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Access to Four-Year Public Colleges and Degree Completion
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ABSTRACT

Does access to four-year colleges affect degree completion for students who would otherwise attend two-year colleges? Admission to Georgia's four-year public sector requires minimum SAT scores. Regression discontinuity estimates show that access to this sector increases four-year college enrollment and college quality, largely by diverting students from two-year colleges. Access substantially increases bachelor's degree completion rates for these relatively low-skilled students. SAT retaking behavior suggests students value access to four-year public colleges, though perhaps less than they should. Our results imply that absolute college quality matters more than match quality and suggest potential unintended consequences of free community college proposals.

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1 Introduction

A 2014 White House summit on college access reported that:

> Too few low-income students apply to and attend colleges and universities that are the best fit for them, resulting in a high level of academic undermatch... Students who attend selective institutions, which tend to have more resources available for student support, have better education outcomes, even after controlling for student ability (White House, 2014).

We have clear evidence that students, particularly low-income ones, do not attend the highest quality colleges available to them (Bowen et al., 2009; Dillon and Smith, 2013; Smith et al., 2013; Hoxby and Avery, 2013) and that initial college choices can be altered by relatively low-cost interventions (Pallais, 2015; Bettinger et al., 2012; Hoxby and Turner, 2013; Carrell and Sacerdote, 2013; Castleman et al., 2014; Smith et al., 2015). Less clear is the extent to which changing such college choices affects students' longer-run outcomes such as degree completion and labor market earnings.

Whether the type and quality of college chosen affects such outcomes bears directly on a number of economic and policy questions. These include: the extent to which postsecondary institutional factors explain dropping college completion rates among U.S. college enrollers (Belley and Lochner, 2007; Bound et al., 2010; Bailey and Dynarski, 2011); the relative importance of "match" quality versus absolute quality (Dillon and Smith, 2013) and how that, in turn, informs debates about affirmative action (Arcidiacono and Lovenheim, 2016); the extent to which informational interventions like the College Scorecard website can improve student outcomes by changing college choices (Hurwitz and Smith, 2016); and, finally, what impact recent proposals to make community college free will have on students choosing between that sector and other options.

Identifying the impact of college choice on longer-run outcomes requires separating student-level factors, such as academic skill and financial resources, from college-level factors, such as funding levels or operational efficiency. The non-random selection of students into colleges of different types and qualities generally confounds attempts to do so. The major empirical challenge is thus to find an exogenous source of variation in college choice. We do so by exploiting minimum test score thresholds used during the college admissions process. Such thresholds are used by one in five U.S. colleges (Briggs, 2009) and by many states' public college systems, including California, Florida and Texas, though often in combination with high school GPA.

We focus on Georgia's state university system (GSUS), which publicly announces minimum SAT scores that are required for first-year admission, irrespective of high school GPA. Such thresholds play an important role in access to the state's public four-year college sector. Regression discontinuity estimates around these minimum thresholds show that access to the four-year public sector increases both the probability of enrollment in any four-year college and the quality of college chosen, largely by diverting students from two-year colleges. Most importantly, access substantially increases bachelor's degree completion rates for these relatively low-skilled students. Missing these thresholds increases SAT retaking rates, suggesting that students value access to the four-year public sector, though perhaps less than the completion benefits suggest they should.

Our works contributes in three ways to existing literature on the impacts of college choice. First, this is the only research in the U.S. context to document the impact of test score-based access to an entire college sector. Our results are driven by one state's set of four-year public colleges, not the potentially idiosyncratic effect of a single college. In this sense, our work resembles recent research exploiting Colombian and Chilean national systems of college admissions thresholds to estimate the impact of college quality and sector on a variety of labor market and other outcomes (Saavedra, 2008; Kaufmann et al., 2013; Hastings et al., 2013).

Our second contribution is to cleanly identify college choice impacts for relatively low-skilled students choosing largely between two- and four-year colleges. Much of the literature estimating the impact of college choice on graduation rates and earnings focuses on higher-skilled students exposed to quality differences within the four-year sector, including the Latin American studies cited earlier, and U.S. studies based on selection on observables models (Black et al., 2005; Black and Smith, 2004, 2006; Long, 2008; Dale and Krueger, 2014), twin fixed effects models (Smith, 2013) and regression discontinuity designs (Hoekstra, 2009; Cohodes and Goodman, 2014). Our focus on low-skilled students supplements evidence that college quality matters for high-skilled students.

Our results are also consistent with previous evidence of a graduation rate penalty associated with choosing a two-year instead of a four-year college (Rouse, 1995, 1998; Leigh and Gill, 2003; Long and Kurlaender, 2009; Reynolds, 2012; Smith and Stange, 2015). Such a penalty may stem from the substantial differences across these two sectors along multiple dimensions, including peer quality, faculty quantity and quality, and funding levels more generally, which affect the quantity and quality of academic resources available to students. Our work is closest in spirit to Zimmerman (2014), in which relatively low-skilled students who would otherwise attend community colleges see substantial labor market returns to access to the least selective four-year public college in Florida. Our demonstration that college quality affects degree completion for such students may explain part of the labor market return observed in that and other contexts.[1]

Our third contribution is to connect test retaking behavior to demand for access to a particular set of colleges, in this case the public four-year sector. Prior research on SAT-taking behavior has shown increased retaking to achieve round-numbered scores (Pope and Simonsohn, 2011) or to increase maximum scores (Vigdor and Clotfelter, 2003), which are an important factor in an increasingly competitive admissions process (Bound et al., 2009). Jepsen et al. (2016) also find substantial retaking of certification exams in order to earn a GED. We document increased rates of test retaking in response to failing to meet publicly known college admissions thresholds. These thresholds have no significance outside of the GSUS admissions process. Increased retaking rates thus indicate that students value access to the four-year public sector, perhaps in part because they perceive the degree completion benefits such access brings. This is the first paper we are aware of to document SAT retaking as evidence of demand for a particular college sector.

The structure of the remainder of the paper is as follows. Section 2 describes the data, the context studied here, and our regression discontinuity methodology. Section 3 presents summary statistics and evidence on the strength of our first stage and the validity of our empirical design. Section 4 describes our enrollment and completion results. Section 5 discusses the broader implications of our results.

2 Data, Context and Empirical Strategy

2.1 Data

We use student-level data for the graduating high school classes of 2004-08, collected from two sources. The first data set, collected and maintained by the College Board (CB), contains information on the nearly 1.5 million students in each high school graduation cohort who take the SAT at least once, a test many four-year colleges require for admission. The SAT contains a math and critical reading section, each of which is scored in increments of 10 on a scale between 200 and 800.[2] Students may retake the SAT as often as the testing schedule permits, with each test administration costing roughly $40 during the time period studied here. Fee waivers are available to low-income students taking the exam for the first or second time.

The CB data contain all scores students ever receive across multiple test takes, as well as the dates of those takes, allowing us to identify both first and maximum SAT scores. College admis-

[1] Canaan and Mouganie (2015) also find labor market returns attributable to college quality for relatively low-skilled French students.

[2] A third section on writing does not play a role in the thresholds studied here.

sions offices frequently rely on students' maximum scores, defined as the sum of their maximum math and critical reading scores regardless of whether they were earned on the same test date. Though we use this maximum score for some analyses, we focus largely on students' first SAT scores to avoid potentially endogenous retaking behavior. The CB data identifies colleges to which students send their SAT scores, which serve as good proxies for actual college applications (Card and Krueger, 2005; Pallais, 2015). The data also contain self-reported information on student race, gender, parental income and education, as well as high school attended. Self-reported year of high school graduation is used to assign students to graduating classes.

These data are then merged with data from the National Student Clearinghouse (NSC), which collects information on the vast majority of students enrolled in U.S. postsecondary institutions. In the years studied here, the NSC captured somewhere between 90 and 95 percent of all Georgia students enrolled in Title IV institutions, according to Dynarski et al. (2015).[3] Data from the NSC allow us to track a student's postsecondary trajectory including initial enrollment and ultimate degree completion. We focus on the 2004-08 high school graduation classes for whom we can observe six-year college graduation rates.

Measuring college quality across the two- and four-year sectors is difficult because traditional data sources such as the Integrated Postsecondary Education Data System (IPEDS) lack comparable measures between the two sectors. IPEDS contains average SAT scores of incoming students at four-year colleges but does not have any similar measure for two-year colleges, which generally do not require students to have taken the SAT. IPEDS is also limited by the fact that degree completion rates reported by colleges do not account for the outcomes of transfer students, a particularly acute problem for the two-year sector, which is designed in part to facilitate transfers to the four-year sector.

We therefore use the merged CB and NSC data to construct measures of college quality that are comparable across these sectors. To measure student quality, we follow Smith and Stange (2015) and assign each college the average score of that college's first-time students on the PSAT, a College Board test taken by high school sophomores and juniors, including many who do not later take the SAT. We standardize PSAT scores by cohort to have mean zero and standard deviation one. We thus assign each student a standardized measure of the quality of peers to whom he is exposed at his initial college. For students who do not initially enroll in college within one year of graduating high school, we assign a value of -0.54 standard deviations, which represents the average standardized PSAT score for all such students.

[3] See Table 2, where the enrollment coverage rate for Georgia ranges from 89.9% in 2005 to 94.8% in 2011. Other mid-Atlantic and Southeast states look similar. Some of those not captured by NSC may be enrolling in for-profit institutions.

To measure institutional degree completion rates, we identify all SAT-takers who enroll in that college and then compute the fraction of such students who complete a bachelor's degree from any institution within six years. This measure has the advantage of being computable for both the two- and four-year sectors, as well as including transfer students among those degree recipients. For students who do not initially enroll in college within one year of graduating high school, we assign a value of 6.7 percent, which represents the average six-year bachelor's degree completion rate for all such students.

2.2 Georgia Context

The main analytic sample consists of all students residing in the state of Georgia at the time of taking the SAT. Georgia's Board of Regents requires that SAT-takers score at least 430 in critical reading and at least 400 in math in order to be admitted to universities within the Georgia state university system. The set of 18 four-year universities governed by this requirement consist of three research universities, two regional universities, and 13 state universities.[4] Five of the 18 universities impose higher minimum thresholds than required by the Board of Regents, though only two impose substantially higher thresholds. Georgia's state and technical colleges, all of which are primarily two-year institutions, impose much lower minimum thresholds.

The Georgia context is interesting for three reasons. First, these thresholds apply to all students considering four-year public institutions in Georgia. As we show later, over 60% of Georgia students near these thresholds who enroll in four-year colleges do so in these GSUS institutions. These thresholds thus affect the majority of college options for students in this market. Second, the GSUS minimum admissions thresholds correspond to roughly the 25th percentile of the distribution of scores among Georgia SAT-takers in the years in question. The marginal student here has relatively low academic skills and is often choosing between two- and four-year colleges. Third, the public nature of these requirements means that students can, in theory, take the thresholds into account when planning their college application process. We explore whether students do, in fact, plan around these thresholds.

2.3 Empirical Strategy

To eliminate selection bias driven by different types of students making different college choices, we exploit the thresholds previously described. We use a regression discontinuity design to compare a variety of outcomes between students just above and below these thresholds. We generate

[4]See Table A.1.

first stage estimates through local linear regressions of the form:

$$GSUS_{ic} = \alpha_0 + \alpha_1 Access_{ic} + \alpha_2 Distance_{ic} + \alpha_3 Access_{ic} * Distance_{ic} + \gamma_c + \mu_{ic} \quad (1)$$

Here, *GSUS* 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 satisfying the SAT admissions requirements on enrollment in Georgia's four-year public sector.

We estimate the impact of access on outcomes through reduced form regressions of the form:

$$Y_{ic} = \rho_0 + \rho_1 Access_{ic} + \rho_2 Distance_{ic} + \rho_3 Access_{ic} * Distance_{ic} + \sigma_c + \nu_{ic} \quad (2)$$

We consider three different sets of outcomes Y. The first are measures of enrollment in other college sectors, in order to estimate which types of colleges students are forgoing when enrolling in the four-year public sector. The second are the measures of college quality mentioned previously, namely student quality and institutional completion rates, in order to estimate how enrollment in the four-year public sector changes the quality of one's initial college. The third are various measures of students' degree completion, in order to estimate the impact of initial college choice on completion rates.

