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Budget Model

Is Income Implicit in Measures of Student Ability?

***Series on community colleges**: The Biden-Harris Administration has advocated for providing free community college. This series of briefs takes a deeper dive into the world of community colleges: who attends, who transfers, who graduates, who achieves high marks, and what factors seem to matter for each. In doing so, we hope to shed light on how some students may benefit from this policy, others may not, and what factors form this partition. More briefs can be found here.*

Summary: Measures of student ability typically used for college admissions implicitly reflect differences in family income across students. However, high school GPA reflects differences in income noticeably less than SAT and ACT scores. However, SAT and ACT scores do capture aspects of student ability missed by school-specific rankings alone.

Key Points

- Family income is positively correlated with high school GPA, high school graduation rank, the math score on the SAT, the verbal score on the SAT, the ACT composite score, and the score on the Armed Services Qualification Test (AFQT).

- SAT math and ACT scores each exhibit robustly positive correlations of 0.22 with household income. However, the correlations between household income and metrics like high school GPA and high school graduation rank are less than half as strong, ranging from 0.06 to 0.10.

- But SAT and ACT scores do capture aspects of student ability missed by school-specific ones. In particular, SAT and ACT scores exhibit markedly stronger correlations with scores on the AFQT exam—an aptitude exam—relative to high school GPA and graduation rank.

Introduction

Whether colleges should consider standardized test exams in their admissions decisions is a debate that has received increasing attention in recent years. Just recently, the University of California system announced that it will no longer consider SAT or ACT scores in admissions decisions or scholarship decisions.[1] Colorado recently passed legislation stipulating that national assessment test scores cannot be required from applicants.[2] Due to the lack of administered testing during the coronavirus pandemic, many colleges removed these exams as requirements for applying.[3]

There is a well-documented gap in standardized examination scores between low-income and high-income students.[4] We ask in this piece whether and to what extent other measures of student ability are related to household income, and how this relation depends on the national or school-specific nature of each measure.

Using data from the National Longitudinal Survey of Youth 1997 (NLSY97)—a representative sample of the cohort of 12--17 years old students in 1997—we observe, in addition to household income, an array of different measures capturing each student's ability. The first set of metrics are the standardized examinations typically used for college admissions—the SATs and ACTs—which we refer to as national measures because they are standardized across all test-takers. For students who take the SATs, we observe their math and verbal scores. And for those who take the ACT, we observe their composite score. The second set of metrics capture the performance of each student relative to their peers-- grade point average (GPA) and class rank—which we refer to as school-specific measures because they are standardized separately for each high school. For each student, we observe their cumulative high school GPA and approximate percentile ranking among the graduating class. The final metric, score on the Armed Services Qualification Test (AFQT), is also national in that it is standardized across all test-takers, but it is not used in college admissions and so reflects a signal of unobserved student ability (with respect to the admissions process).

Relation between Income and Signals of Student Ability

To determine to what extent signals of student ability capture differences in household income, we can take the correlation between them. Correlations fall between -1 and +1, with a positive correlation between income and an ability metric indicating that students with higher incomes tend to be more towards the top of this ranking, a negative correlation the opposite. First, we take the correlations between household income, high school GPA, high school rank, SAT math and verbal scores, and score on the AFQT. The pairwise results for students who take the SAT are displayed in Table 1.

Table 1: Correlation between Household Income, High School Performance, and the SAT

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	Household income	High school GPA	High school rank	SAT math score	SAT verbal score	AFQT exam score
Household income	1.00	-	-	-	-	-
High school GPA	0.07	1.00	-	-	-	-
High school rank	0.06	0.53	1.00	-	-	-
SAT math score	0.22	0.50	0.38	1.00	-	-
SAT verbal score	0.18	0.43	0.34	0.72	1.00	-
AFQT score	0.16	0.45	0.34	0.76	0.78	1.00

Notes: Data are from the publicly available National Longitudinal Survey of Youth 1997. Analysis restricted to sample of high school graduates. Each of the five measures is standardized to have mean zero and standard deviation one. High school rank reflects an imputed percentile based on the numerical rank available for each student and five bins of graduate class sizes for which we assume a fixed class size (50 for bin 1--100, 160 for bin 101--220, 275 for bin 221--330, 400 for bin 331–470, and 1000 for bin 470+). Correlations are weighted according to representative panel sampling weights.

