

Solis, Alex

**Working Paper**

## Credit access and college enrollment

Working Paper, No. 2013:12

**Provided in Cooperation with:**

Department of Economics, Uppsala University

*Suggested Citation:* Solis, Alex (2013) : Credit access and college enrollment, Working Paper, No. 2013:12, Uppsala University, Department of Economics, Uppsala, <https://nbn-resolving.de/urn:nbn:se:uu:diva-204400>

This Version is available at:

<https://hdl.handle.net/10419/82577>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



UPPSALA  
UNIVERSITET

*Department of Economics*

Working Paper 2013:12

*Credit access and college enrollment*

*Alex Solis*

Department of Economics  
Uppsala University  
P.O. Box 513  
SE-751 20 Uppsala  
Sweden  
Fax: +46 18 471 14 78

Working paper 2013:12  
July 2013  
ISSN 1653-6975

## CREDIT ACCESS AND COLLEGE ENROLLMENT

ALEX SOLIS

# CREDIT ACCESS AND COLLEGE ENROLLMENT\*

Alex Solis<sup>†</sup>

May 30, 2012

## Abstract

Does limited access to credit explain some of the gap in schooling attainment between children from richer and poorer families? I present new evidence on this important question using data from two loan programs for college students in Chile. Both programs offer loans to students who score above a threshold on the national college admission test, enabling a regression discontinuity evaluation design. I find that students who score just above the cutoff have nearly 20 percentage points higher enrollment in first, second and third year than students who score just below, which represent relative increases of 100% , 213% and 446% respectively. More importantly, access to the loan program effectively eliminates the family income gradient in enrollment among students with similar test scores.

JEL Codes: I22, I24, I28, O1

Keywords: college enrollment, credit constraints, income gap, college dropout, Chile

---

\*I would like to thank David Card, Alain de Janvry, Frederico Finan, and Elizabeth Sadoulet for their support and advice. Joshua Angrist, Peter Berck, Nils Gottfries, Eric Hanushek, Catie Hausman, Patrick Kline, Gianmarco León, Ethan Ligon, Jeremy Magruder, Edward Miguel, Emmanuel Saez, Sofia Villas-Boas, Brian Wright and seminar participants at the Interamerican Development Bank, LACEA 2010 Annual Meeting, MOOD workshop 2011, NEUDC 2011, New Economic School, PacDev 2011, PUC Rio, Universidad Católica de Concepción, University of Barcelona II workshop on Economics of Education, University of San Francisco, University Pompeu Fabra, Uppsala University, World Bank social mobility workshop and UC Berkeley ARE Development Workshop, Development Seminar, ARE Department Seminar, Development Lunch, and Labor Lunch, provided useful comments. I would like to thank Francisco Meneses, Gonzalo Sanhueza and Humberto Vergara for providing the data and for their comments. I gratefully acknowledge financial support from the Confederación Andina de Fomento CAF and from the Center for Equitable Growth at the University of California, Berkeley. A previous version of this paper circulated under the title “Credit Constraints for Higher Education.” All errors are my own.

<sup>†</sup>Email: alex.solis@nek.uu.se. Department of Economics, Uppsala University P.O. Box 513 75120 Uppsala, Sweden; Uppsala Center of Labor Studies; and Department of Economics, Universidad Católica de Concepción. .

# 1 Introduction

Students from richer families are more likely to attend, persist at, and graduate from college than students from poor families. Whether the gap is due entirely to differences in tastes and abilities, or is partially driven by credit constraints faced by lower income families, is a matter of much debate. Some analysts argue that the gap is mainly a reflection of long-run differences in educational investment, both at home and in schools, that affect the readiness for college (e.g., Cameron and Heckman (2001); Keane and Wolpin (2001); Carneiro and Heckman (2002); and Cameron and Taber (2004)). Others have argued that liquidity constraints prevent some relatively able poor students from enrolling in college (e.g., Lang (1993); Kane (1994, 1996); Card (1999); Belley and Lochner (2007); Lochner and Monge-Naranjo (2011a); and Brown, Scholz and Seshadri (2012)).<sup>1,2</sup>

Measuring the effects of credit constraints on college enrollment is a difficult task because determining whether a family has access to credit is difficult or impossible. Moreover, even if access to credit were directly observed, there are many other unobserved variables that affect college enrollment and are likely to be correlated with access to credit, leading to biased estimates.<sup>3</sup> For example, students from high income families may have better access to credit markets, but also may have stronger preferences for college education, better academic preparation, and superior cognitive and non-cognitive skills unobserved by the econometrician. On the supply side, access to loans is sometimes correlated with ability, for example, Van der Klauuw (2002) argues that colleges' grants are increasingly based on academic merit and are used to encourage the best admitted students to enroll in a given college, rather than being used to assist students from low income families. In addition, the admission process relies on unobserved and subjective measures, such as recommendation letters, parental alumni status, etc. Recognizing the problem, tests of the credit constraint hypothesis have relied mainly on indirect measures of credit access that lead to mixed - and sometimes inconsistent - findings.

In this paper, I exploit sharp eligibility rules of two loan programs recently introduced in Chile. These programs give access to college tuition loans for students who score above a certain threshold on the national college admission test. Around the eligibility cutoff these programs provide tuition loans directly, which are as good as randomly assigned (Lee (2008)) enabling a regression discontinuity design that addresses the problems of unobserved omitted variables and selection. Thus, these loan programs allow for a direct and unbiased estimate of the causal effect of credit access on

---

<sup>1</sup>See Lochner and Monge-Naranjo (2011b) for a detailed review of the literature.

<sup>2</sup>A different approach is given by Attanasio and Kaufmann (2009) and Kaufmann (2010), they use differences in the expected returns and information sets between students from high and low income families to explain the college enrollment differences in Mexico, concluding that the sensitivity of low income students to change in direct costs suggests the presence of credit constraints.

<sup>3</sup>This econometric problem has also been documented in the literature that estimate the price elasticity of demand for college education (e.g. Manski and Wise (1983), McPherson and Schapiro (1991), Van der Klauuw (2002), Dynarski (2003) and Nielsen, Sorensen and Taber (2010)).

college enrollment and college progress.<sup>4,5</sup>

A key feature of my analysis is the availability of detailed student-level data that present several advantages over the samples used in earlier studies. First, I observe the *entire population* of individuals who participate in the national college admission process, including full information on their enrollment (institutions, programs, preferences, etc.). Second, I observe the two variables that *completely determine* college admission: the scores on the national college admission tests<sup>6</sup> and high school GPA, ruling out potential biases from admission processes that weight subjective characteristics. Third, the two loan programs provide access to *standardized loans* to eligible students, offered by the government and private banks, eliminating potential endogeneity of loan offers designed to attract better students. The nature of the loan programs, that gives credit access as good as randomly around the threshold, the admission system characteristics, and the availability of these data, allow a reliable evaluation of the causal effects of credit access on college enrollment and college progress. To the best of my knowledge, this is the first paper that uses an exogenous source of access to loans and the entire population of students and institutions that participate in the college admission process.

My analysis shows that access to the loan programs increases the college enrollment probability by 18 percentage points - equivalent to a nearly 100% increase in the enrollment rate of the group with test scores just below the eligibility threshold. Students from the lowest family income quintile benefit the most: for these students access to the loans causes a 140% increase in the probability of enrollment (on a baseline enrollment rate of 15% for students just below the cutoff).

More importantly, access to the loan programs appears to eliminate the relatively large income gradient in college enrollment. Among those who are barely ineligible for loans, students from the richest quintiles are twice as likely to enroll as students from the poorest quintile. On the contrary, among students who are barely eligible, the enrollment gap is statistically zero.

The literature on the importance of liquidity constraints has focused mainly on college enrollment, but programs that promote enrollment would not have any significant effect on educational attainment if they attract students who are unable to graduate. For this reason, a different strand of literature examines the impact of aid on persistence, dropout and graduation rates (e.g. Dynarski (2003); DesJardins, Ahlburg and McCall (2002); Bettinger (2004); Singell (2004); and Stinebrickner and Stinebrickner (2008)), with a similar level of disagreement on the conclusions, than the literature on college enrollment.<sup>7</sup>

This strand of the literature faces additional econometric problems. Enrolled students constitute

---

<sup>4</sup>In terms of the methodology, Canton and Blom (2010) and Gurgand, Lorenceau and Melonio (2011) perform an RDD analysis using information on Mexican and South African students.

<sup>5</sup>Rau, Rojas and Urzúa (2013) analyzes enrollment, dropout rates, and earnings for one of the two loans analyzed here, The State Guaranteed Loan program. Using a sequential schooling decision model with unobserved heterogeneity.

<sup>6</sup>Language and mathematics tests are mandatory and science and history are optional (students choose at least one of the last two).

<sup>7</sup>See Chen (2008) and Hossler et al (2009) for a survey of the literature.

a self-selected sample of individuals, and therefore the relationship between credit constraints and persistence and dropout rates cannot be interpreted as a causal relation. Furthermore, in most cases, the analysis is performed using information from a single institution or restricted group of institutions. That implies two more concerns. First, the analysis depends critically on the characteristics of the analyzed institution. Second, in many cases, transferred students are mistakenly considered dropouts.

The data used in this paper allows following students up to their third year of enrollment. Using the same exogenous variation in access to loans, I estimate the causal effect on college progress, defined as enrollment in the second and the third year. Using the population of students that participate in the admission process eliminates the selection bias in the analysis of college progress, and using all institutions eliminates the bias associated with transferred students and presents general evidence not contingent on one institution.

In this context, I estimate that for each student who enrolls in second year of college without access to credit, 3.1 enroll in the second year when access to loans is available. Moreover, for every student who enrolls in the third year of college without access to credit markets, 5.5 do so when they have access to loans.

Additionally, access to the loan programs eliminates the income gradient in second and third year college enrollment. Among those barely ineligible for loans, students from the poorest income quintile enroll at 6% and 3% in the second and third years respectively, while students from the richest quintile enroll at 20% in both years. On the contrary, among those barely eligible for loans, there is no statistical difference in the enrollment rate in the second and third year between the richest and the poorest students, both groups enroll at the rate of 20%.

To interpret these results as evidence of credit access, I estimate the effect of lower than market interest rates and low enforceability, a “price effect” (see Dynarski (2003); and Lochner and Monge-Naranjo (2011a)), using a second natural experiment that gives exogenous access to a scholarship program that reduces tuition costs dramatically when loans are available for everybody. Students that score more than the scholarship cutoff face a reduction of 90% on tuition cost while students that are ineligible for the scholarship still can use the loans to finance college. I find that students with access to loans have the same enrollment rate as those who benefit from a reduced tuition cost, i.e. the price effect is zero.

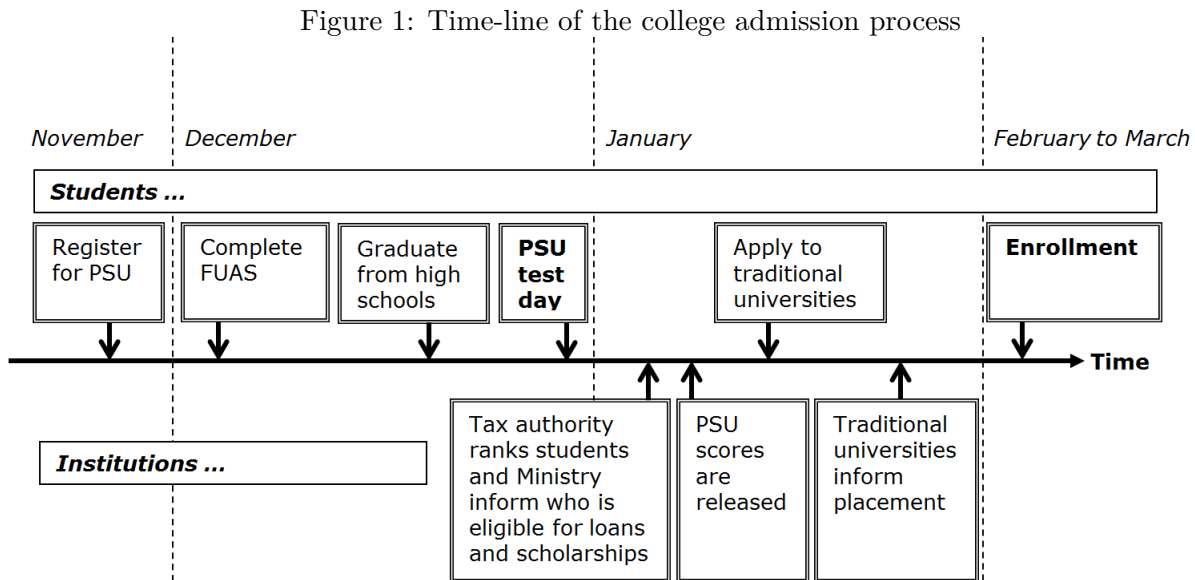
To reinforce the idea of credit access being the most important factor driving the results on enrollment, I use survey data from a subset of students around the threshold, to analyze directly the importance of financial problems on the enrollment decision. The rate of students responding that financial problems prevent them to enroll in college drops between 10 to 12 percentage points at the cutoff. Finally, I present a test that uses the differences in interest rates and enforceability of the two loans and the different predicted responses for different income quintiles to decompose the enrollment effect into price and access effects. I find that the price effect is small and conclude

that the overall effect is driven by loan access.

The paper is organized as follows. Section 2 describes the background and the data. Section 3 discusses the empirical strategy. Section 4 presents the empirical evidence for the effects of credit access on college enrollment and progress, and the enrollment gap by family income. Finally Section 5 presents the decomposition of the effect into access and price effects. Section 6 concludes.

## 2 Background and Data

One key feature of the data is the possibility to observe every aspect of a partially centralized college admission process and the entire population of students that participate in a college admission process nationwide. The admission process is based on the college admission test (Prueba de Selección Universitaria, PSU Test hereafter), which is taken by 96% of all students graduating from high school each year.<sup>8</sup> Some students take it even when they do not plan to enroll in tertiary education, because sometimes it is required as a high school graduation certificate. The test is taken simultaneously across the country only once a year, and can be taken as many times as wanted after paying a fee.<sup>9</sup> The admission process is described in figure 1, it depicts students decisions and the information available for them.



Note: Above the time-line, the decisions taken by students. Below the time-line, the timing of information releases.

Students need to register for the PSU test and complete a socioeconomic verification form

<sup>8</sup>Source: Ministry of Education.

<sup>9</sup>The fee is about \$50 or CLP 25,000 (pesos of 2012) and is waived for all students graduating from public and voucher schools who apply for a waiver.



(Formulario Único de Acreditación Socioeconómica, FUAS) before graduating from high school. Few days after graduation students write the PSU test and within two weeks students know whether they are eligible for the two loans analyzed here and for almost all scholarships available from public funds. Around the same days, students are informed about their scores in the PSU test.

## 2.1 The College Admission Test and Placement.

The PSU test consists of two mandatory tests on language and mathematics and two optional tests. The average on the mandatory tests is referred to as the *PSU score*, and is used for college placement and for loans and grants eligibility.<sup>10</sup>

The tests have only multiple choice questions which are answered on a special sheet that is graded automatically by a photo optical device, and therefore, it is not subject to manipulation by students or graders. PSU scores are normalized to a distribution with mean 500 and standard deviation of 100 to make them comparable among years. The scores range from 150 to 850 points.<sup>11</sup>

Once students know their PSU scores, they can apply to two types of universities, called “traditional” and “private”. The “traditional” universities consist of 25 institutions that were founded before the educational reform of 1981. Some are public and others are privately funded, but all receive direct funding from the government (Aporte Fiscal Directo).

The 33 universities created after the reform of 1981 are called “private” universities. They do not receive direct funding from the government, and before 2006, their students were excluded from the credit system with public funds. Their growth has been rapid and steady, increasing enrollment from a handful of students in 1991 to nearly half of the student body in 2009.

Both types of universities use the PSU test score to select students. Traditional universities use the test as a mechanism to centrally allocate applicants. The allocation process is as follows: After knowing their scores, students apply to up to 8 programs, and all the students applying to any given program are ranked using the scores on the PSU tests (the two mandatory and one optional test), and high school GPA. Seats are offered to the best scoring students in each program and the rest are put on a waiting list. If a student is accepted into more than one program, she is placed in her highest preference and is eliminated from all other rankings. If students do not matriculate in specific dates, spots become available following the ranking on the wait list.

Private universities receive applications independently, but they also select applicants considering the PSU test score and high school GPA. They prefer students with higher PSU scores for four reasons. First, it is required by law that the institutions that receive students with the State

---

<sup>10</sup>The optional tests are (1) History and Social Sciences and (2) Sciences, which includes modules on biology, chemistry, and physics. They are not considered for loan eligibility, but they are considered in the placement score that is a factor in admission to college programs.

<sup>11</sup>The PSU test is implemented by the Council of Chancellors of Chilean Universities (Consejo de Rectores de las Universidades Chilenas: CRUCH), which organizes the traditional universities that are as described below.

Guaranteed Loan program (SGL) select students based on the PSU score.<sup>12</sup> This loan program has become the main source of financing for these universities and explains its rapid growth since 2006. Second, private universities use PSU scores to distinguish the quality of the students, it is the best ability measure available. Third, all the universities in the country compete to get indirect governmental funding (Aporte Fiscal Indirecto), which is calculated based on PSU scores from the students enrolled in each institution every year (this funding is the second source of earnings for private universities). Fourth, the PSU scores of the student body are used to publicize the quality of the programs to attract more students. Each year, before the PSU test, universities disclose the PSU score of the last student enrolled in each program (program cutoff score or puntaje de corte) to signal how much in demand they are.

After the whole enrollment process is finished, universities inform the ministry about the enrollment in all their programs, and the ministry assigns loans, grants and scholarships.

## 2.2 Financial Aid

Financial aid from the Education Ministry is assigned according to the information provided by students before the PSU test, in the economic status verification form (the FUAS form). This information is sent by the ministry to the Chilean tax authority (Servicio de Impuestos Internos or SII) to verify the information and classify students in income quintiles. One of the most important characteristics of the Chilean college admission process is that, except for one program, all aid (loans and scholarships) managed by the State is assigned depending on PSU scores and income quintiles determined by the tax authority with the information from the FUAS form. Table 1 summarizes all college related financial aid given or managed by the Ministry of Education.

The only two college tuition loans given with public funds in the country are the Traditional University Loan program (Crédito Solidario, TUL hereafter) and the State Guaranteed Loan program (SGL hereafter). The same eligibility criteria are used in both programs, namely, students are required to be classified by the tax authority in one of the four poorest income quintiles, and score at least 475 points in the PSU test. The only difference in terms of eligibility is that TUL is given to students enrolling in one of the 25 traditional universities, while the latter can be used at any of the 44 accredited universities in the country (all the traditional universities and 18 private universities).

Both programs aim to cover tuition costs (only), up to the reference tuition. The reference tuition is an amount calculated by the Ministry of Education about how much a program should cost depending on the institution assets' quality and the labor market perspectives after graduation of any program. On average the reference tuition is slightly less than 90% of the actual tuition cost. Any part not covered by these loans has to be covered by the student.

---

<sup>12</sup>Law 20,027, title III, article 7. This law created the SGL on June of 2005. All accredited universities receive students with SGL.

On average, annual college tuition is 1.8 million pesos (pesos of 2009, or 3.6 thousand U.S. dollars), while the median family income is 4.5 million in nominal terms (9 thousand dollars).<sup>13</sup> Therefore, even after receiving one of these loans to matriculate in college, the non-covered portion of the tuition and the indirect costs may still be a financial burden for families in the bottom income quintiles, leaving space for liquidity constraints.

