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Título:

Student Financing and Higher Education: an evaluation of FIES

Tese de Doutorado apresentada ao Programa de Pós-Graduação em Economia da Universidade de Brasília, como parte dos requisitos necessários à obtenção do título de Doutor em Economia.

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Financiamento Estudantil e Ensino Superior: uma avaliação do FIES

RESUMO

A presente tese é composta por dois artigos que buscam analisar o impacto do FIES, principal política de financiamento estudantil para o ensino superior no Brasil, sobre o acesso à universidade e sobre o comportamento das instituições de ensino superior (IES). A estratégia de identificação se baseia em uma reforma que introduziu cotas regionais para os empréstimos concedidos anualmente. Tais cotas dependem das médias regionais do Índice de Desenvolvimento Humano (IDH) de maneira descontínua, permitindo um desenho quase-experimental que explora tanto a mudança na política quanto as descontinuidades introduzidas pela nova regra de alocação.

No primeiro artigo, observamos que cada empréstimo adicional resulta em aproximadamente 0,2 graduações adicionais em seis anos. No entanto, os efeitos são bastante heterogêneos e concentrados principalmente em IES com fins lucrativos e, especialmente, em programas noturnos. Constatamos que o impacto dos empréstimos no ingresso é maior para estudantes provenientes de escolas de ensino médio privadas. O impacto na graduação, por outro lado, é maior para estudantes oriundos de escolas públicas, mais provavelmente afetados por restrições financeiras. Análises adicionais sugerem que estudantes menos favorecidos aumentam sua participação no ENEM após uma expansão na disponibilidade de empréstimos. No entanto, os mesmos costumam apresentar pontuações mais baixas, limitando sua capacidade de obter empréstimos em cursos mais competitivos. Assim, apesar de destacar a importância das restrições financeiras, nossos resultados também indicam que a preparação acadêmica parece ser um obstáculo igualmente importante para o acesso ao ensino superior por estudantes de menor renda.

No segundo artigo, investigamos como as IES com fins lucrativos respondem à disponibilidade de financiamento governamental. Observamos que o aumento na disponibilidade de empréstimos resulta em um impulso significativo na receita de tais instituições, de RS$ 0,73 a RS$ 0,78 para cada real adicional em desembolsos de empréstimos pelo governo federal. Cada aumento de RS$ 1 na receita resulta em aproximadamente um aumento de RS$ 0,4 nos lucros, sendo o restante destinado a despesas adicionais, especialmente em custos de mão de obra. As estimativas de markup são bastante altas em média (64%) e são maiores para IES de maior qualidade, IES menos seletivas e IES que não enfrentam a concorrência de universidades públicas. No entanto, também encontramos evidências indicativas de que as instituições aproveitam esse choque de receita para aprimorar os padrões de qualidade, contratando docentes permanentes com credenciais mais elevadas (mestrado e doutorado). A supervisão dos programas de ensino superior parece desempenhar um papel nesse comportamento, uma vez que os gastos aumentam em áreas incluídas em avaliações anuais de qualidade, resultando em pontuações mais altas para a instituição.

Palavras-chave: financiamento estudantil, educaçao superior, instituições de ensino superior, IES com fins lucrativos, FIES

Student Financing and Higher Education: an evaluation of FIES

ABSTRACT

This thesis consists of two papers that investigate the impact of FIES, the primary higher education financing policy in Brazil, on access to college and on the behavior of higher education institutions. The identification strategy relies on a reform that implemented regional quotas for loans granted. These quotas depend on regional Human Development Index (HDI) values in a discontinuous way, allowing a quasi-experimental design that leverages both the policy change and the discontinuities introduced by the new allocation rule.

In the first paper, we find that each additional loan leads to approximately 0.2 additional college graduates in six years. However, effects are quite heterogeneous, and concentrated mostly in for-profit higher education institutions (HEIs) and, notably, in evening programs. We find that the impact of loans on initial enrollment is higher for more advantaged students, specifically those coming from private high schools. Impact on graduation, on the other hand, is higher for students coming from public high schools, who are more likely to be financially constrained. Further analysis suggests that less advantaged students increase their participation in the selection exam following an expansion in loan availability. However, they usually present lower scores, limiting their capacity to access loans in more competitive majors. Thus, despite highlighting the significance of financial constraints, our results also indicate that poor academic preparation seems to be an equality important obstacle to accessing higher education for students from less advantaged backgrounds.

In the second paper, we investigate how for-profit higher education institutions (HEIs) respond to the availability of government funding. We find that increased loan availability results in a significant boost in revenue for such institutions, of \$0.73-\$0.78 for each additional \$1 in loan disbursements by the federal government. Each \$1 increase in revenue results in approximately a \$0.4 increase in institutional profits, with the remainder resulting in increased expenses, especially in labor-related costs. Markup estimates are quite high on average (64%), and are higher for higher quality HEIs, less selective HEIs and HEIs that do not face competition of public universities. Nevertheless, we also find indicative evidence that institutions take advantage of this revenue shock to improve quality standards by hiring permanent faculty with better credentials (master and doctoral degrees). Oversight of higher education programs seems to have a role in this behavior, since spending increases in areas included in annual quality assessments, resulting in higher quality scores for the institution.

Keywords: student loans, higher education, higher education institutions, for-profit HEIs, FIES

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1. Introduction

The thesis consists of two papers that investigate the impact of FIES, the primary higher education financing policy in Brazil, on access to college and on the behavior of higher education institutions. The identification strategy relies on a reform that implemented regional quotas for loans granted. These quotas depend on regional Human Development Index (HDI) values in a discontinuous way, allowing a quasi-experimental design that leverages both the policy change and the discontinuities introduced by the new allocation rule.

In the first paper, we examine the impact of FIES, the primary student loan program for postsecondary education in Brazil, on college access and completion. We employ a "fuzzy" Regression Discontinuity Design, leveraging a reform that implemented regional quotas for annual loan allocations. These quotas are determined discontinuously based on ranges of regional Human Development Index (HDI) values. We find that each additional loan leads to approximately 0.2 additional college graduates in six years. However, effects are quite heterogeneous, and concentrated mostly in for-profit higher education institutions (HEIs) and, notably, in evening programs. We find that the impact of loans on initial enrollment is higher for more advantaged students, specifically those coming from private high schools. Impact on graduation, on the other hand, is higher for students coming from public high schools, who are more likely to be financially constrained. Further analysis suggests that less advantaged students increase their participation in the selection exam following an expansion in loan availability. However, they usually present lower scores, limiting their capacity to access loans in more competitive majors. Thus, despite highlighting the significance of financial constraints, our results also indicate that poor academic preparation seems to be an equality important obstacle to accessing higher education for students from less advantaged backgrounds.

In the second paper, we investigate how for-profit higher education institutions

(HEIs) respond to the availability of government funding in the form of student loans, by employing a "fuzzy" Regression Discontinuity Design. The identification strategy relies on a reform of FIES, the main program for postsecondary education loans in Brazil, which introduced regional quotas for loans granted. The quotas depend on regional Human Development Index (HDI) values in a discontinuous way, allowing for a quasi-experimental design that explores both the policy change and the discontinuities. We find that increased loan availability results in a significant boost in revenue for such institutions, of \$0.73-\$0.78 for each additional \$1 in loan disbursements by the federal government. Each \$1 increase in revenue results in approximately a \$0.4 increase in institutional profits, with the remainder resulting in increased expenses, especially in labor-related costs. Markup estimates are quite high on average (64%), and are higher for higher quality HEIs, less selective HEIs and HEIs that do not face competition of public universities. Nevertheless, we also find indicative evidence that institutions take advantage of this revenue shock to improve quality standards by hiring permanent faculty with better credentials (master and doctoral degrees). Oversight of higher education programs by the Ministry of Education seems to have a role in this behavior, since spending increases in areas included in annual quality assessments, resulting in higher quality scores for the institution.

2. Student loans, access to college and degree attainment

2.1 Introduction

Access to higher education has been a point of intense debate in many countries. Issues such as persistent social disparities in enrollment, tuition prices, student debt levels, among others, have been at the center of this discussion. Despite this, relatively little is known about the effects of loan policies on enrollment and, particularly, completion of higher education (Dynarski et al., 2022). Recent work has shed some light on these effects, but even so, little is known about how they vary according to characteristics of the students and higher education institutions (HEIs) attended.

This paper contributes to this incipient literature in several ways, and is more closely related to Gurgand et al. (2023), Solis (2017), Melguizo et al. (2016) and Card and Solis (2022). We study the effect of FIES, a federal program that provides funding for postsecondary education in Brazil, on several outcomes, including most of the outcomes covered by the mentioned papers. More precisely, we estimate effects of loans on outcomes such as admission, enrollment and graduation, up to the sixth year since entry. Additionally, we explore the heterogeneity of these effects based on student and HEI characteristics.

Our findings indicate that each additional loan is associated with an increase of approximately 0.43 enrolled students and 0.2 graduates up to the sixth year following admission[1]. Previous studies by Solis et al. (2017) and Melguizo et al. (2016) found that loans raise individual enrollment probabilities by 0.175 and 0.2, respectively.

In addition, we observe that the program's impact is far from homogeneous, primarily affecting students entering programs with courses taught at the evening and students entering for-profit HEIs. These margins where not explored in previous

[1] Figure 2.7 in the Appendix shows that, by the sixth year, the completion rate in Brazilian private universities is very close to its peak value. After this year, they increase only by approximately 3 (4) percentage points, in the case of for-profit (non-profit) HEIs, reaching around 38% (41%) in the tenth year since admission.

literature. Particularly, the higher effect we observe for evening programs, whose main characteristic is having a work-compatible schedule, likely underscores the significance of financial constraints in limiting access to higher education.

We also observe that effects are initially higher for students coming from private high schools. However, over the duration of the program, this situation is reversed. While the effects on persistence for the former students diminish, they increase for students coming from public high schools. This pattern indicates that student loans may not be able to counteract low investments in earlier levels of education, but are important for the persistence of students of less advantaged backgrounds who actually enroll. Testing this explanation, we find that higher loan availability increases the number of students taking, in the following year, the national exam required for applying to FIES. This effect is much higher for students coming from public schools, indicating a higher response to credit availability, which is in line with the notion of greater credit constraints for this group. However, public school students induced to take the exam score much lower than their private school counterparts, limiting their chances of securing loans.

Brazil's large and diversified higher education market provides a valuable context for examining the effects of student aid. This market comprises tuition-free public institutions, non-profit and for-profit private institutions, and an aid system that encompasses gratuity, government subsidies, means-tested and merit-based scholarships, as well as loans. With 8.7 million enrollments in 2018, Brazil ranks as the fourth largest tertiary education market globally, trailing only China (44.9 million), India (34.3 million), and the United States (18.9 million)[2].

FIES applies mostly to students entering private for-profit and non-profit HEIs, since public HEIs in Brazil do not charge tuition or fees, with very few exceptions. Our identification strategy relies on a natural experiment created by the implementation of "loan quotas" across different regions of the country. Prior to 2015,

[2] According to World Bank data, available in `https://databank.worldbank.org/indicator/SE.TER.ENRL?id=c755d342&report_name=EdStats_Indicators_Report`.

there were no restrictions on the number of loans granted per year, and all eligible applicants meeting the necessary criteria were provided with funding[3].

However, amidst a worsening fiscal and economic crisis, among other measures of fiscal tightening, the federal government also limited the amount of loans granted annually. Capping the number of loans would make FIES more selective, disproportionately affecting less developed regions, since students in these regions had, on average, lower scores at the national exam. To mitigate this issue and promote a more equitable regional distribution of loans, the government introduced a system that allocated a predetermined number of loans for each region.