We also generate instrumental variable estimates of the form:

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

where $GSUS$ is instrumented by access according to equation 1. The coefficient of interest, β_1, estimates the impact of enrollment in the four-year public sector on the outcomes mentioned above. Using GSUS as the endogenous regressor allows us to capture the full set of marginal students whose enrollment decisions were altered by the thresholds.[5] 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 in no college at

[5]Using four-year college enrollment as the endogenous variable, for example, would yield estimates that failed to account for the empirically important fact that the thresholds shift some students between private and public four-year colleges.

all.

In Georgia, a student must score at least 430 in reading and at least 400 in math. We therefore define distance from the threshold as:

$$Distance = \min(SAT_R - 430, SAT_M - 400) \tag{4}$$

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 Goodman (2008) and Papay et al. (2014). We show that our estimates are quite similar if we instead define the running variable as distance to just the math threshold or just the verbal threshold.

Because Georgia's admissions thresholds are publicly known, we define each student's distance from the threshold using that student's first SAT scores. This is similar to the approach used by Jepsen et al. (2016), who evaluate the labor market return to earning a GED. First scores do not suffer from potential endogeneity driven by any retaking of the SAT in reaction to scoring below the thresholds. We will provide evidence that, though there is endogenous retaking of SAT in reaction to the thresholds, the magnitude of that endogeneity is quite small. Using maximum scores to define the running variable yields estimates generally similar in magnitude but more precise than those generated by first scores. This increased precision comes from the stronger first-stage relationship between maximum scores and enrollment because maximum scores are the ones considered during the admissions process.

We run the local linear regressions above using bandwidths of 60 SAT points, which corresponds closely to the optimal bandwidths suggested by Imbens and Kalyanaraman (2012) to balance precision against minimization of bias due to nonlinearities far from the threshold. Such optimal bandwidths vary by outcome, so fixing the bandwidth across regressions has the advantage of defining a single sample clearly. We show that our estimates are not sensitive to this bandwidth choice. We cluster standard errors by discrete distance to the threshold, as suggested by Lee and Card (2008). Clustering instead by high school yields very similar standard errors.

3 Summary Statistics and Validity of the Research Design

3.1 Summary Statistics

Table 1 presents summary statistics for Georgia residents from the high school classes of 2004-08. As seen in column 1, this sample is 60 percent white and 26 percent black. Nearly one-third of students are low income, defined here as reporting annual family income of less than \$60,000.[6] The average student in this sample has a first SAT score of 967 and two-thirds have first SAT scores sufficiently high to satisfy the GSUS minimum thresholds. The marginal student studied here is thus at the 34th percentile of the skill distribution of Georgia SAT takers. Most students retake the SAT at least once, so that 73 percent ultimately meet the GSUS thresholds. 37 percent first enroll in a GSUS college within one year of graduating high school, while 61 percent enroll in any four-year college. This implies that three-fifths of students who enroll in a four-year college do so in the in-state public sector. Another 20 percent first enroll in a two-year college. Only 45 percent complete a bachelor's degree within six years of graduating high school.

Our main regression discontinuity sample, shown in column 2, includes those students whose first SAT scores fell within 60 points of the GSUS eligibility threshold. Compared to the overall Georgia sample, these students are slightly more likely to be black and from low income families, score 60 points lower on the SAT, and are less likely to complete a bachelor's degree. We also focus on subgroups of students whose initial college choices are particularly likely to be affected by differences in SAT-based access to the four-year public sector. Such students may lack the resources or information to make application and test retaking decisions that would otherwise limit the extent to which such thresholds constrain their college options.

We use income and SAT-taking dates as two ways to identify subgroups who are likely "disadvantaged" along these dimensions. Low income students, who report family income less than \$60,000 and who comprise one third of the RD sample, are likely constrained financially and along other dimensions.[7] Late SAT takers, who first take the SAT no more than 12 months prior to high school graduation and who comprise one half of the RD sample, are likely less knowledgeable about the college application process generally and about the value of having time to retake the SAT. Given the particular challenges faced by African-Americans in the Georgia context, we also use the intersection of race, income and SAT timing to identify two subgroups of students whom we refer to as "very disadvantaged." One such group are black students from families earning less

[6]The remaining two thirds of students are roughly evenly split between those reporting income over \$60,000 and those not reporting income.

[7]Because one third of the sample does not report income, this threshold identifies the bottom half of the income-reporting distribution. None of our results are sensitive to choosing a lower income threshold to define "low income."

than \$30,000 annually. The other are black students who first take the SAT no more than 6 months prior to high school graduation. We focus on such disadvantaged students both because they are inherently of interest and because they show particularly strong first-stage impacts of the GSUS thresholds on college enrollment. None of our central findings is sensitive to the precise choices that define these groups.

3.2 Validity of the Research Design

We perform two checks that our regression discontinuity design satisfies the key assumption that students on either side of the threshold are similar in terms of observed and unobserved characteristics. First, following McCrary (2008), we check for smoothness in the density of observations, violation of which could suggest that students can at least partially control which side of the threshold they fall on.[8] In the Georgia sample, the density of observations is nearly identical just below and just at the threshold. This suggests students can not manipulate their first SAT scores, an unsurprising result given that SATs are centrally scored and students do not know precisely how scaled scores are generated.

Second, we test for balance in observed covariates across the threshold, for the entire sample as well as for our disadvantaged and very disadvantaged subsamples.[9] Consistent with students' inability to precisely manipulate which side of the threshold they initially fall on, we see little indication of imbalance in observed covariates such as income, parental education, race and gender. The few observed differences are small in magnitude and the number is consistent with the rate of false positives expected given the number of tests being performed. We perform joint tests of imbalance by generating predicted four-year college enrollment and bachelor's degree completion rates, based on students' gender, race, income and parental education. What little evidence we observe of imbalance in predicted outcomes is very small in magnitude and opposite in sign to our subsequent results, again suggesting that our main findings are not generated by imbalance in student types across the threshold. Graphical versions of these balance tests for income and predicted degree completion show no visually apparent discontinuities.[10] We show in later robustness checks that controlling for all observed covariates does not meaningfully change our point

[8]See Figure A.1, which graphs the density of SAT takers as a function of distance of first SAT scores from the admissions threshold. The closed circles represent our Georgia sample and the open circles represent SAT takers from all other states during this time period. The density of observations has a local peak 10 points above the threshold due to the fact that certain scaled scores were more common translations of raw scores during this time period. That this peak appears off the threshold and appears in the non-Georgia sample as well suggests it is unrelated to the GSUS eligibility criteria and thus poses no threat to validity here.

[9]See Table A.2.

[10]See Figure A.2.

estimates, providing further evidence that students on either side of the threshold are practically identical.

4 College Enrollment and Completion Effects

4.1 First Stage

We now show that the GSUS minimum admissions thresholds generate exogenous variation in the probability that a student enrolls in a GSUS college. Figure 1 shows graphically the relationship between distance to the threshold and the probability of enrolling in one of Georgia's four-year public colleges. Panel A, which defines distance using maximum SAT scores, shows a clear and large discontinuity, with students just above the threshold substantially more likely to enroll in the four-year public sector than those just below it. GSUS enrollment below the threshold is non-zero for two reasons. First, students can also gain admission through the ACT exam, the SAT's primary alternative, taken by roughly 30% of Georgia's high school classes of 2004-08. Second, each institution may exempt individual students from these minimum thresholds if such students otherwise demonstrate potential for success through interviews, portfolios or life experiences.

Because the maximum SAT score is potentially endogenous, we present this graphical evidence only to show that GSUS colleges clearly use the SAT thresholds as part of the admissions process. Our first stage will be generated instead by variations on panel B, which defines distance using first SAT scores. This graph also shows a discontinuity, albeit one much smaller than in panel A because GSUS colleges use maximum, and not first, SAT scores in the admissions process. Panel A of Table 2 confirms the existence of a small but clear discontinuity, showing regression estimates of the first stage impact of SAT-based access on enrollment in Georgia's four-year public colleges. For the sample of all students, meeting the GSUS thresholds increases the probability of GSUS enrollment by two to three percentage points. These estimates are relatively stable over a variety of bandwidths and are always highly statistically significant, so that access easily passes traditional tests for being a strong instrument.

Panel B of Table 2 shows little evidence that SAT thresholds affect college enrollment choices of "advantaged" students, those whose families earn over $60,000 or those who take their first SAT more than 12 months prior to high school graduation. Admissions thresholds instead affect disadvantaged students, for whom initial eligibility increases enrollment in GSUS colleges by about four percentage points, from a base enrollment rate of about 35-40 percentage points. Initial eligibility increases GSUS enrollment by an even larger seven to eight percentage points for very disadvantaged students, from a base of 26 percentage points. All of these first stage estimates are highly statistically significant and eligibility easily qualifies as a strong instrument in each of these disadvantaged subsamples. Figure 2 shows graphical versions of these disadvantaged subsamples' first stages. All four panels show visually obvious discontinuities in GSUS enrollment rates at the threshold and nowhere else.

SAT-based eligibility for admission to in-state four-year public colleges substantially and clearly affects the initial college enrollment choices of disadvantaged students and even moreso for students who are more disadvantaged. Students from relatively high income families and who are knowledgeable enough about the admissions process to take the SAT prior to senior year are unaffected by the GSUS thresholds in part, as we show later, because they are more likely to gain eligibility through subsequent retakes of the SAT. We therefore focus our analysis on the Georgia sample as a whole and the disadvantaged subsamples for whom eligibility most changes initial college enrollment.

4.2 College Enrollment Effects

To understand why GSUS enrollment might affect degree completion, we first estimate which alternative college options the marginal student forgoes in order to enroll in the four-year public sector. Table 3 shows estimated impacts on the type and quality of the college chosen. Column 1 shows reduced form estimates of the impact of eligibility on the probability of enrolling in any four-year college. For the sample as a whole, eligibility increases four-year college enrollment by 1.7 percentage points. Consistent with effects on GSUS enrollment, eligibility impacts on four-year college enrollment are higher for disadvantaged students, around two to three percentage points, and even higher for very disadvantaged students, around five to six percentage points. These reduced form impacts can be seen graphically in Figure 3, where each disadvantaged subsample shows visually clear discontinuities in four-year college enrollment at the GSUS eligibility threshold.

The remaining columns in Table 3 present instrumental variables estimates of the impact of GSUS enrollment on the type and quality of college chosen. These estimates represent local average treatment effects for compliers, those students induced to enroll in GSUS because of their first SAT score-based eligibility. Column 2 suggests that, for the sample as a whole, enrolling in GSUS colleges increased by 81 percentage points the fraction enrolling in any four-year college. In other words, 81 percent of compliers would not have enrolled in a four-year college if not for enrollment in the in-state four-year public sector. Instead, 67 percent would have enrolled in a two-year college, another 15 percent would not have enrolled in any college, and the remaining 19 percent would have enrolled in either an in-state private or out-of-state four-year college.

Estimates for the disadvantaged subgroups tell a similar story. Two-thirds to three-fourths of disadvantaged or very disadvantaged compliers would not otherwise have enrolled in a four-year college, with roughly half instead choosing two-year colleges and a smaller fraction not enrolling anywhere. Eligibility for admission to the four-year public sector thus raises the rate of enrollment in four-year colleges largely by attracting students who would otherwise have enrolled in two-year colleges.