---

<sup>13</sup>Calculated using the household survey CASEN 2009. Per capita Income (PPP) is approximately 14 thousand dollars (pesos of 2009). The difference is indication of the inequality in the income distribution.

Table 1: Requirement for scholarships

<b>PANEL A: Requirements for loans and scholarships.</b>						
	% Recipients <sup>1</sup> with respect to:		Requirements:			Cover (6)
	Population	Eligibles	Income quintiles	PSU Cutoff	Institution type	
	(1)	(2)	(3)	(4)	(5)	
<b>Loans</b>						
State Guaranteed	9.46%	27.90%	1 to 4	<b>475</b>	Accredited <sup>+</sup>	(a)
Traditional Loan	8.58%	21.92%	1 to 4	<b>475</b>	Traditional <sup>++</sup>	(a)
<b>Scholarships and Grants</b>						
Bicentenario	4.70%	55.14%	1 and 2	550	Traditional	(a)
Juan Gomez Millas	0.02%	0.87%	1 and 2	640	Accredited <sup>2</sup>	(a)
PSU Score grant	0.02%	0.05%	1 to 4	-	Accredited <sup>3</sup>	(b)
Exellence	2.32%	4.78%	1 to 4	-	Accredited <sup>2,4</sup>	(a)
Teacher's children: BHDP	1.02%	3.98%	1 to 4	500	All <sup>5,6</sup>	(c)
Pedagogy: BPED	0.07%	0.74%	all	600	Accredited <sup>5</sup>	(b)

**PANEL B: Income quintile definitons.**<sup>(\*)</sup>

Income Quintile	I	II	III	IV
Upper bound Monthly family Income in CLP	178,366	306,000	469,625	777,218
Upper bound Monthly family Income in USD	364	624	958	1,586

Notes:

(1): Column (1) reports the ratio of recipients over students taking the test for the first time. Column (2) correspond to the ratio of recipients over those that take the PSU test for the first time, have applied to the benefit, belong to eligible quintiles and score more than the respective cutoff.

(2): Only students graduating from voucher and public high schools.

(3): National or regional best PSU score.

(4): Only for students in the top 5% of their graduating high school.

(5): Only student with high school GPA greater than 5.5 are eligible for BHDP, and only GPA greater than 6.0 for BPED. High School GPA goes from 1 to 7 points.

(6): Only for children of teachers and employees from voucher of public schools.

(<sup>+</sup>): "Accredited" refers to all accredited colleges (traditional and private) and accredited vocational institutions.

(<sup>++</sup>): "Traditional" refers to traditional universities which are all accredited.

(a): Funds up to reference cost.

(b): Funds up to fixed value, about the same magnitude than reference tuition US\$2,250 for univ., which corresponds to the average reference tuition, and US\$1,000 for vocational programs).

(c): Funds up to US\$1,000 which correspond to a quarter of the university average tuition or total vocational school tuition.

(\*): Source: CASEN 2009. Calculated using autonomous income per family. Household autonomous income included salaries, rents, subsidies from the governments, pensions, etc. for all members of the family.

**2.2.1 The Traditional University Loan Program**

The Traditional University Loan Program is managed by the universities, which determine the amount to lend and are in charge of the collection process.<sup>14</sup>

<sup>14</sup>It was introduced in 1981 as part of an educational reform. However the eligibility criteria used in this paper was introduced in 2006.

This loan has special conditions that make it very attractive to students. The real interest rate on this loan is about 2% per year with a maximum of 15 years of payments - after that, the debt is written off. Repayment starts two years after the student's graduation and the installments correspond to 5% of the borrower's income. Moreover, any portion of tuition not covered by this loan can be covered by the State Guaranteed Loan.

Despite these special characteristics, the loan has a low repayment rate (from 52 to 60% for the years considered). One possible reason is that the universities are in charge of collecting loan payments in the first stage and, in a second stage, a central organization named Fondo Solidario; neither are specialists in collecting loans. In recent years, the Chilean government has made some modifications that allow the tax authority to retain tax refunds and publicize names of defaulting students; this has increased the repayment rate to 80% (in some cases) of all reprogrammed loans.<sup>15</sup> The low enforceability and the low interest rate indicate the existence of a subsidy component in this loan scheme.

### **2.2.2 State Guaranteed Loan program**

The State Guaranteed Loan program allows private banks to provide college tuition loans to eligible students. These loans are guaranteed by the state and by higher education institutions. To be eligible, students need to fulfill the three requirements mentioned above and enroll in one of the 44 accredited universities.

Out of the 58 institutions that provide college education in Chile, 77.6% participate in the program. Of the remainder, 19% are not accredited institutions and 3.4% have dropped out of the program. Some institutions ask for higher PSU scores to guarantee the loan, but 85% of all programs require the standard 475 PSU score to be eligible.

This loan scheme is very similar to loans currently available in the conventional financial market. First, the real interest rate was about 6% per year in the years considered, which corresponds to the government long-run interest rate,<sup>16</sup> and is slightly higher than the mortgage rate for the same period. Anecdotally, this loan and its interest rate led to massive street protests in 2011 and 2012. It was considered too expensive, because some graduates had to pay up to 17% of their income after graduation.

Second, private banks make the loans and are in charge of the repayment process. Private banks can use all available legal mechanisms to recover the debt, including release of information to credit score institutions, asset impoundment, and judicial collection. Releasing information to credit scores institutions is important in the labor market in Chile, because usually firms request that potential employees not appear as defaulters in credit score records.

---

<sup>15</sup>Source: Fondo Solidario de Crédito Universitario.

<sup>16</sup>Source: International Comparative Higher Education and Finance Project. State University of New York at Buffalo.

Third, installments do not depend on the borrower’s income. The SGL program requires students to start repayment 18 months after graduation in monthly installments for 20 years.

Fourth, to increase the enforceability of the debt, the loan contract has special clauses that involve the tax authority and employers. Employers are mandated to deduct repayments directly from payroll and to make payments directly to banks. The law also establishes penalties to employers who do not comply with this process. Additionally, the loan contract allows the tax authority to retain tax refunds in case the former student does not pay the lending bank. This last characteristic has proven to be an efficient measure, increasing repayment for these traditional loans since 2002.

In the case of dropouts, the higher education institution guarantees the loan: 90% of the capital plus interest for the first year, 70% for the second, and 60% for the third year onward. The state guarantees up to 90% when the educational institution covers less than that percentage. In the event that a student stops paying, after the bank implements all mechanisms used to collect the loans, the guarantors (the state and/or the educational institution) must pay the bank and become responsible for enforcing collection from the student.

For all these reasons, I argue that this loan scheme can be used as a market benchmark.<sup>17</sup>

### 2.2.3 Other Loans Available

In order to have a broad picture of what type of loans students have available in the conventional financial market, here I briefly describe other sources of financing. First, some colleges offer scholarships or loans to complement the loans described above. The objective of these loans is to attract the best students, and therefore, these scholarships and loans require much higher PSU scores than 475. Hence, the presence of such loans will not confound the effects of the two loan programs that I study.

There are two types of loans given by private banks: the Corfo loans (“crédito Corfo”),<sup>18</sup> and private bank loans. To get any of these loans, students need a guarantor, who needs to certify a good credit record, be employed, have a regular income source, and have a minimum family income or assets to use as collateral.

Corfo loans are offered by private banks, which manage the entire process, using resources coming from the Corfo development office. These loans have interest rates that vary among banks, ranging from 6.8% to 8.5% (real annual), and require a minimum guarantor monthly income of CLP 600,000 (USD 1,225), corresponding to a family income in the bottom part of the fourth income quintile (see Panel B on Table 1 for the definition of the income quintiles).

Secondly, banks also offer loans with their own resources. The most relevant is the one given by

---

<sup>17</sup>This program was designed to give a market alternative to students who did not have access to traditional loans: students in private universities and vocational schools.

<sup>18</sup>Corfo (Corporación de Fomento a la Producción) is a development office from the government.

BancoEstado.<sup>19</sup> This loan is aimed at lower income families, but the two poorest income quintiles and part of the third are excluded. The minimum family monthly income required to apply for this loan is CLP 350,000 (USD 714). The real interest rate lies between 6.6% and 6.8% annually. All other loans from private banks have very similar requirements but ask for higher minimum family income, starting at CLP 600,000 (USD 1,225).

Both of these loans depend on family characteristics that exclude students from the poorest families. The income requirement is the main source of exclusion, but some families are excluded when they do not have a stable income source or have bad credit records. This is especially important in a country with high levels of labor market informality. According to the national household survey CASEN, in 2006, 36% of all workers are in the informal sector (self-employed or without a contract), and therefore students from those families were excluded from getting college loans in the regular market. Moreover, students need to rely on family altruism to get support when asking for loans.<sup>20</sup> In contrast, the two loan programs analyzed in this paper do not depend in family characteristics for 80% of the population (the four poorest income quintiles).

### 2.3 Data and Sample

This paper combines several sources of administrative data that allows to observe in detail the outcome of the college admission process. The first data source in this paper is the registry of students who enroll for the PSU test. It contains individual data on PSU scores, high school GPA, which determine placement in universities; and a rich set of socioeconomic characteristics, such as self-reported family income, parent education, school of graduation, etc. for the years 2007 to 2009.

The PSU data set also contains information on the application preferences to traditional universities and the placement results from the centralized mechanism.

The second source of data used in this paper is the enrollment in higher education data set from the Ministry of Education. It includes the enrollment outcome of the process described above (for all programs and institutions) for the same period of time.<sup>21</sup>

The enrollment data for 2008 and 2009 also contain information about the enrollment status of students enrolled initially in 2007 and 2008. I use this data to measure the effect of credit access on college progress (enrollment in the second and third year of college) and on dropout rates.

The third source of information is the FUAS application form data set for the same years. The key element in this data set is the income quintile reported by the tax authority that determines eligibility for the two loan programs and for six scholarship programs. Moreover this data set contains the assignment to benefits and take up for the traditional loan.

---

<sup>19</sup>A private bank with partial ownership by the government of Chile.

<sup>20</sup>Brown, Scholz and Seshadri (2012) have indicated this factor as an important source of credit constraints.

<sup>21</sup>All data sets were merged using the national identification number, RUN (Rol Único Nacional).

The last set of information used in this paper corresponds to loan take up for the State Guaranteed Loan Program from the INGRESA commission, the organization created to manage this credit program in 2006.<sup>22</sup>

The data present two sources of selection that may be problematic. First, students that do not complete the FUAS socioeconomic form before the PSU test are not eligible, and therefore they are not affected by the cutoff. Second, because students can take the PSU test as many times as desired, a student may try repeatedly until getting a score equal to or greater than 475, self-selecting to be eligible for loans

I address the first problem by restricting the analysis to students who comply with all the requirements to get the TUL or the SGL loan before the PSU test (*preselected students*, hereafter). For this sample of students, crossing the threshold implies a sharp change in access to tuition loans. To address the second problem (to eliminate the self-selection into treatment), I restrict the sample to students that are first-time test takers. Specifically, to students that graduate from high school the same year they take the PSU test.

### 3 Empirical Strategy

As described in the previous section, two financing programs in Chile offer college tuition loans to students who satisfy three conditions: first, complete the socioeconomic verification form FUAS before taking the PSU test; second, are classified in one of the poorest four income quintiles by the tax authority; and third, score at least 475 points on the PSU test.

This last requirement enables a sharp regression discontinuity design for those students that comply with the first two conditions. Students receive access to loans as good as randomized around the cutoff (Lee, 2008) and, therefore comparing college enrollment rates for the group at or just above the cutoff (the “treatment” group) and the group just below (the “control” group) gives the causal effect of credit access on college enrollment.

Hahn, Todd and Van der Klaauw (2001), Van der Klaauw (2008), Lee (2008), and Lee and Lemieux (2010) describe the conditions under which a RDD gives a causal estimation. The intuition is simple. If we assume that each individual’s score (the running or assignment variable) has a random component with a continuous density, then the probability of scoring  $\epsilon$  above the cutoff or scoring  $\epsilon$  below is the same (for a sufficiently small  $\epsilon$ ). Therefore, even though the score depends on the individual characteristics (selection), being eligible for treatment in this small neighborhood of the cutoff is as good as random assignment. Thus, students barely below the cutoff can be used as a counterfactual to students barely above the cutoff, because the only difference between these

---

<sup>22</sup>The assignment rule was fulfilled for all years except 2006, the first year of implementation, when the commission managing the SGL program misassigned part of the loans. Therefore, I do not consider 2006 from the analysis. In all other years, the assignment rule was fulfilled perfectly.



two groups is that students above the cutoff receive the treatment.

Ideally, we would compare the average outcome for students at a small neighborhood of the threshold, but usually there is not enough data in this small vicinity, and thus the estimation suffers from small sample bias. Lee and Lemieux (2010) suggest the following equation as an equivalent specification to estimate the RDD.

$$Y_i = \beta_0 + \beta_1 \cdot \mathbf{1}(T_i \geq \tau) + f(T_i - \tau) + \xi_i \quad (1)$$

Where  $\mathbf{1}(T_i \geq \tau)$  is an indicator function for whether the student  $i$ 's PSU score  $T_i$  is equal to or greater than the eligibility threshold  $\tau$ ; the term  $(T_i - \tau)$  accounts for the influence of the running variable on  $Y_i$  in a flexible nonlinear function  $f(\cdot)$ ; and  $\xi_i$  is, a mean zero error. The parameter  $\beta_0$  captures the expected value of  $Y_i$  for students barely below the cutoff and  $\beta_1$  captures the increase in the expected value of  $Y_i$  for individuals  $\epsilon$  above the cutoff.

Equation (1) allows using students who are not necessarily close to the cutoff. The advantage is the increased statistical power due to adding more data to the estimation. The disadvantage is the bias produced by individuals who are farther from the cutoff when  $f$  is not correctly specified. Imbens and Kalyanaraman (2012) propose a method to calculate an asymptotically optimal bandwidth to use a local linear regression in equation (1), where they use a squared error loss function to weigh these two biases.

The results shown in this paper are based on a local linear regression using the optimal bandwidth of Imbens and Kalyanaraman, which in this case gives a bandwidth of 44 PSU points around the cutoff ( $w^* = 44$ ). Nevertheless, the results are highly robust to different bandwidths and functional specifications.<sup>23</sup>

Alternatively, to use the whole population of students, the follow specification interacts the condition of being preselected with the indicator of scoring at least the cutoff.

$$Y_i = \beta_0 + \beta_1 \cdot \mathbf{1}(T_i \geq \tau) + \beta_2 \cdot PreSel_i + \beta_3 \cdot \mathbf{1}(T_i \geq \tau) \cdot PreSel_i + f(T_i - \tau) + \xi_i \quad (2)$$

In this case  $\beta_1$  is the change in the probability of enrollment in college after scoring at least the cutoff for those ineligible for loans (those who did not complete FUAS or were classified in the richest quintile). This parameter captures whether scoring more than the cutoff plays the role of a signal for the students. For example, scoring the cutoff or more may be interpreted by students as they are suitable for college because the State want to finance their studies in case of being eligible.

The variable  $PreSel_i$  is an indicator of being classified in one of the poorest four income quintiles

---

<sup>23</sup>Additionally, I will use equation (1) to test if baseline characteristics are balanced around the threshold to test the local continuity assumption implicit in RDD.

after filling the FUAS form. The coefficient  $\beta_2$  captures if there is any difference in the probability of enrollment between those who complete FUAS and those who don't. Those who complete the socioeconomic form may be more interested in the loans, either because they have higher preferences for college or higher preferences for the terms of the loans.

In this specification, the parameter of interest is  $\beta_3$  which measure the effect on college enrollment for those students that scoring at least the cutoff imply a change in their access to tuition loans.

### 3.1 Enrollment in Second and Third year

One concern from the policy maker's perspective is that access to loans may have an effect only on initial enrollment, but not on the graduation rate, if loans are given to students without the proper preparation for college education. Hence, it is not sufficient to observe an effect in the first year enrollment rate to reduce the education attainment gap.

I estimate the causal effects of access to loans on enrollment in second and third year of college, using the same exogenous variation. In this case, I deal with the problem of selection into treatment in the second or third year of college using a fuzzy RDD.

In the previous case, eligibility for loans was determined sharply by the score in one PSU attempt. For second (third) year enrollment, students have the chance to retake the PSU test once (twice) (since the test is written once a year). Students with scores lower than the cutoff may enroll in college for the first year, expecting that they can get access to loans from the second (third) year if they score at least 475 in a subsequent attempt, thus self-selecting into treatment. For this case, eligibility is not fully determined by the score of the first attempt (the probability of being eligible for loans for second and third year enrollment is not zero for the control group). Nevertheless, the probability of being eligible still jumps discontinuously at the threshold, because not all students who scored below 475 in their first attempt retake the test, and only a portion of those succeed in scoring 475 or more in subsequent attempts. This allows a fuzzy RDD, where eligibility in the second and third year is instrumented by being eligible in the first, i.e. a dummy for scoring greater than or equal to 475 in the first year.

Specifically, I perform a two stage least square regression as follows:

$$Elig_i = \gamma_0 + \gamma_1 \cdot \mathbf{1}(T_i \geq \tau) + f(T_i - \tau) + \eta_i \quad (3)$$

$$Y_i = \beta_0 + \beta_1 \cdot Elig_i + f(T_i - \tau) + \nu_i \quad (4)$$

The term  $\mathbf{1}(T_i \geq \tau)$ , the indicator function for scoring greater than or equal to the cutoff in the first attempt, is used as instrument for being eligible for loans.  $Elig_i$  takes on the value 1 if student  $i$  is eligible for college loans in the year of analysis, and zero otherwise. The dependent variable  $Y_i$  corresponds to the outcome of interest: enrollment in the second year, or enrollment in the third

year (or dropout status for the analysis in the appendix). All the other variables are defined as in equation (1).

Now, the parameter  $\beta_1$  measures the effect of having access to college loans on enrollment in the second and third year for those for whom the treatment status does not change in the following years, after taking the PSU test for the first time.

## 4 Results

This section presents the empirical evidence organized as follows. Section 4.1 tests the conditions for a valid RDD: random loan assignment, absence of manipulation of PSU scores, and balance on baseline characteristics between the eligible and non-eligible students around the cutoff. Section 4.2 shows results for the estimation of the causal effect of loan access on college enrollment. Section 4.3 presents results by income groups and revisits the college enrollment gap. Section 4.4 presents the effects on college progress, and the family income gap on progress. Section 5 decomposes the price and the access effect.

