College Access, Initial College Choice and Degree Completion

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ABSTRACT

We explore whether initial college choice affects low-skilled students' degree completion rates. Admission to Georgia's public universities requires minimum SAT scores. Regression discontinuity estimates show that access to such universities increases four-year college enrollment and the quality of college chosen. Most importantly, access to public universities substantially increases bachelor's degree completion rates. SAT retaking behavior suggests students value access to this sector. Our degree completion results may partly explain the labor market return to college quality. Proposals to make community college free could lower degree completion rates if quality reforms do not accompany price reforms.

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1. Introduction

The Obama administration has, through efforts such as the College Scorecard, attempted to provide students with better information about college quality, partly with the hope that such information will improve the quality of colleges student choose. Such efforts stem in part from concerns highlighted in a report on a 2014 White House summit on college access:

> "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 – that is, many low-income students choose a college that does not match their academic ability. 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."[1]

We have clear evidence that students, particularly low-income ones, do not attend the highest quality colleges available to them (Roderick et al., 2008; Bowen et al., 2009; Dillon and Smith, 2013; Smith et al., 2013). We also have clear evidence that low-cost interventions can alter these enrollment patterns (Hoxby and Turner, 2013). Somewhat less clear is the evidence on whether improving the quality of college chosen affects longer-run outcomes such as degree completion rates.

Such evidence matters in part because of the need to explain recent negative trends in U.S. college completion rates. Completion rates among college enrollers are lower now than in the

[1] White House Summit on College Education (2014, p. 4). Available at: http://www.whitehouse.gov/sites/default/files/docs/increasing_college_opportunity_for_low-income_students_report.pdf

1970s, due in part to low completion rates of students from lower socioeconomic backgrounds (Belley and Lochner 2007; Bound et al. 2010; Bailey and Dynarski 2011). Explanations for the trend tend to focus either on student-level factors, such as academic skill and financial resources, or postsecondary institution-level factors, such as funding or management quality. The non-random selection of students into different colleges generally confounds attempts to distinguish the influence of these two types of factors. The major empirical challenge is thus to find an exogenous source of variation in college choice.

We do so by exploiting the use of test score thresholds by colleges during the admissions process. Across the U.S., roughly one in five colleges report using specific scores as a minimum threshold for admission (Briggs, 2009). Such thresholds are used by public college systems in a number of states, including California, Florida and Texas, though often in combination with other factors such as 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. This is the first paper in the U.S. context to document the importance of test score thresholds across an entire college system, as opposed to a single institution. In this sense, our work resembles recent research exploiting the Chilean, Colombian and French national systems of college admissions thresholds to estimate the impact of college quality on a variety of labor market and other outcomes (Saavedra, 2008; Kaufmann et al., 2012; Hastings et al., 2013; Palau-Navarro et al. 2014; Canaan and Mouganie, 2015).

We use a regression discontinuity design to compare the relatively low-skilled students just above and below the relevant thresholds. Our first major finding is that access to the four-year public college sector substantially increases the overall rate of four-year college enrollment and

improves the quality of colleges chosen, in part by diverting students from two-year colleges. That college choice is sensitive to small test score differences suggests students do not face a continuum of postsecondary options in terms of cost and quality, either because students do not apply sufficiently widely or because such a continuum does not exist in the market due to the in-kind nature of the public subsidy for state colleges. It also suggests that students may not be retaking the SAT sufficiently often, a low cost step that in Georgia could grant them access to the four-year public sector. That apparently small costs have disproportionate impacts on students' college decisions and can, in some cases, be remedied by relatively low-cost interventions has been well documented in previous work (Pallais, 2015; Bettinger et al., 2012; Hoxby and Turner, 2013; Carrell and Sacerdote, 2013; Castleman et al., 2014; Smith et al. 2015). We document a new aspect of the college admissions process, a systematic admissions threshold that affects college choice for students whose retesting and application behavior may be suboptimal.

Our second, and most important, finding is that, for the marginal students, enrollment in four-year public colleges instead of alternatives such as two-year colleges roughly doubles bachelor's degree completion rates. The substantial graduation rate impacts we observe are consistent with the previously documented graduation rate penalty associated with choosing a two-year instead of a four-year college (Rouse, 1995; Rouse, 1998; Leigh and Gill, 2003; Long and Kurlaender, 2009; Reynolds, 2012; Smith and Stange, 2015), as well as with literature showing a strong relationship between four-year college quality and graduation rates (Black et al., 2005; Long, 2008; Smith, 2013). That college quality affects degree completion may explain part of the labor market return to college quality observed in research using selection on observables models (Black and Smith, 2004; 2006) and research exploiting admissions thresholds at individual four-year public colleges (Hoekstra, 2009; Zimmerman, 2014). Our

focus on college pathways and degree completion for low skilled students supplements the evidence in Cohodes and Goodman (2014) that college quality matters for high-skilled students' graduation rates.

Our third finding is that failing to meet the GSUS admissions thresholds increases the likelihood that a student will retake the SAT. Given that the GSUS thresholds have no significance outside of Georgia, we interpret our results as evidence of demand for access to public four-year colleges. Students appear to value this set of college options. Prior research on SAT-taking behavior has shown increased retaking to achieve round-numbered scores (Pope and Simonsohn, 2011) or simply to increase maximum scores (Vigdor and Clotfelter, 2003), which are an important factor in an increasingly competitive admissions process (Bound et al., 2009). Ours is the first research to document exam retaking as evidence of demand for a particular college sector.

Our degree completion results have two additional implications for policy, both of which we discuss further in the paper's conclusion. First, the marginal students generating our estimates are, by definition, among the lowest-skilled at their colleges and are thus "overmatched" to such institutions. They nonetheless appear to benefit greatly from having chosen the higher quality college option, suggesting that absolute measures of quality are more important than the notion of match quality that has come to dominate discussions of optimal college choice (Dillon and Smith, 2013). Such results are also inconsistent with recent claims that absolute quality does not matter (Heil et al., 2014) . Second, the Obama administration's recent proposal to lower the cost of community college, modeled on Tennessee's Promise program, may not lead to increased degree completion rates. If lowering the cost of two-year colleges relative to four-year colleges induces substantial flows out of the latter sector, our results imply that the resulting drop in

college quality could reduce overall completion rates, especially at the bachelor's level. Price reforms absent quality reforms may have unintended negative consequences.

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 implications of those results and concludes.

2. The Data, Context, and Empirical Strategy

2.1 The Data

We use student-level data for the graduating high school classes of 2004-07, 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, allowing us to identify both first and maximum SAT scores. College admissions offices frequently rely on students' maximum scores, defined as the sum of the maximum math and critical reading scores earned regardless of whether they were earned on the same test date. Though we use this

[2] We ignore a writing section that does not play a role in the thresholds studied here.

maximum score for some analyses, we focus largely on students' first SAT scores to avoid endogenous retaking, as described further below. The CB data set also identifies colleges to which students send official copies of their SAT scores, which serve as good proxies for actual college applications (Card & Krueger, 2005; Pallais, 2015).[3] In addition, the CB data set contains information on student race, gender, parental income and education, and 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).[4] Data from the NSC allow us to track a student's postsecondary trajectory including enrollment, transfer behavior and degree completion. We focus on the 2004-07 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

[3] When registering for the SAT, the student has the option to send his scores to four colleges for free. Scores may also be sent at a later date for a fee of $11.25 per score send.

[4] 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.

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 can thus assign each student a measure of the quality of the peers to whom he is exposed at his initial college. Those who do not enroll initially are not assigned such a value. 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, we assign a value of zero to this institutional completion rate variable.

2.2 Georgia Context

The main analysis sample consists of all students residing in the state of Georgia at the time of taking the SAT. Georgia's Board of Regents has required 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 (GSUS).[5] We describe the set of 18 four-year universities governed by this requirement in panel A of Table A.1. These consist of three research universities, two regional universities, and 13 state universities. Columns 8 and 9 show that five of the 18

[5] This requirement has been in effect since well before 2004.

