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# Achievement vs. Aptitude: The Incentive – Screening Tradeoff in College Admissions

Rick Harbaugh\*

Preliminary

## Abstract

School entrance examinations are both an incentive system to motivate students and a screening device to identify students with the most potential. To maximize incentives to acquire knowledge, exams should only reward achievement. But to identify the most able students, exams should also reward aptitude. Using a model in which schools are interested in both aptitude and achievement, we show how competition between schools leads each school to put more emphasis on aptitude tests which perform a primarily screening role, and less emphasis on achievement tests and grades which provide incentives for learning. This result is broadly consistent with the comparative reliance on aptitude tests in the United States relative to countries with more centralized education systems. We evaluate the theory through an analysis of the implicit weights on aptitude tests and grades in the admissions process of U.S. colleges. Colleges facing more competition for applicants, including public colleges with low tuition subsidies and private colleges, put more emphasis on aptitude tests.

Key words: school choice, human capital, education

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## 1. Introduction

Examinations are both an incentive device to reward hard work and a screening device to evaluate students. When students vary in their aptitude for learning, these roles are in conflict. From an incentive perspective, exams should measure only achievement so as to ensure that even high aptitude students study hard, but from a screening perspective exams should also measure aptitude since it is an important predictor of future success.<sup>1</sup> For instance, an exam narrowly focused on factual course material maximizes study incentives, but an exam with a more analytic emphasis allows the most talented students to demonstrate their abilities.

The tradeoff between incentives and screening is particularly evident and important in the college admissions decision. At its simplest, the choice is how much weight to put on aptitude exams relative to achievement exams and other measures of accumulated knowledge such as high school grades. Colleges are interested in underlying aptitude and in achievement since both are correlated with academic and career success, but rewarding students with high aptitude decreases their study incentives. For instance, if the leading public university in a state relies heavily on aptitude tests, high aptitude students know they can matriculate with only mediocre grades. Despite widespread recognition of this incentive problem, the majority of American colleges rely in significant measure on the aptitude-based SAT-I test rather than more knowledge-based tests such as SAT-II subject tests, Advanced Placement tests, and the ACT test. In contrast, most other countries determine college admission by knowledge-based achievement exams.

To understand why American colleges place such emphasis on screening rather than incentives, we model the admissions decision by schools whose objective is to enroll students with the most promise of future success. Success is a function of both knowledge and aptitude, but knowledge is more readily improvable by students than aptitude. We show that if each school uses knowledge-based achievement exams the competition between students can induce a large amount of preparatory effort. However, competition between schools for the best students gives each school an incentive to accept high-aptitude students even if they have performed slightly worse than other students on achievement measures. Such cream-skimming leads to an equilibrium where schools place a greater emphasis on aptitude tests which perform a primarily screening role, and less emphasis on knowledge-based measures which provide incentives for

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<sup>1</sup>Of course, exams have other roles not considered in this paper such as evaluating student strengths and weaknesses for career guidance or remediation.

learning. This result may explain the reliance on aptitude tests in the United States relative to countries where college admission policies are determined to a large extent by a central education authority.

In order to concentrate on the incentive–screening tradeoff, our analysis abstracts from several issues that have already been explored in the literature. For elite students and colleges, the admissions process is a complicated matching game in which students and schools attempt to find the best match given their preferences and their attractiveness to the other side (Roth and Sotomayor, 1989). For the state colleges that we analyze, this game is much less important and we abstract from it by assuming that students do not vary in their preferences over schools and schools do not vary in their preferences over students. We also abstract from the signaling role that matriculation or graduation plays (Spence, 1974; Costrell, 1994; Bedard 2001) by assuming that the income gain from attending a school depends on the school’s given quality rather than the average quality of matriculants. This assumption also precludes peer effects (Epple, Romano, and Sieg, 2000). Finally, college rankings have themselves become an important determinant of student choice, as seen from evidence that changes in ranking formulas by US News and World Reports result in significant changes in applicant pools for affected universities (Monks and Ehrenberg, 1999). These rankings are open to manipulation by colleges through a number of methods (Ehrenberg, 2001), allowing for strategic considerations not considered in this model.

Our analysis does not make explicit welfare comparisons since it is unclear whether student effort expenditures on studying should be considered a welfare loss or gain. As will be seen in the model, knowledge-based exams can lead to extreme effort levels as students compete with each other for limited positions. This problem has arisen in many countries with centralized education systems and may be a problem for students applying to elite colleges, but it is not currently a widespread concern in the United States. Instead, the problem of underachievement by underincentivized students appears to be more significant. Most students attend public universities where over 70% of students are accepted and where a good SAT score and mediocre grades are sufficient for admission.<sup>2</sup> One indication of the lack of interest in high school studies is that underachieving high school students, namely those with high school grades which rank at least one standard deviation below their rank for SATs, are more likely to take tougher

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<sup>2</sup>From the College Board data for the academic year 1999-2000, 80% of students are enrolled in a public college. The median student among such public college enrollees attends a college with an acceptance rate of 79%.

courses (e.g. math, science, and upper division courses) in their first year of college than either overachieving students or students who perform as predicted.<sup>3</sup>

The value of achievement tests and other achievement measures such as high school rank is often judged simply by their ability to predict success in college. For instance, Bridgeman, Burton, and Klein (2001) find that admissions based on SAT-II subject tests rather than the SAT-I would lead to similar admissions decisions and similar success in college for admitted students. Such comparisons ignore the differential incentive effects on high school students from switching to achievement tests. In recognition of these incentive effects, the President of the University of California system has proposed dropping the SAT-I in favor of SAT-II subject tests or tests even more closely tailored to high school curricula. While switching to achievement exams should induce more effort by high school students, this paper indicates that a complete switch will be difficult for most colleges to maintain since the non-cooperative equilibrium by competing colleges is to rely in part on aptitude tests. Only if colleges have market power over students, e.g. through heavy subsidies for in-state students, or can enter binding agreements to restrict the use of aptitude tests, is a switch to achievement-based measures likely to prove lasting.<sup>4</sup> Colleges in the University of California system, which have consistently maintained the strongest emphasis on grades in our sample,<sup>5</sup> are perhaps uniquely positioned to maintain such a switch.

