The Economic Impact of Access to Four-Year Public Colleges

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Abstract

Using credit bureau data linked to the universe of SAT-takers, we provide the first estimated economic impacts of American students' access to an entire system of public higher education. Two-thirds of Georgia high school graduates who attend college enroll in the state's four-year public sector, which requires minimum SAT scores for admission. Regression discontinuity estimates show that enrollment in this sector boosts students' household income around age 30 by 25 percent, likely driven by previously documented increases in degree completion rates. Access to four-year public colleges has little clear impact on credit scores, student loans, mortgages, or out-of-state migration. Increasing access to public four-year colleges would likely generate enough future tax revenue to pay for itself.

*This paper reflects the views of the authors and not their corresponding institutions or the providers of the data. This research was funded by Arnold Ventures.

1. Introduction

Do public colleges improve economic mobility? Two-thirds of American college students seeking bachelor's degrees enroll in public four-year colleges, which are partially subsidized by state appropriations. We have relatively little evidence to date, however, on whether access to this college sector improves students' economic trajectories. Such evidence is difficult to generate because those who choose to attend four-year public colleges differ from those who attend private four-year colleges, two-year colleges, or no college at all. Providing a rigorous answer to this question is important, given that political debates over the economic benefits of a college education continue to affect policy decisions about public funding of such institutions.

We therefore provide the first estimated economic impacts of American students' access to an entire public system of higher education. We study the state of Georgia, where two-thirds of high school graduates who attend college enroll in the state's four-year public sector. The University System of Georgia (USG), which comprises the state's 17 four-year public colleges, requires minimum SAT scores for admissions. This threshold provides a source of exogenous variation in college access, allowing us to compare otherwise identical students who differed only in their college options. In Goodman, Hurwitz, and Smith (2017), we used a regression discontinuity design to show that students just above this threshold were substantially more likely to attend USG colleges instead of two-year community colleges or no college at all. Enrollment in these four-year public colleges in turn substantially increased bachelor's and overall degree completion rates. We could not, however, measure outcomes beyond degree completion.

We show here that access to and enrollment in this public four-year college sector leads to substantial economic benefits for the marginal student, as measured at roughly age 30. We do so by linking the universe of Georgia SAT takers from the high school classes of 2004-08 to credit bureau data on these individuals measured in November 2017. The credit bureau data contain various measures of economic and financial well-being, including estimated household income, credit scores, outstanding debt, student loans, mortgages, and residential location. Many of these outcomes have not previously been considered in the literature on the economic returns to college.

We first replicate in this data our earlier work on access to four-year public colleges and degree completion. In that earlier work, we showed that some students retook the SAT in order to meet the publicly known admissions threshold, attenuating the relationship between SAT scores and access to the USG. We therefore focus here on the roughly 124,000 Georgia students whose

first SAT take was too late to leave them time to retake before the admissions deadline. Among such students, those just above the USG admissions threshold are five percentage points more likely to enroll at a USG college than those just below, who instead largely attend two-year community colleges or no college at all. Instrumental variable estimates using that first stage suggest access-driven enrollment in a public four-year college relative to those alternatives increases bachelor's degree completion rates by a substantial 41 percentage points.

We then show that enrollment in such four-year public colleges substantially boosts household income as measured around age 30. In particular, such enrollment increases annual household income by 25 percent, or $16,500. Here, household income includes the student's own wage earnings, spousal earnings and non-wage earnings, an arguably more complete measure of economic well-being than individual earnings might capture. These increased earnings come largely from a 31 percentage point increase in the probability of earning more than $50,000, though we see evidence of increases at higher earnings levels as well.

We find little systematic impact of four-year public college enrollment on other financial outcomes. Credit scores appear unaffected, as is the probability of having a mortgage or declaring bankruptcy. We find little impact on the probability of missing student loan payments or other outstanding debt payments. We can rule out meaningful differences in outstanding student loan balances. This last point is of particular importance given a popular narrative that four-year college is expensive and therefore may be difficult to afford. We cannot, however, distinguish whether the similar amounts of outstanding student loans for those who begin at a USG college and elsewhere is driven by the higher estimated income for USG enrollees or simply different beginning loan amounts. Overall, these results do not suggest that there are large differences in other financial measures, beyond income, from starting at a USG college.

Overall, we find that students on the margin between four-year public colleges and two-year community colleges see large economic benefits from access to the four-year sector. Household income is substantially higher around age 30 and other measures of financial well-being are no worse and sometimes better. Interestingly, we find no impact on the probability of living in Georgia, perhaps because most of the marginal students are choosing between in-state two- and four-year public colleges. This implies that out-of-state mobility may not substantially undermine the increase state tax revenue generated by potential expansions of access to public higher education.

Our work makes two major contributions to the research literature. First, we extend prior work on college returns to generate the first estimated economic impacts of American students' access to an entire public system of higher education. Recent well-identified work on the returns to college access in the U.S. have largely exploited thresholds generated by a single institution's admissions process (Hoekstra, 2009; Zimmerman, 2014). Well-identified research showing substantial returns to access to broader sets of institutions or degree programs has largely been conducted outside of the U.S., in countries with more centralized admissions systems, such as France (Canaan and Mouganie, 2018) or Chile (Hastings, Neilson and Zimmerman, 2014). The paper closest in spirit to ours is Mountjoy (2019), which uses distance instruments to estimate earnings impacts of community college access on students whose alternatives are either no college or four-year colleges.

Our estimated 25 percent increases in household income returns are remarkably similar to the returns estimated by Hoekstra (2009), who finds that enrollment in a state's most selective public university access increases earnings by 20 percent (for white men), and Zimmerman (2014), who finds that access to a state's least selective public four-year college increases earnings by 22 percent. Our results are also consistent with, though more precisely estimated, than the negative returns to community college enrollment that Mountjoy (2019) observes for students who otherwise would have attended four-year colleges. The local average treatment effect we estimate here is roughly equivalent to the "diversion" effect that paper measures.

Our second main contribution is to expand the set of economic outcomes considered by most literature on the returns to college. The U.S. papers discussed above measure outcomes using state-level administrative data on earnings as reported to unemployment insurance agencies. Linking to the credit bureau data allows us to see measures of total household income, rather than individual wage earnings, as well as a much wider range of financial outcomes including credit scores, debt loads, and student loan burdens. The only other papers in the higher education space to consider such outcomes are Scott-Clayton and Zafar (2019), on the impact of one state's merit scholarship program, and Boatman, Hurwitz, Lee and Smith (2019), on the impact of test-based college credit. These outcomes give a more complete picture of students' economic well-being than considering only income and allow us to study policy questions not focused solely on earnings.

2. Data

This paper uses three main data sources: College Board's SAT data, National Student Clearinghouse (NSC), and TransUnion (TU) credit bureau data. The first two data sets are identical to that of Goodman, Hurwitz, and Smith (2017), which track SAT takers into and through college. The TU data set is the novelty to these analyses and provide financial outcomes for 97 percent of the SAT takers we consider.

2.1. SAT Data

Our starting dataset includes the millions of SAT takers across the United States in the high school graduating cohorts of 2004 to 2008. The SAT is offered by the College Board and is one of two primary college entrance exams, frequently required for admission to four-year colleges. Our primary focus is on the approximately 290 thousand students who live in the state of Georgia and took the SAT over this time period.

The SAT comprises of a math and verbal section, each scored between 200 and 800 for a minimum potential score of 400 and a maximum of 1600 and scores are in increments of 10.[1] The exam is offered approximately six times per year, typically at high schools, and is most frequently taken during junior and/or senior years. There is no limit to the number of times a student can take the exam and we observe all scores on all attempts.

SAT data include basic demographic information that is filled out upon registration. This includes sex, race/ethnicity, parental education and income, home zip code, and high school enrolled in.

