A Quasi-Experimental Estimate of the Impact of Financial Aid on College-Going

by

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April 15, 2002

PRELIMINARY AND INCOMPLETE DRAFT
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This research has been supported by the James Irvine Foundation, the William and Flora Hewlett Foundation and the Lumina Foundation. Jeffrey Geppert provided invaluable assistance in assembling the analysis file and in performing the initial impact estimates. Samuel Kipp III, a former executive director of the California Student Aid Commission, provided expert advice and guidance. The current executive director, Walter Boeck, and the staff of the California Student Aid Commission-- particularly Karen Vogel-Henderson and Sarah Tyson-- were extremely helpful and patient in answering our many queries. Doug Staiger and Enrico Moretti provided many insightful suggestions. Matt Wiswall at UCLA provided research assistance.

Abstract

The Cal Grant program provided approximately $450 million in student grant aid to California undergraduates each year in 1998 and 1999. Eligibility is subject to a minimum GPA and maximum level of family income and assets. The paper uses a regression-discontinuity design to studying discontinuities in college enrollment rates for a sample of 150,000 youth in California applying for financial aid in the Spring of 1998 and 1999. The data collection strategy is novel, identifying applicants' enrollment decisions by matching financial aid files with a large national database of student enrollment data. Because there are multiple dimensions of eligibility and multiple thresholds to be studied, the analysis allows for specification tests, comparing any discontinuities on one dimension of eligibility, for those who satisfy the other two dimensions of eligibility and those who do not. The results suggest large impacts (4 to 6 percentage points) of eligibility for the Cal Grant A award on the proportion of students enrolling in college in the subsequent year.

I. Introduction

Government invests large sums in tuition subsidies and student financial aid for college students with the goal of providing access to post-secondary education for high school graduates. The lion's share of such aid comes in the form of direct state and local appropriations to public post-secondary institutions, which total roughly $50 billion annually.[1] In addition, the federal government provided more than $8 billion in means-tested grants to undergraduates during the 2000-01 school year and guaranteed $37 billion in student loans (and paying the interest on roughly half of that loan volume while students are in school).[2] States added $5 billion in grant aid to students, much of it means-tested. Given the magnitude of such public investment, empirical researchers have been pre-occupied with estimating the impact of these various subsidies on enrollment decisions, particularly for low-income youth.

However, despite more than three decades of effort, much of the available evidence remains problematic. The primary weakness is that the variation in college price is rarely plausibly exogenous. The main source of variation in price are long-standing differences in states' tuition policy, which is likely to be correlated with other policies encouraging college-going. Another source of variation are individual differences in academic talent or financial need which may be only imperfectly measured in observational analyses. Several papers take advantage of large changes in policy, such as the establishment of the federal Pell Grant program in 1973 (Hansen(1983) and Kane(1994)), the termination of tuition benefits for Social Security

[1]In addition to the direct appropriations which allow public institutions to keep tuition low across-the-board,

[2]College Board, *Trends in Student Aid, 2001*, p. 7.

Survivors in 1982 (Dynarski(1999)), within-state increases in tuition policy (Kane(1999)) or the establishment of the Hope Scholarship program in Georgia (Dynarski(2000)). However, the results of that literature have often been conflicting. For instance, while the estimates of the impact of the Hope Scholarship program are large, there was no apparent impact on enrollment of low-income youth after the establishment of the Pell Grant program in the mid-Seventies.

In this paper, I exploit several discontinuities in the eligibility formula for the Cal Grant program in California to form a quasi-experimental estimate of the impact of financial aid on students' enrollment decisions. In order to be eligible for a Cal Grant A, a student must have achieved a minimum high school GPA as well as demonstrate a minimum degree of financial need using the federal need formula. Those who met the GPA and need requirements were eligible for up to $9400 per year to attend a private 4-year institution in California. Those choosing to attend the University of California or California State University were eligible to receive free tuition. Since the tuition at UC ($3609 and $3429 in 1998-99 and 1999-2000 respectively) and at California State University campuses ($1506 and $1428 in 1998-99 and 1999-2000 respectively) were considerably lower than $9400, eligibility for a Cal Grant A also triggered changes in the relative price of different types of colleges as well as lowering the price of college generally.

For the years I will be studying-- those planning to enter college in the fall of 1998 and 1999-- the GPA thresholds were unknown at the time students were applying. With a given a level of state funding, the eventual GPA threshold depended upon the number of qualified students applying. For those applying for the fall of 1996 through 1999, the GPA threshold for the Cal Grant A took on a range of values-- 3.16, 3.05, 3.15 and 3.09 respectively. The resulting

uncertainty surrounding the GPA threshold may have made it difficult for families and students to plan for college, but it was fortuitous for the purpose of evaluation for at least two reasons: First, the students just above and below the threshold might plausibly be expected to have been similar. This would have been less true if the minimum qualifying GPA were announced beforehand, since those most desirous of the financial aid would have been expected to claw their way above the threshold, while those just below the threshold would have contained a disproportionate share of students who did not need the aid. Second, because the GPA threshold was different in the two years we are studying, it allows us to isolate the effect of GPA differences from the effect of the aid itself. (For current cohorts, the GPA threshold is no longer uncertain. Beginning with the class entering in the Fall of 2001, the Cal Grant program was given sufficient funding to guarantee a grant to students with a GPA of 3.00 or higher.)

The manner of data collection employed in the present study is also novel. With data provided by the California Student Aid Commission, we began with the universe of California residents submitting federal financial aid applications by March 2 in 1998 and 1999. There were roughly 160,000 applicants applying as prospective college freshmen in each of the two years, for a total of roughly 320,000. We identified a sub-sample of 150,413 students and asked the California Student Aid Commission to obtain information on subsequent college enrollment from the National Student Clearinghouse– a non-profit organization which collects individual student enrollment information from institutions comprising 80 percent of 2-year and 4-year college enrollment in the United States.[3] Therefore, we can estimate the impact of Cal Grant

[3]The data we were given had been stripped of name, date of birth and Social Security number, but the remaining data items collected on the Free Application for Federal Student Aid were available to us.

receipt on the subsequent college choices of California financial aid applicants, while controlling for the rich array of family background measures available on the federal financial aid form (including parental education, family composition, income and assets).

In this paper, we study discontinuities in college enrollment at the GPA and income thresholds, using as a control group those who failed to meet one of the other dimensions of eligibility. For example, we study the discontinuity in college enrollment at the GPA threshold for those who met the income and asset requirements, using as a control group those who were not financially eligible. The estimates suggest that eligibility for a Cal Grant A results in a 4 to 6 percentage point rise in the proportion of financial aid applicants enrolling in college in the subsequent year. Moreover, the estimated impact at the GPA threshold is similar to the estimated impact at the income threshold.

II. Description of Current Estimates of Price Sensitivity

Over the years, a large literature has developed, studying the impact of various types of tuition and financial aid policies on college-going. In their review of the literature on student responsiveness to changes in college cost, Leslie and Brinkman (1988) report a consensus estimate that a $1000 change in college costs ($2001) is associated with a 4 percentage point difference in college enrollment rates. Table 1 summarizes the results from three recent sets of studies, published since the Leslie and Brinkman review: those that use differences in public tuition levels between states and over time, those that evaluate the impact of financial aid policies that operate outside the usual need-analysis system, and those evaluating changes in financial aid policy operating through the regular financial aid process.

The first three papers use between-state differences in state tuition policy and essentially compare the college entry rates of otherwise similar youth in high and low-tuition states. The empirical strategy in this literature uses the assumption that the price that is relevant for the marginal student is the tuition at public institutions in their state and evaluates the effect of tuition and college-going by comparing college-going rates in high and low-tuition states. Such studies also assume that the supply of college slots is perfectly elastic: given a change in price, it is solely student demand which determines enrollment and not the supply of college slots.

Two characteristics of these studies deserve comment: First, although they use 3 different data sets-- the October Current Population Survey, the National Longitudinal Survey of Youth and the High School and Beyond-- each generates similar results. A $1000 difference in tuition ($2001) is associated with a 5 percentage point difference in college-going. Indeed, these estimates are quite consistent with the older literature summarized by Leslie and Brinkman.

Second, a weakness of these studies is that they rely on relatively fixed differences in tuition levels between states. For instance, California has been a relatively low-tuition state for the past forty years. California has also built a number of community colleges around the state. One may be attributing to tuition policy the effect of these other policy differences, such as the construction of community colleges. As a result, Kane (1999) used administrative data to look at what happens to enrollments within a state when it raises tuition. Interestingly, one sees comparable effects of tuition changes within states over time as one would estimate looking across states.

Also cited in Table 1, Sue Dynarski has recently estimated the impact of two import policy changes, by comparing changes in enrollment rates for affected and unaffected groups.

One study focused on the impact of the cessation of tuition benefits for Social Security survivors and the other evaluated the effect of the Hope Scholarship program in Georgia. Dynarski (1999) found that after the discontinuation of the Social Security Student Benefit program, college entry by students with deceased parents declined by 19.4 to 25.6 percentage points relative to other youth. To convert this estimate to a similar scale reported above, Dynarski calculated that the value of the benefit program had been roughly $6700 ($2001). This implies an impact of 3 to 4 percentage points per thousand dollar change in price. Although the change in policy was plausibly exogenous, it is difficult to know whether the responsiveness of such a narrow subgroup-- youth with deceased parents-- can be generalized to other groups. Moreover, the estimate is based upon an exceedingly small sample of 107 children of deceased parents before the change in policy and 49 after the change.

In a second paper, Dynarski studied enrollment rates for youth in Georgia relative to other southern states, before and after the Hope Scholarship program was initiated in that state. She estimates that the program increased college enrollment rates of 18 to 19-year-olds by 7.0 to 7.9 percentage points. Given the value of the Hope Scholarship, this estimate converts to an estimate of 2 to 3 percentage points per $1000 difference in cost.

Despite the above results, the evidence for the impact of the primary federal grant program for low income youth-- the Pell Grant program-- is much weaker. Lee Hansen (1983) first noted that there had been little evidence of a disproportionate rise in college enrollment by low-income youth during the Seventies, when the Pell Grant program was established. Although that paper was criticized for relying too heavily on two years' of data and for including males, whose decisions may have also been affected by the end of the Vietnam War, later work

(Kane (1994)) confirmed that the result was not sensitive to the choice of annual end-points or to the inclusion of males. Manski (1993) also reported little evidence of a disproportionate growth in BA completion by low-income youth graduating from high school between 1972 and 1980. (Despite little evidence of impacts on enrollment of college-age youth, Seftor and Turner (forthcoming, 2002) report evidence of enrollment impacts on older adults.)