The use of both grades and exams to identify students with a high potential for future success is an example of multi-dimensional screening (Armstrong and Rochet, 1999). We simplify the problem by assuming that the SAT is an accurate measure of aptitude and grades are an accurate measure of achievement. This simplification sacrifices some realism in that SATs and grades are clearly noisy and that they each offer some information on both ability and knowledge. A related complication is that SAT scores, not just achievement exam scores

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<sup>3</sup>“Students with Discrepant High School GPA and SAT Scores”, College Board Office of Research and Development, [www.collegeboard.org/research/html/rs01.pdf](http://www.collegeboard.org/research/html/rs01.pdf).

<sup>4</sup>Recently some colleges have made the SAT optional for admission, though apparently for different reasons than explored in this paper. Optional submission of SATs implies that only students with the best SATs will include their scores in application materials, leading to higher average SAT scores for the college and a higher USNWR ranking (Ehrenberg, 2001).

<sup>5</sup>Seven of the eight University of California campuses regularly have a higher percentage of freshmen from the top 10% of their high school class than do Harvard, Yale, and Princeton. With its low tuition (for in-state students), centralized admissions policies, and paucity of competing private colleges, California’s tertiary education system resembles that of many foreign countries.

or grades, can be raised through student effort (Iyigun and Levin, 1998). Our results hold as long as achievement scores are more readily improved on than aptitude scores<sup>6</sup> and preparation for achievement exams is more generative of productive knowledge.

We concentrate on the case where schools cannot put a negative weight on aptitude in the admissions process. Such negative weights are sometimes used by teachers in the normal grading process when they already know their students' abilities. For instance, some teachers penalize students for not doing as well as they could have given their abilities. In the admissions process, a negative weight induces more effort from high aptitude students, but if a test is the only aptitude measure, students will deliberately underperform so as to be rewarded more for their achievement conditioning on their aptitude. For negative weights to be used successfully, independent measures of aptitude or variables correlated with aptitude must be available. In practice such variables do exist though we will abstract from them in this paper. For instance, students from demonstrably privileged backgrounds based on region, class, ethnicity, high school, or some other measure are sometimes held to a higher admissions standard for aptitude than students from less privileged backgrounds. In addition to other goals such as adjusting for possible test biases, such "reverse discrimination" is consistent with a strategy that maximizes overall student effort by increasing the demands on more privileged students.

This paper is also relevant for the debate on scholarships. Much of the debate has been on the relative virtues of need-based and merit-based scholarships, but this paper suggests that the measure of "merit" deserves consideration. Restrictions on aptitude-based scholarships in favor of need-based scholarships have the advantage of increasing study incentives, while restrictions on achievement-based scholarships can aggravate the cream-skimming problem and undermine study incentives. Remarkably, many merit-based scholarships have used aptitude measures such as the SATs even when achievement measures are available (Bishop, 1997).

We perform an initial test of the theory through an analysis of the weights on achievement (high school grades) and aptitude (SAT scores) in the admissions process of a sample of U.S. colleges. The results are consistent with the hypothesis that competitive pressures lead to more emphasis on aptitude rather than achievement measures. Private colleges appear to put substantially more weight on SATs relative to grades than do public colleges. Among public

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<sup>6</sup>The Educational Testing Service has stopped boasting that the SAT (previously the Scholastic Aptitude Test) cannot be studied for. Nevertheless the score loss from not studying for the SAT is surely less than the score loss from not studying for an achievement-based college entrance exam in a country such as Taiwan or France.

colleges, those with more market power over students put less weight on SATs. For instance, more highly subsidized colleges and colleges with more in-state students deemphasize SATs. These results hold with or without controlling for college reputation.

The empirical section of this paper investigates the college admissions decision, but the theoretical results apply to any level of education where entrance exams are used. They are therefore relevant for the debate over school choice at the primary and secondary levels. Despite the obvious advantages of competition between schools, opponents of school choice have argued that the best schools will enroll only the best students, thereby resulting in a worse learning environment for the remaining students. Such an outcome depends on factors not included in this paper such as peer effects between students or funding decisions based on school performance. Instead, this paper highlights a different aspect of the cream-skimming problem that has not been prominent in the school choice debate. An apparent virtue of school choice is competition between students for entrance into the best schools will force students to work harder. This paper shows that competition between schools for the best students undermines this incentive. Just as competition forces colleges to rely on the SATs, competition will force schools at lower levels to cream-skin based in large part on aptitude tests rather than grades or knowledge tests. Unless schools can reach binding agreements to avoid aptitude tests in their admissions decisions, the potential for greater school choice to strengthen study incentives may not be realized.

## 2. A simple model

There is a continuum of students indexed by their aptitude  $a$  and distributed uniformly over  $[0, 1]$ . Each student invest in their knowledge  $k$  which we also refer to as achievement. Students maximize life-time income  $y$  minus effort costs or disutility of generating knowledge. Assuming life-time income is an additively separable function of aptitude, knowledge, and the binary choice of whether or not to enter school, then aptitude and knowledge can be measured in such a way that  $y = a + k + \theta$  where  $\theta = \bar{\theta} > 0$  for matriculants and  $\theta = 0$  for non-matriculants. The income gain from matriculation,  $\bar{\theta}$ , is assumed to be net of any tuition costs and lost income while studying. The cost of acquiring knowledge  $c(a, k)$  is decreasing in aptitude and increasing in knowledge at an increasing rate. Since each student maximizes  $a + k + \theta - c(a, k)$ , if the knowledge choice does not affect admissions, the individually rational choice is to set marginal benefit equal to marginal cost, or  $c_k = 1$ . This gives the minimum investment that a student

will make,  $\underline{k}(a)$ . To make the model more concrete, we will assume  $c(k, a) = k^2/a$ . Then the minimum knowledge investment that a student with ability  $a$  will make is  $\underline{k}(a) = a/2$ .