For the marginal student, enrollment in the four-year public sector changes not only the sector of college chosen but also the quality of college chosen, as measured by peer quality and institutional graduation rates. Relative to the foregone alternatives that largely consist of two-year colleges, enrollment in four-year public colleges increases the quality of a student's peers by one standard deviation, or by 0.6-0.9 standard deviations for the disadvantaged subsamples. Control complier means, computed as suggested by Abadie et al. (2002) and Abadie (2003), imply that GSUS enrollment raises peer quality from well below average to slightly above average. GSUS enrollment increases by 51 percentage points the average bachelor's degree completion rate of compliers' initial colleges, or by 28-39 percentage points for the disadvantaged subsamples. The control complier means imply this effect represents more than a doubling of the graduation rate of the institution chosen. As a whole, these results make clear that four-year public colleges in Georgia have substantially higher skilled students and higher degree completion rates than the alternatives the marginal student would otherwise have chosen. Access to the four-year public sector thus increases both the overall rate of four-year college enrollment and the quality of the college chosen.[11]

4.3 College Completion Effects

Our ultimate outcome of interest is the completion of a bachelor's degree from any institution within six years of high school graduation. The first two columns of Table 4 respectively show reduced form estimates of the impact of eligibility and instrumental variables estimates of the impact of GSUS enrollment on such completion rates. All such estimated impacts are large and at least marginally statistically significant. Discontinuities in degree completion are also visually apparent in most of the panels of Figure 4. For the sample as a whole, GSUS eligibility raises bachelor's degree completions rates by 0.9 percentage points. Scaled by the first stage, this implies that

[11] Though not shown here, access to the four-year public sector does not change the distance between a student's home and initial college. This suggests that proximity to college, or the probability of living at home while enrolled, does not explain the completion effects we document.

eligibility-induced enrollment into four-year public colleges raises the probability of completing a bachelor's degree by 41 percentage points. Estimated impacts on compliers in the disadvantaged subsamples are quite similar, ranging in magnitude from 29-43 percentage points. Low control complier means imply that, for the entire sample and all disadvantaged subsamples, enrollment in the four-year public sector at least triples bachelor's degree completion rates.

Three other facts are worth noting. First, the increase in bachelor's degree completion driven in part by a shift away from two-year colleges does not decrease associate's degree completion rates in any statistically significant way. This implies that few of the marginal students would have instead completed their associate's degrees if denied access to the four-year sector. Second, across most of the coefficients shown here, IV and OLS analyses yield estimates that are fairly close in magnitude and statistically indistinguishable. This suggests that our controls for academic skill, namely SAT scores, are rich enough to soak up much of the omitted variable bias one might otherwise worry about in non-quasi-experimental estimates. Third, comparing the estimates in column 2 to column 6 of the previous table suggests that differences in the institutional bachelor's degree completion rates of students' initial colleges explain quite well their own probabilities of bachelor's degree completion. In other words, institution-level completion rates predict individual completion rates of compliers fairly accurately, at least conditional on students' own academic skills.

All of the four-year college enrollment and bachelor's degree completion rate estimates are qualitatively robust to using alternative bandwidths and to the inclusion of demographic controls.[12] A number of placebo tests confirm that these results are not driven by spurious characteristics of the data or functional form assumptions of our specifications.[13] Shifting the thresholds in either direction diminishes the magnitude and statistical significance of the GSUS enrollment and bachelor's degree completion estimates, implying that the clearest discontinuities are at the correct thresholds themselves. The advantaged subsamples of students whose GSUS enrollment is unaffected by the thresholds also show no discontinuity in degree completion rates.[14] GSUS thresholds have no impact on the degree completion rates of low income students outside of Georgia for whom the GSUS admissions process is largely irrelevant. In summary, our observed effects appear only for disadvantaged students in Georgia and only at the precise values of the GSUS thresholds.

Our results also do not depend on our choice to use the minimum distance to the two thresholds as the running variable. We can replace that collapsed two dimensional measure with alternative one dimensional measures of distance to either the math or the verbal threshold, eliminating the

[12]See Table A.3.
[13]See Table A.4.
[14]Figure A.3 confirms this visually.

second dimension by conditioning the sample on satisfying the other subject's threshold. These alternatives lead to point estimates that are generally at least as large as those from the minimum distance measure and statistically significant for all disadvantaged subsamples.[15] Our estimates are thus robust to alternate definitions of the running variable.

4.4 SAT Retaking Behavior

Access to the in-state four-year public sector has large benefits to the marginal student studied here. We now provide evidence that the marginal student perceives at least some of the value of this option. Because the Georgia thresholds are publicly known, students who fail to meet those thresholds on their first attempt may retake the SAT in order to gain access to the in-state four-year public sector. Figure 5 shows the graphical version of this relationship between retake probability and distance from the GSUS threshold. Retake rates rise with SAT score in this part of the score distribution and near the threshold roughly 60 percent of students retake the exam. The figure shows a small but clear discontinuity, with those just below the threshold more likely to retake than those just above.

Table 5 presents formal estimates of this discontinuity, running reduced form equation 2 with SAT retaking measures as outcomes. We also replace the $Access$ variable with $1 - Access$, so that the coefficients can be interpreted as the impact of missing the thresholds, rather than achieving them, on one's first take. Panel A shows that, for the full sample, just missing the threshold increases the probability of retaking by three percentage points. This is clear evidence of demand for access to the four-year public sector, given that there is no other reason why this threshold should trigger differential retake rates. Given the degree completion benefits of access to this sector, however, this documented demand is arguably lower than it should be. Retaking the SAT is relatively inexpensive but would yield substantial gains in college access and completion for students near these thresholds.

We also document in panel B that, though retaking in reaction to the threshold does not vary much by income, overall levels of retaking do. At the threshold, 51 percent of low income students retake the SAT, with the mean student taking the exam 1.7 times. For non-low income students near the threshold, 66 percent retake for a mean number of takes of 2.0. Retaking rates are thus substantially higher for higher income students, even conditional on first SAT score. The result is that first SAT scores are a much stronger determinant of eventual access to GSUS for low in-

[15]See Table A.5. Figure A.4 shows the reduced form versions of these alternate measures for the subsample of late SAT takers, with clearly visible discontinuities in GSUS enrollment and bachelor's degree completion at both the math and verbal thresholds.

come students than for higher income students. As shown in column 3, retaking more frequently means that only 41 percent of non-low income students whose first SAT is just below the threshold ultimately fail to score high enough to qualify for access, compared to 60 percent of low income students. This at least partly explains why our first SAT score-based instrument is much stronger for low income students than their higher income counterparts.

These disparities are even more striking when comparing early to late SAT takers, as panel C does. Only thirty percent of early SAT takers who miss the threshold on their first take do not eventually score high enough to access the four-year public sector. Early SAT takers take the test an average of 2.3 times, with 80 percent retaking it at least once. Late SAT takers, who have less time to schedule retakes and may be less aware of the potential benefits of retaking, take the test an average of 1.47 times, with only 40 percent retaking it at least once. As a result, 70 percent of late SAT takers who fail to meet the thresholds on the first take ultimately fail to gain access to the four-year public sector.

Finally, though we provide clear evidence of endogenous retaking due to demand for access to the four-year public sector, the amount of such retaking is particularly small relative to overall retaking rates. Of the 60 percent of students just below the threshold who retake the SAT, roughly three percent, or one in twenty, are retaking specifically to gain access to GSUS. The remaining 57 percent are likely retaking to improve their college options generally and would have retaken in the absence of the minimum GSUS thresholds. Because overall retake rates are so high near the threshold, maximum SAT scores show small and often statistically insignificant discontinuities there, as seen in column 4.

The result is that, though we use first SAT scores throughout this paper, using maximum SAT scores to generate variation in college access is unlikely to introduce much endogeneity. Indeed, when we re-run our analyses using maximum SAT scores to generate the running variable, the magnitudes of our central estimates are still extremely large, statistically significant and more precisely estimated due to a much larger first stage.[16] These results also imply that access to the four-year public sector greatly increases bachelor's degree completion rates, with estimated impacts from instrumental variables models of similar magnitude to corresponding OLS estimates.

5 Discussion and Conclusion

For relatively low-skilled students in Georgia, access to the four-year public sector substantially increases bachelor's degree completion rates. It does so by increasing both the probability of

[16] See Table A.6, which replicates Table 4 using maximum SAT scores instead of first SAT scores.

enrollment in any four-year college and the quality of college chosen, largely by diverting students from two-year colleges. That students retake the SAT in order to gain access to the four-year public sector suggests they perceive at least some, though perhaps not all, of this benefit. We draw three broad lessons from these findings.

First, that small differences in test scores generate large differences in college choice suggests students are not applying to a continuum of college options, perhaps because such a continuum does not exist in the postsecondary market. In Georgia and other states, a student denied access to the four-year public sector does not have other options similar in both price and quality. Community colleges are less expensive but have less money to spend on faculty and other resources to support students progress toward degree completion. Private four-year colleges potentially of interest to the marginal student here can not match the public sector's tuition while maintaining comparable quality, given the in-kind nature of state subsidies for higher education. Regardless of the lack of such a continuum of college options, our results reinforce the benefits of encouraging students to make test-taking and application choices that maximize their available postsecondary options. The thresholds used by Georgia heighten the importance of such choices, with unclear benefits to the state more broadly.

Second, that college sector and quality affect degree completion for relatively low-skilled students is inconsistent with claims that disadvantaged students benefit from choosing colleges that enroll higher proportions of similar peers. By the nature of these minimmum thresholds, the marginal student in this study benefits, in terms of degree completion, from enrolling in a college where he is substantially less academically skilled than his peers. This implies that measures of absolute quality matter more than "match" quality. Our estimates reject the hypothesis that low-skilled students should be discouraged from choosing four-year colleges because they are incapable of completing degrees at such institutions. A substantial fraction of the marginal students we study do succeed in completing their bachelor's degrees, a result consistent with naïve OLS estimates. This finding also bears directly on the debate over affirmative action, as it contradicts the view that students benefit from attending colleges with less academically skilled peers.[17]

Third, our estimates suggest one potential concern about policies to reduce the cost of community college, such as the Tennessee Promise scholarship or the Obama administration's free community college proposal. Lowering such costs may improve college enrollment and degree completion for students who would not otherwise have attended college. By changing the relative

[17] A prominent example of this view arose during oral arguments for the *Fisher v. University of Texas at Austin* affirmative action case, when Supreme Court Justice Antonin Scalia noted that "There are those who contend that it does not benefit African-Americans to get them into the University of Texas where they do not do well, as opposed to having them go to a less-advanced school, a slower-track school where they do well."

price of the two- and four-year sectors, such programs may, however, lower degree completion rates for students drawn out of the four-year and into the two-year sector. This is particularly true given the large existing disparities in degree completion rates between these two sectors and our finding that institutional completion rates are strong predictors of degree completion, particularly for disadvantaged students who are likely most price sensitive. The net completion effect of such proposals thus depends, in part, on the number of students on the margin between no college and two-year college and the number on the margin between two- and four-year college. Early evidence from Tennessee suggests the latter number is nontrivial (Carruthers and Fox, 2016).[18] Our results suggest that policymakers should account for such students when designing proposals to change the price, and potentially quality, of the community college sector.

Our work provides some of the clearest evidence to date on the importance of initial college choice for students with relatively low academic skills. Further research is needed to determine why college choice matters and which aspects of the college experience are responsible for the degree completion effects we document. We also hope in future work to determine how these degree completion effects translate into labor market outcomes.

[18] In the first year of the Tennessee Promise scholarship, the state saw a 25 percent increase in community college enrollment but a five to eight percent decrease in enrollment at four-year public institutions (Ashley A. Smith, "Promise Provides Enrollment Boost", *Inside Higher Ed*, November 24, 2015).