A paper by van der Klaauw (1997) uses an identification strategy most closely related to the one proposed in this paper, but does so to answer a different question. He uses discontinuities in the formula determining fellowship offers at a major east university to identify the effect of such offers on the decisions of students to attend that institution. His estimates suggest that each $1000 in aid ($2001) raises the likelihood of attending the university by 3-4 percentage points. A recent paper by Linsenmeier, Rosen and Rouse (2001) also evaluates the impact of one institution's decision to shift its financial aid to low-income students from loans to grants. They find no statistically significant impact on low-income youth in the aggregate, but do find marginally significant results for low-income minorities. However, while such estimates may be useful to individual institutions seeking to calibrate their own financial aid strategy, it is not very useful in attempting to estimate the impact of public subsidies on the proportion of youth choosing to college. Indeed, such own-price elasticities are probably institution-specific, depend upon the policies in place at rival institutions, and may either overstate or understate the effect of public aid on enrollment in the aggregate.

III. Description of Cal Grant Program

During the period studied in this paper, the Cal Grant program provided approximately $450 million in aid to undergraduate students annually. Most of that aid was divided between two programs: the Cal Grant A and the Cal Grant B programs. In order to qualify for either type of Cal Grant, a student had to meet the following requirements:

- Be a resident of California.
- Be a U.S. citizen or eligible non-citizen (e.g. permanent resident)
- Not have a BA degree or have defaulted on a prior educational loan.
- Have financial need according to the federal financial aid formula

In order to qualify for a Cal Grant A (the more generous of the two most common types of Cal Grants) a student was required to attend a public or private 4-year college in California at least half-time, have a high school GPA above a specific threshold and income and assets below specific limits. For those applying in 1998 and 1999, the minimum GPA was not known at the time of application– either to applicants or to program administrators– since the cut-off ultimately depended upon available funds and the number of eligible applicants. The minimum GPA was eventually established at 3.15 in 1998 and 3.09 in 1999.

A student could only use a Cal Grant A to attend a *four-year* college in California. The maximum award for students choosing to attend a private 4-year college was $9036 and $9420 in the 1998-99 and 1999-2000 school years respectively. Alternatively, a Cal Grant A could be used to pay for the tuition portion of costs at a UC or CSU campus. As mentioned above, UC tuition was $3609 and $3429 in 1998-99 and 1999-2000 respectively and the CSU tuition was $1506 and $1428 in 1998-99 and 1999-2000 respectively. A student meeting the above

eligibility requirements for a Cal Grant A could choose to attend a two-year college, but they would be required to put their award on "reserve," which can be done for up to three years.

Many of those students with high school GPA's below the relevant thresholds receive no funding from the Cal Grant program (although they may qualify for federal aid or institutional awards.) However, a subset of these students with very low income and assets qualify for Cal Grant B awards. Eligibility for a Cal Grant B is based upon an index using information on income, family size, educational attainment of parents, an indicator for those from single parent families and high school GPA.[4] The formula used to calculate the index is not well-documented in the literature that is publicly available. Moreover, the cut-offs for eligibility were also unknown at the time students were applying.

Because of the more stringent financial eligibility requirements, Cal Grant B recipients tend to come from more disadvantaged households than the Cal Grant A recipients. The median parental income for dependent Cal Grant B recipients was $14,000, with a maximum of $35,000. In contrast, the median parental income for Cal Grant A recipients was $31,000, with a maximum income of $68,000. Both programs were restricted to families with assets (excluding home equity) less than $42,000.

A majority (85 percent) of those who qualify for both programs (the Cal Grant A and the Cal Grant B) choose to use the Cal Grant B. There are two primary reasons for this. First, unlike the Cal Grant A, the Cal Grant B award could be used to attend a community college in

[4]In fact, the use of parental education in the Cal Grant B formula is the primary reason for its continuing inclusion on the federal financial aid form, which is meant to serve as the least common denominator for federal and state financial aid programs. Parental education is not directly used in the eligibility for federal financial aid, but will serve as a useful control variable in the present study.

California. A student would receive a $1409 "subsistence" grant each year to attend a community college under the Cal Grant B and would have to wait to use their Cal Grant A. Moreover, a student can also receive the $1409 grant to attend the first year of a 4-year college. But, in the second and subsequent years at a 4-year college, a student would receive the same tuition benefits that were accorded to Cal Grant A recipients, plus the $1409 subsistence grant. A student who is planning to attend the University of California has a choice between a Cal Grant A, with a present value of $\$3609 + \frac{\$3609}{(1+r)} + \frac{\$3609}{(1+r)^2} + \frac{\$3609}{(1+r)^3}$ or a Cal Grant B, with a present value of $\$1410 + \frac{\$3609 + \$1410}{(1+r)} + \frac{\$3609 + \$1410}{(1+r)^2} + \frac{\$3609 + \$1410}{(1+r)^3}$.

Except for those with a very high discount rate (r>.175) or plans to remain in a four-year college for only a year or two, the Cal Grant B is likely to offer the more generous grant to those who qualify.

In other words, for the very lowest income students, the Cal Grant B would provide grants that would allow them to attend a community college as well as awards that are generally more valuable than a Cal Grant A for those who want to attend a four-year college. As a result, in estimating the impact of crossing the Cal Grant A threshold, we will focus on three different groups:

- those who are financially ineligible for *neither* the Cal Grant A nor Cal Grant B
- those who are sufficiently needy to qualify financially for *either* the Cal Grant A or the Cal Grant B
- those who meet the financial eligibility requirements for the Cal Grant A *only*, and whose income or assets are too high to qualify for the Cal Grant B.

If the subsidy available through the Cal Grant A has any impact on college going, we would expect to see an impact of crossing the GPA threshold for the second or third group, but not for the first group. Moreover, we might have expected a larger impact for those who were financially eligible for only the Cal Grant A, since the marginal effect on the total amount of aid received is larger for those who would qualify for the Cal Grant B, even if they miss the GPA threshold for the Cal Grant A. The results below are somewhat surprising, in that we estimate similar effects of crossing the Cal Grant A GPA threshold, whether or not the student was sufficiently poor to quality for a Cal Grant B.

IV. Data Description

The U.S. Department of Education automatically transmits to the California Student Aid Commission (CSAC) all information on family income and resources that are reported on the federal financial aid form (the Free Application for Federal Student Aid (FAFSA)) by California residents. Students are not required to file a separate financial aid application to the state; California residents who submit the federal form by March 2 are considered as a matter of course.

The only additional piece of information applicants are required to file is the "Grade Point Average Verification Form", which must be completed by a qualified staff member at each applicant's high school. The GPA verification form is relatively short– requesting the student's name, social security number, date of birth and permanent mailing address. The school official is expected to fill in the GPA calculation. The GPA calculation is standardized and many high schools submit high school grade point averages electronically to CSAC. For those who are applying during their senior year in high school, the high school GPA consists of an equally weighted average of all coursework taken during the sophomore and junior year of high school, excluding physical education and ROTC courses. There is no additional weighting for advanced placement courses. Freshman year grades do not count. Moreover, senior year grades do not count unless someone is applying to college for the first time after having graduated from high school. (Interestingly, the GPA weighting formula used by the California Student Aid Commission is different from the GPA weighting formula used by the University of California in its admissions process. As a result, the GPA requirements for admission to the University of California do not map directly onto the CSAC GPA.)

Figure 1 portrays the distribution of high school GPA's for those applying for Cal Grants as first-year college students. Although there is a slightly higher proportion of students with GPA's at the top of the distribution in 1998 than in 1999, the distributions are otherwise similar. The two vertical lines in Figure 1 identify the thresholds used in the two years, 3.15 in 1998 and 3.09 in 1999. There does not appear to be any significant "clumping" in the distribution of GPA's near the respective thresholds.

For most of the paper, we will be identifying the impact of Cal Grant eligibility on the likelihood of college attendance for those with high school GPA's near the respective thresholds. Interestingly, the GPA thresholds in 1998 and 1999 lie well within the range of admission standards for all the major segments of postsecondary education in California. Figure 2 reports the distribution of high school GPA (calculated according to the California Student Aid Commission's formula) for those we subsequently observed attending one of the University of California (UC) campuses, one of California State University (CSU) campuses or one of the community colleges (CC) in the state. The vertical lines in Figure 2 depict the 3.09 and 3.15 thresholds. The thresholds lie in the heart of the distributions of GPA's for those who started out at a CSU or community college campus. Moreover, there was a non-negligible portion of those who started at one of the UC campuses with GPA's below the 3.09 and 3.15 threshold (15 percent of UC entrants had high school GPA's below 3.15).[5]

The National Student Clearinghouse Database

The National Student Clearinghouse is a non-profit organization that maintains enrollment information for roughly 2400 two-year and four-year colleges, comprising 80 percent of total college enrollment in the United States.[6] The database was originally established to help student loan guarantors and lenders verify continuing student enrollment. However, the

[5]As noted above, this is partially due to the fact that the GPA used for Cal Grant eligibility is calculated differently from the high school GPA used for University of California admissions.

[6]These rates apply to the 1998-99 time period. The organization now reports to have data for 2700 institutions comprising 91 percent of enrollment.

organization has evolved over time to provide additional services to participating schools, such as helping to satisfy the enrollment reporting requirements for the new education tax credits introduced with the Tax Reform Act of 1997 and allowing colleges to track transfer students. The California Student Aid Commission, a partner in this project, was one of the founding members of the National Student Clearinghouse.

Table 2 reports the participation rates of different types of institutions in the NSC database. The first column simply reports the proportion of students in California attending each type of institution. The second column reports the proportion institutions participating in the database, without weighting by enrollment. When reported simply as a fraction of the total number of institutions, the participation rates are often quite low, with only 55 percent of all institutions nationally participating. However, the non-participants are much smaller on average than those participating. The third column reports the participation rates nationally, weighted by enrollment. When weighted by enrollment, the participation rate overall is 80 percent. The fourth column reports participation rates for institutions located in California, weighted by their enrollment. Nearly ninety percent of enrollment in California is in participating institutions. Ninety-five percent of public 4-year enrollment and nearly ninety percent of public 2-year enrollment in California is in institutions participating in the database. Private 4-year institutions in CA participate at lower rates (78 percent when weighted by enrollment) and private 2-year institutions are the least likely to participate (34 percent). Fortuitously, only 11 percent and 1 percent respectively of enrollment in California institutions attend these institutions. Finally, the last column reports participation rates weighted by the number of California financial aid applicants listing the institution on their federal financial aid form. The

participation rate is even higher, 91 percent and is considerably higher for private 4-year and private 2-year institutions. Apparently, the more selective institutions– with the largest number of applications relative to enrollment-- are more likely to participate.