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.[6]

The Georgia context is interesting for three reasons. First, the GSUS minimum admissions thresholds correspond to roughly the 20^{th}-25^{th} 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. The prior literature on college choice and quality has tended to focus on a much higher point in the skill distribution (Cohodes and Goodman, 2014; Hoxby and Turner, 2013). Second, 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. Most prior research exploiting admissions thresholds has focused on individual institutions, rather than entire postsecondary systems (Hoekstra, 2009; Zimmerman, 2014).

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. Because the public nature of the thresholds may render score-sending behavior endogenous, we define our sample as all students residing in the state of Georgia, rather than just students sending scores to GSUS institutions.

2.3 Empirical Strategy

[6] A few of the GSUS institutions also have small two-year degree programs. In 2012, for example, 1.1% of the undergraduate degrees awarded by GSUS institutions were associates degrees. As such, we assume that enrollment in GSUS institutions is equivalent to enrollment in a four-year degree program.

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

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

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 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:

$$Y_{ic} = \beta_0 + \beta_1 GSUS_{ic} + \beta_2 Distance_{ic} + \beta_3 Access_{ic} * Distance_{ic} + \delta_c + \varepsilon_{ic} \qquad (2)$$

where *GSUS* is instrumented by access according to equation 1. Using *GSUS* as the endogenous regressor allows us to capture the full set of marginal students whose enrollment decisions were

altered by the thresholds.[7] 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 all.

We use 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 induced into 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.

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:

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

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). Our estimates are quite similar if we define the running variable as distance

[7] 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.

from one subject's threshold and limit the sample to students whose score in the other subject exceeds the relevant 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. First scores do not suffer from potential endogeneity driven by any retaking of SAT upon failure to meet 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 a bandwidth of 60 SAT points, and later show our estimates are robust to different bandwidths. This 60 point bandwidth corresponds closely to the optimal bandwidths suggested by Imbens and Kalyanaraman (2012), which balances the need for precision against the desire to minimize bias generated by fitting straight lines to data that may become non-linear 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 test the sensitivity our estimates to a number of bandwidths. 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, The First Stage, 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 through 2007 whose first SAT scores fell within 60 points of the threshold. As seen in column 1, this overall sample is 54 percent female, 56 percent white and 25 percent black.[8] Over one-fourth of students are low income, defined here as reporting annual family income of less than $50,000. The average student in this sample had a first SAT score of 965 and two-thirds had first SAT scores sufficiently high to satisfy the GSUS minimum thresholds. Even so, 61 percent of students retook the SAT at least once. As a result, the average student's maximum SAT score exceeded 1,000, with 73 percent ultimately meeting the GSUS thresholds. 39 percent first enrolled in a GSUS college within one year of graduating high school, while 61 percent enrolled in any four-year college. This means that nearly two-thirds of students who enrolled in a four-year college did so in the in-state public sector. Another 20 percent first enrolled in a two-year college. Only 41 percent completed a bachelor's degree within six years of graduating high school.

The remaining columns show various demographic subgroups of interest, with a focus on low income and black females in part because, as will be seen below, those groups have particularly strong first-stage relationships between first SAT scores and GSUS enrollment. Low income students are disproportionately black. Relative to the overall sample, low income students and black students have lower SAT scores, retake the SAT less frequently, and are substantially less likely to enroll in and graduate from four-year colleges. These differences do not vary substantially by gender of the low income and black students.

3.2 The First Stage

[8] Most of those who are not white or black do not self-report their race.

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 uses the maximum SAT score-based distance measure, shows a clear, large discontinuity, with students with SAT scores just at the threshold substantially more likely to enroll in the four-year public sector than those just below it. We note here that 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 2004-07. 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 may be generated in part by endogenous retaking, we present this graphical evidence only to show that GSUS colleges do appear to use the minimum SAT thresholds in their admissions processes. Panel B of Figure 1, which uses the first SAT score-based distance measure, also shows a discontinuity, but one smaller than in panel A because the maximum SAT score is the measure actually used by colleges in the admissions process. We nonetheless rely on the first SAT score-based distance measure in subsequent analyses because students have no ability to manipulate that score.

Table 2 shows estimates of the first stage impact of SAT-based access on enrollment in Georgia's four-year public colleges. The columns employ different bandwidths, with column 4 also including demographic controls in a specification using our preferred bandwidth of 60. The panels limit the sample to various demographic subgroups of interest. The coefficients in panel A suggest, for example, that SAT-based access increases enrollment in GSUS colleges by about

two percentage points. That estimate, though small in magnitude, is highly statistically significant, so that access easily passes traditional tests for being a strong instrument. Larger bandwidths yield even larger point estimates, though this may be due, in part, to slight non-linearity of the data, hence our focus on narrower bandwidths.

Panels B and C suggest differences in first stage estimates by family income. For narrower bandwidths, there is at most marginally significant evidence that access affects GSUS enrollment for non-low income students. As a result, access does not serve as a strong instrument for such students. In contrast, for low income students, access boosts GSUS enrollment by about three percentage points, a result that is both statistically significant and generally about twice as large as the point estimate for non-low income students. Panel D shows even clearer and slightly larger effects for black students, with estimated impacts between three and five percentage points. Interestingly, for both low income and black students, these effects are driven entirely by female students. As shown in panels E and F, access increases GSUS enrollment by a highly statistically significant five percentage points for low income females and eight percentage points for black females. Figure 2 shows the graphical version of these results, with the discontinuity in GSUS enrollment clearly visible at the threshold. There is no apparent effect of first SAT-score based access on either low income males or black males. As a result, we focus subsequent analysis on the entire sample and the two sub-samples of low income and black females, for whom access provides the largest, clearest source of variation in college choice.

3.3 Validity of the Research Design

Before turning to our main results concerning college enrollment and completion, we first perform two checks of the validity of our regression discontinuity design. The key assumption

underlying the identification strategy is that students on either side of the threshold are similar in terms of observed and unobserved characteristics, so that eligibility for admission is the only factor that differs between them. We present two tests that suggest this is the case. First, we follow the suggestion in McCrary (2008) to check for discontinuities in the density of observations, which would suggest that students can substantially manipulate which side of the threshold they fall on. Panel A of Figure 3 graphs the number of observations in each SAT score cell. No discontinuity in this density is apparent, a fact confirmed by formal statistical tests. Furthermore, the overall shape of that distribution looks quite similar in other states and is due in part to the way in which the College Board translates raw scores into the scaled scores used here.

Second, we test for balance in observed covariates across the threshold in Table 3, for the entire sample as well as our two focal sub-samples. Each column tests for a discontinuity at the threshold in observed covariates such as gender, race, income and parental education. We see no practically or statistically significant differences in gender, race or income across the threshold for any of the three samples. This is unsurprising given students' inability to precisely manipulate which side of the threshold they initially fall on. We see some evidence that students just above the threshold come from slightly less educated families than students just below the threshold. We suspect this is a spurious finding given that students are unable to manipulate their first scores and that Panel B of Figure 3 shows the relationship between parental education and our distance measure is fairly jagged. We show in later robustness checks that controlling for these observed covariates does not substantially change our point estimates, further evidence that magnitude of any such discontinuities is practically insignificant.

4 College Enrollment and Completion Effects

4.1 College Enrollment Effects

We now turn to the question of how the GSUS admissions threshold affects students' college enrollment decisions. In the first four columns of Table 4, we show instrumental variable estimates of the impact of GSUS enrollment on other measures of college enrollment. This allows us to understand which alternative college options the marginal student forgoes in order to enroll in the four-year public sector. Such estimates suggest that, across the entire sample, enrollment in GSUS increased four-year college enrollment by 91 percentage points. Phrased differently, 91 percent of compliers would not have enrolled in four-year public college if not for access to the four-year public sector. 78 percent would have enrolled in a two-year college, while another 13 percent would have enrolled nowhere. Only nine percent would have enrolled in another, non-GSUS four-year college. Estimates from the full sample thus suggest that most students on the margin are choosing between two-year colleges and the four-year public sector.

Low income female compliers are more evenly distributed across the set of forgone alternatives. Enrollment in GSUS colleges replaces two-year college enrollment for 23 percent, no college enrollment for 44 percent, and non-GSUS four-year college enrollment for the remaining 33 percent. As a result, 67 percent of low income females who enrolled in GSUS because of the thresholds would not have enrolled in any four-year college otherwise. For black female compliers, 47 percent would have enrolled in two-year colleges, 14 percent in no college, and 40 percent in other four-year colleges. As a result, 61 percent of black females who enrolled in GSUS because of the thresholds would not have enrolled in any four-year college otherwise.

