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MEASURING THE EFFECT OF STUDENT LOANS ON COLLEGE PERSISTENCE

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ABSTRACT

Governments around the world use grant and loan programs to ease the financial constraints that contribute to socioeconomic gaps in college completion. A growing body of research assesses the impact of grants; less is known about how loan programs affect persistence and degree completion. We use detailed administrative data from Chile to provide rigorous regression-discontinuity-based evidence on the impacts of loan eligibility for university students who retake the national admission test after their first year of studies. Those who score above a certain threshold become eligible for loans covering around 85% of tuition costs for the duration of their program. We find that access to loans increases the fraction who return to university for a second year by 20 percentage points, with two-thirds of the effect arising from a reduction in transfers to vocational colleges and one-third from a decline in the share who stop post-secondary schooling altogether. The longer-run impacts are smaller but remain highly significant, with a 12 percentage point impact on the fraction of marginally eligible retakers who complete a bachelor's degree.

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1 Introduction

In many countries, including the U.S., college completion rates are far below 100%. A growing body of work focuses on the effects of financial aid programs on persistence and degree attainment, exploiting discontinuities or changes in eligibility rules to identify the impacts of grant-based aid.[1] Much less is known about loan programs, even though loans are now the dominant source of college financing in the U.S. (Dynarski (2015)). In contrast to grant-based aid, which lowers the cost of post-secondary schooling, loans only shift these costs intertemporally. It is therefore unclear to what extent findings from the analysis of grant programs can inform our understanding of loan programs.

In this paper, we present new evidence on the impacts of eligibility for loans that cover up to 85% of tuition on the probability that students remain in university and ultimately obtain a degree.[2] A key problem for disentangling causal effects on persistence or re-enrollment behavior is that many of the students who are eligible for grants or loans in later years of their studies were eligible for the same (or similar) benefits prior to entering college. Eligible students may have been induced to enter college by the availability of these benefits, leading to selectivity biases in comparisons between eligible and ineligible enrollees. This concern closely parallels the one identified by Ham and Lalonde (1996) in studying the effects of training programs on post-training employment dynamics.

In their seminal studies of college persistence, DesJardins, Ahlburg, and McCall (2002) and Singell (2004) addressed these selection biases using model-based correction procedures.[3] In contrast, we use a design-based approach that focuses on first-year university students in Chile who initially enrolled without being eligible for a loan, and then ***retook*** the national university admission test (the Prueba de Selección Universitaria or PSU). Retakers with family incomes below the 80th percentile who achieve a minimum 475 point score on the PSU are eligible for loans covering up to about 85% of tuition costs for the remainder of their

[1] For example, Bettinger (2004) studies the effect of the Pell program, Dynarski (2003) studies the Social Security Student Benefit Program, Cornwell et al. (2006) study a scholarship program in Georgia, Cohodes and Goodman (2014) study a grant program in Massachusetts, Bettinger (2015) studies a change in the financial aid formula at Ohio colleges, Castleman and Long (2016) study an aid program in Florida, Denning, Marx, and Turner (2019) study a program in Texas, and Barr (2019) studies the impact of the post-911 G.I. Bill on veterans. Nguyen, Kramer, and Evans (2019) present a comprehensive meta-analysis of 43 studies of grant programs on student enrollment and degree attainment. Dynarski and Scott-Clayton (2013) present a broad overview of research on financial aid programs.

[2] For clarity throughout this paper, we refer to institutions that grant bachelor's degrees as "universities" and institutions that grant shorter vocationally-oriented degrees and certificates as "vocational colleges."

[3] DesJardins, Ahlburg, and McCall (2002) fit a stop-out hazard model with unobserved heterogeneity, while Singell (2004) estimates a two-equation model with one equation representing initial enrollment and the other representing re-enrollment.

studies.[4] This rule sets up a regression discontinuity design that allows us to credibly identify the impacts of loan eligibility on re-enrollment rates of retakers in their second and later years, and on ultimate degree recipiency. Conceptually, our approach is similar to Denning (2019), who studies the effect of reaching age 24 and being considered as financially independent on loan and grant amounts obtained by college seniors in Texas, though our retakers are entering their second year, rather than final year, of studies.

We implement this approach using a database that combines registry data for PSU test takers with administrative records from all higher-education institutions in the country and information on degree recipients. These data allow us to assess the validity of our regression discontinuity (RD) design and to track students between institutions, ensuring that we do not misclassify students who change institutions as dropouts.[5] They also allow us to identify whether students who leave the university system have withdrawn from post-secondary schooling altogether or moved to vocational colleges, where tuition costs are lower and loans are available to students based on high school GPA.[6] Recent work by Bucarey, Contreras, and Muñoz (2018) and Montoya, Noton, and Solís (2018) suggests that the main impact of loan eligibility for entering freshmen in Chile is to shift students from vocational colleges to universities. We study a similar cross-institutional substitution effect in re-enrollment behavior.

Our first main finding is that loan eligibility for PSU-retakers has a large positive impact on university re-enrollment rates in the second through fifth years after initial matriculation. Marginally-eligible retakers have a 21 percentage point lower rate of leaving university after their first year than marginally ineligible retakers, raising their persistence rate into the second year from 56% to 77%. These initial impacts fade somewhat in subsequent years but persist through the fifth year (the nominal duration of bachelor's programs in Chile), leading to a large and significant 12 percentage point impact on bachelor's degree recipiency. We show that these impacts are highly robust to specification issues such as bandwidth choice or the introduction of controls for covariates.

A second finding is that a key channel mediating the response to loans is a reduction in transfers to voca-

[4]University admissions in Chile are based on a combination of PSU scores and high school grades (see Solís (2017)). The 475 point cutoff is about 0.7 of a standard deviation below the mean score for all enrollees. As explained below, students who wish to retake the PSU and become eligible for loans must also submit a socioeconomic verification form and are assigned a family income quintile by the Chilean Tax Authority.

[5]This type of misclassification arises when enrollment status is based on records at a single institution, as in DesJardins, Ahlburg, and McCall (2002) and Singell (2004), or at a subset of institutions, as in recent studies based on state-wide data, including Bettinger (2004) and Goldrick-Rab et al. (2012).

[6]One of the programs that provides loans for university students also provides loans for students at vocational colleges, with eligibility based on either a minimum PSU score or a minimum high school GPA.

tional colleges. Among first-year students who are initially ineligible for loans, retake the PSU, and narrowly miss the 475 point cutoff, about one-quarter transfer to a vocational college in their second year. Scoring just above the threshold cuts this rate in half, accounting for about two-thirds of the overall reduction in dropout rates from university between the first and second years. In the longer term, we find that marginally eligible retakers are less likely to attain a vocational degree or certificate than marginally ineligible retakers, but more likely to obtain some form of post-secondary degree.

A third finding is that once students have access to loans, a switch to grant-based aid has little or no additional impact on persistence. We study the marginal impact of the "Beca Bicentenario" (Bicentennial Bursary, [BB hereafter]), which is available to students in the bottom two quintiles of family income who score above 550 points on the PSU test and are enrolled at one of the 25 publicly funded "Universidades Tradicionales" (Traditional Universities) in Chile.[7] The BB provides a sum equal to the maximum loan amount, allowing students to replace their loans with the BB grant.[8] We find no evidence of a shift in re-enrollment at the 550 point threshold for students at Traditional Universities who retook the PSU exam after their first year, nor do we find any longer-run impact on degree completion. We interpret this as evidence that the causal effect of loan eligibility works through alleviation of credit constraints, and that once these constraints are eased, re-enrollment rates are insensitive to the "price" of college.

Although our research design provides credible evidence on the impacts of loan programs for the persistence of PSU retakers, the fraction of students who enroll in their first year without access to aid and then retake the PSU is small. Moreover, we show that retakers are different from the overall student population: they have lower high school grades and PSU scores, and many have experienced negative family income shocks during their first year. To probe the potential impact of these differences, we examine heterogeneity in the effects of loan eligibility by family income quintile as of second year. We find that the effects of loan eligibility are relatively large and stable over time for those with below-median family incomes. In contrast, for higher-income groups, enrollment impacts fade over time and become insignificant by the third year after matriculation. Given the modest sample sizes available, we cautiously conclude that the impacts of loan eligibility are concentrated among students with low current family incomes, consistent with the presence

[7] These are universities that existed prior to the educational reforms of 1981. During our sample period, they accounted for about 40% of total university enrollment.

[8] Both the loan amount and the BB are credited directly to the university where the student is enrolled, and they are subject to the same cap, so students cannot accept the BB and continue to take out a loan.

of credit constraints.

Our research contributes to the growing literature that studies the impacts of student financial aid on persistence in college enrollment. As noted, most existing studies – including all those covered in the recent meta-analysis by Nguyen, Kramer, and Evans (2019) – address the impacts of grants.[9] The recent study most similar to ours, by Denning (2019), looks at the effect of a combination of grants and loans available to college seniors (with a mix of +$1,000 in grants and +$500 in loans). We fill an important gap by focusing on the extensive margin effect of a relatively large loan amount (covering about 85% of tuition) available from the second year of studies onward.

Most previous studies find modest positive impacts of grants on re-enrollment rates (or negative impacts on dropout/stopout) though Nguyen, Kramer, and Evans (2019) point out that the magnitudes of the effects from more and less generous grant programs have to be interpreted carefully. A few studies, however, find negative impacts of grant programs that divert more able students towards colleges with bigger aid packages but lower graduation rates (e.g., Cohodes and Goodman (2014) and Angrist, Autor, Hudson, and Pallais (2016)).[10] Relative to the existing U.S.-based literature, which finds average impacts on year-to-year persistence and degree completion on the order of 1 percentage point per $1000 in aid, the impacts of the loan program in Chile appear to be relatively large, even adjusting the loan amount for relative income differences between the two countries.

Our second contribution is to the literature on the role of credit constraints in schooling choices (see Lochner and Monge-Naranjo (2012) and Lochner and Monge-Naranjo (2016) for an overview).[11] We interpret the large response to loan eligibility but the small marginal effect of a switch from loans to grants as evidence of credit constraints among university matriculants in Chile. This complements the findings of

[9]Two recent studies focus on programs that indirectly affect the amount of loans taken out by students. Barr, Bird, and Castleman (2019) randomly assign students to loan counselors and find that the intervention lowers the amount of loans taken by the treatment group, but also lowers their persistence rate and increases their loan default rate. Marx and Turner (2018) show that marginal eligibility for Pell Grant aid crowds out loans by more than $1 per dollar of aid among CUNY students and, if anything, leads to worse educational outcomes.

[10]Other papers study the effects of financial incentives that are conditional on student performance on post-enrollment outcomes. Randomized aid schemes provide mixed evidence. Brock and Richburg-Hayes (2006) find positive effects, while Angrist, Lang, and Oreopoulos (2009) find positive effects only for women. Similarly, Garibaldi, Giavazzi, Ichino, and Rettore (2011) study how an increase in tuition after the nominal graduation time leads to a higher probability of on-time graduation for students at Bocconi University in Italy. Similar substitutions patterns are found between public schools and for-profit colleges when aid for students at for-profit colleges is restricted (Cellini (2009) and Cellini, Darolia, and Turner (2020)).

[11]Some previous studies have argued that such constraints are largely absent – e.g., Stinebrickner and Stinebrickner (2008) – but in their review, Lochner and Monge-Naranjo (2012) argue that recent evidence points toward a possible role for credit constraints in college enrollment.

Solís (2017) on the impacts of loan eligibility on initial enrollment in Chilean universities, and of Gurgand, Lorenceau, and Melonio (2011) on the effect of discontinuities in loan eligibility for enrollment outcomes in South Africa. Relatedly, we also contribute to the small literature on debt aversion and college enrollment decisions. Rothstein and Rouse (2011) and Field (2009) show that holding debt induces students to change educational and labor market decisions. In contrast, our finding that eligibility for the Bicentennial Bursary program has little or no impact on re-enrollment suggests that the behavioral impacts of debt in our setting are relatively modest in size.

2 Context, Loan Programs, and Data

2.1 Higher Education in Chile

The Chilean higher education sector consists of two broad sets of institutions: universities (which grant bachelor's and graduate degrees); and Technical Education Centers (Centros de Formación Técnica) and Professional Institutes (Institutos Profesionales), which grant technical degrees and professional certificates. For simplicity, we refer to the latter as "vocational colleges." Most bachelor's programs are designed to last five years, while vocational programs typically last 2-3 years. Courses can sometimes be transferred between institutions, particularly for students transferring from universities to vocational colleges.

Among universities, there are 25 Traditional Universities that predated the educational reforms of the early 1980s. These include public universities (such as the University of Chile) as well as private non-profit universities (such as the Catholic University of Chile). Though these schools vary in prestige, all 25 receive direct funding from the government and share a centralized admission system organized through a council of chancellors (CRUCH, Consejo de Rectores de Universidades Chilenas). Students attending these universities are eligible for loans through the "Crédito Solidario para Universidades Tradicionales" (Traditional University Loan) program (explained below). They are also eligible for the Bicentennial Bursary and various financial aid programs operated by the institutions themselves.

A second group of 30 universities is not funded directly by the government and relies mainly on tuition revenues. These "private universities" were founded after the reforms of the early 1980s and today account for about 60% of university enrollment in Chile. As explained below, students at these universities are eligible for a parallel loan program – the "Crédito con Aval del Estado" (State Guaranteed Loan) program, introduced

in 2006.