Out of 332,322 applicants for first-year grants over the two years 1998 and 1999, we selected a sample of 150,413 applicants using the following criteria: we took all of those with high school GPA's between 2.50 and 3.60, all those with incomes within $1500 of the maximum income limits or with assets within $2000 of the asset limits. We also identified a random sample of roughly 5,100 students drawn from the remainder of the GPA, family income and asset distributions.

We asked the California Student Aid Commission to submit to the National Student Clearinghouse the names, social security numbers and dates of birth of the sample of 150,413 students to verify enrollment. In order to protect the confidentiality of students, we had no direct access to the students' identities. The National Student Loan Clearinghouse matched the student's personal data with their enrollment files and identified up to 11 institutions the sample members were observed attending. The California Student Aid Commission then stripped the students' name, street address and Social Security number before providing us with an analysis file with the enrollment data and all of the data available on the financial aid form. In addition to high school GPA, the file contains a rich array of potential control variables– parental education, detailed income information, detailed asset information, family size and number of other family members in college.

The empirical strategy in this paper will be to explore any discontinuities in college enrollment rates corresponding discontinuities in the eligibility rules-- using the GPA and family

income thresholds employed by the Cal Grant A program. Given our choice of sampling frame, any estimates will be applicable only to those financial aid applicants with GPA's or family income in the neighborhood of the thresholds. To the extent that the availability of aid may have an effect on the decision by youth and their families to submit a federal financial aid form, we may be understating the impacts for the combined pool of applicants and non-applicants. Moreover, to the extent that the impacts differ for those with GPA's or incomes away from the margins we are studying, the local average treatment effects we are estimating may not be generalizable.

As noted above, not every institution considered by CA financial aid applicants chose to participate in the National Student Clearinghouse data-base. In particular, non-collegiate proprietary institutions and private 2-year and 4-year colleges were less likely to participate. To the extent that receipt of a Cal Grant may lead students to be more likely to attend one of the schools in the database, we may overstate the impact of the program on enrollment rates overall. Alternatively, to the extent that Cal Grant recipients are more likely to attend schools that are not in the database, we may understate the impacts. The net effect is ambiguous *a priori*. In order to estimate the direction of this bias, we estimate the impacts for the full sample as well as for a subsample for which we are more confident that the NSC data are complete. On the federal financial aid form, students list up to 6 postsecondary institutions where they would like to have their financial aid information sent. (Only 16 percent of the sample filled out all 6 fields. The remainder of applicants listed less than 6 schools to which they were applying.) In the results below, we also report results for the sample for whom all of the schools listed on the FAFSA (up to 6 schools are listed) are also included in the NSC database.

We limit the analysis to (1) dependent students, (2) who were 17 to 20 in the year of their application and (3) had not attended any institution prior to June of the year in which they were applying. Moreover, we focus on the sample with GPA's from 2.50 to 3.60– in the neighborhood of the GPA thresholds for GPA eligibility. These restrictions reduce the sample to 80,125. Of these students, slightly less than half had full coverage of the institutions they listed on their FAFSA in the NSLC. Even with the likelihood that any one institution participated in the sample was roughly 90 percent, a large share of the sample listed at least one institution among the 6 that they listed on the FAFSA. Table 3 reports the mean characteristics of the whole sample, as well as for the subsample with full NSC coverage. Average incomes were slightly higher for the sample with full NSC coverage – $51,845 versus $47,878 for those without full coverage. Moreover, parental education was also slightly higher for the subsample with full NSC coverage. As a result, we will report the impacts both for the subsample with full NSC coverage as well as for the full sample.

Table 4 reports the proportion of students meeting the eligibility requirements receiving Cal Grants. Between 82 and 90 percent of those who were estimated to be eligible for an award received funding from the Cal Grant program if they decided to enroll in college. The remainder may have enrolled in college less than half time, enrolled in an institution that was not eligible to participate in the program (such as an out-of-state college) or may have been subsequently identified to have been ineligible.

V. Using Discontinuities in GPA

Table 5 reports the proportion of students entering college by eligibility category (financially eligible for A or B, financially eligible for A only and financially ineligible for both), by high school GPA category and by year. The top panel of results apply to 1998, when the threshold was 3.15. Among those who were financially eligible for Cal Grant A, those with GPA's between 3.15 and 3.17 were roughly 8 percentage points more likely to enter college in the subsequent year than those with GPA's between 3.12 and 3.14. By comparison, among those who were financially ineligible for both programs, those with the slightly higher GPA's were .3 percentage points less likely to enroll. The difference-in-the-difference, reported in the last column of Table 5, would imply an 8.8 percentage point impact on college-going. (The difference is statistically significant only at the .10 level and not at the .05 level.)

In 1999, the GPA threshold for Cal Grant A eligibility was 3.09. Again, the point estimates suggest a larger jump in college enrollment rates at the threshold for those who were financially eligible for a Cal Grant A than for those who were financially eligible for neither (as reported in the difference-in-difference column, the difference was .061 points larger), but this difference was not statistically significant at the traditional levels. The estimates in Table 5 do not point to any large impacts of being eligible for a Cal Grant A among those who were sufficiently poor to qualify for a Cal Grant B.

Table 5 also allows one to study the effect of being above and below the 1998 threshold in 1999 and vice versa-- the off-year effects of being above each year's threshold. If the differences noted above reflect program impacts, then we would not expect to see any apparent differences-in-differences for the various groups at the thresholds in the off years. In fact, none

of the point estimates of off-year differences are large or statistically significant.

Table 6 reports the marginal impact of having a GPA at or above the Cal Grant threshold in 1998 and 1999, after including a cubic polynomial in GPA (the results are generally not sensitive to the choice of polynomials as will be shown below). The results are reported for 1998 and 1999 separately, with and without including other covariates (other than the polynomial in GPA), for the full sample and for the subsample of applicants for whom all their college choices were included in the NSC database, and for the three eligibility categories.

There are five findings worth noting in Table 6: First, the results suggest statistically significant increases in college enrollment at the GPA thresholds in 1998 for those who were financially eligible for the Cal Grant A, as well as for those who were eligible for either the Cal Grant A or Cal Grant B. For the subsample with full NSC coverage of their college choices, the difference was roughly 6 percentage points for those financially eligible for only the Cal Grant A and 8 percentage points for those who were sufficiently poor to qualify for the Cal Grant B as well. (As will be shown below, the latter finding is somewhat sensitive to the choice of GPA threshold.) Second, among those who were financially ineligible for both programs, there was no difference in college enrollment at the threshold in any of the specifications. Third, in 1998, the point estimates are larger for the subsample of youth with full NSC coverage of the institutions they list on their applicants than for the full sample.

Fourth, in none of the specifications did the addition of covariates lead to substantive changes in the results. It is worth noting that the regressors include family background measures such as parental education and a dummy variable indicating whether there were other family members attending college. In other words, the dummy indicator for being above the

GPA threshold is not picking up some specification error which would also be correlated with parental education or with having other family members in college.

Finally, the impacts which were statistically significant in 1998 were generally not statistically significant in 1999. We are currently investigating whether there is some plausible reason for the lack of apparent impacts in 1999. For example, we are concerned about whether the GPA threshold was gradually lowered from 3.15 to 3.09, with different waves of students being notified of their eligibility at different times. As illustrated below, we do find evidence of discontinuities at other thresholds, such as the income threshold, for those eligible for Cal Grant A's in 1999.

Figures 3 and 4 summarize graphically the results from specifications (1), (3) and (5) for the subsample with full NSC coverage as well as for the full sample. The solid line in each of the graphs represents the predicted enrollment rates implied by the probit specifications. We divided the sample into groups in categories of three-one-hundredths of a GPA point. The dotted line represents the actual enrollment rates for these groups of students.

As with many regression-discontinuity evaluations, the above specifications simply tested whether there was a statistically significant discontinuity in enrollment rates at the thresholds that were implemented in program rules. However, in order to rule out spurious relationships generated by mis-specification, it is also important to ask whether such a threshold "fits" the data better than other nearby thresholds. In other words, we would like to estimate the optimal location of any break in the relationship, not simply ask whether one could identify a break where the program rules suggest one would expect to find one.

To do so, we re-estimated the probit specifications in columns (2) and (4) for the full sample in 1998, using a range of different GPA thresholds, between 3.00 and 3.25 at intervals of .01. The log likelihoods are reported in Figure 3. For those who were financially eligible for the Cal Grant A, there is a clear "spike" in the log likelihood at 3.15, which corresponds with the eligibility threshold used in that year. Since Figure 3 is reported as the difference in log likelihood relative to the maximum, the horizontal lines drawn at -1.35 and at -1.90 allow one to calculate the 90 and 95 percent confidence interval around the optimal choice of threshold.[7] For those who were financially eligible for a Cal Grant A, the 90 percent confidence interval for the spike would include 3.15 and 3.16. The 95 percent confidence interval would include 3.14 through 3.17. In contrast, 3.15 is only a local optimum for those who were financially eligible for both A and B. The data would actually prefer most a break point at 3.18, with a confidence interval from 3.14 through 3.20. As a result, the results for latter group should be treated with some caution.

Table 7 explores the use of alternative specifications of the polynomial in GPA. We only report the results for those financially eligible for either type of Cal Grant and those financially eligible for a Cal Grant A in 1998. The specifications start with a quadratic in GPA and include successively higher order polynomials. The effect of crossing the GPA threshold is not generally statistically significant for the quadratic specifications. However, the results in columns (2) through (5) indicate that the results are quite robust to the inclusion of cubic and

[7]The likelihood ratio test would require us to multiply the difference by 2. Since the critical value for a χ^2 distribution with 1 degree of freedom is 2.71 and 3.84 at the .10 and .05 level respectively, the 90 and 95 percent confidence intervals would include estimates with differences less than 1.35 and 1.92 respectively.

higher order polynomials in GPA.