For all samples we analyze, access-induced enrollment in the four-year public sector thus greatly increases the probability of enrolling in a four-year college at all. Whether this is driven more by switching from two-year colleges or no college depends on the sample. Also clear from

column 5 is that, conditional on enrolling in college, enrollment in the four-year public sector dramatically improves the quality of peers to which the marginal student is exposed. The estimated impacts of 13-24 point increases in the median PSAT score of one's college peers represents an improvement of 0.4-0.8 standard deviations in peer quality. We cannot distinguish how much of this quality shift comes from forgoing open enrollment two-year colleges or relatively unselective non-GSUS four-year colleges. Nonetheless, the evidence from Table 4 makes clear that access to the four-year public sector increases both the overall rate of four-year college enrollment and the quality of the college chosen.[9]

4.2 College Completion Effects

Having shown that the GSUS admissions threshold generates large and clear impacts on students' initial college choices, we turn now toward estimating the impacts of such choices on college completion. Our main outcome of interest is the completion of a bachelor's degree from any institution within six years of high school graduation. Figure 4 shows the reduced form graphical version of this estimate for our black female subsample, whose large first stage makes the visual evidence clearest. We observe a clear discontinuity, with those just above the admissions threshold substantially more likely to have earned a bachelor's degree than those just below the threshold.

We turn to regression estimates of such discontinuities in Table 5. The previous evidence suggests that access to and enrollment in the four-year public sector dramatically increases college quality as measured by peers' academic skills. The first column of Table 5 presents

[9] Though not shown here, the admissions thresholds do not appear to change the distance between a student's home and initial college, suggesting that proximity to college (or the probability of living at home while enrolled) does not explain the completion effects we document.

another piece of evidence on the impact on college quality using institutional completion rates as the outcome, constructed as described previously by crediting institutions with bachelor's degrees completed anywhere by students who initially start there and by assigning zeroes to those who do not enroll in college. The estimates suggest that enrolling in the four-year public sector increases institutional bachelor's degree completion rates by 52 percentage points. For low income females and black females, that increase is a lower but still highly statistically significant 32 and 30 percentage points, respectively. Such large differences are driven in part by the substantially higher average bachelor's degree completion rates of four-year institutions relative to two-year institutions. Control complier means, as suggested by Abadie et al. (2002) and Abadie (2003), imply that in the absence of access to the four-year public sector, the average complier would have attended a college with a six-year bachelor's degree completion rate of 13 percent. Those in the female subsamples would have attended colleges with completion rates of 28 percent. Enrollment in the four-year public sector thus at least doubles the completion rate of the institutions attended by compliers, bringing it to about 60 percent for all samples.

The remaining columns of Table 5 alternate between instrumental variables and OLS estimates of the impact of GSUS enrollment on individual students' degree completion outcomes. Both sets of columns use the specification from equation 2, with the IV estimates using GSUS enrollment as predicted by the first stage and the OLS estimates using actual GSUS enrollment. The first striking result, in column 2, is that access-induced enrollment in the four-year public sector increases the probability of bachelor's degree completion within six years by 33 percentage points, a result that is marginally statistically significant. This represents a tripling of the bachelor's degree completion rate, given that 16 percent of control compliers finish their bachelor's degree within that timeframe. For the low income and black female subsamples, four-

year public sector enrollment increases bachelor's degree completion by 27 and 28 percentage points, both of which are statistically significant and represent a more than doubling of the completion rate of compliers. For all samples, access to the four-year public sector substantially increases 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, so that overall degree completion rates rise as much as bachelor's degree rates do. This implies that few of the marginal students here would have instead completed their Associates degrees if denied access to the four-year sector. Second, across nearly all of the coefficients shown here, IV and OLS analyses yield estimates that are very 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 the non-quasi-experimental estimates. Third, comparing the estimates in the first two columns suggests that, conditional on a student's own academic skill, the institutional completion rate of his initial college explains quite well his own probability of completion. In other words, using institution-level completion rates to predict individual completion rates would be fairly accurate, particularly for the low income and black female subsamples.

In Table 6, we test the robustness of our central estimates to a variety of alternative bandwidths and to the inclusion of demographic controls. We use bandwidths of 40, 60, 80 and 100, as the optimal bandwidth suggested by Imbens and Kalyanaraman (2012) is approximately 40 for the full sample and 60 for our subsamples. In general, though estimated magnitudes are occasionally sensitive to bandwidth, all of the estimates of central interest are qualitatively robust

to such choices. To check that our results are not being driven by something spurious, such as the general shape of the relationship between college enrollment and SAT scores, we run our analyses in the nearby SAT-taking state of North Carolina. Table 7 shows reduced form estimates that imply the threshold of interest, which has no policy significance in North Carolina, generates no statistically significant changes in any college enrollment or completion patterns. Reassuringly, such effects appear to be specific to Georgia.

4.3 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 very clear discontinuity, with those just below the threshold more likely to retake than those just above.

Table 8 presents formal estimates of this discontinuity, running the reduced form version of equation 2 with SAT retaking measures as outcomes. Panel A shows that, for the full sample, scoring just above the threshold reduces the probability of retaking by three percentage points. Put differently, missing the threshold induces about three percent of students to retake the SAT. 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. This is the first paper we are aware of to document SAT retaking as evidence of demand for a particular college sector.

Three other facts are worth noting. First, panels B and C show that, though retaking behavior in reaction to the threshold does not vary much by income, overall levels of retaking do. At the threshold, 52 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, 67 percent retake for a mean number of takes of 2.0. Retaking rates are substantially higher for higher income students, even conditional on first SAT score. The result, shown in column 4, is that first SAT scores are a much stronger determinant of eventual access to GSUS for low income students than for higher income students. As shown in column 4, retaking more frequently means that 54 percent of non-low income students whose first SAT is just below the threshold eventually score high enough to qualify for access, compared to only 35 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.

Second, panels D and E show that within the sample of low income students, there are few substantial differences by gender in retaking behavior. This implies that such retaking patterns cannot explain why our instrument is so much stronger for low income females than for low income males. Though not shown here, retaking behavior also does not vary by gender among black students. Some other factor in the college enrollment process must be playing a differential role by gender.

Third, the amount of endogenous retaking in reaction to the publicly known thresholds is very small. 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 generally improve their college options 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 no discontinuity there, as seen in column 3. The result is that, though we use first SAT scores throughout this paper, using maximum SAT scores to generate variation in college access would likely not 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 look quite similar to the ones previously, are much more precisely estimated and are much more consistent across demographic subgroups. We show these results in Tables A.2 and A.3, which replicate Tables 4 and 5 using maximum SAT scores instead of first SAT scores. This specification also shows that access to the four-year public sector greatly increases enrollment in four-year colleges, the quality of college chosen, and bachelor's degree completion rates.

5 Discussion and Conclusion

We document substantial college enrollment and degree completion effects generated by the use of test score thresholds in the admissions process. Access to four-year public colleges shifts substantial numbers of students into the four-year college sector, largely but not entirely from the two-year sector. This dramatically changes the quality of the institution attended, as measured both by peers' academic skills and by institutional graduation rates. Increased access to four-year public colleges leads to substantial increases in degree completion rates for the marginal enrollee. We draw three broad lessons from these findings.

First, that small differences in test scores can generate such large differences in initial college choice suggests that students are not applying to a continuum of colleges, either because

they are applying narrowly or because such a continuum may not exist in some postsecondary markets. In Georgia, as well in most states, a student denied access to the four-year public sector may not have other college options available near that point in the price and quality distribution. The in-kind nature of the state subsidy for public colleges means that few, if any, private institutions can set tuition at levels similar to GSUS colleges while also maintaining comparable quality. Our enrollment results may be driven by the way in which such an in-kind subsidy, rather than a subsidy portable to any institution, distorts this particular market. Our results also reinforce previous research emphasizing the benefits of encouraging students to make test-taking and application choices that do not restrict their available postsecondary options. The thresholds studied here are an additional factor contributing to the importance of such choices.