Following the reform, the allocation of loans to regions follows a *weighted relative demand index*, with greater weights assigned to regions presenting lower Human Development Index (HDI) levels. These weights were assigned in an arbitrary and discontinuous manner, according to ranges for the average HDI of Brazilian "microregions" (*microrregiões*), each microregion comprising approximately 10 municipalities. Exploiting this arbitrary weighting scheme, we employ a "fuzzy" Difference-in-Discontinuities design in order to estimate the causal effect of student loans on access to higher education in Brazil. This approach, employed in some recent papers (Grembi et al., 2016; Corbi et al., 2019; Bennedsen et al., 2022), combines the credibility of the RD design with the ability to account for unobserved characteristics that are fixed in time.

In summary, when compared to the previous literature, our findings reveal a higher impact of student loans on higher education enrollment and completion. However, these effects are heterogeneous, depending on both student and HEI characteristics. Notably, characteristics indicative of financial constraints, such as studying in the evening, seem to amplify the effects of loans. However, low investments in earlier educational levels may hinder the ability of loans to stimulate enrollment for

[3]These requirements include restrictions such as a minimum score in the national high school exam (ENEM), maximum per capita household income, minimum score for the intended program in an assessment carried out by the Ministry of Education, among others.

economically disadvantaged students.

The paper is organized as follows: Section 2 provides an overview of the institutional characteristics of the higher education sector in Brazil. Section 3 reviews the relevant literature. Section 4 outlines the empirical strategy and dataset construction. Section 5 presents the results of the empirical analysis. Finally, Section 6 concludes.

2.2 Institutional background

The Brazilian higher education system comprises a diverse mix of institutions, including federal, state, and municipal public universities, as well as for-profit and non-profit private institutions. Public universities are tuition-free and prohibited from charging any fees, including tuition, according to the Brazilian Federal Constitution[4]. The demand for student funding is therefore associated with private universities, which have experienced significant growth in recent decades (panels (a) and (b) of Figure 2.1).

In 1996, private institutions accounted for 67% of admissions and 45% of enrollments in Brazilian higher education. Two decades latter, in 2019, these figures reached 85% and 76%, respectively, still presenting an upward trend. The high participation of the private sector in the supply of higher education in Brazil is a characteristic rarely observed in other countries (Lovenheim and Smith, 2022). In recent decades, distance learning has also stimulated the growth of private institutions, especially the larger ones, despite the fact that such educational programs were not eligible for FIES loans until 2022.

Government action to promote access to higher education occurs in three main ways: public universities, scholarships at private universities and student loans, in descending order of attractiveness to the student. Public universities offer tuition-

[4]A few public institutions that charged tuition fees prior to the enactment of the Constitution in 1988 were exempted from this rule.

free college degrees, accounting for 24.6% of enrollments in 2018. This type of access is typically favored by students due to its cost-free nature, but also because the absence of costs increases selectivity and, consequently, the prestige of the programs offered. In addition, they are also research universities, which is usually associated to a more qualified academic staff.

Scholarships for economically disadvantaged students are granted through the University for All Program (*Programa Universidade para Todos* – Prouni), a federal program created in 2005. Participating institutions are required to offer scholarships at a ratio of 1 to 10.7 paying students and, in return, receive exemption from (some) federal taxes. Prouni is both merit-based and means-tested. To qualify, the student must have a monthly per capita household income (PCHI) of up to 1.5 times the national minimum wage[5]. Selection among eligible candidates is based on scores achieved in the National High School Exam (ENEM), meaning that only high-scoring eligible candidates are granted access to the scholarships. Non-profit HEIs can also participate in a second federal scholarship program (CEBAS Educação) and receive additional tax exemptions in exchange for offering scholarships. These grants are also means-tested, as Prouni, but not necessarily based on merit, since HEIs have autonomy to allocate the grants.

The federal government also offers student loans through the FIES program, established in 1999. In Brazil, funding for private higher education dates back to 1975, with the creation of the Educational Credit Program (Creduc). This program was reformulated several times throughout its existence. In 1999, it was finally replaced by FIES, which experienced great fluctuations in the number of loans offered since its inception. It witnessed rapid growth in the first half of the 2010s, but has been declining since 2015 (Panels (c) and (d) of Figure 2.1). Figure 2.1 shows the

[5]Instead of a full scholarship for every 10.7 paying students, participating institutions can opt to offer a full scholarship for every 22 paying students, supplementing with a combination of 50% and 25% partial scholarships, until the total benefit reaches 8.5% of revenue (simillarly to the standard 1 to 10.7 rule) . In the case of partial grants, the eligibility limit is PCHI of up to 3 minimum wages.

evolution of loans granted, as well as the ratio of new loans to annually admitted students during 1976-2020. In 1976-1998, around 9% of those entering higher education had student loans granted by the federal government. However, this percentage decreased as admissions soared after 1996.

Prior to 2011, access to FIES required the presentation of a guarantor with sufficient income to repay the loans, which could be a hindrance, particularly to low-income individuals. This requirement could be seen as contradictory, since it targeted the program to individuals less likely to face financial restrictions. Therefore, intending to expand the program, the government instituted the FIES Guarantee Fund (Fgeduc), which acted as the guarantor of future FIES loans. As a result of the change, FIES became more targeted on low-income students, but default rates promptly increased (Brasil, 2020).

The plan to increase the program's attractiveness paid off. The number of loans granted experienced substantial growth, surging from 76,000 in 2010 to a peak of 733,000 in 2014, as can be seen in panel (c) of Figure 2.1. However, there was dissatisfaction with the apparent low impact of the program, since the number of enrollments in higher education, already booming, showed no perceptible acceleration in the period, despite the strong expansion of funding. This concern was expressed both within the government (Ministério da Fazenda, 2017) and the general press[6].

As a result, the proportion of FIES-funded students among on-campus private higher education enrollments rose from 5% in 2009 to 39% in 2015 (Ministério da Fazenda, 2017), while the percentage of new loans granted among students admitted to higher education increased from 3% to 24% during the same period (panel (d) of Figure 2.1). However, the program's expansion incurred significant costs due to high default rates and subsidized interest rates. As a final blow, the Brazilian economy, already decelerating, entered its worse recession since the 1930s, culminating

[6]e.g., in `https://oglobo.globo.com/sociedade/educacao/expans~ao-de-fies-prouni-nao-do-matriculas-acelerarem-em-universidades-particulars-15452743` ("*Expansion of Fies and Prouni did not speed up enrollment at private universities*").

in the Federal Government's decision of limiting the number of loans offered and, ultimately, carry out a reformulation of FIES in 2017, with effect in the following year. Dearden and Nascimento (2019) discuss the main aspects of the program's reformulation, as well as institutional aspects of higher education in Brazil.

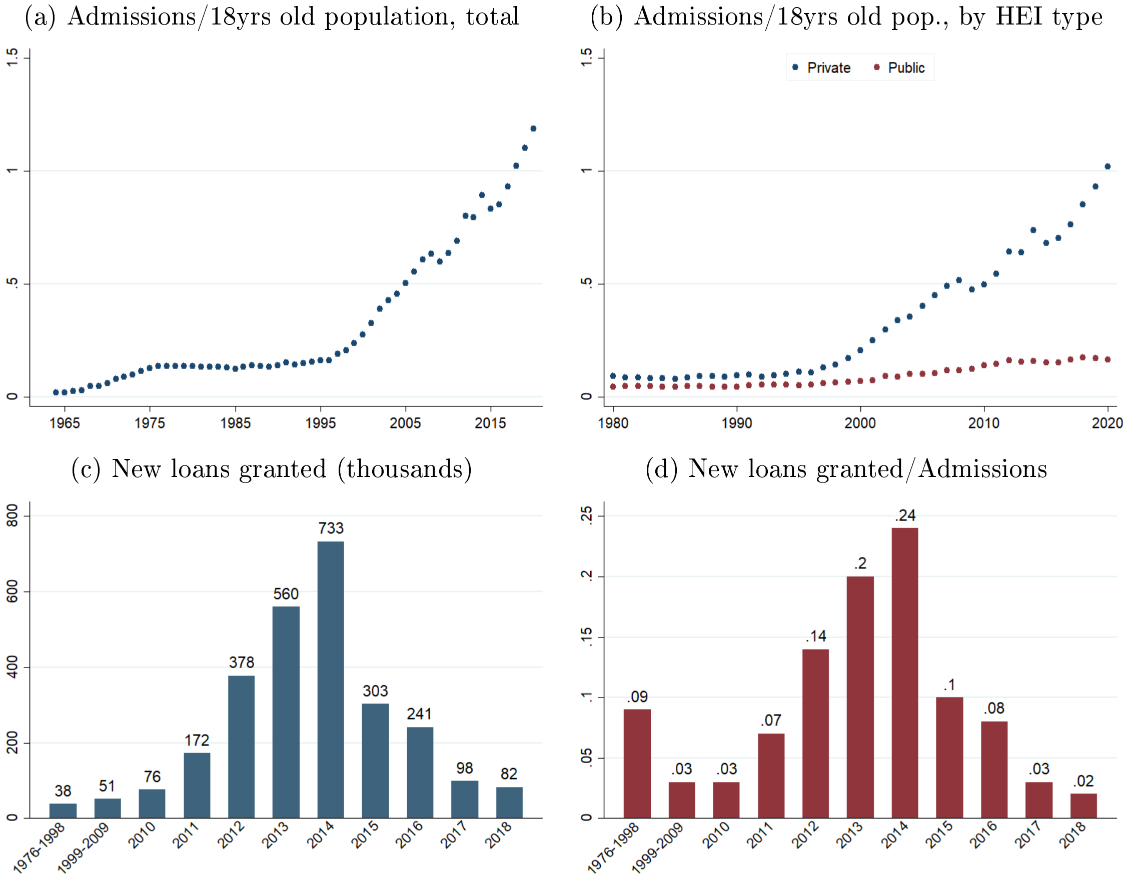
A simple comparative analysis could lead to the conclusion that the program expanded primarily by crowding out other forms of funding, rather than stimulating new enrollment. However, the observed expansion (2010-2014) and subsequent contraction (2015-2017), coincided with a period of economic growth (2.4% annual expansion in GDP per capita) and a subsequent sharp downturn (-2.7% per year), suggesting that the correlation between funding and enrollment could be actually reflecting the economic cycle.

Generally, higher education enrollment has a countercyclical component due to opportunity costs. During economic downturns, enrollment rates can increase as individuals may decide to invest more in education in order to improve their employment prospects. Conversely, enrollment may decline during economic booms due to a more favorable labor market. Most studies testing this hypothesis, such as Dellas and Sakellaris (2003), Sakellaris and Spilimbergo (2000) and Hillman and Orians (2013), find countercyclical enrollment rates for developed countries, but Sakellaris and Spilimbergo (2000) finds procyclical enrollment for non-OECD countries, indicating that credit constraints may be more important in this case. Consequently, simple correlations between loans and enrollment can be biased in either direction, depending on the importance of credit constraints.

During 2013-2017, the majority of FIES loans covered full tuition. Other costs, such as books and living expenses, are not covered. Loans did not cover full tuition mostly when it was not required by the student or when the remaining cost was covered by partial scholarships. To apply for the loan, the student must first be accepted by a participating HEI, which cannot reject her later if she obtains funding. The average annual tuition fee for FIES participants was R$ 15,000.79 in 2018 (US$

7,407.92 PPP), approximately 45.8% of the Brazilian per capita GDP for the same year. This percentage, according to data presented by Solis (2017), is similar to that observed for countries such as Argentina, Chile and the United States, but substantially above the OECD average, likely due to the prevalence of subsidized public HEIs in many of the member countries.

Figure 2.1: Number of new loans granted (Creduc and Fies) and admittance to higher education, by year (1976-2020).