Students typically graduate from high school in November and write the university admission test (PSU) in December. Students who intend to apply for government-administered loans or grants also submit a socioeconomic verification form (Formulario Único de Acreditación Socioeconómica, [FUAS]) that gathers information on household structure and is used (in combination with tax records) to determine the applicant's (equivalized) family income quintile. After receiving their PSU scores in January, students then apply though the centralized admission system to the Traditional Universities or directly to the other institutions. Admission decisions are based exclusively on the PSU test and high school grades, and classes begin in March.

2.2 Student Loan Programs in Chile

Tuition rates at universities in Chile average about one-half of median family income per year. Given this high level, most students rely on a combination of family resources, grants, and loans to finance their education. As noted, there are two key loan programs for university students: the Traditional University Loan [TUL] program, available to students at the Traditional Universities; and the State Guaranteed Loan [SGL] program, available to students at other accredited universities and vocational colleges. While there are some differences between the two programs (explained below), university students from the four lowest income quintiles (i.e., with family incomes below the 80th percentile) are eligible for either loan program, depending on where they are enrolled, if they score at least 475 points on the PSU. Students attending vocational colleges are also eligible for the SGL loan program if they have a PSU above 475 or a high school GPA above 5.3 (on a scale of 4 to 7). Together, the two loan programs serve about 18% of all students taking the PSU test each year, and about 50% of those who have submitted a FUAS form and are classified in the bottom four quintiles of family income.

Both the TUL and SGL programs provide a maximum loan up to a "reference tuition" level (Arancel de referencia) determined by the Ministry of Education and based on the institution and program of study. On average, this amount covers about 85% of actual tuition. Apart from subsidies for very poor students (covering lunch and transportation costs) and scholarships such as the Bicentennial Bursary, few other forms of aid are available, and so most students depend on family support to finance all other costs associated with obtaining a university degree.

In addition to providing loans for students at different sets of institutions, the TUL and SGL programs

differ in terms of administration and loan terms. TULs are low-interest (2% per year) income-contingent loans managed directly by the Traditional Universities using resources provided by the government. In contrast, SGLs are 15-20 year installment loans written by commercial banks, with a default guarantee by the state and the educational institution.[12] For the earlier cohorts we study, SGLs had average interest rates close to 6% – similar to rates on other loans of equivalent duration – though, in 2011, the rate was lowered to 2% in response to ongoing student protests.

Enrolled university students can also become eligible for the SGL program if they successfully complete at least 70% of their required program courses in the previous two semesters (and meet other requirements imposed by their school). Most programs offer five courses per semester, so this criterion implies failing at most one course per semester. Unfortunately, we do not observe student course enrollments or grades, so we cannot determine eligibility through this mechanism. Based on limited data for a couple of cohorts of students, we believe that it affects a very small fraction of students who would otherwise be ineligible for loans (less than 5%). Importantly, students who remain enrolled (or take a gap year) do not lose their eligibility for the duration of their studies (up to the nominal duration of the program plus 2 or 3 years), so this pathway only adds eligible students in later years of study.

As an alternative to the TUL and SGL loans, students (and their families) can potentially apply for regular loans from commercial banks or other financial institutions. Given the high levels of university tuition relative to average incomes and the fact that about 30% of Chileans work in the informal sector, we believe that this option is largely irrelevant for families in all but the top quintile of family income.

2.3 Other grants

Other grants and scholarships for Chilean students are also linked to family income and PSU test scores. Fortunately, all of these programs use higher cutoffs than the 475 point threshold for the TUL and SGL loans, and therefore do not confound our regression discontinuity (RD) design. The largest grant program is the Bicentennial Bursary [BB], which provides an amount equal to the reference tuition level (the same amount as the loans) for students from the lowest two income quintiles who score at least 550 points on the PSU test and are enrolled at a Traditional University. About 5% of all students taking the PSU each year, and 55% of

[12] See World Bank (2011) for a detailed report on the SGL program, including information on average loan amounts per student and many details of the program rules.

those in the lowest four family income quintiles, receive a BB.

Given the higher score threshold for the BB than the loan programs, students who are marginally ineligible for the BB (with scores between 475 and 549 points) are all eligible for loans. Those who meet the 550 point threshold receive the BB, but the grant fully offsets the amount they can receive as loans, so their total "aid package" is constant. Thus, a comparison of enrollment and graduation rates for students who score just above the 550 BB threshold, versus those who score just below, reveals the impact of a switch from loan-based to grant-based financial aid, holding constant the maximum amount of aid. In our analysis below, we therefore conduct a second set of analyses around the 550 threshold to identify the marginal effect of moving from loan to grant aid.

2.4 Data

We construct a panel of administrative records for students who participated in the Chilean university admission system in the post-2006 period, merging registries from four sources using personal identification numbers.

The first source is the registry of PSU-takers. This data set contains information on PSU scores (at each attempt), high school GPA and year of graduation, and a comprehensive set of socioeconomic characteristics, including parental education, type of high school attended,[13] and whether the family is covered by public or private health insurance. The second data source is a registry from the Ministry of Education containing information on all students who are enrolled in higher education institutions (universities and vocational colleges) in years up to and including 2014. For most of our analysis, we focus on students who were enrolled in their first year of university between 2007 and 2013 (without being eligible for a loan) and retook the PSU test prior to their second year of studies. Our enrollment data allow us to follow these students for between 1 and 7 years after their first year of enrollment. The third data source is a file of FUAS applications, supplemented with the family income quintile assigned by the Tax Authority and an indicator for eligibility for loans and grants from the Ministry of Education. Finally, we use information of all graduates from institutions of higher education in the country until 2018, allowing us to study BA attainment in a window of

[13]There are three types of schools in Chile: traditional public schools; privately operated "voucher schools" that are funded by a capitation fee per student paid by the government; and private schools that receive no direct government funding. See Hsieh and Urquiola (2006) for an overview.

between 5 and 11 years after their first year of university.[14]

2.5 Sample

Test Retakers

Simple comparisons between students with different levels of financial aid eligibility determined *before enrollment* cannot be used to identify the impacts of aid on college persistence because these aid differences affect the population at risk of dropping out. This fact has been recognized in the literature and addressed by previous researchers (e.g., DesJardins, Ahlburg, and McCall (2002) and Singell (2004)) using sample selection correction methods. We take a different approach and focus on students who initially enrolled in university without being loan-eligible, then retook the PSU test during their first year. This design avoids selection bias because students do not know their precise score on the second attempt. Under mild assumptions (Lee, 2008), those who end up scoring just above or just below the threshold will be very similar on observed and unobserved characteristics. However, those who score above the threshold gain access to loans, providing an "as good as random" design for evaluating the effect of loans on persistence rates.

There are at least three groups of students who were ineligible for loans in their first year and have an incentive to retake the PSU and (re)submit a FUAS application. The first is students who were financially qualified for aid in their first year but scored less than 475 on their first attempt at the test. A second group comprises students from families whose income was above the 80th percentile when they applied to university, but has subsequently fallen below the 80th percentile. A third group is students from lower-income families who failed to submit the FUAS form in time. To be evaluated for loan eligibility for their later years of university, all three groups have to retake the PSU test and (re)submit their FUAS application.

Sample Derivation and Description

The derivation of our sample of retakers is shown graphically in Figure 1. We begin with the population of university enrollees who are observed in their first year of studies. We focus on seven cohorts who enrolled in university for the first time in 2007 through 2013. Characteristics of this sample of just under 600,000 students are shown in columns 1 and 2 of Table 1. Next, we narrow our focus to the subset of first-year

[14] Similar data are used by Santelices et al. (2015) studying persistence using matching methods, Solis (2013) studying the effect of university enrollment in political participation, and Barrios Fernández (2019) studying peer effects in university completion.

enrollees who were initially ineligible for a loan (around 245,000 students). Of these, 17,626 retook the PSU at the end of their first year in university: their characteristics are shown in columns 3-4 of Table 1. Finally, we define our analysis sample as the subset of initially ineligible retakers who submitted a new FUAS and were financially eligible for a loan (i.e., had family incomes as of their first year of university that were in the first 4 quintiles of the national distribution). These 3,627 students, whose characteristics are shown in columns 5 and 6 of Table 1, comprise about 0.6% of first-year enrollees.

Comparisons across the columns of Table 1 suggest that financially-eligible retakers have lower PSU scores and high school GPA's than typical first-year university students, but come from a similar distribution of high schools and have similar age and gender distributions. Their parents' education levels are also similar to those of average first-year university students, as are their parents' formal sector employment rates. Interestingly, their average family income quintile from their initial FUAS application is 3.34 (on a scale of 1-5) versus an average across all students of 2.61. Thus, based on circumstances at the time of their first PSU attempt, they appear to have had higher-than-average family incomes. By the time of their second PSU attempt, however, their average family income quintile has dropped to 2.45 – roughly a fall of one quintile. Thus, as expected, a significant fraction of retakers have experienced negative family income shocks.

We emphasize that the sample of financially-eligible retakers is relatively small and has somewhat different characteristics than other first-year university students in Chile. Most importantly, these students have lower test scores and high school GPA's than other students. This is not necessarily a problem, since (as we show below) the issue of college persistence is most relevant for academically weaker students who are at risk of dropping out before completing a degree. However, it means that the magnitude of the effects we estimate for this sample cannot be generalized to academically stronger students. In addition, financially-eligible retakers tend to have experienced recent negative shocks to their family income. In the analysis below, we explore differences across family income quintiles in the effects of loan eligibility and document that these effects appear to be larger for students from families with lower current incomes. Again, this heterogeneity means that we need to be cautious in extrapolating the estimated impacts in our sample to other student groups.

3 Estimation Strategy

We use a conventional regression discontinuity (RD) approach to estimate the effect of loan eligibility on the second year enrollment choices of financially-eligible retakers. Specifically, we estimate local linear RD models of the form:

$$N_{i2} = \beta_0 + \beta_1 \cdot \mathbb{1}[T_{i2} \geqslant c] + \beta_2 \cdot d_i + \beta_3 \cdot \mathbb{1}[T_{i2} \geqslant c] \cdot d_i + \epsilon_{i2} \tag{1}$$

where N_{i2} is an indicator for whether student i is not enrolled in university two years after finishing high school, $\mathbb{1}[T_{i2} \geqslant c]$ is an indicator for whether the student's PSU score on her second test attempt, T_{i2}, is greater than or equal to the cutoff, c (475 for loan eligibility and 550 for BB eligibility), $d_i = (T_{i2} - c)$ is the distance to the cutoff point (the running variable), which controls for the influence of the test score on the probability of non-enrollment, and ϵ_{i2} is an error term capturing all other influences. [15] We estimate this model for students with second-attempt scores in a relatively narrow range around the 475 point threshold for loan eligibility. (Robustness of our results to this choice of "bandwidth" are discussed below). Equation (1) assumes that the relationship between non-enrollment and test scores is piece-wise linear, with a slope of β_2 for scores below the threshold and $\beta_2 + \beta_3$ for scores above the threshold. The constant β_0 represents the mean non-enrollment rate for students who score just slightly less than 475 points; while the coefficient β_1 represents the change in mean non-enrollment associated with just passing the 475 point threshold.

Given the definition of our sample of retakers, loan eligibility in the second year after high school shifts from some rate B_2 (for students who score less than 475) to 100% (for students who score 475 points or more), where B_2 is the fraction of students with scores just under 475 who could qualify for an SGL loan in year 2 based on successful completion of their first-year courses. Equation (1) is, therefore, the reduced form for a "fuzzy" RD model (see Lee and Lemieux (2010)) with a share B_2 of always-takers and no never-takers. The local average treatment effect of loan eligibility in year 2 is $\beta_1/(1 - B_2)$: thus, the reduced form estimate $\widehat{\beta}_1$ provides a conservative (lower bound) estimate of the treatment effect. Based on loan participation data for a few cohorts we believe that B_2 is small (under 5%) implying that the bound is relatively tight.

[15] Non-enrollment is equivalent to what many analysts call "status dropouts." We prefer the term non-enrollment to avoid confusion with "event dropout," which is conditional on being enrolled in the previous year. In our analysis, non-enrollment (= status dropout) in second year and event dropout in second year are the same because all students in our sample were enrolled in the first year. For later years, however, non-enrollment and event dropout differ.

In later years, students who become eligible for a loan in their second year retain their eligibility (provided that they remain enrolled or take an approved gap year). Students who failed to reach the 475 point threshold in their second PSU attempt, however, can write the test again or gain eligibility through successful completion of their courses. As a result, the fraction of always takers in the determination of loan eligibility for years $t > 2$ will be larger than B_2, and the effect of scoring 475+ points in the second attempt score on eligibility in year t will be smaller than $(1 - B_2)$

There are two possible approaches to address the changing impact of the second attempt test score on loan eligibility in later years. Our preferred approach, given that passing the 475 threshold ensures eligibility in the future, focuses on the effects per student whose loan eligibility in year 2 was affected by their test score. In that case, we simply estimate a variant of equation (1) with later outcomes. An alternative is to use information on third and later PSU attempts to form an estimate of the fraction of students who are eligible for loans in year t, $Eligible_{it}$, and estimate a first-stage model for this fraction:

$$Eligible_{it} = \pi_0 + \pi_1 \cdot \mathbb{1}[T_{i2} \geqslant c] + \pi_2 \cdot d_i + \pi_3 \cdot \mathbb{1}[T_{i2} \geqslant c] \cdot d_i + \nu_{it} \tag{2}$$

The ratio of the reduced form coefficient β_1 to the first stage coefficient π_1 gives the causal effect on the non-enrollment rate in year t, scaled by the additional share of students who are estimated to be eligible in t as a result of their second-attempt PSU (as in a standard LATE interpretation of IV). We caution that, given the dynamic nature of the enrollment decision, it is likely that enrollment in later years depends on loan availability in all prior years (and not just the current year), so scaling the reduced form effect for outcomes in period t by the first stage effect in eligibility in the current year is likely to overstate the causal effect of eligibility on current period enrollment.