Second, the observed degree completion effects suggest that initial college choice and quality matter. This is consistent with the broader literature on college quality (Cohodes and Goodman, 2014) and the two-year college penalty literature (Long and Kurlaender, 2009; Reynolds, 2012; Smith and Stange, 2015), though inconsistent with claims that disadvantaged students may benefit from choosing colleges that enroll higher proportions of similar peers (Bastedo and Flaster, 2014). 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. Absolute quality appears to matter more than "match" quality. Similarly, our estimates allow us to reject claims that low-skilled students should be discouraged from choosing four-year colleges because they are incapable of completing such programs. A substantial fraction of the marginal students we study do succeed in completing their four-year college degrees, a result consistent with naïve OLS estimates.

Third, our estimates suggest one potential concern about programs that dramatically reduce the cost of community college, such as Tennessee's Promise 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 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. The net completion effect 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 Promise suggests the latter number is nontrivial.[10] Our results suggest that policymakers should consider coupling price reforms with quality reforms in order to avoid potentially negative consequences for degree completion.

Finally, further research is needed to determine why initial college choice matters and which aspects of college quality are responsible for the graduation effects we document. Our work provides some of the clearest evidence to date on the importance of initial college choice for students with relatively low academic skills. The precise mechanism through which this operates warrants more work.

[10] The November 24, 2015 Inside Higher Ed article "Promise Provides Enrollment Boost", by Ashley A. Smith, cites a 25 percent increase in community college enrollment but a five to eight percent decrease in enrollment at four-year public institutions.

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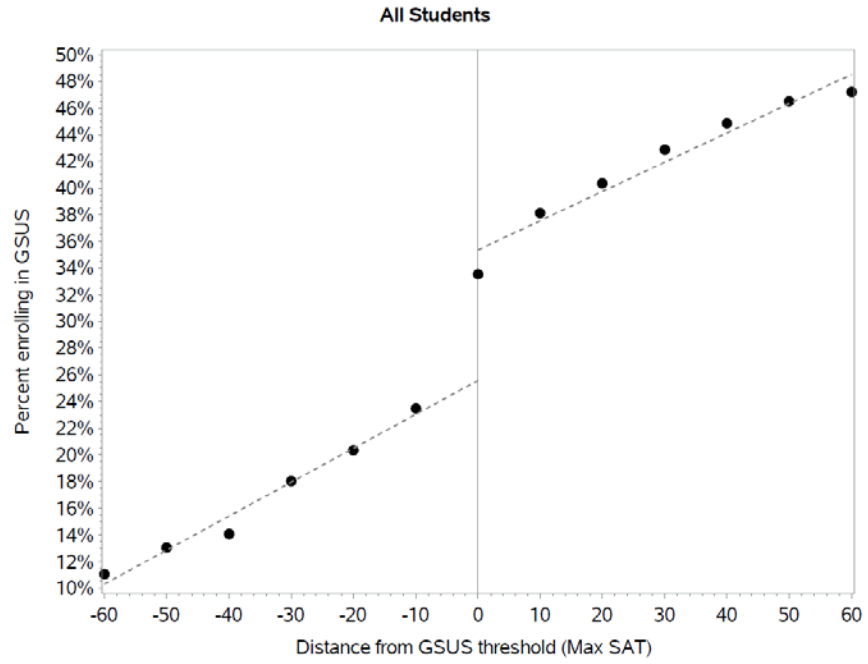
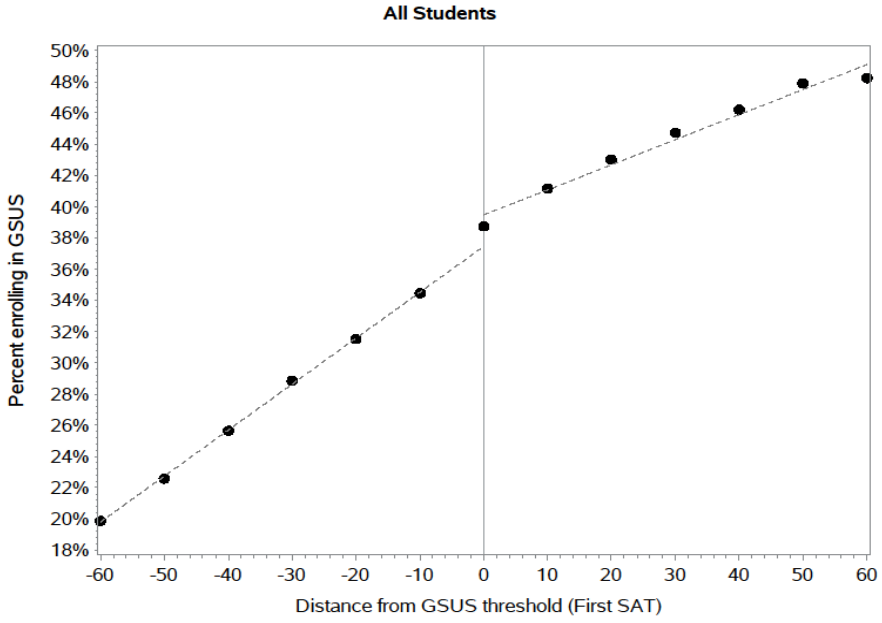
Figure 1: Four-Year Public College Enrollment

