Describing the Marginal Enrollee: Merit-Based Tuition Subsidies Revisited*

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Abstract

I exploit eligibility cutoffs for merit-based tuition subsidies to show that transferable aid induces application to and enrollment in post-secondary school. The results suggest the marginal enrollee is less likely to work while enrolled; spends less time on extra-curricular activities and volunteer work and more time on academics; and has less intention of continuing his education into graduate school. As implied by a model of enrollment and effort decisions in the presence of heterogeneous costs and returns to schooling, the evidence suggests the population on the margin of enrollment is more constrained by low ability than by high costs.

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1 Introduction

Financial aid programs at all levels–federal, state, and institutional–in the United States have been largely need-based since the 1960s, awarding grants and low interest loans on the basis of family income as opposed to academic performance. These programs were broadly aimed at providing greater access to higher education to lower income individuals, otherwise unlikely to attend college, and to expand the set of affordable postsecondary educational opportunities of financially constrained college-goers. The smaller fraction of financial aid allocated on the basis of academic merit was largely distributed at the institutional level in attempts to attract academically gifted students.

However, since the early 1990s, many states–particularly across the southeastern United States–have instituted state-wide merit-based tuition subsidy programs. These programs, most of which have no means restrictions, have had a very different focus. Originally developed in states with below average enrollment rates and academic performance, these programs are aimed at keeping academically proficient students in state for postsecondary schooling and post-schooling employment and at generally improving the employability of the state's labor force.

The largest of these programs is Georgia's "Helping Outstanding Pupils Educationally" (HOPE) Scholarship and Grant Program. Georgia's program was initiated in 1993 and was notable for its simple and comprehensive nature. It mandated, generally, that Georgia residents graduating high school in the spring of 1993 or thereafter with at least a B average and planning to attend an eligible in-state university qualify for one academic year of funding (full in the case of public institutions and partial in the case of private institutions).

Many of the state-wide merit-based scholarship programs share this same simple structure. Each program has academic requirements in the form of a high school grade point average (GPA) cutoff and/or a college board (SAT or ACT) score cutoff. By 2004, more than 15 states had instituted similar programs, most lottery-funded. While these programs differ in some respects, many share the simple academic performance cutoffs and the lack of significant means restrictions which are most important for this study.

The most salient concern with these merit aid programs has been the degree to which they seem to subsidize the education or even leisure of "college-stayers," or individuals who would enroll irrespective of receiving the tuition subsidy. Given that most of these scholarship programs are at least in part funded by state lotteries, which are often perceived as regressive taxes on the poor, many critics argue that merit-based tuition subsidy programs like Georgia's HOPE scholarship amount to wealth transfers from the poor to the rich. To the extent that these programs actually motivate a large population of students on the margin of enrollment to enroll due to a relaxation of financial constraints ("switchers"), these concerns could be overstated.

At a time when budgetary tightening threatens the scope and even the continuing existence of several of these programs, assessing their effectiveness at encouraging enrollment among ex-ante non-enrollees is of the utmost importance. Furthermore, in order to discuss any potential welfare enhancement brought about by such programs, I must first identify the types of individuals on the margin of enrollment, particularly with respect to ability in (or gross return to) school and cost of enrollment. The endogenous timing and location of the institution of these programs (along with the endogenous nature of the receipt of financial aid, more generally, at the individual level) has rendered difficult the identification of the causal effects of these programs (indeed, financial aid more generally) on enrollment, and any subsequent description of the marginal enrollee.

Over the past decade, some studies have exploited the timing and location of the institution of these state-wide scholarship programs to assess their effectiveness. These studies have found increases in enrollment, attainment, and academic performance in response to increases in financial aid. Dynarski (2000) and Cornwell, Mustard, and Sridhar (2006) use difference-in-difference (DD) strategies to estimate the effects of Georgia's HOPE scholarship program on enrollment of first-time freshmen. The two studies use different sources of repeated cross-sectional data to measure the difference in intertemporal change in enrollment between Georgia and various subsets of other Southeastern states. While both find heterogeneous enrollment effects of similar magnitudes, they differ significantly with respect to the degree and nature of the heterogeneity.

More importantly, both studies rely heavily on the assumption that any coincidental trend in relative enrollment rates is due entirely to the institution of this merit scholarship program. This assumption is highly contentious, considering that Georgia's educational enrollment, attainment, and performance (as those in many other program states) deviated significantly from the national average leading up to the institution of the HOPE Scholarship. Therefore, any contemporaneous trends or reversions to the national average in these indicators would be falsely attributed to the HOPE program using this identification strategy. Additionally, the effects of other educational initiatives which predated or coexisted with the HOPE program will be indistinguishable from the true effect of the program on enrollments.

The lack of convincing causal identification of switching in these previous studies, consequently, precludes any attempt of providing a description of the marginal enrollee as well. Though more sophisticated methods have been used to study the effects of these programs since these early studies (Scott-Clayton (2011) explores effects on academic performance using similar methods to those used in this study), effects on enrollments have never been revisited. Other studies have explored effects on measures of effort, enrollment intensity, and academic performance (Cornwell, Lee, and Mustard (2005, 2011); Pallais (2009)), but suffer from the same identification issues described above and, accordingly, also fail to isolate the switchers from the total population.

Empirical description of the population on the margin of enrollment (and therefore, the population most affected by such financial aid programs) necessitates an accurate model of the schooling choice decision. In recent years, the education literature has emphasized the importance of a model of schooling choice which accounts for heterogeneous returns to schooling on the basis of ability or preference (Heckman and Vytlacil (2001)) and heterogeneous costs in the form of access to credit or short-term liquidity (Card (1999)). In the context of such a model, investigating which source of latent heterogeneity encourages (or perhaps discourages) the marginal student's enrollment is likely of more import to policy-makers than quantifying aggregate shifts in enrollment. However, doing so can prove difficult when both ability and costs are often unobservable.

Due to the unobservable nature of these primary determinants of schooling choices, the literature lacks consensus on the relative importance of ability vis-a-vis costs in the enrollment decision. Card (2001) provides suggestive evidence of the importance of heterogeneous marginal costs of schooling, rather than heterogeneous abilities or gross returns, in the optimal schooling decision using a review of studies which compare OLS to IV estimates of returns to schooling. Carneiro and Heckman (2002) take issue with the empirical strategies used in these studies; propose that heterogeneous abilities and returns can account for the differences mentioned; and suggest that the quality of the school attended might be more affected by the binding of financial constraints than the extensive decision of whether to enroll at all. Additional studies have provided evidence for or against the importance of credit constraints using structural estimations (e.g. Cameron and Taber (2004), Keane and Wolpin (2001)) or subjective expectations data (e.g. Attanasio and Kaufman (2009)).

In this paper, I use data on academic performance and enrollment decisions and quasi-experimental methods to causally identify switchers and characterize their post-matriculation behaviors. These post-matriculation behaviors (namely enrollment intensity, employment, extracurricular activities, and academic effort) can, in the context of a model of the enrollment decision and choice of effort in school which accounts for both heterogeneous abilities and costs, be used to comment on the relative importance of ability and cost in the enrollment decision. By comparing the observed enrollment intensity and effort of switchers to those of college-stayers, I can empirically support the hypothesis that the marginal enrollee is more likely constrained by low ability (and therefore, low gross return) than by high cost.

Specifically, I use a fuzzy regression discontinuity (FRD) framework (previously used to explore other topics in the economics of education, e.g. Angrist and Lavy (1999)) to estimate the effects of tuition subsidy programs, such as the ones modeled after Georgia's HOPE Scholarship program, on college applications and enrollment. The structure of these programs lends itself to using the discontinuities in eligibility for tuition subsidies derived from GPA and/or college board scores of potential students to instrument for transferable aid (aid which can be used at multiple institutions). An FRD framework avoids the omitted variables and endogeneity problems faced by DD approaches. That is, identification of the effects of these programs on various outcomes does not rely on assumptions about relative trends between states or cohorts or exogeneity of the decision to institute such programs, but rather compares students within the same state and cohort using an exogenously imposed assignment rule as the source of variation.

I believe this study makes three main contributions to the literature on financial aid and schooling choice. Among the studies of merit-based tuition subsidies, this is the first, to my knowledge, to explore effects on applications along with enrollments using individual panel data to causally identify switchers. Second, I compare consistent FRD estimates of effects on application and enrollment to OLS estimates to show that latent financial need, rather than ability or preference, appears to be the primary source of bias in OLS estimates. That is, I find that financial aid appears to be endogenously allocated (or sought) more on the basis of need than ability. Finally, I derive theoretical predictions for the optimal effort levels of low ability and high cost types and use them to test for which type predominates in the population on the margin of enrollment (that is, which type predominates among switchers). I find that the marginal enrollee is more constrained by low ability than high cost.

The remainder of this paper is organized as follows: Section 2 presents the model and some testable implications; Section 3 discusses the data used in the analysis; Section 4 presents the empirical methodology; Section 5 presents and discusses the empirical results; and Section 6 concludes.

2 Model

Let us consider an infinite horizon utility maximization problem in continuous time in which an individual (who has completed high school) chooses whether to pursue post-secondary education and, when enrolled, how much effort to expend in school. The heterogeneous component of the individual's return to post-secondary school completion will be a function of his cognitive ability and this effort he puts forth while in school. However, he will also incur a heterogeneous disutility from attending school, which also depends on how much effort he expends.

In particular, prior to completion of post-secondary schooling, the individual i receives the following earnings flow:

$$\ln y_{i0} = \alpha + Z_i, \tag{1}$$

where α is a homogeneous intercept and Z_i is the portion of individual ability which does not affect earnings differentially across post-secondary schooling levels. After completing post-secondary education, the individual receives

$$\ln y_{i1} = \alpha + \beta + \phi(\eta_i, e_i) + Z_i, \tag{2}$$

where β is the average return to post-secondary schooling and ϕ is the heterogeneous component of the return. As mentioned above, ϕ is a function of individual cognitive ability (or the portion of individual ability which affects the return to schooling), η_i, and effort, $e_i \geq 0$. I will assume that ϕ is increasing and concave in both its arguments and that ability and effort are substitutes in this schooling returns function (i.e. $\frac{\partial^2 \phi}{\partial \eta_i \partial e_i} < 0$)[1].

I can then express the flow earnings of an individual as a function of a dummy S_{it} for whether he has completed post-secondary education at time t:

$$\ln y(S_{it}; \phi(\eta_i, e_i); Z_i) = \alpha + \beta S_{it} + \phi(\eta_i, e_i) S_{it} + Z_i, \tag{3}$$

The individual's decision can be categorized as the solution to the following maximization problem:

$$\max_{S_{it}, E_{it} | t \in [0,\infty]; e_i \geq 0} U = \int_0^\infty \Bigg(\ln y(S_{it}; \phi(\eta_i, e_i); Z_i) - \Gamma(e_i, c_i; T) E_{it} \Bigg) e^{-\rho_i t} dt \tag{4}$$

where Γ is a cost function, c_i is a heterogeneous utility cost parameter, T is the cost of tuition, ρ_i is the individual's discount rate, and E_{it} is a dummy for whether the individual is enrolled in post-secondary school at time t . I will assume that utility costs and tuition costs are additively separable. In particular, I have that $\Gamma = \gamma(e_i, c_i) + T$. γ is increasing and convex in both its arguments, with $\frac{\partial^2 \gamma}{\partial e_i \partial c_i} > 0$.

Now, if it will take the individual a minimum of τ periods to complete the proposed post-secondary degree, his optimal choice will be to enroll immediately and complete schooling in exactly τ periods (i.e. $\{S_{it} = 0, E_{it} = 1 | 0 \leq t \leq \tau; S_{it} = 1, E_{it} = 0 | \tau < t < \infty\}$) if

$$\int_0^\tau \Bigg(\ln y(0; \phi(\eta_i, e_i); Z_i) - \Gamma(e_i, c_i; T) \Bigg) e^{-\rho_i t} dt + \int_\tau^\infty \ln y(1; \phi(\eta_i, e_i); Z_i) e^{-\rho_i t} dt \geq \int_0^\infty \ln y(0; \phi(\eta_i, e_i); Z_i) e^{-\rho_i t} dt. \tag{5}$$

[1]This implies that there are greater returns to effort at lower ability levels, which I feel accurately describes the interaction of ability and effort in school.

Otherwise, his choice will be to never enroll in post-secondary school and, therefore, never complete (i.e. $\{S_{it} = 0, E_{it} = 0 | t = 0, ..., \infty\}$).

This inequality simplifies to:

$$R(e_i, \eta_i, c_i, \rho_i, \tau, \beta) \equiv \phi(\eta_i, e_i) - \gamma(e_i, c_i)\Big(e^{\rho_i \tau} - 1\Big) + \beta \geq T\Big(e^{\rho_i \tau} - 1\Big) \tag{6}$$

Noting that, because ϕ is concave in e_i and γ is convex in e_i, R is concave in e_i, I know that individual i's optimal effort e_i^* if he chooses to enroll will satisfy the following condition (ignoring the case in which the non-zero constraint on e_i binds):

$$\frac{\partial \phi}{\partial e_i} = \frac{\partial \gamma}{\partial e_i}\Big(e^{\rho_i \tau} - 1\Big) \tag{7}$$

This gives me an optimal effort level e_i^* as a function of η_i, c_i, ρ_i, and τ. Plugging in this optimal effort level into (6), I get

$$\begin{aligned} R\Big(\eta_i, c_i, \rho_i, \tau, \beta\Big) &- K\Big(\rho_i, \tau, T\Big) \geq 0, \text{ where} \\ R\Big(\eta_i, c_i, \rho_i, \tau, \beta\Big) &\equiv \phi\Big(\eta_i; e_i^*(\eta_i, c_i, \rho_i, \tau)\Big) - \gamma\Big(e_i^*(\eta_i, c_i, \rho_i, \tau); c_i\Big)\Big(e^{\rho_i \tau} - 1\Big) + \beta \\ K(\rho_i, \tau, T) &\equiv T\Big(e^{\rho_i \tau} - 1\Big) \end{aligned} \tag{8}$$

Notice that R depends on η_i and c_i, while K does not. I can show that (8) can be represented as a cutoff rule in either η_i, c_i orρ_i holding all other parameters constant. In order to do so, I must verify that the LHS of (8) is either monotonically increasing or decreasing in each of these parameters, for a given value of all other parameters. Indeed, using the envelope theorem

1. $\frac{\partial LHS}{\partial \eta_i} = \frac{\partial R}{\partial \eta_i} = \frac{\partial \phi}{\partial \eta_i}[e_i^*] > 0$. Therefore, there exists a cutoff value $\underline{\eta}$ for each set of parameter values $\{c_i = c, \rho_i = \rho, \tau, T, \beta\}$ such that $\{S_{it} = 0, E_{it} = 1 | 0 \leq t \leq \tau; S_{it} = 1, E_{it} = 0 | \tau < t < \infty\}$ if $\eta_i \geq \underline{\eta}$ and $\{S_{it} = 0, E_{it} = 0 | t = 0, ..., \infty\}$ if $\eta_i < \underline{\eta}$

2. $\frac{\partial LHS}{\partial c_i} = \frac{\partial R}{\partial c_i} = -\Big(e^{\rho_i \tau} - 1\Big)\frac{\partial \gamma}{\partial \eta_i}[e_i^*] < 0$. Therefore, there exists a cutoff value $\overline{c}$ for each set of parameter values $\{\eta_i = \eta, \rho_i = \rho, \tau, T, \beta\}$ such that $\{S_{it} = 0, E_{it} = 1 | 0 \leq t \leq \tau; S_{it} = 1, E_{it} = 0 | \tau < t < \infty\}$ if $c_i \leq \overline{c}$ and $\{S_{it} = 0, E_{it} = 0 | t = 0, ..., \infty\}$ if $c_i > \overline{c}$

3. $\frac{\partial LHS}{\partial \rho_i} = \frac{\partial R}{\partial \rho_i} - \frac{\partial K}{\partial \rho_i} = -\gamma(e_i^*, c_i)\tau e^{\rho_i \tau} - T\tau e^{\rho_i \tau} < 0$. Therefore, there exists a cutoff value $\overline{\rho}$ for each set of parameter values $\{\eta_i = \eta, c_i = c, \tau, T, \beta\}$ such that $\{S_{it} = 0, E_{it} = 1 | 0 \leq t \leq \tau; S_{it} = 1, E_{it} = 0 | \tau < t < \infty\}$ if $\rho_i \leq \overline{\rho}$ and $\{S_{it} = 0, E_{it} = 0 | t = 0, ..., \infty\}$ if $\rho_i > \overline{\rho}$

Then, because $\frac{\partial LHS}{\partial T} < 0$, those induced to switch by the receipt of a tuition subsidy ($T \downarrow$) could have lower ability or higher costs (i.e. utility costs, cost of accessing credit, or opportunity cost of time spent in school) than those who enroll without the subsidy, depending on which cutoff rule is most binding. In the empirical analysis that follows, I will aim to determine which type of individual (low ability or high cost) predominates on the margin of enrollment. It is this population which is, potentially, induced to enroll by receipt of a tuition subsidy.

