleges incurred from submitting or receiving additional applications, or benefits students received from any other channels (*e.g.*, obtaining a better financial aid package). However, the benefits to sending an additional score report appear so large that they are likely to have greatly outweighed the time and monetary costs of sending an additional application.

First, I consider the benefit low-income students receive from attending more selective colleges. I use Dale and Krueger's (2002) estimate that low-income students receive a 4% wage premium for attending a college whose students score 100 points higher on the SAT. I use this estimate because it is directly comparable to the college selectivity measures in the AFS, it examines low-income students separately, and because Dale and Krueger's methodology generally finds smaller returns to college quality than do other approaches, making my estimates more conservative. A concern with using this estimate is that the low-income students have relatively low graduation rates and inducing them to attend more selective colleges may decrease graduation rates. Dale and Krueger (2002) do not condition on graduating from college, so their estimate of the return to college quality takes potential falling graduation rates into account. However, they consider students attending highly-selective colleges among whom dropout is a smaller issue. To the extent that inducing students to attend more-selective colleges decreases graduation rates, this may overestimate the effect of attending a more-selective college. However, recent papers find that graduation rates decrease when students are induced to attend less-selective colleges (Cohodes and Goodman, 2013) and that students induced to attend college or attend more-selective colleges after receiving assistance with or information about the application process have high college persistence rates (Hoxby and Turner, 2013; Bettinger *et al.*, 2012; Carrell and Sacerdote,

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<sup>19</sup>Dale and Krueger (2002) suggest displaced higher-income students would not suffer earnings losses.

2013).

Based on the concordance produced by the College Board, one ACT point is equivalent to 44 SAT points. Day and Newburger (2002) estimate that the average college graduate will earn \$2.1 million in 1999 dollars over her lifetime. Under these assumptions, the benefit a low-income student receives from attending a college with average ACT scores one point higher is  $\$2,100,000 \times 4\% \times 0.44 = \$36,960$ .

I find that 80.1% of low-income students sent an additional score report after the cost change (Table 1). Using only ACT-takers, I estimate that the average low-income student attended a college with ACT scores 0.236 points higher after the cost change. (I use this estimate instead of the difference-in-difference estimate because it is more conservative and not potentially biased upward by the displacement of SAT-takers.) Thus, if the only low-income ACT-takers affected by the policy were those who sent an additional score report, then the expected benefit these students received from sending the additional report was

$$\frac{\$36,960 \times 0.236}{0.801} \approx \$10,900. \quad (3)$$

If, in fact, low-income ACT-takers who did not send additional score reports were displaced from selective colleges by those who did, this calculation understates the benefits obtained by students who sent additional score reports. In either case, the benefits low-income students received through this channel far outweighed the \$6 cost of sending additional score report.

I next consider the benefits low-income students could have obtained through increased college matriculation. I estimate the fraction of students that would have had to have been induced to attend college for the average benefit of sending an additional score report to exceed \$6. I assume students induced to attend college by sending an additional score report attend two years of college. This is somewhat arbitrary, but is intended to account for dropout. To calculate the earnings gain from attending two years of college, I use Card's (1995) estimate that students' earnings increase by 10% for each additional year of college.<sup>20</sup> I use Day and Newburger's (2002) estimate that high school graduates from these cohorts will have lifetime earnings of \$1.2 million in 1999 dollars. Thus, the benefit of attending two years of college is  $\$1.2 \text{ million} \times 20\% = \$240,000$ .

This benefit is offset by tuition costs and foregone earnings. The Digest of Education Statistics reports that the average tuition, room, and board at four-year colleges and universities was \$12,352 in 1999-2000. This likely overestimates low-income students' costs because they receive financial aid and may be more likely to attend less-expensive colleges. To cal-

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<sup>20</sup>Card (1995) estimates the gains to an additional year of education to be between 10% to 14%. I use his lower-bound estimate here to be conservative.



culate forgone earnings, I use Day and Newburger’s (2002) estimate that recent high school graduates earn \$20,975 per year in the labor market. This estimate is for ages 25 to 29 and thus may overstate earnings at ages 18 and 19, but I use it to be consistent with the lifetime earnings measures (Day and Newburger do not show average earnings for younger ages). Under these assumptions, the benefit of attending two years of college is approximately \$173,350. Thus, only  $\frac{\$6}{\$173,350} = 3.5 \times 10^{-5}$  or one out of approximately every 29,000 students who sent an additional score report would have had to attend two years of college for the benefits of sending an additional score report through this channel to exceed \$6.

## 6 Conclusion

The colleges a student applies to greatly affect whether she attends college, the type of college she attends, and her future earnings. Yet, little is known about how students decide where to apply. This paper analyzes the effect of the ACT’s increasing the number of free score reports it provided from three to four, a \$6 decrease in students’ cost of sending a fourth score report. It finds that when the fourth score report became free, students sent many more score reports and applications. They sent their scores to a wider range of colleges and low-income students also attended more-selective colleges as a result.

I estimate that the expected benefit a low-income ACT-taker received from sending an additional score report likely far exceeded \$6. Thus, it seems unlikely that it could be optimal for so many low-income students to change their application behavior as a result of a \$6 cost change. It is not necessarily surprising that students may not be applying to the optimal set of colleges, given the difficulty in identifying this set. Students must choose one of over  $2^{2,400}$  combinations of colleges to apply to. The value of applying to even one combination depends on many parameters students may not know: the probability of admission to each set of colleges in the combination, the utility from attending each college, and the cost of applying. The utility a student would get from attending a given college depends on her financial aid package (which is often not revealed until after admissions decisions), her earnings after attending the college, her earnings if she did not attend a four-year college, and the utility derived from experiences she would have at the school. Avery and Kane (2004) show that students have difficulty estimating even part of this utility.