Now consider the maximum knowledge investment that a student would make in order to matriculate. Individual rationality requires that a student receive at least as much utility from matriculating as not matriculating. Since students choose  $k = a/2$  when not matriculating, the maximum knowledge investment that a student with ability  $a$  will make is  $\bar{k}$  such that

$$a + \bar{k} + \bar{\theta} - c(a, \bar{k}) = a + \underline{k}(a) - c(a, \underline{k}(a))$$

or

$$a + \bar{k} + \bar{\theta} - \bar{k}^2/a = a + a/2 - (a/2)^2/a$$

or

$$\bar{k}(a) = \frac{a}{2} + (a\bar{\theta})^{1/2}.$$

Regarding the school's admissions decision, first assume there is only one school with capacity  $m < 1$ . At this stage  $m$  is given, though capacity is a strategic decision in that a lower  $m$  allows the school to set higher standards, much as a lower quantity allows a monopolist to set a higher price. The school is assumed to set its admissions policy so as to maximize the total future income of its student body or some strictly increasing function thereof.<sup>7</sup> To do this it assigns points to each applicant based on their aptitude and knowledge,  $p(a, k)$ . The fraction  $m$  students with the highest points are admitted.

For a single school the best admissions strategy is clearly to put all emphasis on knowledge. Since the marginal student  $1 - m$  has only slightly higher ability than the next student, the marginal student must study hard enough that the next student will not grab the last spot. Therefore the marginal student  $1 - m$  is forced to invest  $\bar{k}(1 - m)$ . The competition for entrance will force each student to invest as much in knowledge as the marginal student, leading to total future income of

$$\int_{1-m}^1 (a + \bar{k}(1 - m) + \bar{\theta}) da.$$

If the school is not financially constrained, it might have the opportunity to choose capacity so as to maximize total future income,<sup>8</sup> but we will take capacity as given.

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<sup>7</sup>This could reflect altruism, concern for future donations, the goals of the community, or other factors.



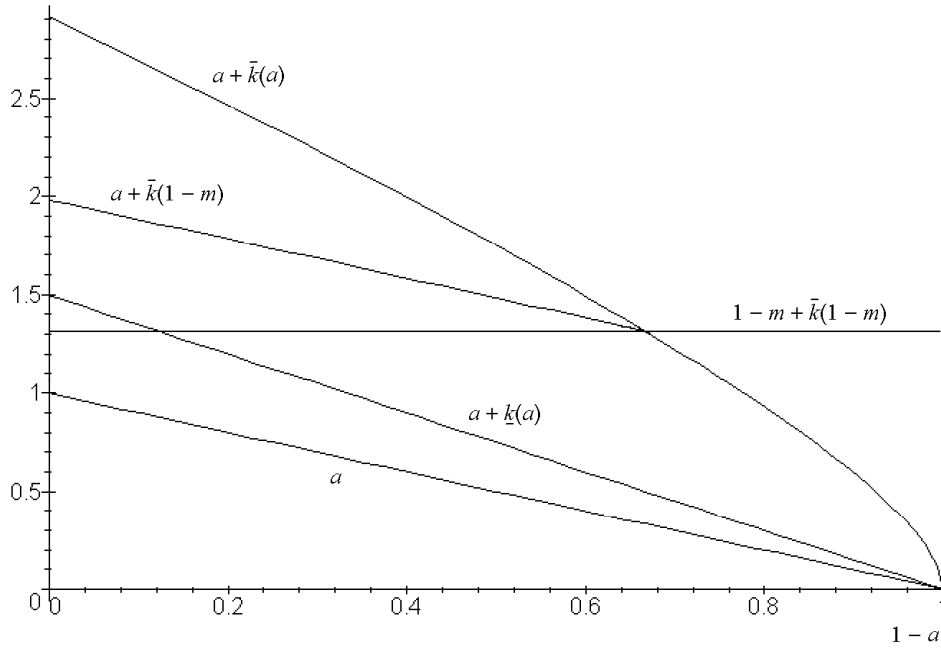


Figure 2.1: Knowledge investment,  $\bar{\theta} = 2$ .

Figure 2.1 shows the problem for  $m = 2/3$  where the  $x$ -axis is  $1 - a$  so that the highest aptitude students with the largest demand for knowledge are aligned from left to right as in a standard demand curve. The bottom line shows aptitude  $a$ . The second line shows aptitude plus the amount of knowledge that each student would choose if admissions were independent of knowledge,  $a + \underline{k}(a)$ . Since knowledge is less costly for high aptitude students they would invest more in knowledge. The top line shows the maximum knowledge that each student would be willing to obtain in order to gain entrance,  $a + \bar{k}(a)$ . Since the marginal student is willing to invest up to  $\bar{k}(1 - m)$  if the college uses only knowledge tests and ignores aptitude tests, all students must invest that much to ensure admission. This is shown by the horizontal line which shows aptitude plus knowledge for the marginal student,  $1 - m + \bar{k}(1 - m)$ . Inframarginal students have to meet the knowledge standard set by the marginal student, so the second line

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Student effort costs in acquiring knowledge are not considered.

<sup>8</sup>The income-maximizing capacity choice is approximately  $m = .91$  if the school is subsidized sufficiently to set tuition at 0. The school balances the gains from more enrollment with the losses due to lower standards that allow higher ability students to slack off.

from the top shows aptitude plus the knowledge standard,  $a + \bar{k}(1 - m)$ . Unless the school knows each student's aptitude and demands more knowledge from higher aptitude applicants, high aptitude students invest considerably less than the maximum.