(A) Maximum SAT Score



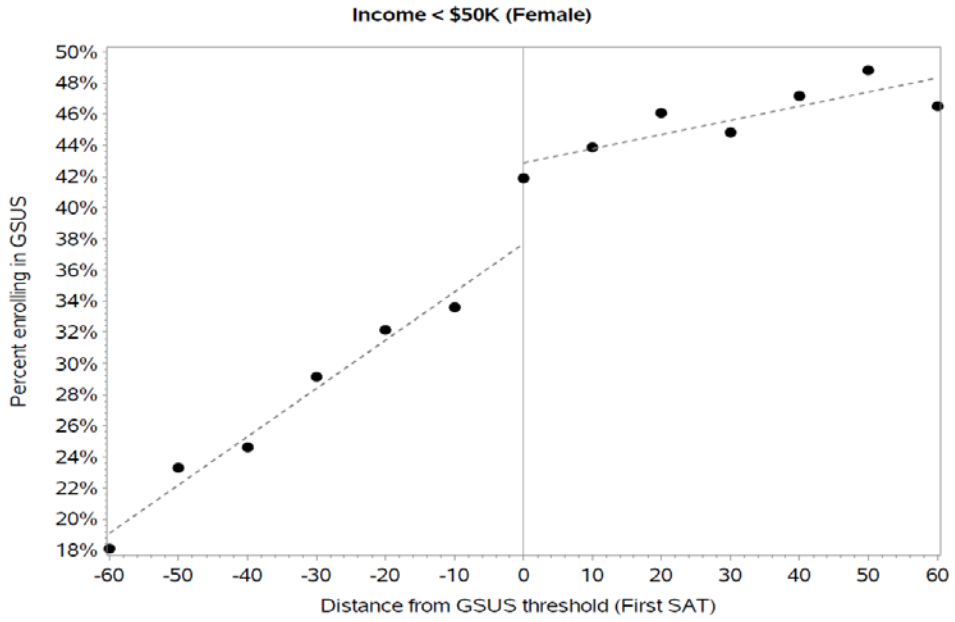
(B) First SAT Score



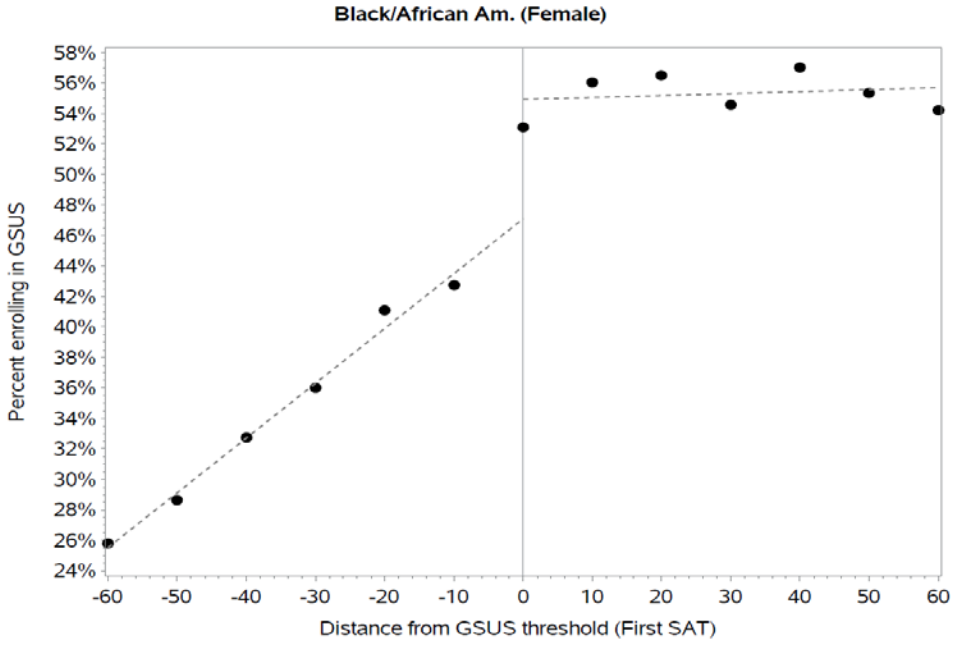
Notes: Shown above is the fraction of students enrolling in a GSUS college within a year of graduating high school, as a function of the distance from the GSUS threshold of their maximum (panel A) or first (panel B) SAT scores. The sample consists of the 2004-07 graduating high school classes residing in Georgia the time of taking the SAT.

Figure 2: Four-Year Public College Enrollment, Low Income and Black Females

(A) Low income females



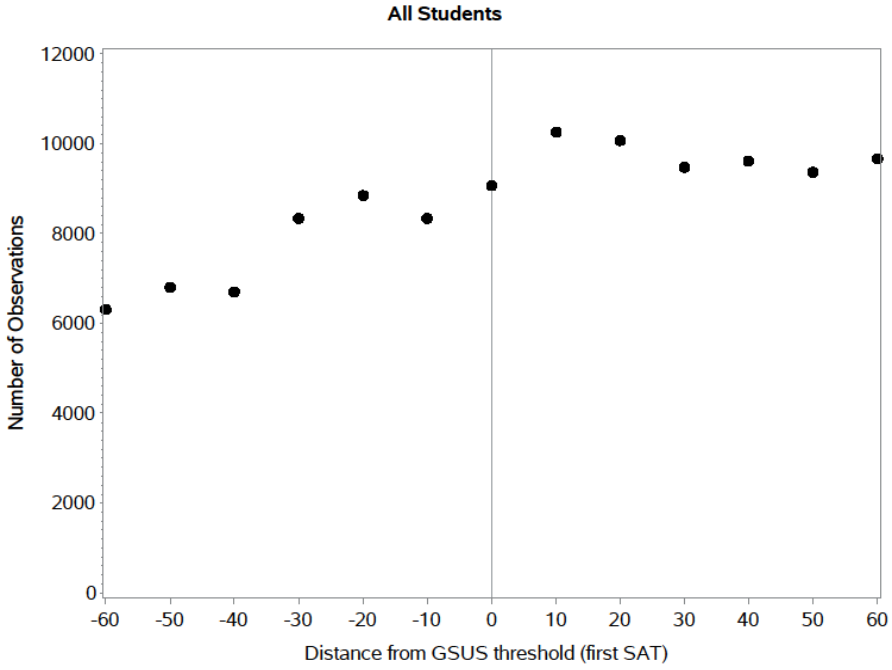
(B) Black females



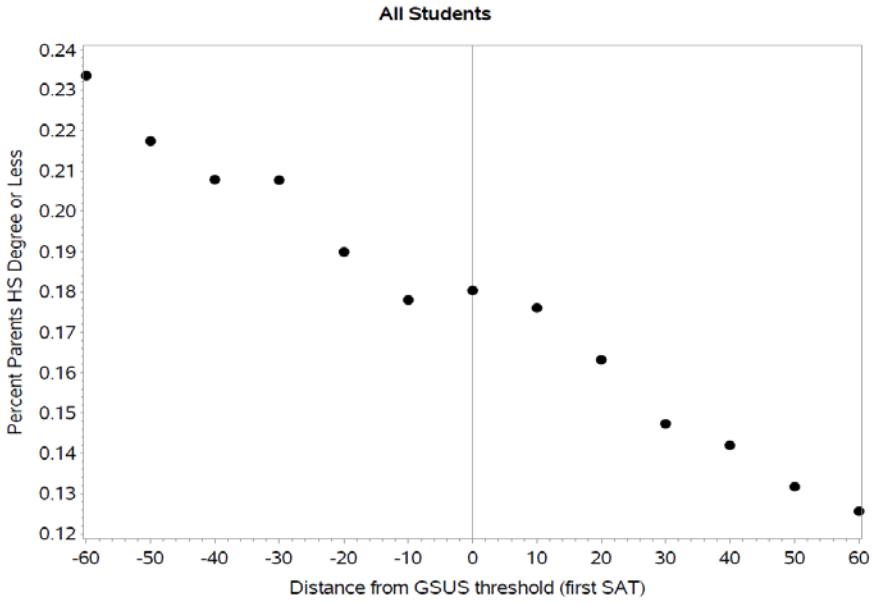
Notes: Shown above is the fraction of students enrolling in a GSUS college within a year of graduating high school, as a function of the distance from the GSUS threshold of their first SAT scores. The sample consists of the 2004-07 graduating high school classes residing in Georgia the time of taking the SAT. Panel A limits the sample to female students with annual family income of less than $50,000. Panel B limits the sample to black female students.