It may not be the \$6 cost that was important. If it were, then higher-income students should respond similarly to a \$6 decrease in application fees and score-sending costs.<sup>21</sup> Yet, they do not appear to do so. There is no relationship in the ACS data between changes

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<sup>21</sup>Low-income students may be more responsive to changes in score-sending costs than application fees as they can often waive application fees, but not score-sending costs.

in colleges' application fees and changes in the number of applications they received during the period from 1993 to 2002. This lack of relationship could result from the endogeneity of application fees. However, many colleges go to great lengths to encourage applications. If they believed application fees substantially increased their applicant pools, they would likely greatly reduce these fees.

An alternative explanation is that the cost of the fourth score report fell to \$0. Several studies (*e.g.*, Kremer and Miguel, 2007 and Ariely, 2008) have found that demand is discontinuous at a price of zero. However, even though the fourth score report cost \$0, sending an additional application was still costly for higher-income students because of application fees.

A final alternative is that students may interpret the ACT providing three (or four) free score reports as a signal that sending three (or four) applications is recommended and use that signal as a rule of thumb about how many colleges to apply to. This explanation is consistent with the Madrian and Shea (2001), Choi *et al.* (2002), and Thaler and Sunstein (2008) results that default 401(k) plans and Medicare Part D plans have large effects on plan choices. College application guides show that many students are looking for an authority to provide a rule of thumb on how many colleges they should apply to. "How many applications are enough?" is the first frequently asked question on the College Board's website for college counselors<sup>22</sup> and is prominently featured in many other college guides. The College Board suggests sending five to eight applications, many more than students send on average. If students are responding to the rule of thumb, providing them with rules of thumb based on data as opposed to the pricing structure of the ACT could lead to large changes in application behavior, facilitating higher college attendance and better student-college matches.

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<sup>22</sup>See <http://professionals.collegeboard.com/guidance/applications/how-many> (accessed September 17, 2013).

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Figure 1. Number of Scores Sent by High School Graduation Year

Figure 1a: Students Who Took the ACT

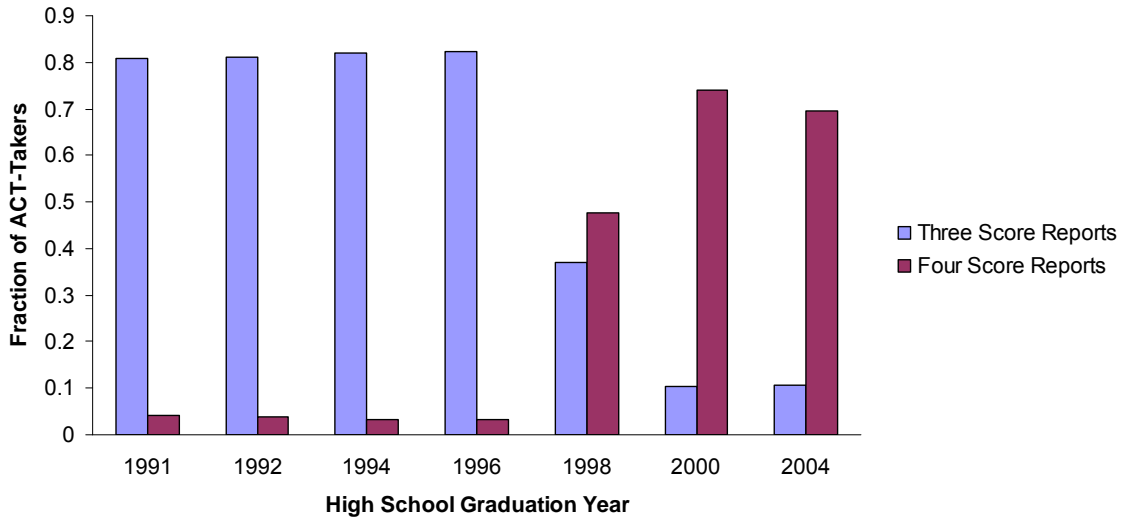
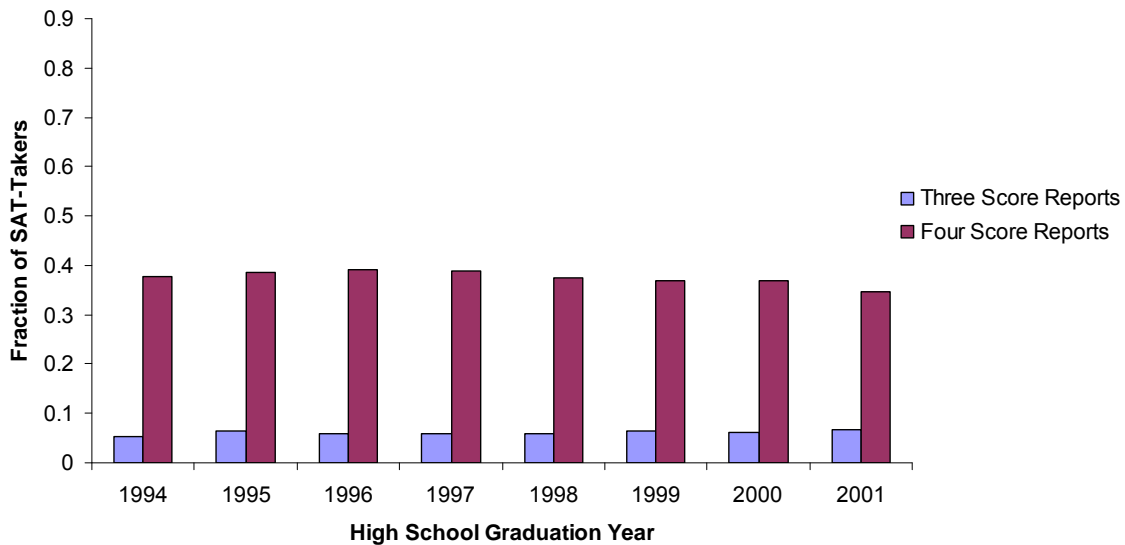
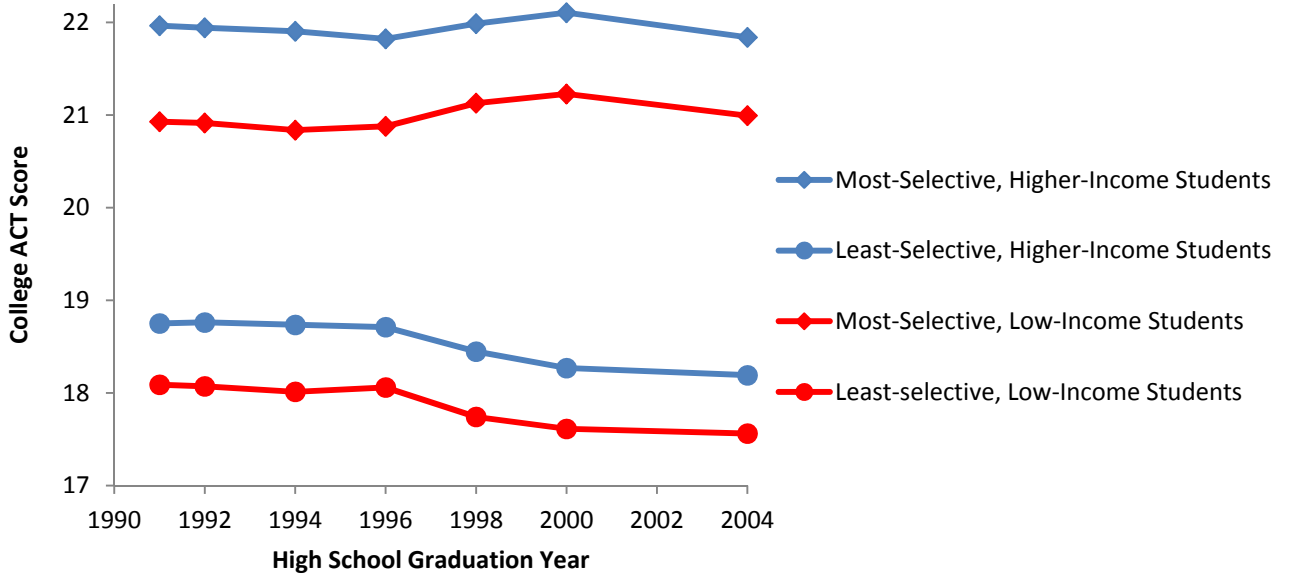