Now assume there are two schools, 1 and 2, with capacity  $m_1$  and  $m_2$  and contributions to income  $\bar{\theta}_1 = \bar{\theta}_2 > 0$ . If the schools are part of a system with a centralized admissions policy, or if the schools can find a mechanism to enforce a collusive agreement, then clearly the same result applies as above and all weight is put on knowledge.<sup>9</sup>

Consider instead the decentralized solution where the two schools choose their admissions policies competitively. If one school emphasizes knowledge like a monopoly school, the other school has an incentive to cream-skin by admitting high aptitude students. In particular, suppose both schools follow the monopoly strategy of putting all emphasis on knowledge. Then if one school put slightly less emphasis on knowledge, it could choose from all the highest aptitude students, ensuring a more successful class. The other school could then do the same, resulting in lower and lower knowledge standards. This process continues but does not result in all students being let in based on their aptitude. As long as knowledge is at all important marginal students must compete with each other to gain entrance just as in the monopoly case.<sup>10</sup> The marginal student  $1 - m$  will still be forced to invest in knowledge up until they are indifferent, giving the same  $\bar{k}(1 - m)$  as in the monopoly case. But students can rely on their aptitude to do better than students with lower aptitude. So all students must have aptitude plus knowledge of at least  $a + k \geq \bar{k}(1 - m)$  to gain entrance. The schools can enforce this outcome directly by explicitly requiring all students to meet this standard. Or they can just use the point system  $p(a, k) = a + k$  and competition between students will lead to the same outcome.

In Figure 2.1 the decentralized solution is represented by the horizontal line. Competition for admission forces students with low ability to invest heavily in knowledge, but higher aptitude students can slack off. In this example the highest ability student's investment in knowledge is completely unaffected by the admissions policy. They invest the minimum amount  $\underline{k}(a) = a/2$ , which is above that required for admission.

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<sup>9</sup>Just as a monopolist benefits from versioning products (2nd degree price discrimination), a central authority would benefit from having high and low quality schools rather than identical schools. Though not considered in this version of the paper, such a strategy seems common in tertiary education.

<sup>10</sup>Competition may also lead each school to choose higher capacity. Higher capacity means more students benefit from the increase in productivity from receiving an education but the admissions standards for all students also fall.

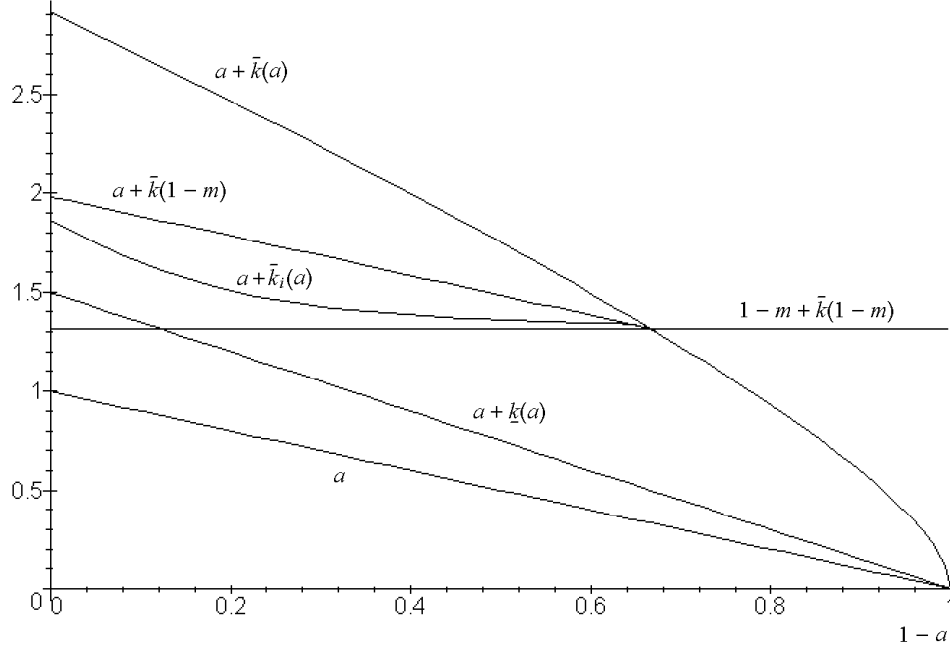


Figure 2.2: Knowledge investment with in-district subsidies,  $\bar{\theta}_i = 2$ ,  $\bar{\theta}_o = 1.8$ .

### 2.1. Preferences for local school

Now consider  $n > 2$  schools in different districts where students prefer the school in their district. For instance colleges from adjacent states are in competition, but students of each state prefer to go to their own state's school. This could reflect transportation costs, lower in-state tuition, or affinities relating to sports rivalries or other factors. To capture these differential gains, we assume the income gain from matriculation is  $\bar{\theta}_i$  and  $\bar{\theta}_o$  for in-district and out-of-district students respectively where  $\bar{\theta}_i > \bar{\theta}_o > 0$ .

Since there are at least two out-of-district schools, these schools behave competitively in their admission of out-of-district students. Therefore a student in any district which has at least the income potential as the marginal student in another district can go to that school, but at the cost of a  $\bar{\theta}_i - \bar{\theta}_o$  lower payoff. The marginal conditions for each district remain the same as in the single district case, so the marginal student invests  $\bar{k}(1 - m) = \frac{1-m}{2} + (1 - m)^{1/2} \bar{\theta}_i^{1/2}$ .