The first column reveals that the relationships between income and each measure of student ability are all positive. In other words, every measure of student ability or performance implicitly reflects some difference in student income. That said, the degree to which income is captured is less severe for school-specific measures. High school GPA and class rank each have weakly positive correlations with household income, falling between 0.06 and 0.07, whereas SAT scores, especially on the math section, have correlations with household income roughly 3 times as large. Thus, selecting on national measures will bias more towards wealthier students than selection solely on school-specific measures.

However, the SAT does offer new information beyond high school GPA and class rank, and therein lies the trade-off. While performance on the SATs is strongly correlated with high school GPA (0.50 for math, 0.43 for verbal) and class rank (0.38 for math, 0.34 for verbal), it is even more robustly related to performance on the AFQT, with correlations of 0.76 and 0.78 for math and verbal, respectively. For comparison, the correlation between high school GPA and AFQT score is 0.45. As an exam intended to capture cognitive ability and a measure often used in the literature to reflect individual ability (Griliches and Mason, 1972; Arcidiacono et al., 2010; Agarwal and Mazumder, 2013), differences in performance on the AFQT are markedly better captured by the SATs than by school-specific measures.

We repeat this exercise using performance on the ACT in lieu of the SAT. The pairwise correlations among students who take the ACT are reported in Table 2. Again, the degree to which income is captured by rankings of student performance is less severe for school-specific measures. The ACT composite score has a noticeably positive correlation with household income that is roughly 2.3 times as large as the positive correlations for high school GPA or class rank. That said, as with the SAT, performance on the ACT captures degrees of student ability

that would be omitted by focusing only on school-specific measures. Students' composite scores on the ACT have a very strong correlation (0.82) with unobserved ability as measured by scores on the AFQT, noticeably above the still robustly positive correlations of the AFQT with high school GPA (0.55) and class rank (0.52). While standardized exams reveal some student ability not captured through school-specific measures, they also reflect students' environments outside the classroom, in this case household income.

Table 2: Correlation between Household Income, High School Performance, and the ACT

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	Household income	High school GPA	High school rank	ACT composite score	AFQT exam score
Household income	1.00	-	-	-	-
High school GPA	0.09	1.00	-	-	-
High school rank	0.10	0.76	1.00	-	-
ACT composite score	0.23	0.59	0.55	1.00	-
AFQT score	0.21	0.55	0.52	0.82	1.00

Notes: Data are from the publicly available National Longitudinal Survey of Youth 1997. Analysis restricted to sample of high school graduates. Each of the five measures is standardized to have mean zero and standard deviation one. High school rank reflects an imputed percentile based on the numerical rank available for each student and five bins of graduate class sizes for which we assume a fixed class size (50 for bin 1--100, 160 for bin 101--220, 275 for bin 221––330, 400 for bin 331–470, and 1000 for bin 470+). Correlations are weighted according to representative panel sampling weights.

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This analysis was produced by Jason Sockin.

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1. https://www.nytimes.com/2021/05/15/us/SAT-scores-uc-university-of-california.html ↵

2. https://leg.colorado.gov/sites/default/files/2021a_1067_signed.pdf ↩

3. https://www.washingtonpost.com/local/education/coronavirus-sat-act-admission/2020/06/15/18c406dc-acca-11ea-a9d9-a81c1a491c52_story.html ↩

4. https://www.washingtonpost.com/news/wonk/wp/2014/03/05/these-four-charts-show-how-the-sat-favors-the-rich-educated-families/ and https://www.brookings.edu/blog/the-avenue/2019/05/17/students-need-more-than-an-sat-adversity-score-they-need-a-boost-in-wealth/ ↩