Figure 1b: Students Who Took the SAT



Notes: The bars indicate the fraction of each high school class that sent either exactly three or exactly four score reports. The analysis is limited to students who sent at least one score report. Data in Panel A come from the ACT database and data in Panel B come from a database of SAT-takers produced by the College Board.

Figure 2. Selectivity of Score Reports by High School Graduation Year



Notes: The y-axis measures the 25<sup>th</sup> percentile ACT scores of incoming freshmen at the most- and least-selective colleges students sent scores to. The data points marked with diamonds show the average selectivity of the most-selective college each student sent scores to. The data points marked with circles show the average selectivity of the least-selective college each student sent scores to. The blue data points include data from middle- and high-income students (students with family incomes at least \$36,000 per year), while the red data points include data from only low-income students (students with family incomes below \$36,000 per year). The data come from the ACT database and the American College Survey.

Table 1. Change in the Number of Scores Sent by Family Income  
 Dependent Variable: Number of Score Reports Sent  
 ACT Data

<u>A. Middle- and High-Income Students</u>					
Class of 1998	0.388** (0.028)	0.488** (0.025)	0.489** (0.025)	0.456** (0.024)	0.455** (0.024)
Post-1998	0.610** (0.026)	0.798** (0.027)	0.799** (0.027)	0.779** (0.012)	0.779** (0.013)
Constant	3.036** (0.015)	3.091** (0.026)	3.030** (0.040)	2.455** (0.223)	2.423** (0.250)
Observations	938,257	938,257	938,257	938,257	938,257
R-squared	0.093	0.095	0.097	0.121	0.160
<u>B. Low-Income Students</u>					
Class of 1998	0.508** (0.023)	0.593** (0.027)	0.593** (0.026)	0.561** (0.018)	0.561** (0.019)
Post-1998	0.656** (0.037)	0.810** (0.019)	0.809** (0.019)	0.803** (0.012)	0.801** (0.012)
Constant	2.924** (0.011)	2.962** (0.021)	2.899** (0.032)	2.519** (0.149)	2.542** (0.145)
Observations	819,576	819,576	819,576	819,576	819,576
R-squared	0.130	0.131	0.135	0.163	0.210
Time Trend	No	Yes	Yes	Yes	Yes
Demographics	No	No	Yes	Yes	Yes
High School Performance	No	No	No	Yes	Yes
High School Fixed Effects	No	No	No	No	Yes

Notes: Each panel displays the results of estimating Equation (1) where the dependent variable is the number of score reports a student sent. Data come from the ACT database. Panel A includes only middle- and high-income students (students with family incomes at least \$36,000 per year) while Panel B includes only low-income students (students with family incomes below \$36,000 per year). All regressions include only students who sent at least one score report. Standard errors (in parentheses) are clustered at the state level. The first column of each panel adds no controls, the second column adds a linear time trend, the third column adds controls for demographics (see footnote 11), the fourth column adds controls for high school performance (see footnote 11), and the fifth column adds high school fixed effects. When high school fixed effects are added, the control for attending a private high school is dropped. Two asterisks indicate the coefficient is significant at the 5% level.