A student with ability  $a$  needs to invest at least  $k_o$  such that

$$a + k_o = 1 - m + \frac{1 - m}{2} + (1 - m)^{1/2} \bar{\theta}_i^{1/2}$$

to guarantee a spot. Therefore, the maximum that the local school can require them to study is  $\bar{k}_i$  such that

$$a + \bar{k}_i + \bar{\theta}_i - \bar{k}_i^2/a = \max\{a + k_o + \bar{\theta}_o - k_o^2/a, a + \underline{k} - \underline{k}^2/a\}.$$

Clearly for  $\bar{\theta}_i - \bar{\theta}_o$  big enough each college can act like a monopoly, and as  $\bar{\theta}_i - \bar{\theta}_o$  approaches zero the schools will compete so intensely that students can rely on aptitude rather than achievement. The intermediate case is shown in Figure 2.2 where  $\bar{\theta}_i = 2$  and  $\bar{\theta}_o = 1.8$ . Students of only slightly higher than marginal ability are forced to follow the standards set by a monopoly school since they have little to offer the out-of-district school. But students of higher aptitude have the attractive option of switching schools so they can only be forced to invest  $\bar{k}_i(a)$  and end up with total aptitude plus knowledge of  $a + \bar{k}_i(a)$ . As seen from the figure, they invest more than in the competitive case but less than in the monopoly case. Interestingly, for very high ability students the school can substantially increase the knowledge requirements, though still less than in the monopoly case. High ability students find investment in knowledge to be less costly than other students so they are willing to make the extra investment rather than suffer the 10% loss in income from switching schools.

### 3. Empirical analysis

As an initial evaluation of the theory, we analyze the weights on aptitude and achievement in the admissions process of U.S. colleges. The Common Data Set (CDS) prepared annually by U.S. colleges includes two measures that allow insight into these weights: 1) median SAT or ACT scores for freshmen<sup>11</sup> and 2) Percent of freshmen who ranked in the top 10% of their high school class. The CDS also has two useful measures of the competitive environment: 1) tuition for in-state and out-of-state students, which allows us to determine how heavily subsidized in-state students are, and 2) percentage of freshmen from out of state, which indicates to what extent the school competes nationally. The data comes from two compilations of the

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<sup>11</sup>The Common Data Set reports the 25th and 75th percentile scores for each test. For simplicity we refer to the average of these two scores as the “median”. Some colleges permit either the SAT or ACT, but all show a predominance of applicants submitting one or the other test.

Common Data Sets reported by each college: the College Board (CB) annual survey<sup>12</sup> and the annual “America’s Best Colleges” by U.S. News and World Report (USNWR). We restrict our attention to “National Universities” that meet criteria determined by the Carnegie Foundation and generally represent the most prominent and prestigious colleges.

Before beginning our formal analysis of panel data for 1987-2000, we first note several regularities that are apparent in the cross-sectional data and that are broadly consistent with our argument that greater competition between colleges makes it difficult for them to enforce tough achievement standards on their incoming students. Table 2 reports descriptive statistics for the year 2000, the most recent year in our sample. In the sample almost all private colleges, which presumably face more competition for students than public colleges, use the aptitude-oriented SAT.<sup>13</sup> Among public colleges, about half of these rely primarily on the SAT and about half on the more achievement-oriented ACT.<sup>14</sup> SAT users are concentrated on the coasts where competition is intensified by the proximity of large private colleges and by other state schools. In contrast, ACT users are limited almost entirely to state schools in the Midwest where competition with private schools and other state schools is mitigated by geographic distance.

[Table 1 here.]

Comparing private and public colleges which use the SAT test, our theory predicts private colleges will put relatively more emphasis on the test than on grades in their admission decisions. As seen from Table 1, private colleges in our sample generally attract students with both better grades and higher SAT scores, making a comparison of their relative weights difficult. This pattern is apparent in Figure 1 where public colleges are denoted by their two-letter state abbreviations and private colleges are denoted by an “X” if they are secular and “O” if they are religious. While the many differences between public and private colleges preclude any direct

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<sup>12</sup>Source of Data: the Annual Survey of Colleges of the College Board and Data Base, 2001-02. Copyright © 2001 College Entrance Examination Board. All rights reserved.

<sup>13</sup>Whereas some private schools were at one time the default option in their region, the expansion of subsidized public schools has made it unlikely that a private school would be in a dominant position over a given pool of students.

<sup>14</sup>According to the ACT website, “The ACT Assessment tests are curriculum based. The ACT Assessment is not an aptitude or an IQ test. Instead, the questions are directly related to what you have learned in your high school courses in English, mathematics, and science.” (<http://www.act.org/aap/faq/general.html#2>) Although the ACT has been successfully positioned as an achievement-oriented alternative to the SAT, the actual differences between the exams may not be as significant as generally believed (Dorans, 2000).

comparisons, Figure 1 suggests that public colleges may have a greater ability to enforce higher achievement standards on their incoming students than secular private colleges. Religious private colleges, which are generally affiliated with particular religions or religious denominations, presumably have a more focussed market than secular private colleges and therefore face less competition. They appear to behave similarly to public colleges in their admissions standards.

[Figure 1 here.]

These comparisons between SAT and ACT users and between private and public colleges suggest that competition between colleges may lead to less emphasis on achievement and more emphasis on aptitude. To investigate this link more thoroughly we concentrate on the set of public colleges which use the SAT and test how their relative weights on the SAT test and on grades vary as subsidies for in-state students vary. Our theory predicts that higher subsidies for in-state students will have two related effects. First, since the college is more attractive to in-state students, competition among them for limited positions increases. As a result we expect more students with high measures of achievement and aptitude to apply. Second, high aptitude students are less interested in going to a competing out-of-state college and therefore less able to play colleges off of each other. Therefore the college can shift its admissions policy to place more emphasis on achievement and less on aptitude. Because of these two effects, we expect that our measurement of achievement will rise while our measure of aptitude may rise or fall.