A final issue in estimating the first stage model is that we only observe FUAS data and verified family income quintiles up to 2014. For the effects on graduation, we assume that an individual's financial eligibility status is the same as it was in 2014. This mainly affects the later cohorts in our sample who were only partway through their university programs by 2014.

3.1 Decomposing Non-Enrollment Outcomes

Equation (1) provides a simple framework for analyzing the effects of loan eligibility on the probability of non-enrollment in a given year t after first enrollment. One simple extension is to classify non-enrollees by whether they are currently attending a vocational college or out of higher education altogether. Specifically, let V_{it} be an indicator that individual i is enrolled in a vocational college in year t and let M_{it} be an indicator that individual i is not enrolled in any form of tertiary education. We can fit variants of equation (1) that model the effects of loan eligibility on the probability of vocational college enrollment and the probability of not being enrolled in any form of higher education. Since $N_{it} = V_{it} + M_{it}$, the estimated effect of loan eligibility on university non-enrollment is equal to the *sum* of the effects on vocational enrollment and non-enrollment in any tertiary education.

Another useful extension is to classify current non-enrollees by the pathway leading to their current state. For example, we can partition all the students who are not enrolled in year $t = 3$ into two groups: those who dropped out in their second year and have remained unenrolled since then; and those who were enrolled in their second year but dropped out in their third. Formally:

$$P(N_{i3} = 1) = P(N_{i2} = 1, N_{i3} = 1) + P(N_{i2} = 0, N_{i3} = 1) \tag{3}$$

Again, the estimated effect of loan eligibility on university non-enrollment in year 3 is equal the *sum* of the effects on the probabilities of each of two pathways, allowing us to decompose the effect of loan eligibility into an immediate impact on dropout after year 1 and a delayed impact on dropout after year 2. A similar decomposition is easily developed for non-enrollment in years $t > 3$ (see below).

It is also possible to combine information on prior enrollment choices and the alternative activities of each student. For example, we can decompose non-enrollment in year 5 into pathways defined by enrollment status in year 2 and the student's activity in year 5:

$$\begin{aligned} P(N_{i5} = 1) \quad = \quad & P(N_{i2} = 1, V_{i5} = 1) + P(N_{i2} = 1, M_{i5} = 1) \\ & + P(N_{i2} = 0, V_{i5} = 1) + P(N_{i2} = 0, M_{i5} = 1). \end{aligned} \tag{4}$$

We present a decomposition based on this equation below.

4 Results

4.1 Validity of the RD

Following the recommendations of Imbens and Lemieux (2008), we begin our empirical analysis by implementing a set of checks for the validity of our RD design. First, we check that PSU scores have a smooth histogram in the neighborhood of the 475 point threshold. Then we check that the conditional means of retakers' predetermined characteristics smoothly through the threshold.

The PSU test consists of a battery of multiple-choice questions graded by a photo-optical device and reported in 1/2 point intervals. Given this, it seems very unlikely that scores can be manipulated. Consistent with this observation, Figure 2 shows that the histogram of second-attempt PSU scores is continuous at both the 475 point threshold for loan eligibility and also at the 550 point threshold for eligibility for a BB. More formally, following the procedure suggested by McCrary (2008), we estimate piece-wise fourth-order polynomials for the frequency distribution of PSU scores in the intervals $[300, 474.5]$,$[475, 549.5]$, and $[550, 800]$. The fitted polynomials are plotted in the figure, along with their associated confidence intervals, and the actual means for 5-point bins of scores, each of which contains an average of 60 students for bins in a neighborhood of the 475 threshold. The estimated polynomials show no evidence of jumps or "spikes" in the frequency distributions of scores.

Next, in columns 1-3 of Table 2, we show a series of estimated local linear RD models based on equation (1) that take as their dependent variables the characteristics of second-attempt test takers listed in the row headings. Column (1) presents the estimate of β_0, which corresponds to the mean of the characteristic for test-takers with scores just under 475 points. Column (2) presents the estimate of β_1, which represents the jump in the conditional mean of the characteristic at 475 points. Column 3 presents the estimated standard error of $\widehat{\beta}_1$. Columns (4) to (6) present parallel estimates for RD models around the 550 point threshold for the Bicentennial Bursary, fit to the characteristics of students who were enrolled at a Traditional University in their first year without holding a BB grant, but where financially-eligible for a BB grant in their second year.

All the specifications in this table and following tables in the paper are estimated using a 75 PSU-point window around the discontinuity threshold (so the models for the 475 point threshold use observations with scores from 400 to 549.5 points, while the models around the 550 threshold use observations with scores from

475 to 624.5 points). This 75-point bandwidth is approximately equal to the Calonico et al. (2014) optimal bandwidth for the reduced form model of our main outcome variable, non-enrollment in the second year after high school. We evaluate the sensitivity of our results to the size of the bandwidth in the Appendix and show that they are robust to alternative choices.[16]

Among the 21 predetermined variables tested in Table 2, only the student's score on her first attempt at the PSU shows evidence of a discontinuity at the 475 point threshold. The point estimate (-8.17, t=2.69, p-value=0.007) suggests that students who scored just above the 475 point threshold in their second attempt have lower average scores on their first attempt than those who scored just below. In Appendix Figure A.1 we show graphs of the relationships between the second attempt test score (the running variable d_i in our RD models) and the means of several predetermined characteristics, including the first-attempt PSU score. A visual examination of the graph for first-attempt scores suggests that the reason for the apparent downward jump in first attempt scores at the 475 point threshold for the second-attempt score is that the true conditional expectation function exhibits some convexity that is not well captured by the local linear approximating function.[17] As would be expected if the relationship between first-attempt scores and second-attempt scores is convex to the right of the 475 point threshold, we also see that estimated local linear approximation over-estimates the conditional mean just to the left of the 550 point threshold – a problem that is confirmed by the estimated negative jump in first-attempt test scores at this threshold from the model in columns 4-6.[18] Given the visual evidence, however, and the absence of discontinuities for any of the other 20 predetermined characteristics, we believe that the data are consistent with a valid research design.

4.2 Main results

Next, we turn to our main analysis of the effect of achieving loan eligibility on the basis of the second-attempt PSU on non-enrollment rates in subsequent years. We start by describing the results in graphical form. Figure 3 graphs the fraction of students who fail to re-enroll at university in their second year ($t = 2$)

[16] As a placebo test, we also estimated RD models for re-enrollment in the second through the fifth years after initial enrollment for retakers that did not apply for aid (either loans or BB), and therefore should not be affected by the cutoffs. We find insignificant effects.

[17] We are using a 75-point bandwidth and a uniform kernel for all the characteristics in Table 2, but the use of a triangular kernel, which puts more weight on data closer to the threshold, leads to insignificant estimates of the jumps in first-attempt scores at 475 and 550 points.

[18] We note that the sample for A.1 is our main analysis sample, whereas the sample for the models in columns 4-6 of 2 consists of enrollees at Traditional Universities who were initially ineligible for the BB, retook the PSU, and were financially eligible for the BB, so the results are not strictly comparable.

against their second-attempt PSU score. As in Figure 2, each dot in the figure represents the mean outcome for students in a 5-point bin of PSU scores. The solid lines represent the fitted local linear regression models, using bandwidths of 75 points around the 475-point threshold for loan eligibility and the 550 point threshold for BB eligibility. We also show the estimated 95% confidence intervals around the local linear models.

The figure shows that the second year non-enrollment rate decreases steadily with the second-attempt PSU score, starting at close to 80% for students with PSUs in the 300's and ending at essentially 0 for students with scores above 700. There is also a very clear discontinuous jump of about -20 percentage points in non-enrollment at the 475 point threshold for loan eligibility. Figure 4 presents similar graphs of non-enrollment in the third through fifth years after matriculation. In constructing each figure, we limit attention to the set of cohorts that are potentially observed in that year. (For example, when studying enrollment in the fifth year, we limit the sample to cohorts who enrolled for the first time between 2007 and 2010, and thus would reach their fifth year of enrollment by 2014). All three of these graphs show the same general pattern as the graph for re-enrollment in the second year of university. In particular, all three exhibit clear discontinuous jumps at the 475 point threshold for loan eligibility.

Table 3 presents estimation results for a series of local linear RD models over time horizons from two to five years after first enrollment. The first column reports estimates of the first stage model (2) for (estimated) loan eligibility in the year of interest; while columns 2-7 present reduced form estimates of the effect of having a second-attempt PSU score above 475 points (i.e., equation (1)) for university non-enrollment, vocational college enrollment, and no post-secondary enrollment, with and without the addition of cohort dummies and the list of control variables described in Table 2. In all cases, we report the estimate of the constant representing the expected value of the outcome of interest for students who score just under 475 points (i.e., the estimate of β_0, as well as the estimated jump in the outcome at the 475 point threshold (i.e., the estimate of β_1).[19]

We begin in Panel A with outcomes in the second year after initial entry to university. Since our estimate of eligibility in year 2 is 100% for those with scores ≥ 475, and 0 for those with scores < 475, the first stage model for loan eligibility in year 2 is degenerate, with a constant of 0 and intercept of 1 (and no sampling variability). Consistent with Figure 3, the estimated reduced form effect on non-enrollment is -0.21 and is

[19] In estimating the model with controls, we deviate all the control variables from their sample means, so that the constant of the regression has the interpretation of the mean non-enrollment rate for students who score just below the 475 point threshold.

highly significant ($t = 5.2$). Columns 4 and 6 show that the 21 percentage-point (ppt.) gain in university enrollment in the second year for those who are marginally eligible for loans arises from a 14-ppt. decline in vocational college enrollment and a 7.1-ppt. decline in the fraction of retakers who leave post-secondary education altogether. Thus, 2/3 of the effect on university enrollment arises because loan-eligible students stay in university, rather than shift to vocational colleges, which have lower tuition and a different threshold for loan eligibility based only on high-school GPA.

Columns 3, 5, and 7 of the table present models that include cohort dummies and the predetermined covariates listed in Table 2.[20] Reassuringly, we find that their addition has little or no effect on any of the point estimates.

Looking at models for the third through fifth years since initial enrollment (Panels B, C, and D), we see that the reduced form impact of loan eligibility fades by about 40% in the third year, to about -12 ppt. Interestingly, the constants in the reduced form model (representing the mean non-enrollment rates for students who score just under 475 points) are nearly the same in second and third years, so this "fade out" arises because about 40% of the marginally eligible students who re-enroll in the second year end up dropping out in the third year.

By year 5 the reduced form effect of marginally passing the 475 threshold is still about the same as it was in year 3, suggesting that most of the fade out of the loan eligibility effect occurs in year 3. As shown by the estimated constant for the first stage model reported in Panel D, by year 5, about 16 percent of the students who just barely missed the 475 threshold on their second attempt at the PSU are eligible for loans. Thus, the first-stage impact on loan eligibility in year 5 is 0.86. Scaling the reduced form by this number yields an IV estimate of -0.14 on non-enrollment in year 5. As noted, however, this scaling assumes that the impact on the fifth year non-enrollment is attributable to loan eligibility status in that year, whereas the pattern of non-enrollment over years 2-5 suggests that most of the non-enrollees in year 5 actually dropped out in year 2 or 3. Thus, we prefer to focus on the reduced form estimates, which give the impacts in years 2-5 per student who became loan-eligible in year 2.

The temporal pattern of the reduced form impacts over the years 2-5 is summarized in Figure 5. The left panel shows the estimated mean non-enrollment rates for students who are marginally ineligible and

[20]There are a small number of observations with missing values for high-school GPA. To keep them in the analysis, we use missing-indicator method, where we imputed the mean of the variable and included a dummy for missing GPA.

marginally eligible for loans at each time horizon, while the right panel shows the difference between these two, which is the implied impact of loan eligibility.

We have experimented extensively with the choice of bandwidth for the local linear models, and with the choice of a triangular kernel versus a uniform kernel.[21] In Appendix Figure A.2, we show the estimated reduced-form effects of marginally passing the 475-PSU threshold on non-enrollment rates in years 2-5 using bandwidths from 40 to 200 points. In all cases, the magnitudes of the estimated effects are relatively stable. In Appendix Table A.1, we report a parallel version of Table 3 in which we use a triangular kernel and a different bandwidth for each time horizon, choosing the bandwidth selected by the Calonico et al. (2014) (CCT14) procedure for the reduced form model at that horizon. Again, these estimates are quite similar to those reported in Table 3.

4.3 Long-term Effect on Degree Completion

The results in Table 3 suggest that loan eligibility had an effect on the enrollment behavior of test retakers extending at least to their fifth year after initial enrollment. In this section, we confirm this long-run effect using data on degree completion. As discussed above, our graduation data extend to 2018, four years later than our enrollment data, so we are able to track degree completion over a relatively long time horizon – at least 10 years after initial enrollment for the earliest cohorts in our study sample.

Panel A of Table 4 presents a series of reduced-form models for degree completion by 2018. We show models for completion of a bachelor's degree (columns 1-2), completion of a vocational degree (columns 3-4), and completion of any type of post-secondary degree (columns 5-6). We present models without covariates in the odd-numbered columns, and models that control for cohort dummies and the predetermined covariates in the even-numbered columns.