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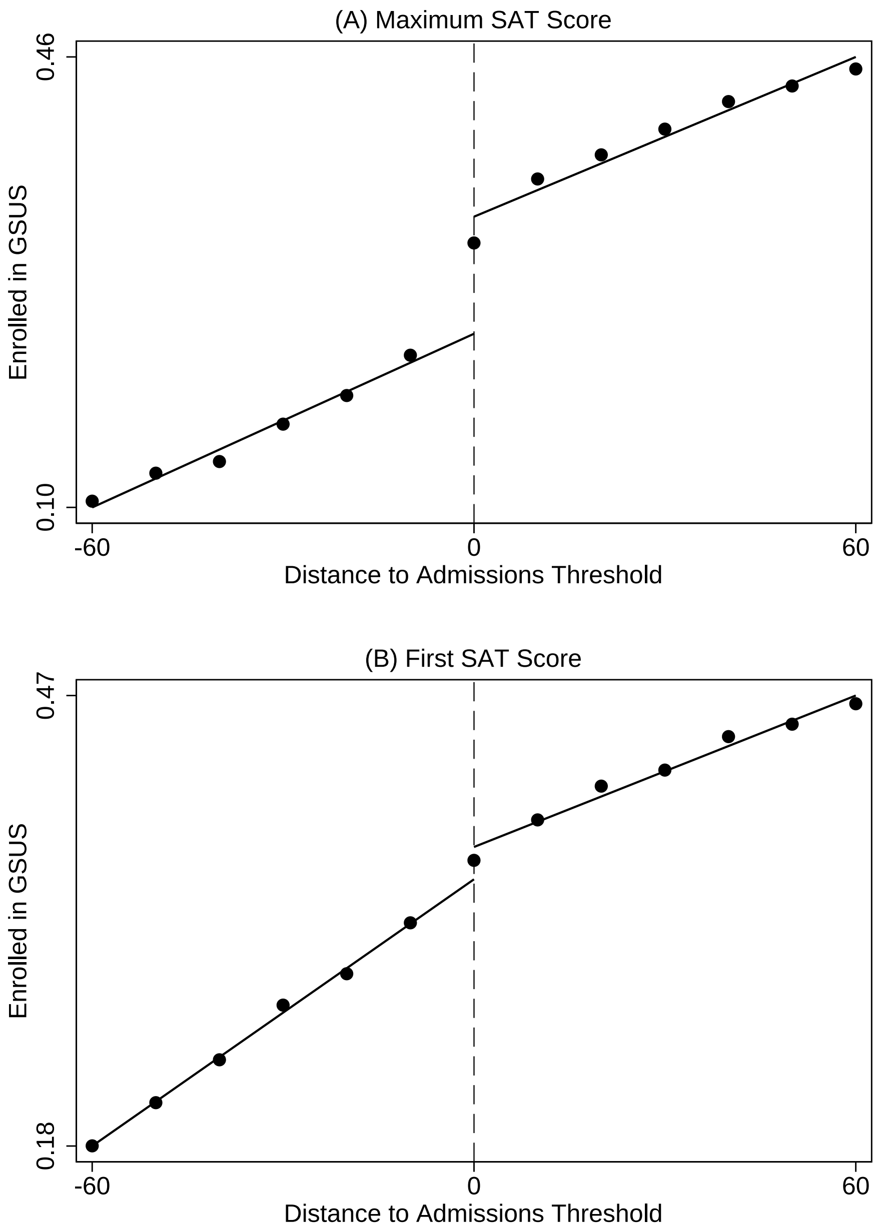
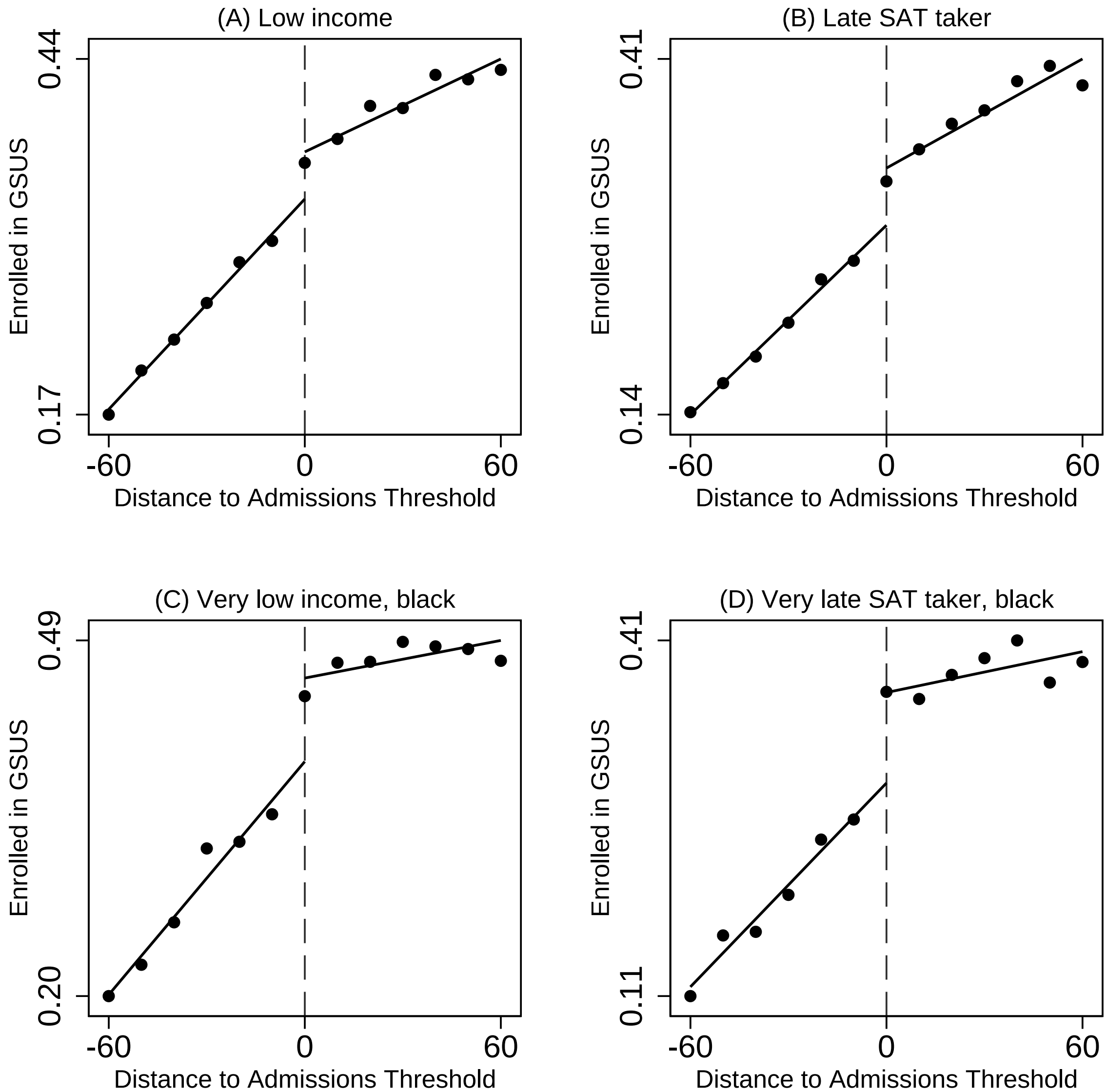
Figure 1: First Stage



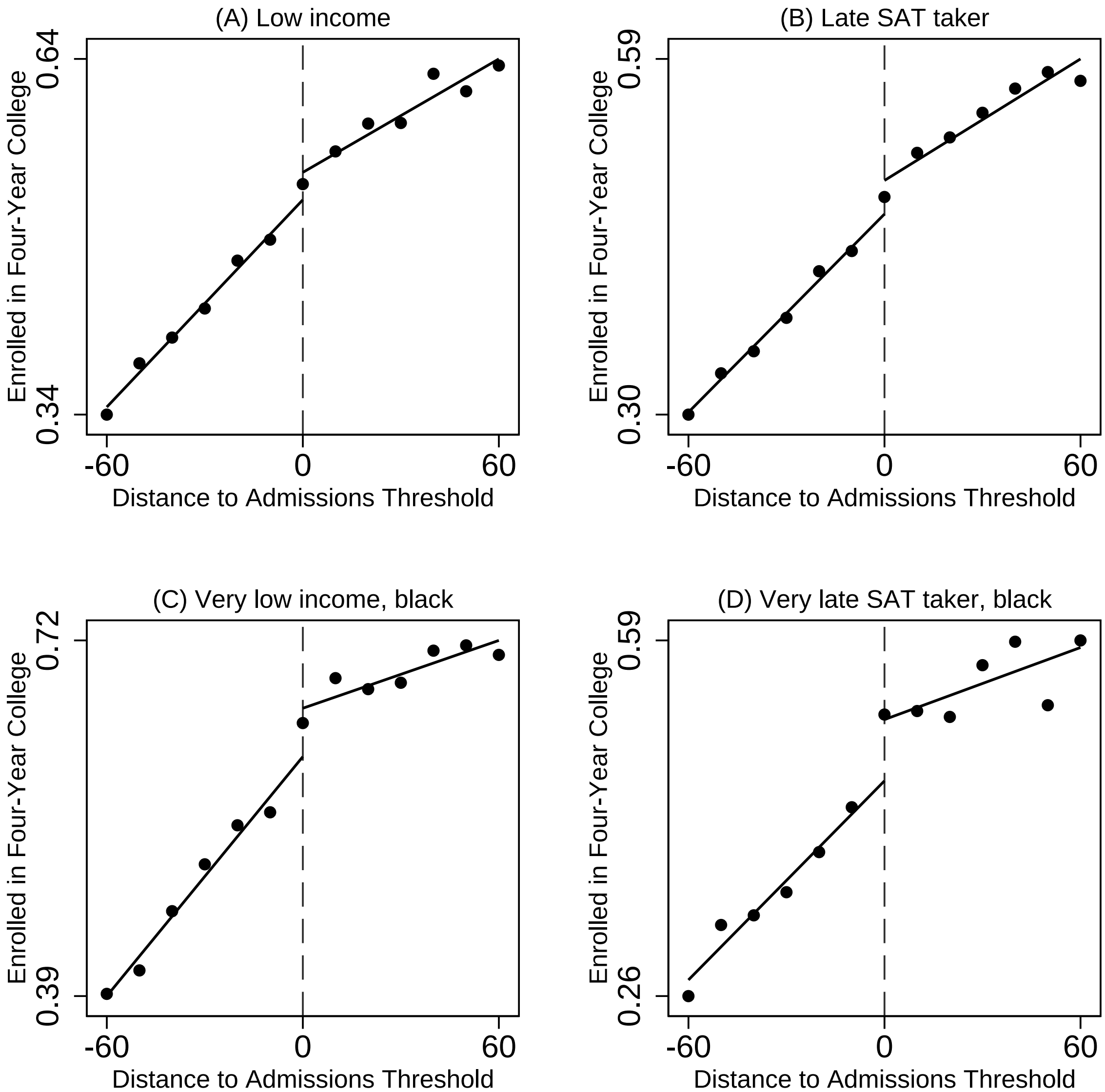
Notes: Panel A shows the fraction of students enrolling at in-state, public, four-year colleges within one year of high school graduation, as a function of the distance of students' maximum SAT scores from the GSUS eligibility threshold. Panel B shows enrollment rates by the distance of students' first SAT scores from the threshold. The sample comprises Georgia's 2004-08 high school classes. Also shown are fitted regression lines from the baseline specification using a bandwidth of 60 points.