While either being of low ability type or high cost would individually predict non-enrollment, the optimal effort level under these two types (once induced to enroll) is quite different. Therefore, because neither ability nor cost is perfectly observable in the data, I can rely on the implications of these parameters for optimal effort to differentiate empirically between these two types. That is, I can provide evidence as to whether ability or cost is the more binding constraint to enrolling by exploring the amount of effort the switchers put forth.

Utilizing the concavity of ϕ, the convexity of γ, and the assumptions on the cross-partials of ϕ and γ ($\frac{\partial^2 \phi}{\partial \eta_i \partial e_i} < 0$ and $\frac{\partial^2 \gamma}{\partial e_i \partial c_i} > 0$), I can make the following statements about the optimal effort, e_i^*:

1. $\frac{\partial e_i^*}{\partial c_i} < 0$. As c_i increases the RHS of (7) increases and e_i^* has to decrease in order to satisfy the optimality condition.

2. Similarly, $\frac{\partial e_i^*}{\partial \rho_i}$, $\frac{\partial e_i^*}{\partial \tau} < 0$. As ρ_i or τ increase the RHS of (7) increases and e_i^* has to decrease in order to satisfy the optimality condition.

3. On the other hand, $\frac{\partial e_i^*}{\partial \eta_i} < 0$. That is, as η_i increases the LHS of (7) decreases and e_i^* has to decrease in order to satisfy the optimality condition.

2.1 Testable Implications

The combination of these theoretical results provide several testable implications. First and foremost, a tuition subsidy will induce greater enrollment. Accordingly, to test this prediction, I will estimate the effects of the receipt of a tuition subsidy on the probability of applying to post-secondary schools, number of applications, and probability of enrollment.

Second, I also expect that high cost (particularly, utility cost) individuals, once induced to switch, will opt to enroll at a lower intensity (i.e. part-time). That is, if the marginal enrollee is constrained by the utility cost of school, then I would expect switchers to be inclined to devote less time to school and undertake fewer classes at a time. I can test for this directly by exploring the degree to which the tuition subsidy predicts part-time vs. full-time enrollment, conditional on some enrollment.

Additionally, if the marginal student is more cost constrained, the model predicts that his expected attainment, conditional on enrollment, is lower than the unconstrained college-stayer.

That is, a high utility cost and/or discount rate should deter the pursuit of longer programs of study (e.g. educational tracks which require graduate training) and, although not explicitly modeled, could reduce the expectation of college completion. On the other hand, if low ability is the more binding constraint for the population on the margin of enrollment, I would expect switchers to show higher effort in school than college-stayers. If high cost is the more binding constraint, I would expect switchers to show lower effort. I will test this in the data by exploring whether, conditional on enrollment, being a switcher who was induced to switch by the tuition subsidy predicts less participation in extracurricular activities and volunteer work and less part-time employment. If so, I have evidence that the population on the margin is more ability constrained than cost or credit constrained.

3 Data and Constructed Variables

3.1 Educational Longitudinal Study of 2002

The data used in this analysis are taken from a survey by the National Center for Education Statistics (NCES) called the Education Longitudinal Study of 2002 (ELS). The ELS aims to follow a cohort of students from their sophomore year in high school through postsecondary education into graduate education and/or the workforce. The study consists of a baseline survey of high school sophomores conducted in the spring of 2002. The questionnaires were administered to students, parents, math and English teachers, school principals, and head librarians. The sample includes over 15,000 students from 750 schools. The schools were selected first and then tenth-grade students were chosen randomly from these schools so as to make the sample nationally representative of the 2002 sophomore class. Non-public schools such as Catholic and other private schools were sampled at a higher rate so as to ensure comparison with public schools. Similarly, some types of students from less numerous population groups were also selected at higher rates so as to allow for proper comparison between African American, Asian American, Hispanic and White students.

The first followup was conducted in 2004 and reinterviewed both persisting students of varying status and dropouts. Questionnaires were filled out by continuing students and dropouts as well as school administrators. This round also included data on cognitive test scores for students in the original 750 sampled schools as well as those who transferred to other schools. These test scores will be used as measures of ability in the empirical specifications, along with smooth functions of GPA and SAT/ACT scores. This sample was also ”freshened” with spring 2004 seniors who were not sophomores in 2004 so that this followup both continues the spring 2002 sophomore longitudinal sample as well as represents the nations spring 2004 seniors. The sample used in this paper is the ”freshened” spring 2004 senior sample because high school students who dropped out prior to this point are not relevant for the study. The first followup also includes the high school transcripts of sample members who were last enrolled in school in the spring of 2004. This data will include information on courses completed, grades including GPA, attendance, SAT/ACT scores, etc.

The second followup was conducted in 2006. At the time of this survey, many members of the sample were in their second year of postsecondary education. Others had entered the workforce. This followup resurveys all members who were in the original spring 2002 sophomore class cohort as well as those who were added as spring 2004 seniors. It includes information on postsecondary institutions attended and type and location of institutions, among other variables, as well as enrollment intensity information. It includes reasons for pursuing or not pursuing postsecondary education, as well as courses taken, major field of study (if chosen), and financial aid data. The survey also gathers information regarding employment after high school for both those currently pursuing postsecondary educations and those who are not. This includes information on type of work, hours, and wages. Finally, information on the student's time-use while enrolled (e.g. extracurricular activities, volunteer work, and academic habits) are also collected.

Because this study follows a nationally representative sample of students from high school into postsecondary institutions and/or the workforce, it can be used to measure the effects of tuition subsidy programs on applications, enrollment, and post-matriculation behaviors. The discontinuity can be estimated for high school graduating seniors and used to compare the behavior of those who qualify for the scholarship with those who do not but are fundamentally the same types of sample members, conditional on observables and smooth functions of GPA and college board scores.

3.2 Merit-Based Tuition Subsidy Programs

3.2.1 Program Details

As mentioned above, the analysis in this study will focus on merit-based tuition subsidy programs in Missouri, Georgia, Florida, Louisiana, and South Carolina. While these programs differ along some dimensions, they all share a similar eligibility cutoff rule in GPA and/or college board scores and a lack of financial need eligibility requirements. The relevant features of these programs are summarized in Table I and discussed in greater detail in Appendix A.

Missouri's program is called "Bright Flight" and was first instituted in 1987. It offers 2000 dollars per academic year in tuition assistance to students who achieve ACT scores in the top 3% state-wide. In the 2004-05 academic year, this cutoff was a score of 30. As discussed earlier, Georgia's program, entitled "HOPE," was instituted in 1993 and awarded full tuition and fee coverage for public schools (and roughly equivalent value awards for private schools) to students with a graduating GPA of 3.0 or above. Though the requirements were slightly amended over the years (in particular, the way in which GPA is calculated), the general structure of the program eligibility remained the same.

Florida's program, which began in 1997, offered two award levels corresponding to two eligibility cutoffs. In this study, I will focus on the higher of the two awards which offers full tuition and 600 dollars for fees and other expenses at public institutions (again, equivalent value awards are offered to those enrolling in private institutions) to students with a graduating GPA of 3.5 or above *and* an SAT score of at least 1270. In Louisiana, the "TOPS" program offers three award levels with three corresponding eligibility cutoffs. I will focus on the lowest award level which offers full tuition to students with at least a 2.5 graduating GPA *and* an ACT score of 20. Finally, I will study the South Carolina "LIFE" scholarship which is one of two similar awards offered in the state. The LIFE scholarship offers a one time award of up to 4700 dollars to students who satisfy two of three possible criteria: a graduating GPA of at least 3.0, an SAT score of at least 1100, and a class rank in the top 30%. Because the GPA and class rank criteria are likely closely related, I will focus my attention at the SAT cutoff. I discuss this in greater detail below.

3.2.2 Constructed Program Dummy

In order to conduct the various analyses proposed above, a variable indicating eligibility for the program must be constructed. The Program dummy indicates whether or not the student, given his state of residence, satisfies the eligibility criteria, in terms of GPA and/or SAT/ACT score, for the merit-based tuition subsidy program in his state, by assigning that student a 1 if he is above the cutoff(s) for the program in his state and a 0 otherwise. Once, I control for smooth non-linear functions of both running variables, GPA and SAT/ACT (along with state fixed effects), this dummy will correspond to only the discontinuities in the running variables which constitute the eligibility criteria.

It is important to note, first, that throughout the analysis SAT and ACT are often used interchangeably. The concordance between the two scores in the data is *strict* with regards to the assignment rule. That is, there is no instance in which a student qualifies for the scholarship under the assignment rule cutoff in one board score but not under the other. Furthermore, in the instance that a student has taken only one of these two board exams, the other score is imputed using the appropriate concordance table for that test date. Nevertheless, as a rule the Program assignment dummy is defined in the analysis in terms of the "favored" test for that state. That is, in most cases the assignment rule for the state is published in terms of one of these board scores, the more prevalent one, and this preference is used in the analysis.

The program eligible students in the sample are residents of one of five states considered here with a merit-based tuition subsidy program in place in the 2004-05 academic year: Florida, Georgia, Louisiana, Missouri, and South Carolina. Because Florida and Louisiana offer several distinct awards based on varying levels of academic achievement, I must first choose which of the corresponding eligibility levels to use as the instrument for receipt of transferable aid. That is, I must decide at which eligibility cutoff to estimate the discontinuity in receipt of transferable aid[2]. I opt to use the higher cutoff in Florida and the lower cutoff in Louisiana, as discussed above. The reasoning behind these choices is discussed in Appendix B.

In a fuzzy regression discontinuity approach, the running variables are mapped into a binary assignment variable which switches at the eligibility cutoffs according to a discontinuous assignment rule. This predicted aid function is then used to instrument for an observed treatment variable. The treatment variable is a binary variable for whether the student was offered aid which could be used at "more than one school in the state". The survey question specifically excludes federal and institutional aid, and offers as an example aid to attend schools in the student's state. This type of aid is denoted "transferable aid." The probability function for receipt of transferable aid should also exhibit discontinuities at the cutoff values of GPA and/or SAT/ACT in the relevant state. I will confirm this now.

3.2.3 Graphical Analyses

Figures I-V depict the discontinuities in the probability of receiving transferable aid corresponding to the eligibility cutoffs in each state. Unlike for the other programs considered, the assignment rules for the programs in Georgia and Missouri are defined in terms of single running variables: GPA and ACT, respectively. Accordingly, figures I and II each consist of a single graph depicting the relevant discontinuity. Figure I shows a jump of roughly 13 percentage points at the 3.0 GPA cutoff in the state of Georgia. Because the sample size from Missouri is much smaller than that of the other states considered and variation in ACT scores is particularly discrete, the graph in Figure II is less smooth. Nevertheless, Figure II shows a jump of roughly 50 percentage points corresponding to the cutoff at 30 in ACT scores.

Figure III depicts the high cutoff in GPA and SAT for Florida. Because the assignment rules in Florida are defined in terms of both GPA and SAT, the discontinuities in probability of receipt of transferable aid corresponding to cutoff values in one of these variables should be examined within a restricted sample which conditions on being above the cutoff value in the other running variable. That is, in order to properly explore the discontinuity at the high cutoff in GPA I must restrict the sample to those students who are above the corresponding high cutoff in SAT.

Panel A of Figure III shows the selected cutoff in both GPA and SAT in the unrestricted sample to provide a rudimentary comparison of the relative magnitudes of the jumps corresponding

[2] I restrict my attention to only one discontinuity per state due to the discrete nature of the endogenous regressor (transferable aid) and to the fact that the analysis is aggregated across several states, several of which offer only a single award level

to each cutoff. Panel B of Figure III shows the cutoffs in GPA and SAT for the restricted samples which condition on the sample of students who passes the SAT and GPA cutoff, respectively. In these figures, I see a jump of roughly 40 and 20 percentage points, respectively.

It is important to note that the shallowing just to the left of the cutoff in the restricted sample GPA graph in Panel B of Figure III could perhaps be attributable to "gaming" on the part of aid-seeking agents in Florida. That is, I might be concerned that students who are aware of the assignment rule and eager to receive transferable aid are manipulating their cumulative GPAs so as to fall immediately above the cutoff. In practice, if this were the cause of the shallowing to the left of the cutoff I should expect to find a corresponding spike in probability of transferable aid to the right of cutoff, which I do not.

Also, as discussed by Imbens and Lemieux (2008), this sort of gaming should generate a discontinuity in the density of the running variable at the cutoff value. That is, I should find a shallowing in the density of GPA to the left of the cutoff and a spike in density to the right of the cutoff. Accordingly, Figure VI presents histograms of GPA in Florida for the unrestricted and restricted samples. I do not find evidence of a bunching in the density just above the cutoff in GPA. It is, therefore, unlikely that gaming of this type is an issue here.

Figure IV presents the graphs of the discontinuities at the low cutoff in Louisiana. Panel A shows a jump of roughly 5 percentage points at the selected GPA cutoff and of roughly 15 percentage points at the ACT cutoff in the unrestricted samples. In Panel B, I find in the restricted sample figures a jump of nearly 20 percentage points at the GPA cutoff and of roughly 5 percentage points at the ACT cutoff.[3]

Figure V presents the discontinuity in probability of receiving transferable aid at the SAT cutoff for South Carolina. Because eligibility for South Carolina's program requires meeting 2 out of 3 criteria, with only 2 of these criteria depending explicitly and predictably on GPA and SAT and the third depending on unobserved class rank (perhaps some function of GPA), presenting pictures of discontinuities over restricted samples will not better inform the analysis. The cutoff in GPA does not correspond to a distinct discontinuity in the probability of receiving transferable aid (see Appendix Section B). However, the SAT graph depicts a large jump of more than 50 percentage points in the probability of receiving transferable aid at the cutoff value.

The SAT picture in Figure V raises similar "gaming" concerns as those raised by the Florida GPA cutoff picture. Figure VII presents the histogram for SAT in South Carolina, analogous to that for GPA in Florida presented in Figure VI. Here, again, I do not find evidence of a bunching in the density of SAT at the cutoff value, alleviating concerns of running variable manipulation.

Along with providing evidence in support of the exogeneity of the eligibility cutoff (that is, lack of manipulation of the running variables), Figures I-V provide graphical evidence of the

[3]Once again, for a more in-depth discussion of how I choose, in states with multiple awards levels and eligibility cutoffs, at which cutoff to estimate the discontinuity in transferable aid, see Appendix B.

predictive power of the constructed program assignment instrument and of the general validity of the RD framework employed here. An absence of graphical evidence of these discontinuities would likely foreshadow a weak first stage estimate and largely preclude the application of an RD design.