The models in columns 1-2 suggest that loan eligibility in year 2 increased the university graduation rate by about 12 ppt. - very similar to the effect on year 5 university enrollment. Given that most bachelor's programs last 5 years, we might have expected the two effects to be about the same, and reassuringly they are. Consistent with the decomposition of non-enrollment patterns in Table 3, the estimates in columns 3-4 suggest that about one half of the increase in bachelor degree attainment is offset by a reduction in

[21] As noted, for our main analysis, we use a uniform kernel, which is equivalent to running unweighted OLS regression models for the first stage and reduced-form models, using only observations for students with scores between 400 and 549.5.

graduation from vocational colleges. However, given the sampling errors, we cannot be too certain of the exact share. The remainder is due to a reduction in the share of retakers who have no higher education degree or certificate (see columns 5-6).

5 Mechanisms

In this section, we present three additional sets of analyses that shed light on the mechanisms underlying the positive effects of loan-eligibility on enrollment and degree attainment. We begin with an analysis of the effect of eligibility for the Bicentennial Bursary, which is available to students attending Traditional Universities who have family incomes below the 40th percentile of the national distribution and score at least 550 points on the PSU. We compare the effects of BB eligibility and loan eligibility to gain some insights into the question of how much of the effect of the loan program arises through an opening up of credit versus a reduction in the cost of university education. Next, we use the framework developed in Section 3.1 to decompose the effect of loan eligibility on non-enrollment status in year 5 into effects on alternative pathways characterized by earlier enrollment choices and activities in year 5. Finally, we examine heterogeneity in the response to loan eligibility across family income quintiles.

5.1 Loans Vs. Grants

A critical question for the design of student aid programs is whether children from lower-income families are less likely to attend university because they lack access to credit, or because they perceive the costs as too high relative to the returns (see, e.g., Lochner and Monge-Naranjo (2012)). Under the first explanation, the TUL and SGL loan programs affect students' choices because they open up access to credit that is otherwise unavailable to lower-income families. Under the second, they affect choices because they partly subsidize the cost of university thought below-market interest rates (particularly in the case of the TUL program and in the post-2011 period for the SGL program).

Some evidence on the importance of the cost channel comes from a comparison of second-attempt test takers with family incomes under the 40th percentile who enrolled in their first year without a Bicentennial Bursary and scored just below or just above the 550 point threshold for BB eligibility in the second PSU attempt. Students on both sides of the threshold continue to be eligible for a loan, but those who score 550

points or more can replace their loan with a bursary, completely eliminating about 85% of their tuition costs.

As a point of departure, we note that Figure 3 shows no evidence of a jump in non-enrollment rates of students around the 550 point threshold for BB eligibility. Nevertheless, the sample used in this figure includes students with family incomes between the 40th and 80th percentiles (who are eligible for a loan but ineligible for a BB), and those in private universities (who are not eligible for the BB unless they transfer to a Traditional University). As a result, any effect of BB eligibility may be difficult to discern.

Table 5 presents a series of RD models fit to PSU retakers who were enrolled in their first year at a Traditional University without being eligible for a BB and had family incomes (based on the FUAS they submitted at the end of their first year) below the 40th percentile. In this sample, those who score above 550 points on their second attempt PSU are automatically qualified for a BB. The format of the table is the same as Table 3, with a first stage model in column 1 and reduced-form models for various enrollment outcomes in columns 2-5.[22] We estimate models for non-enrollment at Traditional Universities (column 2), enrollment at a Private University (column 3), enrollment in a vocational college (column 4), and withdrawal from any form of post-secondary education (column 5).

Panel A presents a series of models for outcomes in the second year after high school graduation. Note that the 550 point threshold is a sharp RD design for BB eligibility in year 2: thus (as in Table 3), the first stage model in column 1 is degenerate, with an intercept of 0, a slope coefficient of 1, and no sampling error. Passing the 550 point threshold is associated with relatively small and statistically insignificant changes in all the outcomes in columns 2-5, including most importantly, the probability of dropping out of a Traditional University. In contrast to the effect of loan eligibility, it appears BB eligibility has little or no effect on second-year outcomes.

Looking in later years (panels B, C, and D), we continue to see little evidence that reaching the 550-point BB threshold has an effect on remaining in a Traditional University, or of enrolling in a private university or vocational college, or of leaving post-secondary schooling altogether. This is confirmed by the models in panel B of Table 4, which examine effects on degree attainment. We see no evidence in these models that attaining eligibility for a BB affects the probability of attaining a bachelor's degree at a Traditional University (columns 1-2), at a Private University (columns 3-4), or at vocational college (columns 5-6).

[22] Students can retake the PSU a third or fourth or even fifth time, and some eventually reach the 550 point threshold, so in later years, the design for BB eligibility is a fuzzy RD with a fraction of always takers that represent the set of students who **later** pass the 550 threshold.

We conclude from this analysis that the availability of a BB grant that fully replaces any loans – and thereby reduces the out of pocket costs of university by around 85% – has little or no effect on enrollment choices or degree attainment. While potentially surprising, this is consistent with the findings in Solís (2017) on the effects of BB eligibility on first-year enrollment. Using an RD design similar to the one we adopt here, Solís (2017) finds no evidence that students who score just above 550 points on their ***first-attempt*** PSU – and can, therefore, attend a Traditional university for only about 15% of the regular tuition cost faced by other students – have higher overall university entry rates than those who score just below 550 points – and therefore have to rely on loans to finance their first year of university.

5.2 Decomposing the dynamic dropout process

Next, we present two simple decompositions of the effect of loan eligibility in year 2 on the probability of non-enrollment in year 5. The first looks at how loan eligibility affects the likelihood of alternative enrollment pathways that end with non-enrollment in year 5. Extending the logic of equation (3), we write

$$P(E_{i5}=0)=\sum_{E_{i2}\in\{0,1\}}\sum_{E_{i3}\in\{0,1\}}\sum_{E_{i4}\in\{0,1\}}P(E_{i2},E_{i3},E_{i4},E_{5i}=0),$$

where $E_{it}(=1-N_{it})$ is an indicator for enrollment at university in year t. Starting with year 2 there are $2^3=8$ possible sequences that end with non-enrollment in year 5. In panel A of Table 5, we show reduced form models (analogous to equation 1) for all 8 sequences. The primary impact of loan eligibility is to reduce the probability of dropping out immediately after the first year and remaining unenrolled thereafter (the pathway in column 1). The effects on all the other pathways are small and statistically indistinguishable from 0.

Our second set of decompositions – presented in Panel B – look at the effects of loan eligibility on sequences of enrollment choices characterized by the combination of university enrollment status in year 2 and outcomes in year 5. We begin in column 1, showing the impact of loan eligibility on the probability of non-enrollment in year 5: this is -0.12 (as in Panel D of Table 3). Next, in columns 2 and 3 we show the decomposition into pathways characterized only by enrollment status in year 2:

$$P(E_{i5}=0)=P(E_{i2}=1,E_{i5}=0)+P(E_{i2}=0,E_{i5}=0).$$

Here we see that loan eligibility leads to a small (+3.9%) increase in the probability that students enroll in year 2 but have dropped out of university by year 5, and a large (-16%) reduction in the probability of dropping out immediately in year 2 and remaining unenrolled in university by year 5. The increase in the prevalence of enrolling in year 2 but ultimately dropping out by year 5 contributes to the "fade out" effect documented in Table 3.

Finally, in columns 4-7, we follow equation (4) and decompose non-enrollment in year 5 into 4 pathways: two that start with university enrollment in year 2 but end with either enrollment in vocation college $(i.e., V_{i5} = 1)$ (column 4) or non-participation in higher education $(i.e., M_{i5} = 1)$ (column 5); and two that start with university non-enrollment in year 2 and end with either $V_{i5} = 1$ (column 6) or $M_{i5} = 1$ (column 7). As expected, given the findings in Panel A, loan eligibility primarily affects the likelihood of dropping out immediately in year 2 and still being out of university in year 5. Moreover, the impacts on moving to vocational college versus being out of tertiary education altogether are about the same in year 5 as they are in year 2 (see Table 3). We conclude that retakers who fail to achieve loan eligibility drop out of university immediately and either switch to vocational college or leave education altogether. Then, they persist with those choices over the next three years.

5.3 Effects by Family Income

Finally, we turn to the analysis of the effects of loan eligibility on students from different income groups. Given the modest size of our test retaker sample, we form two groups: students with incomes below the 40th percentile, and those with incomes from the 40th to 80th percentiles (recall that students with family incomes in the top quintile of family income are ineligible for loans). Table 7 presents estimates of the effect of loan eligibility for these two groups in years 2-5, following the same format at Table 3, with results for lower-income students in the odd-numbered columns (labeled $q_{1,2}$) and results for richer students in the even-numbered columns (labeled $q_{3,4}$). The bottom rows of the table also show p-values for tests that the intercept terms and slope coefficients (i.e., the estimates of β_0 and β_1) are the same for the two groups at each time horizon.

Although the estimates for the two subgroups are somewhat imprecise, they point to two interesting patterns. First, for the lower-income subgroup, the effect on loan eligibility on non-enrollment in years 2-5 is relatively stable at about -20 percentage points. In contrast, for the higher-income subgroup, the effect at year

2 is relatively large (-26 ppt.), but then fades almost immediately, with no impact (or even a wrong-signed impact) in years 4 and 5 . Taken together, these patterns suggest that responses of students from higher-income families drive the partial fade-out in the impact of loan eligibility on the pooled sample (shown by the estimates in Table 3)

Table 8 presents estimated models for degree attainment for the two subgroups, similar to the models presented in Panel A of Table 4. These show that loan eligibility is associated with an estimated 16-ppt. rise in the probability of attaining a BA degree by lower-income students (standard error = 4.7 ppt.), accompanied by a 6.8-ppt. decline the probability of obtaining a vocational degree (standard error = 4.3 ppt.) and a 9.0-ppt. increase in the probability of obtaining any post-secondary degree (standard error = 5.3 ppt.). The magnitude of the BA effect is only slightly smaller than the magnitude of the effect on 5th-year enrollment, giving us some confidence that loan eligibility has a relatively large effect on students from poorer families. And, as we have seen in earlier tables, a sizable share of the BA attainment effect (about 40%) is offset by a reduction in the probability of receiving a degree from a vocational college. In contrast, the estimated effects on degree completion for students from richer families are all small and statistically insignificant (e.g., +3.8-ppt. effect on BA degree attainment, with a standard error of 7.1 ppt.). Again, these results are consistent with the absence of any large effect of loan eligibility for the 5th-year enrollment rate of students from these families.

Overall, we conclude that our main findings on loan eligibility are mainly driven by responses of students from lower-income families. This is similar to findings on the effects of loan eligibility for initial university enrollment reported by Solís (2017). Nevertheless, we caution that the sample sizes for the higher-income group in our analysis of test retakers are small, and we cannot rule out that higher-income students exhibit some responsiveness to loan eligibility.

We have also examined the heterogeneity of responses by student gender. The results – presented in Appendix Table B.1 – show no significant differences between the responses of male and female students to loan eligibility. If anything, however, the results suggest that the impacts on 5th-year enrollment and BA degree attainment are slightly larger for males.

6 Conclusion

The test-based eligibility rules for student loans in Chile set the stage for credible regression discontinuity-based designs that can help identify the causal effects of loan eligibility on student decisions to enroll, persist, and graduate from higher education. In this paper, we focus on the persistence dimension, using an RD design to measure the effects on re-enrollment and graduation for students who retook the national entrance exam after their first year of study. We show that access to loans increases the fraction of students with scores around the cutoff who re-enroll for a second year by about 20 percentage points. This effect fades to around 12 percentage points by the fifth year of studies, but remains highly significant and translates into a similar-sized effect on the probability of bachelor degree recipiency. Relative to the average effect in the U.S.-based studies summarized by Nguyen et al. (2019) – around a 1 percentage point impact on year-to-year persistence per $1,000 - this impact is relatively large. Assuming maximum loan amounts of around $4,000 per year, the gain is on the order of 3 percentage points of degree completion per $1,000, or 1.2 points per $400 (which is roughly the equivalent of $1000 in relative income in Chile).

We find that about two-thirds of the reduction of dropout from university arises from a decrease in transfers to vocational colleges, which have lower tuition costs and loan eligibility based on either the PSU cutoff or a minimum high school GPA threshold. The other third comes from students who stop post-secondary schooling altogether. Examining the pathways to ultimately leaving university, we find that the long-term effect of loan eligibility is driven by an immediate reduction in the fraction of students who drop out after their first year.

Importantly, we also find that once students have access to loans, the availability of grants has little or no additional impact on persistence. We study a second sharp discontinuity in financial aid arising from the Bicentennial Bursary, a grant that fully offsets government-administered loans, and is available to students enrolled at any of the Traditional Universities in Chile who score above a higher threshold than the one for loan eligibility. The absence of any large or significant effect of grant eligibility suggests that access to credit, rather than changes in the cost of university education, is the main driver of the large impact of the loan program. It also points to an absence of debt aversion, in contrast to some earlier studies in other settings.

We note that there are at least two important limitations to our analysis. First, the test retakers in our analysis have below-average high school GPA's and relatively low entrance exam scores. They also come

from families that have experienced recent negative income shocks. Thus, we interpret our results as most relevant for students whose academic preparation and/or financial position put them at relatively high risk of dropout. A second limitation is that a large share of the enrollment response to loan eligibility in our analysis arises because students who fail to meet the test score threshold for loan eligibility transfer to vocational colleges, where loans can be obtained based on high school GPA. We would not necessarily expect to see such a large university-to-vocational college substitution effect in the absence of this feature of the loan programs in Chile.