Table 8 explores subgroup impacts in 1998 for those who were financially eligible for the Cal Grant B and those who were financially eligible for only the Cal Grant A. The table reports threshold impacts, from specifications estimated separately by whether or not the family reported any financial assets (home equity is not included), whether there were other family members enrolled in college, parental education and gender. The only statistically significant difference was for those with other family members in college. Among those who were financially eligible for the Cal Grant A, receiving a Cal Grant A had a larger impact for those who had other family members in college. On the one hand, one might expect those with other family members in college to have stronger preferences for schooling and lower price elasticities. On the other hand, those with other family members in college may be more liquidity constrained. The results suggest that the latter effect may dominate.

VI. Using Discontinuities in Income

The preceding analysis relied upon the discontinuities in the high school GPA requirements for identification. One advantage of the high school GPA requirement is that the thresholds were unknown at the time of application. However, there are other thresholds in the formula– specific income limits, for instance– which could be used for identification, as long as parents and students are only vaguely aware of where those thresholds lie. Because the income information is supposed to be drawn from parent's 1040 tax forms, it is not we are concerned that families misrepresent their income on the form, but that those who meet the income threshold are simply more likely to apply.

One test of the precision of people's awareness of the thresholds is to study the distribution of income around the thresholds and look for any spikes in the distribution near the thresholds. Unfortunately, the program thresholds often correspond with round numbers (for example, the income limit for a family of size 4 was $59,000 in 1999) and, looking at one year alone, it is impossible to distinguish strategic responses from simple rounding by respondents. Fortunately, the thresholds change from year to year, so it is possible to investigate whether changes in the thresholds correspond with changes in the pattern of reporting. The program imposes separate income thresholds for families of different sizes-- for families of 3 or fewer, 4, 5 or 6 and more. In 1998, the thresholds were $53,100, $57,500, $61,900 and $67,000 respectively;in 1999, the thresholds were $54,500, $59,000, $63,500 and $68,700. Figure 6 reports the distribution of family income in the range from $40,000 to $80,000 for dependent students who are both GPA and asset eligible for a Cal Grant A. Although there does appear to be some clumping in the distribution of income-- potentially due to rounding-- the nature of the bunching of responses does not appear to be sensitive to changes in the income thresholds from year to year.

Table 9 reports the marginal impacts on the likelihood of enrolling in college of having income above the threshold for eligibility for a Cal Grant A. As above, the estimates are reported for the subsample with full NSC coverage as well as for the full sample. Moreover, the estimates are reported separately for those who meet both the asset and GPA test for eligibility and for those that fail to meet one of those eligibility criteria. If any difference in college enrollment is due to Cal Grant eligibility, then there should be no discontinuity at the income threshold for those who fail to meet one of the other eligibility criteria.

When pooling the data for 1998 and 1999, among those meeting both the asset and GPA tests, those who had incomes immediately above the thresholds were nearly 6 percentage points less likely to enroll in college in the subsequent year. Column (2) provides a specification test by testing the same relationship for those failing one of the other criteria. There is no apparent effect of the income threshold for those failing one of the other eligibility criteria.

Figures 7 and 8 summarize the results from specifications (1) and (2) in Table 9. We calculated mean enrollment rates in $3000 intervals according to their distance from the income thresholds. (Because different family sizes use different thresholds, we first took the difference from the respective threshold and include dummies for family size in each specification.) The figures also contain plots of "predicted" enrollment rates. (Note that because the equations included other regressors, the predicted line is not a "smooth" function of income differences alone.)

Columns (3) through (6) of Table 9 report the impacts for 1998 and 1999 respectively. Recall that we did not find a statistically significant discontinuity at the GPA threshold for the Cal Grant A program in 1999. However, when studying enrollment rates above and below the income threshold, the results in 1998 and 1999 seem to be more consistent, with a 6 percentage point drop in enrollment for the GPA and asset eligible sample for those just above the threshold.

As we did with the GPA eligibility rules, we also compared the use of alternative income thresholds. We re-estimated the probit specifications in Table 9, trying alternative thresholds in $1000 intervals from $20,000 below the actual threshold to $20,000 above the actual threshold. We did so for those who were GPA and asset eligible (for whom we might have expected a discontinuity) as well as for those who were either GPA or asset ineligible (for whom there

should have been no discontinuity in enrollment rates at the income threshold). The results are reported in Figure 9. For the potentially eligible group, the data strongly prefer a threshold in the neighborhood of 0, although the most preferred threshold is actually $2000 below the actual threshold. For those who were ineligible for due to their GPA or assets, there is no apparent threshold in the near zero.

VII. Conclusion

Given the size of the public investment devoted to subsidizing the price of higher education, the quality of the evidence on the impact of price subsidies has been surprisingly weak. The evidence on the impact of means-tested grant programs has been particularly ambiguous**.** There was no disproportionate rise in enrollment by low-income youth following the establishment of the Pell Grant program in the mid-Seventies (Hansen (1983) and Kane(1994)). Beyond the magnitude of public dollars at stake, there is another reason to redouble efforts to estimate the impact of means-tested financial aid programs. Since the labor market payoff to college began rising in the late Seventies, college enrollment rates have risen substantially. In 1980, 25 percent of 18-24 year-olds were enrolled in college. By October 2000, 36 percent of 18-24 year-olds were enrolled in college. As college enrollment rates have risen, so too has the cost of broad-based subsidies to keep tuition low at public institutions. Although broad-based subsidies have the advantage of transparency and do not impose additional taxes on income and savings such as those implicit in means-tested financial aid formulae (Feldstein(1995), Dick and Edlin (1997)), they are also harder to sustain as an increasingly large fraction of the population takes the government up on its generous offer.

Moreover, the size of the college-age cohorts, which declined in size by nearly 20 percent between 1980 and 1995 has turned around and is expected to rise by roughly the same amount in the coming 10 years.

The most consistent evidence of price impacts has been drawn from programs that operate outside the federal need analysis system-- such as tuition policy, or the Hope Scholarship program in Georgia or the termination of tuition benefits for Social Security survivors. Given the complexities of the financial aid programs, one hypothesis to account for the failure to find an effect of means-tested programs is that students only learn about the amount of means-tested aid available to them quite late in the process– after they have submitted their financial aid forms and college applications. If the financial aid process is sufficiently opaque, perhaps only those who are committed to going to college expend the effort to find out how much grant aid they may receive. The above results are intended to identify the impact of additional dollars on students' enrollment decisions, among those who have already gone through the process of applying for college and financial aid.

Perhaps contrary to expectations, the results suggest that additional financial aid dollars have a large impact on students' decisions even when provided late in the process. Financial aid applicants were 4 to 6 percentage points more likely to enroll in college as a result of the receipt of a Cal Grant A award, even after they have already made the investment of filing a federal financial aid form and applied to college. In future work with these data, we hope to study the effect on eventual college enrollment rates– not just focusing on enrollment in the one year following application. Moreover, we hope to learn more about the impact of aid availability on the choice of different types of colleges and on the length of time students remain in college.

With the addition of Social Security earnings records, the study would provide a means for estimating the effect of educational attainment on earnings for those who were on the margin of deciding whether or not to go to college.

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Table 1. Estimated Impact of a $1000 Change in Direct Cost of College on College Entry Rates College (per $1000 2001)

Study:	Estimate:	Brief Description:
Literature Before 1987:		
Leslie and Brinkman (1987)	-.04 (.004)	Literature review of 25 articles
Based on Between-State Differences in Tuition:		
Cameron and Heckman (1999)	-.06 (.02)	State differences in public tuition charges. (NLSY)
Kane (1994)	-.04 (.01)	State differences in public tuition charges. (October CPS)
Kane (1999)	-.04 (.01)	State differences in public tuition charges. (NELS)
Based On Non-Traditional Financial Aid:		
Dynarski (1999)	-.04 (.02)	End of Social Security Student Benefit Program
Dynarski (2000)	-.03 (.02)	Hope Scholarship Program in Georgia
Before-After the Pell Program was Established in 1973:		
Hansen (1983)		No disproportionate growth by low-income. (Oct. CPS)
Kane (1994)		No disproportionate growth by low-income. (Oct. CPS)
Manski (1993)		No disproportionate growth in BA Completion by Low-Income (NLS-72 and HSB)

Table 2..
Participation Rates in the National Student Clearinghouse

	% of CA Students Attending	National Unweighted	National Weighted by Enrollment	California Weighted by Enrollment	National Weighted by California FAFSA Applicants
Public 4-Year	25.3	.227	.864	.947	.953
Private 4-Year	10.9	.389	.770	.783	.843
Public 2-Year	62.6	.599	.766	.892	.879
Private 2-Year	1.1	.211	.375	.335	.902
Total:	100.0	.552	.804	.888	.908

Note: The percentage of CA students attending each type of institution was calculated using the proportion of college students attending each type of institution in CA.

Table 3. Characteristics by Extent of NSC Coverage of FAFSA Colleges

(Standard Deviations in Parentheses for Continuous Var.)	Full Sample	Full NSC Coverage	Incomplete NSC Coverage
Percent of Full Sample	100	45	55
Prop. Receiving a Cal Grant A	.163	.171	.156
Prop. Receiving a Cal Grant B	.190	.173	.204
Dependent Family Income	$49,674 (47,159)	$51,845 (46,454)	$47,878 (47,661)
Family Size	4.34 (1.51)	4.31 (1.47)	4.36 (1.53)
Prop. w/ Oth Fam Memb in Coll	.342	.356	.332
Prop. with GPA$3.09	.563	.593	.539
GPA	3.13 (.31)	3.15 (.30)	3.11 (.31)
Assets>0	.630	.666	.600
Net Worth if >0 (Excludes Housing)	$46,170 (149,119)	$45,740 (139,590)	$46,565 (157,365)
Mother's Highest: #Jr. High	.143	.119	.162
High School	.369	.366	.371
College	.394	.422	.361
Unknown	.095	.092	.096
Father's Highest: #Jr. High	.132	.110	.151
High School	.327	.327	.328
College	.417	.448	.391
Unknown	.124	.115	.131
Sample Size	80,125	36,271	43,854

Note: Estimated for those who were dependents, with no prior college enrollment spells, aged 18 to 20 and with GPA's in the 100 percent sampling range-- 2.50 to 3.60.