Table 2. Changes in the Selectivity of Score Reports Sent  
ACT Data: Middle- and High-Income Students

<u>A. Dependent Variable: Selectivity Range</u>					
Class of 1998	0.376** (0.027)	0.516** (0.033)	0.518** (0.033)	0.505** (0.034)	0.507** (0.033)
Post-1998	0.581** (0.036)	0.842** (0.037)	0.847** (0.037)	0.873** (0.035)	0.882** (0.035)
Constant	3.165** (0.091)	3.242** (0.088)	3.650** (0.130)	1.316** (0.444)	1.349** (0.475)
Observations	881,709	881,709	881,709	881,709	881,709
R-squared	0.009	0.009	0.014	0.062	0.150
<u>B. Dependent Variable: Selectivity of Students' Most-Selective College</u>					
Class of 1998	0.086** (0.022)	0.287** (0.023)	0.293** (0.023)	0.290** (0.030)	0.273** (0.021)
Post-1998	0.075** (0.029)	0.453** (0.029)	0.463** (0.029)	0.524** (0.031)	0.509** (0.029)
Constant	21.902** (0.146)	22.013** (0.144)	23.156** (0.191)	19.453** (0.872)	18.730** (0.696)
Observations	881,709	881,709	881,709	881,709	881,709
R-squared	0.000	0.001	0.019	0.244	0.349
<u>C. Dependent Variable: Selectivity of Students' Least-Selective College</u>					
Class of 1998	-0.290** (0.029)	-0.229** (0.023)	-0.225** (0.022)	-0.215** (0.025)	-0.235** (0.020)
Post-1998	-0.506** (0.037)	-0.390** (0.026)	-0.385** (0.026)	-0.348** (0.029)	-0.373** (0.026)
Constant	18.736** (0.164)	18.771** (0.164)	19.505** (0.193)	18.137** (0.764)	17.381** (0.490)
Observations	881,709	881,709	881,709	881,709	881,709
R-squared	0.007	0.007	0.024	0.116	0.288
Time Trend	No	Yes	Yes	Yes	Yes
Demographics	No	No	Yes	Yes	Yes
High School Performance	No	Yes	No	Yes	Yes
High School Fixed Effects	No	Yes	No	No	Yes

Notes: Each panel displays the results of estimating Equation (1). The dependent variable is the difference between the 25th percentile ACT scores of incoming freshmen at the most- and least-selective colleges a student sent scores to (Panel A), the 25th percentile ACT score of incoming freshmen at the most-selective college she sent scores to (Panel B) and the 25th percentile ACT score of incoming freshmen at the least-selective college she sent scores to. Data come from the ACT database and American College Survey. The regressions include all middle- and high-income students (students with family incomes at least \$36,000 per year) who sent a score report to a college for which the ACS has selectivity information. Standard errors (in parentheses) are clustered at the state level. The first column of each panel adds no controls, the second column adds a linear time trend, the third

column adds controls for demographics (see footnote 11), the fourth column adds controls for high school performance (see footnote 11), and the fifth column adds high school fixed effects. When high school fixed effects are added, the control for attending a private high school is dropped. Two asterisks indicate the coefficient is significant at the 5% level.

Table 3. Changes in the Selectivity of Score Reports Sent  
ACT Data: Low-Income Students

<u>A. Dependent Variable: Selectivity Range</u>					
Class of 1998	0.555** (0.036)	0.639** (0.040)	0.640** (0.040)	0.635** (0.039)	0.652** (0.040)
Post-1998	0.695** (0.041)	0.847** (0.045)	0.844** (0.044)	0.890** (0.040)	0.925** (0.041)
Constant	2.833** (0.107)	2.870** (0.109)	3.216** (0.153)	1.875** (0.550)	1.699** (0.579)
Observations	737,135	737,135	737,135	737,135	737,135
R-squared	0.011	0.012	0.017	0.057	0.161
<u>B. Dependent Variable: Selectivity of Students' Most-Selective College</u>					
Class of 1998	0.238** (0.031)	0.370** (0.026)	0.380** (0.027)	0.386** (0.034)	0.383** (0.030)
Post-1998	0.225** (0.042)	0.462** (0.036)	0.484** (0.039)	0.561** (0.034)	0.570** (0.034)
Constant	20.890** (0.192)	20.948** (0.187)	21.911** (0.239)	19.318** (0.518)	18.784** (0.468)
Observations	737,135	737,135	737,135	737,135	737,135
R-squared	0.001	0.002	0.036	0.173	0.302
<u>C. Dependent Variable: Selectivity of Students' Least-Selective College</u>					
Class of 1998	-0.317** (0.042)	-0.270** (0.022)	-0.259** (0.021)	-0.249** (0.023)	-0.269** (0.020)
Post-1998	-0.470** (0.063)	-0.385** (0.033)	-0.360** (0.031)	-0.329** (0.030)	-0.355** (0.030)
Constant	18.058** (0.211)	18.078** (0.212)	18.695** (0.295)	17.442** (0.703)	17.085** (0.612)
Observations	737,135	737,135	737,135	737,135	737,135
R-squared	0.005	0.005	0.053	0.100	0.306
Time Trend	No	Yes	Yes	Yes	Yes
Demographics	No	No	Yes	Yes	Yes
High School Performance	No	Yes	No	Yes	Yes
High School Fixed Effects	No	Yes	No	No	Yes