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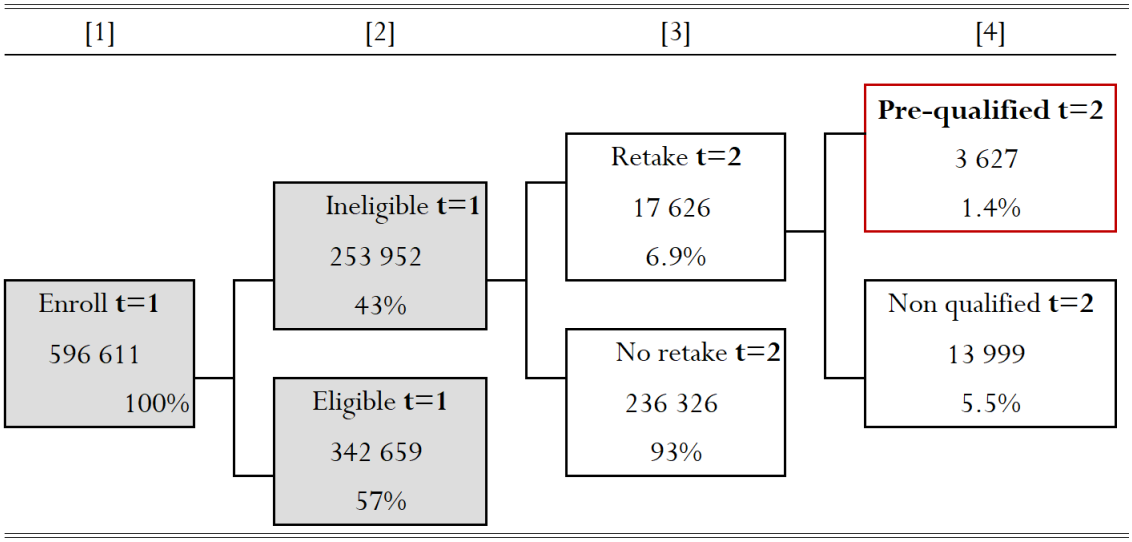
7 Tables and Figures

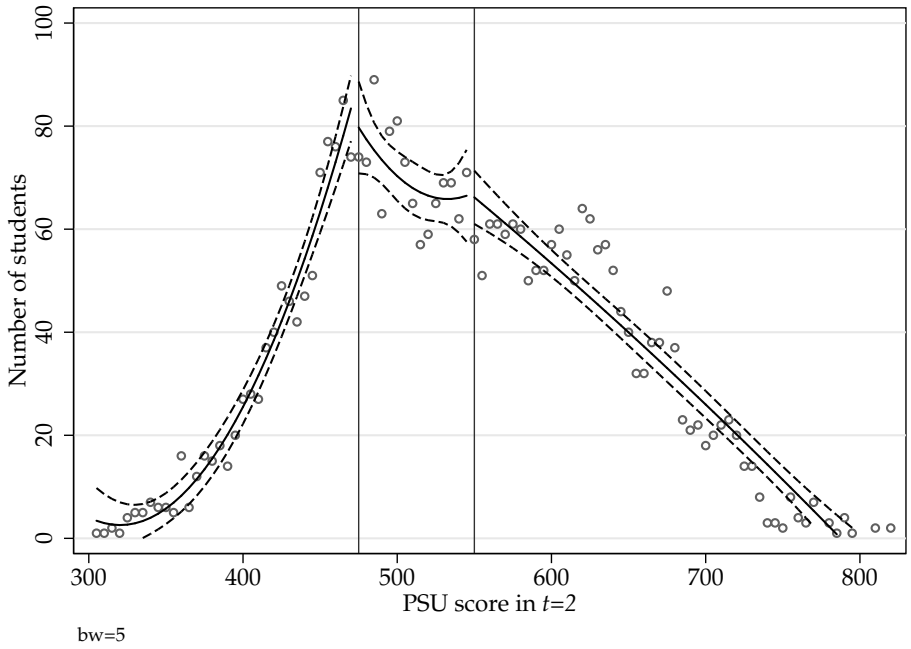
7.1 Figures

Figure 1: Derivation of Sample.



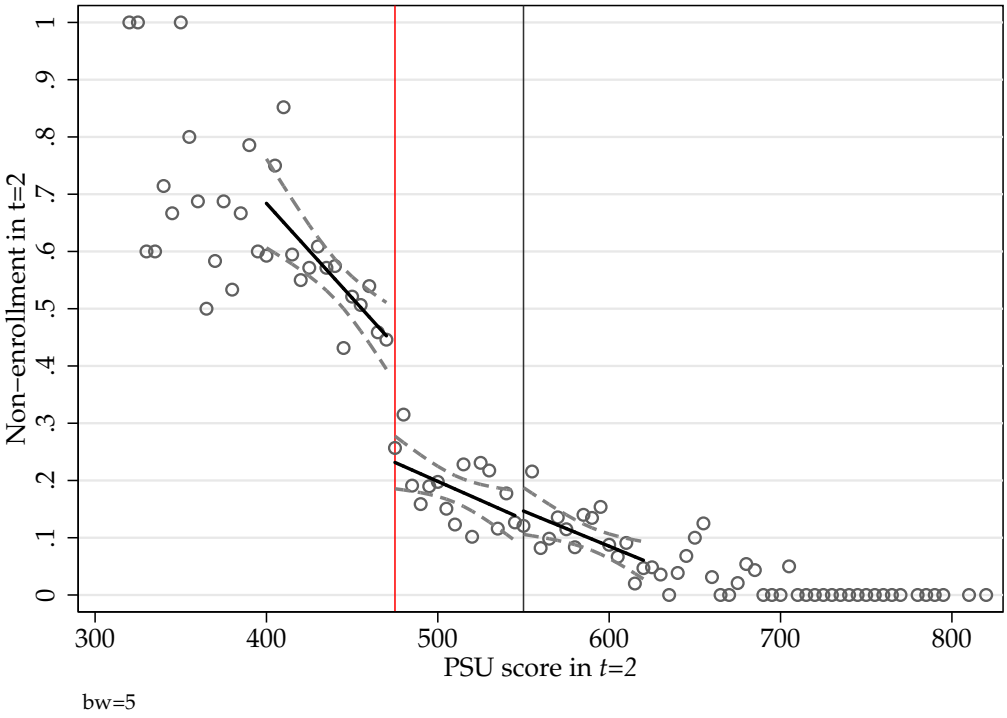
Note: Column [1] shows the number of students enrolled in universities in the semester after their first PSU attempt. Column [2] divides this population into students who are ineligible or eligible for loans based on their financial eligibility status as of year 1 and first attempt PSU score. Column (3) splits the subgroup who were ineligible for loans in their first year into those who retook the PSU at the end of their first year (just prior to the start of their second year), and those who did not. Column (4) splits the retakers from column 3 into those who are financially eligible for loans in year 2 ("pre-qualified") and those who were not.

Figure 2: Test for Smooth Histogram of Second-attempt PSU Scores (McCrary Test).



Note: Vertical lines at 475 and 550 correspond to the score thresholds for eligibility for loans and the Bicentennial Bursary (BB), respectively. Each dot represents the number of students in a 5-point bin of PSU scores. Solid lines represent the fitted values from a fourth-order polynomial model of the histogram fit separately to each of the three intervals. Dashed lines represent 95% confidence intervals.

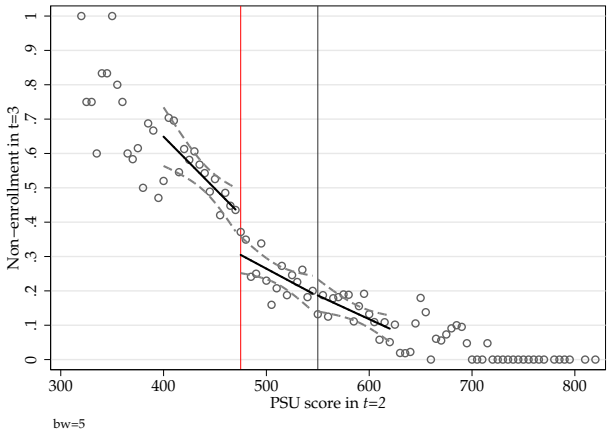
Figure 3: Non-enrollment in Year Two (t=2) and Second-attempt PSU Score.



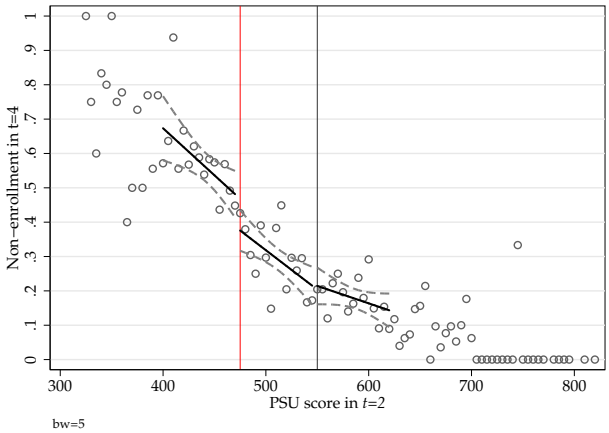
Note: Vertical lines at 475 and 550 correspond to the score thresholds for eligibility for loans and the Bicentennial Bursary (BB), respectively. Each dot represents the average non-enrollment rate for students in a 5-point bin of PSU scores. Solid lines represent fitted local linear regressions, fit separately to observations with scores in the intervals [425,474.5], [475,549.5], and [550,625]. Dashed lines represent 95% confidence intervals. The sample includes all cohorts whose second-year eligibility status is observed.

Figure 4: Non-enrollment in Third through Fifth Years (t=3,4,5) and Second-attempt PSU Score.

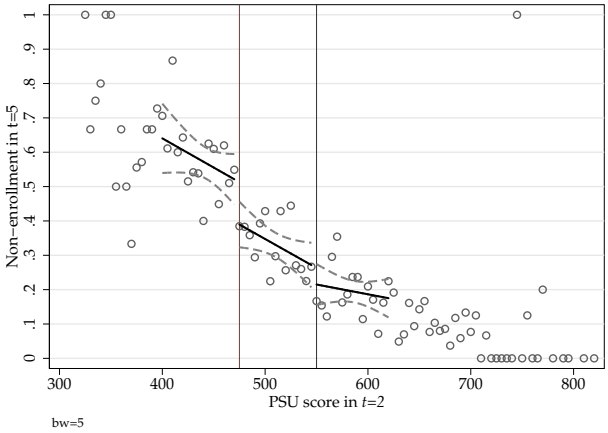
Panel [A]: Non-enrollment at t=3



Panel [B]: Non-enrollment at t=4

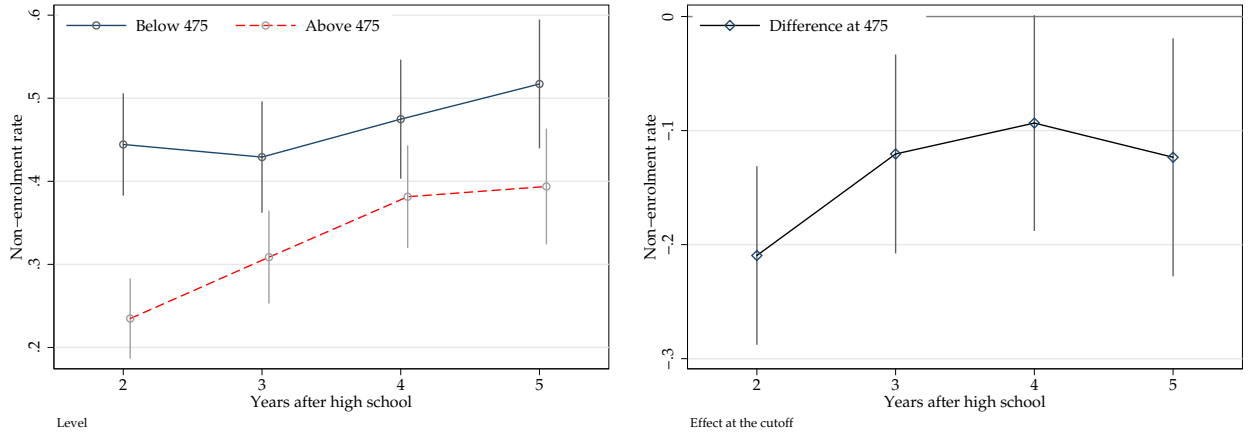


Panel [C]: Non-enrollment at t=5



Note: See notes to Figure 3. Sample for panel [A] includes all cohorts whose third-year eligibility status is observed. Sample for panel [B] includes all cohorts whose fourth-year eligibility status is observed. Sample for panel [C] includes all cohorts whose fifth-year eligibility status is observed.

Figure 5: Estimated Non-enrollment Rates for Students with Scores Just Above/Below Eligibility Threshold and Implied Causal Effects in Years 2-5.



Note: The figure on the left shows the estimated non-enrollment rates in years 2-5 for students with scores just below and just above the 475-point threshold for loan eligibility. The figure on the right shows the implied causal effects of achieving loan eligibility on non-enrollment rates in years 2-5.