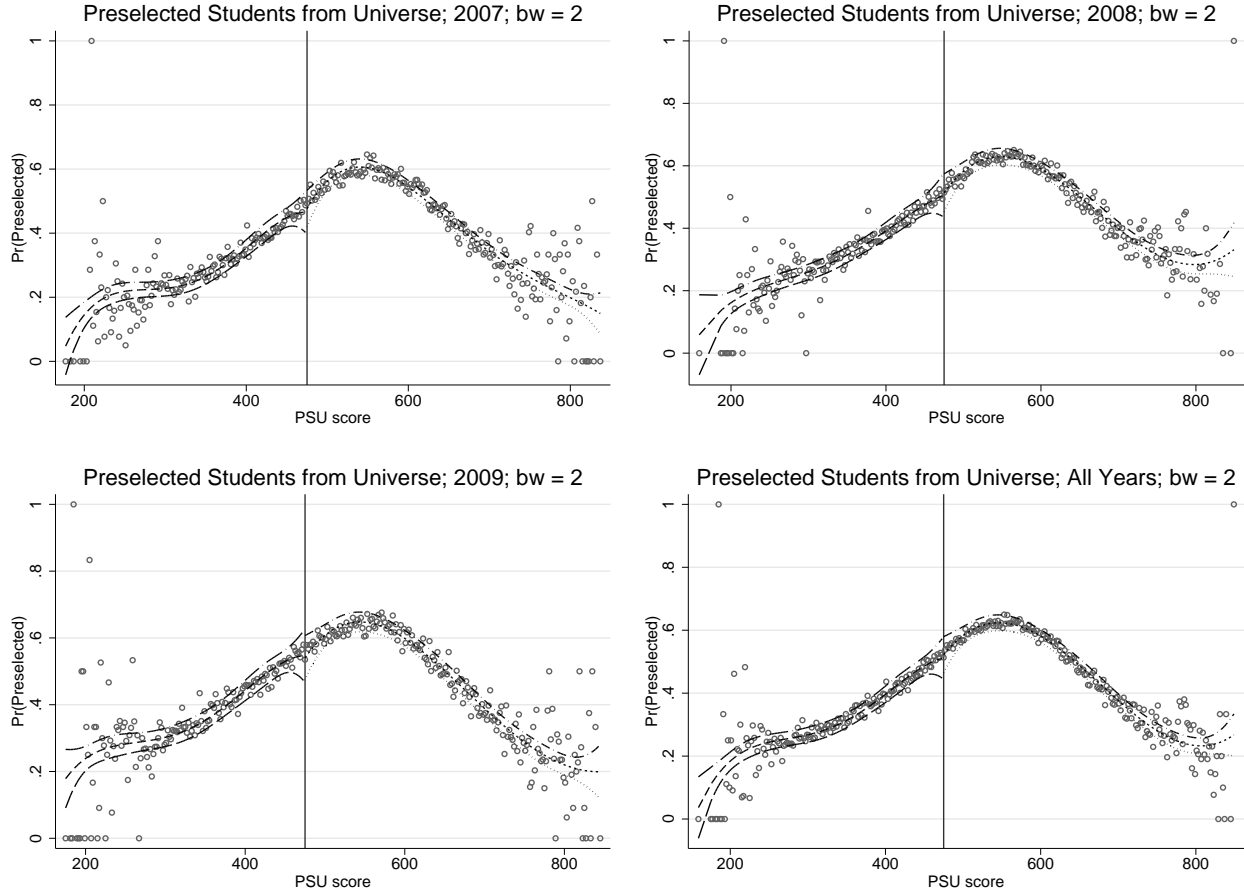
All the following RD results are restricted to the group who took the PSU test for the first time (see section 2.3 for details), and scored 44 PSU points around the loan program cutoff which correspond to the I&K optimal bandwidth that allows to control linearly for the running variable (see section 3).

### 4.1 Conditions for a valid RD design

#### 4.1.1 Loan Eligibility

Figure 2 shows that the probability of completing the FUAS socio economic form and being classified into the four poorest income quintiles (being pre-selected for loans) do not change at the cutoff (for all students and for students by year of PSU process). Each dot in every figure represents the average rate of pre-selection for students in bins of 2 PSU points, and the dashed lines correspond to fitted values from a regression that control for the PSU score using fourth order splines at each side of the threshold and 95% confidence intervals. For pre-selected students, loan eligibility changed sharply from 0 to 1 at 475, and forms the basis for the RD evaluation design.

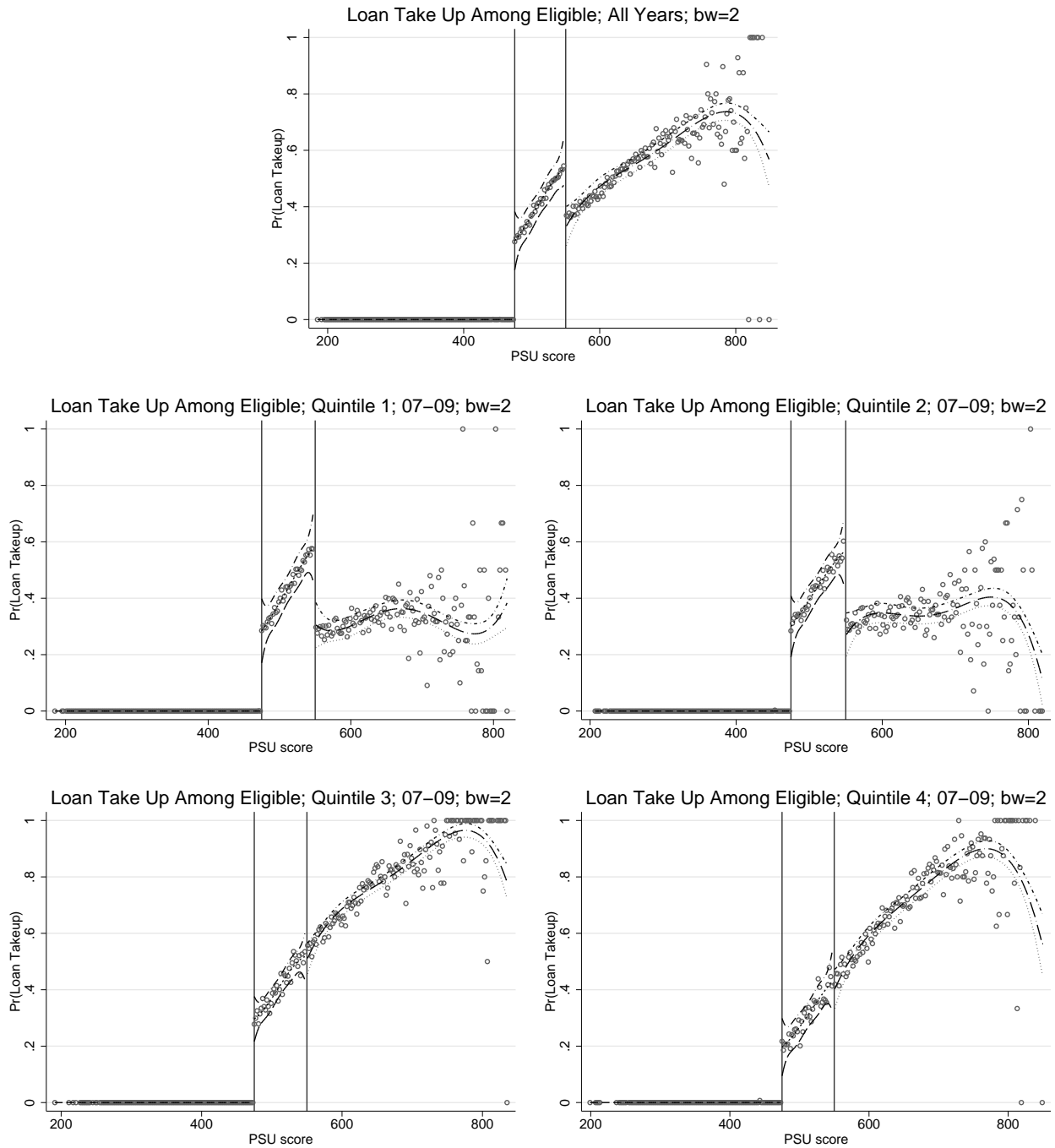
Figure 2: Probability of being *Preselected* for loans.



Note: Each dot indicates the preselection rate of students with scores in an interval of 2 PSU points (all students included). On average each dot contains 670 students. The dashed lines represent fitted values from a 4th order polynomial spline and 95% confidence intervals for each side. The vertical line indicates the cutoff (475).

Figure 3 shows loan take up among preselected. The upper left graph shows take up for all students in all years pooled together, while the other graphs show the same by income quintile. As before, each dot represents average take up among students within 2 PSU points and dashed lines fitted values and 95% confidence intervals. The first vertical line indicates the loan eligibility threshold (at 475) while the second vertical line (at 550) corresponds to the cutoff for the Bicentenario Scholarship, that will be used in section 4.3 to estimate the price effect directly. These graphs show that a third of the students took up any of the two loans around the threshold, while nobody from below the cutoff, as expected. For the discontinuity that occurs at 550, the take up of the two loans is substituted by the Bicentenario scholarship (more details will be given in section 5.1)

Figure 3: Loan take up. Probability of taking up a college tuition loan among preselected eligible students.

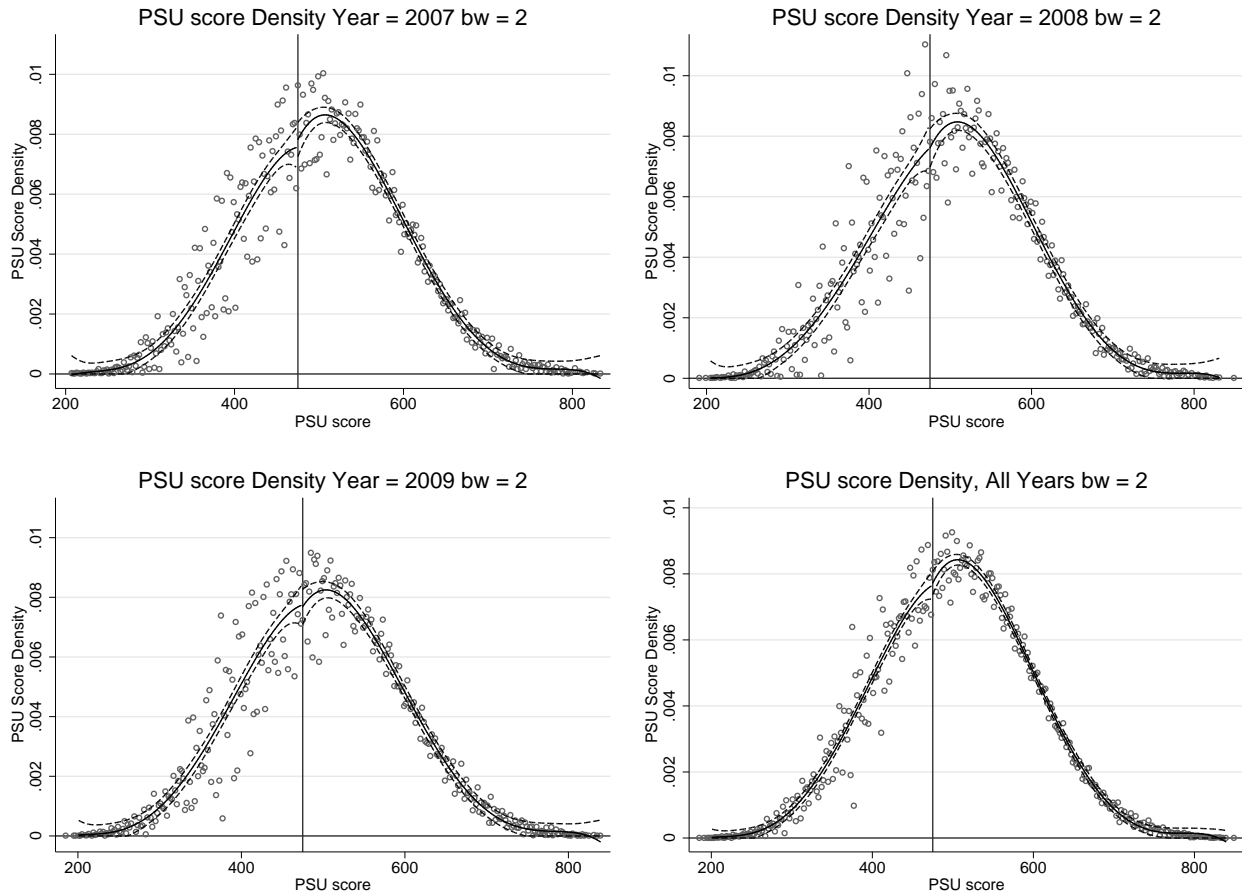


Note: Each dot represents average loan take-up relative to eligible students, in an interval of 2 PSU points. To the right of the cutoff, each dot contains on average roughly 441 students receiving the loans. The dashed lines represent fitted values from a 4th order spline and 95% confidence intervals for each side. The vertical line indicates the cutoff (475).

#### 4.1.2 Local Continuity Assumption: Manipulation of the Assignment variable.

Because the eligibility conditions are public knowledge, students may try to self-select into treatment manipulating their score to be just above the cutoff. This would violate the assumption that the assignment variable density is continuous at the cutoff (McCrary, 2008). I argue that manipulation is not feasible in this context. First, as explained in section 2.2, the PSU test contains only multiple choice questions that are graded by an optical device, and therefore it is an objective measure of the test outcome. Second, to verify this formally, Figure 4 shows the empirical density function of PSU scores, and fitted values from an estimation using fourth order splines for the assignment variable at each side of the cutoff, plus 95% confidence intervals. The test shows that the density function is statistically continuous at the cutoff, which confirms that PSU scores are not subject to manipulation around the cutoff.

Figure 4: RD for PSU scores frequency distribution.



Note: Each dot represents the density of PSU scores in an interval of 2 points. The sample considers only students who satisfy all requirements to be eligible for college loans and take the PSU immediately after graduating from high school.

### 4.1.3 Local Continuity Assumption: Balance of Covariates.

As a second test for the validity of the regression discontinuity design, I show that baseline characteristics are balanced at the cutoff.

First, as mentioned in section 2, no other aid or loan program influences the financial conditions for students in the vicinity of 475 (see Table 1). Secondly, I use equation (1) to show the balance on covariates at the discontinuity, where  $Y_i$  is now a covariate.

Table 2 and 3 shows the balance of covariates (for a linear  $f$  using the optimal bandwidth of  $w^* = 44$  PSU points) for the population of students, for the group that is preselected for loans, and for preselected students by income quintile. The first column in each category shows the level of the covariate at the cutoff (the parameter  $\beta_0$  in equation 1), the second column shows the change on the covariate for students barely above the threshold ( $\beta_1$ ) and the third column the  $t$ -value of the difference. In Table 2 the population, the preselected sample and the first two income quintiles, and in table 3 the last three income quintiles. Table 2 shows that all covariates are balanced with few exceptions. The population is not balanced at the 10% level of significance in number of females and high school GPA. Above the threshold there is approximately 1% more females students, and surprisingly students have a 0.3% lower GPA. For the second poorest income quintile, number of females and the indicator whether the student work previous the PSU test are not balanced at the 5% of significance. Table 3 reports similar conclusions, students above the cutoff are very similar to those barely below the cutoff, except for two or three characteristics in each quintile.<sup>24</sup> This evidence shows that the differences that appear in the data are in line with error of type I, i.e. from the 170  $t$ -tests reported in these tables, 13, 6 and 0 reject the null at the significance levels of 10%, 5% and 1% respectively, below the hypothetical levels of 17, 8.5 and 1.7.

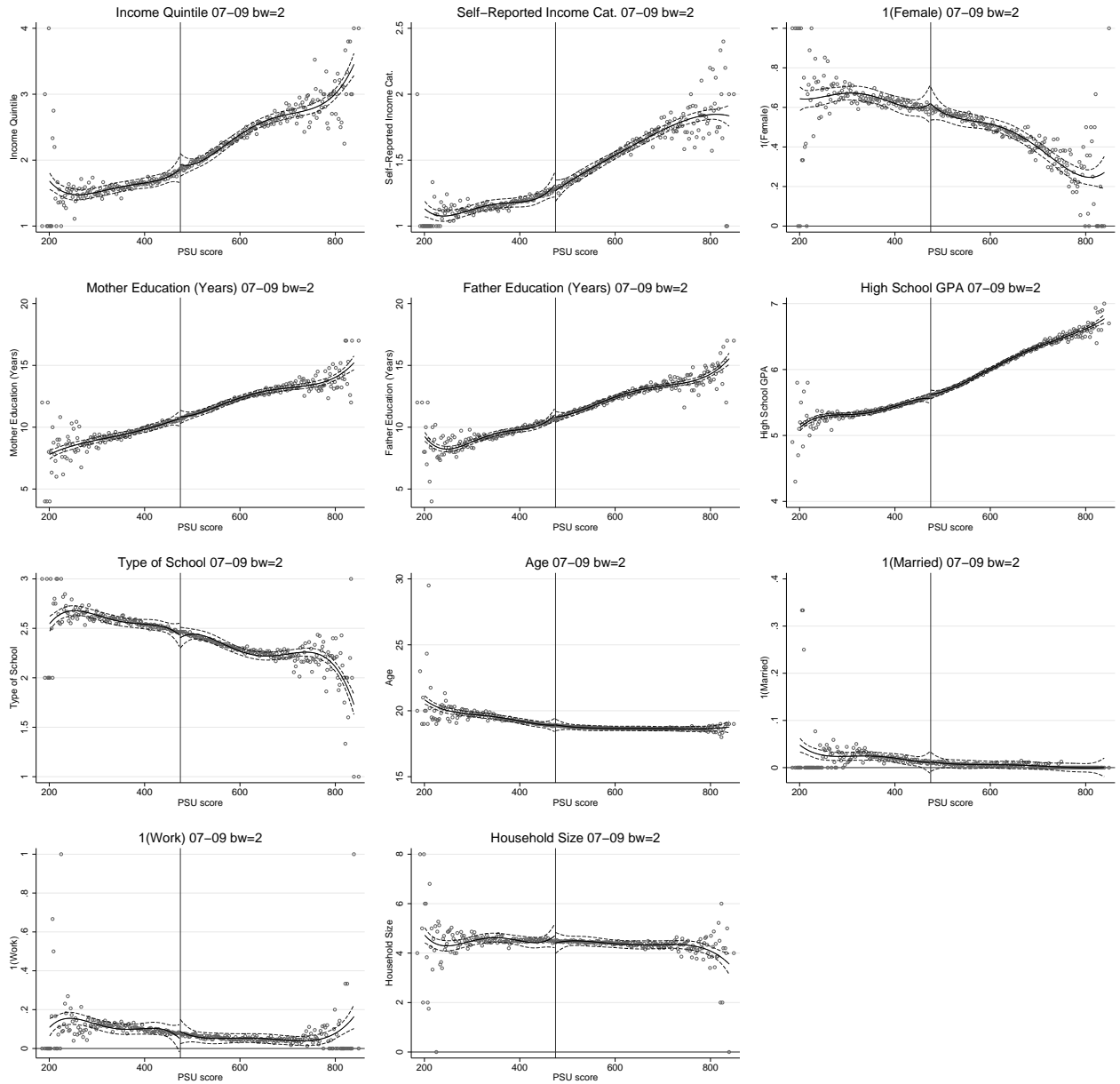
Figure 5 shows the balance on 11 of these baseline characteristics presented in Table 2 for the preselected group. All variables appear perfectly balanced at the cutoff.

All the conditions for a valid RDD are satisfied. Therefore, the comparison between students barely eligible and barely ineligible will give the causal effects of access to loans on enrollment and progress.

---

<sup>24</sup>The unbalance on type of high school is considered as only one characteristics since voucher, public and private schools are perfectly collinear.

Figure 5: RD for base line characteristics. Full sample.



Note: Each dot represents the average of the variable in an interval of 2 PSU points. The dashed lines represent fitted values from a 4th order spline and 95% confidence intervals for each side.

The vertical line indicates the cutoff (475). These graphs show the full sample of preselected first-time takers students.

Self-reported income is classified in three categories, 1 being the lowest. School type is classified in three categories, 1 for private, 2 for voucher, and 3 for public schools.