Notes: Panel (a) presents the ratio of higher education admissions to the population estimate of 18-year-old individuals in each year. Panel (b) presents the same statistic disaggregated for public and private higher education institutions. Panel (c) presents the number of *new* FIES loans granted in each year. Panel (d) presents the annual ratio of newly granted loans to the number of admissions in higher education. Admitted students refer to those who were enrolled at any point, not including accepted students who never enrolled. The number of admissions exceeds the number of admitted students due to the possibility of students being admitted to multiple institutions within a given year.
Data sources: Ministério da Fazenda (2017), INEP (2000), FNDE (2022), Higher Education Census (INEP) and population estimates from IBGE (Brazilian Geography and Statistics Bureau). For the 1976-1979 and 1983-1984 periods, admissions were estimated based on the number of vacancies and the average filling rate observed during 1980-1982.

2.3 Related literature

The literature on educational access generally points to three main access barriers: financial constraints, informational/behavioral constraints, and academic constraints (Long and Riley, 2007; Page and Scott-Clayton, 2016). These barriers not only affect the likelihood of entering higher education but also influence persistence and completion rates.

The literature concerning financial constraints to college access is the most relevant in the context of this paper, although assessing the existence of informational problems can be important, as these may also affect access to funding. Some studies, mainly in the context of the United States, indicate that informational complexities can lead individuals, especially those with less favored socioeconomic status, to overestimate the costs involved in higher education, specially when there is a great diversity of federal, state and private sources of financial aid and financing[7]. In the Brazilian case, however, it is observed that a high percentage of potential applicants (individuals who have taken the national high school exam) are aware of and show interest in the main funding programs (FIES and Prouni)[8].

The main economic justification for providing student loans is the presence of imperfections in the credit market, which lead individuals to invest suboptimally in education. Unlike investments in physical capital, the human capital to be acquired through education cannot be used as a collateral for obtaining loans. As several authors have pointed out, such as Lochner and Monge-Naranjo (2012), in the absence of market imperfections, the decision to pursue higher education should be based on estimates of cost and return, which, in general, would be independent of

[7] See Dynarski et al. (2022) for a recent literature review on the subject.

[8] In 2016, 52% and 75% of students taking ENEM declared applying for FIES and Prouni, respectively, as one of the most relevant factors (5 in a scale of 0 to 5) for their decision to take the exam.

family income. Such independence, however, as mentioned by Carneiro and Heckman (2002), is conditioned to several other factors, normally correlated with family income, such as greater investments in education at earlier life stages, which would result in greater ability; fewer informational constraints; greater appreciation of education, among others. Moreover, if education is also considered a consumption good, individuals with higher incomes could demand a greater amount of it. In light of these considerations, eliminating borrowing constraints alone would not suffice to eliminate the existing correlation between family income and the likelihood of entering higher education.

Lochner and Monge-Naranjo (2016) review the theoretical and empirical literature on credit restrictions and educational investments, while Dynarski, Page, and Scott-Clayton (2022) presents a recent review on the empirical literature regarding the effects of financial aid on student decisions. Dynarski, Nurshatayeva, Page, and Scott-Clayton (2022) reviews the literature on non-financial barriers to college access. Yannelis and Tracey (2022) survey the empirical literature on student loans, focusing on defaults, credit outcomes, and earnings. Due to the difficulty in controlling for all the factors involved, the empirical identification of credit constraints has proved to be fairly complex, with evidence on this issue being, until recently, scarce and, in most cases, indirect.

Indirect evidence. Carneiro and Heckman (2002) argue that, after controlling for ability, parental income has a relatively small effect on enrollment in the US context. According to these authors, only 8% of individuals face credit constraints that would prevent them from entering higher education. Cameron and Taber (2004), also in the case of the US, uses return to schooling to test the existence of credit constraints but do not find evidence of inefficiencies in access to college. Attanasio and Kaufmann (2009), on the other hand, study the case of Mexico, where the availability of university loans is limited. They argue that expectations regarding wages after graduation should be positively correlated with college entry, so that a break in this correlation – which they find in data – would also be evidence of financial constraints.

However, other indirect methods, exploring the effects of financial deregulation (Sun and Yannelis, 2016) and income windfalls (Manoli and Turner, 2018) find evidence of financial constraints. For Brazil, Chein and Pinto (2018) find that enrollment probabilities are related to wealth among middle and higher income individuals, but not for low income ones. This pattern cannot be explained by means-tested funding policies, since, although FIES and Prouni restrict eligibility by income, in practice, they only restrict access to funding for relatively high income levels[9]. If higher-income individuals face financial constraints, the same would likely apply to low-income individuals. Hence, the lack of correlation between wealth and enrollment in higher education among low-income groups may be explained by other barriers, such as financial constraints that impede access to earlier levels of education.

Overall, the indirect evidence does not point to an important role for credit constraints in explaining access to higher education. It suggests that, instead, the correlation between family income and access to college mostly results from dynamic complementarity between early and late investments in education (Cunha and Heckman, 2007; Cunha et al., 2010). In other words, the returns to higher education are influenced by investments in earlier levels of education. Nevertheless, recent research applying quasi-experimental methods has provided direct evidence of financial constraints.

Direct evidence: extensive margin. One of the earliest studies to directly examine the effects of financial constraints, focusing on the drop-out decision, is Stinebrickner and Stinebrickner (2008). They find that credit constraints explain

[9]The lowest income threshold for eligibility pertains to full PROUNI scholarships, requiring applicants to have per capita family incomes below 1.5 times the national minimum wage. However, in 2017, a student at this income level would fall just within the top income quartile. FIES and partial PROUNI scholarships, on the other hand, require incomes below 3 times the minimum wage.

only a small portion of attrition among students from low-income families. More recently, four studies present direct empirical evidence on the effect of loans on college enrollment, persistence, and completion (Gurgand et al., 2023; Solis, 2017; Melguizo et al., 2016; Card and Solis, 2022). These studies employ regression discontinuity methods to analyze the effect of student loans in South Africa, Chile and Colombia. The first study focuses on a student loan program in South Africa, in which eligibility is based on meeting a pre-established credit score threshold. The remaining three studies are based on the requirement of a minimum score on exams to access funding.

Gurgand et al. (2023) find that access to credit increases higher education enrollment by 42 percentage points among applicants, a substantially larger effect compared to other studies. Another notable aspect is that the entire effect is driven by female applicants, while the effects on men are essentially null. Similarly, Solis (2017) observe an increase of 18 percentage points in the probability of entering higher education in the year following high school (with a 16 p.p. increase in the subsequent three years), with a greater effect observed among students in the lowest quintile.

Solis (2017) also notes that access to loans significantly reduces the enrollment gap between the highest and lowest quintiles of the income distribution. For individuals just below the cutoff point, the richest quintile was twice as likely to access higher education as the lowest quintile, but for individuals just above the cutoff point, the difference becomes statistically insignificant. Card and Solis (2022) extend the work of Solis (2017), finding that access to loans increases persistence in the second year by 20 p.p., mostly through a reduction in transfers to vocational colleges, and graduation by 12 p.p., among students who had already completed the first year. Bucarey et al. (2020) and Montoya et al. (2018), however, in the context of the same Chilean program, find that loans induced transfers from vocational education to universities, but resulted in reduced degree completion and future earnings while increasing debt. Higher scoring students, on the other hand, seem to benefit from the policy.

Melguizo et al. (2016) use cutoff scores on high school exit exams, which determine eligibility for a Colombian student credit program. The study finds that access to the program increases the probability of entering higher education by between 0.16 and 0.34 percentage points, depending on the use of controls. They also observe higher effects for low-income individuals.

For Brazil, Duarte (2020) find that crossing the minimum eligibility score for federal aid (450 points in ENEM) increases the probability of students enrolling in higher education by 10 percentage points. Unlike other studies, this threshold refers to both loans and grants, and passing does not guarantees access to financial aid, giving only the right to apply for it[10]. The population considered refers to all participants in ENEM, and not just applicants to loans and grants. This broader population probably explains the smaller effect size found in this study, which can be seen as a lower bound for the true effect.

Direct evidence: intensive margin. In the context of New Zealand, Chu and Cuffe (2021) find that continued access to loans by students with low academic performance increases re-enrollment, completion, and future labor market returns. For the United States, Black et al. (2020) finds that increasing borrowing limits raised student debt, but improved degree completion, future earnings, with no discernible impact on homeownership or other forms of debt. However, Denning and Jones (2021) find that higher limits increased borrowing, but they find no effect on student GPA, credits, persistence, or graduation rates.

[10] In fact, only a small fraction of students are able to access FIES with a score close to 450, as show in Figure 3.4, in Appendix 2.D, since FIES cutoff scores are considerably higher than that value for most programs.

2.4 Problem definition and empirical strategy

Prior to 2015, FIES loans were not subject to a cap, and all qualified applicants received funding. However, due to worsening fiscal conditions and increasing default rates, the government introduced a nationwide limit on loan approvals. This new system also implemented loan quotas for each region of the country, defined at the level of microregions (*microrregiões*). To each microregion were assigned weights, defined according to a discontinuous scale, decreasing in average HDI values[11]. The weights are presented in Table 2.1. For the sake of brevity, we use the term "region" interchangeably with "microregion".

To allocate the loans, the total number of available slots for FIES is determined on an annual basis, taking into account the budget allocated to the program[12]. Once total slots are established, they are distributed among different regions according to the following formula:

$$F_{mt} = \frac{SRC_{mt}\sigma_m}{\sum_{m' in \mathcal{M}} SRC_{m't}\sigma_{m'}}\mathcal{F}_t \tag{2.1}$$

where SRC is the Social Relevance Criteria, described in Appendix 3.A, representing an index that captures local demand for loans; σ_m is the weight assigned to region m; and $\mathcal{F}_t = \sum_m F_{mt}$ is the total number of slots available in year t.

Table 2.1 presents the weights σ_m assigned to each HDI range. We observe that the loan quotas exhibit discontinuities at the arbitrary HDI levels of 0.6, 0.7 and 0.8. Crossing these cutoff points, from a higher to a lower HDI, would generate increments of 9.1%, 22.2% and 28.6%, respectively, in the number of slots reserved

[11] The HDI is calculated at the municipal level and averaged at the microregion level. This indicator is a version of the Human Development Index initially proposed by UNDP (1990). The index is calculated from four indicators: life expectancy at birth, average years of schooling, expected years of schooling and GDP per capita. These indexes are not directly comparable to country HDIs, since they are standardized based on the average indicator values of Brazilian municipalities.

[12] Although the selection processes occur twice a year, the number of slots is determined annually. Furthermore, any unfilled slots from the first semester are carried over and made available in the second semester. Therefore, the analysis is conducted on an annual basis.

Table 2.1: Microregion weights and HDI ranges

HDI Level	HDI Range	Weights
Low	0.500 to 0.599	1.2
Middle	0.600 to 0.699	1.1
High	0.700 to 0.799	0.9
Very high	0.800 to 1	0.7

Data sources: Ministry of Education's *Portarias* of number 13/2015, 9/2016, 25/2016, and 12/2017. The table shows weight values assigned to each HDI range.

for the region. Figure 2.6, in Appendix 2.D, illustrates Brazilian microregions and their corresponding HDI values.