3.3 Summary Statistics

Tables IIa-IIc report summary statistics for variables of interest. Table IIa shows demographic characteristics; while Tables IIb and IIc show outcomes. Number of observations and means and standard deviations of variables of interest are reported for the discontinuity sample as well as for the whole sample. The discontinuity sample is a subsample of all students who fall within .5 of the relevant GPA cutoff for their state program and/or 200 points of the SAT cutoff (4 points of the ACT cutoff).[4] Within each sample, statistics are reported for conditional subsets Program=1 and Program=0 along with the unconditioned statistics.

As a general rule I expect that for the whole sample, demographic variable means might differ between the subsets of those who do and do not qualify for merit aid based on eligibility cutoffs. These differences should be attenuated or even altogether absent in the discontinuity sample. In Table IIa, I do find this to be generally true in some of the demographic characteristics; however, some larger differences in means of certain demographic characteristics exist in the discontinuity sample. Namely, the sample means of the probabilities of being Black, coming from an Urban area, and having a sibling exhibit slightly larger differences across eligible and ineligible subsets of the Discontinuity Sample. This motivates the inclusion of these covariates in the specifications used in the analysis below. To be cautious, I also include the other demographic covariates in the specifications.

The other general pattern I might expect to see is a noticeable difference in the mean values of the probability of receiving transferable aid and the various outcomes explored in the analysis between the subsamples of eligible and ineligible individuals. Further, I would hope that these differences are robust to the restriction of the sample to the smaller neighborhood around the discontinuity. I find a difference of roughly 22 percentage points in receipt of transferable aid between program-eligible and ineligible subsets for the discontinuity sample. This difference is roughly 27 percentage points for the whole sample. These differences are of roughly similar magnitudes to the discontinuities depicted in Figures I-V.

I find little evidence of differences across sample means in application, enrollment, and employment outcomes in Table IIb. I find, in Table IIc, on the other hand, larger differences in sample means for participation in extracurricular activities and volunteer work and expecta-

[4]In the additional results reported in the appendix, I explore the robustness of first stage estimates to alternate neighborhoods around the discontinuity. In particular, I explore a smaller neighborhood (.25 around GPA, 100 around SAT / 2 around ACT) and a larger neighborhood (.75 around GPA, 300 around SAT / 6 around ACT)

tions of graduating college. These differences in sample means of course, provide no evidence of causal effects, and in particular do not account for the differential abilities, preferences, and financial restrictions across eligible and ineligible students. To account for these, largely unobservable, characteristics and elicit causal effects of receipt of transferrable aid on outcomes, I must employ a more sophisticated strategy.

4 Empirical Methodology

The analysis in this paper is aimed primarily at studying the effects of transferable aid on post-secondary applications and enrollment, as well as employment, time-use, and expected attainment among enrolled students. Consistent estimates of these effects are hitherto lacking in the literature due to the pervasive endogeneity and omitted variables issues plaguing traditional treatment effects specifications. In the absence of experimental treatments, exogenous variation in aid is very difficult to find. That is, in general it is easy to argue that the decisions of whether to apply to post-secondary school, how many schools to which to apply, whether to seek financial aid, and whether to ultimately enroll are at least in part jointly determined and likely dependent on unobserved ability, preferences, and access to financial resources.

In this section, I propose a fuzzy regression discontinuity (FRD) strategy which overcomes these issues. By restricting the sample to those students who fall within a small neighborhood of the eligibility cutoffs in GPA and SAT/ACT, controlling for smooth functions in these observed ability variables, and using only the discontinuity in the eligibility function as an excludable instrument for the receipt of transferable aid, I can identify a causal effect of transferable aid on outcomes of interest.

4.1 Ordinary Least Squares

As a first pass, I estimate an ordinary least squares specification of transferable aid on the various outcomes of interest. The main specification equation estimated is:

$$y_i = Aid_i\beta + X_i'\gamma_1 + A_i'\gamma_2 + \mu_j + \mu_r + \nu_i, \tag{9}$$

where y_i is an outcome of interest, X_i is a vector of demographic characteristics including parents' education and income, student's gender, dummies for whether the student is married, has children, has siblings, and comes from an urban area, as well as dummies for which language is spoken in the student's home; A_i is a vector of smooth polynomial functions in GPA and composite college board scores up to a third degree and interactions of these terms as well as SAT math subscores and scores from cognitive tests in reading and math; μ_j and μ_r are state and race group effects, respectively, and ν_i is an individual error term.

4.1.1 Sources of Bias

As mentioned above, to the degree that receipt of transferable aid is correlated with unobservable determinants of application, enrollment, and post-enrollment outcomes such as ability or cost, I expect OLS estimates of β to be biased. In order to overcome these endogeneity issues, I propose using a fuzzy regression discontinuity design described below. Nevertheless, I run OLS specifications of all of the analyses for the sake of comparison. In particular, when I compare these biased OLS estimates to those obtained using the unbiased FRD estimator, I can learn a bit about the primary source of this bias. That is, I might expect that unobserved ability, preferences for education, and financial constraints might all bias the OLS estimate (specifically if aid is allocated on the basis of these unobservables). However, the signs of the biases contributed by these sources will likely differ.

In particular, if it is the case that the receipt of transferable aid corresponds to a student having higher unobservable ability or a higher preference for education, then I would expect OLS to *overestimate* the effect of aid on the probabilities of applying to and enrolling in post-secondary school. On the other hand, if the receipt of transferable aid corresponds more strongly to the likelihood that the student needs aid in order to enroll, (that is, if students who are most credit constrained pursue it most vigorously), I would expect OLS to *underestimate* the effect of aid on application and enrollment.

To see this, let us consider the case in which $\nu_i = \varphi\eta_i + \zeta c_i + \varepsilon_i$ where η_i and c_i are the individual's ability and cost of schooling, respectively (both unobserved by the econometrician), and ε_i satisfies the usual Gauss-Markov assumptions, but φ and ζ are in general non-zero. Then, when the outcome of interest is a binary for whether the individual is applying to or enrolled in post-secondary schooling, I would expect $\varphi > 0$ and $\zeta < 0$. Indeed, the model set forth in section 2 predicts so. However, the bias in the OLS estimate of β will, of course, depend not only on the sign of φ and ζ, but also on the signs of $cov(Aid_i, \eta_i)$ and $cov(Aid_i, c_i)$.

I can reasonably argue that $cov(Aid_i, \eta_i) \geq 0$; that is, transferable aid (particularly the type measured in the data) is not likely given specifically to low ability students. Similarly, I would expect that aid is not likely given to students who particularly need it the least (i.e. I expect $cov(Aid_i, c_i) \geq 0$). Following this logic, I can argue that an attenuated OLS estimate of the effect of aid on application or enrollment is evidence of transferable aid being allocated (or likely also pursued) on the basis of need.

These comparisons of OLS to FRD estimates can provide some evidence of the roles of ability and need in the allocation of financial aid. It should be noted, however, that this comparison does not fully inform the roles of ability and cost constraints in the *enrollment decision*, more generally. For this I must employ the tests presented in section 2.1.

4.2 Regression Discontinuity: Two Stage Least Squares Estimates

In order to overcome the issues faced by the OLS specification above, I will use the constructed Program assignment variable as an instrument for transferable aid in a Two Stage Least Squares Regression framework. Hahn, Todd, and Van der Klauuw (2001) establish the equivalence of a fuzzy RD to an instrumental variable two stage least squares estimator in which the discontinuity is used as the instrument and the sample is restricted to a neighborhood around the discontinuity.

I will control for smooth nonlinear functions of GPA and college board scores in both stages and exclude only the Program dummy, representing the discontinuity, from the second stage. The econometric model consists of the first stage equation:

$$Aid_i = Program_i\beta + X_i'\gamma_1 + A_i'\gamma_2 + \mu_j + \mu_r + \varepsilon_i, \tag{10}$$

where X_i, A_i, μ_j, and μ_r are as in the OLS specification above and ε_i is an individual error term. The second stage equation is:

$$y_i = Aid_i\phi + X_i'\delta_1 + A_i'\delta_2 + \mu_j + \mu_r + \xi_i, \tag{11}$$

where X_i, A_i, μ_j, and μ_r are, of course, exactly the same as in the first stage, and ξ_i is an individual error term.

4.2.1 Identifying Assumptions

Once the assignment variable is constructed, the empirical strategy proceeds as a standard instrumental variables two stage least squares. The first identifying assumption needed for consistent estimation of ϕ is that $Program_i$, in fact, sufficiently moves Aid_i. That is, I must first establish statistically that the constructed Program variable is as predictive of transferable aid as Figures I-V suggest. First stage results from the OLS estimation of equation (10) provide evidence to support this assumption and are reported in the next section.

The second identifying assumption needed to consistently estimate ϕ is that conditional on X_i, A_i, μ_j, and μ_r the variation in $Program_i$ derived from the assignment rules does not affect y_i except through its effect on Aid_i. In practice, this reduces to the assumption that any effects GPA and board scores might have on y_i are sufficiently controlled for in A_i. This is not a very contentious assumption considering A_i includes all smooth polynomial functions of GPA, composite college board scores, and math subscores up to the third degree and all interactions of these terms.

Therefore, the predictive variation in $Program_i$ is derived strictly from the discontinuities at the various eligibility cutoffs. In practice, this requires only the assumption that GPA and college board scores have no discontinuous relationship with y_i, within a bandwidth around the eligibility cutoffs, except through the discontinuous transferable aid function.

4.2.2 Bandwidth Size

Imbens and Lemieux (2008) present a detailed discussion of the algorithm by which the optimal bandwidth around the discontinuity can be selected. The tradeoff in practice is a standard variance-bias one. That is, a smaller bandwidth will provide a more unbiased estimate of the effects of interest but will likely be imprecisely estimated due of course to the reduced sample size. Conversely, a larger bandwidth will likely improve the precision of the estimates through an increased sample size, but will increase the bias as observations further away from the discontinuity are included in the regression.

Here I am faced with a small sample size which requires use of a larger bandwidth around the discontinuity than might be otherwise optimal. To reduce any bias that might be introduced by this large bandwidth, I include a rich set of covariates in A_i and X_i as well as state and race fixed effects. The state fixed effects also ensure that any structural differences between the programs in different states or basic state characteristics are not attributed to access to transferable aid by forcing the within state comparison.

For the sake of transparency, I also report below results with the bandwidth around the discontinuity widened to include the whole sample. Additionally, I check the robustness of the first stage results to both smaller and larger neighborhoods around the discontinuity and report these results in the Appendix.

5 Results

5.1 First Stage

Table III presents results from the first stage regressions of transferable aid on the program dummy. Columns 1 and 2 show results from regressions run on the smaller sample drawn from around the discontinuity and columns 3 and 4 show the same specifications run on the whole sample. The specifications reported in columns 1 and 3 exclude demographic characteristics, while columns 2 and 4 include all controls mentioned above.

I find that the program dummy is strongly predictive of transferable aid, and that the first stage results are robust to the size of the bandwidth around the discontinuity and the inclusion of additional controls. The point estimates are of roughly the same magnitude across all specifications and are of similar magnitude to the discontinuities depicted in Figures I-V. Eligibility for a merit-based tuition subsidy corresponds to an 18 to 24 percentage point rise in the probability of actually receiving transferable aid. The specification in column 2 is the preferred one for the second stage analysis presented below. The point estimate in column 2 is just over 21 percentage points and the F-statistic is nearly 10.

5.2 Applications and Enrollment

In Table IV, I report results from second stage regressions of a binary for whether the student applied to post-secondary schools and, conditional on applying at all, the number of schools to which the student applied on a binary for whether the student received transferable aid. Columns 1 and 2 report these regressions results from the discontinuity sample, while columns 4 and 5 report results from the same regressions run on the whole sample.

In columns 1 and 2, I find that an increase in the probability of receiving transferable aid from 0 to 1 induces a 23 percentage point increase in the probability of applying to post-secondary institutions. Interestingly, however, transferable aid reduces the number of schools to which the student applies, conditional on applying at all. The magnitude of this point estimate is large at 4 and a half applications. These results are robust to the widening of the bandwidth around the discontinuity. The point estimates of the whole sample results are 25 percentage points and greater than 3 applications.

The positive effect of transferable aid on applications is clear evidence of the tuition-subsidy inducing switching. That is, the program is motivating students who otherwise found it suboptimal to attend post-secondary schooling to apply to post-secondary institutions. The results on the conditional number of applications sent can also be due to a binding financial constraint for the population on the margin. It is common practice for financially constrained students who do not have transferable aid to apply to numerous schools in order to receive a variety of institutional aid offers from different schools which can then be used in a bargaining process with the institutions of choice. Amongst students who have received transferable aid, this process would not be necessary. Rather, unconstrained students would apply only to their institutions of choice. Students whose financial constraints have been relaxed would, therefore, apply to less institutions than their still constrained counterparts, conditional on applying at all.

The same columns in panel B of Tables IV show results from OLS specifications of regressions of application outcomes on transferable aid. The marked attenuation in the magnitude of the OLS estimates as compared to that of the FRD estimates is further evidence of the role of financial need in the allocation of transferable aid in the sample. As mentioned in section

4.1.1, a downward bias in the OLS estimates of the effect of transferable aid on the probability of applying to school is most likely due to a joint determination of aid and applications on the basis of financial constraints. Bias due to unobserved latent ability or preference for education would likely enlarge OLS estimates.

Notice that if, in fact, the population on the margin is made up of two types of potential enrollees, low ability and high cost, then the apparent endogenous easing of financial constraints through need-based aid (as evidenced by the possible dependence of receipt of aid on latent heterogeneous costs) might suggest that the remaining population on the margin is disproportionately of the low ability type. I will discuss this possibility further when I test the model implications set forth in section 2.1.

Finally, in columns 3 and 6 of Table IV, I report results from regressions of number of acceptances (conditional on applying) on the receipt of transferable aid conducted on the discontinuity and whole samples, respectively. This is to check that receipt of transferable aid, after controlling for all observable measures of ability and for the number of applications submitted, does not directly affect the probability of being accepted to post-secondary institutions. While such an effect does not invalidate the analysis conducted in this study, it would suggest a different (or at least additional) mechanism by which aid might affect enrollment. I do not find evidence of such an effect. These results support the notion put forth by the theoretical framework presented in section 2 that financial aid simply lowers the cutoff value above which an individual's net return to schooling must lie in order to justify enrollment. Notice I have abstracted away from the strict notion of access to post-secondary education entirely, implicitly assuming that should a student desire to pursue additional schooling he can find some institution which will take him.

In Table V, I present results from second stage IV regressions of binary enrollment outcomes on the receipt of transferable aid. Columns 1 and 4 report results from regressions (once again, conducted on the discontinuity and whole samples, respectively) of a binary for whether a student enrolled in a post-secondary institution in the two years following graduation from high school on the binary for the receipt of transferable aid, as usual using the program assignment dummy as an instrument. I find that receipt of transferable aid induces a 21.6 percentage point increase (33.3 percentage points in the whole sample) in the probability of enrollment. These results are significant at the 10 and 5 percent level in the discontinuity and whole samples, respectively.

Once again, the corresponding OLS estimates presented in Panel B appear strongly attenuated in comparison to the FRD estimates. The same arguments presented above in the discussion of results on application outcomes can be employed here. I interpret these results as additional evidence of the joint determination of receipt of transferable aid and the decision to enroll on the basis of financial constraints.

5.3 Describing the Marginal Enrollee

Now that I have established that receipt of transferable aid does in fact induce application to and enrollment in post-secondary education, I can compare post-matriculation behaviors of these switchers to those college-stayers who would have enrolled without the subsidy. In particular, I can explore enrollment intensity, expected attainment, employment and time-use of switchers to characterize the population on the margin of enrollment.