Our theory predicts that in-state and out-of-state students will be treated differently because the college has no market power over out-of-state students. In particular, aptitude will be weighted more heavily for out-of-state students than in-state students. Although we cannot differentiate high school grade and SAT scores for the in-state and out-of-state students in our data, the summary statistics for each college will be affected by the proportions of in-state and out-of-state students. We predict that increases in the proportion of out-of-state students are expected to be correlated with decreases in overall emphasis on achievement.

[Figures 2, 3 here.]

First we investigate the impact of changes in subsidies and out-of-state enrollment on achievement as measured by the percentage of freshmen who were in the top 10% of their high school class. Figure 2 shows the relationship between subsidies and this measure of achievement for the leading public college in each state over the entire period 1987-2000. As seen from the figure, schools with higher subsidies appear to have higher-achieving incoming

students. The results in Table 2 tend to support such a relationship both for the entire sample of colleges and for the leading colleges. Cross-sectional results, shown only for the most recent year, and pooled regression results indicate a statistically and economically significant impact of the subsidy rate in the expected direction. Of course, such a relationship could be spurious due to the many other factors that vary between colleges. Random effects and fixed effects regressions reduce this problem by allowing us to control for college specific factors, such as geographic location, that are constant across time. These regressions show smaller though still significant results. Note that year dummies are included for the random effects and fixed effects regressions but not shown.<sup>15</sup>

[Table 2 here.]

Regarding aptitude, it would seem that SAT scores should also rise as subsidies increase and schools attract a higher quality of student, but our theory shows that SAT scores need not rise if colleges react to greater subsidies by putting more emphasis on grades. Figure 3 shows the relationship between subsidies and median SAT scores for the leading public college in each state over the entire period 1987-2000. In contrast to the clear relationship between class rank and subsidies, there does not appear to be a relationship between SAT scores and subsidies. The results in Table 3 confirm that there is no statistically significant relationship in the data. Even if the estimated parameters were significant, the relative effects on SATs are smaller than the effects on class rank in all cases.<sup>16</sup>

[Table 3 here.]

We interpret the positive relation between subsidies and achievement in terms of the competitive environment of colleges. A related explanation is that voters believe achievement should be emphasized and are therefore more willing to subsidize colleges which place more emphasis on achievement. Such behavior by voters is consistent with our model in that voters are right to believe that colleges deemphasize achievement in the admissions process and that colleges which receive state subsidies should and can place greater emphasis on achievement.

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<sup>15</sup>Also not shown are results with alternative measures of aptitude, achievement, and subsidies. All of these are consistent with the shown results. In particular, we also checked aptitude as measured by 75th percentile SAT scores; achievement as measured by percent of incoming freshmen in the top 25% of their high schools class; and subsidies as measured by the difference in in-state tuition from the mean of out-of-state tuition for all schools in each year.

<sup>16</sup>The results in Table 3 are also invariant to alternative measures of achievement, aptitude, and subsidies.

## 4. Conclusion

Aptitude tests such as the SAT exam help predict college performance. This paper argues that even if aptitude tests are good predictors, their use in admissions decisions has negative incentive effects on high school students. We show that colleges would like to place more emphasis on measures of high school achievement in order to strengthen study incentives, but competition between colleges makes this difficult. In support of this theory we find that when colleges face more competition for students they tend to place more emphasis on aptitude measures and less on achievement measures.

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Table 1: Common Data Set Variables: Year 2000 Descriptive Statistics

Variable	Description	SAT Public Mean (n=77)	SAT Private Mean (n=80)	ACT Public Mean (n=78)	ACT Private Mean (n=9)
SAT	Median freshmen scores	1123	1260		
ACT	Median freshmen ACT scores			25.52	26.44
Class Rank	% freshman in top 10% high school class	36.65	53.73	23.19	29.87
In-State Students	% freshmen from in state	86.56	48.14	84.56	68.18
Tuition	Tuition (for non-residents if public)	11,816	21,910	9,707	14,282
In-State Tuition	Tuition for state residents	4,067		3,690	