Table 2: Balance of Covariates. Population, preselected and by income quintiles

Variable:	Population					Preselected					Quintile 1					Quintile 2								
	Level (1)	Dif (2)	abs(t) (3)	Level (4)	Dif (5)	abs(t) (6)	Level (7)	Dif (8)	abs(t) (9)	Level (10)	Dif (11)	abs(t) (12)	Level (1)	Dif (2)	abs(t) (3)	Level (4)	Dif (5)	abs(t) (6)	Level (7)	Dif (8)	abs(t) (9)	Level (10)	Dif (11)	abs(t) (12)
Self-reported Income	1.38	0.003	(0.58)	1.28	-0.003	(0.405)	1.12	-0.005	(0.764)	1.28	-0.004	(0.279)	1.12	-0.005	(0.764)	1.28	-0.005	(0.764)	1.12	-0.005	(0.764)	1.28	-0.004	(0.279)
Income quintile	2.09	0.014	(0.777)	1.83	0.020	(1.334)	1			2			1			1			1			2		
Mother years of education	10.96	-0.019	(0.518)	10.66	-0.002	(0.035)	9.86	-0.093	(1.343)	10.92	0.104	(1.039)	9.86	-0.093	(1.343)	10.92	0.104	(1.039)	9.86	-0.093	(1.343)	10.92	0.104	(1.039)
Father years of education	11.03	-0.008	(0.19)	10.64	-0.010	(0.174)	9.81	-0.068	(0.875)	10.79	0.031	(0.28)	9.81	-0.068	(0.875)	10.79	0.031	(0.28)	9.81	-0.068	(0.875)	10.79	0.031	(0.28)
1(female)	0.541	0.009	(1.729)*	0.593	0.001	(0.191)	0.593	0.015	(1.583)	0.613	-0.037	(2.467)**	0.593	0.015	(1.583)	0.613	-0.037	(2.467)**	0.593	0.015	(1.583)	0.613	-0.037	(2.467)**
High school GPA	53.94	-0.175	(1.751)*	55.13	-0.070	(0.59)	55.59	-0.114	(0.7)	54.92	0.063	(0.249)	55.59	-0.114	(0.7)	54.92	0.063	(0.249)	55.59	-0.114	(0.7)	54.92	0.063	(0.249)
Public high school	0.437	0.005	(0.938)	0.476	0.011	(1.501)	0.553	0.003	(0.308)	0.45	0.019	(1.225)	0.553	0.003	(0.308)	0.45	0.019	(1.225)	0.553	0.003	(0.308)	0.45	0.019	(1.225)
Voucher high school	0.515	-0.004	(0.701)	0.508	-0.009	(1.204)	0.438	-0.003	(0.299)	0.532	-0.013	(0.882)	0.438	-0.003	(0.299)	0.532	-0.013	(0.882)	0.438	-0.003	(0.299)	0.532	-0.013	(0.882)
Private high school	0.043	0.000	(0.216)	0.013	-0.002	(1.585)	0.006	0.000	(0.149)	0.012	-0.004	(1.265)	0.006	0.000	(0.149)	0.012	-0.004	(1.265)	0.006	0.000	(0.149)	0.012	-0.004	(1.265)
1(married)	1.02	-0.001	(0.718)	1.02	0.000	(0.089)	1.02	-0.002	(0.625)	1.02	-0.001	(0.282)	1.02	-0.002	(0.625)	1.02	-0.001	(0.282)	1.02	-0.002	(0.625)	1.02	-0.001	(0.282)
1(work)	0.03	0.001	(0.628)	0.028	0.000	(0.033)	0.03	-0.004	(1.151)	0.022	0.010	(2.061)**	0.03	-0.004	(1.151)	0.022	0.010	(2.061)**	0.03	-0.004	(1.151)	0.022	0.010	(2.061)**
HH size	4.47	-0.005	(0.241)	4.49	-0.021	(0.829)	4.59	0.006	(0.172)	4.46	-0.048	(0.899)	4.59	0.006	(0.172)	4.46	-0.048	(0.899)	4.59	0.006	(0.172)	4.46	-0.048	(0.899)
Mother has formal work	0.291	0.001	(0.304)	0.279	-0.001	(0.206)	0.216	-0.010	(1.306)	0.315	-0.013	(0.936)	0.216	-0.010	(1.306)	0.315	-0.013	(0.936)	0.216	-0.010	(1.306)	0.315	-0.013	(0.936)
Father has formal work	0.552	0.004	(0.811)	0.515	0.005	(0.771)	0.437	-0.003	(0.265)	0.549	0.018	(1.181)	0.437	-0.003	(0.265)	0.549	0.018	(1.181)	0.437	-0.003	(0.265)	0.549	0.018	(1.181)
Will leave HH	0.202	0.000	(0.035)	0.23	-0.003	(0.577)	0.246	-0.004	(0.424)	0.223	-0.010	(0.76)	0.246	-0.004	(0.424)	0.223	-0.010	(0.76)	0.246	-0.004	(0.424)	0.223	-0.010	(0.76)
Both parents live	0.771	0.001	(0.34)	0.77	0.006	(0.979)	0.756	0.004	(0.438)	0.773	0.001	(0.112)	0.756	0.004	(0.438)	0.773	0.001	(0.112)	0.756	0.004	(0.438)	0.773	0.001	(0.112)
Mother Housewife	0.498	-0.001	(0.156)	0.514	0.002	(0.318)	0.551	0.008	(0.864)	0.481	0.016	(1.046)	0.551	0.008	(0.864)	0.481	0.016	(1.046)	0.551	0.008	(0.864)	0.481	0.016	(1.046)
Parents do not work	0.11	-0.002	(0.516)	0.118	-0.001	(0.305)	0.136	0.008	(1.126)	0.112	-0.009	(0.995)	0.136	0.008	(1.126)	0.112	-0.009	(0.995)	0.136	0.008	(1.126)	0.112	-0.009	(0.995)
Both parents work	0.162	0.001	(0.298)	0.138	-0.001	(0.153)	0.088	-0.007	(1.377)	0.147	-0.003	(0.23)	0.088	-0.007	(1.377)	0.147	-0.003	(0.23)	0.088	-0.007	(1.377)	0.147	-0.003	(0.23)
Mother some higher educ.	0.175	0.000	(0.029)	0.146	0.001	(0.195)	0.081	0.002	(0.298)	0.145	0.008	(0.782)	0.081	0.002	(0.298)	0.145	0.008	(0.782)	0.081	0.002	(0.298)	0.145	0.008	(0.782)
Father some higher educ.	0.189	-0.001	(0.274)	0.15	0.000	(0.052)	0.095	-0.005	(0.845)	0.137	0.003	(0.322)	0.095	-0.005	(0.845)	0.137	0.003	(0.322)	0.095	-0.005	(0.845)	0.137	0.003	(0.322)
Mother dropout high Sch.	0.439	0.000	(0.076)	0.459	-0.002	(0.245)	0.551	0.015	(1.566)	0.419	-0.013	(0.894)	0.551	0.015	(1.566)	0.419	-0.013	(0.894)	0.551	0.015	(1.566)	0.419	-0.013	(0.894)
Father dropout high Sch.	0.451	-0.002	(0.346)	0.482	-0.003	(0.424)	0.572	0.014	(1.467)	0.461	-0.024	(1.613)	0.572	0.014	(1.467)	0.461	-0.024	(1.613)	0.572	0.014	(1.467)	0.461	-0.024	(1.613)
Mother college graduate	0.059	0.002	(0.87)	0.042	0.001	(0.22)	0.017	0.002	(0.701)	0.033	0.005	(0.875)	0.017	0.002	(0.701)	0.033	0.005	(0.875)	0.017	0.002	(0.701)	0.033	0.005	(0.875)
Father college graduate	0.074	0.000	(0.057)	0.046	-0.001	(0.259)	0.022	0.003	(0.968)	0.036	0.002	(0.308)	0.022	0.003	(0.968)	0.036	0.002	(0.308)	0.022	0.003	(0.968)	0.036	0.002	(0.308)
Observations	150356					79352					41303					17249								

Note: Dif refers to the  $\beta_1$  of equation (1). t-values in parenthesis (in absolute values). (\*\*):  $p \leq 5\%$ , (\*):  $p \leq 10\%$ . Self-reported income is classified in three categories, 1 being the lowest.

Table 3: Balance of Covariates. Population, preselected and by income quintiles. Continued..

Variable:	Quintile 3			Quintile 4			Quintile 5		
	Level (1)	Dif (2)	abs(t) (3)	Level (4)	Dif (5)	abs(t) (6)	Level (7)	Dif (8)	abs(t) (9)
Self-reported Income	1.53	-0.015	(0.752)	1.71	-0.005	(0.209)	1.68	0.066	(2.077)**
Income quintile	3			4			5		
Mother years of education	11.72	0.104	(0.884)	12.65	-0.147	(1.081)	12.52	-0.115	(0.698)
Father years of education	11.72	0.179	(1.404)	12.76	-0.208	(1.462)	12.57	-0.162	(0.907)
1(female)	0.577	0.025	(1.324)	0.578	-0.020	(0.958)	0.564	0.017	(0.723)
High school GPA	54.35	0.182	(0.569)	54.29	-0.262	(0.778)	54.31	-0.348	(0.84)
Public high school	0.359	0.042	(2.28)**	0.3	0.009	(0.482)	0.3	0.038	(1.716)*
Voucher high school	0.615	-0.032	(1.719)*	0.661	-0.012	(0.622)	0.648	-0.042	(1.817)*
Private high school	0.023	-0.010	(1.897)*	0.036	-0.004	(0.535)	0.047	0.002	(0.184)
1(married)	1.02	0.009	(1.309)	1.01	0.003	(0.494)	1.02	0.007	(0.789)
1(work)	0.037	-0.009	(1.417)	0.024	0.007	(1.119)	0.032	-0.011	(1.432)
HH size	4.32	0.018	(0.292)	4.34	-0.132	(1.96)*	4.38	-0.040	(0.498)
Mother has formal work	0.352	0.039	(2.128)**	0.416	0.005	(0.248)	0.392	-0.001	(0.028)
Father has formal work	0.639	0.006	(0.331)	0.675	-0.006	(0.302)	0.645	0.005	(0.199)
Will leave HH	0.213	-0.002	(0.163)	0.185	0.012	(0.718)	0.223	-0.019	(0.962)
Both parents live	0.795	0.012	(0.818)	0.798	0.015	(0.879)	0.8	0.023	(1.217)
Mother Housewife	0.475	-0.018	(0.948)	0.455	-0.028	(1.325)	0.441	0.009	(0.363)
Parents do not work	0.097	-0.014	(1.307)	0.074	-0.007	(0.603)	0.085	0.004	(0.273)
Both parents work	0.209	0.014	(0.919)	0.27	0.005	(0.257)	0.257	-0.010	(0.476)
Mother some higher educ.	0.225	0.013	(0.828)	0.365	-0.044	(2.221)**	0.342	-0.006	(0.261)
Father some higher educ.	0.228	0.020	(1.226)	0.335	-0.023	(1.149)	0.328	-0.001	(0.023)
Mother dropout high Sch.	0.335	-0.017	(0.991)	0.253	-0.014	(0.79)	0.262	0.017	(0.803)
Father dropout high Sch.	0.348	-0.022	(1.225)	0.259	0.006	(0.306)	0.28	0.022	(1.014)
Mother college graduate	0.075	-0.006	(0.585)	0.141	-0.006	(0.447)	0.149	0.010	(0.546)
Father college graduate	0.084	-0.013	(1.322)	0.136	-0.011	(0.791)	0.167	-0.001	(0.034)
Observations									
					9301				7115

Note: Dif refers to the  $\beta_1$  of equation (1). t-values in parenthesis (in absolute values). (\*\*):  $p \leq 5\%$ , (\*):  $p \leq 10\%$ . Self-reported income is classified in three categories, 1 being the lowest.

## 4.2 Effect on College enrollment

Table 4 shows the main estimations of the paper. Column (1) (our preferred specification) shows the estimation of equation (1) for pre-selected students (those for what access to loans change sharply at the cutoff.), where  $Y_i$  is the probability to enroll in college,  $f$  is linear, under the sample of students within the optimal bandwidth of 44 points. It shows that scoring at least the cutoff implies an increment of 17.4 percentage points in the probability of enrolling in college. This implies a relative increase in the probability of enrollment of nearly 100% (The probability of enrollment for the control group is 18.3%). Column (2) shows the same estimation for the sample of non-pre-selected students. It shows that the probability of college enrollment does not increase at the cutoff, which is indication that students do not consider that scoring more than 475 is a signal of suitability of college (either to college admissions officers, or to students themselves). Additionally, non-pre-selected students around the cutoff have a lower enrollment rate than pre-selected students below the cutoff. This indicates that those who self-select to complete FUAS have higher preferences for college.

Table 4: Effects on College Enrollment. Comparing Pre-selected with non.

Dependent Variable:	College Enrollment							
	Pre-selected	Not eligible	Population, 07-09 pooled			Population, by year		
			Linear	Poly 4th	Linear	2007	2008	2009
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$1(T \geq \tau)$	.174 (.006)***	.003 (.006)	.003 (.006)	.008 (.006)	.023 (.018)	-.013 (.009)	.011 (.010)	.012 (.009)
Const.	.183 (.004)***	.158 (.004)***	.158 (.004)***	.159 (.004)***	.136 (.015)***	.153 (.006)***	.178 (.006)***	.143 (.006)***
Pre-selected			.025 (.005)***	.026 (.006)***	.022 (.021)	.001 (.009)	.032 (.010)***	.040 (.009)***
Pre-selected $\times 1(T \geq \tau)$			.172 (.008)***	.162 (.008)***	.164 (.027)***	.202 (.014)***	.148 (.015)***	.165 (.014)***
Obs.	79352	71004	150356	485629	13969	47221	49493	53642
$R^2$	.107	.02	.101	.352	.048	.102	.093	.108
Bandwidth	44	44	44	All	4	44	44	44

Note: Robust standard errors in parenthesis. (\*\*\*) :  $p \leq 1\%$ , (\*\*):  $p \leq 5\%$ , (\*):  $p \leq 10\%$

Column (3) estimates equation (2) for the whole population of students for the optimal bandwidth and replicates results for columns (1) and (2). To show that the results are not sensible to the chosen bandwidth and the specification of  $f$ , Column (4) estimates equation (2) where  $f$  is a different 4th order polynomial spline for each of the four groups of students (preselected and non-pre-selected, below and above the cutoff), and the sample is the whole population of students. The results are basically the same, i.e. the probability of enrolling into college increase roughly 100%, from 18.5% of those that were pre-selected but score barely less than 475 to 34.7% of those barely

above the threshold. Column (5), shows a third specification,  $f$  is linear again, but the bandwidth is 4 PSU points.<sup>25</sup> The results are even stronger: scoring equal to or greater than 475 implies an increase of 16.2 percentage points in the probability of enrolling, but this time the control group enrolls at a 13.6%, and therefore the relative increase is 120%. Moreover the pre-selected group is now not statistically different than the group that did not complete FUAS. Nevertheless these results may be affected for small sample bias, despite the fact that the sample is quite large (roughly 14,000 students).

Finally columns (6) to (8) show regressions for the preferred specification (equation (2) with a linear  $f$ , within a bandwidth of 44 points) for each year separately. As a sign of robustness, these columns show that the same conclusions can be inferred every single year, considering that each year is an independent the natural experiment.

To have a broader perspective of the results presented above, Figure 6 shows the enrollment rate for the whole PSU support for the population of preselected students. The upper figure shows the effect for the 3 years pooled together and the smaller figures below for each year separately. This pictures show why the estimation is not sensible to bandwidth or functional specification. Appendix B shows a sensitivity analysis: for different bandwidths from 2 to 80 PSU points, I show estimations of equation (1) using a linear (to the left) and 4th order polynomial (to the right) specification of  $f$  to find very similar estimations for the effect (top figures) and the relative change (bottom figures).<sup>26</sup>

### 4.3 Enrollment Gap by Family Income

This section addresses the question whether access to these loans helps to reduce the existing enrollment gap between students from high and low income families, exploiting the income quintile classification given by the ax authority.

I estimate the effect on the probability of enrollment by income quintiles interacting equation (1) with dummies for the quintiles. The analysis is equivalent to the one in section 4.2 comparing individuals with and without access to loans, but within income quintiles. In this case information on income quintile is missing for all the students that did not complete the FUAS form, and therefore the analysis is restricted to those with income quintile information.<sup>27</sup>

Table 5 shows the estimation. The first column presents results for all the years pooled together and the following columns for each year separately. Focusing on all years together we observe that the effect is stronger for the poorest quintile. Access to these loans caused an increase in the enrollment probability of 20 percentage points for students in the first quintile, whereas the

---

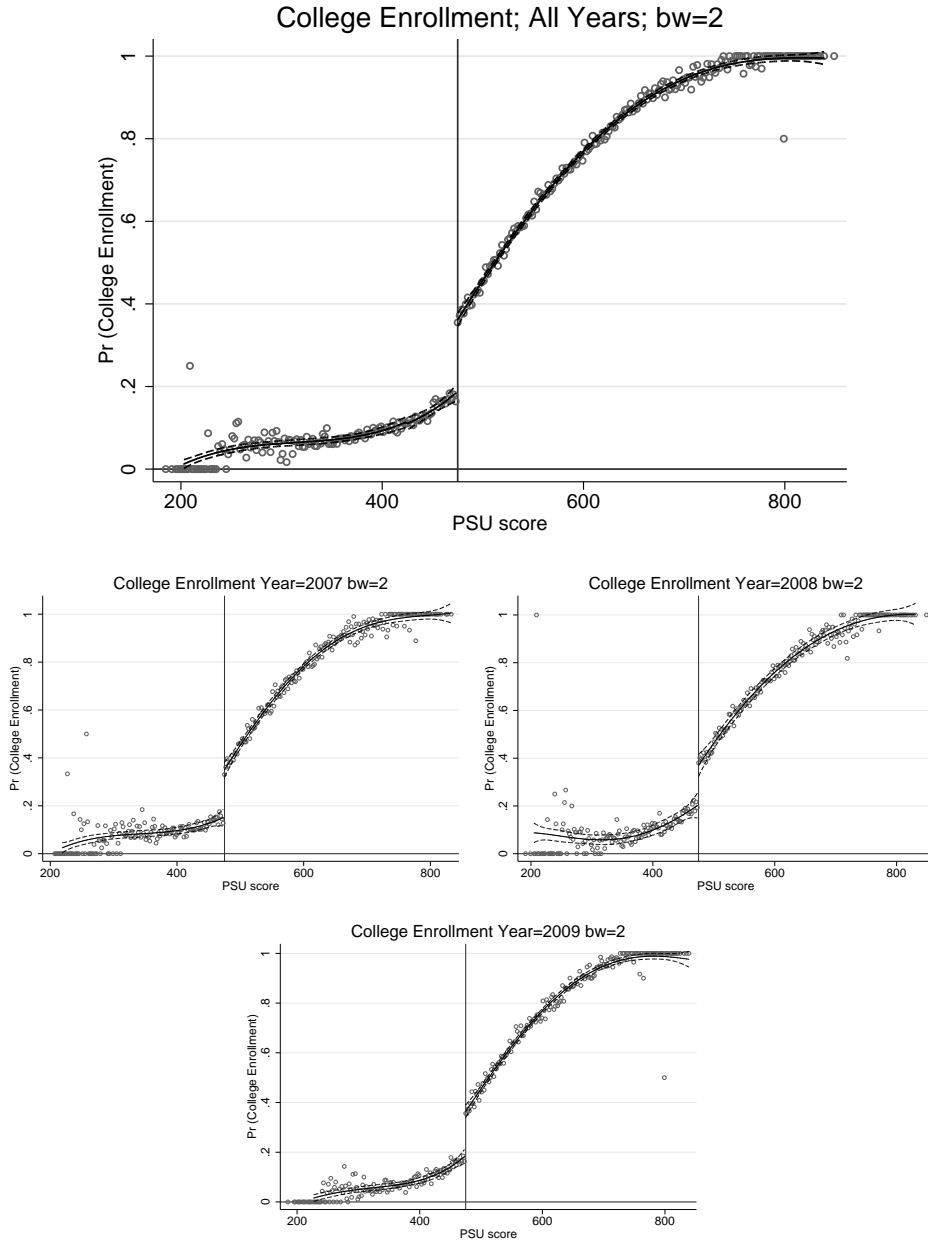
<sup>25</sup>4 PSU points is the maximum bandwidth that fail to reject the null of no difference in baseline characteristics when simple  $t$ -test are used (not controlling by PSU score)

<sup>26</sup>With respect to the enrollment rate for the control group.