Figure 3: Validity of the Regression Discontinuity Design

(A) Number of Observations

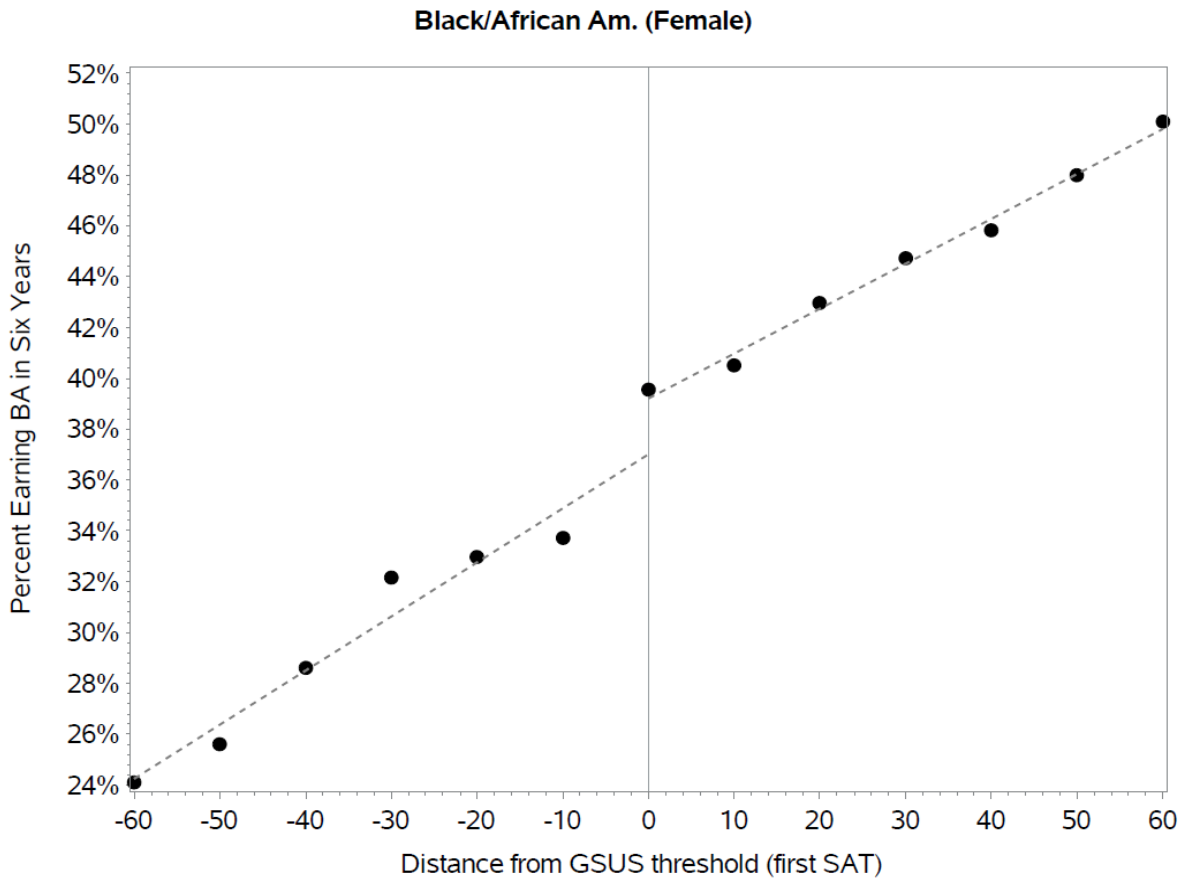


(B) Low Parental Education



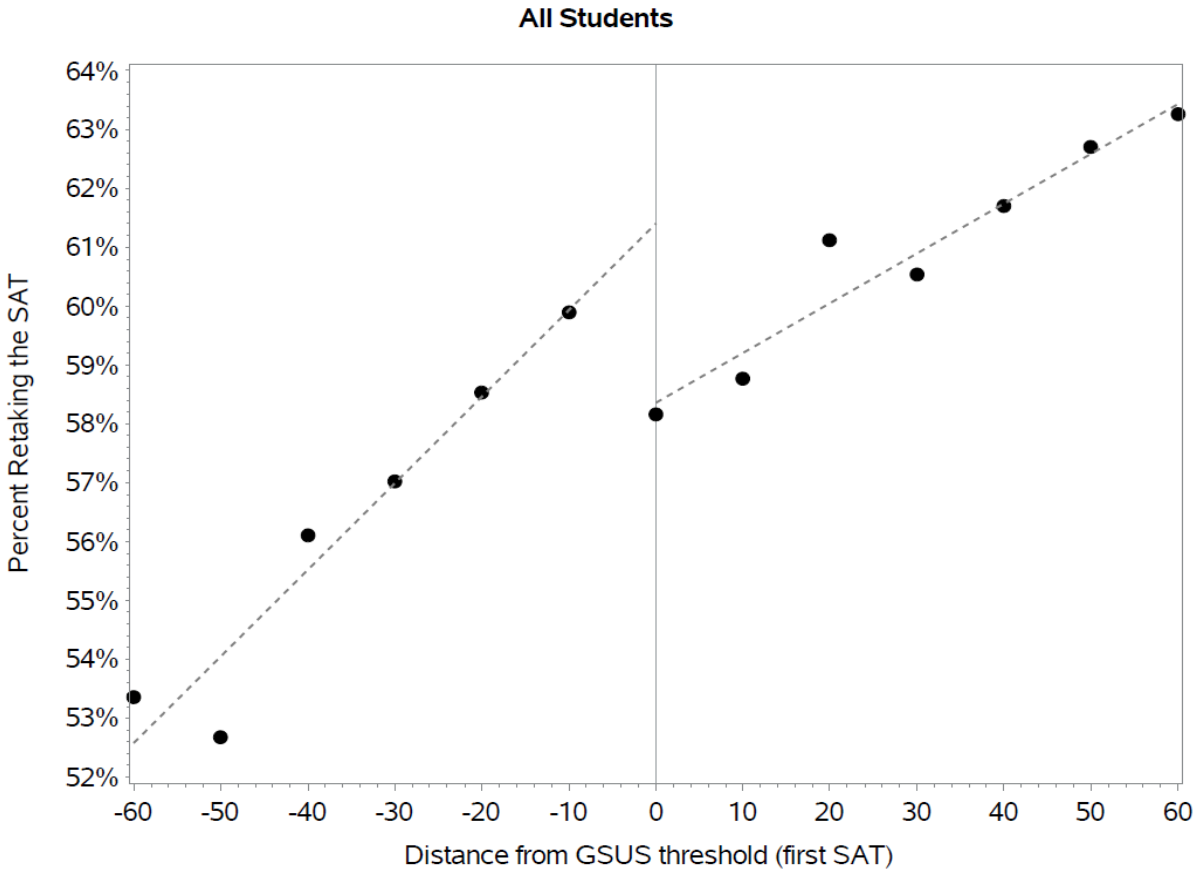
Notes: Shown above are the number of observations (panel A) and the fraction whose parents have no college education (panel B) as a function of the distance from the GSUS threshold of their first SAT scores. The sample consists of the 2004-07 graduating high school classes residing in Georgia the time of taking the SAT.

Figure 4: Bachelor's Degree Completion, Black Females



Notes: Shown above is the fraction of students completing their bachelor's degrees within six years of graduating high school, as a function of the distance from the GSUS threshold of their first SAT scores. The sample consists of black female students from the 2004-07 graduating high school classes residing in Georgia the time of taking the SAT.

Figure 5: SAT Retaking



Notes: Shown above is the fraction of students retaking the SAT as a function of the distance from the GSUS threshold of their first SAT scores. The sample consists of the 2004-07 graduating high school classes residing in Georgia the time of taking the SAT.

Table 1: Summary Statistics

	(1)	(2)	(3)	(4)	(5)
	All Georgia SAT Takers	Low Income Students	Low Income Females	Black Students	Black Females
(A) Demographics					
Female	0.54	0.60	-	0.58	-
White	0.56	0.37	0.36	-	-
Black	0.25	0.46	0.47	-	-
Hispanic	0.03	0.05	0.05	-	-
Low income	0.27	-	-	0.50	0.53
(B) Test scores					
First SAT score	965	891	879	843	840
Access to GSUS from first SAT	0.66	0.50	0.49	0.40	0.40
Retook SAT at least once	0.61	0.49	0.50	0.53	0.54
Maximum SAT score	1,009	926	924	886	889
Access to GSUS from maximum SAT	0.73	0.58	0.57	0.50	0.50
(C) College outcomes					
Enrolled on time at GSUS college	0.39	0.32	0.33	0.33	0.36
Enrolled on time at any four-year college	0.61	0.49	0.50	0.56	0.58
Enrolled on time at any two-year college	0.20	0.25	0.25	0.20	0.21
Completed bachelor's degree within six years	0.41	0.28	0.31	0.30	0.33
N	234,536	62,708	37,539	57,620	33,702

Note: The sample consists of all Georgia SAT takers from the 2004-07 graduating high school classes whose first SAT scores place them within 60 points of the GSUS thresholds. Column 1 includes all students, columns 2 and 3 limit the sample to those reporting family income of less than $50,000, and columns 4 and 5 limit the sample to black students. In panel C, on-time college enrollment is defined as enrollment within one year of high school graduation. Completion of a bachelor's degree within six years includes students who earned these degrees by June six years after high school graduation.

Table 2: First Stage Impact of Access on Enrollment in Georgia Four-Year Public College

	(1) BW = IK	(2) BW = 40	(3) BW = 60	(4) BW = 60	(5) BW = 80	(6) BW = 100
(A) All students						
Access	0.018***	0.018***	0.020***	0.020***	0.033***	0.040***
(Control mean = 0.345)	(0.002)	(0.002)	(0.004)	(0.004)	(0.007)	(0.007)
(B) Non-low income						
Access	0.011*	0.013	0.011*	0.010	0.023***	0.029***
(Control mean = 0.365)	(0.005)	(0.008)	(0.005)	(0.006)	(0.008)	(0.008)
(C) Low income						
Access	0.027***	0.020*	0.027***	0.030**	0.036***	0.049***
(Control mean = 0.326)	(0.009)	(0.010)	(0.009)	(0.010)	(0.008)	(0.010)
(D) Black students						
Access	0.032***	0.032***	0.045***	0.043***	0.057***	0.062***
(Control mean = 0.416)	(0.006)	(0.006)	(0.009)	(0.009)	(0.011)	(0.010)
(E) Low income females						
Access	0.052***	0.051***	0.052***	0.053***	0.063***	0.073***
(Control mean = 0.336)	(0.011)	(0.011)	(0.011)	(0.012)	(0.009)	(0.009)
(F) Black females						
Access	0.078***	0.072***	0.078***	0.078***	0.091***	0.096***
(Control mean = 0.427)	(0.013)	(0.014)	(0.013)	(0.015)	(0.014)	(0.013)
(G) Low income males						
Access	-0.023**	-0.032***	-0.013	-0.008	-0.007	0.011
(Control mean = 0.310)	(0.007)	(0.008)	(0.009)	(0.009)	(0.008)	(0.013)
(H) Black males						
Access	-0.031	-0.031	-0.007	-0.010	0.005	0.011
(Control mean = 0.398)	(0.023)	(0.023)	(0.021)	(0.019)	(0.020)	(0.018)
Demographic controls	N	N	N	Y	N	N