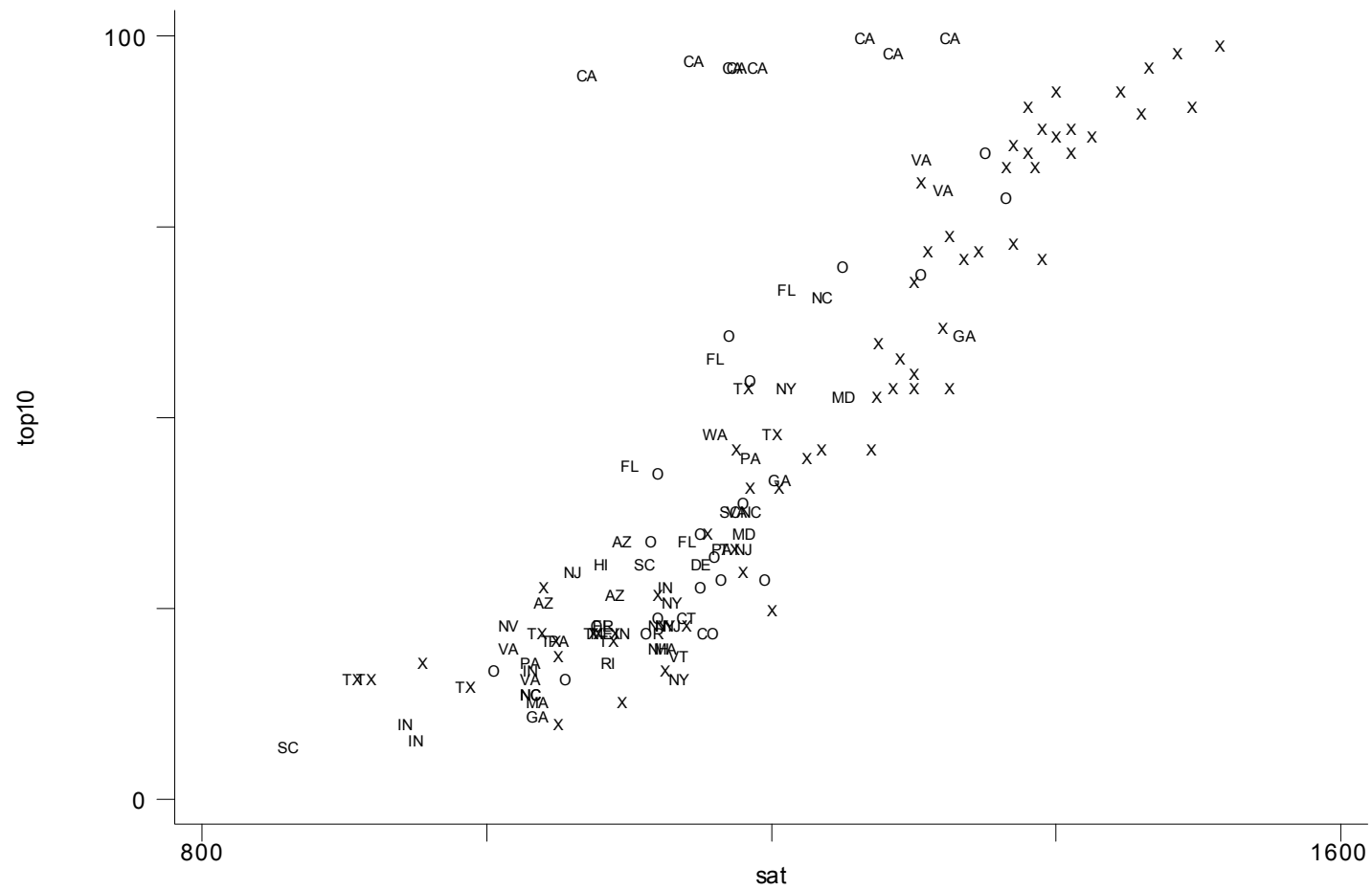


Table 2: Achievement Emphasis

	Dependent Variable: Class Rank			
<i>All Colleges</i>	2000	Pooled	Random Effects	Fixed Effects
Tuition Subsidy	.821 (.009)	.703 (.000)	.144 (.000)	.135 (.001)
In-State Students	.228 (.292)	.331 (.000)	.112 (.025)	.105 (.042)
N	63	801	801	801
R <sup>2</sup>	.119	.100	.098	.096
<i>Lead Colleges</i>				
Tuition Subsidy	.706 (.118)	.596 (.000)	.219 (.003)	.214 (.005)
In-State Students	.647 (.014)	.653 (.000)	.204 (.025)	.149 (.053)
N	25	312	312	312
R <sup>2</sup>	.317	.290	.287	.262

P values in parentheses.

Table 3: Aptitude Emphasis

	Dependent Variable: Median SAT			
<i>All Colleges</i>	2000	Pooled	Random Effects	Fixed Effects
Tuition Subsidy	.699 (.526)	.492 (.128)	-.002 (.991)	-.018 (.925)
In-State Students	-1.447 (.077)	-1.125 (.000)	.008 (.963)	.065 (.733)
N	68	893	893	893
R <sup>2</sup>	.053	.030	.006	.002
<i>Lead Colleges</i>				
Tuition Subsidy	.980 (.510)	.640 (.130)	.507 (.098)	.512 (.102)
In-State Students	.647 (.014)	1.389 (.000)	.566 (.091)	.390 (.285)
N	24	326	326	326
R <sup>2</sup>	.110	.107	.104	.090

P values in parentheses.