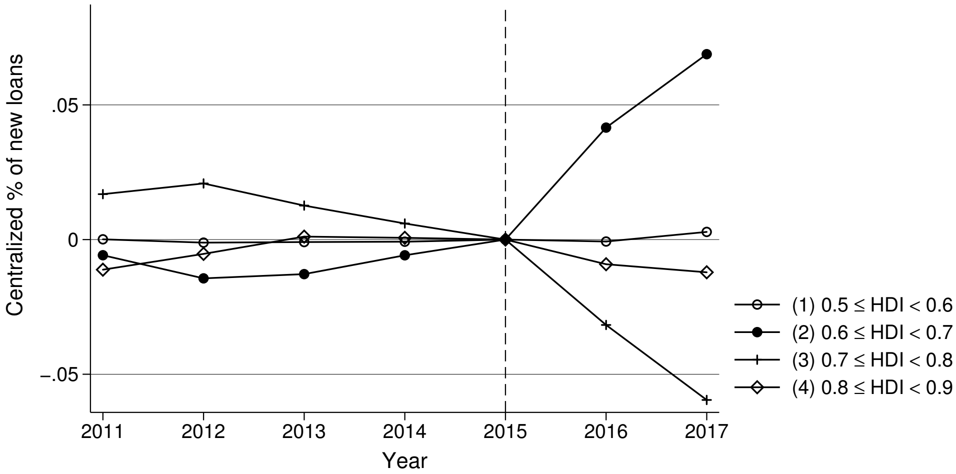
Figure 2.2 illustrates the evolution of FIES loans, categorizing regions based on their HDI levels: (1) $0.5 \leq HDI < 0.6$, (2) $0.6 \leq HDI < 0.7$, (3) $0.7 \leq HDI < 0.8$; and (4) $0.8 \leq HDI < 0.9$. We center the shares in 2015, the last year before the introduction of the allocation rule, by subtracting out of all values the percentage of loans received by each region in that year. Notably, the implementation of the rule significantly altered loan distribution across HDI groups. As expected, there was an increase in the participation of groups (1) and (2), which received higher weights, and a decrease for groups (3) and (4), which received lower weights[13].

To the best of our knowledge, no other government policy employs a similar rule. The utilization of HDI weights began during the selection process for the first semester of 2016, with slots allocated at the microregion level. This approach was maintained until the first half of 2018. Subsequently, the system transitioned to an allocation by mesoregions, representing a more aggregated regional level. The remaining components of the rule remained unchanged and are still in effect[14]. The

[13]Changes in the participation of groups (2) and (3) are more noticeable due to their larger size. Despite the distribution rules providing weights for five HDI intervals, in practice, over 90% of the regions with at least one functioning HEI fall within the HDI range of 0.6 to 0.8. This fact can be seen in Figure 2.6, in Appendix 2.D. In 2017, 361 regions had positive enrollment in higher education, but only 12 had HDI between 0.5 and 0.6 and only five had HDI of 0.8 or higher.

[14]Brazil consists of 137 mesoregions, which are further subdivided into a total of 558 microregions. On average, each microregion comprises approximately 10 municipalities.

Figure 2.2: Percentage of FIES loans granted by HDI group, centered around 2015 values.



Note: The graph displays the percentage of FIES loans granted to each HDI group, centered around 2015 values, denoted by a vertical line. This year represents the last year prior to the rule change. *Data source*: Fundo Nacional de Desenvolvimento da Educação (FNDE).

Brazilian territory is divided into 5,570 municipalities, which correspond to the lowest government level. It is important to note that microregions and mesoregions do not represent administrative or political divisions, but rather regional classifications established by the Brazilian Institute of Geography and Statistics (IBGE). Among the 558 microregions, approximately 370 had higher education enrollment during the period from 2013 to 2017.

Following the regional allocation, the slots within each region are further divided based on areas of knowledge and HEI quality levels. The application of these criteria results in multiple "boxes", each differing in at least one criterion. Ultimately, the slots within each box are filled in a descending order of ENEM scores.

In equation 3.4, the weights σ_m are plausibly exogenous, while SRC_{mt} is evidently endogenous as it depends on local demand for student loans. We leverage both the policy change and the discontinuities introduced by the allocation rule in a "fuzzy" Difference-in-Discontinuities approach[15].

[15] Our approach is akin to the one used by Corbi et al. (2019).

The first stage is a linearized version of Equation 3.4:

$$FS : F_{mt} = \alpha_0 + \beta Z_Y^j + P'_{bt}(HDI_m) + \eta'_m + \iota'_t \tag{2.2}$$

where:

- α_0 is the intercept;
- Z_Y^j are the (excluded) instruments;
- $P'_{bt}(HDI_m)$ is a set of first-order RD polynomials defined on the distance to the closest cutoff, one for each combination of year t and side b of the closest cutoff.;
- η'_m are region fixed effects; and
- ι'_t are year fixed effects.

The second stage is:

$$SS : I_{mt} = \alpha_1 + \tau \hat{F}_{mt} + P_{bt}(HDI_m) + \eta_m + \iota_t \tag{2.3}$$

where:

- α_1 is the intercept,
- F_{mt} is the number of loans predicted by the first stage;
- $P_{bt}(HDI_m)$ is a set of first-order RD polynomials defined on the distance to the closest cutoff, one for each combination of year t and side b of the closest cutoff;
- η_m are region fixed effects; and
- ι_t are year fixed effects.

We define the excluded instruments as follows:

$$Z_Y^j = \begin{cases} 1, & \text{if t} = Y \text{ and } HDI_m = j \\ 0, & \text{otherwise} \end{cases} \tag{2.4}$$

where $j \in \{[0.5, 0.6), [0.6, 0.7), [0.8, 0.9)\}$ are the HDI_m ranges and $Y \in \{2016, 2017\}$ refer to the treated years. Range $[0.7, 0.8)$ is the baseline. We estimate the model using a panel IV with errors clustered at the region level. Our main tables use a bandwidth of size 0.03, which is about half the maximum possible bandwidth of 0.05, considering that HDI ranges are of size 0.1. However, our sensitivity analysis shows broadly similar results regardless of bandwidth size.

It should be noted that HDI_m values do not vary by t, as this index is based on variables derived from the Demographic Census, which had been conducted in 2010. Therefore, HDI values cannot be manipulated and were not influenced by policy changes, as they were determined prior to the implementation of the rule. Consequently, any contemporary correlation between the instruments and shocks in the demand for higher education is excluded.

2.4.1 Data

Table 2.7 in Appendix 2.C provides the sources of the data used in this paper, along with a description of the main procedures involved in constructing the dataset. Our dataset has three primary sources. The first is the FIES data provided by FNDE (*Fundo Nacional de Desenvolvimento da Educação*), which contains individual-level information on FIES beneficiaries, such as HEI and program attended. The second is the Higher Education Census (*Censo da Educação Superior*), containing individual-level data on higher education students. The third is the National High School Exam – ENEM (*Exame Nacional do Ensino Médio*), which contains individual-level data on ENEM takers. We aggregate the three datasets at the microregion level.

Table 3.2 presents summary statistics for the main variables.

The data allows us to estimate two types of effects, depending on how the dependent variables are constructed. Specifically, we can aggregate enrollment by the region of birth of the student or by the region in which the program takes place. In the former case, we estimate an *individual* effect, measuring the increase in the probability of enrollment in higher education for students exposed to the treatment (i.e., greater loan availability). In the latter case, we estimate a *regional* effect, capturing both the increase in enrollment by students in the region and a relocation effect, as the allocation of more loans to less developed regions not only increases enrollment among locals but also attracts students from other regions.

Table 2.2: Summary statistics, all (birth) regions – 2013-2017 cohorts.

	Mean	SD	Min	Max	Obs.
All regions					
HDI	0.722	0.051	0.503	0.824	1825
Loans granted	1697	6804	1	153627	1522
Admissions	4468	16743	129	303349	1825
Evening	3169	11669	105	218894	1825
Daytime	1299	5139	13	84456	1825
For-profit	2285	7884	60	118135	1825
Non-profit	2183	9334	20	185214	1825
Public High Sch.	3078	11661	88	226458	1825
Private High Sch.	1390	5504	26	76892	1825
Enrollment ($t = 1$)	3502	12891	108	227452	1825
Enrollment ($t = 2$)	2626	9218	85	169162	1825
Enrollment ($t = 3$)	2112	6938	79	125313	1825
Enrollment ($t = 4$)	1688	5115	61	89453	1825
Enrollment ($t = 5$)	1178	3277	37	48346	1825
Enrollment ($t = 6$)	579	1628	4	21204	1451
Graduation ($1 \leq t \leq 6$)	1677	5684	53	99297	1451

Data sources: FIES Open Data (*Dados abertos FIES*), Higher Education Census, and United Nations Development Programme for HDI. *Notes*: data referring to year $t = 6$ does not include the 2017 cohort, since the 2022 edition of the Higher Education Census was not available.

We restrict our empirical analysis to the period from 2013 to 2017, with 2016-

2017 as the "treated" years. Our instrumental variables are constructed based on the reforms implemented in 2016, as discussed earlier. In Brazil, students are admitted into specific programs/degrees, selecting their majors at the time of college application, and any subsequent changes in majors (except in very specific transfer scenarios) are treated as new admissions. This allows us to track cohorts of students over time based on their year of admission. As a result, we can estimate the effects of loans not only on admission, but also on persistence and completion.

In the subsequent analysis, the variable t represents the number of years since admission, with $t = 1$ denoting the year of admission into higher education. Consequently, the count of enrolled and graduating students for $t = \{1, 2, 3, 4, 5, 6\}$ is limited to individuals who entered in $t = 1$. For example, "enrolled in $t = 3$" refers to students who were admitted in $t = 1$ and remained enrolled by the end of year $t = 3$. More precisely, enrollment in $t = 3$ refers to the number of individuals who entered higher education in $\{2013, 2024, 2015, 2016, 2017\}$ and remain enrolled in $\{2015, 2016, 2017, 2018, 2019\}$. Due to data limitations, we do not have enrollment and completion information in $t = 6$ for students admitted in 2017[16]. Thus, the estimates for $t = 6$ are based on a smaller sample, comprising only those admitted between 2013 to 2016.

Previous trends: The validity of the method can be compromised if the instruments are correlated with region-specific trends. For instance, if regions with the lowest HDI values were already experiencing a catch-up process, the estimated effects would be biased upward. Figures 2.9 to 2.17, in Appendix 2.E, presents event studies for the main outcomes used in the paper.

For outcomes in year 1, we observe that regions within the 0.5, 0.6 and 0.8 HDI ranges exhibit similar trends to the baseline group (range 0.7) prior to the introduction of the rule. For outcomes in years 2 to 6, we also observe similar trends up to the 2014 cohort. However, for the 2015 cohort, we observe slightly higher values

[16] Our data covers only the period up to 2021.

compared to the baseline year (which is set as 2014 in this case) for the 0.5 and 0.6 HDI ranges. This discrepancy may arise because loans are not necessarily granted to first-year students. Therefore, students from the 2015 cohort, initially unaffected by the rule, could benefit from increased loan availability in the subsequent year if they are still enrolled. There are no signs, however, that older cohorts (2013 to 2014) are affected in a similar fashion. For instance, the effect of remaining in college in the third year only because of loans, conditional on having already completed two years, is likely negligible, since most students that depend on loans would not persist for that long, specially considering that many programs funded by FIES have a expected duration of 3 years or less. In light of the above, as a conservative measure, we drop the 2015 cohort from regressions when the outcomes refer to years $t \geq 2$. Nonetheless, this exclusion has minimal effects on the coefficients and does not qualitatively alter the interpretation of the results.

In Appendix 2.E, we also present placebo tests (Table 2.14), for varying bandwidths, where we exclude the actual treated years (2016-2017) and designate the period 2014-2015 as a false treatment. As expected, the coefficients are usually not statistically significant and alternate signs.

We also show in Appendix 2.E the results of the IV first stage estimation (Table 2.13), without the RD polynomials, demonstrating that all instruments exhibit the expected signs and are jointly statistically significant[17].

2.5 Results

2.5.1 Effects on admission, enrollment, and graduation

We begin by estimating the impact of loans on admission and enrollment in the region where the program's classes are conducted, as shown in Table 2.3. The top

[17] When the polynomials are included, signs and statistical significance of the instruments vary due to the multicollinearity introduced by the polynomials.

panel presents the results for ordinary least squares (OLS) estimates, which exhibit a notable positive bias with coefficients generally exceeding 1. This upward bias is expected since the number of loans F_{mt} is influenced by the regional demand for higher education (as indicated in Equation 3.4). On the other hand, fixed effects (FE) coefficients tend to be smaller and apparently downward biased. Difference-in-differences estimates are also relatively high for initial outcomes.