<sup>27</sup>Appendix C shows the analysis for the whole population estimating the income quintile using observable characteristics from the sample that have this information and performing a prediction for those out of the sample. The results are very similar to those presented here.

enrollment rate for barely ineligible students is 13.3 percent in this quintile. This implies that having access to tuition loans led to a 151% increase in the enrollment rate.

Figure 6: RD for College enrollment. Full sample.



Note: Each dot represents average college enrollment within bins of 2 PSU points ( $bw=2$ ). The dashed lines represent fitted values from a 4th order spline and 95% confidence intervals for each side. The vertical line indicates the cutoff (475). These graphs show the full sample of students fulfilling all requirements to be eligible for college loans and taking the PSU immediately after graduating from high school.

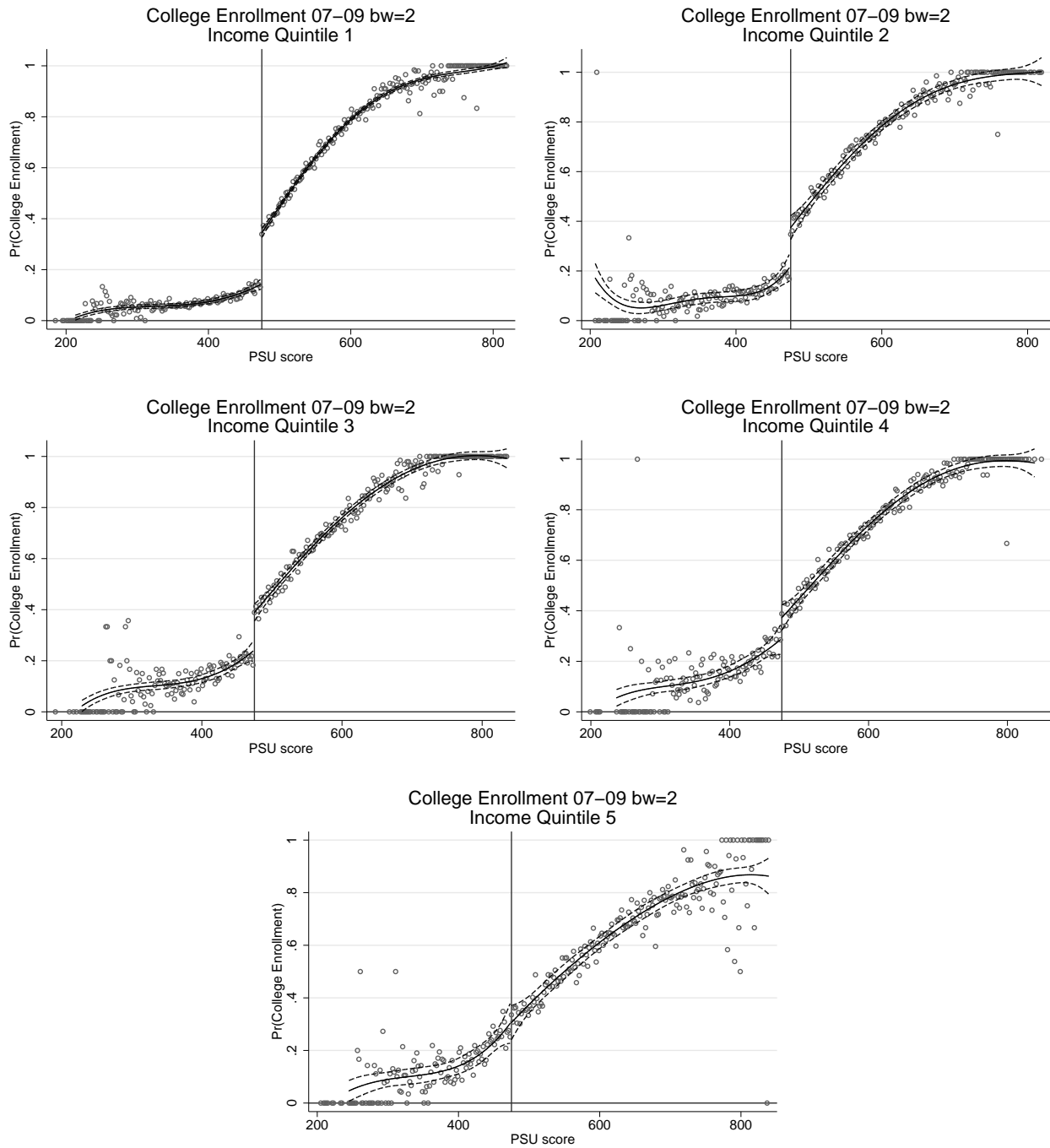
Table 5: RD College Enrollment by income quintile. By year and full sample.  $w = 44$  PSU points.

	Pooled	2007	2008	2009
	07 to 09			
	(1)	(2)	(3)	(4)
$\mathbf{1}(T \geq \tau) \times q_1$	.201 (.008)***	.210 (.015)***	.186 (.016)***	.203 (.013)***
$\mathbf{1}(T \geq \tau) \times q_2$	.171 (.013)***	.211 (.026)***	.160 (.022)***	.157 (.022)***
$\mathbf{1}(T \geq \tau) \times q_3$	.164 (.017)***	.210 (.031)***	.162 (.028)***	.134 (.029)***
$\mathbf{1}(T \geq \tau) \times q_4$	.070 (.020)***	.064 (.032)**	.033 (.036)	.110 (.034)***
$\mathbf{1}(T \geq \tau) \times q_5$	.031 (.022)	-.091 (.058)	.042 (.030)	.085 (.044)*
$q_1$	.133 (.008)***	.164 (.009)***	.142 (.007)***	.146 (.005)***
$q_2$	.166 (.016)***	.219 (.014)***	.190 (.014)***	.195 (.009)***
$q_3$	.154 (.020)***	.242 (.019)***	.257 (.020)***	.224 (.011)***
$q_4$	.232 (.023)***	.345 (.026)***	.290 (.024)***	.287 (.014)***
$q_5$	.318 (.038)***	.248 (.019)***	.372 (.032)***	.292 (.015)***
Obs.	84605	24126	28536	31943
$R^2$	.378	.377	.379	.384

Note: Robust standard errors in parenthesis. (\*\*\*) :  $p \leq 1\%$ , (\*\*) :  $p \leq 5\%$ , (\*) :  $p \leq 10\%$

The effects are slightly smaller but not significantly different for quintiles 2 and 3 (an increase of 17 and 16 percentage points in each case). Because the enrollment rate for the students barely below the threshold are 17% and 15% respectively, these increments imply relative increases of 103% and 106% in the probability of enrollment for quintiles 2 and 3 respectively. For the fourth quintile, the effects are weaker: the effect is not statistically different from zero in 2008 and only significant at the 5% level for 2007. For all the years pooled together, having access to loans causes an increment in the enrollment probability of 7 percentage points. Figure 7 shows the estimations in graphical form by income quintile.

Figure 7: RD for College enrollment by income quintile. Whole PSU support.



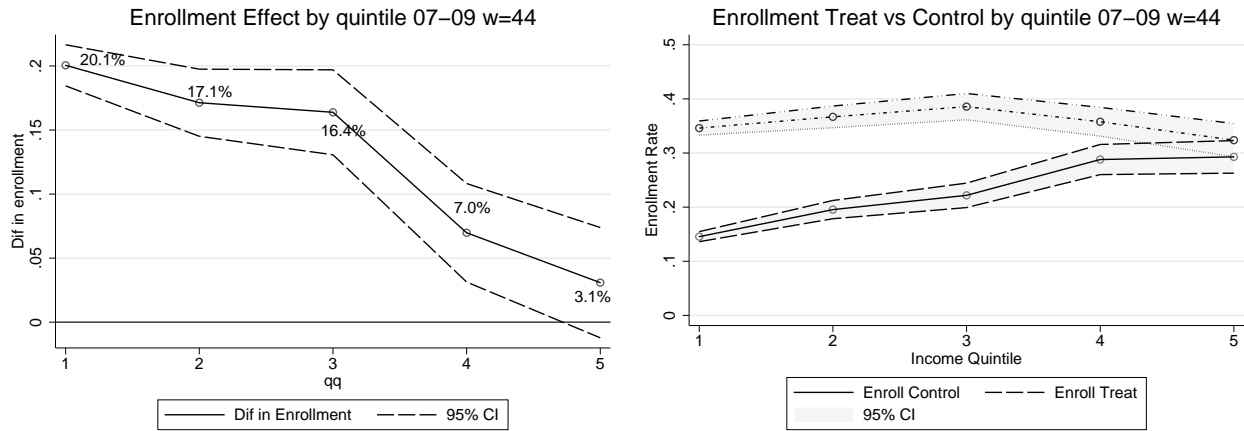
Note: Each dot represents average college enrollment within bins of 2 PSU points ( $bw=2$ ). The dashed lines represent fitted values from a 4th order spline and 95% confidence intervals for each side. The vertical line indicates the cutoff (475).

These graphs show the full sample of students fulfilling all requirements to be eligible for college loans and taking the PSU immediately after graduating from high school.

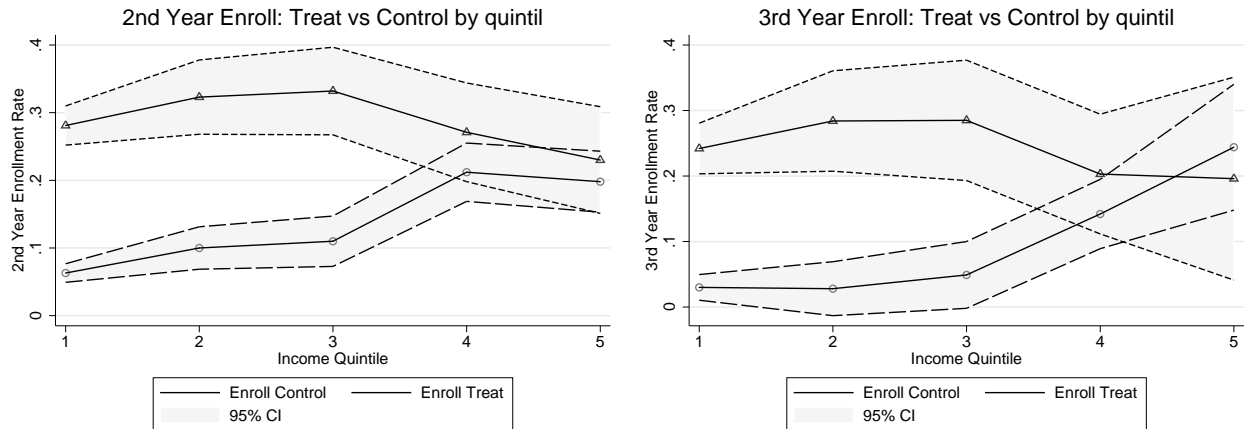
To see what happened with the enrollment gap by family income, Figure 8 shows these results in perspective for all years pooled together.<sup>28</sup> The graph on the left of panel A reproduces the results of Table 5, showing the jump in enrollment at the discontinuity by quintile, plus 95% confidence intervals, while the graph on the right (of panel A) shows the estimates for the enrollment rate separated for ineligible and eligible students at the threshold, and 95% confidence intervals.

Figure 8: Enrollment rate by quintile years 2007 to 2009 pooled together.

Panel A: First year enrollment.



Panel B: Second and third year enrollment.



Note: On the upper left figure, each point represents the effect of access to college loans on enrollment by income quintile (and 95% confidence intervals from robust standard errors) for all years of the sample pooled together. The upper right and the bottom figures show the estimation of the enrollment rate (first, second and third year respectively) at each side of the cutoff by income quintile (and 95% confidence interval).

The latter figure shows that the college enrollment rate increases with family income for the

<sup>28</sup>Equivalent figures for each year show the same patterns. These results are not shown but are available upon request.



group without access to tuition loans. Thus the enrollment gap between student from the poorest income quintile and students from the richest is very similar to the enrollment gap found in the whole population - 15 percentage points, and is statistically different than zero. The enrollment rate for the poorest quintile is 15% percent, while the richest income quintile has an enrollment rate of 30%.<sup>29</sup>

On the contrary, among students with access to loans, the enrollment gap by income quintile is statistically zero. The enrollment rate is 35% for the poorest quintile and 33% for the richest.

In conclusion, conditional on being around the cutoff (i.e. graduating from high school, taking the PSU test, and scoring around 475), access to these programs eliminates the college enrollment gap by family income.

#### 4.4 College Progress.

In the previous section, I showed that access to loans has an important effect in the first year enrollment, and reducing the enrollment gap by family income. Nevertheless, if the students receiving these loans are not prepared to succeed in college and drop out easily, the effects on first year enrollment may not be enough to increase the educational attainment of the students or to reduce the educational attainment gap. I explore the persistence of the effects of having access to loans analyzing college progress, defined as enrollment in the second and third year, and showing the effects on the educational gap by family income on the enrollment on second and third year. In appendix A I present evidence that access to loans decreases the dropout rate.

##### 4.4.1 Effect on College Progress

Here second and third year enrollment are defined as being enrolled continuously since the first year. This ad hoc definition is consequence of data availability: I observe only three years with full information (PSU scores, income quintile, enrollment) and therefore is not possible to determine if a student stops studying for one year to work and to acquire financial resources, which is a way to solve access to financial markets problems or drop out definitely.<sup>30</sup> On the other hand, one could believe that not eligible students are simply delaying enrollment, rather than changing their rate of college enrollment. To rule out this possibility I show the probability of ever enrolling in college.

Panel A in Table 6 presents results using the linear specification described before for the prese-

---

<sup>29</sup>The population enrollment gap (poorest to richest) calculated with this data may present biases if students from the richest income quintile do not apply for benefits, because may they know a priori that they are not eligible. In that case, quintile information would be missing, and therefore those students wouldn't be considered in the calculations of Table 5 and Figure 8. I address that problem calculating the population enrollment gap using the Chilean household survey: CASEN 2006 and 2009, finding similar estimates than those calculated using this data.

<sup>30</sup>I do not observe class performance for these students while in college, therefore this definition is agnostic about students' true advancement in coursework.

lected sample in the first three columns and for the whole population in the last three.<sup>31,32</sup>

Table 6: Enrollment in Second and third years of college for all students around the cutoff in 2007 and 2008.  $w = 44$

PANEL A: 2SLS IV Regression						
Dependent Var.:	Pre-selected			Population		
	Enrollment 2nd year	Enrollment 3rd year	Ever Enrolled	Enrollment 2nd year	Enrollment 3rd year	Ever Enrolled
	(1)	(2)	(3)	(4)	(5)	(6)
Eligible	.197 (.010)***	.190 (.012)***	.154 (.008)***	.199 (.013)***	.201 (.016)***	.146 (.011)***
Const.	.099 (.006)***	.048 (.007)***	.316 (.005)***	.090 (.004)***	.052 (.004)***	.287 (.004)***
$1(T \geq \tau)$				-.001 (.006)	-.009 (.008)	.007 (.007)
Pre-selected				.008 (.007)	-.007 (.008)	.031 (.007)***
Obs.	48044	22819	78072	94234	46153	147638
$R^2$	.074	.086	.119	.052	.064	.113
PANEL B: First Stage						
Instrumented: Ever been Eligible for loans						
Intrument—>	$1(T \geq \tau)$			Pre-selected $\times 1(T \geq \tau)$		
Intrument	.782 (.005)***	.790 (.008)***	.867 (.003)***	.768 (.008)***	.773 (.012)***	.858 (.005)***

Note: Robust standard errors in parenthesis. (\*\*\*) :  $p \leq 1\%$ .

Column (1) shows the enrollment probability in the second year: having access to college tuition loans increases the probability of reaching the second year of college by 20 percentage points. In relation to the enrollment rate for the control group (10 percent), the effect at the discontinuity is equivalent to a 200%. Column (2) shows that third year enrollment,<sup>33</sup> increases by 19 percentage points for those barely eligible for loans. Relatively to the enrollment rate for the control group (4.8 percent), the effect is equivalent to a 400% increase in the probability of reaching up to third year in consecutive years. Column (3) shows that just having access to the loans increases the probability of ever being enrolled in college in 15 percentage points which, relatively to those just ineligible, correspond to an increase of 50%.

<sup>31</sup>The results are highly robust to different functional specifications and different bandwidths. These results are not shown but are available upon request.

<sup>32</sup>Panel B in Table 6 shows the first stages of the different definitions of eligibility used in the 2SLS setting for enrollment in second and third year, i.e. the portion of compliers.

<sup>33</sup>Here, we only observe the behavior of the cohort that took the PSU for the first time in 2007. They are the only ones that can be track up to the third year in the data.

Columns (4) to (6) repeat these estimations now including the students that did not apply for financial aid and people classified in the richest quintile. The results are almost identical for the group of pre-selected students. Moreover, crossing the cutoff acts as a placebo test for ineligibles and confirms that students scoring at least the cutoff do not consider the loan programs as a signal about their suitability to succeed in college. Finally, these estimations show that pre-selected students do not react differently than the rest of the population, since the parameter is statistically zero in columns (4) and (5).

The difference in the enrollment rate between eligible and ineligible students continues stable from the first to the second, to the third year, and increase dramatically in relative terms, indicating that credit access not only matters for initial enrollment, but also helps students stay in college.

#### 4.4.2 College Progress by Income Quintile

Table 7 shows the effect on college progress by income quintile. As before, the dummy for being eligible on the first attempt is used as instrument for being eligible in the second and the third year, using the linear specification described before.<sup>34</sup>

As before, columns (1) to (3) show enrollment in the second year and column (4) enrollment in the third year.

These results show that the effects are very similar in absolute value for the first three income quintiles, but they are stronger for the poorest in relative terms. Students that have access to the loan programs increase their second year enrollment rate by 21 percentage points compared to the enrollment rates for ineligibles: 6%, 11% and 12% for quintiles 1, 2 and 3 respectively. This represents relative increases of 350%, 200% and 180% respectively. The fourth income quintile also benefits from the loan programs; eligible students increase their enrollment probability in the second year by 6 percentage points. Students in the fifth income quintile have statistically the same second year enrollment rate around the cutoff.

Similar changes occur for the third year enrollment. The poorest 3 income quintiles have higher impacts in the enrollment in the third year. The first three quintiles increase its enrollment by roughly 20 percentage points, representing relative increments of 600%, 500% and 400%. Finally, the results are in the same line for the probability of ever being enrolled in college.

Regarding the enrollment gap by family income, Panel B of Figure 8 shows the enrollment rate separated for students barely eligible and ineligible by income quintile. The left graph shows enrollment in second year and the right shows enrollment in the third. Those figures show a strong income gradient in college progress for students that have no access to tuition loans, i.e. the second year enrollment rate among students from the richest income quintile is 3 times the rate for the

---

<sup>34</sup>The results are also highly robust to different specifications and bandwidths. Those results are available upon request.

poorest. This gap increases to 8 times (richest to poorest) enrolling in the third year. On the contrary, the gap between the poorest and the richest quintiles is statistically zero when access to the loans is granted. In conclusion, access to loans not only reduces the gap in initial enrollment, the effects are persistent in later years, allowing students from poor backgrounds have the same enrollment rate as the richest of the country.