Table 4. Proportion of Eligible Students Receiving Awards

	Financially Elig for A or B	Financially Elig for A Only	Financially Ineligible
With 2.50#GPA#Threshold			
P(Enrolling in College)	.702	.743	.771
P(Cal Grant A or B|Enrolling in College)	.844	.000	.000
P(Cal Grant A|Enrolling in College)	.000	.000	.000
P(Cal Grant B|Enrolling in College)	.844	.000	.000
With Threshold#GPA#3.60			
P(Enrolling in College)	.774	.825	.826
P(Cal Grant A or B|Enrolling in College)	.906	.824	.000
P(Cal Grant A|Enrolling in College)	.077	.824	.000
P(Cal Grant B|Enrolling in College)	.829	.000	.000

Note: The above were estimated for dependent students, aged 17-20, with full NSC coverage.

Table 5. Difference-in-Difference Estimates of the Impact of Cal Grant Eligibility on College Enrollment

1998: GPA Threshold of 3.15

GPA Range	Fin. Eligible for A or B (1)	Fin. Eligible for A Only (2)	Fin. Eligible for Neither (3)	Difference-in-Difference	
				Incremental Effect of A Above B (1)-(3)	Incremental Effect of A Only (2)-(3)
3.06-3.08	.655 (.044)	.713 (.028)	.750 (.027)		
3.09-3.11	.640 (.037)	.714 (.026)	.761 (.025)	-.026 (.079)	-.010 (.053)
3.12-3.14	.665 (.036)	.679 (.024)	.718 (.025)		
3.15-3.17	.613 (.039)	.764 (.023)	.715 (.024)	-.049 (.063)	.088 (.048)

1999: GPA Threshold of 3.09

GPA Range	Fin. Eligible for A or B (1)	Fin. Eligible for A Only (2)	Fin. Eligible for Neither (3)	Difference-in-Difference	
				Incremental Effect of A Above B (1)-(3)	Incremental Effect of A Only (2)-(3)
3.06-3.08	.735 (.035)	.668 (.031)	.780 (.027)		
3.09-3.11	.740 (.033)	.731 (.025)	.782 (.025)	.003 (.060)	.061 (.054)
3.12-3.14	.703 (.030)	.726 (.025)	.745 (.022)		
3.15-3.17	.686 (.033)	.758 (.023)	.744 (.025)	-.016 (.055)	.033 (.048)

Note: Estimated for dependent applicants, aged 17 to 20, for the subsample with full NSC coverage.

Table 6. Marginal Impacts of Crossing Calgrant GPA Threshold on College Going in the Subsequent Year

	Fin. Eligible for A Only		Fin. Eligible for B or A		Fin. Eligible for Neither	
	(1)	(2)	(3)	(4)	(5)	(6)
	1998: Subsample with Full NSC Coverage					
GPA$315	.064	.066	.076	.080	.000	-.001
	(.023)	(.023)	(.039)	(.039)	(.023)	(.023)
Sample Size	6,902		2,956		7,016	
	1998: Full Sample					
GPA$315	.041	.042	.043	.042	-.004	-.005
	(.018)	(.018)	(.026)	(.026)	(.018)	(.018)
Sample Size	15,552		8,707		15,038	
	1999: Subsample with Full NSC Coverage					
GPA$309	.014	.014	.035	.034	.004	.006
	(.025)	(.025)	(.033)	(.033)	(.024)	(.024)
Sample Size	7,186		4,716		7,495	
	1999: Full Sample					
GPA$309	.015	.016	-.012	-.013	.011	.012
	(.019)	(.019)	(.024)	(.024)	(.019)	(.019)
Sample Size	15,537		10,572		14,719	
Order of Polynomial in GPA?	3	3	3	3	3	3
Covariates Included?	No	Yes	No	Yes	No	Yes

Note: The sample was limited to dependent students, aged 17-20, who had not been enrolled in college previously. The above represent marginal impacts on probability of college enrollment in year following Cal Grant application, evaluated at the mean characteristics of those in the sample. All specifications also included GPA, GPA^2, GPA^3. Other covariates included an indicator of whether there were others in the household planning to be in college, dummies for family size, mother's education, father's education, an indicator of whether the family had zero assets and family income for dependent students.

Table 7.
Varying the Order of the Polynomial in GPA

	(1)	(2)	(3)	(4)	(5)
	Financially Eligible for A Only				
	1998: Subsample with Full NSC Coverage				
GPA$315	.023	.080	.080	.060	.062
	(.032)	(.039)	(.040)	(.042)	(.042)
Sample Size	2,956				
	1998: Full Sample				
GPA$315	.019	.042	.043	.049	.048
	(.021)	(.026)	(.027)	(.029)	(.028)
Sample Size	8,707				
	Financially Eligible for A or B				
	1998: Subsample with Full NSC Coverage				
GPA$315	.055	.066	.065	.050	.052
	(.019)	(.023)	(.023)	(.025)	(.025)
Sample Size	6,902				
	1998: Full Sample				
GPA$315	.019	.042	.043	.038	.039
	(.015)	(.018)	(.018)	(.020)	(.020)
Sample Size	15,552				
Order of Polynomial in GPA?	2	3	4	5	6
Covariates Included?	Yes	Yes	Yes	Yes	Yes

Note: The sample was limited to dependent students, aged 17-20, who had not been enrolled in college previously. The above represent marginal impacts on the probability of college enrollment in year following Cal Grant application, evaluated at the mean characteristics of those in the sample. Other covariates included an indicator of whether there were others in the household planning to be in college, dummies for family size, mother's education, father's education, an indicator of whether the family had zero assets and family income for dependent students.

Table 8. Subgroup Impacts

	Financially Eligible for B or A			Financially Eligible for A Only		
	(1)	(2)	Diff.	(3)	(4)	Diff.
	Zero Assets	Assets>0		Zero Assets	Assets>0	
GPA$315	.082 (.046)	.063 (.077)	.019 (.089)	.083 (.040)	.057 (.028)	.026 (.049)
	Other Fam In College	No Other Fam in Coll		Other Fam In College	No Other Fam in Coll	
GPA$315	.084 (.048)	.062 (.069)	.022 (.084)	.128 (.039)	.033 (.029)	.095 (.048)
	No Coll Educ Parents	2 Coll Educ Parents		No Coll Educ Parents	2 Coll Educ Parents	
GPA$315	.070 (.043)	.122 (.235)	-.052 (.239)	.052 (.037)	.038 (.039)	.024 (.054)
	Females	Males		Females	Males	
GPA$315	.012 (.058)	.110 (.077)	-.098 (.096)	.029 (.034)	.088 (.038)	-.059 (.051)

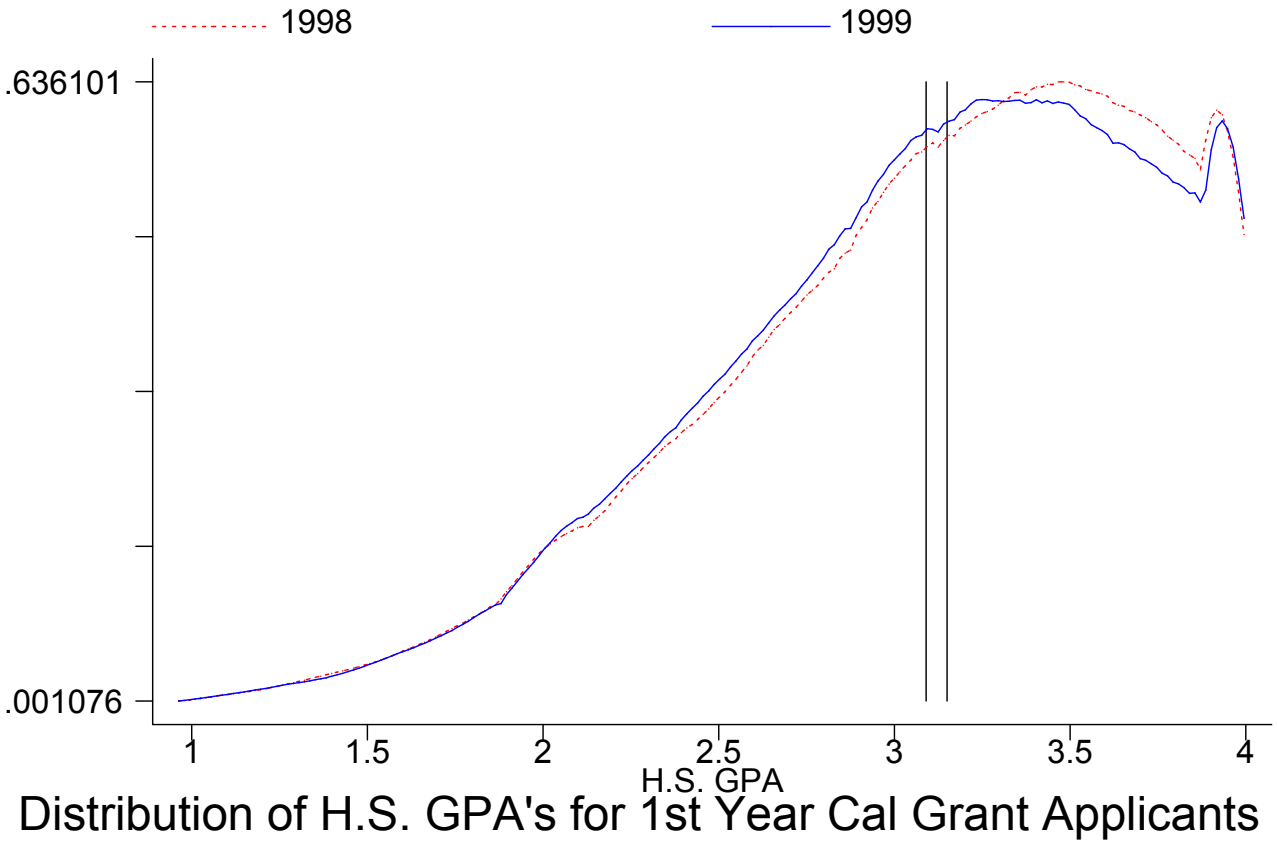
Note: Each of the specifications above were estimated separately, with a cubic in GPA and the other covariates described in Table 4. The sample was limited to dependent students, aged 17-20, who had not been enrolled in college previously. The above represent marginal impacts on probability of college enrollment in year following Cal Grant application, evaluated at the mean characteristics of those in the sample.