7.2 Tables

Table 1: Descriptive Statistics

	Enrolled in t=1		Retakers in t=2		Analysis Sample	
Variable	Mean (1)	S. D. (2)	Mean (3)	S. D. (4)	Mean (5)	S. D. (6)
PSU (1st attempt)	566.5	(87.3)	600.0	(91.1)	529.7	(93.9)
1st PSU>=475	0.88	(0.33)	0.86	(0.35)	0.60	(0.49)
Fin. qualified t=1	0.65	(0.48)	0.09	(0.29)	0.33	(0.47)
Retake PSU in t=2	0.06	(0.24)	1.00	-	1.00	-
PSU (2nd attempt)	600.5	(78.1)	606.0	(89.7)	543.2	(92.8)
Change in PSU	4.55	(33.95)	5.95	(36.43)	13.58	(38.78)
High school GPA	5.83	(0.49)	5.92	(0.49)	5.71	(0.49)
Public high school	0.29	(0.45)	0.13	(0.34)	0.31	(0.46)
Voucher high school	0.49	(0.5)	0.33	(0.47)	0.52	(0.5)
Private high school	0.21	(0.41)	0.53	(0.5)	0.16	(0.36)
Age in t=0	19.37	(2.27)	19.09	(1.6)	19.38	(2.23)
Female	0.52	(0.5)	0.47	(0.5)	0.52	(0.5)
Quintile in t=1	2.61	(1.39)	4.21	(1.42)	3.34	(1.71)
Quintile in t=2	2.53	(1.37)	3.33	(1.54)	2.45	(1.16)
Household size	4.35	(1.85)	4.39	(2.07)	4.35	(1.85)
Father in formal job	0.60	(0.49)	0.73	(0.45)	0.57	(0.49)
Mother in formal job	0.39	(0.49)	0.47	(0.5)	0.40	(0.49)
Mother College	0.22	(0.41)	0.49	(0.5)	0.22	(0.42)
Father College	0.18	(0.39)	0.40	(0.49)	0.20	(0.4)
Father dropout	0.30	(0.46)	0.18	(0.39)	0.29	(0.45)
Mother dropout	0.28	(0.45)	0.18	(0.38)	0.27	(0.44)
Observations	596,611		17,626		3,627	

Note: The first two columns describe students who were enrolled in university in the term after their first PSU attempt. Columns (3) and (4) describe the subset of first-year enrollees who retook the PSU in the interval between their first and second years of university. Columns (5) and (6) describe the analysis sample. This is the subset of retakers who were ineligible for loans in their first year, but were financially eligible (i.e., pre-qualified) for loans in their second year. High school GPA ranges from 4 to 7 in intervals of 0.1. Quintiles are means of family income quintiles, ranging from 1 (poorest) to 5 (richest). See text for further information.

Table 2: Tests for Continuity of Means of Predetermined Characteristics at Cutoffs for Loan and Bursary Eligibility

	Models at 475-Point Cutoff			Models at 550-Point Cutoff		
	(1)	(2)	(3)	(4)	(5)	(6)
Covariate	Intercept	Jump	(Std. Err.)	Intercept	Jump	(Std. Err.)
First attempt PSU	457.08	-8.17	(3.03)	535.00	-6.20	(1.74)
Income quintile = 1	0.44	-0.04	(0.04)	0.57	0.02	(0.03)
Income quintile = 2	0.26	0.04	(0.04)	0.43	-0.02	(0.03)
Income quintile = 3	0.17	0.02	(0.03)	-	-	-
Income quintile = 4	0.13	-0.02	(0.03)	-	-	-
Average income quintile	1.99	0.01	(0.09)	1.43	-0.02	(0.03)
Female	0.60	0.00	(0.04)	0.55	-0.01	(0.03)
Age	19.59	-0.18	(0.23)	19.10	0.05	(0.11)
High school GPA	5.50	-0.01	(0.04)	5.90	-0.03	(0.03)
Household size	4.79	-0.20	(0.17)	4.41	0.14	(0.11)
Private high school	0.03	0.02	(0.02)	0.02	0.00	(0.01)
Voucher high school	0.54	0.00	(0.04)	0.50	-0.01	(0.03)
Public high school	0.41	-0.02	(0.04)	0.48	0.01	(0.03)
In public health system	0.69	0.03	(0.04)	0.64	0.00	(0.03)
Mother has no high school	0.34	0.02	(0.04)	0.38	-0.02	(0.03)
Father has no high school	0.40	0.05	(0.04)	0.40	0.02	(0.03)
Mother has univ. degree	0.10	0.02	(0.03)	0.00	0.02	(0.02)
Father has univ. degree	0.07	0.05	(0.03)	0.08	0.00	(0.02)
Mother in formal work	0.35	-0.01	(0.04)	0.29	0.03	(0.03)
Father in formal work	0.53	-0.04	(0.04)	0.45	0.01	(0.03)
Mother is housewife	0.41	0.04	(0.04)	0.48	0.00	(0.03)
Observations		1,826			3,141	

Note: Table shows estimation results for equation 1 using the predetermined characteristic in the row heading as the dependent variable. Columns 1-3 present results for model estimated around 475-point threshold for loan eligibility. Columns 4-6 present results for model estimated around 550-point threshold for Bicentennial Bursary eligibility. Sample for models at 475 point cutoff includes university students with second-attempt PSU scores between 400 and 549.5 who were financially qualified for loans (i.e., with family incomes in quintiles 1-4). Sample for models at 550 point cutoff includes students enrolled at Traditional Universities in their first year with second-attempt PSU scores between 475 and 625 who were ineligible for a Bicentennial Bursary (BB) in their first year but were financially qualified for a BB (i.e., with family incomes in quintiles 1-2) in their second year. Intercepts (reported in columns 1 and 4) represent the estimated means of the dependent variable for students with scores just below the cutoff. Jumps (reported in columns 2 and 5) represent the estimated discontinuities in the means of the dependent variable at the cutoff. Robust standard errors for estimated jumps are reported in columns 3 and 6.

Table 3: Estimated Effects of Loan Eligibility on University Non-enrollment in Years 2-5.

	First Stage	Reduced Form Models					
	Loan Eligible in Year t	Not Enrolled in Year t		Vocational Enrollment in Year t		No Post-Secondary Enrollment in Year t	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Second Year:							
$\mathbb{1}(PSU_2 \geqslant 475)$	1.00	-0.21***	-0.20***	-0.14***	-0.14***	-0.071**	-0.066**
	(.)	(0.040)	(0.040)	(0.034)	(0.034)	(0.032)	(0.031)
Intercept	0.00	0.44***	0.43***	0.26***	0.26***	0.18***	0.17***
	(.)	(0.031)	(0.031)	(0.029)	(0.029)	(0.025)	(0.025)
Observations	1,826	1,826	1,826	1,826	1,826	1,826	1,826
B. Third Year:							
$\mathbb{1}(PSU_2 \geqslant 475)$	0.90***	-0.12***	-0.11***	-0.16***	-0.16***	0.035	0.042
	(0.015)	(0.044)	(0.044)	(0.039)	(0.039)	(0.033)	(0.032)
Intercept	0.097***	0.43***	0.42***	0.32***	0.32***	0.11***	0.097***
	(0.011)	(0.034)	(0.035)	(0.032)	(0.033)	(0.024)	(0.024)
Observations	1,603	1,603	1,603	1,603	1,603	1,603	1,603
C. Fourth Year:							
$\mathbb{1}(PSU_2 \geqslant 475)$	0.90***	-0.093*	-0.090*	-0.086**	-0.088**	-0.0075	-0.0027
	(0.017)	(0.048)	(0.048)	(0.043)	(0.043)	(0.038)	(0.038)
Intercept	0.097***	0.47***	0.46***	0.29***	0.31***	0.18***	0.15***
	(0.013)	(0.037)	(0.038)	(0.034)	(0.035)	(0.029)	(0.030)
Observations	1,390	1,390	1,390	1,390	1,390	1,390	1,390
D. Fifth Year:							
$\mathbb{1}(PSU_2 \geqslant 475)$	0.86***	-0.12**	-0.13**	-0.092**	-0.100**	-0.031	-0.027
	(0.021)	(0.053)	(0.053)	(0.044)	(0.044)	(0.047)	(0.047)
Intercept	0.14***	0.52***	0.51***	0.26***	0.29***	0.26***	0.22***
	(0.015)	(0.040)	(0.042)	(0.035)	(0.037)	(0.037)	(0.039)
Observations	1,157	1,157	1,157	1,157	1,157	1,157	1,157
Covariates			x		x		x
Cohort Fixed Effects			x		x		x

Note: Column 1 shows estimated first-stage model for effect of passing 475-point threshold at second attempt of PSU on loan eligibility at different time horizons. Columns 2-7 show estimated reduced-form models for university non-enrollment (columns 2-3) vocational college enrollment (columns 4-5) and no post-secondary enrollment (columns 6-7). Samples include students with second-attempt PSU scores between 400 and 549.5 (75-point bandwidth) whose eligibility status is observed at the specific time horizon. Robust standard errors in parentheses. *: p-value$<$ .1; **: p-value$<$ .05; ***: p-value$<$ .01.

Table 4: Estimated Regression Discontinuity Models for Degree Attainment.

[A]. Reduced-Form Models for Effects of Achieving Loan Eligibility in Second Attempt PSU (475-point cutoff).

	University		Vocational College		Any Higher Educ. Degree	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}(PSU_2 \geqslant 475)$	0.12***	0.11***	-0.048	-0.050	0.071	0.059
	(0.039)	(0.038)	(0.035)	(0.035)	(0.043)	(0.042)
Intercept	0.25***	0.26***	0.23***	0.24***	0.48***	0.50***
	(0.027)	(0.026)	(0.027)	(0.028)	(0.032)	(0.031)
Observations	1,826	1,826	1,826	1,826	1,826	1,826
Covariates		x		x		x
Cohort Fixed Effects		x		x		x

[B]. Reduced-Form Models for Effects of Achieving Bursary Eligibility in Second Attempt PSU (550-point cutoff).

	Traditional University		Private University		Vocational College		Any Higher Educ. degree	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}(PSU_2 \geqslant 550)$	0.028	0.032	0.014	0.012	-0.014	-0.014	0.027	0.030
	(0.031)	(0.029)	(0.022)	(0.022)	(0.019)	(0.019)	(0.033)	(0.030)
Intercept	0.32***	0.28***	0.12***	0.12***	0.093***	0.090***	0.54***	0.49***
	(0.020)	(0.019)	(0.014)	(0.014)	(0.014)	(0.014)	(0.022)	(0.021)
Observations	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141
Covariates		x		x		x		
Cohort Fixed Effects		x		x		x		

Note: Table presents estimated reduced-form models for attainment of degrees from university, vocational college, or any form of higher education. Models in panel [A] show reduced-form effect of achieving loan eligibility in second PSU attempt (i.e., scoring 475 or above). Models in panel [B] show reduced-form effect of achieving eligibility for Bicentennial Bursary in second PSU attempt (i.e., scoring 550 or above). Sample in panel [A] includes university students with second-attempt PSU scores between 400 and 549.5 who were financially qualified for loans (i.e., with family incomes in quintiles 1-4). Sample in panel [B] includes students enrolled at Traditional Universities in their first year with second-attempt PSU scores between 475 and 625 who were ineligible for a Bicentennial Bursary (BB) in their first year but were financially qualified for a BB (i.e., with family incomes in quintiles 1-2) in their second year. Robust standard errors in parentheses. *: $p < 10\%$, **: $p < 5\%$, ***: $p < 1\%$.

Table 5: Estimated Effects of Eligibility for Bicentennial Bursary on Non-enrollment at Traditional Universities in Years 2-5.

	First Stage	Reduced Form Models			
	Loan Eligible in year t	Not enrolled at Trad. Univ. in year t	Private Univ. Enrollment in Year t	Vocational Enrollment in Year t	No Post-Secondary Enrollment in Year t
	(1)	(2)	(3)	(4)	(5)
A. Second Year:					
$\mathbb{1}(PSU_2 \geqslant 550)$	1.00	0.023	0.041	-0.024	0.0053
	(.)	(0.030)	(0.026)	(0.015)	(0.017)
Intercept	0.00	0.30***	0.17***	0.061***	0.069***
	(.)	(0.021)	(0.017)	(0.012)	(0.012)
Observations	3,141	3,141	3,141	3,141	3,141
B. Third Year:					
$\mathbb{1}(PSU_2 \geqslant 550)$	0.96***	0.0023	0.046*	-0.045**	0.0010
	(0.0091)	(0.033)	(0.027)	(0.018)	(0.019)
Intercept	0.045***	0.36***	0.19***	0.10***	0.072***
	(0.0091)	(0.023)	(0.018)	(0.015)	(0.014)
Observations	2,812	2,812	2,812	2,812	2,812
C. Fourth Year:					
$\mathbb{1}(PSU_2 \geqslant 550)$	0.93***	0.016	0.0094	-0.019	0.025
	(0.012)	(0.036)	(0.029)	(0.021)	(0.023)
Intercept	0.074***	0.40***	0.21***	0.10***	0.086***
	(0.012)	(0.024)	(0.020)	(0.016)	(0.015)
Observations	2,504	2,504	2,504	2,504	2,504
D. Fifth Year:					
$\mathbb{1}(PSU_2 \geqslant 550)$	0.91***	-0.045	0.0051	-0.021	-0.029
	(0.014)	(0.039)	(0.031)	(0.024)	(0.027)
Intercept	0.094***	0.47***	0.21***	0.11***	0.15***
	(0.014)	(0.027)	(0.021)	(0.018)	(0.020)
Observations	2,176	2,176	2,176	2,176	2,176

Note: Column 1 shows estimated first-stage model for effect of passing 550-point threshold at second attempt of PSU on Bicentennial Bursary (BB) eligibility at different time horizons. Columns 2-7 show estimated reduced-form models for non-enrollment at a Traditional University (column 2), enrollment at a Private University (column 3), enrollment at a vocational college (columns 4) and no post-secondary enrollment (column 5). Samples include students enrolled at Traditional Universities in their first year who were ineligible for BB in the first year, with second-attempt PSU scores between 475 and 625 (75-point bandwidth) and family incomes as of year 2 in quintiles 1-2, whose eligibility status is observed at the specific time horizon. Robust standard errors in parentheses. *: p-value$<$ .1; **: p-value$<$ .05; ***: p-value$<$ .01.