Table 7: Enrollment in Second and third years of college for students around the cutoff by quintile.  $w = 44$

2SLS IV Regression				
Dependent Var.:	Enrollment 2nd year in 2008	Enrollment 2nd year in 2009	Enrollment 2nd year pooled	Enrollment 3rd year in 2009
	(1)	(2)	(3)	(4)
<i>Eligible</i> × $q_1$	.228 (.017)***	.207 (.019)***	.218 (.013)***	.212 (.017)***
<i>Eligible</i> × $q_2$	.261 (.033)***	.198 (.031)***	.223 (.023)***	.256 (.033)***
<i>Eligible</i> × $q_3$	.266 (.038)***	.189 (.037)***	.222 (.027)***	.236 (.039)***
<i>Eligible</i> × $q_4$	.084 (.038)**	.029 (.045)	.059 (.030)**	.061 (.038)
<i>Eligible</i> × $q_5$	-.054 (.062)	.062 (.039)	.032 (.033)	-.048 (.062)
$q_1$	.044 (.010)***	.083 (.012)***	.063 (.007)***	.030 (.010)***
$q_2$	.058 (.021)***	.128 (.021)***	.100 (.016)***	.028 (.021)
$q_3$	.060 (.026)**	.147 (.026)***	.110 (.019)***	.049 (.026)*
$q_4$	.152 (.027)***	.278 (.034)***	.212 (.022)***	.142 (.027)***
$q_5$	.275 (.049)***	.171 (.026)***	.198 (.023)***	.244 (.049)***
Obs.	24172	28583	52755	24172

Note: Robust standard errors in parenthesis. (\*\*\*) :  $p \leq 1\%$ , (\*\*):  $p \leq 5\%$ , (\*):  $p \leq 10\%$

## 5 Price versus access effect

A natural question is whether these effects in enrollment are a consequence of access to credit markets (an “access effect”) or are due to a change in the price of higher education (a “price

effect”), a consequence of implicit subsidy components, such as lower than the market interest rates or low repayment enforceability, that are present in these tuition loans.<sup>35</sup>

To decompose the total effect into price and access effects, I present the following three tests.

## 5.1 Estimating the price effect directly

The first test estimates the price effect directly, specifically it compares the enrollment rate of students who must finance the full tuition cost to those who receive a scholarship that covers it almost in full, in a context where access to credit is available for everybody (no access effect). As usual, students who receive scholarships are different from those who do not. To address these endogeneity problems, I use another natural experiment of the same type as exogenous variation in access to scholarships.

Table 1 presented the requirements to qualify for scholarships delivered by the Ministry of Education. Most of them depend on PSU score cutoffs, enabling the use of a regression discontinuity design. In particular, the Bicentenario scholarship is available to students who comply with the following requirements. First, complete the FUAS socioeconomic form and are classified on the two poorest income quintiles. Second, enroll in traditional universities, and third, score above 550 points in the PSU test.<sup>36</sup> This scholarship program is the third in importance in the country, it is given to 4.7% of the universe of students and 55% of eligible students. Moreover, it covers in full the reference tuition<sup>37</sup> (on average 90% of the total tuition cost), hence constitutes a significant drop in the cost of university education.

Because all students scoring 475 PSU points or higher have access to college credit markets (secured by the existence of the two loan programs discussed above), there is no access effect around the Bicentenario grant cutoff. Therefore, the comparison between the college enrollment rates of those who score barely above the grant cutoff of 550 PSU points, with those slightly below gives the causal effect of the reduction in tuition cost on the enrollment rate, the price effect.

The upper graph in Figure 9 shows the rate of students receiving the Bicentenario grant among students who meet all requirements around the grant cutoff point (as before the sample is restricted to preselected students that take the PSU for the first time to avoid selection). By definition, nobody below the threshold received the benefit, while 38% of students barely above the threshold received the grant, and therefore their tuition was reduced by approximately 90%.

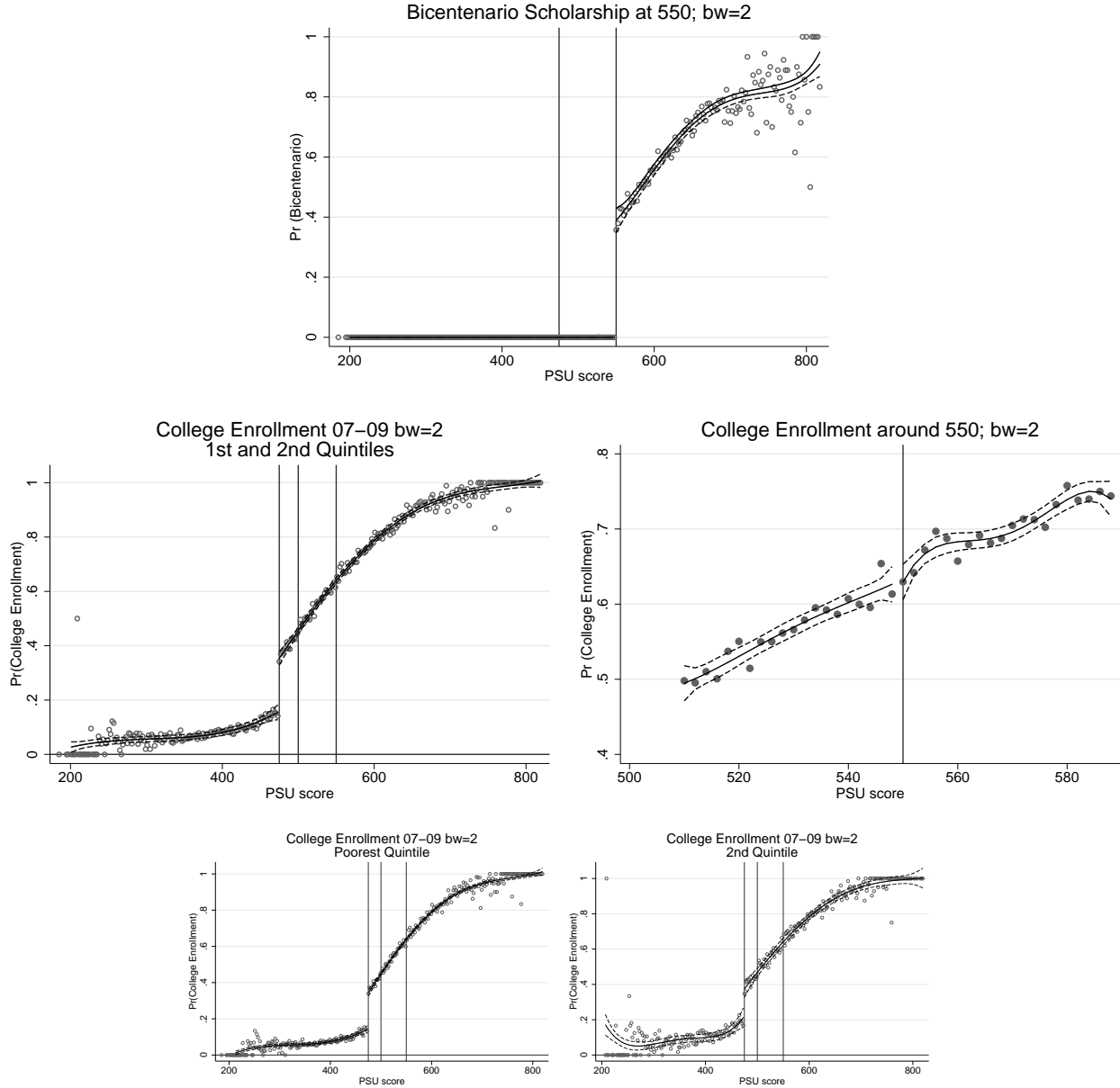
---

<sup>35</sup>Dynarski (2003) called these effects the liquidity and subsidy effects respectively.

<sup>36</sup>The same tests are made to check the validity of RDD: Balance on observed characteristics, bunching at the cutoff, and a discontinuous number of recipients around the cutoff. Those tests are not presented here but are available upon request.

<sup>37</sup>Reference tuition is a value determined by the Ministry of Education. It calculates what the tuition at a given university should be based on its characteristics (quality of education, demand for programs, prestige, etc.). On average, reference tuition corresponds to 90% of effective tuition fixed by universities.

Figure 9: Estimating the price effects using Bicentenario Scholarship.



Note: Each dot represents average take up (the upper graph) and average college enrollment (all the rest) within bins of 2 PSU points ( $bw=2$ ). The dashed lines represent fitted values from a 4th order spline and 95% confidence intervals for each side. The vertical lines indicate the loan cutoffs (475), the Teacher's Children scholarship (500), and the Bicentenario scholarship (550).

The middle graphs on Figure 9 show the effects on enrollment around the scholarship cutoff. The left graph reproduces Figure 6 for the two poorest income quintiles (eligible quintiles) with vertical lines at 475, 500 and 550. The right graph shows a close-up of the previous graph to enlarge

the effects around 550. Finally, the bottom graphs shows enrollment for the two poorest quintiles separately.

More formally, Table 8 presents the same outcomes. Column (1) shows the change in the probability of receiving the Bicentenario scholarship and Column (2) shows a linear regression for equation (1) around the cutoff of 550. The reduction in the tuition costs did not affect enrollment. This indicates that investment in college education has returns that largely compensate the cost of loans, and therefore students with access to financing are able to invest optimally. On the contrary, the enrollment rate for students below 475 shows that with no access, many students underinvest in college education.

Table 8: Measuring the price effects from exogenous change in college tuition.

	Bicentenario Scholarship			Teacher's children Schol.	
	Recipients Bicentenario scholarship at 550	College Enrollment at 550	Recipients of any benefit at 550	Recipients Teacher's Children at 500	College Enrollment at 500
	(1)	(2)	(3)	(4)	(5)
$\mathbf{1}(T \geq \tau_s)$	.378 (.006)***	.012 (.009)	.009 (.009)	.021 (.002)***	-.008 (.006)
Const.	.00005 (.004)	.633 (.006)***	.625 (.006)***	-2.99e-14 (.001)	.468 (.004)***
Obs.	48370	48370	48370	82991	82991
$R^2$	.327	.03	.015	.013	.109

Note: Robust standard errors in parenthesis. (\*\*\*) :  $p \leq 1\%$ .

All regressions are based on equation (1), using 44 point around the cutoff and a linear specification.

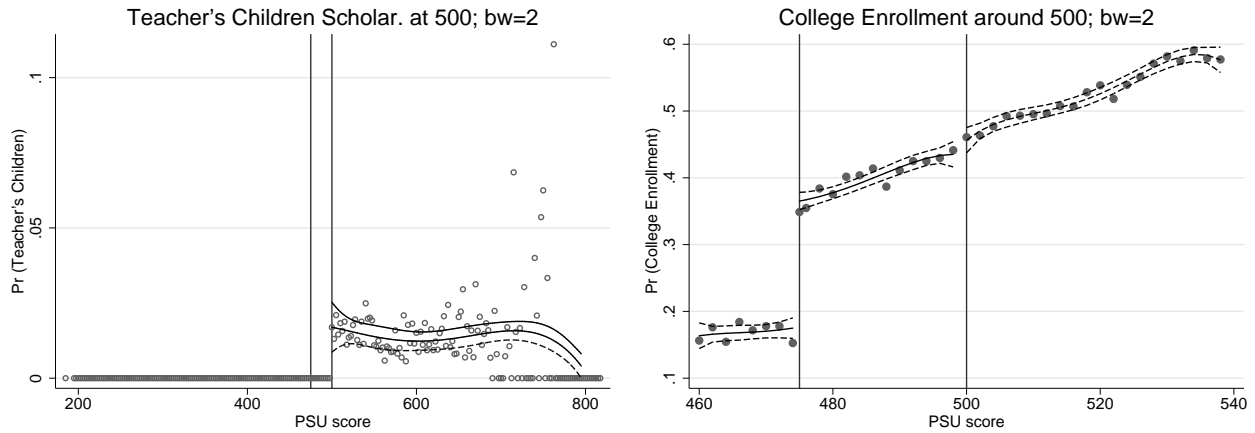
If this scenario were true for those around 475, we could conclude that the effects for enrollment and progress are mainly due to the difference in access to credit markets. However, there may be differences between the enrollment decisions of students receiving this grant and those who get scores around 475. To eliminate in part this problem, I perform the same analysis using another scholarship with a cutoff point closer to 475: the scholarship for teachers' children, which considers a cutoff of 500 points. The main disadvantage is that this program generates much less variation in the rate of beneficiaries than the previous program (see Table 1).

To gain access to this scholarship, students need to satisfy the following requirements. First, complete the FUAS form and being classified in one of the four poorest income quintiles. Second, be children of teachers or employees of public and voucher schools, and third, score 500 points or more in the PSU. This scholarship provides a benefit level similar to the reference tuition discussed in the previous section and the Bicentenario scholarship.

The left graph of Figure 10 shows the change in the rate of beneficiaries from this scholarship relative to eligible students. Being a child of a teacher or employee of an eligible school is not observable in the data; therefore, this graph shows the rate relative to all those who meet all the other requirements.<sup>38</sup> The right graph confirms what the previous figures show, that there is no change in college enrollment, despite the significant drop in the price of education. These results are confirmed in Table 8. Column (4) shows the change in the probability of receiving the scholarship and column (5) shows the change in the enrollment rate at the cutoff. The price effect is again statistically zero, so it can be concluded that the effect on enrollment and progress corresponds to a change resulting from access to credit markets.

The price effects measured by both of these scholarships use students that have higher PSU scores than 475, and therefore they may not fully reflect the population of interest: the students around the loan threshold. To address that problem, the following two tests shed light on what it happens around 475.

Figure 10: Estimating the price effects using Teacher Children Scholarship



Note: Each dot represents average take up (the left graph) and average college enrollment (the right graph) within bins of 2 PSU points ( $bw=2$ ). The dashed lines represent fitted values from a 4th order spline and 95% confidence intervals for each side. The vertical lines indicate the loan cutoffs (475), and the Teacher's Children scholarship (500).

## 5.2 Evidence from a Survey

To shed more light about the importance of liquidity constraints on the students college enrollment decisions, this section presents evidence from a survey applied to the same students across the eligibility cutoff. Students that were first time takers and completed the FUAS socio economic form

<sup>38</sup>Even though the industry in which parents work is observable in the data, it does not mention whether those working in education correspond to eligible schools or other educational institutions. In addition, many students do not report industry.



between 2007 and 2009 were invited by email to answer a web survey performed in October of 2012. The survey was designed for a broader study on the relationship of education on different outcomes (see Solis, 2013). The survey was administered by the Universidad Católica de Concepción, a traditional university that is part of CRUCH, which sent the emails and merged the responses to administrative data from the PSU process, to enrollment on higher education, etc.

The first concern it is how representative of the population it is the survey sample. Over the 200 thousand emails that were sent, roughly 25 thousand were opened (12.5%), and 10 thousand responded (5%), and thus, the rate of response among those who viewed the invitation was 40%.

There is many reasons that potentially can explain this rate of response. First, these emails addresses were self-reported by students between 2007 and 2009, and they may have not been kept by the students after they entered to study or work. Second, it may be that the invitation email went directly to spam folders, mainly because the invitation was sent through an email address not previously known by the students, and contained words such as “invitation”, “survey”, “questionnaire”, “raffle”, “Ipad”, and “tablet”, all of which are considered to raise red flags from email servers. Third, students may follow common recommendation from IT technicians that suggest not opening emails from unknown senders.<sup>39</sup>

To show whether there is selection among the survey respondents, I use equation (1) to compare baseline characteristics between survey respondents and the population across the cutoff and results are reported on Table 9.<sup>40</sup> For each base line characteristic, Column (1) indicates the population level for students at the cutoff ( $\epsilon$  below the cutoff), Column (2) indicates the jump on the value of that characteristics for students that are (barely) above the cutoff, Column (4) shows the level for survey respondents (below the cutoff), Column (5) shows the difference in levels for survey respondents above the cutoff, and finally Column (7) compares the levels between the population and the survey.

This table shows, first, that surveyed students above and below the threshold are comparable in observables, suggesting that both groups can be considered as a good counterfactual. Second, that around the threshold, survey respondents are almost identical to the population, except for 2 characteristics that are significantly different at the 10% level: Sex and type of high school. Moreover, Panel A in Table 10 shows that students that answer the survey show the same increases in college enrollment relative to the population previously presented (this table shows a linear specification with the optimal bandwidth  $w^* = 44$ , a fourth order polynomial using the whole sample and by income quintile. Together, this evidence suggests that the surveyed sample is a representative sample of the population of interest.

---

<sup>39</sup>To increase the response rate the survey offered a raffle of 3 tablets and 5 gift cards (\$20 each).

<sup>40</sup>Each element of equation (1) is interacted with an indicator for survey respondents

Table 9: Survey Balance of Covariates

	Population			Survey			Difference	
	Level	Jump	Sd	Level	Jump	Sd	Level	Sd
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Income quintile	1.82	0.01	(0.02)	1.87	-0.03	(0.09)	0.04	(0.07)
Self-reported income	1.28	-0.01	(0.01)	1.32	-0.05	(0.04)	0.04	(0.03)
Mother years of Ed.	10.61	0.01	(0.05)	10.76	-0.03	(0.3)	0.15	(0.24)
Father years of Ed.	10.60	-0.02	(0.06)	10.66	0.17	(0.35)	0.06	(0.28)
1(Female)	0.59	0.01	(0.01)	0.64	-0.04	(0.04)	0.06	(0.03)*
High School GPA	55.94	0.05	(0.06)	56.06	0.16	(0.36)	0.12	(0.28)
Public School	0.48	0.01	(0.01)	0.54	-0.05	(0.04)	0.06	(0.03)*
Voucher School	0.51	-0.01	(0.01)	0.44	0.06	(0.04)	-0.07	(0.04)*
Private School	0.01	0.00	(0.002)	0.02	-0.01	(0.01)	0.00	(0.01)
Who Finance Studies	1.90	0.01	(0.02)	1.76	0.13	(0.13)	-0.14	(0.1)
1(Married)	0.01	0.00	(0.002)	0.00	0.02	(0.01)**	-0.01	(0.01)
1(Work)	0.08	0.00	(0.004)	0.07	0.01	(0.02)	-0.01	(0.02)
HH size	4.49	-0.02	(0.03)	4.68	0.03	(0.15)	0.19	(0.12)
Mother in formal work	0.27	0.00	(0.01)	0.32	-0.02	(0.04)	0.04	(0.03)
Father in formal work	0.51	0.01	(0.01)	0.55	-0.06	(0.04)	0.04	(0.03)
Live with parents	1.72	0.00	(0.02)	1.66	0.00	(0.12)	-0.06	(0.09)
Will live out HH	0.23	0.00	(0.01)	0.19	0.02	(0.03)	-0.04	(0.03)
Expect aid to study	0.37	0.00	(0.003)	0.36	0.00	(0.04)	0.00	(0.03)
Both parent live	0.77	0.01	(0.01)	0.77	0.01	(0.03)	0.00	(0.03)

Note: Robust standard errors in parenthesis. (\*\*):  $p \leq 5\%$ , (\*):  $p \leq 10\%$

Figure 13 shows the questionnaire structure and Panel B of Table 10 shows the results for the main questions. The first 4 columns in Panel B of Table 10 show the RD regressions where the dependent variable is an indicator whether a student reported not having enrolled because financial problems (specifically the indicator takes the value of 1 if a student marked options “I could not afford it” or “I had to work to get income”, in question Q2b of figure 13). Columns (1) and (2) consider the whole sample of surveyed students across the threshold (for a linear and a 4th order polynomial specification of the control function  $f$  in equation (1)). These columns indicate that 30% of all students below the eligibility cutoff report that financial problems prevent them to enroll in college. Whereas becoming eligible for loans reduce that figure in 10 to 12 percentage points. Columns (3) and (4) show the same regressions but conditional to the sample of students that never enrolled in college. Among them, 56% report that they never enrolled in college because financial problems while the answer rate get reduced in 12 to 14 percentage point for those students that become eligible.