Figure 2: GSUS Enrollment



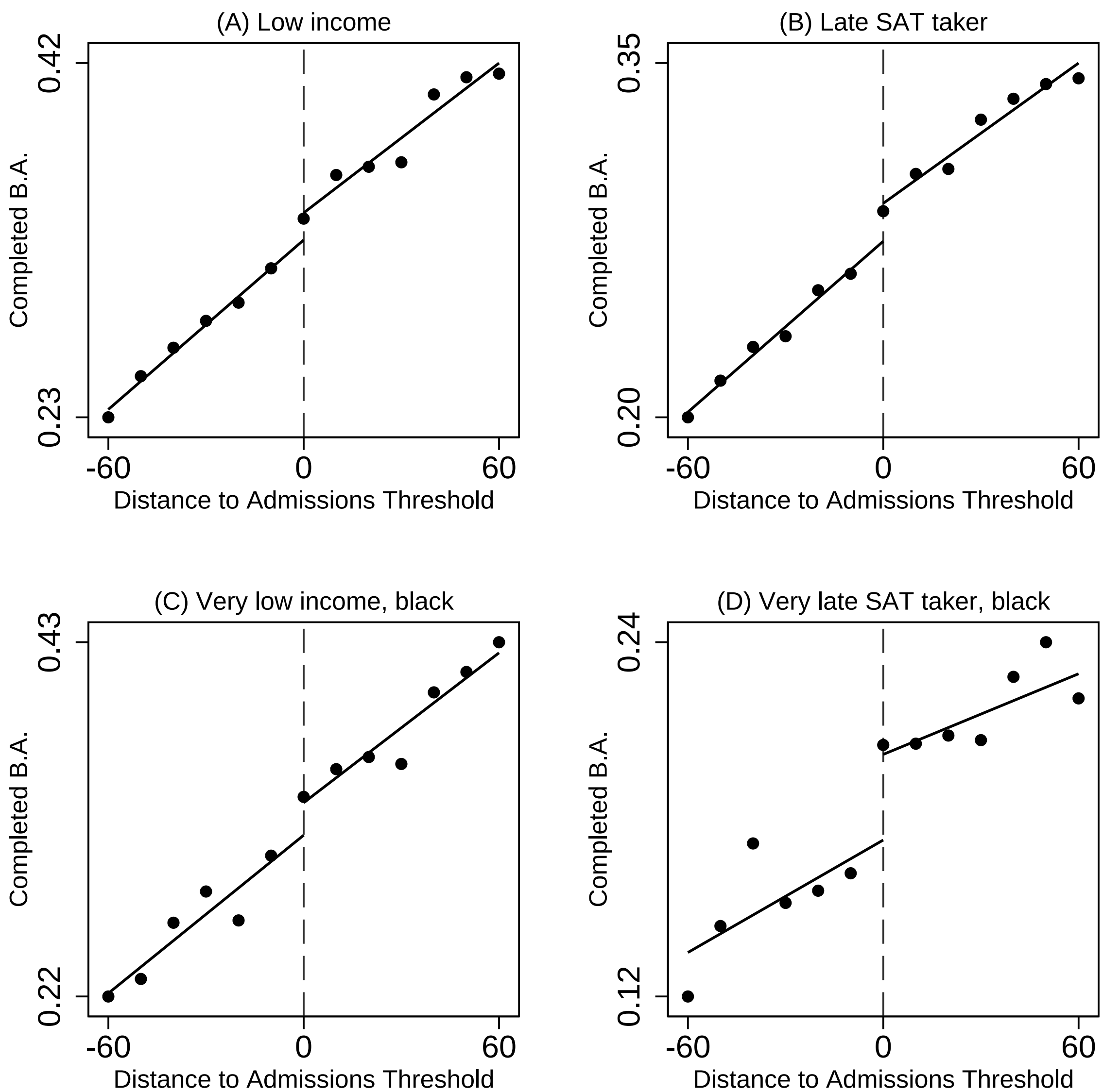
Notes: Each panel shows the fraction of students enrolling at in-state, public, four-year colleges within one year of high school graduation, as a function of the distance of students' first SAT scores from the GSUS eligibility threshold. Panel A includes students who reported family incomes below $60,000. Panel B includes students who took their first SAT no more than 12 months prior to June of their high school graduation year. Panels C and D include black students who respectively reported family income of less than $30,000 and who took their first SAT no more than 6 months prior to June of their high school graduation year. Also shown are fitted regression lines from the baseline specification using a bandwidth of 60 points.

Figure 3: Four-Year College Enrollment



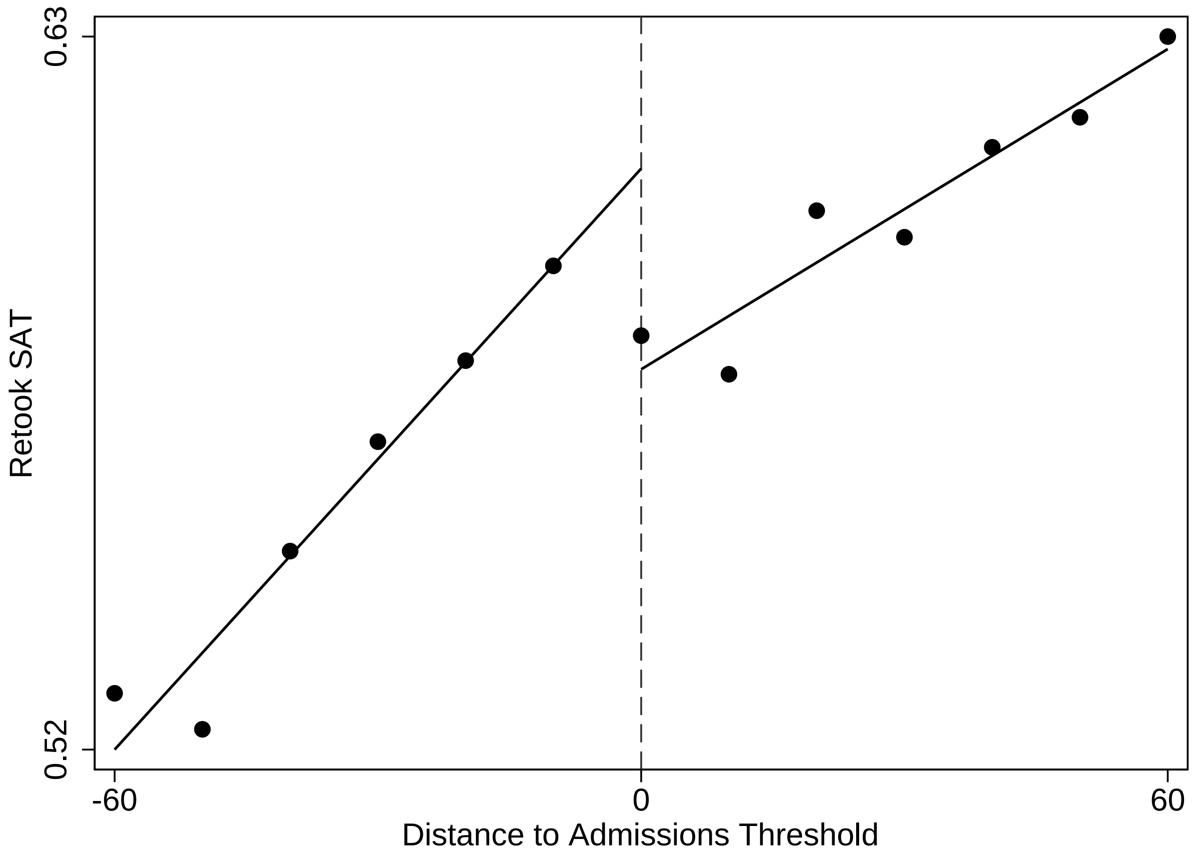
Notes: Each panel shows the fraction of students enrolling at any four-year college within one year of high school graduation, as a function of the distance of students' first SAT scores from the GSUS eligibility threshold. Panel A includes students who reported family incomes below $60,000. Panel B includes students who took their first SAT no more than 12 months prior to June of their high school graduation year. Panels C and D include black students who respectively reported family income of less than $30,000 and who took their first SAT no more than 6 months prior to June of their high school graduation year. Also shown are fitted regression lines from the baseline specification using a bandwidth of 60 points.

Figure 4: Bachelor's Degree Completion



Notes: Each panel shows the fraction of students completing a bachelor's degree within six years of high school graduation, as a function of the distance of students' first SAT scores from the GSUS eligibility threshold. Panel A includes students who reported family incomes below $60,000. Panel B includes students who took their first SAT no more than 12 months prior to June of their high school graduation year. Panels C and D include black students who respectively reported family income of less than $30,000 and who took their first SAT no more than 6 months prior to June of their high school graduation year. Also shown are fitted regression lines from the baseline specification using a bandwidth of 60 points.

Figure 5: SAT Retaking



Notes: Shown above is the fraction of students retaking the SAT at least once, as a function of the distance of students' first SAT scores from the GSUS eligibility threshold. Also shown are fitted regression lines from the baseline specification using a bandwidth of 60 points.

Table 1: Summary Statistics

	All Georgia students	RD analysis sample	Disadvantaged: Low income students	Disadvantaged: Late SAT takers	Very disadvantaged: Very low income, black	Very disadvantaged: Very late SAT takers, black
	(1)	(2)	(3)	(4)	(5)	(6)
(A) Demographics						
Female	0.54	0.57	0.61	0.56	0.66	0.55
White	0.60	0.57	0.40	0.49	0.00	0.00
Black	0.26	0.30	0.44	0.37	1.00	1.00
Hispanic	0.04	0.04	0.05	0.05	0.00	0.00
Low income	0.32	0.35	1.00	0.43	1.00	0.60
(B) SAT scores						
First SAT score	966.75	905.56	892.14	891.67	862.69	856.92
GSUS eligible, first SAT	0.66	0.60	0.54	0.55	0.43	0.40
Retook SAT at least once	0.60	0.59	0.50	0.38	0.47	0.17
Maximum SAT score	1009.62	946.41	923.46	911.74	887.08	862.83
GSUS eligible, maximum SAT	0.73	0.73	0.66	0.63	0.54	0.43
(C) College outcomes						
Enrolled at GSUS college	0.37	0.36	0.33	0.29	0.36	0.27
Enrolled any four year college	0.61	0.57	0.51	0.46	0.57	0.43
Enrolled any two year college	0.20	0.24	0.25	0.29	0.19	0.25
Completed BA within six years	0.45	0.40	0.33	0.28	0.30	0.18
N	300,796	144,676	51,248	73,195	11,807	10,628

Notes: Listed above are mean values of key variables. Column 1 includes all Georgia SAT takers from the high school classes of 2004-08. Column 2 limits the sample to those within 60 SAT points of the GSUS eligibility threshold. Columns 3 and 4 limit the regression discontinuity sample respectively to students who report family income of less than $60,000 and who take their first SAT no more than 12 months prior to June of their high school graduation year. Columns 5 and 6 limit the regression discontinuity sample to black students who respectively report family income of less than $30,000 and who take their first SAT no more than 6 months prior to June of their high school graduation year. Panel C defines uses indicators for college enrollment within one year and B.A. completion within six years of high school graduation.

Table 2: First Stage Impact of Eligibility on GSUS Enrollment

	BW = 40 (1)	BW = 50 (2)	BW = 60 (3)	BW = 70 (4)	BW = 80 (5)
(A) All students					
All	0.018***	0.019***	0.021***	0.025***	0.032***
(Control mean = 0.33, IK = 40)	(0.004)	(0.004)	(0.005)	(0.005)	(0.007)
(B) Advantaged students					
Non-low income	0.009	0.006	0.007	0.013	0.021*
(Control mean = 0.36, IK = 50)	(0.013)	(0.011)	(0.011)	(0.011)	(0.012)
Early SAT taker	0.004	0.006	0.000	0.004	0.012
(Control mean = 0.30, IK = 50)	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)
(C) Disadvantaged students					
Low income	0.034***	0.036***	0.036***	0.037***	0.042***
(Control mean = 0.35, IK = 60)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)
Late SAT taker	0.036***	0.037***	0.044***	0.045***	0.052***
(Control mean = 0.41, IK = 60)	(0.006)	(0.005)	(0.007)	(0.006)	(0.007)
(D) Very disadvantaged students					
Very low income, black	0.074***	0.067***	0.070***	0.066***	0.077***
(Control mean = 0.26, IK = 40)	(0.012)	(0.014)	(0.014)	(0.013)	(0.013)
Very late SAT taker, black	0.063***	0.081***	0.079***	0.071***	0.087***
(Control mean = 0.26, IK = 60)	(0.012)	(0.010)	(0.009)	(0.011)	(0.014)

Notes: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). Each estimate comes from a local linear regression of an indicator for on-time enrollment in a GSUS college on an indicator for scoring at or above the GSUS threshold, using the listed bandwidth and controlling for high school class fixed effects. The sample comprises Georgia's 2004-08 graduating high school classes. Low income and very low income students are those reporting family income less than $60,000 and $30,000 respectively. Late and very late SAT takers are those who respectively took their first SAT no more than 12 or 6 months prior to the June of their high school graduation year. Also listed are the Imbens-Kalyanaraman optimal bandwidth (rounded to tne nearest 10) and the mean rate of on-time GSUS enrollment for students 10 SAT points below the threshold.