Notes: Each panel displays the results of estimating Equation (1). The dependent variable is the difference between the 25th percentile ACT scores of incoming freshmen at the most- and least-selective colleges a student sent scores to (Panel A), the 25th percentile ACT score of incoming freshmen at the most-selective college she sent scores to (Panel B) and the 25th percentile ACT score of incoming freshmen at the least-selective college she sent scores to (Panel C). Data come from the ACT database and American College Survey. The regressions include all low-income students (students with family incomes below \$36,000 per year) who sent a score report to a college for which the ACS has selectivity information. Standard errors (in parentheses) are clustered at the state level. The first column of each panel adds no controls, the second column adds a linear time

trend, the third column adds controls for demographics (see footnote 11), the fourth column adds controls for high school performance (see footnote 11), and the fifth column adds high school fixed effects. When high school fixed effects are added, the control for attending a private high school is dropped. Two asterisks indicate the coefficient is significant at the 5% level.

Table 4. Change in the Number of Applications Sent  
 Dependent Variable: Number of Applications Sent  
 AFS Data

<u>A. Middle- and High-Income Students</u>									
		<u>ACT-Takers Only</u>				<u>ACT-Takers and SAT-Takers</u>			
Class of 1998 × ACT						0.100** (0.015)	0.196** (0.019)	0.176** (0.019)	0.128** (0.018)
Post-1998 × ACT						0.007 (0.014)	0.132** (0.021)	0.130** (0.021)	0.072** (0.021)
ACT						-1.235** (0.006)	-1.132** (0.014)	-1.112** (0.014)	-1.108** (0.014)
Class of 1998	0.032** (0.011)	0.105** (0.014)	0.113** (0.014)	0.105** (0.014)		-0.068** (0.010)	-0.092** (0.013)	-0.068** (0.013)	-0.028** (0.012)
Post-1998	0.080** (0.010)	0.174** (0.015)	0.190** (0.015)	0.186** (0.015)		0.073** (0.010)	0.043** (0.015)	0.054** (0.015)	0.116** (0.014)
Constant	2.777** (0.004)	2.856** (0.010)	3.110** (0.045)	2.853** (0.234)		4.012** (0.004)	3.988** (0.009)	4.335** (0.023)	4.223** (0.063)
Observations	328,271	328,271	328,271	328,271		879,176	879,176	879,176	879,176
R-squared	0.000	0.001	0.017	0.039		0.096	0.096	0.108	0.142
<u>B. Low-Income Students</u>									
		<u>ACT-Takers Only</u>				<u>ACT-Takers and SAT-Takers</u>			
Class of 1998 × ACT						0.011 (0.025)	0.164** (0.032)	0.108** (0.031)	0.076** (0.030)
Post-1998 × ACT						-0.078** (0.025)	0.116** (0.036)	0.118** (0.035)	0.077** (0.034)
ACT						-0.977** (0.009)	-0.836** (0.019)	-0.811** (0.019)	-0.832** (0.019)
Class of 1998	0.105** (0.017)	0.109** (0.021)	0.120** (0.020)	0.108** (0.020)		0.094** (0.018)	-0.055** (0.024)	0.005** (0.023)	0.022** (0.023)
Post-1998	0.112** (0.016)	0.116** (0.024)	0.154** (0.022)	0.141** (0.022)		0.190** (0.019)	0.000 (0.027)	0.033 (0.026)	0.060** (0.026)
Constant	2.571** (0.006)	2.575** (0.013)	2.747** (0.044)	2.721** (0.370)		3.549** (0.007)	3.411** (0.015)	3.763** (0.026)	3.449** (0.081)
Observations	156,477	156,477	156,477	156,477		337,705	337,705	337,705	337,705
R-squared	0.001	0.001	0.057	0.075		0.074	0.074	0.117	0.141
Time Trends	No	Yes	Yes	Yes		No	Yes	Yes	Yes
Demographics	No	No	Yes	Yes		No	No	Yes	Yes
High School Performance	No	No	No	Yes		No	No	No	Yes
High School Fixed Effects	No	No	No	No		No	No	No	No

Notes: The first four columns of each panel display the results of estimating Equation (1), while the last four columns display the result of estimating Equation (2). The dependent variable is the number of applications a student sent and data come from the AFS. Panel A includes middle- and high-income students (students with family incomes at least \$40,000 per year)

while Panel B is limited to low-income students (students with family incomes below \$40,000). The first four columns of results include students who only took the ACT, while the last four include students who took the ACT or the SAT, but not both. Huber-White standard errors are in parentheses. The first column of each panel adds no controls, the second column adds a linear time trend, and the third column adds controls for demographics (see footnote 11), and the fourth column adds controls for high school performance (see footnote 11). Two asterisks indicate the coefficient is significant at the 5% level.