Table 10: Survey outcomes

<b>PANEL A: College Enrollment for Surveyed</b>							
Dependent Var.	College enrollment						
	Linear w=44 (1)	4th Pol. All sample (2)	q1 (3)	q2 (4)	Linear, w=44 q3 q4 q5 (5) (6) (7)		
$1(T \geq \tau)$	.175 (.006)***	.170 (.006)***	.200 (.008)***	.169 (.014)***	.165 (.017)***	.072 (.020)***	.035 (.022)
1(survey)	.029 (.026)	.028 (.032)	-.010 (.032)	.024 (.054)	.104 (.082)	.115 (.092)	.085 (.099)
$1(\text{survey}) \times 1(T \geq \tau)$	.003 (.038)	.015 (.040)	.010 (.049)	.041 (.078)	.005 (.111)	-.067 (.120)	-.110 (.137)
Const.	.182 (.004)***	.183 (.004)***	.145 (.005)***	.195 (.009)***	.219 (.012)***	.285 (.014)***	.289 (.016)***
Obs.	77544	230653	40317	16876	11244	9107	6948
$R^2$	.108	.336	.132	.109	.077	.047	.021

<b>PANEL B: Survey outcomes</b>								
	Did financial problems prevent you from enrolling in College:				Dropout due to	Work on	Months of Work	Earnings
	Full sample (1)	Never enrolled (2)	Never enrolled (3)	Never enrolled (4)	financial problems (5)	college (6)	in college (7)	in college (8)
$1(T \geq \tau)$	-.102 (.036)***	-.117 (.040)***	-.119 (.061)*	-.143 (.070)**	.013 (.025)	-.004 (.059)	-.212 (.543)	38.62 (130)
Const.	.301 (.03)***	.301 (.036)***	.562 (.044)***	.571 (.053)***	.060 (.02)***	.630 (.048)***	4.44 (.45)***	577.1 (108)***
$f$ Specification	Linear	4th pol.	Linear	4th pol.	Linear			
Obs.	2370	8447	1011	2109	1359	1359	1359	1356
$R^2$	.041	.089	.009	.016	.002	.0004	.001	.002

Note: Robust standard errors in parenthesis. (\*\*\*) :  $p \leq 1\%$ , (\*\*):  $p \leq 5\%$ , (\*):  $p \leq 10\%$

These outcomes are difficult to interpret because they are potentially contaminated by response or social desirability bias. It could be simpler for students to blame financial problems when they are not interested in college education, especially when the society sees college education as a social ladder and pressure young individuals to pursue it. On the other hand, it could be that students do not want to reveal their true financial status because the potential stigma of being poor. Nevertheless, if the proportion of students affected by these biases is balanced across the threshold the effects would be consistently estimated.

Moreover, these outcomes can also reflect that fact that students were surveyed in 2012, and the outcome analyzed previously is enrollment in 2007 through 2009 at the first attempt on the PSU

test. Many students who did not enroll in the first attempt enrolled in subsequent years, sometimes after they score at least the cutoff in the following attempts on the PSU test. Therefore, students that enrolled, but not in their first attempt are not asked why they did not in the first attempt.

With these problems in mind it is interesting to see that the magnitude of the effects across the threshold is not statistically different than the increment in college enrollment presented previously, and this evidence goes in line with the idea that liquidity constraints are the most important cause of the difference in college enrollment across the cutoff.

Column (5) on Table 10, shows if the dropout decision is affected by access to the loan programs (question Q7 in the survey presented in figure 13). The reported results are conditional on having enrolled in college once and therefore it suffers for at least two types of biases: small sample bias and selection bias. The former because only 13% of respondents have enrolled and dropout, and the latter because those who enroll in college from below the cutoff are from families with higher income and more educated backgrounds, which should bias the effects negatively. Contrary to the liquidity constraint hypothesis, the estimated effect is positive, but not significantly different than zero. These results are consistent with those on Stinebrickner and Stinebrickner (2008) for the U.S. who find that credit constraints are not an important factor to determine dropout decisions.

Finally to investigate why students with access to the two loan program dropout less, and enroll in second and third year with higher probability than their counterfactual below the cutoff (see section 4.4 below) I analyze answers to questions about work during college. Column (6) shows that the probability of working during college, column (7) and (8) show the intensity of the work during college, measured as the number of months during the year worked, and total earnings. The liquidity constraint hypothesis predicts that access to loans would allow students to avoid working in the intensive and extensive margins: Students that do not have access to loans (below the cutoff) would need to find a job and work more hours to fund their investments in college. Again the analysis presented in this table, is conditional on having enrolled in college and therefore cannot be interpreted as causal. The first two measures of work are consistent with the liquidity constraint hypotheses, and the third is not, although neither is significantly different than zero.

Table 11: RD Private College Enrollment by income quintile. By year and full sample.  $w = 44$  PSU points.

PANEL A: Regression by quintile				
Dependent Var.:	College Enrollment in year			
	Pooled			
	07 to 09	2007	2008	2009
	(1)	(2)	(3)	(4)
$1(\text{PSU} \geq \tau) \times \text{q1}$	.105 (.007)***	.107 (.011)***	.073 (.013)***	.125 (.011)***
$1(\text{PSU} \geq \tau) \times \text{q2}$	.086 (.011)***	.097 (.020)***	.059 (.019)***	.112 (.020)***
$1(\text{PSU} \geq \tau) \times \text{q3}$	.071 (.015)***	.085 (.025)***	.076 (.025)***	.060 (.027)**
$1(\text{PSU} \geq \tau) \times \text{q4}$	.020 (.018)	-.012 (.026)	.019 (.032)	.053 (.032)*
$1(\text{PSU} \geq \tau) \times \text{q5}$	.018 (.020)	-.056 (.040)	.048 (.028)*	.019 (.042)
q1	.100 (.004)***	.074 (.007)***	.120 (.008)***	.106 (.007)***
q2	.140 (.008)***	.092 (.013)***	.159 (.013)***	.152 (.012)***
q3	.173 (.010)***	.109 (.017)***	.175 (.018)***	.219 (.018)***
q4	.219 (.013)***	.158 (.020)***	.242 (.024)***	.260 (.023)***
q5	.231 (.014)***	.189 (.032)***	.209 (.018)***	.316 (.031)***
Obs.	86463	24889	29404	32170
$R^2$	.206	.167	.204	.243
PANEL B: Relative increase				
Quintile				
q1	105%	145%	61%	118%
q2	61%	105%	37%	74%
q3	41%	78%	43%	27%
q4	9%	-8%	8%	20%
q5	8%	-30%	23%	6%

Note: Robust standard errors in parenthesis. (\*\*\*) :  $p \leq 1\%$ , (\*\*):  $p \leq 5\%$ , (\*):  $p \leq 10\%$

### 5.3 Responses for Differentiated Access to Credit Markets

The third test analyzes the different response of groups with differentiated access to credit markets. The price and the access effects can be decomposed by observing the different aggregate behavior of these groups. The price effect can be obtained decomposed from the access effect by observing

the behavior of students from families that traditionally have had access to loans in the Chilean financial market.

As discussed in section 2, the fourth and fifth quintiles have access to private loans with interest rates similar to the SGL. The fourth quintile is also eligible for SGL and TUL, so the total effect for that group is composed only of the price effect. Under the hypothesis that the price effect is zero, the inclusion of the SGL should not produce any change in the enrollment rate for the fourth quintile.

This hypothesis is tested using the enrollment rate in private universities where SGL is the only program available. Table 11 shows that there is no change in enrollment for the fourth quintile in private universities in 2007, 2009 and for all the sample pooled together and in 2008 the effects is marginally significant. This confirms that SGL is equivalent to the loans in the conventional credit market (without price effect). Additionally, the larger response for the first two quintiles, which do not have access to other loans in the formal market, indicates that these effects are driven by the accessibility of loans rather than a change in the price of education.<sup>41</sup>

Having access to the SGL implies a 105% increase in the probability of enrollment for the first quintile, while the increment is 61% and 44% for quintiles two and three respectively, indicating that those with less financial opportunities are the ones driven the effects.

None of the three tests presented here are a perfect measure of how important the access effect is, but taken together they are evidence indicating that the results shown in the previous sections are mainly driven by the partial elimination of credit access restrictions for the lowest income quintiles.

## 6 Conclusions

In this paper, I exploit the sharp eligibility rules of two programs in Chile that give access to tuition loans to students who score above a given threshold on the national college admission test. This enables a regression discontinuity design which, combined with full information on students' enrollment and financial aid benefits, and an admission system that weights only two observed variables, allow the unbiased estimation of the causal effect of credit access on college enrollment and progress.

The results around the cutoff show that, for every student who enrolls in college with no access to loans, 2 students enroll when these loans are available. This change in enrollment is mainly driven by students from families of the poorest three income quintiles. This enrollment effect is enhanced over time in the second and third years of college. For each student without access to these loans who persists in the second and in third years, 3.1 and 5.5 students enroll in the second and third year respectively when they do have access to these financial programs.

---

<sup>41</sup>Panel B of Table 11 gives the relative importance of these effects, the change in enrollment relative to the rate of those barely ineligible.

The results above are interpreted as the effects of access to credit markets on college enrollment and college progress, because three different tests that decompose the total effect into price and access effects indicate that price component is very small to non-significantly different than zero.

Most strikingly, this paper shows that access to the loan programs appears to eliminate the relatively large income gradient in college enrollment and progress. Among students who are barely ineligible for loans, those coming from the richest quintile are twice as likely to enroll as students from the poorest income quintile, an enrollment gap very similar to the whole population. In contrast, among students who are barely eligible, the gap is zero.

The same is true for enrollment in the second and third year. Students from the richest income quintile are 3 and 8 times more likely to enroll compared to students from the poorest income quintile in second and third year respectively when these loan programs are barely not available. On the contrary, among students that are barely eligible, there is no statistical difference between the enrollment rates of the richest and the poorest students.

Around the threshold all baseline characteristics are balanced, including ability and family income, therefore, I conclude that access to financing explains almost entirely the enrollment and the educational attainment gap between students with different family income (conditional on participating in the admissions process and being at the cutoff).

The evidence shows that incomplete credit markets prevent students from low income families from investing in human capital. Credit access therefore has implications for the inter-generational distribution of education and income.

## 7 References

1. Attanasio, O. and K. M. Kaufmann, “Educational Choices, Subjective Expectations, and Credit Constraints,” NBER Working Papers #15087, 2009.
2. Becker, Gary S., “Human Capital and the Personal Distribution of Income”. (W. S. Woytinski Lecture) Ann Arbor Michigan: University of Michigan Press, 1967.
3. Belley, Philippe, and Lance Lochner, “The Changing Role of Family Income and Ability in Determining Educational Achievement,” *Journal of Human Capital*, 1 (2007), 37–89.
4. Bettinger, Eric, “How Financial Aid Affects Persistence,” NBER Working Paper No. w10242, (2004).
5. Brown, Meta, John K. Scholz and Ananth Seshadri, “A New Test of Borrowing Constraints for Education,” *Review of Economic Studies*, 79 (2012), 511–538.
6. Canton, Erik, and Andreas Blom, “Student support and academic performance: Experiences at private universities in Mexico” *Education Economics*, 18 (2010), 49–65.

7. Card, David, "The Causal Effect of Education on Earnings," In O. Ashenfelter, and D. Card, eds., *Handbook of Labor Economics, Vol. 3A* (Amsterdam: Elsevier Science, North-Holland, 1999), 1801–63.
8. ———, "Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems," *Econometrica*, 69(2001), 1127–60.
9. Carneiro, Pedro, and James J. Heckman, "The Evidence on Credit Constraints in Post-secondary Schooling," *Economic Journal*, 112 (2002), 705-34.
10. Cameron, Stephen, and James J. Heckman, "The Dynamics of Educational Attainment for Black, Hispanic, and White Males," *Journal of Political Economy*, 109 (2001), 455–99.
11. Cameron, Stephen, and Christopher Taber, "Estimation of Educational Borrowing Constraints Using Returns to Schooling," *Journal of Political Economy*, 112 (2004), 132-182.
12. Chen, Rong, "Financial Aid and Student Dropout in Higher Education: A Heterogeneous Research Approach" in J. C. Smart, ed., *Higher Education: Handbook of Theory and Research, Vol. 23* (Amsterdam: Elsevier Science, North-Holland, 2008), 209-239.
13. DesJardins, Stephen L., Dennis A. Ahlburg, and Brian P. McCall, "Simulating the Longitudinal Effects of Changes in Financial Aid on Student Departure from College," *The Journal of Human Resources*. 37 (2002), 653-679.
14. Dinkelman, Taryn & Claudia. A. Martínez, "Investing in Schooling in Chile: The Role of Information about Financial Aid for Higher Education," *The Review of Economics and Statistics* (forthcoming)
15. Dynarski, Susan M., "Does Aid Matter? Measuring the Effect of Student Aid on College Attendance and Completion," *American Economic Review*, 93 (2003), 279-288.
16. Gurgand, Marc, Adrien Lorenceau, and Thomas Melonio, "Student Loans: Liquidity Constraint and Higher Education in South Africa," Paris School of Economics working paper No. 2011-20, 2011.
17. Hahn, Jinyong, Petra E. Todd, and Wilbert Van der Klaauw, "Identification and Estimation of Treatment Effects with a Regression-Discontinuity Design," *Econometrica*, 69 (2001), 201-209.
18. Heckman, James J., Thomas M. Lyons, and Petra. E. Todd, "Understanding Black-White Wage Differentials, 1960-1990," *The American Economic Review*, 90 (2000), 344-349.



19. Hossler, Don, Mary Ziskin, Jacob P.K. Gross, Sooyeon Kim, and Osman. Cekic (2009) “Student Aid and Its Role in Encouraging Persistence” in J. Smart, ed., *Higher Education: Handbook of Theory and Research, Vol. 24*, (Amsterdam: Elsevier Science, North-Holland, 2000), 389-425.
20. Imbens, Guido W., and Karthik Kalyanaraman, “Optimal Bandwidth Choice for the Regression Discontinuity Estimator,” *The Review of Economic Studies*, 79 (2012), 933–959.
21. Imbens, Guido W., and Thomas Lemieux, “Regression Discontinuity Designs: A Guide to Practice,” *Journal of Econometrics*, 142 (2008), 615–635.
22. Kane, Thomas J., “College Entry by Blacks since 1970: The Role of College Costs, Family Background, and the Returns to Education,” *Journal of Political Economy*, 105 (1994), 878-911.
23. ———, “College Costs, Borrowing Constraints and the Timing of College Entry,” *Eastern Economic Journal*, 22 (1996), 181–94.
24. Keane, Michael P., and Kenneth I. Wolpin, “The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment,” *International Economic Review*, 42 (2001), 1051-1103.
25. Lang, Kevin, “Ability Bias, Discount Rate Bias, and the Return to Education,” Manuscript. Department of Economics, Boston University, 1993.
26. Lee, David. S., “Randomized Experiments from Non-random Selection in U.S. House Elections,” *Journal of Econometrics*, 142 (2008), 675–97.
27. Lee, David S., and Thomas Lemieux, “Regression Discontinuity Designs in Economics,” *Journal of Economic Literature*, 48 (2010), 281–355.
28. Lochner, Lance J., and Alexander Monge-Naranjo, “The nature of credit constraints and human capital”, *American Economic Review* 101 (2011), 2487–2529.
29. ———, “Credit Constraints In Education” NBER Working Paper No. w17435, 2011.
30. Manski, Charles F., and David A. Wise, *College Choice in America*, Cambridge, MA. Harvard University Press, 1983.
31. McCrary, Justin, “Manipulation of the Running Variable in the Regression Discontinuity Design: A Density Test” *Journal of Econometrics*, 142 (2008), 698–714.

32. McPherson, Michael S., and Morton O. Schapiro, "Does Student Aid Affect College Enrollment? New Evidence on a Persistent Controversy," *American Economic Review*, 81 (1991), 309-18.
33. Nielsen, Helena S., Torben Sørensen, and Christopher R. Taber, "Estimating the Effect of Student Aid on College Enrollment: Evidence from a Government Grant Policy Reform," *American Economic Journal: Economic Policy*, 2 (2010), 185-215.
34. Rau, Tomás, Eugenio Rojas, and Sergio Urzúa. "Loans for Higher Education: Does the Dream Come True?", NBER working paper no 19138 (2013)
35. Singell, Larry D., "Come and Stay a While: Does Financial Aid Effect Retention Conditioned on Enrollment at a Large Public University?," *Economics of Education Review*, 23 (2004), 459-71.
36. Solis, Alex. "Does Higher Education Cause Political Participation?: Evidence From a Regression Discontinuity Design". Mimeo (2013) (available at <http://alexsolis.webs.com/EducationonpoliticalparticipationNew.pdf>)
37. Stinebrickner Ralph, and Todd Stinebrickner, "The Effect of Credit Constraints on the College Drop-Out Decision: A Direct Approach Using a New Panel Study," *The American Economic Review*, 98 (2008), 2163-2184.
38. Van Der Klaauw, Wilbert, "Estimating the Effect of Financial Aid Offers on College enrollment: A Regression-Discontinuity Approach," *International Economic Review*, 43 (2002), 1249-1287.
39. Van Der Klaauw, Wilbert, "Regression-Discontinuity Analysis: A Survey of Recent Developments in Economics," *Labour*, 22 (2008), 219-245.

## A Appendix: Dropout Rates

Few papers try to document the causal effects of financial aid on retention conditional on enrollment and dropout rates. Exceptions are Dynarski (2003), Bettinger (2004), Singell (2004) and Stinebrickner and Stinebrickner (2008), with mixed conclusions.

In this section, I study the effects of college loans on the dropout status of the students in this quasi experiment. The main difference between these results and those in the previous section is that here the sample is restricted to students who enrolled in college when they first took the PSU test, while in the previous analysis the comparison was made with respect to all students around the cutoff. This analysis shed light on the potential problems faced by the literature.

Because this section compares only students who self-selected into college around the cutoff, the estimates are no longer causal effects, but rather are correlations that can be illustrative in comparison to the previous results. First I check what types of biases are underlying the correlations by comparing observable characteristics. Table 12 shows the estimation of equation (1) for the same group of covariates for students around the cutoff, with each column corresponding to those who enrolled in 2007 through 2009. As expected, students without access to loans who enroll in college are different from those eligible for loans: they come from higher income families (indicated by the income quintile and the self-reported income), suggesting that these students relied on family resources to enroll; they have better educated parents and come from higher quality schools (more students from public schools above the cutoff, and more students from voucher schools below), which may indicate a higher preference for college education.

The available data does not provide a definitive measure of dropout status for the students. Some students may not enroll in one year but go back to finish their programs after some time out. I will therefore use different definitions of dropout. The first definition, named “dropout after 1 year” is an indicator function that takes the value 1 if a student enrolls after taking the PSU test for the first time, but is not enrolled the year immediately after. Similarly, “dropout after 2 years” takes the value of 1 if somebody enrolled in 2007, but was not enrolled in 2009. Because these definitions do not capture the possibility of coming back after some years of absence, I define a third measure of attrition. The variable “dropout in 2009” is an indicator variable that takes the value of 1 for any student who enrolled in 2007 or 2008 but was not enrolled in 2009, the last year I observe the enrolling behavior of these students. This measure allow those who enroll in 2007 to miss 2008 but come back in 2009, but do not capture those who may come back in later years. Finally, to distinguish between the first two definitions, I define a variable named “dropout in 2nd year” to equal 1 if a student enrolled the first 2 years but did not show up in the third.