Table 3: Initial College Enrollment

	Any four-year college (RF) (1)	Any four-year college (IV) (2)	Any two-year college (IV) (3)	No college (IV) (4)	College mean PSAT (IV) (5)	B.A. completion rate (IV) (6)
(A) All students						
All	0.017***	0.813***	-0.666***	-0.147	1.034***	0.511***
	(0.004)	(0.143)	(0.122)	(0.154)	(0.383)	(0.124)
Control (complier) mean	0.52				-0.80	0.10
(B) Disadvantaged						
Low income	0.024***	0.648***	-0.450***	-0.198	0.776***	0.352***
	(0.007)	(0.082)	(0.163)	(0.123)	(0.257)	(0.061)
Control (complier) mean	0.49				-0.59	0.23
Late SAT taker	0.029***	0.666***	-0.474***	-0.192***	0.893***	0.389***
	(0.008)	(0.075)	(0.057)	(0.065)	(0.117)	(0.026)
Control (complier) mean	0.43				-0.66	0.20
(C) Very disadvantaged						
Very low income, black	0.046**	0.663***	-0.600***	-0.064	0.907***	0.375***
	(0.016)	(0.136)	(0.145)	(0.126)	(0.331)	(0.091)
Control (complier) mean	0.56				-0.83	0.19
Very late SAT taker, black	0.059***	0.753***	-0.449***	-0.304***	0.626***	0.275***
	(0.010)	(0.124)	(0.138)	(0.098)	(0.113)	(0.060)
Control (complier) mean	0.44				-0.74	0.20

Notes: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). Column 1 presents reduced form estimates of the impact of eligibility on four-year college enrollment. The remaining columns present instrumental variables estimates of GSUS enrollment on college enrollment outcomes, with GSUS enrollment instrumented by eligibility. The final columns characterize each student's initial college by the mean standardized PSAT score and completion rate of B.A.s within six years of all students who enrolled on time in that college. Column 1 also lists the mean four-year college enrollment rate for those 10 SAT points below the threshold, while columns 5 and 6 list the predicted outcomes for untreated compliers. All regressions use a bandwidth of 60 and include high school class fixed effects.

Table 4: College Degree Completion

	Completed B.A. within six years			Completed A.A. within six years		
	(RF)	(IV)	(OLS)	(RF)	(IV)	(OLS)
	(1)	(2)	(3)	(4)	(5)	(6)
(A) All students						
All	0.009**	0.410***	0.257***	-0.002	-0.084	-0.066***
	(0.003)	(0.131)	(0.010)	(0.003)	(0.137)	(0.002)
Control (complier) mean	0.37	0.19		0.05	0.08	
(B) Disadvantaged						
Low income	0.015***	0.425***	0.275***	0.002	0.045	-0.076***
	(0.004)	(0.128)	(0.007)	(0.005)	(0.131)	(0.002)
Control (complier) mean	0.31	0.16		0.06	0.00	
Late SAT taker	0.019***	0.424***	0.256***	-0.003	-0.078	-0.072***
	(0.004)	(0.061)	(0.005)	(0.003)	(0.063)	(0.001)
Control (complier) mean	0.26	0.11		0.06	0.08	
(C) Very disadvantaged						
Very low income, black	0.020*	0.289*	0.248***	-0.006	-0.082	-0.060***
	(0.011)	(0.154)	(0.010)	(0.005)	(0.068)	(0.004)
Control (complier) mean	0.30	0.10		0.04	0.08	
Very late SAT taker, black	0.030***	0.385***	0.207***	-0.016*	-0.206*	-0.061***
	(0.007)	(0.085)	(0.009)	(0.009)	(0.116)	(0.004)
Control (complier) mean	0.16	0.00		0.05	0.21	

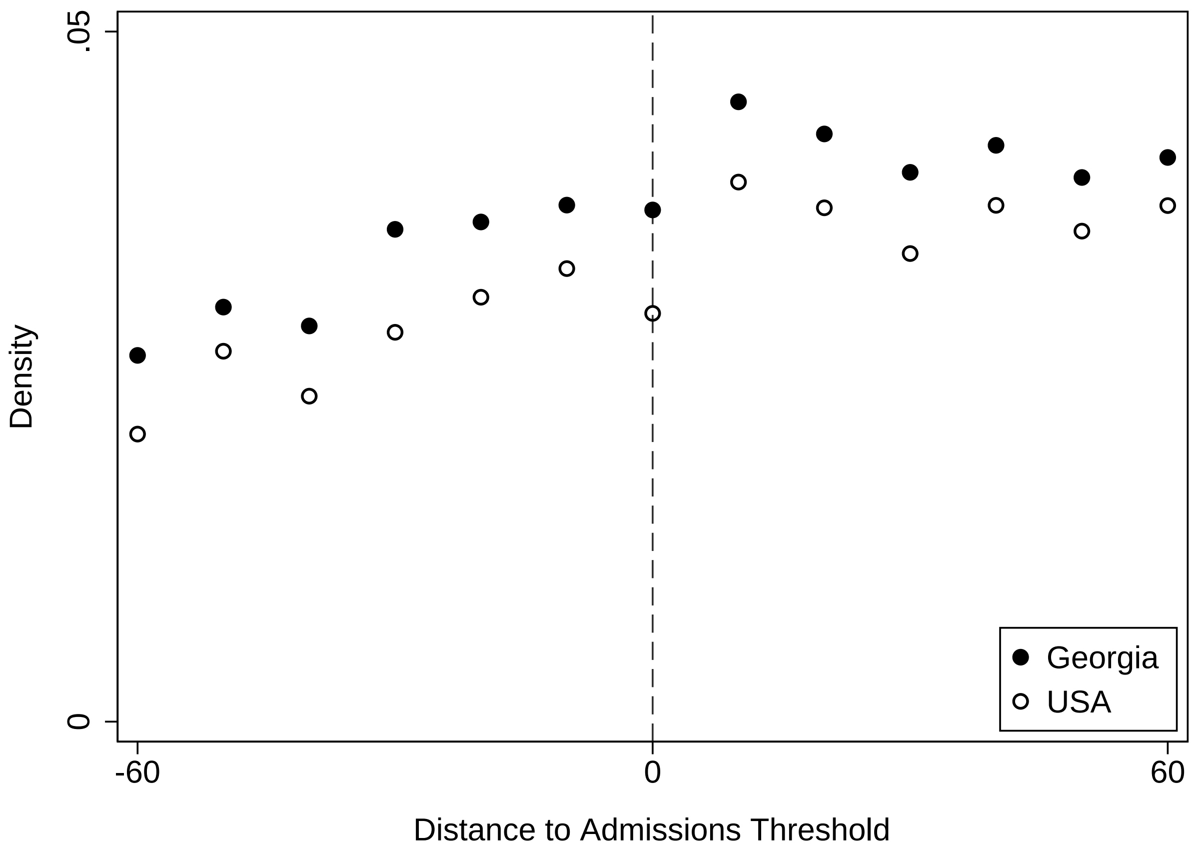
Notes: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). Columns 1 and 4 present reduced form estimates of the impact of eligibility on B.A. and A.A. completion within six years of high school graduation. Columns 2 and 5 present instrumental variables estimates of the impact of GSUS enrollment on degree completion, with GSUS enrollment instrumented by eligibility. Columns 3 and 6 present OLS estimates of the impact of GSUS enrollment on degree completion. Columns 1 and 4 list the mean completion rates for those 10 SAT points below the threshold, while columns 2 and 5 list the predicted completion rates for untreated compliers. All regressions use a bandwidth of 60 and include high school class fixed effects.

Table 5: SAT Retaking Behavior

	Retook SAT (1)	Number of takes (2)	Ever GSUS eligible (3)	Maximum SAT (4)
(A) All students				
All	0.031***	0.047***	-0.509***	2.691**
	(0.005)	(0.012)	(0.004)	(1.029)
Control mean	0.58	1.87	1.00	936.15
(B) By income				
Non-low income	0.032**	0.071***	-0.412***	4.273**
	(0.011)	(0.021)	(0.009)	(1.679)
Control mean	0.66	2.02	1.00	947.52
Low income	0.037***	0.049***	-0.596***	2.338
	(0.007)	(0.010)	(0.007)	(1.839)
Control mean	0.51	1.71	1.00	922.50
(C) By SAT taking date				
Early SAT taker	0.011***	0.007	-0.300***	1.942
	(0.003)	(0.020)	(0.003)	(1.270)
Control mean	0.80	2.34	1.00	964.90
Late SAT taker	0.030***	0.041***	-0.700***	0.814
	(0.007)	(0.008)	(0.005)	(1.323)
Control mean	0.40	1.47	1.00	911.40

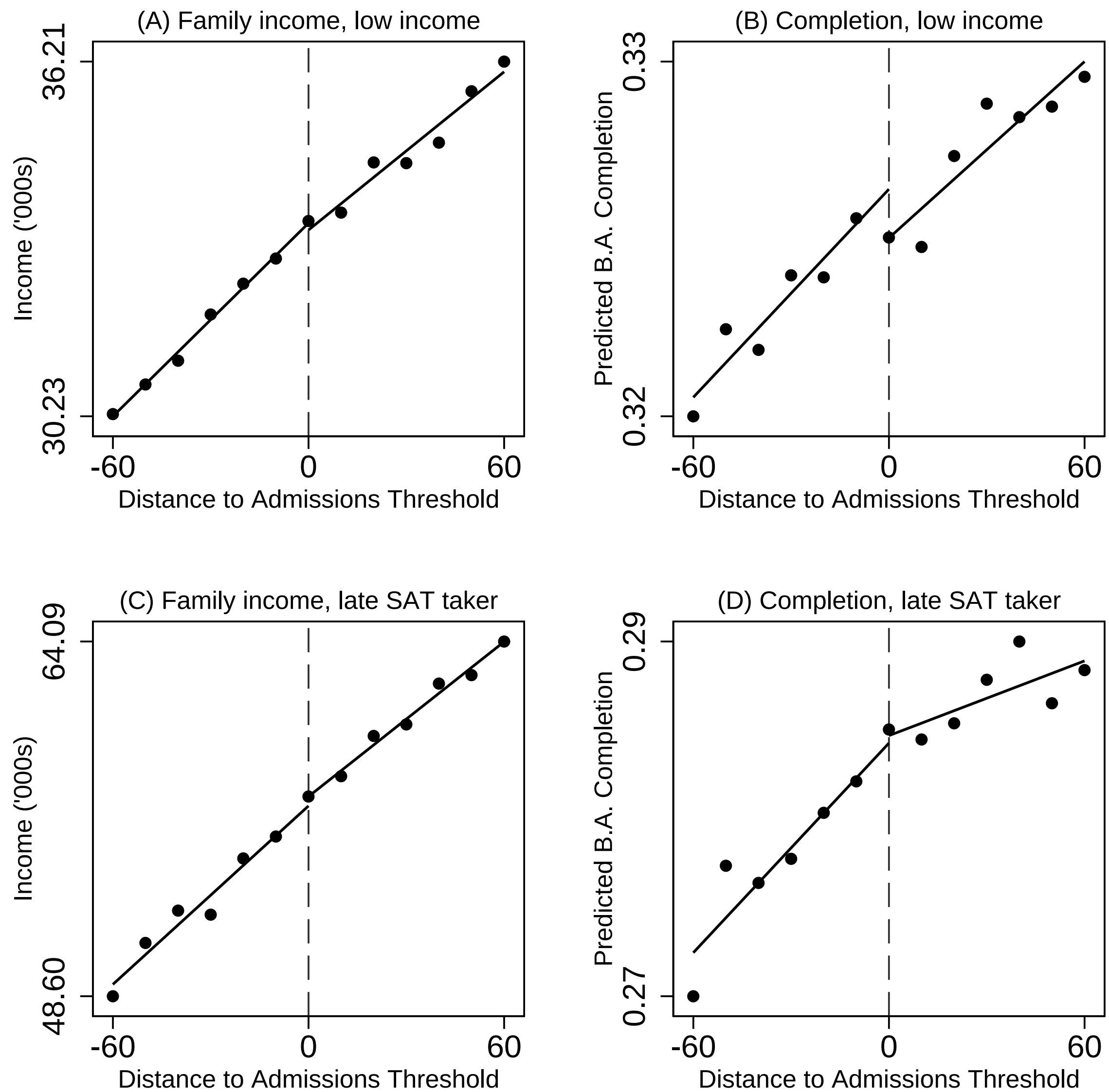
Notes: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). Each coefficient is a reduced form estimate of the impact of initially scoring below the GSUS threshold on the listed outcome. Low income students are those reporting family income less than $60,000. Late SAT takers are those who took their first SAT no more than 12 months prior to June of their high school graduation year. Listed below each estimate is the mean outcome for students at the threshold. All regressions use a bandwidth of 60 and include high school class fixed effects.