Table 9. Marginal Impacts of Crossing Cal Grant Income Threshold on College Going in the Subsequent Year

	Pooling 1998 and 1999		1998		1999	
	GPA& Asset Eligible	GPA or Asset Ineligible	GPA& Asset Eligible	GPA or Asset Ineligible	GPA& Asset Eligible	GPA or Asset Ineligible
	(1)	(2)	(3)	(4)	(5)	(6)
	Subsample with Full NSC Coverage					
Income Above Threshold	-.056	.026	-.055	-.005	-.058	.060
	(.023)	(.023)	(.032)	(.032)	(.032)	(.032)
Sample Size	8896	9288	4095	4681	4801	4607
	Full Sample					
Income Above Threshold	-.031	.019	-.035	-.017	-.028	.062
	(.018)	(.018)	(.027)	(.025)	(.025)	(.025)
Sample Size	17778	19882	8381	10470	9397	9412
Order of Polynomial in Income?	3	3	3	3	3	3
Covariates Included?	Yes	Yes	Yes	Yes	Yes	Yes

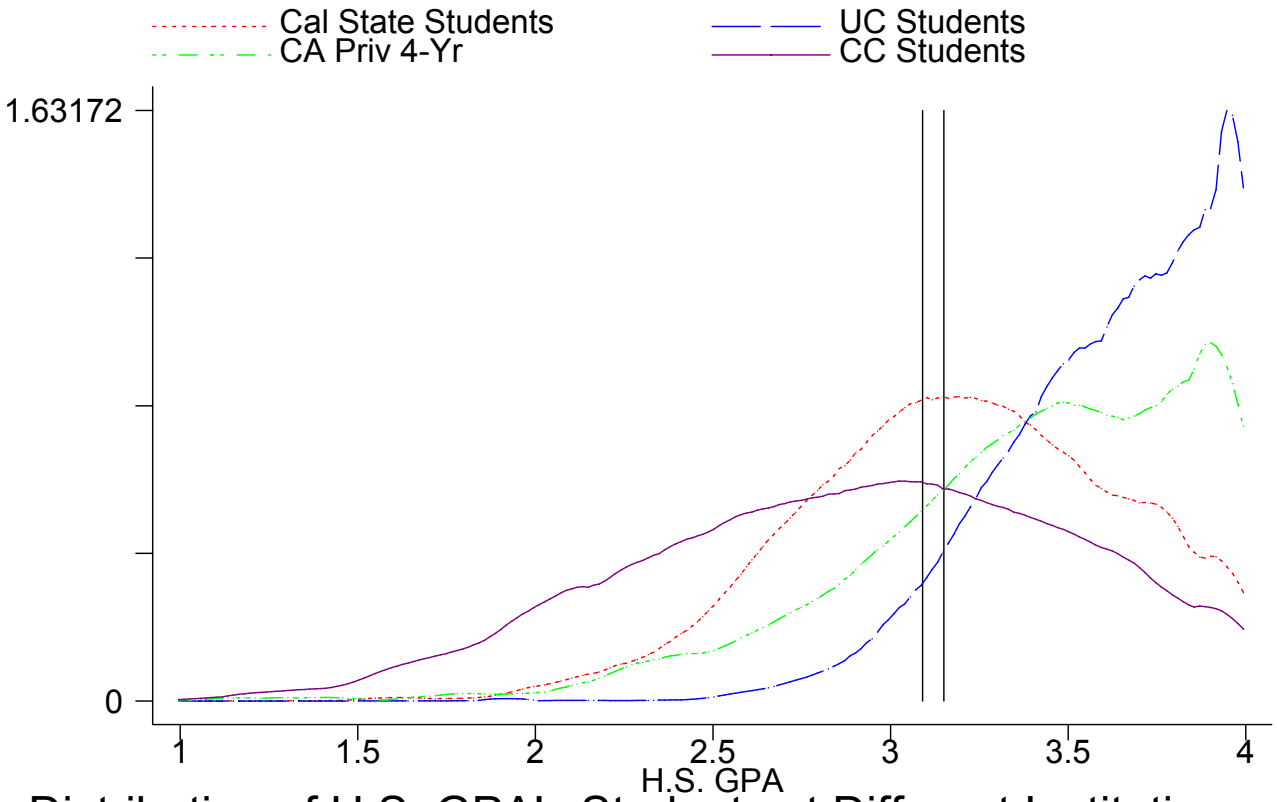
Note: The sample was limited to dependent students, aged 17-20, who had not been enrolled in college previously, who had GPA's between 2.50 and 3.60 and who had family income within $30,000 above or below the income threshold. The above represent marginal impacts on probability of college enrollment in year following Cal Grant application, evaluated at the mean characteristics of those in the sample. All specifications also included GPA, GPA^2, GPA^3. Other covariates included an indicator of whether there were others in the household planning to be in college, dummies for family size, mother's education, father's education, an indicator of whether the family had zero assets and family income for dependent students.

Figure 1.



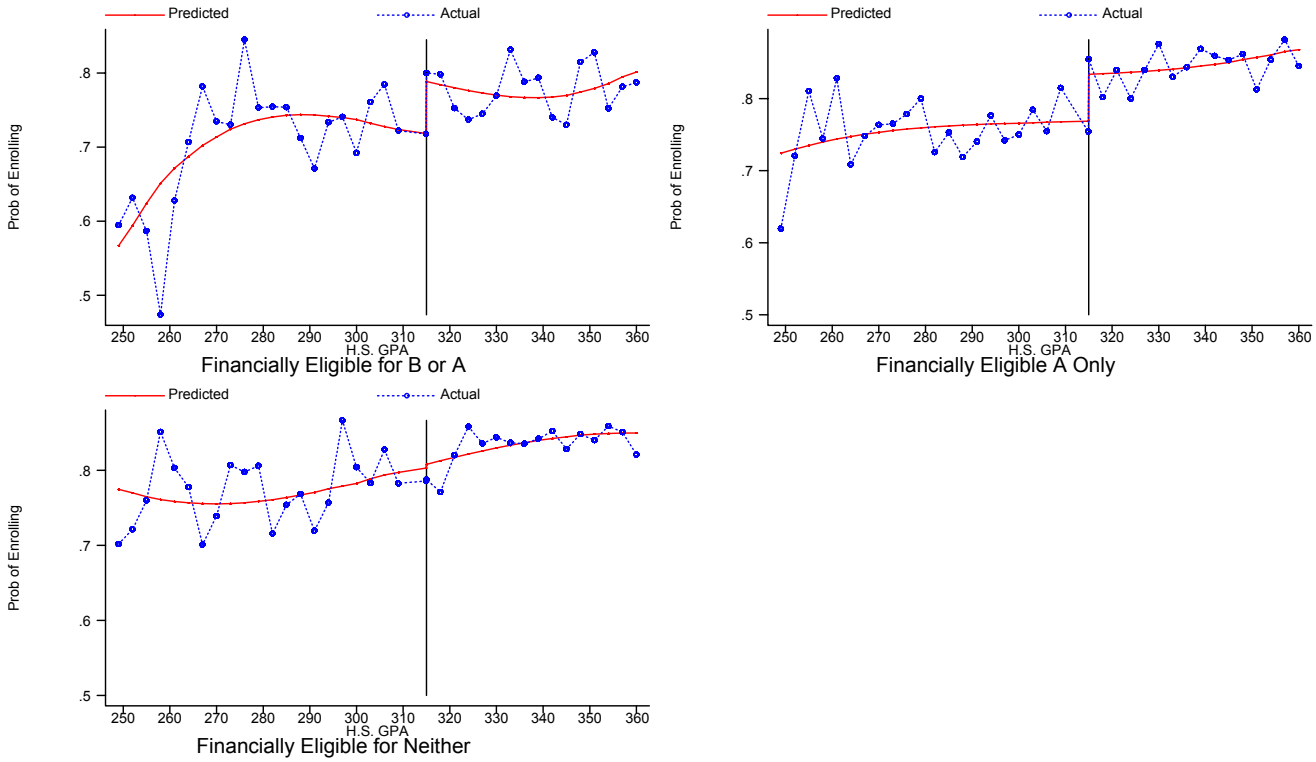
Distribution of H.S. GPA's for 1st Year Cal Grant Applicants

Figure 2.



Distribution of H.S. GPA's Students at Different Institutions

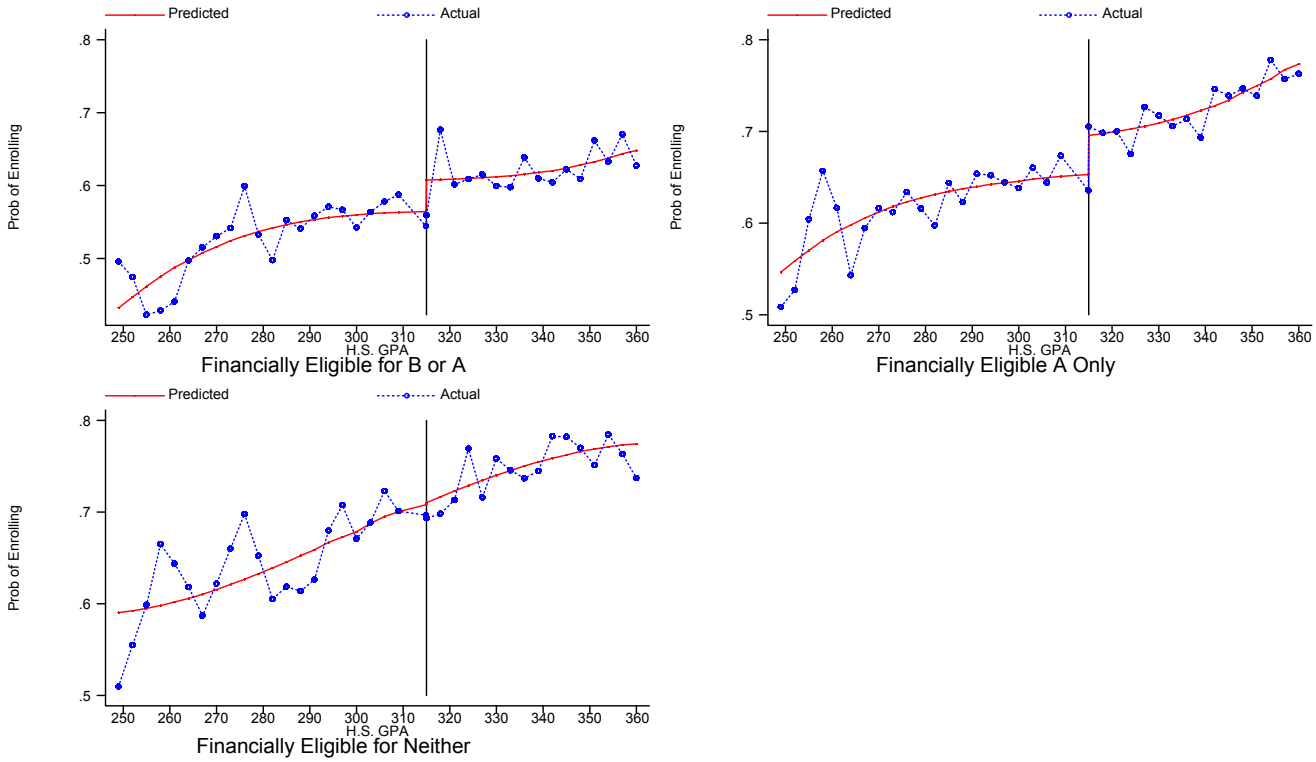
Figure 3.