Table 5. Change in the Selectivity of College Attended  
 Dependent Variable: Selectivity of College Attended  
 AFS Data

<u>A. Middle- and High-Income Students</u>								
	<u>ACT-Takers Only</u>				<u>ACT-Takers and SAT-Takers</u>			
Class of 1998 × ACT					0.108**	0.272**	0.212**	-0.081**
					(0.023)	(0.032)	(0.029)	(0.026)
Post-1998 × ACT					0.204**	0.415**	0.353**	-0.055*
					(0.022)	(0.035)	(0.032)	(0.029)
ACT					-1.910**	-1.743**	-1.649**	-1.830**
					(0.010)	(0.023)	(0.021)	(0.019)
Class of 1998	0.047**	0.076**	0.018	-0.017	-0.062**	-0.196**	-0.193**	0.037**
	(0.015)	(0.022)	(0.020)	(0.019)	(0.018)	(0.023)	(0.021)	(0.017)
Post-1998	-0.039**	0.000	-0.061**	-0.080**	-0.243**	-0.415**	-0.416**	-0.042**
	(0.013)	(0.024)	(0.021)	(0.020)	(0.017)	(0.026)	(0.024)	(0.020)
Constant	19.408**	19.441**	20.182**	19.006***	21.319**	21.184**	22.000**	19.664**
	(0.007)	(0.016)	(0.062)	(0.302)	(0.007)	(0.016)	(0.039)	(0.089)
Observations	325,801	325,801	325,801	325,801	871,857	871,857	871,857	871,857
R-squared	0.000	0.000	0.079	0.192	0.091	0.091	0.146	0.380
<u>B. Low-Income Students</u>								
	<u>ACT-Takers Only</u>				<u>ACT-Takers and SAT-Takers</u>			
Class of 1998 × ACT					0.411**	0.506**	0.326**	0.136**
					(0.043)	(0.058)	(0.049)	(0.046)
Post-1998 × ACT					0.661**	0.783**	0.608**	0.311**
					(0.040)	(0.063)	(0.054)	(0.051)
ACT					-1.391**	-1.301**	-1.171**	-1.571**
					(0.016)	(0.032)	(0.029)	(0.028)
Class of 1998	0.269**	0.391**	0.318**	0.255**	-0.142**	-0.115**	-0.013	0.091**
	(0.025)	(0.036)	(0.031)	(0.030)	(0.035)	(0.045)	(0.038)	(0.034)
Post-1998	0.251**	0.406**	0.300**	0.236**	-0.410**	-0.377**	-0.311**	-0.104**
	(0.023)	(0.040)	(0.034)	(0.032)	(0.033)	(0.049)	(0.043)	(0.038)
Constant	18.542**	18.656**	20.136**	19.391**	19.933**	19.957**	21.249**	19.465**
	(0.010)	(0.021)	(0.068)	(0.464)	(0.013)	(0.024)	(0.043)	(0.121)
Observations	154,603	154,603	154,603	154,603	332,940	332,940	332,940	332,940
R-squared	0.002	0.002	0.171	0.250	0.047	0.047	0.182	0.326
Time Trends	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Demographics	No	No	Yes	Yes	No	No	Yes	Yes
High School Performance	No	No	No	Yes	No	No	No	Yes
High School Fixed Effects	No	No	No	No	No	No	No	No

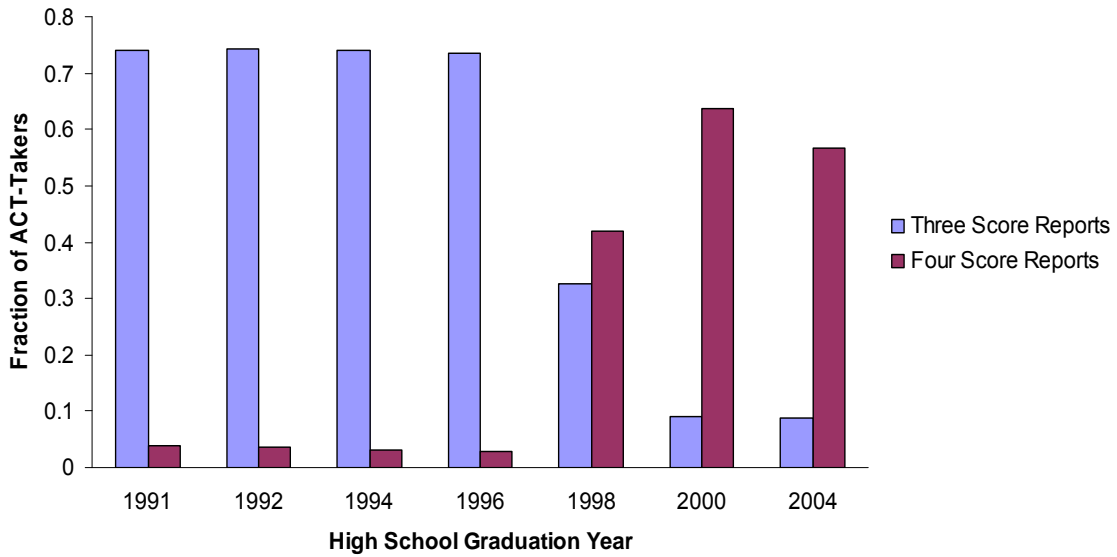
Notes: The first four columns of each panel display the results of estimating Equation (1), while the last four columns display the result of estimating Equation (2). The dependent variable is the median ACT score of incoming freshmen at the college a student attended. Data come from the AFS. Panel A includes middle- and high-income students (students with

family incomes at least \$40,000 per year) while Panel B is limited to low-income students (students with family incomes below \$40,000). The first four columns of results include students who only took the ACT, while the last four include students who took the ACT or the SAT, but not both. Huber-White standard errors are in parentheses. The first column of each panel adds no controls, the second column adds a linear time trend, and the third column adds controls for demographics (see footnote 11), and the fourth column adds controls for high school performance (see footnote 11). Two asterisks indicate the coefficient is significant at the 5% level.