2.2. National Student Clearinghouse

National Student Clearinghouse tracks college enrollment and completion in the U.S. As of 2015, over 3,600 colleges and universities participate in the NSC, comprising over 98% of all students enrolled in American postsecondary institutions. This coverage has changed over time with approximately 91% of all students enrolled in the postsecondary system accounted for during the 2011-12 academic year (Dynarski, Hemelt and Hyman 2015). The biggest hole in NSC data are for-profit universities.

[1] The SAT later introduced the writing section but this was not relevant for most of the students in the sample and often not used in admissions.

NSC data are merged with SAT takers and track college enrollment spells up to six years after high school graduation. This included the names and lengths of enrollment at each college, whether it is the initial college, a transfer, or the final college. The type of degree earned is recorded, along with the date of completion. NSC are merged with Integrated Postsecondary Education Data System (IPEDS) to get information on the type of college, such as two- or four-year, as well as for-profit or not-for-profit status and public or private.

2.3. TransUnion Credit Bureau

TransUnion is one of three main credit bureaus in the U.S. They collect and generate financial metrics for most people in the U.S. These data were merged with SAT and NSC data in November 2017 and represent a single cross-section of student's financial status as of that month. The matching process is described in the Appendix B1 and leads to a 97 percent match rate in the state of Georgia.[2]

TU has a wide range of variables but we focus on a few key measures of financial health, especially as it relates to college going. Estimated income is of primary interest. TU uses a wide range of financial characteristics to estimate a consumer's joint gross adjusted income (line 37 of the 1040 federal tax form). This algorithm is based on multiple income sources and debt service parameters.[3] Because this is such an important variable in our analysis, Appendix B2 describes in more detail how it is constructed, trained, and we also validate with external data sources.

We also consider several other TU variables, including credit score, outstanding student and non-student loans, mortgages, overdue payments, defaults, and bankruptcies. We also know where students live in 2017, giving us the ability to look at whether out-of-state mobility is impacted by college access and enrollment.

2.4. Analytic Data Set

Table 1 shows the summary statistics for our analytic dataset, which consists of all Georgia SAT takers in the high school graduating cohort of 2004 to 2008 who took the SAT for the first

[2] This was the same matching process and variables used in Boatman et al., (forthcoming).

[3] The income source data includes: investment income, alimony, business income, IRA distributions, pensions and annuities, real estate income, unemployment compensation, and Social Security benefits. The debt service information includes monthly spend data, and up to 30 months of extended account history, including credit lines, length of credit history, historical credit card balances, and recent credit card transactions.

time their senior year of high school (late) and matched to the credit bureau data.[4] We focus on late takers because our previous work showed that these students are the most impacted by the USG access threshold, both in terms of having time to retake and ultimately gain access (first stage) and in terms of earning a bachelor's degree (second stage). As we show and confirm in Appendix Table A2, the enrollment patterns of early SAT takers are not statistically impacted by the USG access threshold.

Late SAT takers differ substantially from all SAT takers, as shows in Appendix Table A1 – they are more likely to be black, have low parental income, and their first SAT scores that are 65 points below the full Georgia sample. The right panel of Table 1 shows the summary statistics for students with an initial SAT score within 60 SAT points of the USG threshold, which is our primary bandwidth.

As Table 1 shows, 54 percent of the late Georgia SAT takers are female. 49 percent are white and 38 percent are black. Black students are by far the largest minority group and as such, we typically exclude subgroup analyses for Hispanics and Asians. Nearly 43 percent of the sample are "low-income", which we define to have a self-reported parental income of less than $50,000. One-third of the later SAT takers are defined to be late SAT takers who first take the SAT in January of their senior year in high school.

The average first SAT score (our running variable) is 900 and 54 percent of these late SAT takers achieve the minimum SAT score to have access to a USG college. 29 percent of the sample begin at a USG college within one year of high school graduation and 47 percent enroll in any four-year college. 26.1 percent earn a bachelor's degree within six years of high school graduation.

Turning to financial outcomes, the average estimated income in 2017 is $62,206. As described in Appendix B, we explain why this average is higher than other data sources that report income, such as the College Scorecard. 62 percent of the sample have credit scores above a 600 and 31 percent are above a 700. Also, 19.5 percent of students have been delinquent on any payments in the last year. The delinquent payments are an average of $156.

In total, students have over $21,000 in any type of loans as of November 2017, $19,000 of which are government student loans. Private student loans only average $1,910. And approximately 11 percent of the sample have missed student loans within the past year.

[4] Appendix Table A1 shows the summary statistics for all Georgia SAT takers and all Georgia SAT takers who matched to credit bureau data. They are very similar to one another due to the 97 percent match rate.

Table 1 also shows that 17.7 percent of the students have at least one mortgage. And 2.9 percent have declared bankruptcy. Finally, an overwhelming fraction (four-fifths) live in Georgia in 2017.

3. Methodology

To estimate the causal impact of access to and enrollment in four-year public colleges on long term financial outcomes in the state of Georgia, we follow the details of Goodman, Hurwitz, and Smith (2017). To eliminate selection bias driven by different types of students making different college choices, we exploit the University System of Georgia (USG) access thresholds. We use a regression discontinuity design to compare a variety of outcomes between students just above and below these thresholds.

In Georgia, a student must score at least 430 in reading and at least 400 in math to be eligible for admission to a USG four-year college. We therefore define distance from the access threshold (our running variable) as:

$$Distance_{GA} = \min(SAT_R - 430,\ SAT_M - 400) \qquad (1)$$

This minimum function collapses the two-dimensional threshold into a single dimension, where negative values imply a student has missed at least one threshold and zero or positive values imply a student has met or exceeded both thresholds. This method of collapsing a multi-dimensional boundary into a single dimension is discussed in Reardon and Robinson (2012) and has previously been used in papers such as Cohodes and Goodman (2014) and Papay, Murnane, and Willet (2014).[5]

Because Georgia's admissions thresholds are publicly known, we define each student's distance from the threshold using that student's first SAT scores. First scores do not suffer from potential endogeneity driven by any retaking of SAT upon failure to meet the thresholds.[6]

We generate first stage estimates by running local linear regressions of the form:

[5] Our estimates are quite similar if we define the running variable as distance from one subject's threshold and limit the sample to students whose score in the other subject exceeds the relevant threshold.

[6] We formally test this with covariate balancing and density tests, as done in Goodman, Hurwitz, and Smith (2017) and find no methodological red flags.

$$USG_{ic} = \alpha_0 + \alpha_1 Access_{ic} + \alpha_2 Distance_{ic} + \alpha_3 Access_{ic} * Distance_{ic} + \gamma_c + \mu_{ic} \quad (2)$$

Here, USG indicates the initial enrollment of student *i* in high school class *c* in a Georgia four-year public college, (within one year of high school graduation). *Access* is an indicator for meeting or exceeding the relevant test score threshold and *Distance* measures the number of SAT points each student's score is from the threshold. We control flexibly for time-varying shocks by including high school class fixed effects (γ_c). Because the two sets of students on either side of the threshold are nearly identical in terms of academic skill and other characteristics, the coefficient of interest, α_1, estimates the causal effect of being above the admissions threshold on enrollment in Georgia's four-year public sector.

We then generate instrumental variable estimates of the impact of enrollment in the four-year public sector by running regressions of the form:

$$Y_{ic} = \beta_0 + \beta_1 USG_{ic} + \beta_2 Distance_{ic} + \beta_3 Access_{ic} * Distance_{ic} + \delta_c + \varepsilon_{ic} \quad (3)$$

where *USG* is instrumented by access according to equation 2. Using USG as the endogenous regressor allows us to capture the full set of marginal students whose enrollment decisions were altered by the thresholds. This implies that we are estimating the impact of enrollment in the four-year public sector relative to the full set of forgone alternatives, including enrollment in two-year colleges, in non-GSUS four-year colleges, and no college at all. The outcomes of primary interest, *Y*, include all college completion outcomes and economic outcomes available from the credit bureau data.

We test the robustness of all our decisions by varying bandwidths and using the optimal bandwidths suggested by Imbens and Kalyanaraman (2012). We also try different weights in the local linear regression, adding polynomials, and adding control variables. We also cluster standard errors by discrete distance to the threshold, as suggested by Lee and Card (2008).