Subsample with Full NSLC Coverage

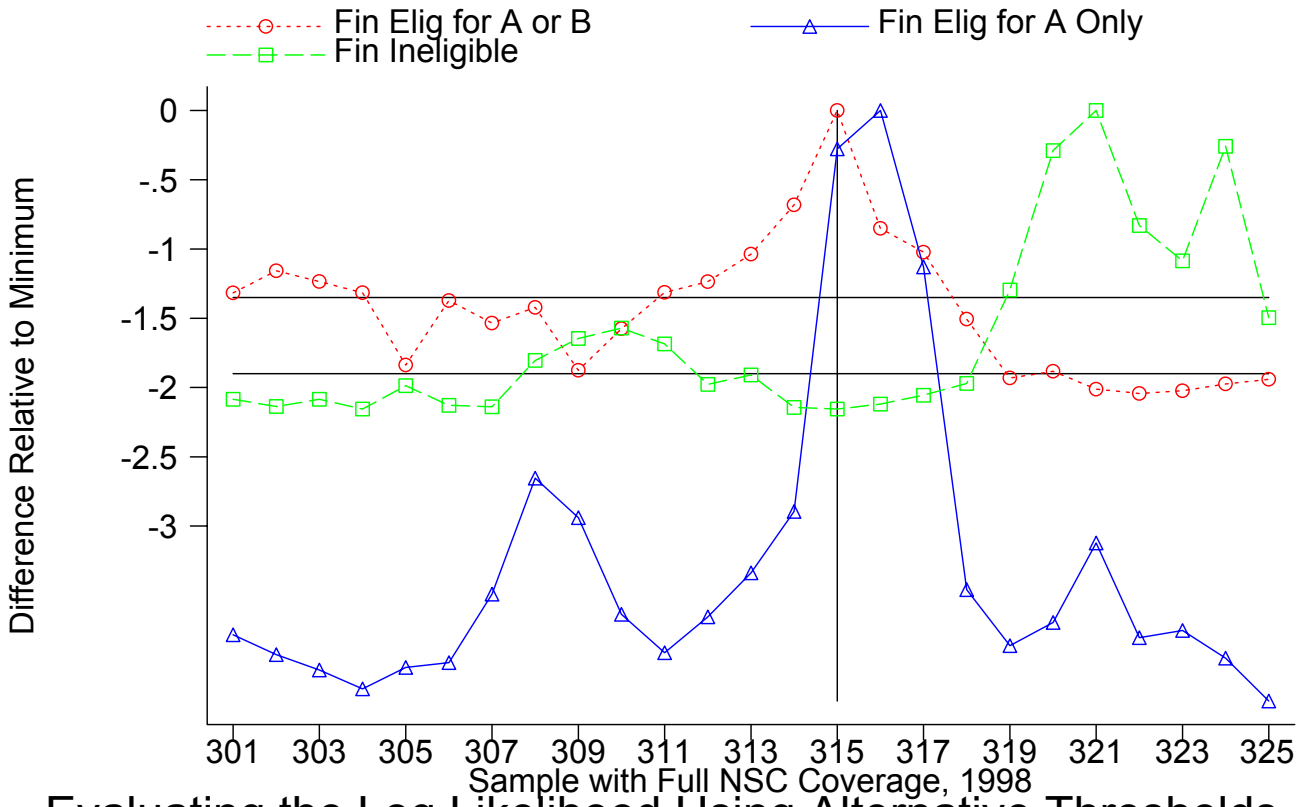
Regression Discontinuity Results for 1998

Figure 4.

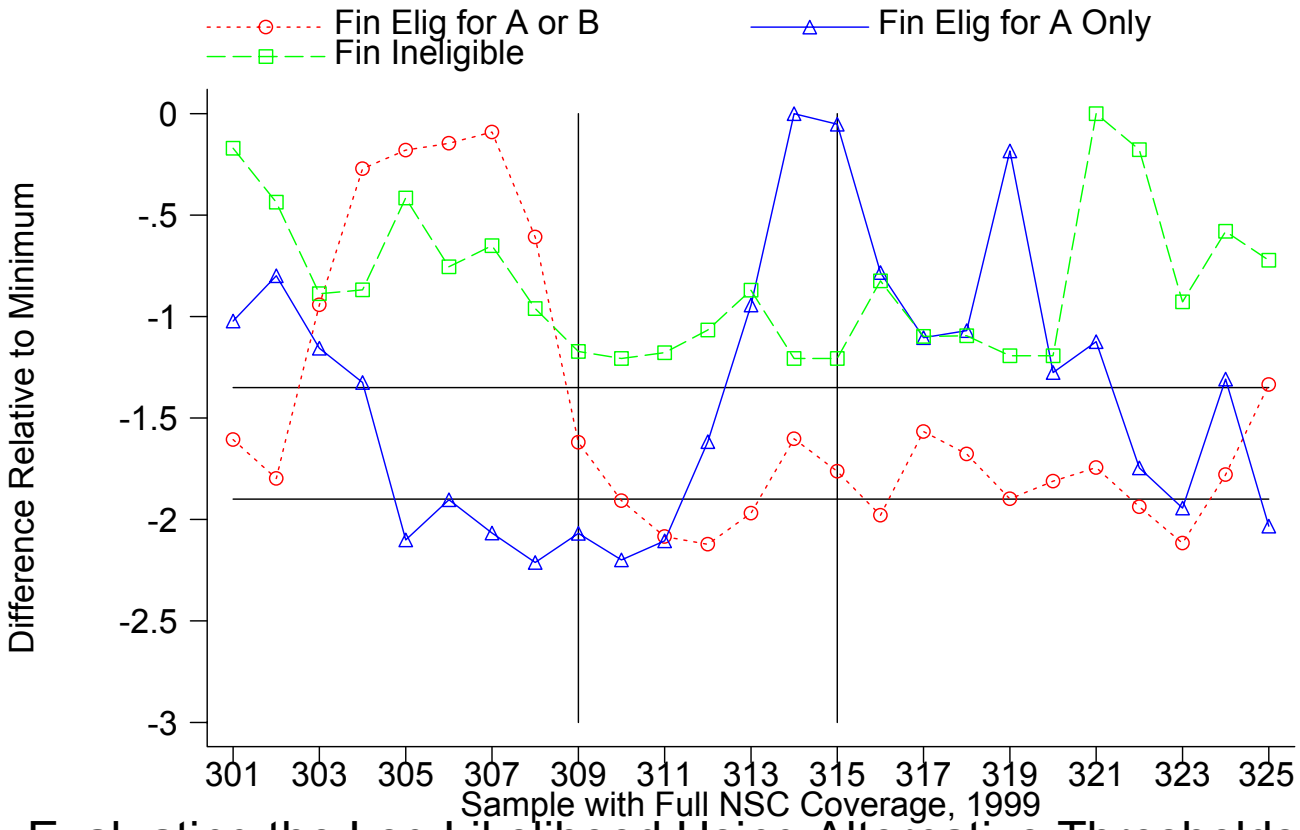


Full Sample

Regression Discontinuity Results for 1998

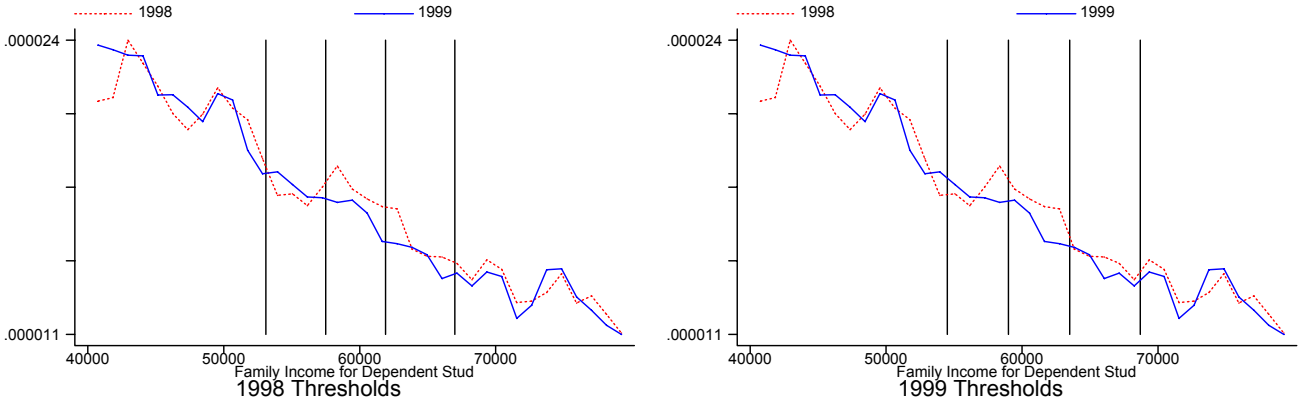


Evaluating the Log Likelihood Using Alternative Thresholds



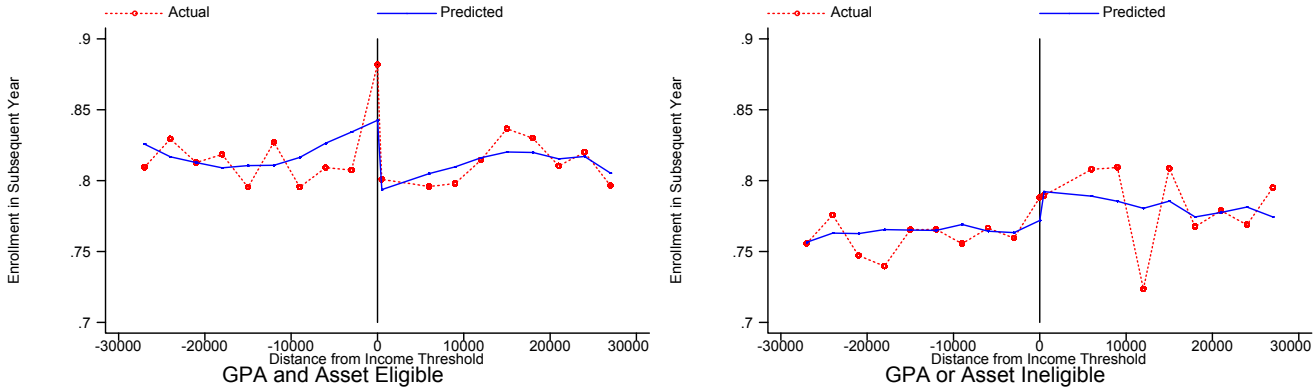
Evaluating the Log Likelihood Using Alternative Thresholds

Figure 6.