Figure A.1: Density of Distances to the Threshold



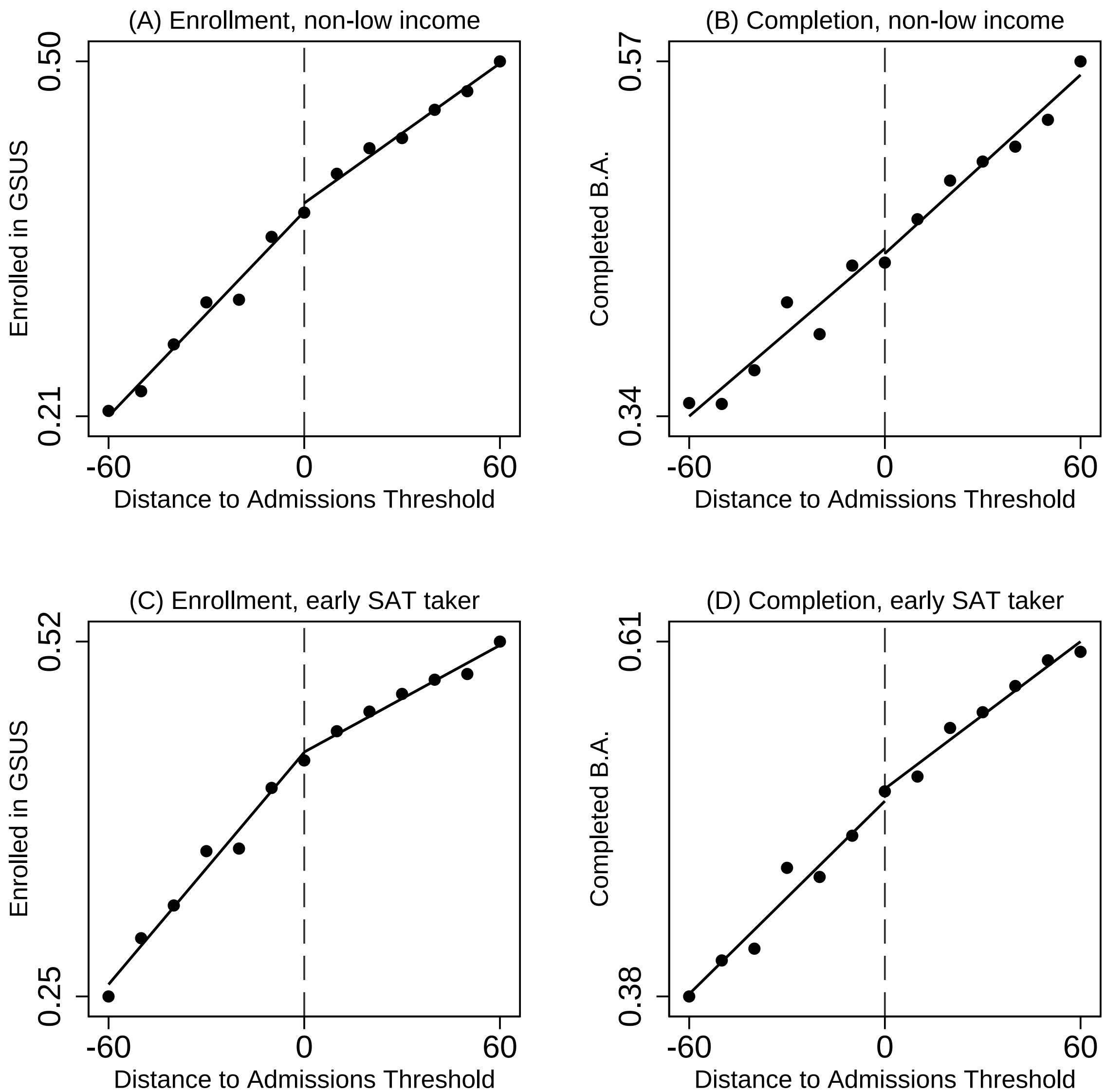
Notes: The closed circles show the fraction of Georgia students whose first SAT scores place them at a given distance from the GSUS eligibility threshold. The open circles show the fraction of non-Georgia students whose first SAT scores place them at that distance. Both samples consist of the 2004-08 graduating high school classes.

Figure A.2: Covariate Balance



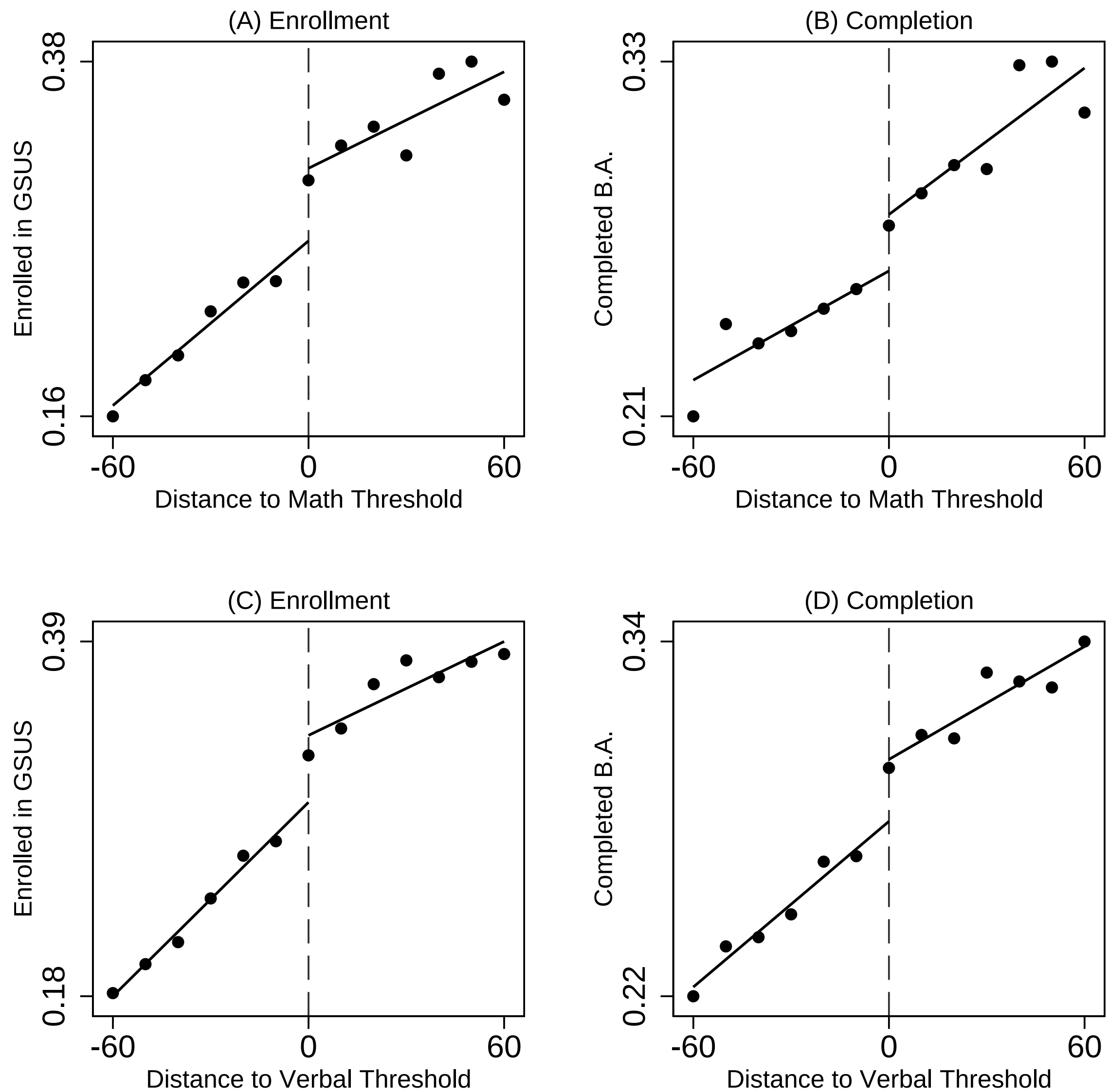
Notes: Panels A and C show mean reported income for low income and late SAT taking students respectively, as a function of the distance of students' first SAT scores from the GSUS eligibility threshold. Panels B and D show the mean predicted B.A. completion rates for low income and late SAT taking students respectively, with predictions based on gender, race, family income and parental education. Also shown are fitted regression lines from the baseline specification using a bandwidth of 60 points.

Figure A.3: Placebo Tests



Notes: Panels A and C show mean GSUS enrollment rates for non-low income and early SAT taking students respectively, as a function of the distance of students' first SAT scores from the GSUS eligibility threshold. Panels B and D show the mean B.A. completion rates for non-low income and early SAT taking students respectively. Also shown are fitted regression lines from the baseline specification using a bandwidth of 60 points.

Figure A.4: Alternative Distance Measures



Notes: Panels A and B show mean GSUS enrollment rates and B.A. completion rates, as a function of the distance of students' first SAT scores from the math threshold. Panels C and D show such outcomes as a function of the distance of students' first SAT scores from the verbal threshold. The sample in each panel consists of late SAT takers whose other SAT subject score satisfies the GSUS eligibility requirements. Also shown are fitted regression lines from the baseline specification using a bandwidth of 60 points.

Table A.1: Characteristics of GSUS Colleges

	(1) FTE students	(2) Tuition and fees	(3) Median SAT score	(4) Admit rate	(5) Instr. spending per FTE	(6) Six-year grad. rate	(7) SAT thresholds Verbal	(8) SAT thresholds Math	(9) Total
(A) Research universities									
Georgia Institute of Technology	15,789	4,076	1325	70	8,988	72	430	400	
Georgia State U.	21,437	3,920	1090	56	5,161	41	430	400	900
U. of Georgia	30,388	4,078	1205	75	6,057	72	430	400	
(B) Regional universities									
Georgia Southern U.	14,374	2,912	1050	54	4,130	38	430	400	960
Valdosta State U.	8,854	2,860	1005	68	4,361	38	440	410	
(C) State universities									
Albany State U.	3,129	2,774	920	84	5,211	40	430	400	
Armstrong Atlantic State U.	5,138	2,602	1020	84	4,370	18	460	430	
Augusta State U.	4,884	2,592	970	66	3,761	19	430	400	
Clayton State U.	4,208	2,670	995	71	3,525	14	430	400	
Columbus State U.	5,541	2,676	980	62	4,048	27	440	410	
Fort Valley State U.	2,283	2,782	930	44	6,106	30	430	400	
Georgia Coll. &State U.	4,762	3,596	1120	44	5,205	37	430	400	
Georgia Southwestern State U.	1,902	2,798	965	75	4,901	32	430	400	
Kennesaw State U.	13,854	2,724	1065	61	3,789	31	490	460	
North Georgia Coll. & State U.	3,836	2,808	1075	36	4,488	50	430	400	
Savannah State U.	2,415	2,830	880	49	4,737	31	430	400	
Southern Polytechnic State U.	2,857	2,754	1135	62	5,340	23	500	500	
U. of West Georgia	8,399	2,774	1000	61	3,911	30	430	400	
(D) Other GA public colleges									
State colleges (primarily two-year)	2,503	1,575	887	73	3,324		330	310	
Technical colleges (two-year)	1,776	1,127			3,097		330	310	

Notes: Figures in columns 1-6 are taken from the 2004 Integrated Postsecondary Education Data System. Median SAT scores are computed as the sum of the mean of the 25th and 75th percentile math and verbal SAT scores. The SAT thresholds listed in columns 7-9 are taken from academic handbooks from 2004.