Table 13 reports the estimate of the same linear specification in a 2 stage least square setting to control for self-selection on the eligibility condition, adding as covariates all the observable characteristics to control for any selection on observables. Column (1) shows the dropout rate after the

first year of college. Students barely eligible for loans drop out 6 percentage points less frequently than ineligible. The dropout rate for students without access to these loans is 19%; this implies that the probability of dropping out after the first year of college experiences a 31% decrease.

Column (2) shows the estimates for the definition “dropout in 2009” indicating that eligible students drop out 5 percentage points less than constrained ones. Column (3) shows dropout rates over a longer span of time: “dropout after 2 years of college.” Eligible students dropped out less frequently, by 11 percentage points. In relative terms, this effect implies a 38% decrease in this dropout rate. Column (4) shows that the dropout rate does not fall significantly for the students enrolled in a second year, but the relative magnitudes confirm the previous result: there is a 26% reduction in the dropout probability.

These correlations help explain the long run enrollment results previously reported but they also help to reconcile results from the literature. One important issue is the selection process that is evident here. Students who enroll in college are different than the underlying population, and therefore the effects estimated from the sample conditional on enrollment present a bias towards zero. In this case, the dropout results are much smaller than the results from enrollment and progress which are due to family income compensating for access to loans. Nevertheless, they are relatively large and highly significant.

Table 12: Balance among covariates for Students that choose college in their first PSU test.  $w = 44$

Year Process ( $w = 44$ )	2007		2008		2009	
Variable	dif	abs(t)	dif	abs(t)	dif	abs(t)
Self reported income	-0.14	(4.79)***	-0.07	(2.38)**	-0.13	(4.96)***
Quintile	-0.20	(2.91)***	-0.19	(3.31)***	-0.25	(4.71)***
Mother education	-0.22	(1.68)*	-0.35	(2.71)***	-0.17	(1.35)
Father education	-0.51	(3.33)***	-0.30	(2.01)**	-0.12	(0.80)
1(female)	0.08	(2.68)***	-0.03	(1.41)	0.02	(0.90)
High school GPA	0.90	(1.91)*	0.49	(1.10)	0.40	(1.0)
H. school type	0.11	(3.31)***	0.10	(3.82)***	0.06	(2.27)**
1(married)	-0.01	(1.23)	0.02	(1.86)*	0.01	(1.46)
1(work)	0.01	(0.46)	0.01	(0.35)	0.01	(0.58)
HH Size	0.13	(1.16)	0.02	(0.18)	0.12	(1.39)
1(mother works)	-0.04	(0.28)	0.25	(1.99)**	0.15	(1.21)
1(father works)	0.06	(0.52)	0.01	(0.15)	0.11	(1.18)
Will live outside HH	0.02	(0.64)	-0.03	(1.23)	-0.01	(0.60)
Who finance college	0.14	(1.43)	0.04	(0.55)	0.13	(1.72)*
Expect aid to finance	0.01	(0.69)	0.01	(0.87)	-0.01	(0.76)
Both Parents live	0.00	(0.05)	0.01	(0.44)	-0.01	(0.27)
Obs (N)	6,728		8,022		8,980	

Note: Dif refers to the  $\beta_1$  of equation (1). t-values in parenthesis (in absolute values). (\*\*\*):  $p \leq 1\%$ , (\*\*):  $p \leq 5\%$ , (\*):  $p \leq 10\%$

Table 13: Dropout rate in 2nd and 3rd years of college around the cutoff.  $w = 44$

Dep. Variable :	Dropout after 1 year of college	Dropout in 2009	Dropout after 2 year of college	Dropout in 2nd year of college
	(1)	(2)	(3)	(4)
Eligible	-.058 (.017)***	-.051 (.018)***	-.110 (.033)***	-.010 (.024)
Const.	.188 (.099)*	.201 (.105)*	.293 (.155)*	.038 (.124)
Covar	Y	Y	Y	Y
% Decrease	31%	25%	38%	26%
Obs.	14750	14750	6728	6728
$R^2$	.032	.04	.067	.018

Note: Robust standard errors in parenthesis. (\*\*\*) :  $p \leq 1\%$ , (\*\*):  $p \leq 5\%$ , (\*):  $p \leq 10\%$ . All regressions are based on equation (1), using 44 point around the cutoff and a linear specification.

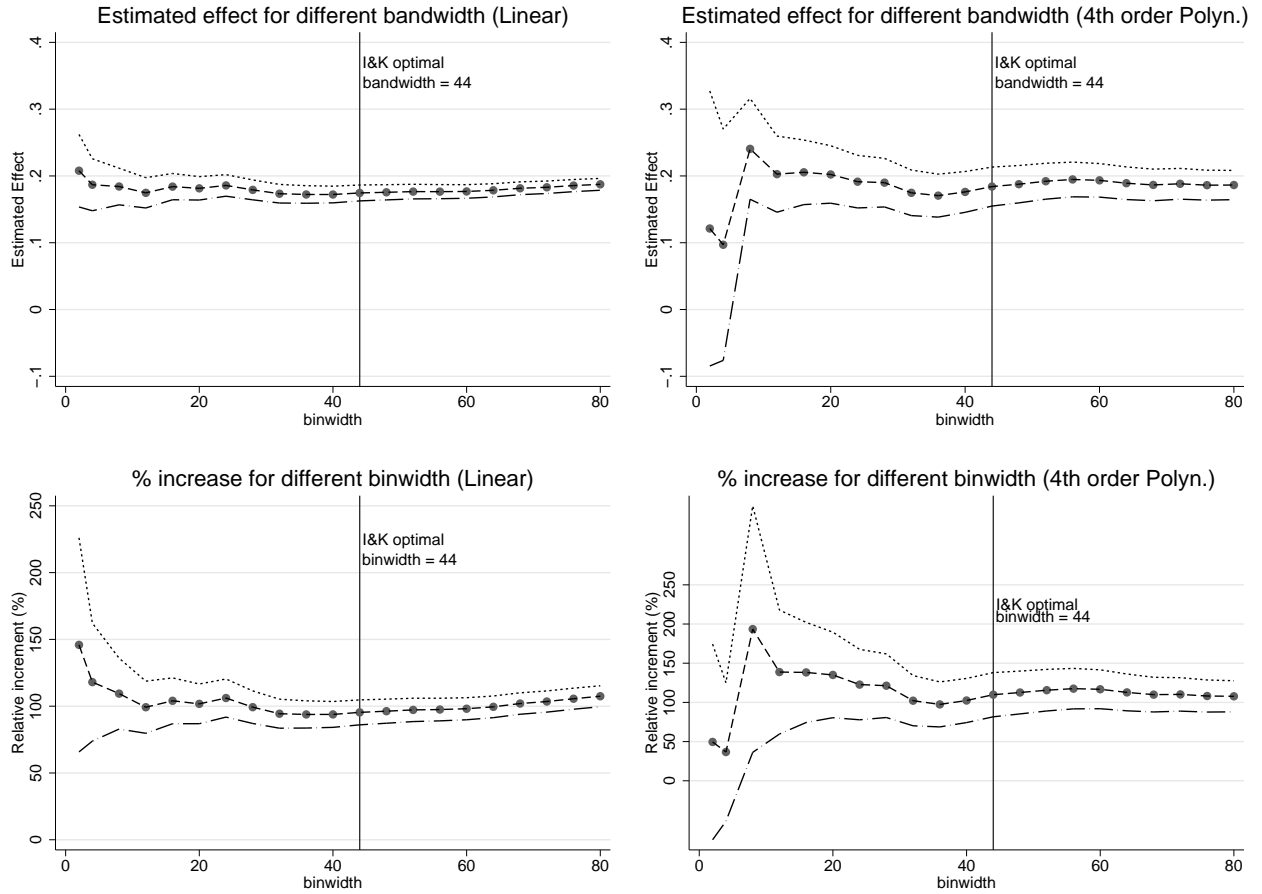
Covariates are “self reported income”, income quintile, mother education, father education, age, female dummy, high school GPA, health insurance system, married dummy, work dummy, dummy for public schools, dummy for voucher schools, household size.

## B Appendix: Sensitivity analysis

To give a sense of how insensitive these results are to the chosen bandwidth and specification, Figure 11 presents estimates of  $\beta_1$  and  $\beta_1/\beta_0$  for different bandwidths (from 2 to 80 PSU points) comparing the linear with a fourth order spline specification. The upper left graph shows estimations of  $\beta_1$  for the linear specification with a vertical line for the optimal bandwidth used throughout the paper ( $w^* = 44$ ), while the upper right graph shows it for a fourth order polynomial spline. We can observe that the results are not sensitive to bandwidth and are almost the same for the two specifications, estimating an effect of roughly 18 percentage points.

The graphs on the bottom present the relative increase in the enrollment probability, i.e. the ratio  $(\beta_1/\beta_0)$ , with a 95% confidence interval (standard errors calculated using the delta method). The relative increase is very close to 100% for both specifications and for all bandwidth, except for some small ones.

Figure 11: Comparison of different bandwidth in the estimation of the effect of loan access on college enrollment.



Note: The graphs on the top show the RD estimation of the effect of being eligible for loans on college enrollment using different bandwidths and 95% confidence intervals constructed using robust standard errors. The graph on the bottom show the relative increase in enrollment:  $(\lim_{T \downarrow \tau} \Delta Enrollment) / (\lim_{T \uparrow \tau} Enrollment) = \beta_1 / \beta_0$ , Where  $\beta_0$  is the enrollment rate for students without access to loans at the cutoff and  $\beta_1$  the loans access effect (see equation (1)), and 95% confidence interval using delta method standard errors. “I&K optimal bandwidth” refers to the optimal bandwidth  $w = 44$ , estimated using Imbens and Kalyanaraman (2012).

## C Appendix: Analysis by quintile for the whole population

To determine how important access to tuition loans is explaining the college enrollment gap by family income is necessary to estimate enrollment by income quintile. Unfortunately in the data used in this paper the income quintile information is only available for those students that completed the FUAS form. Hence the analysis in section 4.3 uses the sub-sample of individuals that completed that socioeconomic form. In this appendix I estimate the income quintile for the whole population using all characteristics available for the students. I performed an estimation of the income quintile using the sample with the information and performed an out of sample prediction for those with no information.

The effects of enrollment by income quintile calculated in this way are almost identical than those reported in section 4.3.

Figure 12: Effects on College Enrollment. By income quintiles (predicted using self reported income category)

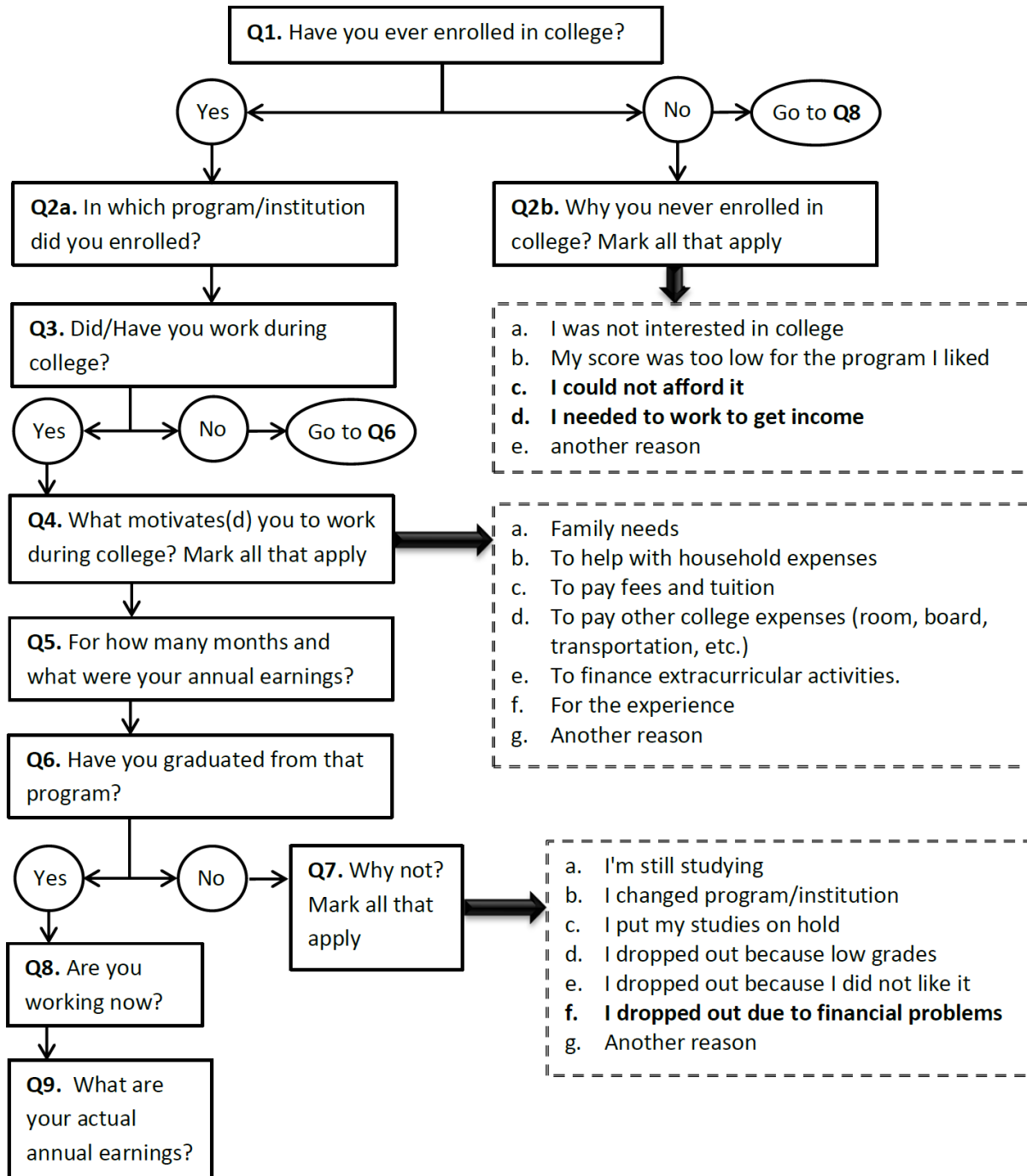
	All	q1	q2	q3	q4	q5
	(1)	(2)	(3)	(4)	(5)	(6)
$1(T \geq \tau)$	.003 (.006)	-.003 (.006)	.002 (.015)	.002 (.019)	.020 (.021)	.010 (.017)
Const.	.158 (.004)***	.088 (.004)***	.125 (.010)***	.192 (.013)***	.228 (.015)***	.327 (.012)***
Pre-selected	.025 (.005)***	.058 (.006)***	.071 (.013)***	.032 (.017)*	.059 (.020)***	
Pre-selected $\times 1(T \geq \tau)$	.172 (.008)***	.202 (.010)***	.168 (.020)***	.162 (.025)***	.051 (.029)*	
Obs.	150356	74412	24701	18534	15838	12163
$R^2$	.101	.151	.129	.083	.045	.018

Note: Robust standard errors in parenthesis. (\*\*\*) :  $p \leq 1\%$ , (\*\*) :  $p \leq 5\%$ , and (\*) :  $p \leq 10\%$ .



## D Appendix: Survey

Figure 13: Survey Questions Structure



## WORKING PAPERS\*

Editor: Nils Gottfries

- 2012:5 Pedro Carneiro and Rita Ginja, Long Term Impacts of Compensatory Preschool on Health and Behavior: Evidence from Head Start. 82 pp.
- 2012:6 Magnus Carlsson and Stefan Eriksson, Do Reported Attitudes towards Immigrants Predict Ethnic Discrimination? 23 pp.
- 2012:7 Mikael Bask and Christian R. Proaño, Optimal Monetary Policy under Learning in a New Keynesian Model with Cost Channel and Inflation Inertia. 25 pp.
- 2012:8 Mikael Elinder and Oscar Erixson, Every man for himself. Gender, Norms and Survival in Maritime Disasters. 78 pp.
- 2012:9 Bertil Holmlund, Wage and Employment Determination in Volatile Times: Sweden 1913–1939. 43 pp.
- 2012:10 Indraneel Chakraborty, Hans A. Holter and Serhiy Stepanchuk, Marriage Stability, Taxation and Aggregate Labor Supply in the U.S. vs. Europe. 63 pp.
- 2012:11 Niklas Bengtsson, Bertil Holmlund and Daniel Waldeström, Lifetime versus Annual Tax Progressivity: Sweden, 1968–2009. 56 pp.
- 2012:12 Martin Jacob and Jan Södersten, Mitigating shareholder taxation in small open economies? 16 pp.
- 2012:13 John P. Conley, Ali Sina Önder and Benno Torgler, Are all High-Skilled Cohorts Created Equal? Unemployment, Gender, and Research Productivity. 19 pp.
- 2012:14 Che-yan Liang and Mattias Nordin, The Internet, News Consumption, and Political Attitudes. 29 pp.
- 2012:15 Krzysztof Karbownik and Michal Myck, For some mothers more than others: how children matter for labour market outcomes when both fertility and female employment are low. 28 pp.
- 2012:16 Karolina Stadin, Vacancy Matching and Labor Market Conditions. 51 pp.
- 2012:17 Anne Boschini, Jan Pettersson, Jesper Roine, The Resource Curse and its Potential Reversal. 46 pp.
- 2012:18 Gunnar Du Rietz, Magnus Henrekson and Daniel Waldenström, The Swedish Inheritance and Gift Taxation, 1885–2004. 47pp.

---

\* A list of papers in this series from earlier years will be sent on request by the department.

- 2012:19 Helge Bennmarker, Erik Grönqvist and Björn Öckert, Effects of contracting out employment services: Evidence from a randomized experiment. 55 pp.
- 2012:20 Pedro Carneiro and Rita Ginja, Partial Insurance and Investments in Children. 32pp.
- 2013:1 Jan Pettersson and Johan Wikström, Peeing out of poverty? Human fertilizer and the productivity of farming households. 43 pp.
- 2013:2 Olof Åslund and Mattias Engdahl, The value of earning for learning: Performance bonuses in immigrant language training. 52 pp.
- 2013:3 Michihito Ando, Estimating the effects of nuclear power facilities on local income levels: A quasi-experimental approach. 44 pp.
- 2013:4 Matz Dahlberg, Karin Edmak and Heléne Lundqvist, Ethnic Diversity and Preferences for Redistribution: Reply. 23 pp.
- 2013:5 Ali Sina Önder and Marko Terviö, Is Economics a House Divided? Analysis of Citation Networks. 20 pp.
- 2013:6 Per Engström and Eskil Forsell, Demand effects of consumers' stated and revealed preferences. 27 pp.
- 2013:7 Che-Yuan Liang, Optimal Inequality behind the Veil of Ignorance. 26 pp.
- 2013:8 Pia Fromlet, Monetary Policy Under Discretion Or Commitment? -An Empirical Study. 57 pp.
- 2013:9 Olof Åslund and Mattias Engdahl, Open borders, transport links and local labor markets. 41 pp.
- 2013:10 Mohammad Sepahvand, Roujman Shahbazian and Ranjula Bali Swain, Time Investment by Parents in Cognitive and Non-cognitive Childcare Activities. 31 pp.
- 2013:11 Miia Bask and Mikael Bask, Social Influence and the Matthew Mechanism: The Case of an Artificial Cultural Market. 13 pp
- 2013:12 Alex Solis, Credit access and college enrollment. 54 pp