4. Results

4.1. College Enrollment and Completion

Table 2 shows the results for the impact of USG access on college enrollment and completion. This is essentially a replication of Goodman, Hurwitz, and Smith (2017) with similar

results.[7] The first row of results includes all late SAT takers and the first stage (from equation 2) suggests that students who score just above the USG minimum SAT threshold are 4.6 percentage points more likely to enroll at a USG college than students who score just below. Figure 1 confirms this visually.

The next few columns are results from two-stage least squares (equation 3) and show that students who begin at a USG college are 61.6 percentage points more likely to enroll in any four-year college than those who do not enroll at USG. The next column suggests that about two-thirds of that result come at the expense of two-year college enrollment. The next column is a primary result from our initial paper and shows that students who begin at a USG college are 40.9 percentage points more likely to earn a bachelor's degree than those who enroll in the alternative (mostly two-year colleges). Figure 2 confirms this visually.

The next few rows run the same analyses for the subgroups we consider throughout the text – black and white students and low-income and high-income students. The results are qualitatively similar for each subgroup.

4.2. Estimated Income

Table 3 shows the results of the impact of beginning at a USG college on estimated income. The first row considers six transformations of income for late SAT takers. The first column implies that students who begin at USG are earning $16,458 more in 2017 than students who did not begin at USG. Figure 3 confirms this visually. The second column uses the logarithm of estimated income and the point estimate implies a 25 percent increase in estimated income for students starting at a USG college.

The next few outcomes are indicators for whether the estimated income is above a threshold - $25,000, $50,000, $75,000, and $100,000. The estimates show that there is a 31 percentage point increase in the probability of having an estimated income greater than $50,000 after starting at a USG college and no statistical effect on being above $25,000. There is also a positive but statistically insignificant increase in the probability of earning above $75,000 and a 12.4 percentage point increase in the probability of earning more than $100,000. Combined, this generally suggest an upward shift in incomes, especially in the middle-income ranges.

[7] The sample differs slightly because we only use the SAT takers matched to credit bureau data and we focus on some different (and some of the same) subgroups.

The net few panels show directionally similar results for all subgroups but with varying magnitudes and statistical precision. Notably, white students have larger point estimates than black students and low-income students have higher point estimates than high-income students.

Appendix Tables A3 and A4 show that these results are robust when the outcomes are estimated income and logarithm of estimated income, respectively. We show this for various bandwidths, including polynomials and controls, and using different weights.

4.3. Other Financial Outcomes

Table 4 shows the results of the impact of starting college in USG on a variety of financial outcomes. The first panel (all late SAT takers) has positive coefficients on credit score outcomes. The point estimates suggest a 18.8 percentage point and 20.8 percentage point increase in the probability of having a credit score greater than 600 and 700, respectively. The next two columns show no statistical effect on the probability of being delinquent on any payments in the last year or the total past due in the last year.

Next, we consider the outcome of student loans for all late SAT takers. We find positive but statistically noisy point estimates close to $5,000 for outstanding student loans, mostly driven by government student loans. Private student loans are more precisely estimated and we can rule out impacts of beginning at a USG college close to $6,000 (positive or negative). Nor are students more or less likely to miss any students loan payments in the last year. Overall, as of 2017, students who begin at USG colleges do not have noticeably different amounts of student loans or ability to repay their loans than students who begin college elsewhere, which is typically the two-year sector. Due to the nature of the financial data (a single cross-section), we cannot fully distinguish whether this is because students had higher loan balances but their relatively higher incomes from Table 3 allow them to pay them off or whether their loans at the end of their education were relatively similar.

Next, we see that the one measure of economics success, our indicator for home ownership (any mortgage), is positive (12 percentage points), which is large relative to the mean, but noisy. On the flip side, bankruptcy is a measure of extreme economic duress and we find that students who begin at a USG college are 7.7 percentage points less likely to have ever been bankrupt than their peers. While both measures are imprecise, both measures point in favor of starting at a USG college over the alternative.

Finally, the last outcome, whether the student lives in Georgia in 2017, should be of great interest to state policy makers who subsidize and fund education through the taxes levied on Georgia residents. We find no statistical impact on the probability of staying instate several years after college. This is likely because students are largely choosing between the two-year and four-year public colleges in Georgia and not fleeing the state for education or work.

Scrolling down to the next few panels shows that most subgroups have relatively similar results to the previously described full sample in that there is not overwhelming evidence that starting at a USG college drastically changes these other financial outcomes, with a few exceptions. White and high-income students who start at a USG college have between $20,000 and $40,000 in additional student loans than their peers but at the same time, they are much less likely to declare bankruptcy.

Though not included, none of the statistically significant results have visually compelling counterparts. Together with Table 4, we take this as evidence that there are few substantial differences in these other financial outcomes.

5. **Conclusion**

This paper shows that access to and enrolling in the four-year public college system in Georgia has long-term financial benefits for students in our sample. Not only are students more likely to earn a college degree, typically a bachelor's degree, but they earn higher incomes about 10 years after initial enrollment. We find few other financial differences from starting at a USG college, including credit scores, student loans, and having a mortgage.

This paper focuses on late SAT takers, which is a select subsample of all SAT takers. We focus on this subsample because they are the most impacted by the minimum admission threshold. That is to say, the threshold determines the type of college that late SAT takers enroll in while early SAT takers manage to enroll at USG or comparable colleges by other means. In practice, this is usually accomplished through SAT retaking, which has been shown to have its benefits in other settings (Goodman, Gurantz, & Smith; *forthcoming*) but has a clear theoretical benefit in Georgia. This has two important implications. First, we are only estimating the impacts of attending a USG college for late takers and we cannot say the same results hold for early takers. Early and late SAT takers vary on quite a few dimensions and whether the treatment effect of a USG college extends beyond our subsample is an open question. Second, there may be benefits

to taking the SAT (or ACT) early or retaking the SAT (or ACT) to get over the admission threshold. Goodman, Gurantz, & Smith (*forthcoming*) show that retaking rates are a related to initial test date and having more opportunities to improve one's score and in this context, score above the minimum threshold requires early action and some planning.

Our paper not only focuses on late SAT takers but it identifies causal effects of access and enrollment at a USG college for those with SAT scores around the minimum SAT threshold. There are many students in Georgia around the threshold but it should be restated that the impacts we estimate are only for these students. Higher (and lower) scoring students who easily gain access may have different financial returns to starting (or not starting) at a USG college.

Also, we use data that measures financial outcomes in November 2017. We do not know what happens in the very long-term. But previous descriptive research shows that earning profiles of bachelor's degrees holders tend to steepen later than non-bachelor's degree holders, ultimately surpassing non-degree holders in levels and rates. Our results suggest that these USG enrollees are already at higher earnings levels than the alternative, we just don't know what the relative rate of increases will be in future years.

Finally, we should note that public college options in the U.S. are context dependent. In Georgia, we show that the four-year public college options have large financial returns. This may not be true in other states. In some states, the two-year public colleges may provide a great pathway for students at this margin, perhaps leading to high earning jobs or simply success in transferring to the four-year system. Extending our research to other contexts is a great line of research but demands high quality data and a similar admission criteria, which frequently don't exist.