5.3.1 Enrollment Intensity and Expected Attainment

As proposed in section 2.1, if the population on the margin is predominantly made up of high cost types, I would expect switchers to be more likely to enroll part-time so as to reduce utility costs of enrollment and defer costs into the heavily discounted future. Columns 2 and 5 of Table V show regressions of binaries for full-time enrollment (as compared to part-time or none at all) on transferable aid; and columns 3 and 6 show results from regressions of binaries for full-time enrollment (conditional on some enrollment) on transferable aid. Though the results lack precision, they suggest switchers are no more likely to enroll part-time than college-stayers. I interpret this as evidence that, perhaps, the population on the margin of enrollment is not predominantly made up of high cost individuals.

Similarly, I would expect that high cost types, once induced to enroll by receipt of a tuition subsidy, would be less likely to pursue educational paths which require additional graduate training and, perhaps, would be less optimistic about completing even the undergraduate degree. Table VI shows results from the regression of binaries for whether an individual expects to complete college (columns 1 and 3) and attend graduate school (columns 2 and 4). I find no evidence that switchers are any less likely to complete college or attend graduate school than college-stayers. This is additional evidence that marginal enrollees are not likely high cost individuals.

5.3.2 Employment and Time-Use

Another implication of the model discussed in section 2.1, is that a population of marginal enrollees made up mostly of low ability types will put forth more effort in school than higher ability college-stayers. On the other hand, if high cost types are the individuals switching into post-secondary schooling, I would expect them to expend less effort. I test this implication by exploring the employment, extracurricular activities, and academic habits of switchers as compared to college-stayers.

In Table VII, I report results from regressions of binaries for whether the individual, while enrolled, was employed at all, employed part-time (vs. not at all), employed full-time (vs. part-time or not at all), and employed full-time (vs. part-time, conditional on some employment) on receipt of aid. Though estimates once again lack precision, I find suggestive evidence that switchers are less likely to be employed than college-stayers and are particularly less-likely to be employed part-time. Receipt of transferable aid reduces the probability of some employment by 38 percentage points and the probability of part-time employment by 73 percentage points in the discontinuity sample. The estimate of the effect on part-time employment is significant at the 10 percent level.

Columns 1 and 2 of Table VIII reports results from regressions of binaries for whether the individual participated in extracurricular activities and volunteer work, respectively, on transferable aid. Those induced to enroll by receipt of aid are significantly less likely to participate in both extracurricular activities and community service. Receipt of transferable aid causes a 67 percentage point decrease in the probability of participation in extracurricular activities and a 75 percentage point decrease in the probability of volunteering. Columns 3-5 of Table VIII present results from regressions of binaries for whether the student worked on academics in the library, met with an academic advisor, and talked with a professor on the aid dummy. Though estimates of these effects are insignificant at conventional levels, they are all positive.

Taken together, the results reported in Tables VII and VIII provide evidence that switchers tend to expend greater effort toward academics than college-stayers and, therefore, further evidence that the marginal enrollee is more likely of the low ability than the high cost type.

6 Conclusion

Effective policies regarding financial aid, whether need or merit-based, require an accurate model of the relative roles of heterogeneous abilities and costs in an individual's schooling decision and empirical evidence of which source of latent heterogeneity is most pronounced among individuals on the margin of enrollment. The unobservable nature of ability in and cost of school (and, accordingly, in the net return to school) has long plagued estimates of the effects of financial aid on enrollment decisions. Using a fuzzy regression discontinuity design and panel data on academic performance and enrollment decisions, this study provides consistent estimates of the effects of tuition subsidies on application to and enrollment in post-secondary educational institutions.

Unlike previous studies employing difference-in-difference strategies that cannot separate coincident trends in state-wide educational outcomes from effects of tuition subsidy programs, I am able to causally identify switching into enrollment and, subsequently, characterize post-matriculation behaviors of switchers. In particular, using a model of enrollment decisions and effort in school, I differentiate between low ability and high cost individuals on the margin of enrollment. Attenuated OLS estimates of the effects of aid on application and enrollment suggest that the endogeneity in receipt of financial aid is primarily caused by latent heterogeneity in costs rather than ability. Accordingly, I suspect that the remaining population on the margin is made up predominantly of low ability type individuals.

The model developed in this study provides testable implications on post-matriculation enrollment intensity and effort for low ability and high cost types. Corresponding empirical results support the hypothesis that the marginal enrollee is of low ability. Though large estimates of causal effects of receipt of aid on applications and enrollment suggest that concerns that these programs merely subsidize the leisure of college-stayers rather than inducing switching are over-stated, additional results suggest that tuition subsidies artificially raise net returns among individuals with low gross returns to education. These results beg the question: "Is inducing a low ability, low return individual to enroll a worthwhile policy endeavor?" The answer, particulary from a society welfare enhancing perspective, is beyond the scope of this paper. Nevertheless, I hope that the results of this study encourage further research on the topic.

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A Additional Program Details

A.1 Georgia's HOPE Scholarship and Grant Program

In 1993 the state of Georgia instituted the Hope Scholarship and Grant Program which rewards students varying amounts of financial assistance in degree, diploma, and certificate granting programs in the state of Georgia. The HOPE Scholarship covers full tuition and fees as well as a modest book allowance for students meeting academic performance criteria to attend Georgia public universities. Since 1996, the program also offers awards of roughly equivalent value for students meeting the same academic criteria to attend eligible private universities in the state. The HOPE Grant covers full tuition for students attending two-year non-degree granting institutions, but does not have any academic performance requirements. These scholarships and grants are available for both full and part-time enrollment.

The HOPE Scholarship program is particularly notable for its simple and comprehensive nature. It specifies that any Georgia resident graduating from high school with at least a "B" grade point average (3.0 GPA) is guaranteed one year of full-tuition funding at an eligible public university in Georgia. The courses used to calculate GPA for the program were restricted to Math, English, Social Science, Science, and Foreign Languages in 2000 in an attempt to reduce the number of eligible recipients. However, the number of HOPE recipients only dropped by 4.3 percent in that year, a much smaller drop than the predicted 35 percent, and this change had little effect on the ability of the observed assignment rule to predict treatment. Originally, the program also included a maximum family income criterion set at 66,000 dollars. This income cap was raised to 100,000 dollars in 1994 and removed altogether in 1995. The funding provided for students attending private institutions was begun in 1996 and was originally only 500 dollars, but was increased quickly to 3000 dollars a year. It can be coupled with the Georgia Tuition Equalization Grant of 900 dollars per academic year. Half-time students attending private universities can receive 1500 dollars per academic year if they are enrolled in 6-11 hours per semester or quarter. However, half-time students do not qualify for the Georgia Tuition Equalization Grant.

A.2 Florida's Bright Futures Scholarship Program

In 1997 the state of Florida instituted the Florida Bright Futures Scholarship Program which offers varying levels of tuition subsidy for Florida residents of different levels of high school academic performance. The program has quickly grown to be the second largest of its type in the country, though it is still significantly smaller in comparison to Georgia's HOPE. Total disbursements were nearly $270 million in the 2004-2005 academic year, on which the analysis of this paper is focused.

The Bright Futures Scholarship Program consists of three separate scholarships which offer different levels of funding and require different levels of academic performance. The Florida Academic Scholars Award (FAS) covers full tuition and up to 600 dollars for fees and college-related expenses for students enrolled in a public Florida institution. It also offers a subsidy for tuition at private Florida institutions equivalent to the average award given to students attending public institutions. In order to be eligible for the FAS students must graduate from a Florida high school with a 3.5 weighted GPA, 75 hours of community service, and at least a best composite score of 1270 on the SAT (or 21 ACT). The GPA is calculated using 4 English, 3 Math, 3 Natural Science, 3 Social Science, and 2 Foreign Language credits, much like it has been for the HOPE since 2000. The SAT/ACT score can be the composite of the best scores from different testing dates, but does not include the newly added writing sections or any subject test scores.

The Florida Medallion Scholars Award offers full-funding for students to attend a public associate's degree-granting institution in the state. It also offers 75 percent funding for students to attend other public institutions in the state including bachelor's degree-granting institutions. Furthermore, it offers students attending private institutions of various types an award equivalent to 75 percent funding at a comparable public institution. In order to be eligible for the FMS, a student must graduate from a Florida high school with a 3.0 weighted GPA (calculated as above) and at least a best composite score of 970 on the SAT (or 20 ACT). There is no community service requirement for this award and the SAT/ACT score is calculated as above. There are other ways to qualify for both of these awards, such as National Merit Scholar and Finalist; however, it is very unlikely that a student satisfies these requirements but not the general GPA and SAT/ACT requirements set forth above. Therefore, I will ignore these complications in this discussion.

The program also includes the Florida Gold Seal Vocational Scholars Award (GSV) which offers 75 percent of tuition and fees to attend public technical colleges and an equivalent-value award to attend private technical colleges. This award is for non-degree granting institutions and is similar to the HOPE Grant. However, the GSV does have academic requirements similar to those of the other awards, though less rigorous and more focused on vocational preparation. A student must have a weighted graduating high school GPA of 3.0 (weighted with more stress on non-academic coursework) and a minimum of 3.5 GPA in three vocational credits. The student must also have a minimum score of 440 in each of the sections of the SAT (17-English, 18-Reading, 19-Math in the ACT or 83-Reading, 83-Sentence Skills, 72-Algebra in the CPT).

The RD analysis employed in this paper cannot separately estimate multiple discontinuities in the running variables corresponding to eligibility for these several distinct awards in Florida. Therefore, I must choose one of the awards and corresponding eligibility cutoffs to instrument for the receipt of transferable aid. Figure III depicts the discontinuity in probability of receiving transferable aid corresponding to each of these cutoffs in order to motivate this decision.

A.3 Missouri Higher Education Academic Scholarship Program ("Bright Flight")

Missouri set up a merit-based scholarship program, the Higher Education Academic Scholarship Program, or more commonly known as the "Bright Flight" Scholarship program much earlier in 1987. Although this program is much smaller than those of Georgia and Florida, it is similar in structure. It offers a scholarship of $2,000 per full-time academic year (pro-rated by semester) at an eligible Missouri post secondary institution to any Missouri high school graduate with a composite score on the ACT or SAT in the top 3 percent of all Missouri students taking those tests. The student must achieve this score by the June test date of their senior year in high school. The qualifying score is reevaluated in the fall of every year, but was consistently a composite score of 30 on the ACT from the 1990s through the current year. It was only this year (for the 2008 graduating high school class) that the qualifying score was raised to 31.

Students must not have delayed enrollment in postsecondary education nor be pursuing a degree or certificate in theology or divinity studies to be eligible for the award. The award can be renewed for up to 10 semesters or until a student has received their first undergraduate degree, whichever occurs first. Unlike Georgia's HOPE, the award is not available in any form to students who are enrolled part-time. The award is not available for summer terms. Also, any student who does not enroll full-time in an eligible Missouri institution for two consecutive semesters is no longer eligible for the award, and eligibility cannot be reestablished after it is lost. Also, to continue to receive the scholarship, a student must maintain a cumulative grade point average of at least 2.5. High school graduates who are unable to enroll in postsecondary institution for a full academic year after graduation may qualify for deferment of their awards for certain approved reasons, such as military service or work for non-profit organizations. Students need not apply for the Bright Flight Scholarship. Rather they are notified in the spring term of their senior year of high school if they are eligible and they receive the award automatically when they enroll in an eligible Missouri institution.

A.4 Louisiana's Tuition Opportunity Program for Students Scholarship Program

In 1998, Louisiana instituted the Tuition Opportunity Program for Students (TOPS) Scholarship. The program consists of three awards offering different amounts of funding as reward for different levels of academic performance: the Opportunity, Performance, and Honors Awards. The express purpose of the program is to offer incentives for Louisiana residents to prepare for and pursue in-state postsecondary education in order to better educate the Louisiana workforce and improve its employability. This program is a combination of and expansion on the previous programs of Louisiana Tuition Assistance Plan and the Louisiana Honors Scholarship Program. The TOPS Opportunity Award provides an amount equal to full tuition for students enrolled full-time at an eligible college or university for up to eight semesters or 12 quarters, including summer sessions. The TOPS Performance Award provides an annual stipend of 400 dollars, prorated by two semesters or three quarters, in addition to the full tuition scholarship included in the Opportunity Award. The TOPS Honors Award is the same as the Performance Award except that it offers an annual stipend of 800 dollars, prorated as above. Louisiana also instituted a TOPS Tech Award similar in structure to the HOPE Grant and Florida's GSV, in that it offers full tuition funding for public technical colleges and the equivalent of average public full tuition for private technical colleges.

In order to be eligible for the TOPS Awards a student must be a citizen or permanent resident of the United States and a resident of the state of Louisiana. The student must have graduated from high school, but unlike in some other programs, a student may be eligible even if he/she graduated from an eligible out-of-state high school, so long as they meet the other requirements. The student must earn a cumulative GPA in a core curriculum of 2.5 in order to qualify for the Opportunity Award and 3.5 in order to qualify for the Performance or Honors Award. Under special circumstances, a student might be able to establish eligibility by graduating in the top five percent of his/her class in lieu of the core curriculum GPA requirement. The student must also have achieved an ACT score of the states prior year average plus 3 points, but never less than a 20, in order to qualify generally for the Opportunity Award. The qualifying score for 2004 fall term entering freshmen was 20. The student must achieve a score of 23 to qualify for the Performance Award and a score of 27 to qualify for the Honors Award. Under special circumstances, such as home schooling or high school equivalence, the student might be required to achieve scores of up to 23, 26, and 30 in order to qualify for the Opportunity, Performance, and Honors Awards, respectively. The TOPS Tech Award requires a GPA of 2.5 in a core curriculum and ACT scores of 17 generally, but up to 20 in special cases. These special circumstance students make up a small percentage of students claiming these scholarships; therefore, I will focus on the general set of requirements.

In order to maintain any of these awards, a student must remain enrolled as a full-time student in an eligible institution. Further, at the end of each academic year the student must have earned a total of at least 24 college credit hours (or equivalent units) for that academic year, not including summer sessions, with a cumulative GPA of at least a 2.3 with the completion of less than 48 credit hours and a 2.5 with the completion of more than 48 credit hours in order to maintain the Opportunity Award, if enrolled in an academic program. The student must simply maintain a cumulative GPA of 2.5 if enrolled in a vocational or technical program in pursuit of a certificate, diploma, or a non-academic degree. Similarly, a student must continue to earn at least a 3.0 GPA in order to maintain receipt of a Performance or Honors Awards. So long as a student does not go longer than two years without satisfying this minimum performance requirement, he/she may have their tuition scholarship reinstated after reestablishing minimum performance. A student receiving a Performance or Honors Award, failing to meet continuing academic requirements for these awards, but meeting requirements for continuing receipt of an Opportunity Award, may continue to receive full tuition funding without continuing receipt of the annual stipend. However, failure to earn the required number of credit hours, irrespective of GPA, will result in permanent cancelation of eligibility. In order to maintain a TOPS Tech Award, a student must maintain full-time enrollment, earn at least 24 credit hours each academic year, and maintain at least a cumulative GPA of 2.5. The same cancelation and reinstatement rules apply here.

As with Florida's program, the multi-level structure of Louisiana's scholarship requires that I choose one award and corresponding eligibility cutoff to instrument for receipt of transferable aid in the state of Louisiana.

A.5 South Carolina's LIFE and HOPE Programs

South Carolina also instituted its merit-based aid program in 1998. The Legislative Incentive for Future Excellence (LIFE) Scholarship program awards merit scholarships to graduating South Carolina high school students who meet eligibility requirements. The award can be applied to cost of attending postsecondary education in the state for up to 10 semesters. The express purpose of the program is to increase access to higher education, improve employability of South Carolina students, and encourage students to prepare for and complete college. The LIFE Scholarship awards an amount up to $4,700 per academic year, not to exceed cost-of-attendance.