Table 6: Decomposition of the Effect of Loan Eligibility on Pathways to Non-enrollment in Year 5.

Panel [A]: Temporal Decomposition:

	P($E_5=0$, $E_4=0$, $E_3=0$, $E_2=0$)	P($E_5=0$, $E_4=1$, $E_3=0$, $E_2=0$)	P($E_5=0$, $E_4=0$, $E_3=1$, $E_2=0$)	P($E_5=0$, $E_4=0$, $E_3=0$, $E_2=1$)	P($E_5=0$, $E_4=1$, $E_3=1$, $E_2=0$)	P($E_5=0$, $E_4=1$, $E_3=0$, $E_2=1$)	P($E_5=0$, $E_4=0$, $E_3=1$, $E_2=1$)	P($E_5=0$, $E_4=1$, $E_3=1$, $E_2=1$)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}(PSU_2 \geqslant 475)$	-0.13***	-0.0061	-0.014	0.016	-0.0075	-0.0034	0.0038	0.023
	(0.046)	(0.0061)	(0.0092)	(0.025)	(0.0091)	(0.0022)	(0.024)	(0.030)
Intercept	0.30***	0.0055	0.015	0.050***	0.012	0.000	0.061***	0.075***
	(0.038)	(0.0054)	(0.0091)	(0.016)	(0.0074)	(0.000)	(0.017)	(0.022)
Observations	1,157	1,157	1,157	1,157	1,157	1,157	1,157	1,157

Panel [B]: Alternative Activity Decomposition:

	P($E_5=0$)	P($E_5=0$, $E_2=1$)	P($E_5=0$, $E_2=0$)	P($V_5=1$, $E_2=1$)	P($M_5=1$, $E_2=1$)	P($V_5=1$, $E_2=0$)	P($M_5=1$, $E_2=0$)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\mathbb{1}(PSU_2 \geqslant 475)$	-0.12**	0.039	-0.16***	0.0036	0.035	-0.096***	-0.067*
	(0.053)	(0.043)	(0.047)	(0.028)	(0.035)	(0.037)	(0.037)
Intecept	0.52***	0.19***	0.33***	0.078***	0.11***	0.18***	0.15***
	(0.040)	(0.030)	(0.039)	(0.019)	(0.025)	(0.032)	(0.032)
Observations	1,157	1,157	1,157	1,157	1,157	1,157	1,157

Note: Table shows reduced-form estimates of the effects of passing 475-point threshold at second attempt of PSU on various pathways to non-enrollment in year 5. In panel [A], there are 8 pathways, each described by university enrollment status in years 2-4, which all end with non-enrollment in year 5. For example, the pathway in column 1 is the sequence of enrollments ($E_2=0, E_3=0, E_4=0$), representing students who leave university in year 2 and never return in years 3-5. Panel [B] presents decompositions based on the student's activities in years 2 and 5. For reference, column 1 shows the reduced-form effect of loan eligibility on non-enrollment in year 5. Columns 2-3 present a decomposition based on enrollment status in year 2 (either $E_2=1$ or $E_2=0$). Columns 4-7 present a decomposition based on enrollment status in year 2 (either $E_2=1$ or $E_2=0$) and the student's alternative activity in year 5 (either enrolled in vocational college, $V_5=1$, or not enrolled in any higher education $M_5=1$). Samples include students with second-attempt PSU scores between 400 and 549.5 (75-point bandwidth) whose eligibility status in year 5 is observed. Robust standard errors in parentheses. *: p-value$<.1$; **: p-value$<.05$; ***: p-value$<.01$.

Table 7: Estimated Effects of Loan Eligibility on University Non-enrollment in Years 2-5 by Income Quintile.

	First Stage		Reduced Form Models					
	Loan Eligible in Year t		Not Enrolled in Year t		Vocational Enrollment in Year t		No Post-Secondary Enrollment in Year t	
	$q_{1,2}$	$q_{3,4}$	$q_{1,2}$	$q_{3,4}$	$q_{1,2}$	$q_{3,4}$	$q_{1,2}$	$q_{3,4}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Second Year:								
$\mathbb{1}(PSU_2 \geqslant 475)$	1.00	1.00	-0.19***	-0.26***	-0.15***	-0.12**	-0.039	-0.14**
	(.)	(.)	(0.049)	(0.069)	(0.042)	(0.059)	(0.039)	(0.055)
Intercept	0.00	0.00	0.45***	0.43***	0.28***	0.23***	0.17***	0.20***
	(.)	(.)	(0.038)	(0.057)	(0.035)	(0.050)	(0.030)	(0.049)
Observations	1,198	628	1,198	628	1,198	628	1,198	628
B. Third Year:								
$\mathbb{1}(PSU_2 \geqslant 475)$	0.91***	0.89***	-0.16***	-0.041	-0.21***	-0.048	0.046	0.0065
	(0.023)	(0.035)	(0.055)	(0.075)	(0.048)	(0.065)	(0.041)	(0.054)
Intercept	0.089***	0.11***	0.48***	0.32***	0.37***	0.21***	0.11***	0.11***
	(0.023)	(0.035)	(0.042)	(0.058)	(0.040)	(0.053)	(0.029)	(0.041)
Observations	1,051	552	1,051	552	1,051	552	1,051	552
C. Fourth Year:								
$\mathbb{1}(PSU_2 \geqslant 475)$	0.92***	0.88***	-0.17***	0.063	-0.11**	-0.042	-0.061	0.10
	(0.025)	(0.043)	(0.058)	(0.084)	(0.053)	(0.071)	(0.047)	(0.065)
Intercept	0.085***	0.12***	0.55***	0.31***	0.33***	0.20***	0.22***	0.11**
	(0.025)	(0.043)	(0.044)	(0.063)	(0.042)	(0.057)	(0.036)	(0.046)
Observations	929	461	929	461	929	461	929	461
D. Fifth Year:								
$\mathbb{1}(PSU_2 \geqslant 475)$	0.86***	0.86***	-0.20***	0.043	-0.11**	-0.052	-0.087	0.095
	(0.031)	(0.049)	(0.064)	(0.096)	(0.052)	(0.082)	(0.059)	(0.079)
Intercept	0.14***	0.14***	0.58***	0.38***	0.27***	0.24***	0.31***	0.14**
	(0.031)	(0.049)	(0.047)	(0.073)	(0.042)	(0.065)	(0.046)	(0.060)
Observations	783	374	783	374	783	374	783	374
E. P-values for test of homogeneity in intercept (β_0) and jump (β_1) coefficients								
	β_0	β_1	β_0	β_1	β_0	β_1	β_0	β_1
Second Year	-	-	0.398	0.209	0.224	0.361	0.303	0.093
Third Year	0.304	0.304	0.034	0.121	0.030	0.048	0.456	0.290
Fourth Year	0.259	0.259	0.011	0.032	0.057	0.241	0.058	0.042
Fifth Year	0.486	0.486	0.029	0.040	0.345	0.274	0.032	0.057

Note: Columns 1-2 show estimated first-stage model for effect of passing 475-point threshold at second attempt of PSU on loan eligibility at different time horizons for students with family incomes in quintiles 1-2 (column 1) or quintiles 3-4 (column 2). Remaining columns show estimated reduced-form models for university non-enrollment (columns 3-4), vocational college enrollment (columns 5-6), and no post-secondary enrollment (columns 7-8) for the two income groups. Samples include students with second-attempt PSU scores between 400 and 549.5 (75-point bandwidth) whose eligibility status is observed at the specific time horizon. Panel E shows the p-values for test of equality of the estimated intercept and jump coefficients of the models for students in the lower and higher-income groups. Robust standard errors in parentheses. *: p-value$<$ .1; **: p-value$<$ .05; ***: p-value$<$ .01.

Table 8: Estimated Reduced-Form Models for Degree Attainment by Income Quintile.

	Graduation from College		Graduation from Vocational Education		Graduation from Higher education	
	$q_{1,2}$	$q_{3,4}$	$q_{1,2}$	$q_{3,4}$	$q_{1,2}$	$q_{3,4}$
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}(PSU_2 \geqslant 475)$	0.16***	0.038	-0.068	-0.0077	0.090*	0.030
	(0.047)	(0.071)	(0.043)	(0.062)	(0.053)	(0.077)
Intercept	0.22***	0.31***	0.24***	0.22***	0.47***	0.53***
	(0.031)	(0.051)	(0.034)	(0.047)	(0.038)	(0.058)
Observations	1,198	628	1,198	628	1,198	628
p-value β_1		0.104		0.225		0.274
p-value β_0		0.096		0.322		0.210

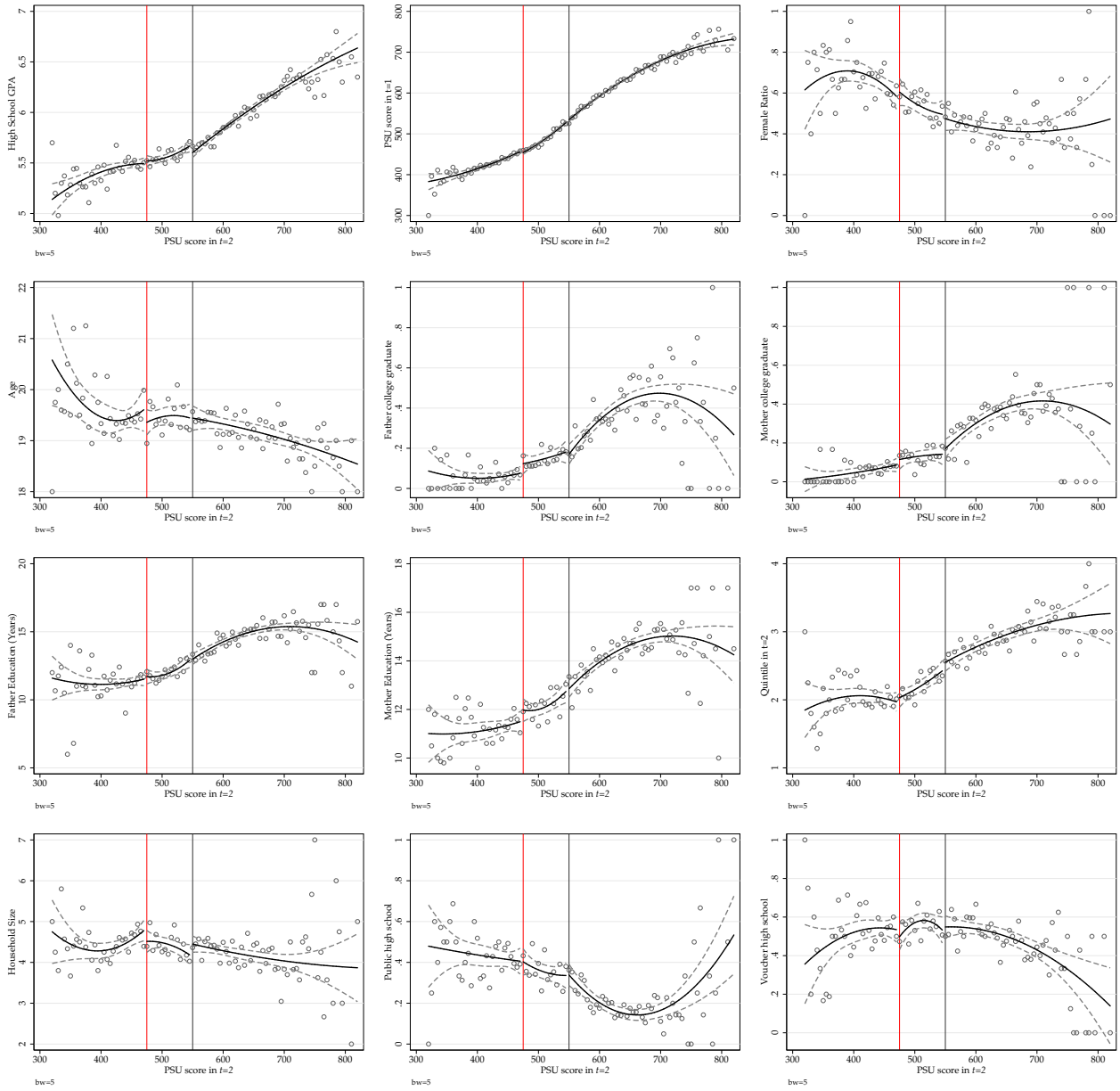
Note: Table presents estimated reduced-form models for effect of passing 475-point threshold at second attempt of PSU on attainment of degrees from university, vocational college, or any form of higher education for students with family incomes in quintiles 1-2 (columns 1,3,5) or quintiles 3-4 (columns 2,4,6). Sample includes university students with second-attempt PSU scores between 400 and 549.5 who were financially qualified for loans with family incomes in indicated quintile group. Robust standard errors in parentheses. *: p-value$<$ .1; **: p-value$<$ .05; ***: p-value$<$ .01.

Appendix

A Additional Results on Validity of Design and Robustness of Estimates

A.1 Balance of covariates

Figure A.1: Balance of Covariates. Graphical form in $t = 2$.