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Figures

Figure 1 – Probability of Enrolling in a USG College by Distance to USG Admission Threshold for Late SAT Takers in Georgia

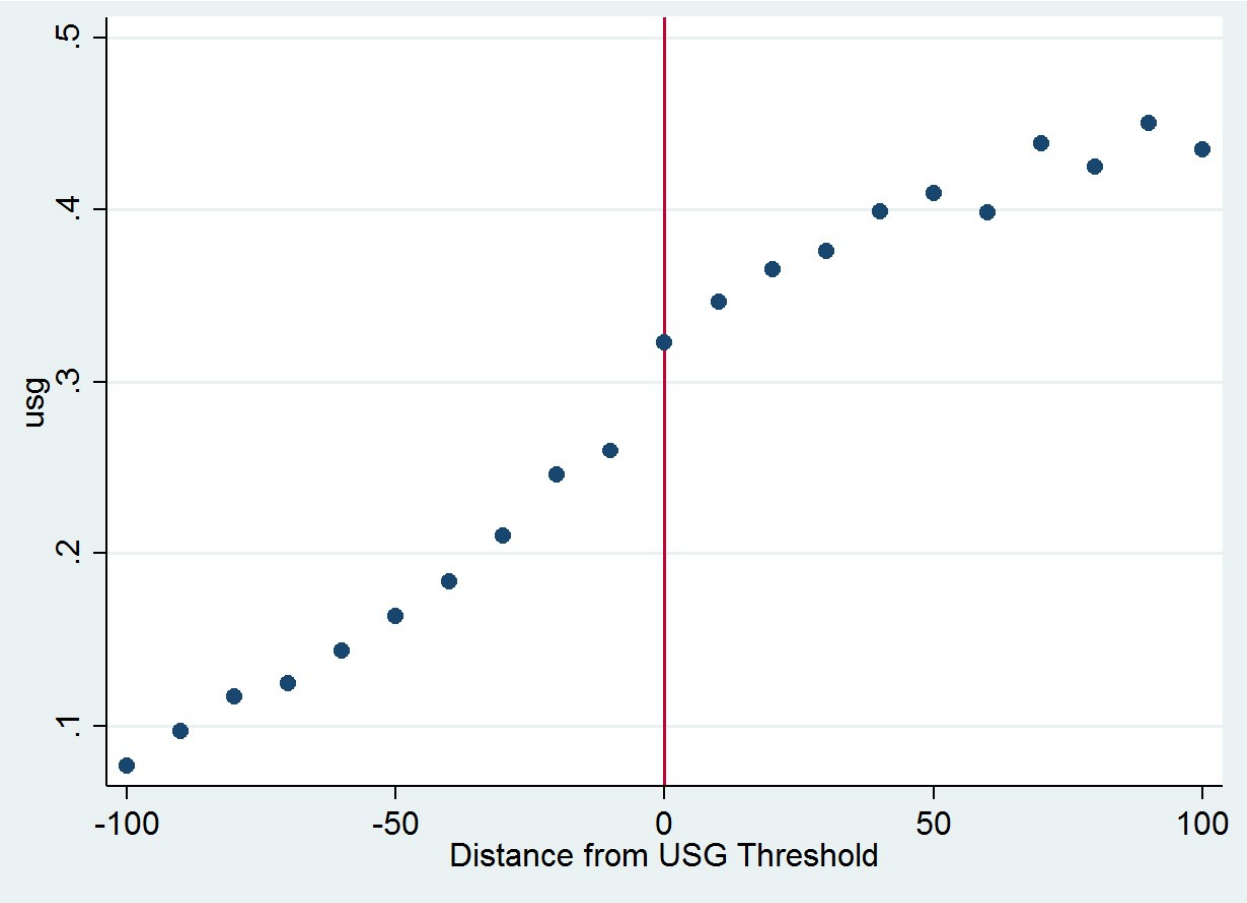


Figure 2 – Probability of Earning a BA in 6 Years by Distance to USG Admission Threshold for Late SAT Takers in Georgia

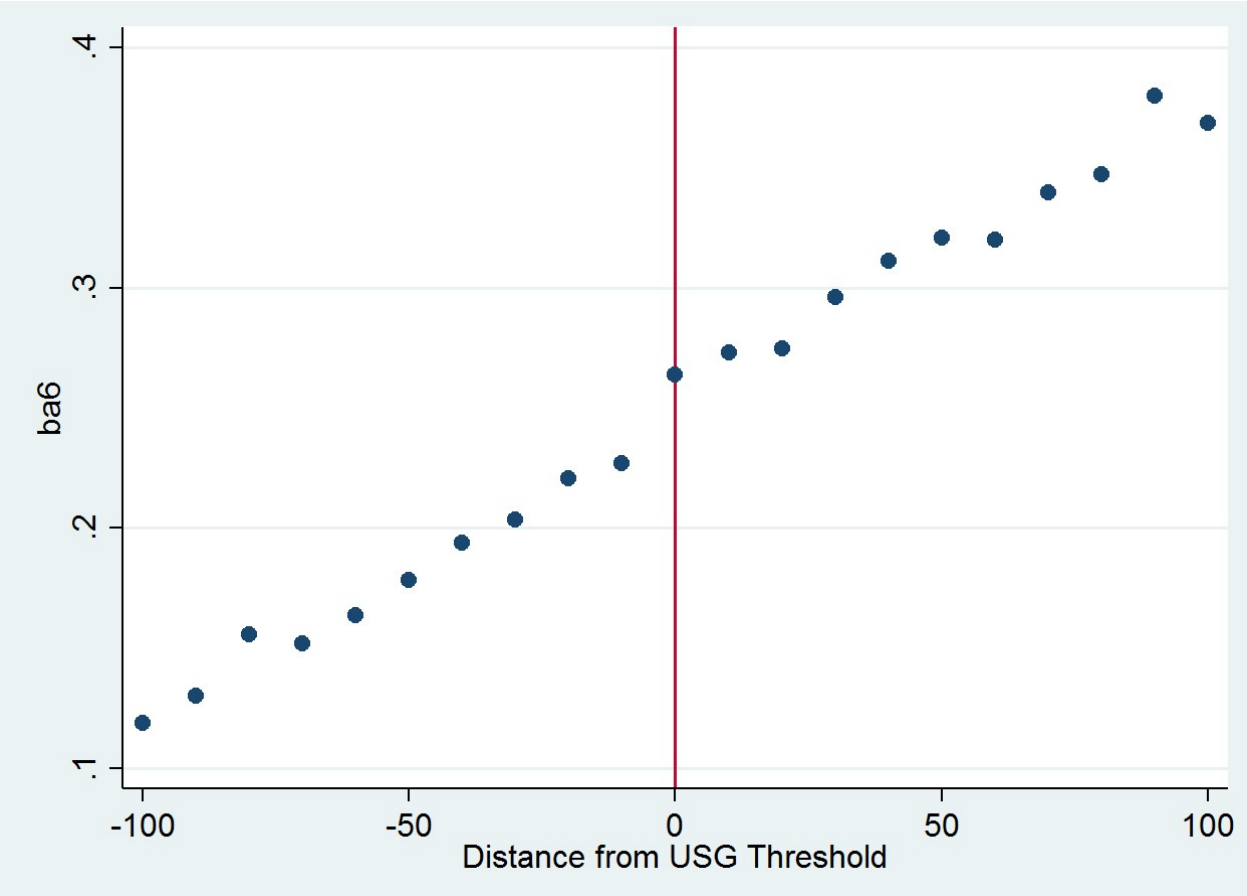
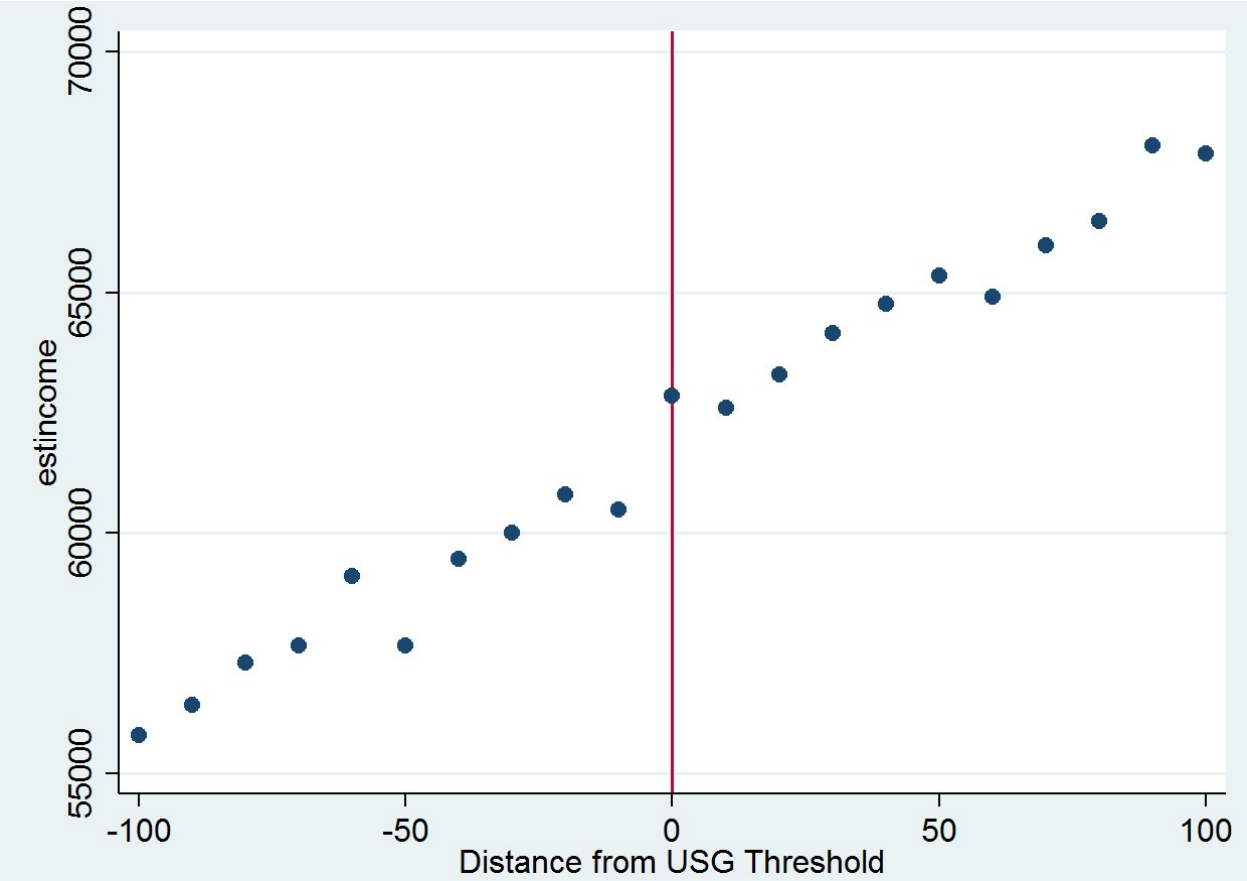