In order to be eligible for the LIFE Scholarship, a student must have graduated from high school and enroll full-time in an eligible public or private South Carolina college or university. The student must be a South Carolina resident at the time of high school graduation and upon enrollment in the postsecondary school. Most importantly, the student must meet two of the following three performance requirements: achieve at least a 3.0 graduating high school grade point average, score an 1100 on the SAT (24 on ACT), and/or rank in the top 30% of the graduating class. However, if the student plans to attend a 2-year or technical school, the latter two requirements are waived and only the GPA requirement must be met. Further, for students planning to attend 4-year institutions, who meet the GPA requirement, but otherwise fail to meet the requirements for the LIFE, the HOPE scholarship program offers a one time award of up to $2,800 to students who meet the other non-academic requirements listed above. This award is only available for the freshman year, after which students must then meet the continuing eligibility requirements for the LIFE Scholarship to maintain financial assistance. South Carolina also has another scholarship for higher achieving students, the Palmetto Fellows Scholarship, which crowds out the LIFE Scholarship, but is very competitive and awarded to only a small group of students. In order to preserve eligibility for either the LIFE or Palmetto Scholarships a student must maintain a cumulative undergraduate GPA of 3.0 and complete a minimum of 30, 60, and 90 credit hours by the end of the first, second, and third academic years, respectively.

Eligibility can be regained as in other programs once requirements are met.

There is no application for the HOPE or LIFE Scholarship programs. In order to be a Palmetto Fellow, a student must meet fairly rigorous academic requirements, be nominated by their guidance counselor and chosen amongst all nominees in the state. I will therefore be focusing my analysis on recipients of the HOPE and LIFE Programs in their first year. South Carolina also has a Lottery Tuition Assistance Program, much like the HOPE grant, which offers purely need-based aid to students enrolling in 2-year degree and certificate granting institutions. However, its need-based structure and lack of academic requirements make it irrelevant for this study.

B Additional Graphical Analyses

Panel A of Figure B.1 shows both low and high cutoffs in GPA and SAT for Florida in the unrestricted sample to provide a rudimentary comparison of the relative magnitudes of the jumps corresponding to each cutoff. It is clear from Panel A that the high cutoff in both GPA and SAT corresponds to the larger jump in probability of receiving transferable aid in the unrestricted sample. To be sure that this dominance in magnitude is preserved in the restricted sample comparisons, Panels B and C of Figure B.1 compare figures for the the unrestricted and restricted samples at the low and high cutoffs, respectively. The jumps at the low cutoff in GPA and SAT in the unrestricted sample appear to be of roughly 10 and 20 percentage points, respectively. The corresponding jumps at the high cutoff in GPA and SAT are both of roughly 30 percentage points. In the restricted sample, the jumps at the low cutoff fall to 5 percentage points in GPA and negative 5 percentage points in SAT. However, the jumps in the restricted sample pictures of the high cutoff remain fairly stable and large at roughly 40 and 20 percentage points in GPA and SAT, respectively. In light of this evidence, I use the high cutoff values in GPA and SAT to construct the HOPE assignment variable for Florida.

Figure B.2 presents the analogous graphs of the discontinuities in Louisiana. It is clear from Panel A that the low cutoff in GPA and corresponding low cutoff in ACT represent the largest positive jumps in probability of receiving transferable aid. The high cutoffs in GPA and ACT correspond to discontinuous *drops* in probability of receiving transferable aid and the middle cutoff in ACT does not seem to correspond to a discontinuity at all. Panel B confirms that the discontinuities at the low cutoff values in GPA and ACT are robust to restrictions on the sample. The pattern in the discontinuities at the mid and high cutoffs in GPA and ACT persist in the restricted sample pictures presented in Panels C and D. I will therefore use the low cutoff values in GPA and ACT to construct the program assignment variable for Louisiana.

Figure B.3 presents the discontinuities in probability of receiving transferable aid in GPA and SAT for South Carolina. Because eligibility for South Carolina's program requires meeting 2 out of 3 criteria, with only 2 of these criteria depending explicitly and predictably on GPA and SAT and the third depending on unobserved class rank (perhaps some function of GPA), presenting pictures of discontinuities over restricted samples will not better inform the analysis. It is clear that the cutoff in GPA does not correspond to a distinct discontinuity in the probability of receiving transferable aid. This could be due to a relationship between the third, unobserved criterion, class rank, and GPA. Nevertheless, the SAT graph depicts a large discontinuity in probability of receiving transferable aid at the cutoff value. I will thus use the SAT cutoff to construct the $Program_i$ instrument in South Carolina.

Finally, figure B.4 looks for discontinuities in the probability function of selected demographic characteristics at the eligibility cutoffs. I have conducted this analysis only for Georgia due to the large sample size and the simplicity of the assignment rule in this state. I explore the probability that an individual is from a household with an income smaller than 35, 000 dollars a year, the probability of receiving a pell grant, the probability of being Hispanic, and the probability of being married. I find no evidence of discontinuities in the probability functions of any of these demographic characteristics at the 3.0 GPA eligibility cutoff. This evidence supports the assumption that assignment above and below the cutoff within a sufficiently small neighborhood is effectively random.

C Additional Results

Table C.1 presents results from first stage regression specifications with and without the demographic covariates conducted on samples corresponding to varying bandwidth sizes around the discontinuity. The medium bandwidth sample is the same as the discontinuity sample shown in the main results tables. Similarly, the whole sample is the same. The small bandwidth sample includes all individuals fall within .25 of GPA or 100 of SAT / 2 of ACT. The large bandwidth sample includes all individuals fall within .75 of GPA or 300 of SAT / 6 of ACT. I see that the first stage results are largely robust to the size of the bandwidth around the discontinuity.

Tables C.2-C.5 report results from regressions identical to those in the main results tables discussed above, except for the inclusion of additional spline controls in GPA SAT/ACT with the nodes at the cutoff values. I see that the major results are quite robust to the inclusion of these additional controls.

D Construction of variables

The following list describes the construction of variables used in analysis:

- gpa is the graduating cumulative GPA of the student taken from his high school transcript.
- $gpasq$ and $gpacub$ are the square and cube of GPA.

- $satc$ is the composite SAT score of the student.
- $satcsq$ and $satccub$ are the square and cube of composite SAT.
- All GPA and SAT composite score terms are included in all specifications along with interactions of these terms.
- $satm$ is the individual's SAT math subscore. $math$ and $read$ are the individual's scores on cognitive tests in math and reading. They are included in all specifications as well.
- fem is a binary for whether the individual is a female
- $racecat$ is a categorical variable for the race of the individual. Race categories White, Black, Hispanic, Asian, and other (including Native American).
- $income$ is a categorical variable measuring 13 household income levels. Fixed effects for these 13 levels are included where noted.
- $mothed$ and $fathed$ are the highest completed education level of the individual's mother and father, respectively.
- $married$ is a binary for whether the individual is married.
- $child$ is a binary for whether the individual has a child.
- $siblings$ is a categorical variable for the number of siblings an individual has. Fixed effects for the number of siblings are included.
- $urban$ is a binary for whether the individual comes from an urban household.
- $homelang$ is a categorical variable for which language is spoken predominantly in the individual's household.
- aid is a binary for whether the individual received transferable aid to pursue post-secondary education
- $apply$ is a binary for whether the individual applied to at least one post-secondary educational institution
- $numapplycon$ is the number of institutions to which the individual applied, conditional on applying to at least one institution
- enr is a binary for whether the individual enrolled in a post-secondary educational institution at any time in the 2 years following high school graduation

- $enrfull$ is a binary for whether the individual enrolled full-time in a post-secondary institution. It takes value 0 if the individual is enrolled part-time or not at all.

- $enrfullcon$ is a binary for whether the individual enrolled full-time in a post-secondary institution (conditional on some enrollment). It takes value 0 if the individual is enrolled part-time, and is left missing if the individual never enrolled.

- emp is a binary for whether the individual was employed at all while enrolled in a post-secondary institution.

- $emppart$ is a binary for whether the individual was employed part-time while enrolled in a post-secondary institution. It takes value 0 if the individual was not employed while enrolled, and is left missing if the individual was employed full-time or never enrolled.

- $empfull$ is a binary for whether the individual was employed full-time while enrolled in a post-secondary institution. It takes value 0 if the individual was employed part-time or was not employed at all while enrolled, and is left missing if the individual was never enrolled.

- $empfullcon$ is a binary for whether the individual was employed full-time while enrolled in a post-secondary institution (conditional on some employment). It takes value 0 if the individual was employed part-time, and is left missing if the individual was not employed at all or if the individual never enrolled.

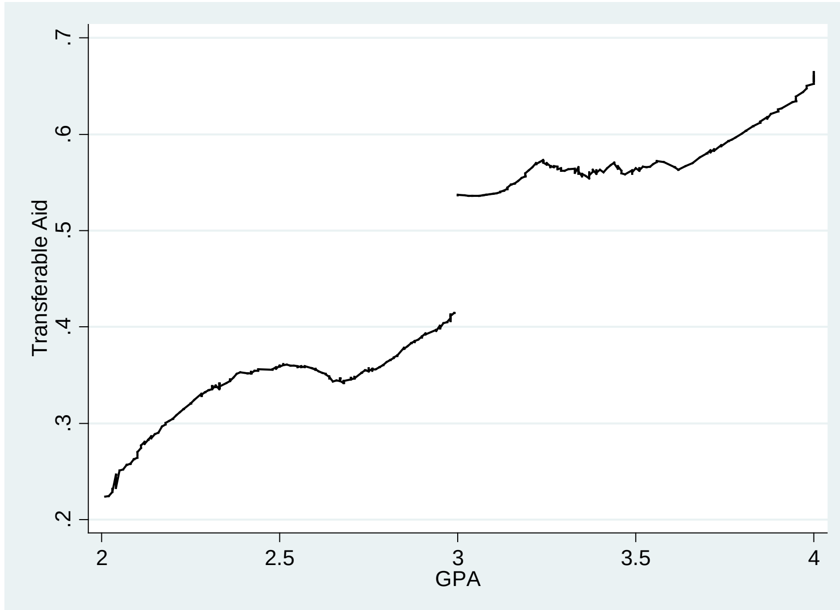
- $extracurr$ is a binary for whether the individual participated often in extracurricular activities while enrolled (takes value 0 if participated infrequently or not at all); and $commserv$ is a binary for whether the individual participated in community service or volunteer work while enrolled.

- $library$ is a binary for whether the individual worked at all in the library on academic assignments; $meetadv$ is a binary for whether the individual met at all with his academic advisor; $talkprofsome$ is a binary for whether the individual talked at all with a professor about academic matters while enrolled.

- $expgradcol$ is a binary for whether the individual expects to graduate college; $expgradschl$ is a binary for whether the individual expects to attend graduate school.

Figure I

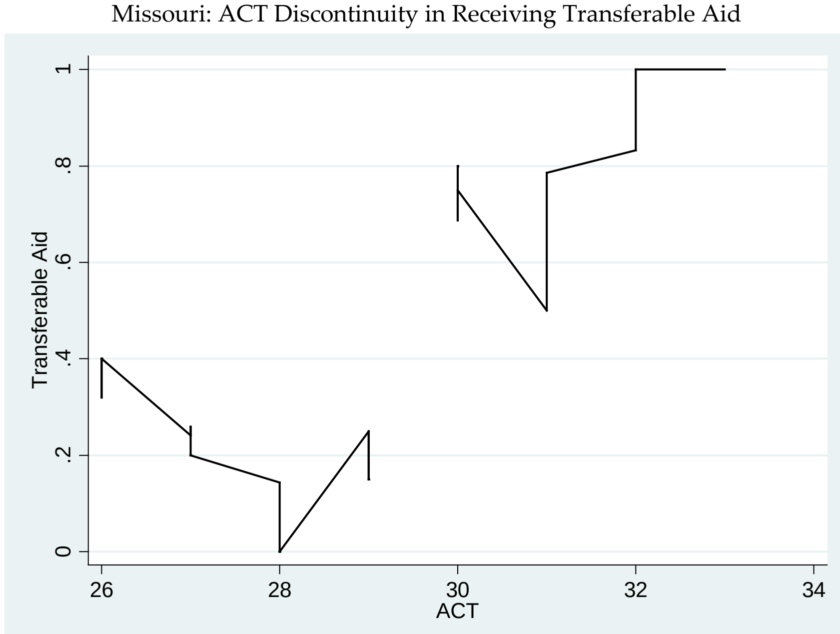
Georgia: GPA Discontinuity in Receiving Transferable Aid