The Difference-in-Discontinuities (RD) estimates are presented in the bottom panel of Table 2.3. Granting 100 more loans would result in 45.6 additional enrollments in the region. The effect on enrollment remains significant throughout the duration of the program but diminishes over time. This decline is expected, as graduates exit the dataset in the year following their graduation.

Table 2.4 presents a similar estimation, but this time focusing on the individual effect. We observe an increase of 0,43 in admissions for each additional loan granted. This value is notably higher than most estimates found in previous studies, which typically range around 0.2. By the end of the first year, the effect on enrollment diminishes to 0.35, indicating that many of the induced admissions drop out during the first year of college[18].

To understand this, we should notice that the estimated coefficients (τ) refer to the share of loan recipients that are "compliers" – individuals altering their actions because they receive loans[19]. The remaining loan recipients ($1-\tau$) maintain the same course of action they would have taken even without funding. In other words, they would still drop out or persist irrespective of the availability of loans. For admission,

[18]This high initial effect, followed by a sharp decline, is likely associated with a known problem of the FIES selection process. At the end of each year, the Brazilian Ministry of Education faces a tight schedule, since they have to run, in sequence, the 1) National High School Exam (ENEM), 2) the unified selection process for public universities (SISu), 3) the selection process for Prouni grants, and, finally, 4) the selection process for FIES. Consequently, the FIES selection typically takes place around March of the following year, when most HEIs have already commenced their classes for the first semester. As a result, many students enroll before their loan status is confirmed (Brasil, 2020). If they receive the loans, their entire first semester will be covered, but students who do not meet the criteria to access the loans may be forced to drop out.

[19]Appendix 2.A discusses how the estimated effects can be interpreted in terms of compliers and non-compliers.

dropping out is not a possibility. Hence, given our results, approximately 57% of students receiving loans would still enter higher education even without funding[20]. However, the same student can be a complier for one outcome and a non-complier for the other. For example, a student could enter because of loans but still drop out. In this case, the student would be a complier for admission but not for graduation. The opposite could also happen when a student who would have entered higher education anyway graduates just because of the loan.

Overall, results suggest that most non-compliers refer to those who would have entered higher education anyway, but the share of those who enter just because of loans but still evade seems to be noteworthy. In fact, graduation rates are notably low in Brazil, with only 35% of students in private HEIs completing higher education within the first six years since entry (see Figure 2.7 in the Appendix)[21].

The top panel of Table 3.6 presents the impact on graduation. The first six columns display the effect of loans on graduation in years 1 to 6, respectively. As expected, we find no effects on graduation in the initial years, since higher education programs have a minimum duration of 2 years[22]. The last column of the top panel presents the cumulative effect of loans on graduation up to the sixth year, with the dependent variable being the sum of the dependent variables in the first six columns. We find that one additional FIES loan increases graduation by 0.21 in this specification.

[20]It should be noted that loans could still be important in this case by allowing students to choose more expensive, and presumably higher quality, majors.

[21]It should be noted that changing majors are usually computed as evasions in Brazil, which lowers the graduation rate.

[22]Higher education programs in Brazil normally last between 2 and 6 years, with 3 and 4 years being the most common, but 2 and 5 years also being adopted in some cases. The estimated effects match this pattern, but suggest that most students take longer than expected to graduate.

Table 2.3: Effect of the FIES loans on admission and enrollment in private universities – regional effect.

Dep. var.:	Admissions	Enrollment	Enrollment	Enrollment	Enrollment	Enrollment	Enrollment
Model	$t = 1$	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			Panel A: *OLS*				
OLS	2.342***	1.867***	1.296***	1.033***	0.817***	0.600***	0.310***
	(0.133)	(0.103)	(0.056)	(0.040)	(0.030)	(0.018)	(0.011)
N	1516	1516	1213	1213	1206	1200	896
R2	0.71	0.73	0.73	0.75	0.75	0.77	0.86
			Panel B: *Fixed Effects*				
FE	0.385***	0.358***	0.319***	0.278***	0.230***	0.181***	0.109***
	(0.020)	(0.012)	(0.009)	(0.014)	(0.016)	(0.020)	(0.020)
N	1516	1516	1213	1213	1206	1200	896
R2	0.54	0.71	0.80	0.85	0.87	0.84	0.71
			Panel C: *Difference-in-Differences*				
DD	0.541***	0.510***	0.412***	0.384***	0.314***	0.251***	0.135***
	(0.038)	(0.038)	(0.023)	(0.019)	(0.014)	(0.013)	(0.012)
N	1508	1508	1203	1203	1196	1190	885
Clusters	314	314	312	312	312	312	305
F(6, Clusters-1)	10.35	10.35	10.35	10.35	10.07	10.13	3.67
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.013
			Panel D: *Difference-in-Discontinuities*				
RD	0.456***	0.377***	0.345***	0.355***	0.304***	0.231***	0.155***
	(0.111)	(0.082)	(0.046)	(0.041)	(0.035)	(0.022)	(0.019)
N	742	742	594	594	590	587	435
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03	0.03
First Stage F	7.46	7.46	7.46	7.46	7.78	7.54	11.12
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on admissions and enrollment in years 1 to 6 in higher education programs taught in the region, using the methods of OLS, FE, DD (Difference-in-Differences) and RD (Difference-in-Discontinuities). Robust standard errors presented in parentheses, clustered by region of the program. FE, DD and RD (Difference-in-discontinuities) regressions include region and year fixed effects. RD includes one polinomial for each year and each side of the closest cutoff, considering a bandwidth of 0.03.

Table 2.4: Effect of the FIES loans on admission and enrollment in private universities – individual effect.

Dep. var.:	Admissions	Enrollment	Enrollment	Enrollment	Enrollment	Enrollment	Enrollment
Model	$t = 1$	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
				Panel A: *OLS*			
OLS	2.096***	1.669***	1.152***	0.909***	0.714***	0.520***	0.265***
	(0.227)	(0.182)	(0.112)	(0.081)	(0.061)	(0.042)	(0.024)
N	1516	1516	1213	1213	1213	1213	903
R2	0.71	0.72	0.72	0.73	0.73	0.74	0.84
				Panel B: *Fixed Effects*			
FE	0.338***	0.305***	0.271***	0.228***	0.181***	0.138***	0.080***
	(0.060)	(0.036)	(0.030)	(0.014)	(0.008)	(0.009)	(0.012)
N	1516	1516	1213	1213	1213	1213	903
R2	0.55	0.72	0.80	0.85	0.87	0.85	0.68
				Panel C: *Difference-in-Differences*			
IV	0.225***	0.231***	0.193***	0.202***	0.157***	0.116***	0.065***
	(0.038)	(0.028)	(0.028)	(0.021)	(0.018)	(0.017)	(0.015)
N	1508	1508	1203	1203	1203	1203	892
Clusters	314	314	312	312	312	312	305
F(6, Clusters-1)	10.35	10.35	10.35	10.35	10.35	10.35	4.20
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.006
				Panel D: *Difference-in-Discontinuities*			
RD	0.432***	0.351***	0.330***	0.350***	0.284***	0.209***	0.138***
	(0.077)	(0.059)	(0.047)	(0.053)	(0.051)	(0.032)	(0.019)
N	742	742	594	594	594	594	440
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03	0.03
First Stage F	7.46	7.46	5.84	5.84	5.84	5.84	9.70
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimation results for the impact of FIES loans on the number of admissions and enrollments in higher education of individuals born in the region, using the methods of OLS, FE, DD (Difference-in-Differences) and RD (Difference-in-Discontinuities). robust sdandard errors, clustered by region of birth, presented in parentheses. FE, DD and RD regressions include region and year fixed effects. RD includes one polinomial for each year and each side of the closest cutoff, considering a bandwidth of 0.03.

Table 2.5: Effect of loans on graduation – individual effect – difference-in-discontinuities estimates.

Dep. Var:	Graduation $t = 1$	Graduation $t = 2$	Graduation $t = 3$	Graduation $t = 4$	Graduation $t = 5$	Graduation $t = 6$	Graduation $1 \leq t \leq 6$
RD	-0.000	-0.002	0.034***	0.023*	0.077**	0.103***	0.211***
	(0.003)	(0.008)	(0.008)	(0.013)	(0.031)	(0.022)	(0.056)
N	742	594	594	594	594	440	440
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03	0.03
First Stage F	7.46	5.84	5.84	5.84	5.84	9.70	9.70
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Dep. Var:	Persistence $t = 1$	Persistence $1 \leq t \leq 2$	Persistence $1 \leq t \leq 3$	Persistence $1 \leq t \leq 4$	Persistence $1 \leq t \leq 5$	Persistence $1 \leq t \leq 6$
RD	0.351***	0.331***	0.350***	0.317***	0.265***	0.247***
	(0.059)	(0.050)	(0.053)	(0.057)	(0.040)	(0.043)
N	742	594	594	594	594	440
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03
First Stage F	7.46	5.84	5.84	5.84	5.84	9.70
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: The table presents estimates of the impact of loans on graduation and persistence. Persistence for year T represents the sum of students still enrolled in year T, plus graduation up to year $T - 1$. Robust standard errors, clustered by region of birth, in parenthesis. All regressions include region and year fixed effects. RD includes one polinomial for each year and each side of the closest cutoff, considering a bandwidth of 0.03.

Taking advantage of the linear setting, we take a similar approach in the bottom panel of Table 3.6. We estimate persistence effects by summing up, for a given year T, the number of graduates in years $t < T$ to the enrollment in year $t = T$. Hence, the dependent variables, in this case, are the number of students that did or still could graduate up to year t. Persistence is higher by approximately 0.25 in the sixth year, as some students remain enrolled due to the loans. However, it's unlikely for the program to have positive effects beyond this timeframe, as semesters beyond the normal duration of the program are not covered by FIES[23].

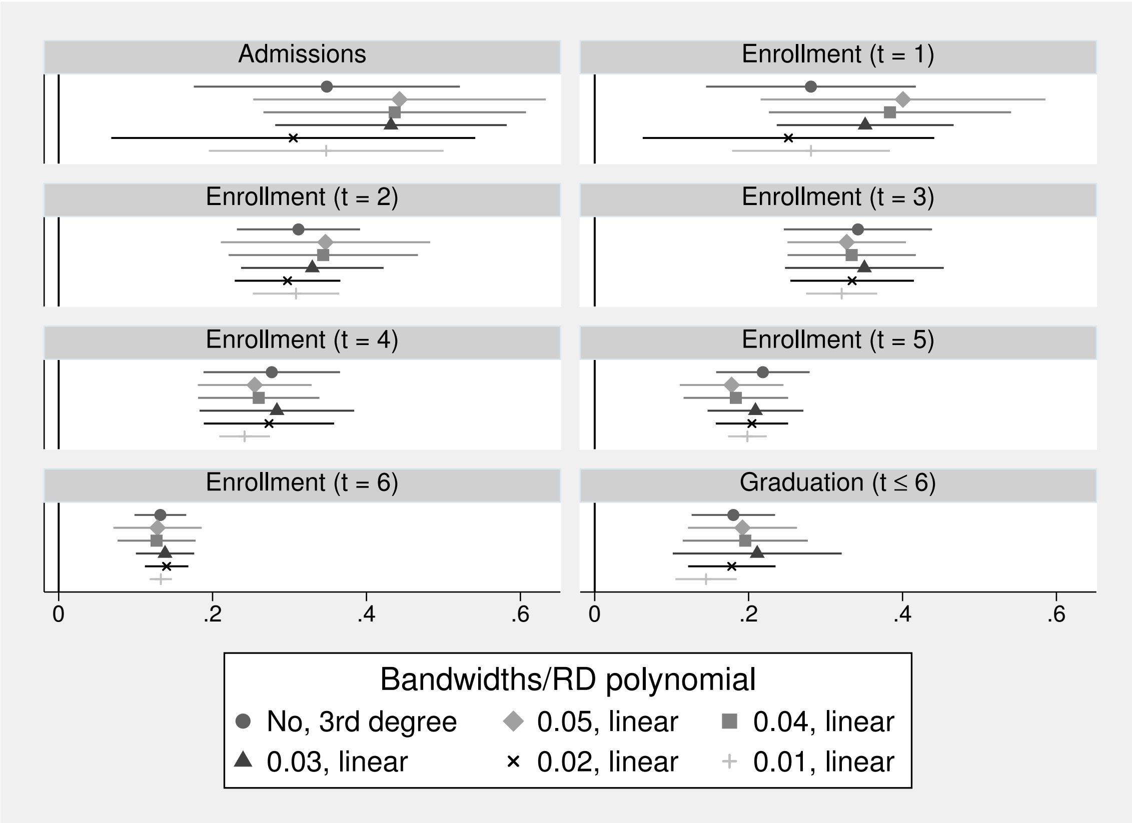
To the best of our knowledge, our study is the only one presenting estimates of loan effects throughout the duration of higher education. Consequently, we cannot ascertain whether and to what extent these effects decline over time in other contexts, or if this phenomenon is unique to the Brazilian case. In principle, effects could increase over the duration of college if loans are more important for persistence than for access.