Note: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All estimates come from a local linear regression of an indicator for on-time enrolllment in a GSUS college on an indicator for scoring at or above the GSUS threshold, using the listed bandwidth. In column 1, the Imbens-Kalyanaraman optimal bandwidth (rounded up to the nearest 10) is 60 in panels B, C, D and G; 50 in panel E; and 40 in panels A, F and H. The sample consists of the 2004-07 graduating high school classes residing in Georgia when taking the SAT. Each regression includes class fixed effects. No other controls are included, except in column 4, which replicates column 3 while controlling for gender, race, family income and parental education. Also listed is the mean value of the outcome for students with SAT scores 10 points below the threshold. Low income students are those reporting family income of less than $50,000.

Table 3: Covariate Balance Tests

	(1)	(2)	(3)	(4)	(5)	(6)
	Male	Low income	Black	Hispanic	Parent some college	Parent B.A. or higher
(A) All students						
Access	-0.006	-0.005	-0.003	0.001	0.006	-0.015**
	(0.005)	(0.004)	(0.006)	(0.002)	(0.004)	(0.006)
Mean below threshold	0.422	0.318	0.303	0.034	0.313	0.398
(B) Low income females						
Access			-0.008	0.001	-0.023**	-0.003
			(0.017)	(0.006)	(0.009)	(0.011)
Mean below threshold			0.511	0.049	0.428	0.238
(C) Black females						
Access		-0.014			-0.003	-0.019*
		(0.013)			(0.009)	(0.011)
Mean below threshold		0.553			0.407	0.338

Note: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All estimates come from a local linear regression of the listed covariate on an indicator for scoring at or above the GSUS threshold, using a bandwidth of 60. The sample consists of the 2004-07 graduating high school classes residing in Georgia when taking the SAT. Each regression includes class fixed effects. Also listed is the mean value of the outcome for students with SAT scores 10 points below the threshold. Low income students are those reporting family income of less than $50,000. The sample sizes are 112,878 in panel A, 20,598 in panel B, and 18,845 in panel C.

Table 4: Initial College Enrollment

	(1) Enrolled in any 4-year college	(2) Enrolled in any 2-year college	(3) Did not enroll in any college	(4) Enrolled in non-GSUS 4-year college	(5) College's median PSAT score
(A) All students					
Enrolled GSUS	0.913***	-0.778***	-0.134	-0.087	24.133***
	(0.167)	(0.117)	(0.241)	(0.167)	(8.149)
N	112,878	112,878	112,878	112,878	91,197
(B) Low income females					
Enrolled GSUS	0.668***	-0.228	-0.440***	-0.332***	13.006***
	(0.107)	(0.158)	(0.131)	(0.107)	(3.015)
N	20,598	20,598	20,598	20,598	15,929
(C) Black females					
Enrolled GSUS	0.605***	-0.470***	-0.135	-0.395***	14.398***
	(0.137)	(0.091)	(0.182)	(0.137)	(3.169)
N	18,845	18,845	18,845	18,845	15,502

Note: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All estimates come from a local linear regression, using a bandwidth of 60, of the listed outcome on an indicator for enrollment in a GSUS college, where such enrollment has been instrumented with an indicator for scoring at or above the GSUS threshold. The sample consists of the 2004-07 graduating high school classes residing in Georgia when taking the SAT. Each regression includes class fixed effects and no other controls. Low income students are those reporting family income of less than $50,000. In columns 1-4, outcomes are indicators for first-time enrollment within one year of high school graduation. Column 5 uses an outcome the median PSAT score of peers at a given student's enrolled college, with non-enrollers treated as missing.

Table 5: College Degree Completion

	(1)	(2)	(3)	(4)	(5)
	College's six-year bachelor's degree completion rate	Completed bachelor's degree within six years		Completed associate's degree within six years	
	IV	IV	OLS	IV	OLS
(A) All students					
Enrolled GSUS	0.522***	0.332*	0.240***	0.034	-0.060***
	(0.105)	(0.183)	(0.010)	(0.255)	(0.002)
CCM	0.126	0.160		0.063	
(B) Low income females					
Enrolled GSUS	0.321***	0.268***	0.263***	0.007	-0.079***
	(0.059)	(0.096)	(0.011)	(0.185)	(0.004)
CCM	0.279	0.222		-0.009	
(C) Black females					
Enrolled GSUS	0.302***	0.280**	0.223***	0.068	-0.052***
	(0.052)	(0.123)	(0.018)	(0.050)	(0.004)
CCM	0.278	0.165		0.029	

Note: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All estimates come from a local linear regression, using a bandwidth of 60, of the listed outcome on an indicator for enrollment in a GSUS college, where such enrollment has been instrumented in columns 1, 2 and 4 with an indicator for scoring at or above the GSUS threshold. Columns 3 and 5 present the un-instrumented versions of those same regressions. The sample consists of the 2004-07 graduating high school classes residing in Georgia when taking the SAT. Each regression includes class fixed effects and no other controls. Low income students are those reporting family income of less than $50,000. Column 1 measures the NSC-based bachelor's degree completion rate of the first college a student enrolls in, where non-enrollees are assigned zeroes. Also listed are the control complier means. The sample sizes are 112,878 in panel A, 20,598 in panel B, and 18,845 in panel C.

Table 6: Robustness Checks

	(1) Enrolled on time, any 4-year college	(2) Enrolled on time, any 2-year college	(3) Median PSAT score, on time college	(4) College's bachelor's degree completion rate	(5) Completed bachelor's degree within six years
(A) All students					
Bandwidth = 40 (IK)	0.975***	-0.747***	20.366***	0.436***	0.525***
	(0.223)	(0.115)	(7.556)	(0.091)	(0.177)
Bandwidth = 60	0.913***	-0.778***	24.133***	0.522***	0.332*
	(0.167)	(0.117)	(8.149)	(0.105)	(0.183)
Bandwidth = 60, controls	0.990***	-0.852***	25.807***	0.570***	0.333*
	(0.165)	(0.133)	(8.482)	(0.104)	(0.203)
Bandwidth = 80	0.781***	-0.645***	18.817***	0.400***	0.330***
	(0.101)	(0.078)	(4.774)	(0.066)	(0.099)
Bandwidth = 100	0.773***	-0.684***	18.685***	0.413***	0.323***
	(0.072)	(0.063)	(4.476)	(0.048)	(0.075)
(B) Low income females					
Bandwidth = 40	0.690***	-0.446***	7.851**	0.173***	0.413***
	(0.089)	(0.105)	(3.302)	(0.031)	(0.098)
Bandwidth = 60 (IK)	0.668***	-0.228	13.006***	0.321***	0.268***
	(0.107)	(0.158)	(3.015)	(0.059)	(0.096)
Bandwidth = 60, controls	0.703***	-0.226	11.447***	0.333***	0.298***
	(0.116)	(0.167)	(2.701)	(0.050)	(0.101)
Bandwidth = 80	0.660***	-0.268**	17.864***	0.349***	0.388***
	(0.073)	(0.111)	(3.592)	(0.052)	(0.071)
Bandwidth = 100	0.685***	-0.380***	17.904***	0.363***	0.358***
	(0.061)	(0.085)	(2.744)	(0.043)	(0.053)
(C) Black females					
Bandwidth = 40	0.788***	-0.503***	15.552***	0.325***	0.478***
	(0.133)	(0.119)	(4.256)	(0.060)	(0.119)
Bandwidth = 60 (IK)	0.605***	-0.470***	14.398***	0.302***	0.280**
	(0.137)	(0.091)	(3.169)	(0.052)	(0.123)
Bandwidth = 60, controls	0.624***	-0.481***	15.188***	0.314***	0.298**
	(0.143)	(0.092)	(3.121)	(0.052)	(0.132)
Bandwidth = 80	0.561***	-0.429***	14.529***	0.295***	0.289***
	(0.109)	(0.071)	(3.454)	(0.057)	(0.100)
Bandwidth = 100	0.552***	-0.449***	16.855***	0.309***	0.170*
	(0.101)	(0.068)	(3.406)	(0.049)	(0.096)

Note: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All estimates come from a local linear regression, using the listed bandwidth, of the listed outcome on an indicator for enrollment in a GSUS college, where such enrollment has been instrumented with an indicator for scoring at or above the GSUS threshold. The sample consists of the 2004-07 graduating high school classes residing in Georgia when taking the SAT. Each regression includes class fixed effects. Low income students are those reporting family income of less than $50,000. The third row of each panel includes controls for gender, income, race and parental education.