Note: Running-Mean Smoothing

Figure II

Missouri: ACT Discontinuity in Receiving Transferable Aid

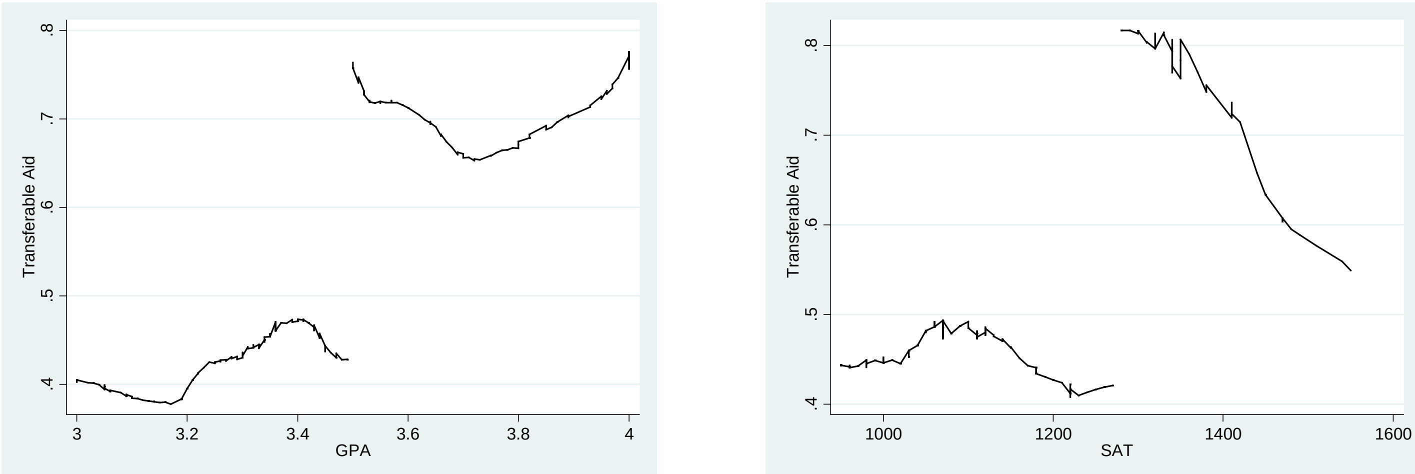


Note: Running-Mean Smoothing

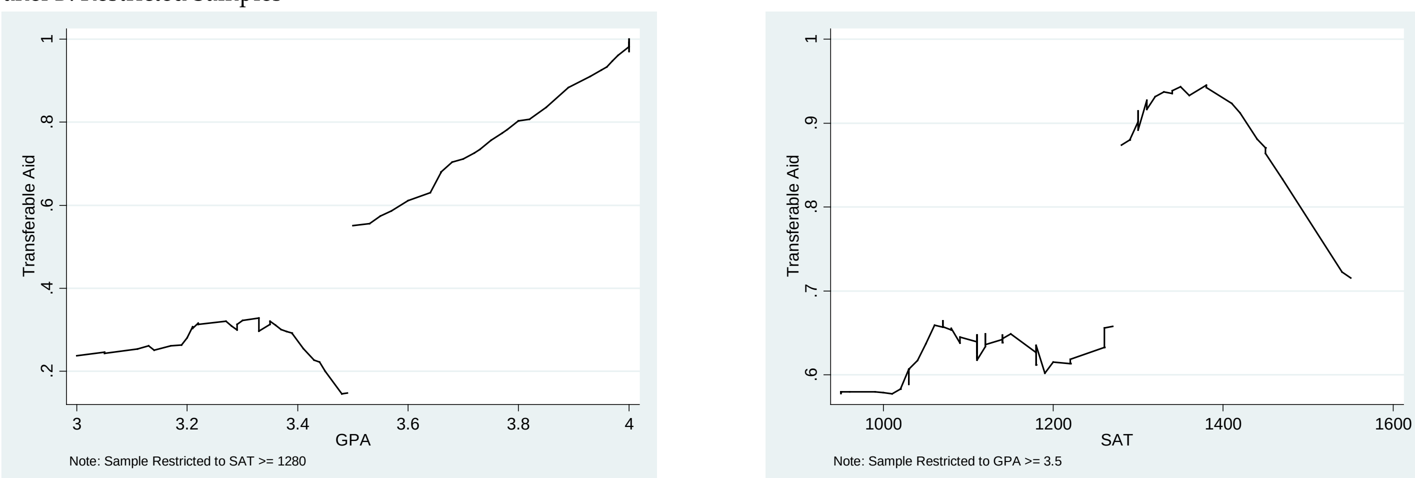
Figure III

Florida: GPA and SAT Discontinuities at High Cutoff

Panel A: Unrestricted Sample



Panel B: Restricted Samples

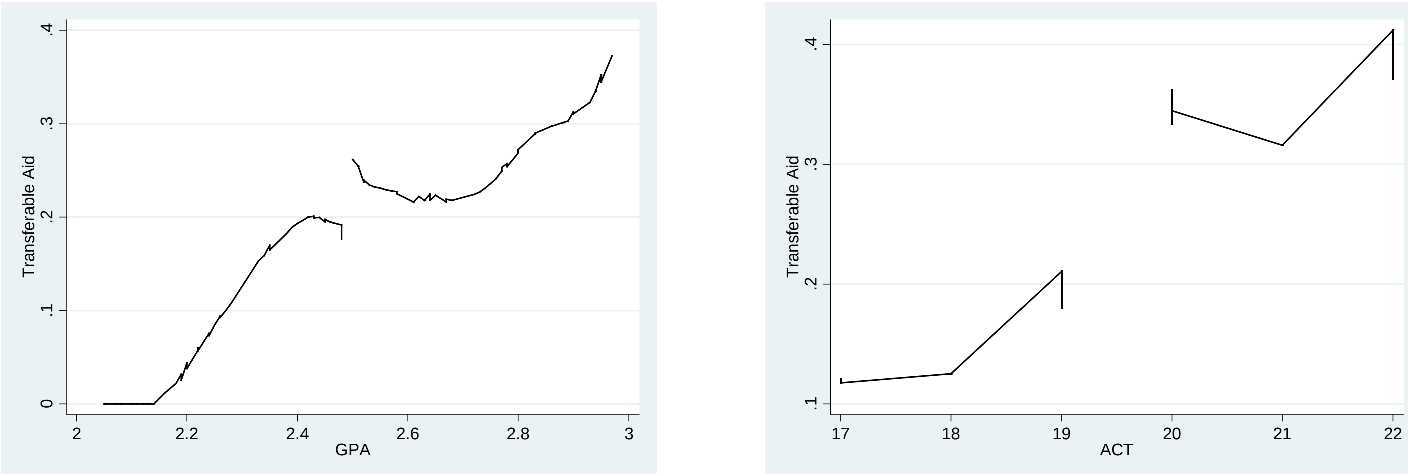


Note: All pictures use running-mean smoothing.

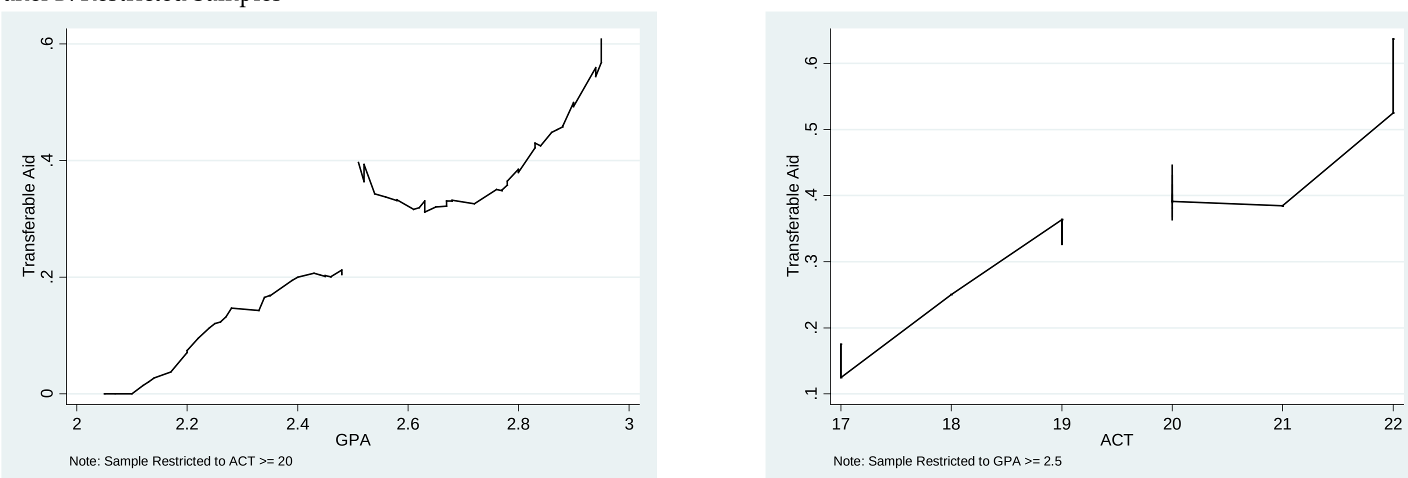
Figure IV

Louisiana: GPA and ACT Discontinuities at Low Cutoff

PanelA: Unrestricted Sample



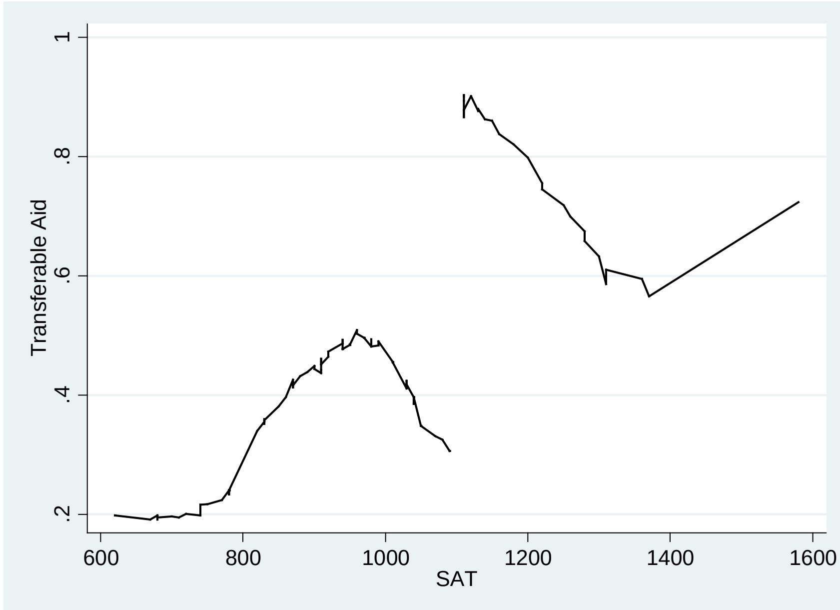
Panel B: Restricted Samples



Note: All pictures use running-mean smoothing.

Figure V

South Carolina: SAT Discontinuity in Receiving Transferable Aid



Note: Running-mean smoothing.

Figure VI

Florida: GPA Histograms

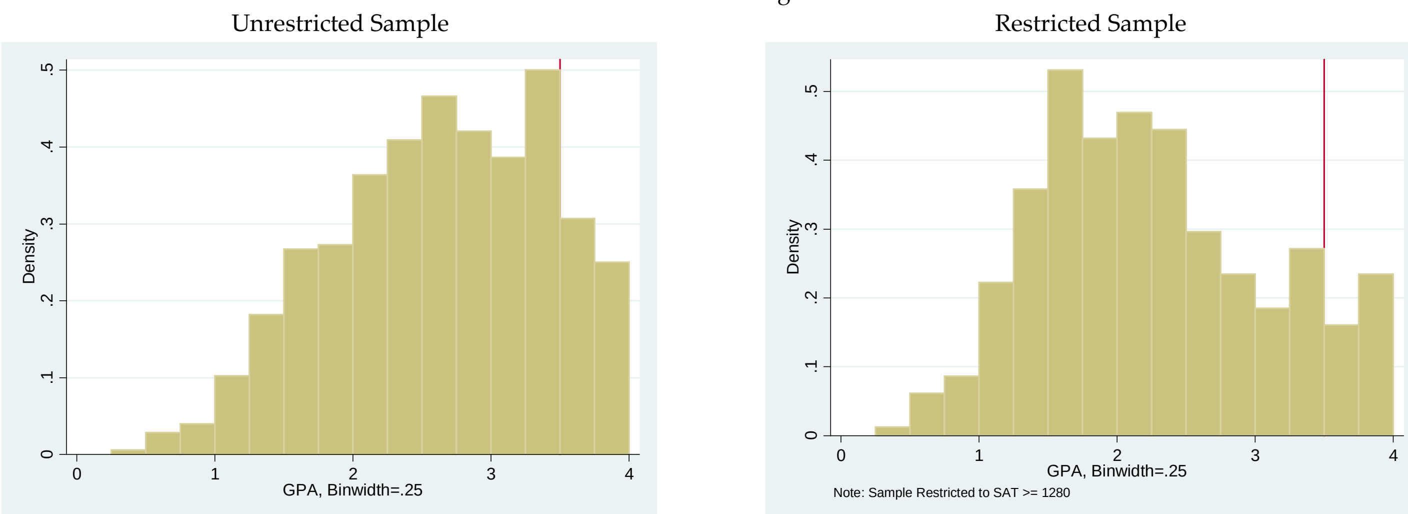


Figure VII

South Carolina: SAT Histogram

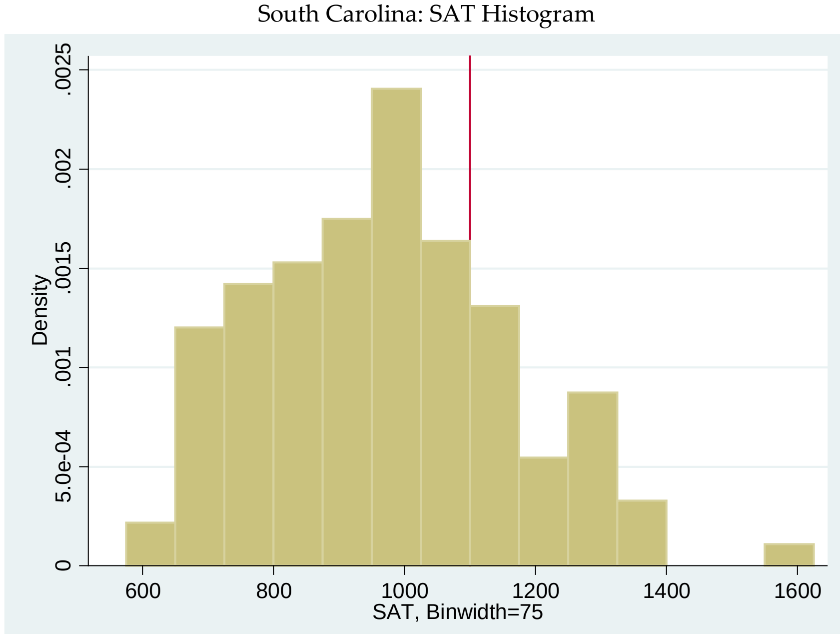
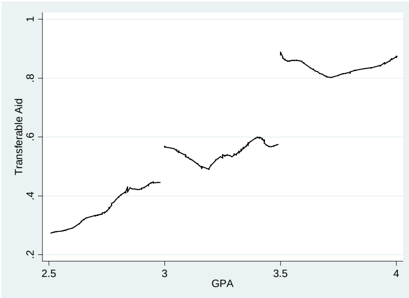
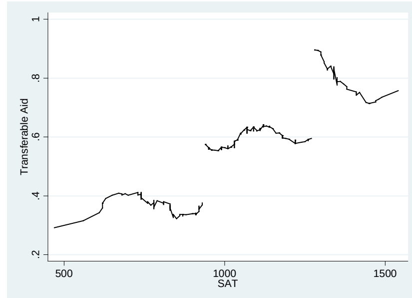


Figure B.1

Florida Discontinuities

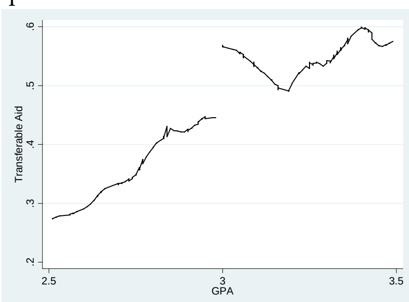
Panel A: Both Cutoffs, Unrestricted Samples

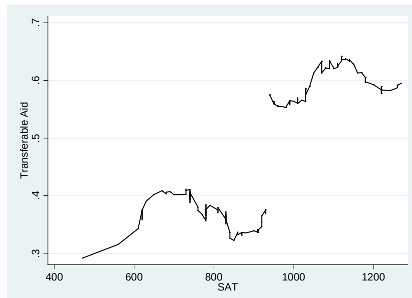




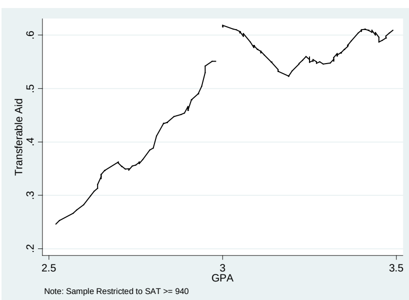
Panel B: Low Cutoff

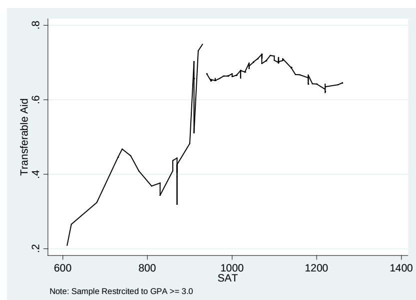
Unrestricted Sample





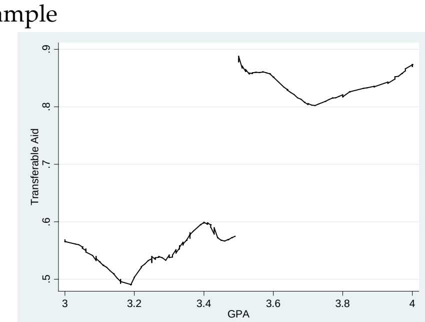
Restricted Sample



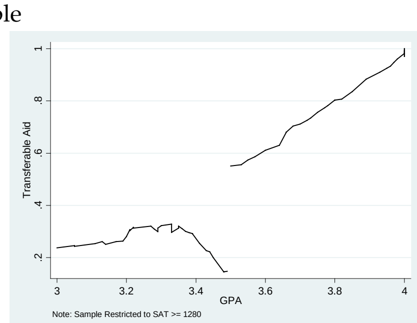


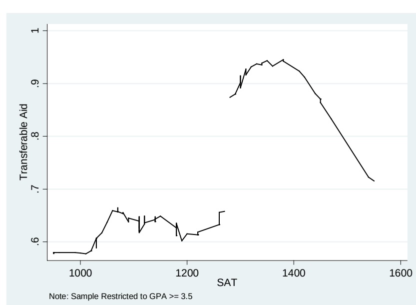
Panel C: High Cutoff

Unrestricted Sample



Restricted Sample



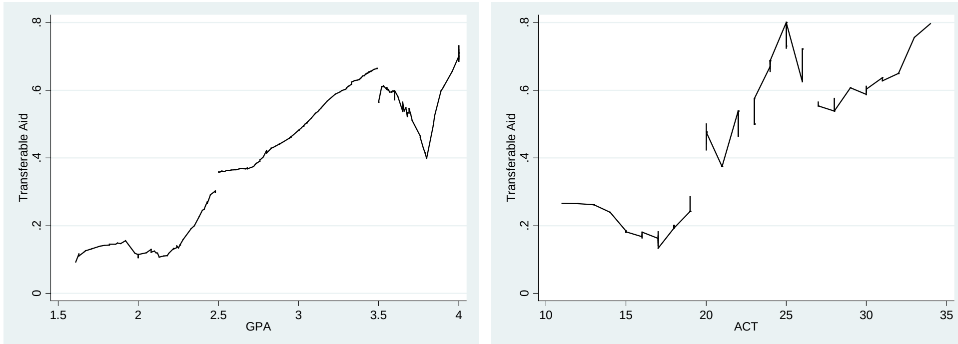


Note: All pictures use running-mean smoothing.