Figure 3 – Estimated Income in 2017 by Distance to USG Admission Threshold for Late SAT Takers in Georgia



Tables

Table 1 - Summary Statistics

	Georgia Late SAT Takers (n = 123,888)		Georgia Late SAT Takers, w/i 60 SAT Points of USG Minimum (n = 68,101)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Female	0.543	0.498	0.564	0.496
White	0.491	0.500	0.493	0.500
Black	0.380	0.485	0.383	0.486
Low-Income	0.426	0.495	0.432	0.495
Late SAT Taker	1.000	0.000	1.000	0.000
First SAT	900.1	172.1	890.3	82.4
Above USG Minimum (Access)	0.536	0.499	0.547	0.498
Enroll in USG	0.292	0.455	0.301	0.459
Enroll in 4-Year College	0.472	0.499	0.476	0.499
Enroll in 2-Year College	0.283	0.450	0.294	0.456
Earned BA in 6 Years	0.261	0.439	0.254	0.435
Estimated Income	62,206	26,610	61,965	25,481
Credit Score Above 600	0.616	0.486	0.616	0.486
Credit Score Above 700	0.314	0.464	0.304	0.460
Delinquent on any Payments in Last Year	0.195	0.396	0.198	0.398
Total Past Due in Last Year	156	1,547	159	1,076
Total Outstanding Loans	21,259	39,859	21,352	38,660
Outstanding Government Student Loans	19,348	37,087	19,419	35,904
Outstanding Private Student Loans	1,910	11,549	1,933	11,424
Any Student Loans Past Due in Last Year	0.109	0.312	0.112	0.315
Any Mortgage	0.177	0.382	0.184	0.387
Ever Bankrupt	0.029	0.168	0.030	0.171
Lives in Georgia in 2017	0.808	0.394	0.814	0.389

Table 2 - The Impact of USG Access on College Enrollment and Completion

	Reduced-Form	Instrumental Variables			
	USG	*Enroll in 4-Year*	*Enroll in 2-Year*	*BA in 6 Years*	*AA in 6 Years*
			All		
Access/USG	0.046***	0.616***	-0.441***	0.409***	-0.108
	(0.007)	(0.067)	(0.083)	(0.107)	(0.091)
Observations	68,101	68,101	68,101	68,101	68,101
			Black		
Access/USG	0.073***	0.546***	-0.475***	0.292***	0.016
	(0.009)	(0.077)	(0.040)	(0.089)	(0.052)
Observations	26,057	26,057	26,057	26,057	26,057
			White		
Access/USG	0.037***	0.786***	-0.731***	0.392*	-0.407***
	(0.009)	(0.094)	(0.155)	(0.210)	(0.148)
Observations	33,564	33,564	33,564	33,564	33,564
			Low-Income		
Access/USG	0.045***	0.549***	-0.373***	0.275***	0.002
	(0.010)	(0.096)	(0.105)	(0.091)	(0.176)
Observations	29,401	29,401	29,401	29,401	29,401
			High-Income		
Access/USG	0.048***	0.634***	-0.649***	0.460**	-0.236
	(0.006)	(0.120)	(0.220)	(0.203)	(0.145)
Observations	19,274	19,274	19,274	19,274	19,274

Table 3 - The Impact of Enrolling in USG College on Estimated Income, Instrumental Variables

	Income	*Log (Income)*	*Income > $25k*	*Income > $50k*	*Income > $75k*	*Income > $100k*
				All		
USG	16,458.288***	0.252***	-0.008	0.311***	0.133	0.124***
	(3,799.591)	(0.066)	(0.011)	(0.091)	(0.104)	(0.038)
Observations	66,356	66,356	66,356	66,356	66,356	66,356
				Black		
USG	5,110.233	0.139**	0.008	0.338***	-0.045	-0.015
	(3,686.997)	(0.059)	(0.007)	(0.095)	(0.059)	(0.022)
Observations	25,466	25,466	25,466	25,466	25,466	25,466
				White		
USG	11,591.002	0.089	-0.035**	-0.089	-0.028	0.164*
	(7,709.990)	(0.139)	(0.015)	(0.157)	(0.206)	(0.096)
Observations	32,659	32,659	32,659	32,659	32,659	32,659
				Low-Income		
USG	10,946.574*	0.212**	-0.010	0.268*	0.017	0.094*
	(5,599.327)	(0.108)	(0.026)	(0.162)	(0.089)	(0.057)
Observations	28,615	28,615	28,615	28,615	28,615	28,615
				High-Income		
USG	6,221.903	0.041	-0.003	0.014	-0.026	0.045
	(12,406.272)	(0.171)	(0.011)	(0.314)	(0.236)	(0.162)
Observations	18,833	18,833	18,833	18,833	18,833	18,833

Table 4 - The Impact of Enrolling in USG College on Financial Outcomes, Instrumental Variables