Robustness. We first assess the robustness of the results to varying bandwidth sizes. We also include a scenario including all observations and a 3rd degree RD polynomial. Figure 3.2 illustrates the results of these tests, showing that the estimated coefficients remain fairly similar independently of the range considered. It should be noted that 0.05 is the maximum possible range for the running variable, since each HDI range is of size 0.1. Latter outcomes (years $t \geq 3$) are particularly robust. The scenario "0.03, linear" corresponds to the results presented in Tables 2.4 and 3.6.

Regarding the imputation procedure for the missing region of birth information, altering the definition of comparable group – using or not the criteria of type of institution, study shift, and type of secondary educational institution attended –

[23] The duration of FIES loans depend on the *expected* duration of the program. If a student takes longer than expected to graduate, the final years are not be covered by the loans. This deadline can be extended for up to one year, since students can request the suspension of funding for 2 consecutive semesters. Hence, for most students, it is unlikely that the effects extend for more than 6 years.

Figure 2.3: Estimated coefficients and 95% confidence intervals at varying bandwidth sizes.



Notes: The graphs present estimates of the effects of loans on admission, enrollment and graduation, for varying bandwidth sizes. The "0.02, linear" scenario corresponds to the estimates presented in the bottom panel of Table 2.4 and in the top panel of Table 3.6. The "No bandwidth" scenario includes a third degree polynomial of the distance from the closest HDI cutoff, while the remaining estimates include a linear polynomial. The lines represent the 95% confidence intervals.

does not qualitatively change the results presented. Furthermore, as the region of the program is known in all cases, estimates based on the region of the program serve as an additional robustness check for the imputation procedure, given that most students attend college in their region of birth.

In Appendix 2.F (Tables 2.15 to 2.17), we investigate whether FIES loans impact admission, enrollment, or graduation in other sectors of postsecondary education not covered by the program. Our results indicate that remote education, public universities, and vocational education were not affected by FIES loans.

2.5.2 Heterogeneity

We now turn to the analysis of how the effects of loans are influenced by selected characteristics of students and HEIs they attend. Figure 2.4 presents estimates separately by type of HEI attended (for-profit or non-profit), shift of study in college (day or evening), and type of high school attended by the student (public of private), for three bandwidth sizes (0.01, 0.02, 0.03). Tables 3.7 to 2.26, in Appendix 2.F, present the complete estimation results for these outcomes. The literature lacks a clear-cut prediction regarding how the influence of loans should vary based on these factors. We discuss the most likely scenarios, and briefly compare our results to the relevant literature.

Institution type. Effects could be more pronounced for non-profit institutions if for-profit ones respond to increased aid availability by raising their prices. Evidence tends to suggest that institutions, particularly in the for-profit sector, often capture a portion of aid in the form of higher prices (Dynarski et al., 2022). Consequently, market power could mitigate the effects of loans in the case of profit-seeking institutions[24]. On the other hand, non-profit institutions are notoriously slow to expand capacity and may not promptly respond to loans by admitting more students. For instance, Blair and Smetters (2021) note that elite colleges in the United States have barely expanded supply since 1970. They propose a model in which HEIs seek to maximize prestige (measured by selectivity), explaining why elite colleges do not expand despite facing excess demand. If non-profit HEIs compete in prestige or focus only on expanding quality, effects should be higher in the for-profit sector.

Despite the comparable size of for-profit and non-profit HEIs in aggregate (see Table 3.2 in Appendix 2.D), our findings indicate that effects are primarily driven by for-profit institutions. The fact that loans expand enrollment mostly in for-profit HEIs aligns with the perspective that they are more dependent on aid (Cellini, 2021;

[24]Kargar and Mann (2023) finds relatively high markups for American colleges.

Dynarski et al., 2022). Ávila and Terra (2024a) find that only for-profit HEIs are financially affected by FIES, with loans increasing their revenue, expenditure, and profits. This concentration of effects in for-profit institutions is a point of caution, considering that graduates from this sector usually experience worse labor market outcomes and higher default rates (Cellini and Chaudhary, 2014; Cellini and Turner, 2019; Deming et al., 2012; Armona et al., 2022).

Shift of study. In this case, effects could also vary in either direction. If financially constrained individuals enroll due to loans but still have to work to fund their living expenses, loans would likely increase enrollment more in evening programs. However, if individuals who previously had to work to afford higher education can now dedicate themselves exclusively to college due to loans, the expansion in aid should increase enrollment in daytime programs and probably even decrease enrollment in evening programs.

Results reveal a robust positive effect of FIES on admissions, enrollment, and graduation in evening programs. One additional loan increases admissions in evening programs by 0.221-0.338 and graduation by 0.117-0.176. Coefficients for daytime programs are much lower, but still mostly statistically significant at conventional levels. The inclination of students to predominantly enroll in evening programs due to the influence of loans warrants further discussion. An important characteristic of the evening shift is allowing students to work during the day, which may be appealing for financially constrained individuals.

Evidence suggests that students reduce their labor supply in response to increased financial aid in the form of grants (Denning, 2019; Broton et al., 2016; Park and Scott-Clayton, 2018; Carlson et al., 2022; Kofoed, 2022). In the context of loans, Black et al. (2020) find that increasing borrowing limits also lead to a reduction in labor supply among college students. These findings are not inconsistent with our results, as the former refers to all students receiving loans, while our findings indicate, albeit indirectly, that students induced to enroll because of loans are likely to work during their college years. Moreover, it is not clear whether intensive and extensive margin effects should be similar, given that changes in borrowing limits only affects those already enrolled. For instance, another strand of literature suggests that indebted students behave differently in the labor market, with a lower probability of choosing public interest jobs and a greater probability of choosing higher-paying positions (Rothstein and Rouse, 2011; Field, 2009).

Hence, a related possibility is debt aversion, which could cause students to try to repay their debts as quickly as possible. Caetano et al. (2019) and Gopalan et al. (2021) find evidence of debt aversion in the case of student loans, while Di Maggio et al. (2019) find that debt influences risk-taking behavior, reducing the probability of job changes and geographical mobility[25]. Although debt aversion could also be a contributing factor, we believe that the preference for the evening shift is more likely associated with financial constraints. This is supported by the fact that debt-averse students have the option to borrow less than the maximum amount, but such behavior is rarely observed in the case of FIES.

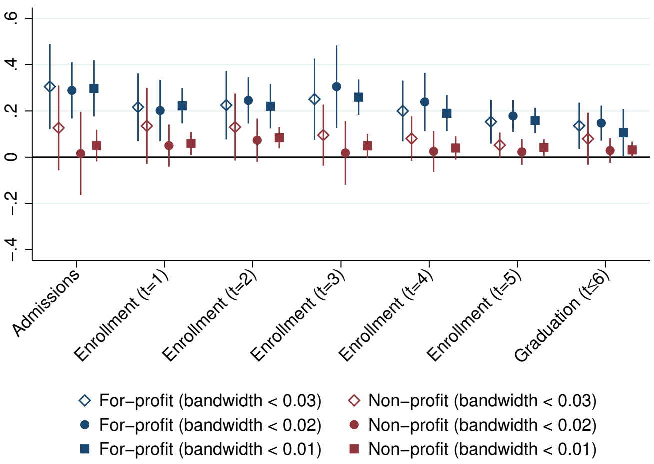
Student responses should also depend on whether loans can fund living expenses or just tuition and college fees, such as in FIES. While our study does not determine whether students change labor supply in response to loans, our findings indicate that work compatibility plays an important role in shaping how students respond to loan policies. In this regard, one important concern is determining whether working while studying has a detrimental effect on students[26].

[25] Moreover, Booij et al. (2012), for the Netherlands, find that, despite informational constraints, informing students about student loan conditions did not significantly increase take-up, even under favorable conditions, as students preferred to work part-time to avoid accumulating debt.

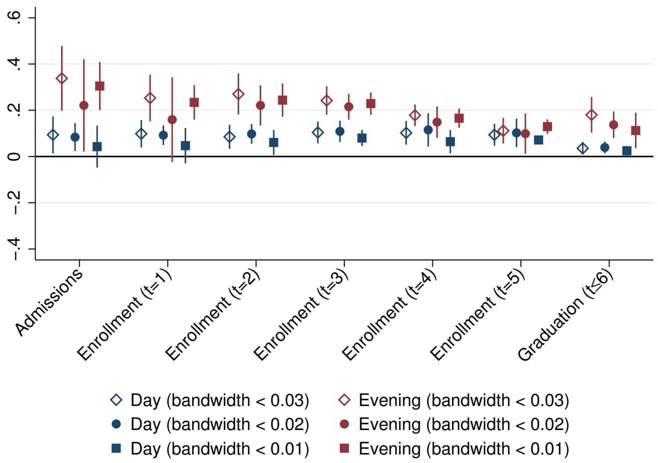
[26] Neyt et al. (2019) review the literature on the impact of student employment on educational outcomes, arguing that student employment tends to have a more detrimental effect on persistence than on academic performance. Conversely, work experience accumulated during college, when related to the field of study, can enhance job prospects, but does not lead to higher future wages (Weiss et al., 2014; Sanchez-Gelabert et al., 2017).

Figure 2.4: Impact of loans on admissions, enrollment and graduation, by type of high school attended, shift of study, and type of HEI.

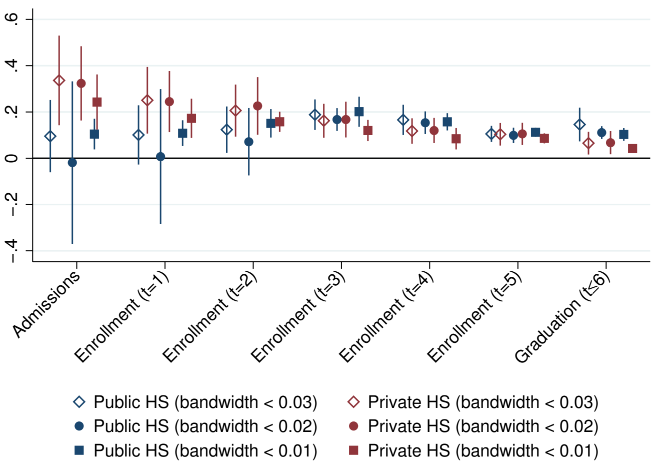
(a) Type of HEI



(b) Shift of study



(c) Type of high school attended



Notes: The graphs present estimates of the effect of loans on admission, enrollment and graduation, by: whether the student attended a public or private high school (panel a); whether the student attend college classes at evening or daytime (panel b); or whether the student attends a for-profit or non-profit HEI (panel c). Lines correspond to 95% confidence intervals.