Figure B.2

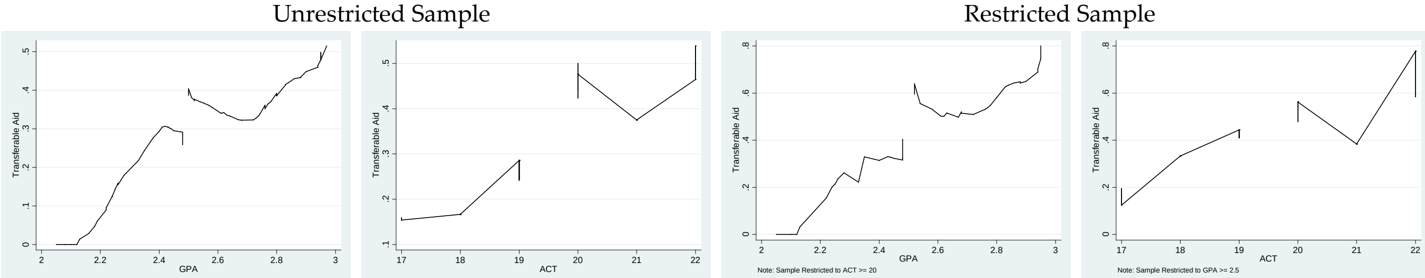
Louisiana Discontinuities

Panel A: All Cutoffs, Unrestricted Samples



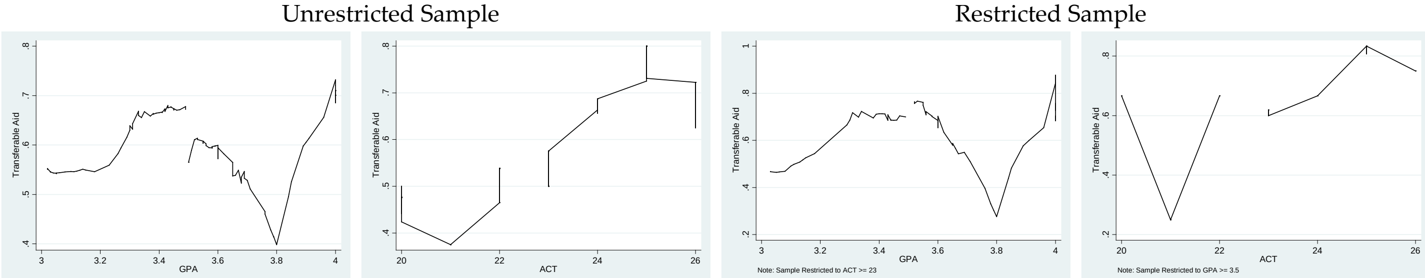
Panel B: Low Cutoff

Unrestricted Sample | Restricted Sample



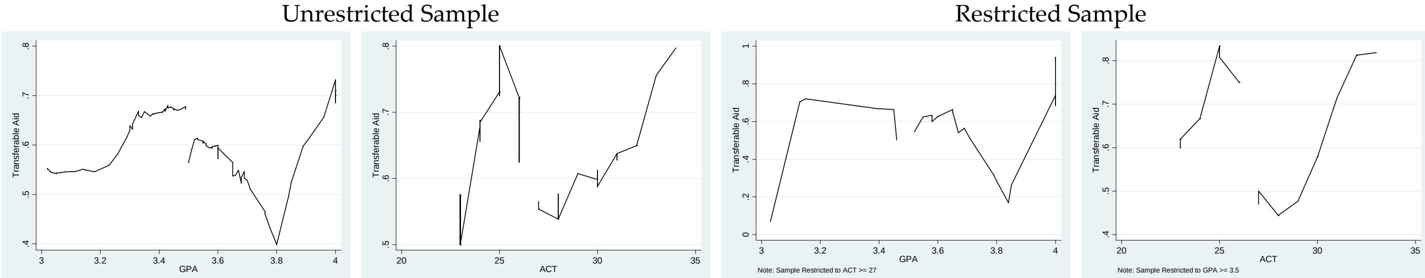
Panel C: Mid Cutoff

Unrestricted Sample | Restricted Sample



Panel D: High Cutoff

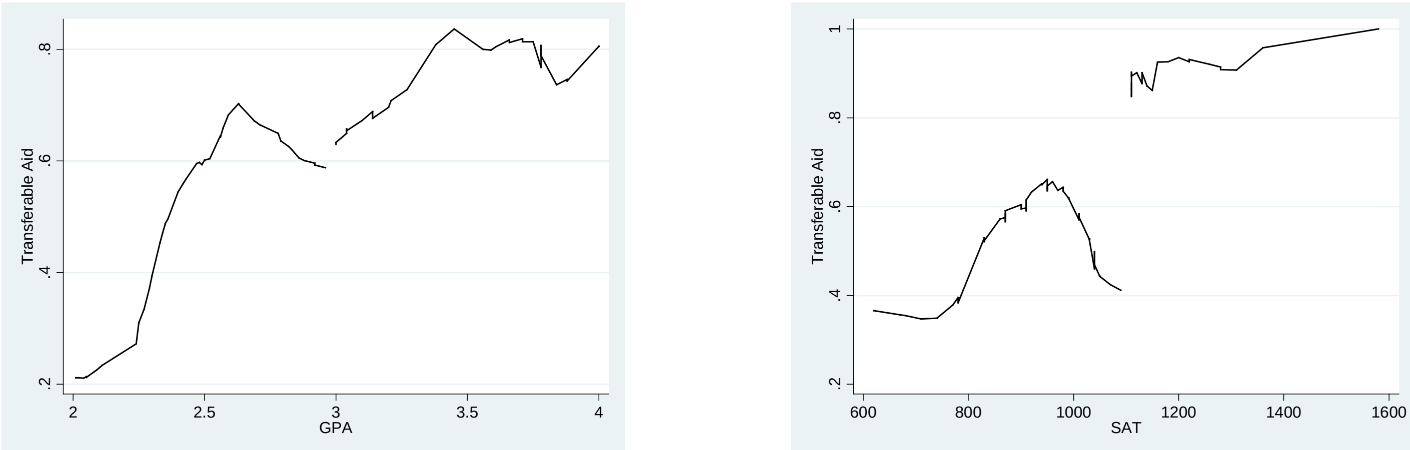
Unrestricted Sample | Restricted Sample



Note: All pictures use running-mean smoothing.

Figure B.3

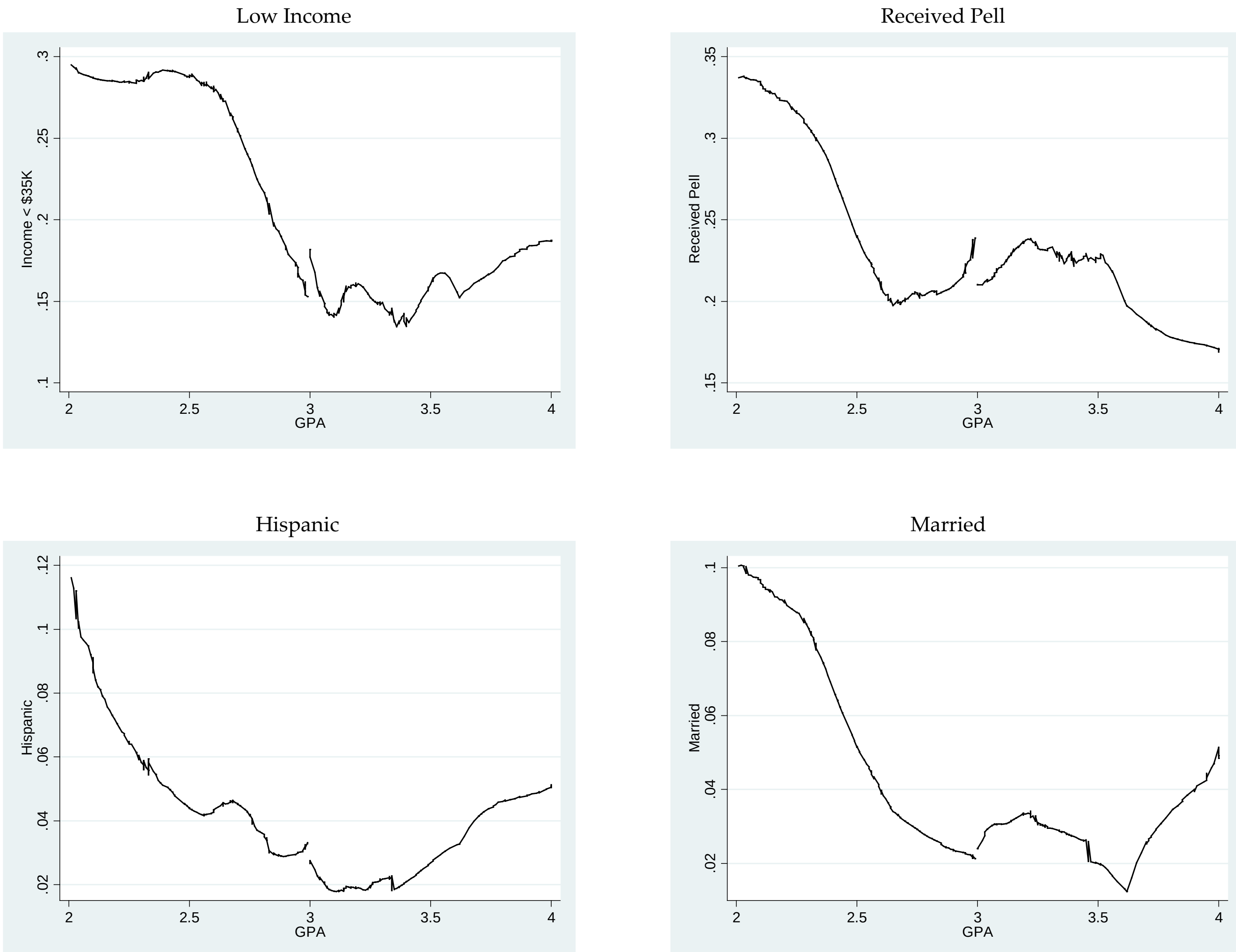
South Carolina Discontinuities



Note: All pictures use running-mean smoothing.

Figure B.4

Georgia: GPA Discontinuities in Demographic Covariates



Note: All pictures use running-mean smoothing.

Table I

Merit-Based Scholarship Program Details

State	Program Name	Year Instituted	Academic Eligibility Criteria	Award Amount (per Academic Year)	Eligibile Institutions	Part-time Students Eligible	Continuation Requirement	Non-Academic Eligibility Requirements	Application	Funding Source	Number of Awards Disbursed (2004-2005)	Program Expenditure (2004-2005)
Missouri	Bright Flight	1987	ACT score in top 3% of state (>=30 in 2004-2005academic year)	$2000 per academic year	Public/Private, 4yr/2yr, Instate	No	Cum GPA >= 2.5	Must not be pursuing a degree in Theology or Divinity	No	General Revenues	8,390	$16,055,000
Georgia	HOPE	1993	Core GPA >= 3.0	Full tuition and fees plus $300 at public instituions; Up to $3000 at private institutions	Public/Private, 4yr/2yr, Instate	Yes	Cum GPA >= 3.0 after 30, 60, and 90 semester hours (after each academic year)	None	FAFSA	Lottery	236,368	$426,500,000
Florida	FAS	1997	Core GPA >= 3.5 AND SAT >= 1270 (ACT >= 29)	Full tuition and up to $600 for fees and other expenses at public institutions; Equivalent value award at private institutions	Public/Private, 4yr/2yr, Instate	Yes	Cum GPA >= 3.0 after each semester (at least 6 hours)	75 hours of community service	Yes	Lottery	130,597	$268,944,369
	FMS		Core GPA >= 3.0 AND SAT >= 970 (ACT >= 20)	Full funding for 2yr and 75% funding for 4yr public institutions; Equivalent value award at private institutions			Cum GPA >= 2.75 after each semester (at least 6 hours)	None				
Louisiana	TOPS (Opportunity, Honors, and Performance awards)	1998	GPA >=2.5 (Opportunity) or >=3.5 (Honors or Performance) AND ACT >=20 (Opportunity) or >= 23 (Honors) or >= 27 (Performance)	Full Tuition (Opportunity) plus $400 (Honors) or $800 (Performance)	Public/Private, 4yr/2yr, Instate	No	Cum GPA >= 2.5 (Opportunity) or >= 3.0 (Honors or Performance)	None	FAFSA or TOPS Application	General Revenues	42,439	$117,041,879
South Carolina	LIFE	1998	2 of the following: (1) GPA >= 3.0, (2) SAT >= 1100 (ACT >= 24), or (3) Rank in top 30% of class	Up to $4700, not to exceed cost of attendance	Public/Private, 4yr/2yr, Instate	No	Cum GPA >= 3.0 and maintain 30 credit hours per academic year	None	No	General Revenues and Lottery	28,433	$127,152,542
	HOPE		GPA >= 3.0	One time award of up to $2800	Only 4yr Public/Private, Instate		(After freshman year must meet continuing requirements for LIFE)				2,522	$6,045,918

Table IIa: Summary Statistics (Demographic Characteristics)

Summary Statistics by Sample and Treatment Status

	Discontinuity Sample						Whole Sample					
	All		Qualified for Merit Aid		Did Not Qualify for		All		Qualified for Merit Aid		Did Not Qualify for	
Observations	750		288		462		1223		358		865	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Demographic Characteristics												
Female	0.531	0.499	0.532	0.500	0.530	0.500	0.530	0.499	0.550	0.498	0.522	0.500
Low Income	0.189	0.392	0.163	0.370	0.206	0.405	0.236	0.425	0.159	0.366	0.268	0.443
Middle Income	0.383	0.486	0.368	0.483	0.392	0.489	0.374	0.484	0.344	0.476	0.386	0.487
Hispanic	0.087	0.282	0.061	0.240	0.103	0.304	0.087	0.281	0.061	0.239	0.097	0.296
Black	0.168	0.374	0.133	0.340	0.191	0.393	0.189	0.392	0.127	0.334	0.215	0.411
Asian	0.051	0.220	0.061	0.240	0.045	0.207	0.047	0.213	0.066	0.249	0.040	0.195
Urban	0.375	0.484	0.438	0.497	0.335	0.473	0.338	0.473	0.405	0.492	0.310	0.463
Married	0.014	0.116	0.014	0.118	0.013	0.115	0.025	0.156	0.017	0.130	0.028	0.166
Child	0.020	0.141	0.021	0.144	0.020	0.140	0.037	0.188	0.020	0.140	0.044	0.205
Sibling	0.366	0.799	0.297	0.717	0.410	0.845	0.420	0.867	0.253	0.663	0.489	0.931

Notes: The sample, unless otherwise noted, is made up of individuals aged 7 and above who reported illnesses that began in the two weeks prior to survey.