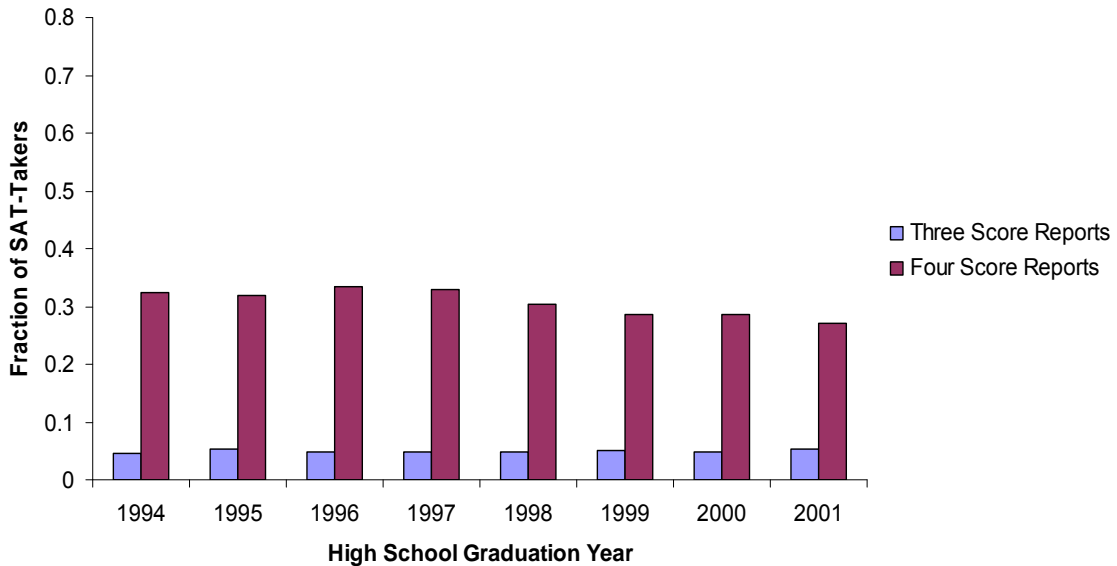


Appendix Figure 1. Number of Scores Sent by High School Graduation Year  
Including Students Who Sent Zero Score Reports

1a: Students Who Took the ACT



1b: Students Who Took the SAT



Notes: The bars indicate the fraction of each high school class that sent either exactly three or exactly four score reports. The analysis is not limited to students who sent at least one score report. Data in Panel A come from the ACT database and data in Panel B come from a database of SAT-takers produced by the College Board.

Appendix Table 1. Descriptive Statistics from the High School and Entering College Classes of 1996  
ACT and AFS Data

	A. ACT Data		B. AFS Data			
	Sent Score Reports	All Students	ACT Only	SAT Only	All ACT-Takers	Non-ACT-Takers
Score Reports	2.95	2.63				
Applications			2.67	3.93	3.04	3.74
ACT Score Equivalent	20.9	20.9	22.5	24.4	23.3	24.4
Income < \$36,000	42%	41%				
Income ≥ \$80,000	7%	7%				
Income < \$40,000			34%	29%	31%	31%
Income ≥ \$75,000			25%	36%	29%	34%
H.S. GPA	3.08	3.07	3.27	3.32	3.33	3.26
U.S. Citizen	97%	97%	99%	94%	99%	94%
Female	56%	56%	57%	50%	56%	53%
Caucasian	72%	71%	80%	72%	79%	70%
Black	10%	9%	10%	9%	10%	10%
Asian	3%	3%	2%	8%	2%	7%
Hispanic	5%	5%	2%	4%	2%	5%
Other Race	3%	4%	5%	6%	6%	6%
No Race Given	7%	8%	1%	2%	1%	2%

Notes: Each cell presents the mean of the indicated characteristic for the indicated sample. Panel A uses data from the ACT database on students graduating high school in 1996 while Panel B uses data from the AFS on freshmen starting college in 1996. "ACT Score Equivalent" is the ACT score of students who took the ACT. For students who only took the SAT, I convert their SAT scores into an ACT score equivalent using a concordance produced by the College Board.

Appendix Table 2. Score-Sending and Application Patterns by Family Income in the Class of 1996  
ACT and AFS Data

<u>A. Dependent Variable: Number of Scores Sent</u>				
Middle-Income	0.084** (0.004)	0.092** (0.004)	0.052** (0.003)	0.028** (0.004)
High-Income	0.194** (0.014)	0.201** (0.014)	0.153** (0.013)	0.112** (0.013)
Constant	2.904** (0.011)	2.864** (0.023)	2.108** (0.370)	2.245** (0.419)
Observations	252,120	252,120	252,120	252,120
R-squared	0.006	0.008	0.028	0.132
<u>B. Dependent Variable: Number of Applications Sent</u>				
Middle-Income	0.094** (0.020)	0.219** (0.019)	0.192** (0.019)	
High-Income	0.372** (0.023)	0.504** (0.022)	0.464** (0.022)	
Constant	2.538** (0.015)	2.567** (0.084)	2.473** (0.354)	
Observations	58,968	58,968	58,968	
R-squared	0.008	0.045	0.065	
Demographics	No	Yes	Yes	Yes
High School Performance	No	No	Yes	Yes
High School Fixed Effects	No	No	No	Yes

Notes: Panels A and B display the results of regressing the number of score reports sent (Panel A) and the number of applications sent (Panel B) on indicators for coming from middle- and high-income families. Regressions in Panel A use data from the ACT and are limited to students in the class of 1996 who sent at least one score report. In this panel, middle-income indicates an annual family income between \$36,000 and \$80,000, high-income indicates a family income of at least \$80,000, and standard errors (in parentheses) are clustered at the state level. Regressions in Panel B use data from the AFS database and are limited to students who took only the ACT and entered college in 1996. In this panel, middle-income indicates students with family incomes between \$40,000 and \$75,000, high-income indicates family incomes of at least \$75,000, and robust Huber-White standard errors are in parentheses. The first column of each panel adds no controls, the second column adds controls for demographics (see footnote 11), the third column adds controls for high school performance (see footnote 11), and the fourth column (Panel A only) adds high school fixed effects. When high school fixed effects are added, the control for attending a private high school is dropped. Two asterisks indicate that the coefficient is significant at the 5% level.