Type of high school. Graduating from a public high school indicates lower socioeconomic status, given the generally lower income of students from these schools. Conversely, graduating from a private high school indicates higher financial capacity, as the student could afford to pay for secondary education. Therefore, if financial constraints are the determining factor, loans should matter more for public school graduates. On the other hand, if dynamic complementarity — as discussed in section 2.3 — are more important, graduates from private schools, which usually exhibit better academic performance, should benefit more. Hence, even if financial constraints are relaxed, returns to postsecondary education may be too low for some students, in which case loans would not increase their probability of attending college.

As discussed earlier, Solis (2017) and Melguizo et al. (2016) found that loans increase college attendance more for lower-income students. It should be noted, however, that the effects they estimate are local in relation to ability, as their identification strategy is based on discontinuities in cutoff scores[27]. In contrast, our results apply to a broader class of students as we leverage discontinuities that impact aid availability at the regional level[28]. Given that academic performance is highly correlated with family income, the impact of loans on enrollment, when unconditioned on performance, may differ from those studies.

Since we do not restrict loans by type of high school attended, but only the outcome, higher values for public school graduates should be expected, since they represented approximately 69% of students entering higher education in 2013-2017. In addition, 75.7%-76.9% of loans granted were destined to public school students during 2013-2017.

As shown in Figure 2.4, for initial enrollment, the impact of loans is primarily observed among students who attended private high schools. However, for latter outcomes, and especially for graduation, effects become higher for students that

[28]To be more precise, our results are conditioned on a similar regional development level.

[28]Gurgand et al. (2023) departs from this strategy, using credit score cutoffs. They do not find income to be a major source of heterogeneity.

attended public high schools. In this case, the effects are more than twice the effect for private high school graduates (0.103-0.146 against 0.042-0.067). This indicates that loans may not be effective for all low-income students, but they increase the persistence of those who actually enroll.

Hence, this pattern may suggest that public school students face academic barriers that inhibit loan policies from increasing college access for this group. To further investigate this hypothesis, we examine how loans influence future participation in the National High School Exam (ENEM). Taking ENEM and scoring above 450 points is a requirement for applying to FIES loans. However, actual cutoff rates are higher and vary depending on region, degree/major, and quality score of the HEI. This can be observed in Figure 3.4 in Appendix 2.D, which presents the distribution of cutoff scores for programs participating in FIES, comparing them to admission cutoffs for federal universities. The median cutoff value for FIES loans is approximately 550 points.

Table 2.6 presents the results. We estimate effects for two groups of students: (*i*) exam takers who attended all three years of high school ("ensino médio") in public schools, including those operated by the federal, state or municipal governments ("Public HS"); and (*ii*) exam takers who attended all three years of high school in private schools, include for-profit and non-profit ("Private HS").

We observe that one additional loan induces, in the following year, approximately 1.04-1-18 and 0.28-0.33 extra ENEM takers from, respectively, public and private high schools. For students coming from private schools, both past graduates and high school seniors are induced to take the exam, while, for public schools, only older individuals are induced, which could result from informational constraints[29].

[29] Summing effects for High School Seniors and Past High School Graduates does not necessarily add to the effect observed for all ENEM takers because some of the exam takers were in neither of the former two groups. During this period, ENEM was also used as a high school certificate exam for high school dropouts. Hence, some students were not graduated or graduating from high school.

Table 2.6: Effect on future ($t+1$) exam participation.

Panel A: *Exam applicants and takers*

Dep. var.:	ENEM Applicants			ENEM Takers			High School Seniors			Past High Sch. grad.		
Bandwidth	0.01	0.02	0.03	0.01	0.02	0.03	0.01	0.02	0.03	0.01	0.02	0.03
Public HS	1.450***	1.637***	1.871***	1.041***	1.131***	1.184***	-0.054	-0.131	-0.123	0.665***	0.682***	0.715***
	(0.373)	(0.342)	(0.327)	(0.245)	(0.221)	(0.196)	(0.075)	(0.184)	(0.158)	(0.113)	(0.142)	(0.151)
Private HS	0.463***	0.532***	0.463***	0.296***	0.333***	0.281***	0.081***	0.087***	0.067***	0.187***	0.212**	0.182***
	(0.041)	(0.145)	(0.092)	(0.030)	(0.089)	(0.054)	(0.010)	(0.011)	(0.025)	(0.033)	(0.083)	(0.052)
N	180	427	742	180	427	742	180	427	742	180	427	742

Panel B: *Number of takers by score range*

Dep. var.:	Score $\in [0, 450)$			Score $\in [450, 500)$			Score $\in [500, 550)$			Score ≥ 550		
Bandwidth	0.01	0.02	0.03	0.01	0.02	0.03	0.01	0.02	0.03	0.01	0.02	0.03
Public HS	0.338***	0.494***	0.562***	0.442***	0.461***	0.481***	0.275***	0.278***	0.259***	-0.015	-0.102	-0.118
	(0.121)	(0.139)	(0.174)	(0.088)	(0.090)	(0.080)	(0.053)	(0.059)	(0.073)	(0.023)	(0.099)	(0.109)
Private HS	0.032***	0.042***	0.045***	0.074***	0.089***	0.083***	0.110***	0.126***	0.112***	0.081***	0.076***	0.041
	(0.005)	(0.013)	(0.015)	(0.009)	(0.028)	(0.021)	(0.012)	(0.033)	(0.021)	(0.018)	(0.019)	(0.032)
N	180	427	742	180	427	742	180	427	742	180	427	742

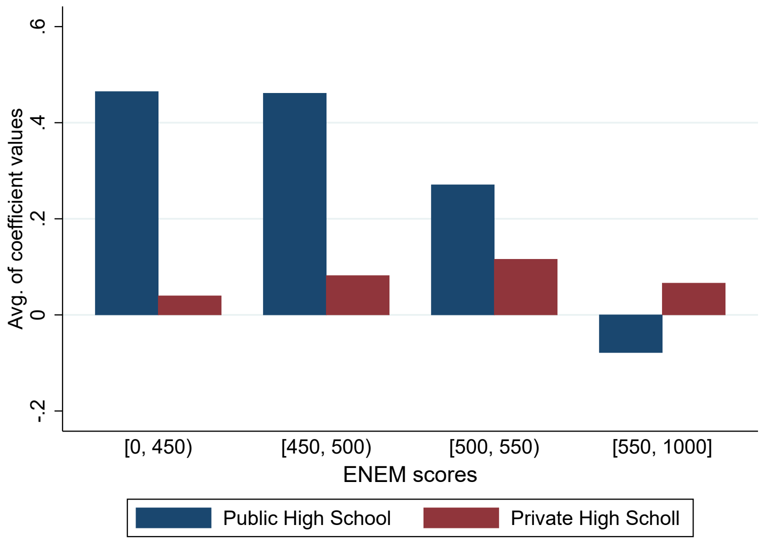
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the effects of loans on future participation in ENEM, a high school exit exam required to apply for FIES loans. We present estimates for two subgroups of exam takers: (i) those who attended all three years of high school () in public schools; and (ii) those who attended all three years of high school in private schools. We observe that students react to an increase in aid availability by increasing their participation in ENEM in the following year, and the effect is higher for public school students. However, public school students tend to present lower scores, as shows in Panel B. Robust standard errors in parenthesis, clustered by region. All regressions include region and year fixed effects, as well as first-order RD polynomials for each year and side of the closest cutoff.

The results indicate that nearly all public school students induced to take the exam score below 550, rendering them unable to access loans in more competitive programs. Around 41.6% score below 450, making them ineligible for FIES. Conversely, private school graduates exhibit more favorable outcomes, with only 13% (averaging values across three bandwidths) scoring below 450. Figure 2.5 visually illustrates these effects.

In summary, additional investigation reveals that less advantaged students are responsive to loans in terms of their participation in ENEM. However, they generally achieve lower scores, with 82.8% scoring below 500 points. Conversely, most private high school graduates induced to take the exam score above this level, presenting a better chance of actually getting loans in more competitive majors. Consequently, even public school students who successfully secure a loan may be enrolling in programs of lower quality due to insufficient academic performance. Results also reveal that only older public school students are induced to take the exam. These students may face less stringent credit constraints, possibly because they are already employed, which could also explain the lower initial impact of loans for public school students.

Figure 2.5: Effect of loans on $t + 1$ exam participation, by score range and type of high school – averaged across bandwidths 0.01, 0.02, and 0.03.



2.6 Final remarks

In this paper, we investigate the effects of student loans on college access through a natural experiment arising from the implementation of a regional allocation rule for FIES, Brazil's primary funding program for postsecondary education. Since 2016, the share of loans allocated annually to each region depend discontinuously on regional Human Development Index values. In this setting, we employ a Difference-in-Discontinuities approach, leveraging both the policy change and the discontinuities created by the new rule. By tracking cohorts throughout their college years, we estimate the effects of loans on enrollment, persistence, and completion, up to the sixth year since entry. Previous related studies have primarily focused on the early years of higher education, reporting the effects on admission or persistence only up to the second year. However, our study provides a complete picture of how these effects evolve until graduation. By doing this, we show that the impact on enrollment and graduation can differ significantly, finding that the latter is much lower than the former in the Brazilian case.

Despite skepticism regarding the effectiveness of FIES in promoting higher education enrollment, our findings indicate slightly higher overall impact in the Brazilian context compared to those observed in Chile (Solis, 2017; Card and Solis, 2022) and Colombia (Melguizo et al., 2016). However, the limited availability of international evidence constrains our ability to comprehensively assess the potential for further improvements in this front, especially concerning graduation effects.

We also contribute to the existing literature by analyzing how these effects vary based on selected characteristics of both students and the institutions they attend. We find that loans drive additional enrollment mostly among relatively more advantaged students, specifically those who attended private high schools. This finding contrasts with previous research reporting higher effects for lower-income students (Solis, 2017; Melguizo et al., 2016). Notably, these prior studies employed discontinuities in test scores, measuring an impact that is "local" in terms of ability. In contrast, our analysis employs a different type of discontinuity, not conditioning on ability, which likely accounts for the divergence in results.

The observation of higher effects for more advantaged students suggests that students from public schools, in addition to financial constraints, may also face other obstacles, such as academic constraints. For instance, many could be unable to surpass the minimum scores required for accessing the loans or opt out of postsecondary education altogether due to anticipated low returns.

Additional tests revealed that increased financial aid availability in the students' region increases future participation in the exam required for loan applications. As predicted by the financial constraints hypothesis, this effect is more pronounced for students from public high schools. However, most public school students induced to take the exam obtained low scores, suggesting that low academic performance is a significant hindrance for them to access loans, especially in more competitive majors. Hence, our findings seem to underscore the importance of dynamic complementarity between earlier and later investments in education (Cunha and Heckman, 2007; Cunha et al., 2010), even though financial constraints also appear to be important.

For later outcomes, such as graduation, the situation reverses, with effects being higher for public high school students. This implies that those who actually enroll exhibit higher persistence because of loans, while persistence effects are not as prominent for private school graduates. An important takeaway from this pattern is that focusing only on initial outcomes would understate the importance of loans for less-advantaged students.

In the same sense, the most notable source of heterogeneity we identify is study shift. We observe that loans are particularly effective in increasing enrollment, persistence, and completion in programs offered during evening hours. We interpret this outcome as related to financial constraints since the study shift is closely linked to work-study compatibility. Financially constrained individuals may be compelled to work while studying to cover their living expenses, opting to study in the evening[30].

Thus, our results suggest that prioritizing work-study compatibility can enhance the extensive margin effects of higher education loan programs if the goal is to maximize enrollments in higher education. It remains to be determined whether covering living expenses would influence students' enrollment decisions and choices of study shift. Further research could focus on the labor market returns of marginal students, and how these returns are affected by working while in college, providing insights into how college access could be enhanced for less advantaged individuals.

Despite ranking as the fourth-largest educational market globally, the Brazilian context is notably underrepresented in the international literature. Therefore, we believe it offers a fruitful setting for future research in the economics of higher education. In particular, our empirical strategy can be extended to many other research questions, as shown by a related paper (Ávila and Terra, 2024a), that relies on the same policy change to examine the impact of student loans on the behavior and finances of higher education institutions, focusing on the for-profit sector.