Table IIb: Summary Statistics (Aid, Applications, and Enrollment)

Summary Statistics by Sample and Treatment Status

	Discontinuity Sample						Whole Sample					
	All		Qualified for Merit Aid		Did Not Qualify for		All		Qualified for Merit Aid		Did Not Qualify for	
Observations	750		288		462		1223		358		865	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Aid and Treatment Status												
Qualify for Merit-Aid	0.384	0.487					0.293	0.455				
Received Transferable Aid	0.479	0.500	0.615	0.488	0.394	0.489	0.411	0.492	0.603	0.490	0.332	0.471
College Applications												
Applied	0.962	0.191	0.968	0.176	0.958	0.200	0.955	0.207	0.972	0.166	0.948	0.221
No. of Applications	2.816	2.014	2.872	2.088	2.780	1.968	2.738	1.905	2.947	2.039	2.650	1.839
College Enrollment												
Enrolled in 2yrs after HS Grad	0.959	0.197	0.975	0.156	0.950	0.219	0.934	0.249	0.980	0.140	0.914	0.280
Enrolled Full-Time	0.885	0.3193	0.9329	0.2507	0.8553	0.3522	0.8322	0.3738	0.94	0.2372	0.7876	0.4093
Enrolled Full-Time (Conditional)	0.9224	0.2677	0.9565	0.2043	0.9007	0.2994	0.8915	0.3112	0.959	0.1976	0.8614	0.3458

Notes: The sample, unless otherwise noted, is made up of individuals aged 7 and above who reported illnesses that began in the two weeks prior to survey.

Table IIc: Summary Statistics (Employment, Time-Use, and Attainment Plans)

Summary Statistics by Sample and Treatment Status

	Discontinuity Sample						Whole Sample					
	All		Qualified for Merit Aid		Did Not Qualify for		All		Qualified for Merit		Did Not Qualify for	
Observations	750		288		462		1223		358		865	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Employment (Conditional on Enrollment)												
Employed in 1st yr after HS Grad	0.642	0.480	0.629	0.484	0.650	0.477	0.663	0.473	0.590	0.493	0.696	0.460
Part-Time	0.494	0.500	0.490	0.501	0.497	0.501	0.494	0.500	0.462	0.499	0.513	0.500
Full-Time	0.272	0.445	0.242	0.429	0.291	0.455	0.316	0.465	0.215	0.411	0.362	0.481
Time Use (Conditional on Enrollment)												
Participated Often in Extracurricular Activities	0.341	0.474	0.375	0.485	0.319	0.467	0.319	0.466	0.404	0.491	0.281	0.450
Participated Communtiy Service/Volunteer Work	0.578	0.494	0.622	0.486	0.550	0.498	0.536	0.499	0.659	0.475	0.485	0.500
Worked in Library on School Work at All	0.823	0.382	0.836	0.371	0.814	0.389	0.835	0.371	0.852	0.356	0.828	0.377
Met with Advisor at All	0.900	0.300	0.913	0.282	0.891	0.311	0.880	0.325	0.919	0.273	0.862	0.345
Talked with Professor About Academics at All	0.856	0.351	0.873	0.333	0.845	0.362	0.846	0.361	0.884	0.321	0.829	0.377
Expected Educational Attainment												
Graduate College	0.881	0.324	0.919	0.274	0.857	0.350	0.846	0.362	0.926	0.262	0.812	0.391
Attend Graduate School	0.570	0.495	0.640	0.481	0.526	0.500	0.519	0.500	0.668	0.472	0.458	0.499

Notes: The sample, unless otherwise noted, is made up of individuals aged 7 and above who reported illnesses that began in the two weeks prior to survey.

Table III: First Stage

Program Assignment Dummy on Receipt of Transferable Aid

	Discontinuity Sample		Whole Sample	
Program	**0.240*****	**0.211*****	**0.178*****	**0.189*****
	(0.0627)	**(0.0667)**	**(0.0539)**	**(0.0549)**
GPA	78.11	237.8	-66.12	-155.2**
	(415.4)	(456.1)	-47.29	(61.47)
SAT Composite	0.0126	0.454	-0.244*	-0.480***
	(1.120)	(1.278)	(0.142)	(0.182)
GPA x SAT	-0.0707	-0.537	0.266*	0.533***
	(1.183)	(1.328)	(0.157)	(0.201)
Female		0.0600		0.0591*
		(0.0452)		(0.0346)
Married		0.0110		0.0779
		(0.184)		(0.0912)
Child		-0.201		-0.111
		(0.185)		(0.0754)
F Test (Program=0)	**14.69**	**9.991**	**10.86**	**11.82**
Prob>F	**0.000138**	**0.00164**	**0.00101**	**0.000608**
Observations	715	680	1174	1111
Mean of Dependent Variable	0.479	0.479	0.411	0.411

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). All specifications include state fixed effects, polynomial functions of GPA and SAT/ACT up to the third degree, all interactions of these terms, SAT math subscores and math and reading scholastic test scores. Columns 2 and 4 also inlcude race dummies; dummies for 13 household income levels; a gender dummy; dummies indicating the language which is spoken at home; dummies for whether the individual is married and has children; dummies for number of siblings; and a dummy for whether the individual comes from an urban households. The discontinuity sample includes all individuals who fall within .5 of the GPA cutoff, 200 points of the SAT cutoff (4 points of the ACT cutoff) for the program in their state.

Table IV: Applications

Effects of Merit Aid on Application Outcomes

	Discontinuity Sample			Whole Sample		
Panel A: Second Stage IV						
	Applied	No. of Apps (Conditional on Applying)	No. of Acceptances	Applied	No. of Apps (Conditional on Applying)	No. of Acceptances
Transferable Aid	**0.234***	**-4.501****	**0.0428**	**0.249***	**-3.074***	**0.0240**
	(0.131)	**(2.218)**	**(0.526)**	**(0.138)**	**(1.711)**	**(0.508)**
No. of Apps			0.580***			0.572***
			(0.0327)			(0.0260)
Observations	680	656	656	1111	1064	1064
Mean of Dependent Variable	0.962	2.816	2.153	0.955	2.738	2.010
Panel B: OLS						
	Applied	No. of Apps (Conditional on Applying)		Applied	No. of Apps (Conditional on Applying)	
Transferable Aid	0.0866***	-0.0203		0.0697***	0.0686	
	(0.0219)	(0.156)		(0.0152)	(0.126)	
Observations	680	656		1111	1064	
Mean of Dependent Variable	0.962	2.816		0.955	2.738	

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). All specifications include state fixed effects, polynomial functions of GPA and SAT/ACT up to the third degree, all interactions of these terms, SAT math subscores and math and reading scholastic test scores. Specifications also inlcude race dummies; dummies for 13 household income levels; a gender dummy; dummies indicating the language which is spoken at home; dummies for whether the individual is married; has children and siblings; and a dummy for whether the individual comes from an urban households. The discontinuity sample includes all individuals who fall within .5 of the GPA cutoff, 200 points of the SAT cutoff (4 points of the ACT cutoff) for the program in their state.

Table V: Enrollment by Intensity

Effects of Merit Aid on Enrollment by Intensity *(First 2 Yrs After HS)*

	Discontinuity Sample			Whole Sample		
Panel A: Second Stage IV						
	Enrolled	Enrolled Full-Time	Enrolled Full-Time (Conditional on Enrollment)	Enrolled	Enrolled Full-Time	Enrolled Full-Time (Conditional on Enrollment)
Transferable Aid	**0.216***	**0.134**	**-0.0344**	**0.333****	**0.132**	**-0.105**
	(0.125)	**(0.159)**	**(0.140)**	**(0.152)**	**(0.169)**	**(0.154)**
Observations	680	680	655	1111	1111	1039
Mean of Dependent Variable	0.959	0.885	0.922	0.934	0.832	0.891
Panel B: OLS						
	Enrolled	Enrolled Full-Time	Enrolled Full-Time (Conditional on Enrollment)	Enrolled	Enrolled Full-Time	Enrolled Full-Time (Conditional on Enrollment)
Transferable Aid	0.0324*	0.0360	0.0111	0.0258	0.0481*	0.0270
	(0.0184)	(0.0288)	(0.0238)	(0.0166)	(0.0248)	(0.0206)
Observations	680	680	655	1111	1111	1039
Mean of Dependent Variable	0.959	0.885	0.922	0.934	0.832	0.891

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). See Table IV for additional comments.

Table VI: Expected Attainment

Second Stage IV: Effects of Merit Aid on Expected Educational Attainment

	Discontinuity Sample		Whole Sample	
	Graduate College	Attend Graduate School	Graduate College	Attend Graduate School
Transferable Aid	**-0.0683**	**0.0682**	**0.00142**	**0.211**
	(0.188)	**(0.312)**	**(0.180)**	**(0.288)**
Observations	680	680	1111	1111
Mean of Dependent Variable	0.570	0.570	0.846	0.519

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). See Table IV for additional comments.

Table VII: Employment Outcomes

Effects of Merit Aid on Employment Outcomes *(First Yr After HS, Conditional on Enrollment)*

	Discontinuity Sample			
	Employed	Employed Part-Time	Employed Full-Time	Employed Full-Time (Conditional on Employment)
Transferable Aid	**-0.382**	**-0.733***	**0.300**	**0.550**
	(0.342)	**(0.408)**	**(0.300)**	**(0.468)**
Observations	628	456	625	400
Mean of Dependent Variable	0.642	0.494	0.272	0.431

	Whole Sample			
	Employed	Employed Part-Time	Employed Full-Time	Employed Full-Time (Conditional on Employment)
Transferable Aid	**-0.331**	**-1.042**	**0.324**	**0.443**
	(0.314)	**(0.686)**	**(0.306)**	**(0.411)**
Observations	986	671	982	647
Mean of Dependent Variable	0.663	0.494	0.316	0.483

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). See Table IV for additional comments.

Table VIII: Time-Use of Enrollees

Second Stage IV: Effects of Merit Aid on Time-Use of Enrollees

Discontinuity Sample	Extracurricular Activities	Community Service or Volunteer Work	School Work in Library	Meet with Academic Advisor	Talk with Professor
Transferable Aid	**-0.674***	**-0.753***	**0.181**	**0.109**	**0.288**
	(0.387)	**(0.402)**	**(0.245)**	**(0.166)**	**(0.234)**
Observations	653	679	653	655	655
Mean of Dependent Variable	0.642	0.578	0.823	0.900	0.856

Whole Sample	Extracurricular Activities	Community Service or Volunteer Work	School Work in Library	Meet with Academic Advisor	Talk with Professor
Transferable Aid	**-0.565**	**-0.619***	**0.240**	**0.0395**	**0.294**
	(0.348)	**(0.348)**	**(0.243)**	**(0.187)**	**(0.236)**
Observations	1034	1110	1034	1038	1038
Mean of Dependent Variable	0.319	0.536	0.835	0.880	0.846

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). See Table IV for addtitional comments.

Table C.1: First Stage Robustness

Program Assignment Dummy on Receipt of Transferable Aid

	Small Bandwidth Sample		Medium Bandwidth Sample *(Discontinuity Sample)*		Large Bandwidth Sample		Whole Sample	
Program	**0.243*** **	**0.187** **	**0.240*** **	**0.211*** **	**0.166*** **	**0.144** **	**0.178*** **	**0.189*** **
	(0.0692)	**(0.0738)**	**(0.0627)**	**(0.0667)**	**(0.0573)**	**(0.0593)**	**(0.0539)**	**(0.0549)**
GPA	-1549	-1003	78.11	237.8	-37.72	-163.0	-66.12	-155.2**
	(994.9)	(976.9)	(415.4)	(456.1)	(137.3)	(148.8)	-47.29	(61.47)
SAT Composite	-4.837*	-3.351	0.0126	0.454	-0.321	-0.717	-0.244*	-0.480***
	(2.888)	(2.884)	(1.120)	(1.278)	(0.423)	(0.464)	(0.142)	(0.182)
GPA x SAT	4.666*	3.103	-0.0707	-0.537	0.255	0.648	0.266*	0.533***
	(2.827)	(2.825)	(1.183)	(1.328)	(0.439)	(0.481)	(0.157)	(0.201)
Female		0.108*		0.0600		0.0607		0.0591*
		(0.0596)		(0.0452)		(0.0381)		(0.0346)
Married		0.0994		0.0110		0.0824		0.0779
		(0.218)		(0.184)		(0.159)		(0.0912)
Child		0.229		-0.201		-0.149		-0.111
		(0.196)		(0.185)		(0.125)		(0.0754)
F Test (Program=0)	**12.37**	**6.413**	**14.69**	**9.991**	**8.428**	**5.914**	**10.86**	**11.82**
Prob>F	**0.000482**	**0.0117**	**0.000138**	**0.00164**	**0.00379**	**0.0152**	**0.00101**	**0.000608**
Observations	461	444	715	680	919	874	1174	1111
Mean of Dependent Variable	0.483	0.483	0.479	0.479	0.440	0.440	0.411	0.411

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). See Table III for additional comments. The small neighborhood sample includes individuals who fall within .25 of the GPA cutoff, 100 points of the SAT cutoff (2 points of the ACT cutoff) for the program in their state. The medium neighborhood is the same as the discontinuity sample in previous tables (see Table III notes). The large neighborhood sample includes individuals who fall within .75 of the GPA cutoff, 300 points of the SAT cutoff (6 points of the ACT cutoff) for the program in their state.

Table C.2: Robustness to Running Variable Spline Controls (Applications and Enrollment)

First Stage and Second Stage IV Estimates from Specifications with Additional Spline Controls

Discontinuity Sample						
	First Stage	Applied	No. of Apps (Conditional on Applying)	Enrolled	Enrolled Full-Time	Enrolled Full-Time (Conditional on Enrollment)
Program	**0.203***** **(0.0691)**					
Transferable Aid		**0.304**** **(0.145)**	**-4.260*** **(2.316)**	**0.291*** **(0.149)**	**0.237** **(0.183)**	**-0.0185** **(0.150)**
F Test (Program=0)	**8.589**					
Prob>F	**0.00350**					
Observations	680	680	656	680	680	655
Mean of Dependent Variable	0.479	0.962	2.816	0.959	0.885	0.922

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). See Table IV for additional comments. All specifications also include spline controls in GPA and SAT/ACT with nodes at the cutoff values corresponding to the relevant state's program.

Table C.3: Robustness to Running Variable Spline Controls (Employment)

Second Stage IV Estimates from Specifications with Additional Spline Controls

Discontinuity Sample				
	Employed	Employed Part-Time	Employed Full-Time	Employed Full-Time (Conditional on Employment)
Transferable Aid	**-0.441** **(0.349)**	**-0.893**** **(0.426)**	**0.395** **(0.313)**	**0.814** **(0.691)**
Observations	628	456	625	400
Mean of Dependent Variable	0.642	0.494	0.272	0.431

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). See Table C.2 for additional comments.

Table C.4: Robustness to Running Variable Spline Controls (Time-Use)

Second Stage IV Estimates from Specifications with Additional Spline Controls

Discontinuity Sample					
	Extracurricular Activities	Community Service or Volunteer Work	School Work in Library	Meet with Academic Advisor	Talk with Professor
Transferable Aid	**-0.711***	**-0.752***	**0.0970**	**0.0940**	**0.233**
	(0.394)	**(0.426)**	**(0.241)**	**(0.170)**	**(0.238)**
Observations	653	679	653	655	655
Mean of Dependent Variable	0.341	0.578	0.823	0.900	0.856

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). See Table C.2 for additional comments.

Table C.5: Robustness to Running Variable Spline Controls (Attainment)

Second Stage IV Estimates from Specifications with Additional Spline Controls

Discontinuity Sample		
	Graduate College	Attend Graduate School
Transferable Aid	**0.0163**	**0.159**
	(0.195)	**(0.307)**
Observations	680	680
Mean of Dependent Variable	0.881	0.570

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). See Table C.2 for additional comments.