Income Distribution for GPA and Asset Elig Students

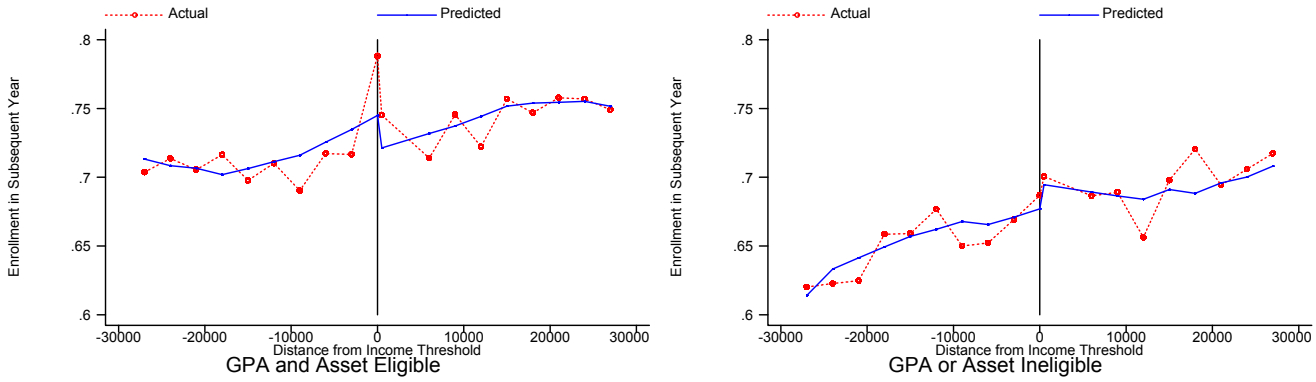
Figure 7.



Sample with Full NSC Coverage

Regression Discontinuity Results using Income Thresholds

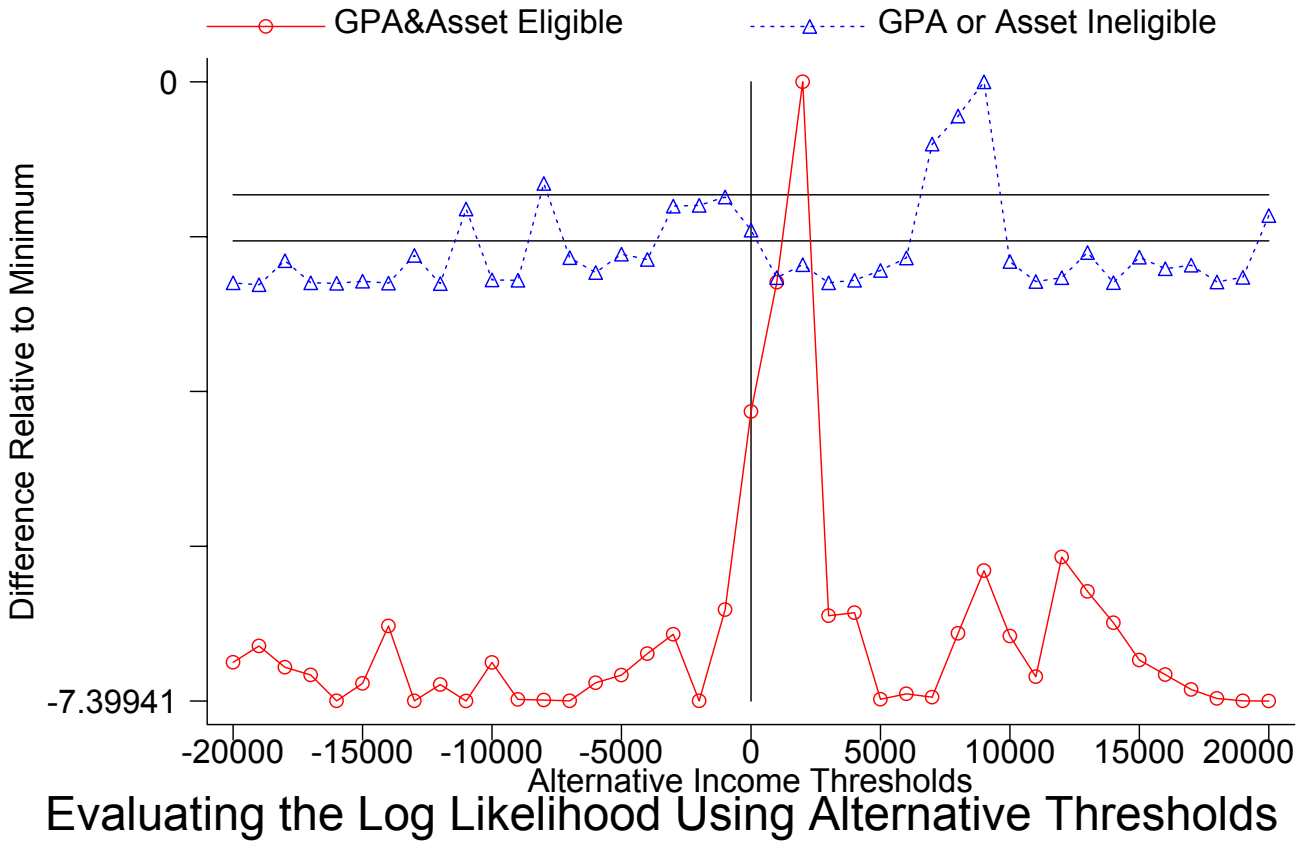
Figure 8.



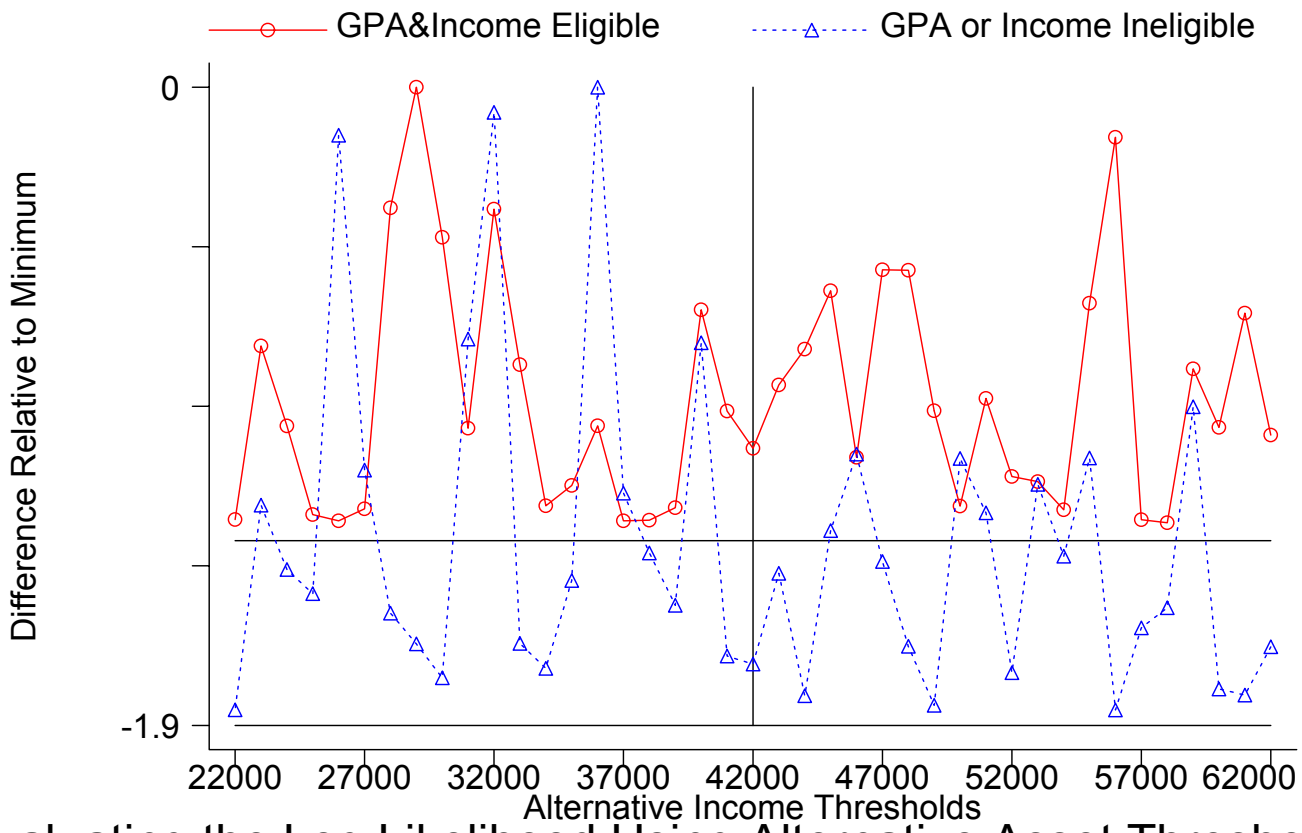
Full Sample

Regression Discontinuity Results using Income Thresholds

Figure 9.



Evaluating the Log Likelihood Using Alternative Thresholds



Evaluating the Log Likelihood Using Alternative Asset Thresholds