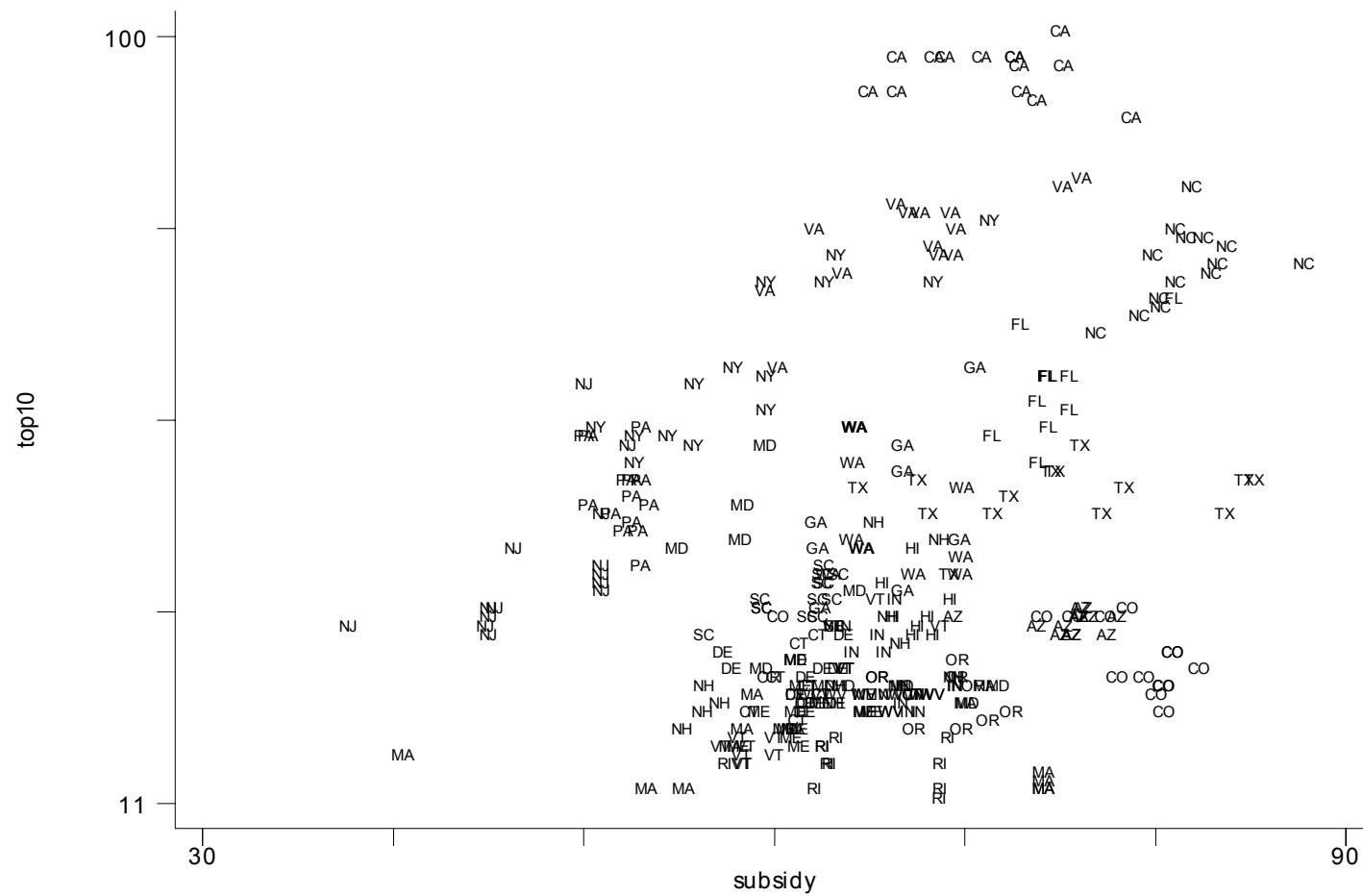


Figure 2: Class rank and subsidies, leading colleges, 1987-2000

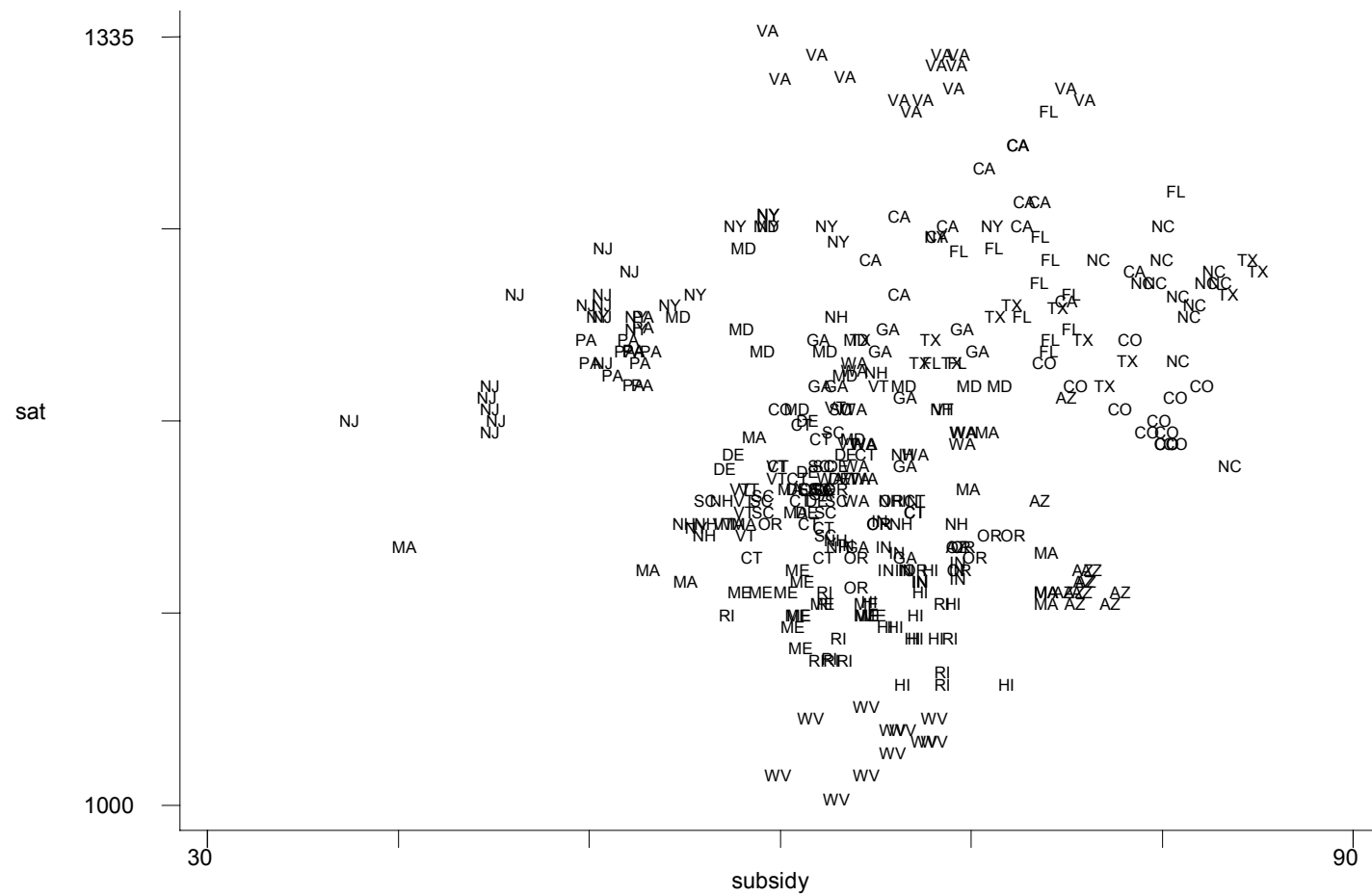


Figure 3: SAT scores and subsidies, leading colleges, 1987-2000