Table 7: North Carolina Placebo Tests

	(1) Enrolled on time, any 4-year college	(2) Enrolled on time, any 2-year college	(3) Median PSAT score, on time college	(4) College's bachelor's degree completion rate	(5) Completed bachelor's degree within six years
All students	0.001	0.001	-0.139	-0.001	-0.002
	(0.005)	(0.003)	(0.089)	(0.003)	(0.007)
Low income students	0.007	-0.001	0.055	0.001	-0.008
	(0.007)	(0.004)	(0.108)	(0.003)	(0.008)
Low income females	0.010	-0.009	0.105	0.003	-0.004
	(0.007)	(0.006)	(0.147)	(0.004)	(0.012)
Black females	-0.000	-0.001	-0.088	-0.002	-0.018
	(0.012)	(0.007)	(0.394)	(0.005)	(0.016)

Note: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All estimates come from a local linear regression, using a bandwidth of 60, of the listed outcome on an indicator for scoring at or above the GSUS threshold. The sample consists of the 2004-07 graduating high school classes residing in North Carolina when taking the SAT. Each regression includes class fixed effects and no other controls. Low income students are those reporting family income of less than $50,000.

Table 8: SAT Retaking and Score Sending Behavior in Georgia

	(1) Retook SAT	(2) Number of takes	(3) Maximum SAT score	(4) Eventual GSUS access	(5) Score sends	(6) Sent score to GSUS
(A) All students						
Access	-0.032***	-0.045***	-2.279	0.497***	-0.071***	-0.005
	(0.005)	(0.011)	(1.299)	(0.006)	(0.022)	(0.003)
Mean below threshold	0.599	1.906	916.941	0.456	3.700	0.679
(B) Non-low income students						
Access	-0.029***	-0.059***	-2.640	0.419***	-0.025	-0.013***
	(0.008)	(0.018)	(1.707)	(0.012)	(0.062)	(0.002)
Mean below threshold	0.666	2.048	924.946	0.538	3.684	0.692
(C) Low income students						
Access	-0.039***	-0.042***	-1.012	0.599***	-0.090***	-0.002
	(0.006)	(0.008)	(1.548)	(0.005)	(0.026)	(0.006)
Mean below threshold	0.520	1.716	904.936	0.354	3.972	0.713
(D) Low income females						
Access	-0.043***	-0.046***	-1.483	0.584***	-0.078	-0.004
	(0.006)	(0.009)	(1.536)	(0.002)	(0.052)	(0.008)
Mean below threshold	0.536	1.745	910.399	0.371	4.100	0.729
(E) Low income males						
Access	-0.031**	-0.033	-0.277	0.625***	-0.103	-0.001
	(0.010)	(0.020)	(1.700)	(0.011)	(0.067)	(0.008)
Mean below threshold	0.494	1.670	896.028	0.326	3.755	0.685

Note: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All estimates come from a local linear regression of the listed outcome on an indicator for scoring at or above the GSUS threshold, using a bandwidth of 60. The sample consists of the 2004-07 graduating high school classes residing in Georgia when taking the SAT. Each regression includes class fixed effects. Also listed is the mean value of the outcome for students with SAT scores 10 points below the threshold. Low income students are those reporting family income of less than $50,000.

Table A.1: Characteristics of GSUS Colleges

	(1) FTE students	(2) Tuition and fees	(3) Median SAT score	(4) Percent admitted	(5) Instr. spending per FTE	(6) Six-year grad. rate	(7) SAT verbal threshold	(8) SAT math threshold	(9) SAT total threshold
I. 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	
II. 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	
III. 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	
IV. Other Georgia 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: Initial College Enrollment, Using Maximum SAT Scores

	(1) Enrolled in any 4-year college	(2) Enrolled in any 2-year college	(3) Did not enroll in any college	(4) Enrolled in non-GSUS 4-year college	(5) College's median PSAT score
(A) All students					
Enrolled GSUS	0.666***	-0.470***	-0.196***	-0.334***	14.152***
	(0.033)	(0.037)	(0.027)	(0.033)	(0.638)
N	101,990	101,990	101,990	101,990	80,263
(B) Low income females					
Enrolled GSUS	0.541***	-0.349***	-0.192***	-0.459***	12.557***
	(0.071)	(0.073)	(0.063)	(0.071)	(1.798)
N	20,612	20,612	20,612	20,612	15,756
(C) Black females					
Enrolled GSUS	0.587***	-0.392***	-0.194**	-0.413***	11.516***
	(0.091)	(0.032)	(0.076)	(0.091)	(1.728)
N	19,408	19,408	19,408	19,408	15,837

Note: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All estimates come from a local linear regression, using a bandwidth of 60, of the listed outcome on an indicator for enrollment in a GSUS college, where such enrollment has been instrumented with an indicator for scoring at or above the GSUS threshold. The sample consists of the 2004-07 graduating high school classes residing in Georgia when taking the SAT. Each regression includes class fixed effects and no other controls. Low income students are those reporting family income of less than $50,000. In columns 1-4, outcomes are indicators for first-time enrollment within one year of high school graduation. Column 5 uses an outcome the median PSAT score of peers at a given student's enrolled college, with non-enrollers treated as missing. The running variable is defined using students' maximum SAT scores.

Table A.3: College Degree Completion, Using Maximum SAT Scores

	(1)	(2)	(3)	(4)	(5)
	College's six-year bachelor's degree completion rate	Completed bachelor's degree within six years		Completed associate's degree within six years	
	IV	IV	OLS	IV	OLS
(A) All students					
Enrolled GSUS	0.313***	0.244***	0.225***	-0.032	-0.061***
	(0.012)	(0.034)	(0.007)	(0.035)	(0.001)
CCM	0.269	0.236		0.089	
(B) Low income females					
Enrolled GSUS	0.297***	0.191***	0.251***	-0.015	-0.077***
	(0.028)	(0.064)	(0.008)	(0.090)	(0.004)
CCM	0.296	0.202		0.052	
(C) Black females					
Enrolled GSUS	0.264***	0.221***	0.211***	0.008	-0.049***
	(0.034)	(0.039)	(0.014)	(0.025)	(0.003)
CCM	0.304	0.240		0.044	

Note: Heteroskedasticity robust standard errors clustered by distance to the admissions threshold are in parentheses (* p<.10 ** p<.05 *** p<.01). All estimates come from a local linear regression, using a bandwidth of 60, of the listed outcome on an indicator for enrollment in a GSUS college, where such enrollment has been instrumented in columns 1, 2 and 4 with an indicator for scoring at or above the GSUS threshold. Columns 3 and 5 present the un-instrumented versions of those same regressions. The sample consists of the 2004-07 graduating high school classes residing in Georgia when taking the SAT. Each regression includes class fixed effects and no other controls. Low income students are those reporting family income of less than $50,000. Column 1 uses an outcome the NSC-based average six-year B.A. completion rate of the first college a student enrolls in within one year of high school graduation among SAT takers, where non-enrollers are assigned zeroes. Also listed are the control complier means. The sample sizes are 101,990 in panel A, 20,612 in panel B, and 19,408 in panel C. The running variable is defined using students' maximum SAT scores.