Appendix Table 3. College Selectivity by Family Income in the Class of 1996  
ACT and ACS Data

<u>A. Dependent Variable: Selectivity of Students' Most-Selective College</u>				
Middle-Income	0.888** (0.074)	0.809** (0.040)	0.341** 0.0250	0.076** (0.020)
High-Income	1.365** (0.098)	1.267** (0.069)	0.740** (0.053)	0.350** (0.033)
Constant	20.878** (0.204)	21.878** (0.250)	16.577** (0.939)	16.840** (1.168)
Observations	231,480	231,480	231,480	231,480
R-squared	0.024	0.051	0.232	0.392
<u>B. Dependent Variable: Selectivity of Students' Least-Selective College</u>				
Middle-Income	0.616** (0.086)	0.496** (0.054)	0.235** (0.042)	0.036** (0.014)
High-Income	0.910** (0.098)	0.775** (0.085)	0.485** (0.067)	0.206** (0.030)
Constant	18.059** (0.211)	18.774** (0.288)	17.733** (0.961)	17.371** (0.901)
Observations	231,480	231,480	231,480	231,480
R-squared	0.014	0.042	0.119	0.342
<u>C. Dependent Variable: Selectivity of Attended College</u>				
Middle-Income	0.698** (0.038)	0.334** (0.027)	0.195** (0.026)	
High-Income	1.082** (0.041)	0.684** (0.030)	0.527** (0.029)	
Constant	18.394** (0.031)	19.402** (0.102)	19.467** (0.519)	
Observations	59,390	59,390	59,390	
R-squared	0.031	0.188	0.272	
Demographics	No	Yes	Yes	Yes
High School Performance	No	No	Yes	Yes
High School Fixed Effects	No	No	No	Yes

Notes: Panels A, B, and C display the results of regressing the 25th percentile ACT score of incoming freshmen at the most-selective college a student sent scores to (Panel A), the 25th percentile score of incoming freshmen at the least-selective college a student sent scores to (Panel B), and the median ACT score of incoming freshmen at the college the student attended (Panel C) on indicators for coming from middle- and high-income families. Regressions in Panels A and B use data from the ACT database and American College Survey and are limited to students in the class of 1996 who sent a score report to a college for which the ACS has selectivity information. In this panel, middle-income indicates an annual family income between \$36,000 and \$80,000, high-income indicates a family income of at least \$80,000, and standard errors (in parentheses) are clustered at the state level. Regressions in Panel C use data from the AFS and are limited to students who took only the ACT and entered college in 1996. In this panel,

middle-income indicates students with family incomes between \$40,000 and \$75,000, high-income indicates family incomes of at least \$75,000, and robust Huber-White standard errors are in parentheses. The first column of each panel adds no controls, the second column adds controls for demographics (listed in footnote 11), the third column adds controls for high school performance (listed in footnote 12), and the fourth column (Panels A and B only) adds high school fixed effects. When high school fixed effects are added, the control for attending a private high school is dropped. Two asterisks indicate the coefficient is significant at the 5% level.

Appendix Table 4. Change in the Number of Scores Sent by Family Income  
 Dependent Variable: Number of Score Reports Sent  
 Including Students Who Sent No Score Reports

	(1)	(2)	(3)	(4)	(5)
<u>A. Middle- and High-Income Students</u>					
Class of 1998	0.295** (0.030)	0.461** (0.021)	0.464** (0.021)	0.412** (0.023)	0.423** (0.024)
Post-1998	0.370** (0.025)	0.685** (0.021)	0.689** (0.021)	0.653** (0.018)	0.662** (0.018)
Constant	2.750** (0.024)	2.843** (0.029)	2.613** (0.054)	1.655** (0.304)	1.774** (0.336)
Observations	1,067,363	1,067,363	1,067,363	1,067,363	1,067,363
R-squared	0.016	0.019	0.021	0.036	0.099
<u>B. Low-Income Students</u>					
Class of 1998	0.411** (0.024)	0.551** (0.021)	0.553** (0.021)	0.516** (0.017)	0.527** (0.018)
Post-1998	0.475** (0.036)	0.732** (0.015)	0.733** (0.015)	0.724** (0.011)	0.724** (0.011)
Constant	2.736** (0.017)	2.799** (0.022)	2.648** (0.042)	1.910** (0.209)	1.967** (0.198)
Observations	891,731	891,731	891,731	891,731	891,731
R-squared	0.037	0.039	0.042	0.063	0.123
Time Trends	No	Yes	Yes	Yes	Yes
Demographics	No	No	Yes	Yes	Yes
High School Performance	No	No	No	Yes	Yes
High School Fixed Effects	No	No	No	No	Yes

Notes: Each panel displays the results of estimating Equation (1) where the dependent variable is the number of score reports a student sent. Data come from the ACT database. Panel A includes middle- and high-income students (students with family incomes at least \$36,000 per year) while Panel B includes only low-income students (students with family incomes below \$36,000 per year). Students who did not send score reports are included. Standard errors (in parentheses) are clustered at the state level. The first column of each panel adds no controls, the second column adds a linear time trend, the third column adds controls for demographics (see footnote 11), the fourth column adds controls for high school performance (see footnote 11), and the fifth column adds high school fixed effects. When high school fixed effects are added, the control for attending a private high school is dropped. Two asterisks indicate the coefficient is significant at the 5% level.