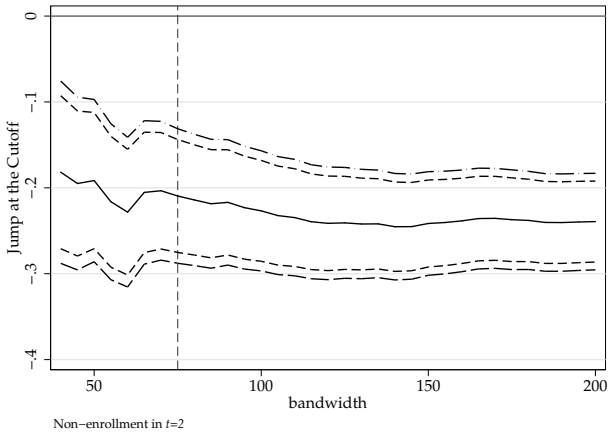


Note: Vertical lines at 475 and 550 correspond to the score thresholds for eligibility for loans and the Bicentennial Bursary (BB), respectively. Each dot represents the average value of each variable for students in a 5-point bin of PSU scores. Solid lines represent fitted local polynomials, fit separately to observations with scores in the intervals [320,474.5], [475,549.5], and [550,820]. Dashed lines represent 95% confidence intervals. The sample includes all cohorts whose second-year eligibility status is observed.

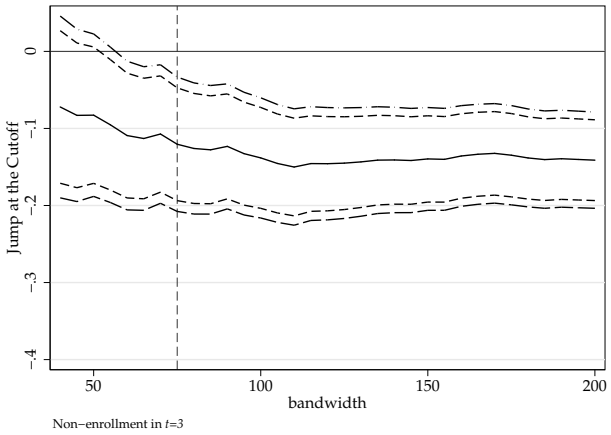
A.2 Sensitivity to Bandwidth

Figure A.2: Sensitivity for Non-Enrollment Rate. Jump for different bandwidths

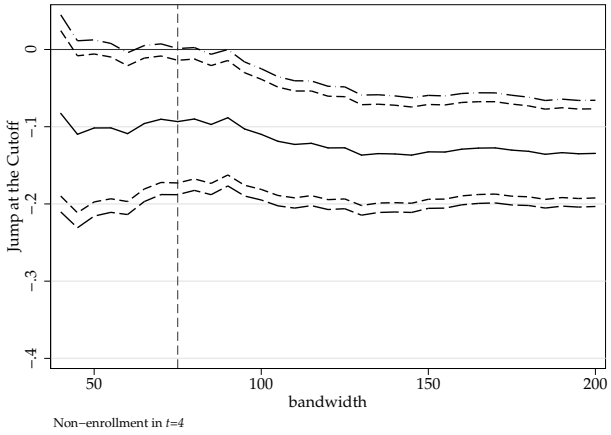
Panel [A]: Non-Enrollment t=2



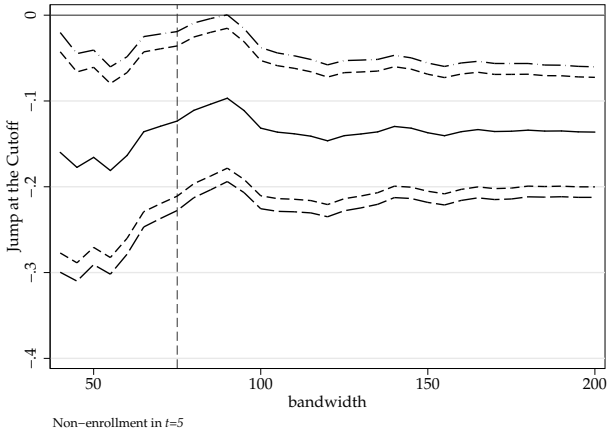
Panel [B]: Non-Enrollment t=3



Panel [C]: Non-Enrollment t=4



Panel [D]: Non-Enrollment t=5



Note: Each figure shows a series of RD models estimated using different bandwidths (bw). Models are estimated including students with second-attempt PSU scores between -bw and bw and a rectangular kernel. The vertical line indicates the bandwidth used throughout the paper (75). Short- and long-dashed lines represent 90% and 95% confidence intervals.

A.3 Sensitivity of Estimates to Bandwidth and Choice of Kernel

Table A.1: Reduced-Form Models of Effect of Loan Eligibility on Non-enrollment Using CCT Optimal Bandwidth and Triangular Kernel

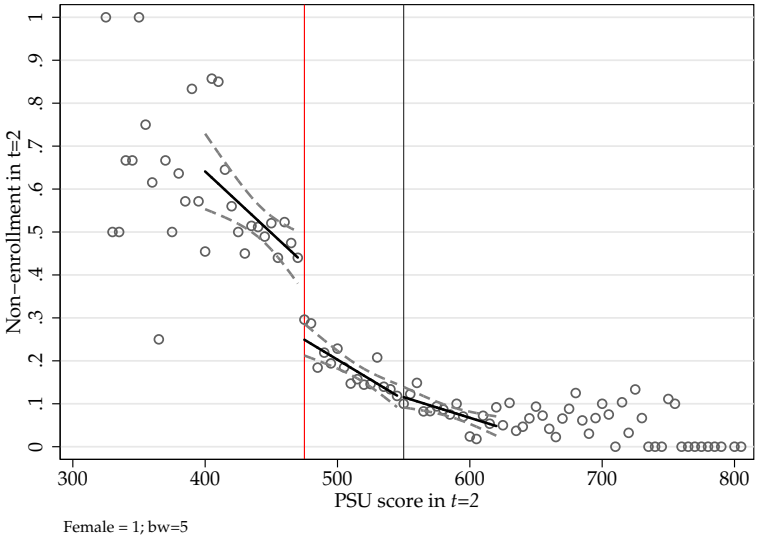
	Local Linear uniform kernel			CCT Bandwidth/triangular kernel		
	Basic Spec.	+covariates	+covariates +Year F.E.	Basic Spec.	+covariates	+covariates +Year F.E.
	(1)	(2)	(3)	(4)	(5)	(6)
A. Second Year Year:						
$\mathbb{1}(PSU_2 \geqslant 475)$	-0.21***	-0.21***	-0.20***	-0.18***	-0.14**	-0.18***
	(0.040)	(0.040)	(0.040)	(0.056)	(0.058)	(0.056)
bw beta	75.0	75.0	75.0	73.7	81.7	73.7
bw bias				46.2	49.2	46.2
B. Third Year:						
$\mathbb{1}(PSU_2 \geqslant 475)$	-0.12***	-0.11***	-0.11***	-0.081	-0.062	-0.066
	(0.044)	(0.044)	(0.044)	(0.055)	(0.067)	(0.067)
bw beta	75.0	75.0	75.0	99.8	80.4	79.8
bw bias				57.8	48.6	48.1
C. Fourth Year:						
$\mathbb{1}(PSU_2 \geqslant 475)$	-0.093*	-0.093*	-0.090*	-0.084	-0.087	-0.082
	(0.048)	(0.048)	(0.048)	(0.060)	(0.066)	(0.063)
bw beta	75.0	75.0	75.0	88.8	91.4	103.2
bw bias				56.1	57.1	61.6
D. Fifth Year:						
$\mathbb{1}(PSU_2 \geqslant 475)$	-0.12**	-0.13**	-0.13**	-0.17**	-0.19**	-0.19**
	(0.053)	(0.053)	(0.053)	(0.076)	(0.083)	(0.083)
bw beta	75.0	75.0	75.0	66.2	63.7	64.8
bw bias				43.9	42.5	43.4

Note: Table shows estimated reduced-form models for the effect of passing the 475-point threshold at the second PSU attempt on university non-enrollment at different time horizons (Panels A-D). Models in columns 1-3 are estimated using a 75-point bandwidth and a rectangular kernel. Models in columns 4-6 are estimated using a bandwidth selected by the RDrobust procedure (Calonico et al., 2014) and a triangular kernel. Columns 1 and 4 present baseline models with no added covariates. Models in columns 2 and 5 include the covariates listed in Table 2. Models in columns 3 and 6 include the covariates listed in Table 2 and fixed effects for each cohort. Robust standard errors in parentheses. *: p-value$<$ .1; **: p-value$<$ .05; ***: p-value$<$ .01.

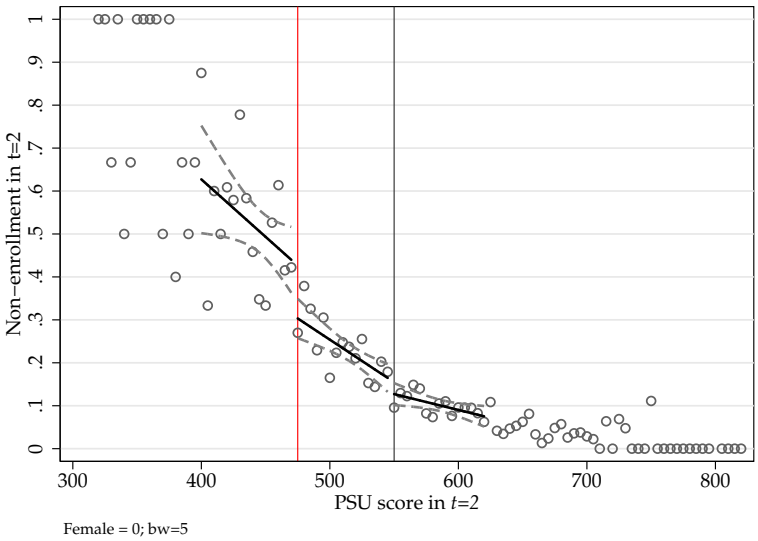
B Heterogeneity by Gender

Figure B.1: Non-enrollment in Year Two and Second-attempt PSU Score by Gender

Panel [A]: Female



Panel [B]: Male



Note: RD estimates of the non-enrollment rate in the second year by gender. Vertical lines at 475 and 550 correspond to the score thresholds for eligibility for loans and the Bicentennial Bursary (BB), respectively. Each dot represents the average non-enrollment rate for students in a 5-point bin of PSU scores. Solid lines represent fitted local linear regressions, fit separately to observations with scores in the intervals [425,474.5], [475,549.5], and [550,625]. Dashed lines represent 95% confidence intervals. The sample includes all cohorts whose second-year eligibility status is observed.

Table B.1: Estimated Reduced-Form Models for Non-enrollment and Degree Attainment by Gender.

	First Stage		Reduced Form					
	Loan Eligible in Year t		Not Enrolled in Year t		Vocational Enrollment in Year t		No Post-Secondary Enrollment in Year t	
	Female	Male	Female	Male	Female	Male	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Second Year:								
$\mathbb{1}(PSU_2 \geqslant 475)$	1.00	1.00	-0.20***	-0.21***	-0.16***	-0.090*	-0.036	-0.12**
	(.)	(.)	(0.052)	(0.063)	(0.046)	(0.051)	(0.039)	(0.053)
Intercept	0.00	0.00	0.45***	0.43***	0.31***	0.18***	0.14***	0.25***
	(.)	(.)	(0.040)	(0.051)	(0.038)	(0.044)	(0.031)	(0.044)
Observations	1,067	759	1,067	759	1,067	759	1,067	759
B. Fifth Year:								
$\mathbb{1}(PSU_2 \geqslant 475)$	0.84***	0.90***	-0.091	-0.14*	-0.054	-0.14*	-0.037	-0.0028
	(0.034)	(0.041)	(0.069)	(0.083)	(0.056)	(0.071)	(0.062)	(0.073)
Intercept	0.16***	0.099**	0.53***	0.49***	0.24***	0.29***	0.29***	0.21***
	(0.034)	(0.041)	(0.051)	(0.064)	(0.043)	(0.059)	(0.048)	(0.058)
Observations	658	499	658	499	658	499	658	499
p-value β_1^{2nd}		-		0.441		0.161		0.116
p-value β_0^{2nd}		-		0.353		0.032		0.046
p-value β_1^{5th}		0.187		0.338		0.202		0.368
p-value β_0^{5th}		0.187		0.325		0.278		0.151

	Graduation from College		Graduation from Vocational Education		Graduation from Higher education	
	Female	Male	Female	Male	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)
C. Degree Attainment:						
$\mathbb{1}(PSU_2 \geqslant 475)$	0.096*	0.14**	-0.068	-0.0076	0.028	0.13*
	(0.052)	(0.058)	(0.047)	(0.052)	(0.056)	(0.067)
Intercept	0.27***	0.22***	0.28***	0.16***	0.55***	0.39***
	(0.036)	(0.039)	(0.036)	(0.042)	(0.040)	(0.050)
Num. Obs.	1,067	759	1,067	759	1,067	759
p-value β_1		0.304		0.211		0.143
p-value β_0		0.220		0.042		0.025

Note: In Panel A and B show the effects on no-enrollment in second and fifth year by gender. Columns 1-2 shows estimated first-stage models for effect of passing 475-point threshold at second attempt of PSU on loan eligibility at different time horizons. Models in columns 3-8 show estimated reduced-form models for university non-enrollment (columns 3-4), vocational college enrollment (columns 5-6), and no post-secondary enrollment (columns 7-8). Panel C shows reduced-form models for effect of passing 475-point threshold at second attempt of PSU on degree attainment from university (columns 1-2), vocational college (columns 3-4), or any form of higher education (columns 5-6). Samples include students with second-attempt PSU scores between 400 and 549.5 (75-point bandwidth) whose eligibility status is observed at the specific time horizon. Robust standard errors in parentheses. *: p-value$<$ .1; **: p-value$<$ .05; ***: p-value$<$ .01.