	Credit Score Above 600	*Credit Score Above 700*	*Delinquent on any Payments in Last Year*	*Total Past Due in Last Year*	*Total Outstanding Loans*	*Outstanding Government Student Loans*	*Outstanding Private Student Loans*	*Any Student Loans Past Due in Last Year*	*Student Debt to Income Ratio*	*Any Mortgage*	*Ever Bankrupt*	*Lives in Georgia in 2017*
						All						
USG	0.188	0.208**	-0.044	-57.384	4,761.018	4,787.065	-26.048	-0.062	-0.012	0.120	-0.077*	0.005
	(0.142)	(0.081)	(0.046)	(208.773)	(7,712.843)	(6,274.959)	(2,905.034)	(0.076)	(0.104)	(0.083)	(0.039)	(0.063)
Observations	67,231	67,231	68,101	67,748	66,532	66,532	66,532	68,101	66,356	68,101	68,101	68,101
						Black						
USG	-0.099	0.012	0.045	74.707	5,440.495	5,178.714	261.781	-0.017	0.070	0.080	-0.007	0.150*
	(0.184)	(0.079)	(0.086)	(279.922)	(5,816.222)	(5,157.916)	(3,934.737)	(0.059)	(0.107)	(0.054)	(0.026)	(0.081)
Observations	25,804	25,804	26,057	25,954	25,524	25,524	25,524	26,057	25,466	26,057	26,057	26,057
						White						
USG	0.073	-0.175	-0.109*	-116.362	23,545.235**	22,029.547**	1,515.688	0.029	0.335**	0.044	-0.158**	-0.063
	(0.167)	(0.248)	(0.065)	(293.823)	(11,409.238)	(8,959.310)	(4,796.894)	(0.112)	(0.150)	(0.156)	(0.075)	(0.114)
Observations	33,087	33,087	33,564	33,360	32,759	32,759	32,759	33,564	32,659	33,564	33,564	33,564
						Low-Income						
USG	0.256	0.291	-0.172*	507.551	-15,896.817	-14,024.815	-1,872.002	-0.207**	-0.491***	0.240	-0.027	0.153
	(0.273)	(0.207)	(0.091)	(386.868)	(11,228.408)	(8,651.105)	(4,528.283)	(0.084)	(0.188)	(0.153)	(0.060)	(0.124)
Observations	29,011	29,011	29,401	29,245	28,684	28,684	28,684	29,401	28,615	29,401	29,401	29,401
						High-Income						
USG	-0.053	-0.119	-0.215	111.434	45,360.937***	41,025.139***	4,335.798	0.105	0.801***	-0.254*	-0.118***	-0.194
	(0.149)	(0.214)	(0.144)	(869.227)	(13,041.122)	(9,962.374)	(6,124.995)	(0.207)	(0.283)	(0.133)	(0.045)	(0.222)
Observations	19,036	19,036	19,274	19,183	18,890	18,890	18,890	19,274	18,833	19,274	19,274	19,274

Appendix A – Appendix Figures and Tables

Appendix Table A1 - Comparing All SAT Takers with Those Matched to Credit Bureau Data

	All Georgia SAT Takers (n = 290,145)		Georgia SAT Takers, Matched to Credit Bureau (n = 281,681)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Female	0.546	0.498	0.547	0.498
White	0.603	0.489	0.606	0.489
Black	0.266	0.442	0.267	0.443
Low-Income	0.321	0.467	0.320	0.467
Late SAT Taker	0.442	0.497	0.440	0.496
First SAT	965.7	190.1	966.6	190.0
Above USG Minimum (Access)	0.657	0.475	0.660	0.474
Enroll in USG	0.379	0.485	0.385	0.487
Enroll in 4-Year College	0.617	0.486	0.625	0.484
Enroll in 2-Year College	0.205	0.404	0.207	0.405
Earned BA in 6 Years	0.428	0.495	0.434	0.496
Estimated Income	71,559	35,429	71,559	35,429
Credit Score Above 600	0.730	0.444	0.730	0.444
Credit Score Above 700	0.457	0.498	0.457	0.498
Delinquent on any Payments in Last Year	0.153	0.360	0.153	0.360
Total Past Due in Last Year	115	1,197	115	1,197
Total Outstanding Loans	22,797	46,823	22,797	46,823
Outstanding Government Student Loans	20,505	43,462	20,505	43,462
Outstanding Private Student Loans	2,292	13,952	2,292	13,952
Any Student Loans Past Due in Last Year	0.080	0.271	0.080	0.271
Any Mortgage	0.230	0.421	0.230	0.421
Ever Bankrupt	0.021	0.144	0.021	0.144
Lives in Georgia in 2017	0.764	0.425	0.764	0.425
Matched to Credit Data	0.971	0.168	1.000	0.000

Appendix Table A2 - Covariate Balance

	Female	White	Black	Hispanic	Low-Income	First SAT Score
Access	0.005	0.014**	-0.020***	0.001	-0.011	0.793
	(0.006)	(0.005)	(0.005)	(0.002)	(0.007)	(0.607)
Observatic	68,101	68,101	68,101	68,101	68,101	68,101
R-squared	0.002	0.034	0.034	0.001	0.009	0.676

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix Table A3 - The Impact of Enrolling in USG College on Estimated Income, Robustness Tests, Instrumental Variables

	BW = 30	*BW = 40*	*BW = 50*	*BW = 60*	*BW = 70*	*BW = 80*	*BW = 90*	*Triangular Weight*	*Covariates*
					All				
USG	11,411.126***	15,996.255***	10,531.296**	16,458.288***	15,825.449***	14,484.140***	12,053.474***	15,820.677***	11,374.788***
	(3,455.888)	(4,439.092)	(4,522.489)	(3,799.591)	(3,031.393)	(2,509.187)	(2,743.547)	(4,010.876)	(3,513.334)
Observations	38,737	48,145	57,781	66,356	73,791	80,480	86,664	62,059	66,356
					Black				
USG	-3,417.691	6,094.185	3,786.862	5,110.233	3,581.750	2,793.037	2,979.442	5,553.173	4,891.035
	(3,080.141)	(5,872.864)	(4,010.691)	(3,686.997)	(3,394.044)	(2,747.264)	(2,502.790)	(4,347.377)	(4,132.340)
Observations	14,727	18,328	22,151	25,466	28,366	30,931	33,293	24,376	25,466
					White				
USG	7,934.122	-4,653.005	-949.264	11,591.002	10,130.193	11,928.761**	7,804.608	12,924.328*	12,334.776
	(14,588.161)	(16,996.675)	(14,999.529)	(7,709.990)	(6,877.358)	(5,615.981)	(5,652.766)	(7,639.626)	(8,516.098)
Observations	19,141	23,809	28,459	32,659	36,206	39,505	42,524	29,953	32,659
					Low-Income				
USG	1,160.995	15,270.037	1,271.035	10,946.574*	12,148.948**	13,826.633***	10,309.591**	10,890.760*	4,653.480
	(4,071.270)	(10,854.691)	(5,143.998)	(5,599.327)	(5,812.585)	(4,673.291)	(4,440.582)	(6,589.442)	(5,100.796)
Observations	16,692	20,717	24,860	28,615	31,832	34,716	37,299	27,002	28,615
					High-Income				
USG	29,920.516*	6,868.752	-1,703.845	6,221.903	4,838.057	5,507.083	5,646.885	5,633.637	8,669.128
	(18,143.774)	(10,866.402)	(15,210.512)	(12,406.272)	(11,508.416)	(10,415.204)	(9,871.841)	(13,594.449)	(13,665.486)
Observations	10,970	13,713	16,417	18,833	20,883	22,791	24,584	17,354	18,833

Appendix Table A4 - The Impact of Enrolling in USG College on Log Estimated Income, Robustness Tests, Instrumental Variables