Table A.2: Covariate Balance Tests

	Income ('000s) (1)	Missing income (2)	Mom, no college (3)	Dad, no college (4)	Black (5)	Other race (6)	Female (7)	Predicted 4-yr coll. (8)	Predicted B.A. (9)
All students	-0.024	0.003	0.010***	0.004	-0.007	0.002	0.007**	-0.002*	-0.001
	(0.376)	(0.004)	(0.003)	(0.005)	(0.005)	(0.003)	(0.003)	(0.001)	(0.001)
Control mean	63.08	0.30	0.26	0.30	0.33	0.14	0.57	0.56	0.39
Low income	-0.102		0.012*	0.004	-0.012	0.005	-0.001	-0.004*	-0.002**
	(0.149)		(0.006)	(0.008)	(0.008)	(0.004)	(0.008)	(0.002)	(0.001)
Control mean	32.89		0.39	0.47	0.47	0.15	0.62	0.52	0.33
Late SAT taker	0.768	0.004	0.006	0.004	-0.018***	0.005	0.005	-0.002	0.002
	(0.494)	(0.003)	(0.005)	(0.006)	(0.006)	(0.004)	(0.005)	(0.001)	(0.001)
Control mean	55.58	0.29	0.31	0.36	0.40	0.14	0.57	0.55	0.37
Very low income, black	0.078		0.008	0.010			0.007	0.001	0.002
	(0.216)		(0.010)	(0.014)			(0.018)	(0.003)	(0.003)
Control mean	17.06		0.42	0.52			0.67	0.55	0.28
Very late SAT taker, black	2.043	-0.013	0.008	0.018*			-0.021	-0.003	-0.004
	(1.399)	(0.011)	(0.009)	(0.010)			(0.017)	(0.004)	(0.004)
Control mean	35.50	0.27	0.32	0.43			0.56	0.60	0.32

Notes: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). Each estimate comes from a local linear regression of the listed covariate on an indicator for scoring at or above the GSUS threshold. All regressions use a bandwidth of 60 and include high school class fixed effects. The sample comprises Georgia's 2004-08 graduating high school classes. Columns 8 and 9 use as outcomes predicted four-year college enrollment and B.A. completion rates generated by regressing indicators for those outcomes on a vector of indicators for gender, race, income and parental education categories.

Table A.3: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
(A) Enrolled 4-year college						
All students	0.739***	0.813***	0.813***	0.776***	0.748***	0.794***
	(0.231)	(0.180)	(0.143)	(0.116)	(0.083)	(0.086)
Low income	0.573***	0.695***	0.648***	0.624***	0.687***	0.747***
	(0.093)	(0.085)	(0.082)	(0.077)	(0.074)	(0.080)
Late SAT taker	0.614***	0.648***	0.666***	0.636***	0.697***	0.738***
	(0.103)	(0.088)	(0.075)	(0.076)	(0.061)	(0.059)
Very low income, black	0.744***	0.603***	0.663***	0.682***	0.657***	0.662***
	(0.125)	(0.175)	(0.136)	(0.132)	(0.134)	(0.138)
Very late SAT taker, black	0.784***	0.833***	0.753***	0.702***	0.765***	0.758***
	(0.198)	(0.132)	(0.124)	(0.127)	(0.109)	(0.109)
(B) Completed B.A.						
All students	0.432**	0.285*	0.410***	0.454***	0.394***	0.388***
	(0.170)	(0.158)	(0.131)	(0.102)	(0.077)	(0.060)
Low income	0.555***	0.436***	0.425***	0.411***	0.484***	0.503***
	(0.172)	(0.141)	(0.128)	(0.125)	(0.118)	(0.121)
Late SAT taker	0.517***	0.457***	0.424***	0.415***	0.435***	0.419***
	(0.078)	(0.068)	(0.061)	(0.060)	(0.056)	(0.048)
Very low income, black	0.481**	0.340*	0.289*	0.350**	0.354***	0.353***
	(0.209)	(0.176)	(0.154)	(0.155)	(0.124)	(0.113)
Very late SAT taker, black	0.806***	0.449***	0.385***	0.446***	0.393***	0.418***
	(0.217)	(0.104)	(0.085)	(0.106)	(0.088)	(0.091)
Bandwidth	40	50	60	70	80	80
Demographic controls	No	No	No	No	No	Yes

Notes: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All coefficients are instrumental variables estimates of the impact of GSUS enrollment on the panel's listed outcome, with GSUS enrollment instrumented by eligibility. All regressions use a bandwidth of 60 and include high school class fixed effects. Column 6 also includes controls for gender, race, family income and parental education.

Table A.4: Placebo tests

Eligibility threshold shifted by	-20	-10	0	10	20
	(1)	(2)	(3)	(4)	(5)
(A) Enrolled, GSUS college					
All students	-0.006	0.005	0.021***	0.021**	0.014
	(0.005)	(0.006)	(0.005)	(0.009)	(0.010)
Low income	-0.010	0.008	0.036***	0.020	0.019*
	(0.008)	(0.014)	(0.007)	(0.016)	(0.010)
Late SAT taker	-0.007	0.013	0.044***	0.023	0.024**
	(0.008)	(0.014)	(0.007)	(0.015)	(0.011)
Very low income, black	-0.027	0.016	0.070***	0.026	0.014
	(0.017)	(0.025)	(0.014)	(0.033)	(0.026)
Very late SAT taker, black	-0.030	0.005	0.079***	0.041	0.045**
	(0.022)	(0.033)	(0.009)	(0.032)	(0.020)
Non-low income	-0.001	0.002	0.007	0.024**	0.003
	(0.006)	(0.006)	(0.011)	(0.010)	(0.012)
Early SAT taker	-0.007	-0.004	0.000	0.016	0.000
	(0.005)	(0.004)	(0.008)	(0.012)	(0.012)
(B) Completed B.A.					
All students	0.006*	0.002	0.009**	0.006	0.001
	(0.003)	(0.004)	(0.003)	(0.005)	(0.006)
Low income	-0.009	0.006	0.015***	0.008	0.005
	(0.007)	(0.008)	(0.004)	(0.006)	(0.006)
Late SAT taker	-0.003	0.006	0.019***	0.006	0.010
	(0.006)	(0.008)	(0.004)	(0.007)	(0.005)
Very low income, black	-0.006	0.004	0.020*	0.017	-0.009
	(0.011)	(0.013)	(0.011)	(0.015)	(0.013)
Very late SAT taker, black	0.002	0.015	0.030***	0.005	-0.002
	(0.015)	(0.017)	(0.007)	(0.014)	(0.013)
Non-low income	0.007	0.003	-0.003	0.014	-0.016
	(0.006)	(0.008)	(0.012)	(0.015)	(0.014)
Early SAT taker	0.005	-0.004	0.008	0.005	-0.010
	(0.006)	(0.006)	(0.007)	(0.011)	(0.011)
Low income, non-Georgia	0.003	0.001	-0.002	0.006	0.010***
	(0.002)	(0.003)	(0.003)	(0.004)	(0.002)

Notes: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All coefficients are reduced form estimates of the impact of GSUS eligibility on the panel's listed outcome, with the threshold shifted by the specified distance. The final row's sample comprises low income SAT takers outside of Georgia. All regressions use a bandwidth of 60 and include high school class fixed effects.

Table A.5: Alternative Distance Measures

Running variable	Both (1)	Math (2)	Verbal (3)
(A) GSUS enrollment (reduced form)			
All	0.021***	0.024**	0.018***
	(0.005)	(0.008)	(0.005)
Low income	0.036***	0.048***	0.030***
	(0.007)	(0.013)	(0.008)
Late SAT taker	0.044***	0.046***	0.041***
	(0.007)	(0.010)	(0.008)
(B) B.A. completion (reduced form)			
All	0.009**	0.008	0.007
	(0.003)	(0.008)	(0.006)
Low income	0.015***	0.028**	0.013**
	(0.004)	(0.013)	(0.006)
Late SAT taker	0.019***	0.018***	0.024***
	(0.004)	(0.005)	(0.005)
(C) B.A. completion (instrumental variables)			
All	0.410***	0.343	0.419
	(0.131)	(0.321)	(0.287)
Low income	0.425***	0.589**	0.425*
	(0.128)	(0.277)	(0.218)
Late SAT taker	0.424***	0.404***	0.576***
	(0.061)	(0.103)	(0.118)

Notes: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). Panels A and B show reduced form estimates of the impact of GSUS eligibility on GSUS enrollment and B.A. completion. Panel C shows instrumental variables estimates of the impact of GSUS enrollment on B.A. completion, instrumenting GSUS enrollment with eligibility. Column 1 repeats estimates from the baseline specification, using as a running variable the minimum of a student's distances to the math and verbal thresholds. Column 2 uses distance to the math threshold as a running variable and conditions the sample on satisfying the verbal threshold. Column 3 uses distance to the verbal threshold as a running variable and conditions the sample on satisfying the math threshold. All regressions use a bandwidth of 60 in the given running variable and include high school class fixed effects.

Table A.6: College Degree Completion, Using Maximum SAT Scores

	Completed B.A. within six years			Completed A.A. within six years		
	(RF)	(IV)	(OLS)	(RF)	(IV)	(OLS)
	(1)	(2)	(3)	(4)	(5)	(6)
(A) All students						
All	0.022***	0.225***	0.244***	-0.002	-0.025	-0.070***
	(0.002)	(0.023)	(0.007)	(0.002)	(0.023)	(0.002)
Control (complier) mean	0.30	0.31		0.06	0.02	
(B) Disadvantaged						
Low income	0.022***	0.229***	0.258***	-0.001	-0.012	-0.077***
	(0.005)	(0.058)	(0.005)	(0.006)	(0.057)	(0.002)
Control (complier) mean	0.27	0.29		0.06	0.01	
Late SAT taker	0.022***	0.251***	0.242***	-0.004	-0.044	-0.072***
	(0.003)	(0.040)	(0.004)	(0.003)	(0.036)	(0.001)
Control (complier) mean	0.24	0.23		0.06	0.04	
(C) Very disadvantaged						
Very low income, black	0.015	0.121*	0.235***	-0.009**	-0.075**	-0.059***
	(0.010)	(0.068)	(0.007)	(0.004)	(0.037)	(0.003)
Control (complier) mean	0.29	0.29		0.05	0.08	
Very late SAT taker, black	0.039***	0.383***	0.206***	-0.012	-0.120*	-0.059***
	(0.012)	(0.088)	(0.012)	(0.008)	(0.068)	(0.003)
Control (complier) mean	0.18	0.00		0.04	0.12	

Notes: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). Distance to the threshold is defined by maximum SAT scores. Columns 1 and 4 present reduced form estimates of the impact of eligibility on B.A. and A.A. completion within six years of high school graduation. Columns 2 and 5 present instrumental variables estimates of the impact of GSUS enrollment on degree completion, with GSUS enrollment instrumented by eligibility. Columns 3 and 6 present OLS estimates of the impact of GSUS enrollment on degree completion. Columns 1 and 4 list the mean completion rates for those 10 SAT points below the threshold, while columns 2 and 5 list the predicted completion rates for untreated compliers. All regressions use a bandwidth of 60 and include high school class fixed effects.