	BW = 30	*BW = 40*	*BW = 50*	*BW = 60*	*BW = 70*	*BW = 80*	*BW = 90*	*Triangular Weight*	*Covariates*
					All				
USG	0.196***	0.239***	0.181**	0.252***	0.239***	0.231***	0.190***	0.235***	0.179***
	(0.074)	(0.076)	(0.083)	(0.066)	(0.060)	(0.049)	(0.050)	(0.066)	(0.065)
Observations	38,737	48,145	57,781	66,356	73,791	80,480	86,664	62,059	66,356
					Black				
USG	0.039	0.148*	0.112*	0.139**	0.110**	0.102**	0.094**	0.144**	0.136**
	(0.058)	(0.088)	(0.066)	(0.059)	(0.053)	(0.042)	(0.038)	(0.072)	(0.065)
Observations	14,727	18,328	22,151	25,466	28,366	30,931	33,293	24,376	25,466
					White				
USG	0.145	-0.105	-0.014	0.089	0.089	0.125	0.075	0.101	0.096
	(0.250)	(0.307)	(0.262)	(0.139)	(0.126)	(0.104)	(0.099)	(0.132)	(0.155)
Observations	19,141	23,809	28,459	32,659	36,206	39,505	42,524	29,953	32,659
					Low-Income				
USG	0.036	0.249	0.062	0.212**	0.219**	0.252***	0.204***	0.225	0.117
	(0.116)	(0.172)	(0.102)	(0.108)	(0.096)	(0.082)	(0.072)	(0.137)	(0.098)
Observations	16,692	20,717	24,860	28,615	31,832	34,716	37,299	27,002	28,615
					High-Income				
USG	0.530**	0.134	-0.026	0.041	0.042	0.044	0.050	0.031	0.070
	(0.243)	(0.156)	(0.228)	(0.171)	(0.162)	(0.151)	(0.142)	(0.187)	(0.193)
Observations	10,970	13,713	16,417	18,833	20,883	22,791	24,584	17,354	18,833

Appendix Table A5 - The Impact of Enrolling in USG on College and Financial Outcomes, Early SAT Takers

	USG (Reduced-Form)	*Enroll in 4-Year*	*Enroll in 2-Year*	*BA in 6 Years*	*AA in 6 Years*
Access/USG	-0.003	-3.702	2.647	1.210	-2.873
	(0.007)	(10.887)	(8.864)	(3.228)	(8.473)
Observations	67,658	67,658	67,658	67,658	67,658

	Income	*Log (Income)*	*Income > $25k*	*Income > $50k*	*Income > $75k*	*Income > $100k*
USG	-57,962.050	0.113	-0.384	-2.378	4.145	0.434
	(259,522.000)	(1.448)	(1.387)	(8.835)	(12.823)	(2.032)
Observations	66,648	66,648	66,648	66,648	66,648	66,648

	Credit Score Above 600	*Credit Score Above 700*	*Delinquent on any Payments in Last Year*	*Total Past Due in Last Year*	*Total Outstanding Loans*	*Outstanding Government Student Loans*	*Outstanding Private Student Loans*	*Any Student Loans Past Due in Last Year*	*Any Mortgage*	*Ever Bankrupt*	*Lives in Georgia in 2017*
USG	0.462	0.271	1.190	1,815.056	-140,863.386	-128,947.612	-11,915.774	-0.936	-1.119	0.436	-1.267
	(4.220)	(3.899)	(2.649)	(4,623.579)	(431,539.372)	(426,257.120)	(96,341.859)	(3.259)	(3.730)	(1.067)	(2.421)
Observations	67,030	67,030	67,658	67,388	66,815	66,815	66,815	67,658	67,657	67,658	67,658

Appendix B – TransUnion Credit Bureau Data

B.1. – Matching Process

The College Board securely sent TransUnion the CLEP data, including first and last name, birthdate, social security number, and home address, as listed when registering for CLEP. Not all exam takers have complete information, but a vast majority do.

TransUnion then performed the match using their proprietary matching algorithm. They then de-identified the data and securely sent it back to the College Board, destroying it immediately upon sending such that in the end, no party had matched identifiable data. The procedure resulted in an approximately 90 percent match rate, which is similar to Scott-Clayton and Zafir (2016) who perform the analysis with Equifax credit bureau for all West Virginia public school students. In our analytic sample, the match rate is 97 percent. All observations were returned to the College Board, regardless of match status.

B.2. – Variable Definitions

Our Variable Name	TransUnion Definition	Our Operation
Estimated Income*	CreditVision Income Estimator	
Credit Score*	VantageScore3.0	Must discretize when outcome
Delinquent on Outstanding Debt in Last 12 Months	Total past due amount of open trades verified in past 12 months	Equals 1 if value >=0, otherwise equals 0
Total Past Due in Last 12 Months	Total past due amount of open trades verified in past 12 months	
Outstanding Government Student Loans	Total balance of open government student loan trades updated in the past 12 months	
Outstanding Private Student Loans	Total balance of open student private loan trades updated in the past 12 months	
Delinquent on Outstanding Student Loans in Last 12 Months	Months since most recent student loan delinquency	Equals 1 if value between 0 and 12, otherwise equals 0

Has Mortgage	Number of open mortgage trades verified in past 12 months	Equals 1 if value >=1, otherwise 0

* We separately discuss these outcomes in the next section.

B.3. Estimated Income

With its proprietary algorithm, TransUnion uses a wide range of financial characteristics to estimate a consumer's joint gross adjusted income (line 37 of the 1040 federal tax form). This algorithm is based on multiple income sources including: investment income, alimony, business income, IRA distributions, pensions and annuities, real estate income, unemployment compensation, and Social Security benefits. In addition, debt service parameters are also factored in such as: monthly spend data, and up to 30 months of extended account history. This history includes credit lines, length of credit history, historical credit card balances, and recent credit card transactions.[8] The estimate does not account for whether someone is employed, but rather predicts a value that is restricted to between $0 and $1 million.

In Figure B1, we compare the median earnings from the College Scorecard to the TransUnion income estimator. To do so, we used the College Board sample of approximately 17 million observations matched to TransUnion data (and National Student Clearinghouse). This allows us to construct college-specific incomes for different cohorts, similar to the reporting level in the College Scorecard.[9]

The left panel plots college level median earnings from the College Scorecard versus median estimated income from TransUnion for students eight years after initial enrollment. The 45-degree line represents a one-to-one correspondence. Most dots are below the 45-degree line, suggesting that the TransUnion income estimator is substantially higher than the Scorecard earnings. However, this is largely a level shift, as the slope of the regression line is parallel to the 45-degree line. This makes sense since the income estimator is joint income and not just earnings, as in the Scorecard. Also, the correlation is about 0.7. The right panel shows colleges where at

[8] Further details on potential uses for the TransUnion CreditVision Income Estimator can be found at https://www.transunion.com/resources/transunion/doc/products/resources/product-creditvision-income-estimator-as.pdf.

[9] The College Scorecard includes all students who received federal financial aid. The College Board data contains observations for people who did and did not receive financial aid, but misses students who did not take the PSAT, SAT, or Advanced Placement exams.

least 80 percent of students enrolled appear in the College Board data. We see the correlation jump to almost 0.8 but the slope of the line changes. We observe similar patterns in Figure B2, which performs the same exercise for students 10 years since initial enrollment.

Overall, we view this as compelling evidence that TransUnion's income estimate contains accurate and valuable information about an individual's income.

B.4. Credit Score

The credit score is known by TransUnion as the VantageScore 3.0. The score was developed jointly by TransUnion, Equifax, and Experian, and is used by many major lenders across the U.S. It serves as their alternative to the FICO score, as it analyzes 24 months of an individual's credit history to develop a score between 300 and 850.

Due to privacy concerns, TransUnion requires that we do not use this raw credit score as an outcome. Consequently, we dichotomize it in several ways, such as credit score greater than or equal to 600 or separately, greater than or equal to 700.

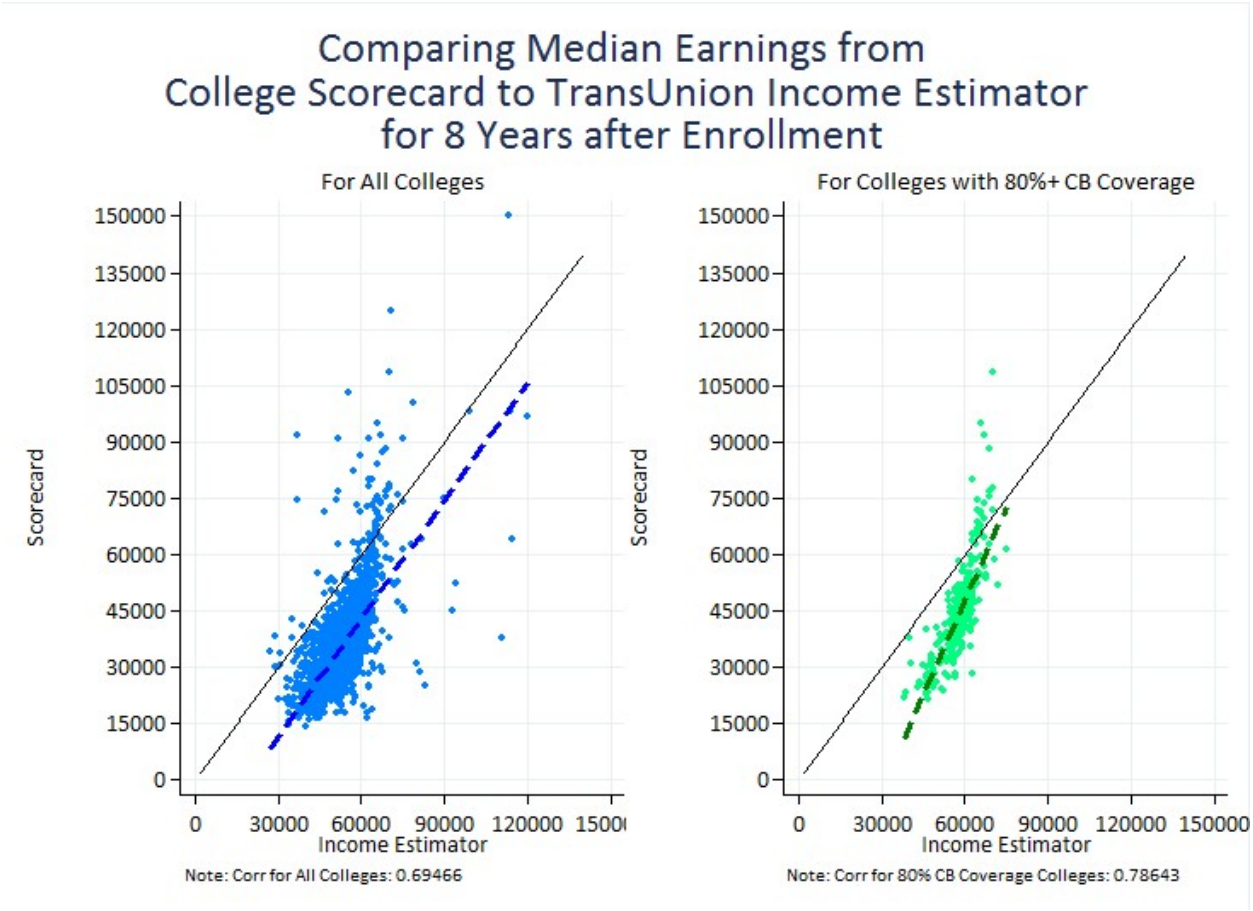
B.5. – Matching, Missingness, and Identification

Our primary specification in equation (1) relies on no strategic manipulation around the USG admission threshold. One concern is that our matching with TransUnion data is somehow related to earning those admission relevant SAT scores. For example, perhaps earning a 430 on math and 400 on verbal improves college completion rates, which in turn increases the odds of opening credit cards, which creates a credit history. This could bias our results in unknown ways, depending on what type of person receives the credit history.

We formally test for such endogenous match rates in Appendix Table B1. To do so, we test whether there was a successful match with TU data for the full Georgia sample and all the subgroups we consider.

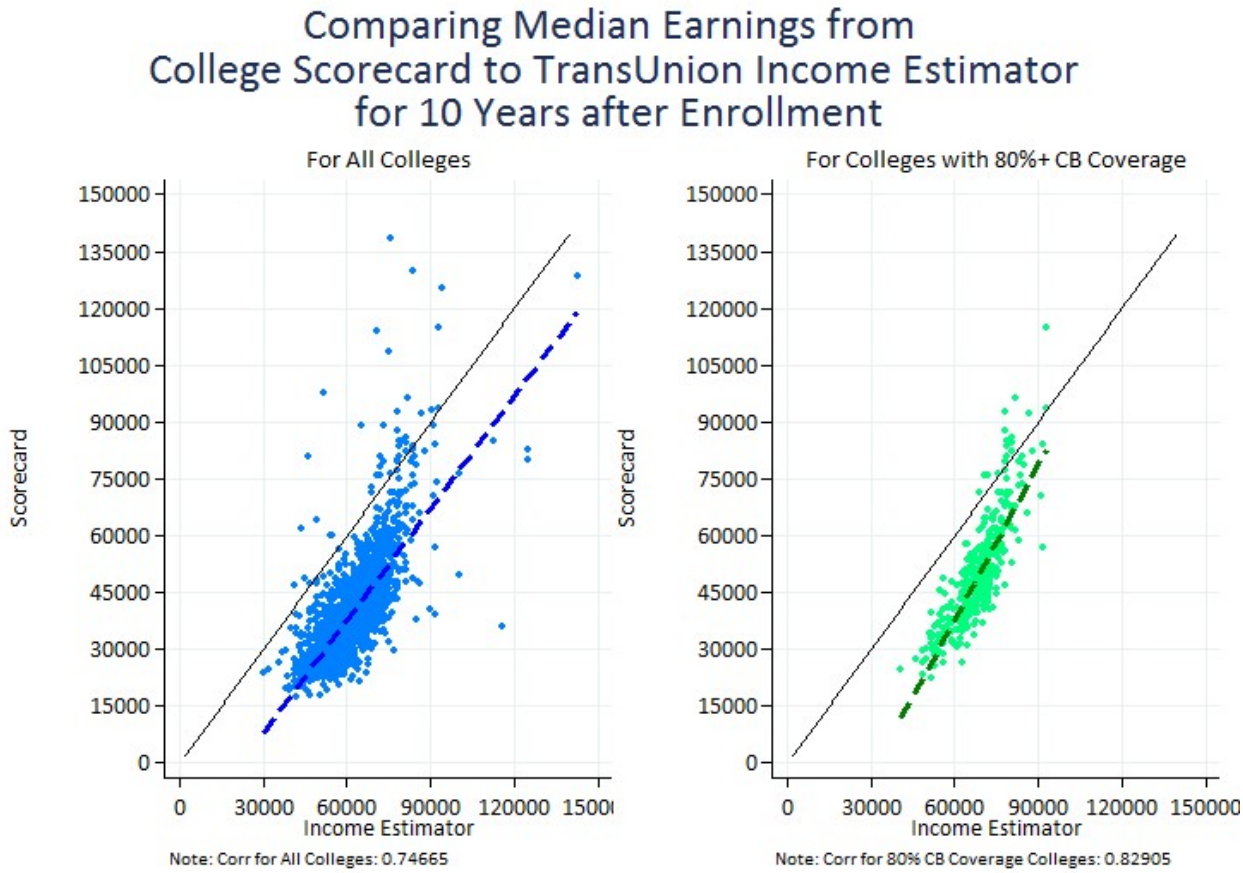
The table shows that we do not see a discontinuous match rate for students just above the USG admission threshold, regardless of subgroup. We take this as evidence that our identification strategy is not threatened by the matching process.

Figure B1



Notes: Scorecard data are from the College Scorecard aggregated data at the college-year level, which is freely available online. Income estimator comes from TransUnion credit bureau. It is merged to individual-level CLEP data and aggregated to the college-year level.

Figure B2



Notes: Scorecard data are from the College Scorecard aggregated data at the college-year level, which is freely available online. Income estimator comes from TransUnion credit bureau. It is merged to individual-level CLEP data and aggregated to the college-year level.

Appendix Table B1 - Matching College Board to TransUnion Data

	All	Late SAT Takers	Late SAT Takers, Black	Late SAT Takers, White	Late SAT Takers, Low-Income	Late SAT Takers, High-Income
Access	-0.001	0.001	-0.000	-0.000	0.004	-0.006
	(0.001)	(0.003)	(0.005)	(0.002)	(0.002)	(0.004)
Observations	139,921	70,404	26,693	34,502	30,335	19,765
R-squared	0.000	0.000	0.001	0.000	0.001	0.001

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1