[30] Working while in college, and consequently accumulating labor experience, may also serve as a means of risk diversification, considering the uncertainty in returns from higher education.

2.A Identification strategy: comparison to previous literature

The total number of individuals entering higher education in region m at a specific time can be represented as the sum of individuals who would enter regardless of government funding (*always takers*) and individuals who would only enter with funding (*compliers*), representing those truly affected by the policy:

$$I_{mt} = A_{mt} + \tau F_{mt} \tag{2.5}$$

where I_{mt} represents the number of students entering higher education, A_{mt} are the *always takers* and F_{mt} represents the number of loans granted. The coefficient $\tau = \delta - \gamma$ represents the effect of loans on entry, where δ is the probability of the loan recipient entering higher education and γ is the probability that loan recipients would have entered higher education even without the loan.

The τ effect is comparable to the effects (locally) estimated by Gurgand et al. (2023), Solis (2017) e Melguizo et al. (2016). In the case of these papers, given a variable z that determines funding based on a cutoff point $\bar{z}$, the probability of an individual entering higher education would be $p_i(T) = \delta(z)T_i + \gamma(z)(1 - T_i)$, where $T_i = \mathbf{1}[z_i \geq \bar{z}]$ and the treatment effect would be $p_i(1) - p_i(0) = \delta(\bar{z}) - \gamma(\bar{z})$ for individuals with a score of $\bar{z}$. In this case, $\tau = \delta - \gamma$ has a similar meaning to that presented in the equation 2.5, but would only refer to individuals with score in the neighborhood of $\bar{z}$.

In the paper, equation 2.5 is generalized to other situations, where I_{mt} represents the number of individuals taking a particular action (admission, enrollment, conclusion, among others), A_{mt} represents the number of individuals who would have taken that action regardless, and τF_{mt} represents the number of individuals who take the action solely due to receiving funding. For instance, τ can also be negative, so that, in this case, τF_{mt} would refer to the number of individuals who refrain from taking the action due to funding (for example, choosing not to enroll in online programs).

2.B Loan allocation rules

1. The "Social Relevance Criteria" (SRC) is calculated through the formula:

$$SRC = 0,7 \times CDHE + 0,3 \times CDSF$$

   where:

   - CDHE is the Coefficient of Demand for Higher Education, given, in year t, by the share of the region in the country-wise total of individuals that scored at least 450 points in ENEM in year $t-2$ and/or registered to take ENEM in year $t-1$.
   - CDSF is the Coefficient of Demand for Student Financing, given by the share of the region in the total number of applicants for FIES in year $t-1$.

2. To prioritize less developed regions, the distribution implied by the SRC is recalculated based on weights depending on HDI ranges. Table 2.1, in the paper, presents the weights for each of these ranges.

2.C Data

Table 2.7 presents data sources and Tables 3.2 to 2.11 present descriptive statistics for the main variables used in the paper. Table 2.12 present the percentage of missings in the region of birth data, by year. The regional distribution of Brazilian microregions and respective average HDIs is shown in Figure 2.6, considering only the municipalities that had HEIs in 2017. Figure 2.7 presents the evolution of completion rates for students admitted in 2011, for each type of HEI. Figure 3.4 presents the distribution of cutoff scores, by degree/shift/institution, for FIES and Federal Universities. Figures 2.9 to 2.17 presents event studies for the dependent variables used in the paper.

We drop two outlier regions from the data: São Paulo (code 35061) and Adamantina (code 35035). The first is dropped due to its size, being the largest microregion in Brazil. Adamantina, on the other hand, despite not being relatively large, presents an unusually large value only for 2017.

Table 2.7: Data sources.

Variables	Sources	Years
Municipal Human Development Index - HDI	UNDP - United Nations Development Programme[31]	2010
FIES loans	Dados abertos FIES – FNDE	2013 a 2021
National high school exam takers and applicants	Microdados do ENEM - INEP	2013 a 2018
Higher education admissions, enrollment and conclusion	Censo da Educação Superior - INEP[32]	2013 a 2021

To estimate the individual effect, we use information on the students' region of birth. However, this information is missing for 23.9% to 34.9% of the data points, depending on the year, as described in Table 2.12 in the Appendix. About 80% of the missing data points occur in programs/years with at least 80% missing individual data, and 72.3% of missing data points occur in programs/years with 90% or more missing individual data. Thus, the missing data appears to be primarily caused by programs that did not adequately capture or report the information for a given year, rather than being directly determined by student characteristics.

Students receiving FIES loans are typically older and already employed. For instance, approximately half of the program's beneficiaries have formal jobs while pursuing their college education (Brasil, 2020). Consequently, a significant portion of these students are expected to be local residents. Calculations using the Census of Higher Education data indicate that the percentage of students enrolling in private higher education in their region of birth varies between 94.6% to 95.4% annually during 2012-2017[33].

In the absence of corrections, calculating enrollment by birth region ignoring the data points with missing information would result in a downward bias, as part of the benefited students would be omitted. On the other hand, imputing values for the missing data results in dependent variables with measurement error, which could also bias the estimated coefficients, depending on the type of measurement error and whether or not it is correlated with the instrument. If such correlation exists, it would render the instrument invalid[34].

As for the type of measurement error, Hyslop and Imbens (2001) show that the estimated coefficient can be biased downwards if the measurement error is of the *Optimal Prediction Error* (OPE) type. In the Classic Measurement Error (CME) case, the error is not correlated with the true values of the variable, but only with the variable measured with error. In the OPE, however, the measurement error is correlated with the real variable, which biases the estimated coefficients downwards even if the explanatory variable is not correlated with the error. This happens when the measurement error results not from random coding or reporting errors, for example, but from the fact that the variable in question is obtained from an estimate, constructed from the minimization of some loss function. However, the attempt to

[33]This high percentage does not seem to be caused by erroneous filling of the reports, since, for example, in 2017, only 13 of the 2,136 reporting HEIs had 100% of their students born in the municipality where the HEI is located.

[34]However, in this case, where the measurement error is considered part of the model error, the Sargan test of overidentified constraints (applicable when there is more than one instrument) would indicate invalidity. Notably, such invalidity is not observed in our empirical analysis.

minimize the prediction error causes the prediction to have a lower variance than the original variable[35].

Consequently, trying to find the "best" estimate for the number of students born in each region would likely generate an OPE error, causing a downward bias in the coefficients from the regression of Y on X. Thus, we take a "naive" approach and assume that the missing data has the same distribution of births as the non-missing for a "comparable" group of students, constructed by combining observations with similar values for year of admission, municipality of study, type of institution attended (for-profit or non-profit), study shift (daytime or evening) and type of secondary educational institution attended (public or private).

In practice, this correction was made by weighting the non-missing observations. For example, if a group has $x\%$ of students missing the information on municipality of birth, each non-missing observation receives the weight $1/(1-x\%)$, in order to compensate for the missing data. These procedures were performed separately for admitted, enrolled and graduating students, at the municipality level, and latter aggregated to the regional level, resulting in a zero mean error, since the actual number of admissions, enrollments and graduations is known. Importantly, the estimated coefficients should not be affected by this procedure, since the measurement error is unlikely to be correlated with our instruments[36].

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[35]In practice, the estimated model with measurement error ν_{mt} in the dependent variable becomes:

$$I_{mt} + \nu_{mt} = \tau F_{mt} + \eta_m + \iota_t + (\xi_{mt} + \nu_{mt})$$

Following Hyslop and Imbens (2001), consider the model $Y^* = \alpha + \beta X + e$, in which the real value Y^* is measured with error ν. Thus, we have:

$$\tilde{Y} = Y^* + \nu = \alpha + \beta X + e + \nu$$

where $\tilde{Y}$ is a signal of the true value Y^* observed by the reporting agent, which is subject to a classical error ν. The unconditional mean of Y^* is $\alpha + \beta\mu_X$, with variance $\beta^2\sigma_X^2 + \sigma_e^2$.

As argued by Hyslop and Imbens (2001), given a signal $\tilde{Y}$, reporting $Y = \tilde{Y}$ would likely generate a classic-type measurement error (ν), whereas reporting $Y = E[Y^*|\tilde{Y}]$ would result in an OPE-type measurement error, since, in the latter case, Y would become a weighted average of $\tilde{Y}$ and the unconditional mean of Y^*, with weights depending on the attempt to minimize the error.

[36]Note that the number of missings does not determine the direction of the error, since its sign will depend on how the distribution of birth municipalities for missings differs from the non-

2.D Summary statistics

Table 2.8: Summary statistics, HDI in 0.5 range.

	Mean	SD	Min	Max	Obs.
HDI $\in [0.5, 0, 6)$					
HDI	0.563	0.029	0.503	0.593	44
Loans granted	382	726	1	2898	27
Admissions	826	531	226	2994	44
Evening	521	336	105	1670	44
Daytime	305	214	81	1324	44
For-profit	615	425	199	2008	44
Non-profit	211	162	20	986	44
Public High Sch.	636	404	172	1941	44
Private High Sch.	190	162	26	1053	44
Enrollment ($t = 1$)	668	427	164	2367	44
Enrollment ($t = 2$)	528	321	116	1734	44
Enrollment ($t = 3$)	443	272	103	1439	44
Enrollment ($t = 4$)	358	216	76	1154	44
Enrollment ($t = 5$)	267	170	45	913	44
Enrollment ($t = 6$)	117	60	20	271	32
Graduation ($1 \leq t \leq 6$)	336	172	71	821	32

missing. Additionally, the same place of birth may be underrepresented in a given region and over-represented in another. Thus, the aggregate (regional) error will be sum of errors for each municipality with higher education enrollment.

Table 2.9: Summary statistics, HDI in 0.6 range.

	Mean	SD	Min	Max	Obs.
$HDI \in [0.6, 0, 7)$					
HDI	0.659	0.025	0.604	0.699	434
Loans granted	793	2967	1	35932	306
Admissions	1783	4211	252	45350	434
Evening	1197	2444	178	26724	434
Daytime	586	1802	53	18742	434
For-profit	1215	3232	87	35265	434
Non-profit	568	1035	31	10256	434
Public High Sch.	1179	2114	190	21608	434
Private High Sch.	604	2160	30	25407	434
Enrollment ($t = 1$)	1465	3442	190	37663	434
Enrollment ($t = 2$)	1128	2565	139	28751	434
Enrollment ($t = 3$)	936	2050	87	23057	434
Enrollment ($t = 4$)	770	1612	76	17959	434
Enrollment ($t = 5$)	577	1228	58	13918	434
Enrollment ($t = 6$)	306	759	22	8050	342
Graduation ($1 \leq t \leq 6$)	712	1393	74	14435	342

Table 2.10: Summary statistics, HDI in 0.7 range.

	Mean	SD	Min	Max	Obs.
$HDI \in [0.7, 0, 8)$					
HDI	0.746	0.024	0.700	0.799	1332
Loans granted	1917	7496	1	153627	1174
Admissions	5345	19221	129	303349	1332
Evening	3830	13446	107	218894	1332
Daytime	1515	5831	13	84456	1332
For-profit	2635	8942	60	118135	1332
Non-profit	2710	10784	47	185214	1332
Public High Sch.	3700	13448	88	226458	1332
Private High Sch.	1645	6246	30	76892	1332
Enrollment ($t = 1$)	4168	14784	108	227452	1332
Enrollment ($t = 2$)	3116	10556	85	169162	1332
Enrollment ($t = 3$)	2497	7926	79	125313	1332
Enrollment ($t = 4$)	1990	5825	61	89453	1332
Enrollment ($t = 5$)	1376	3708	37	48346	1332
Enrollment ($t = 6$)	667	1821	4	21204	1065
Graduation ($1 \leq t \leq 6$)	1980	6493	53	99297	1065

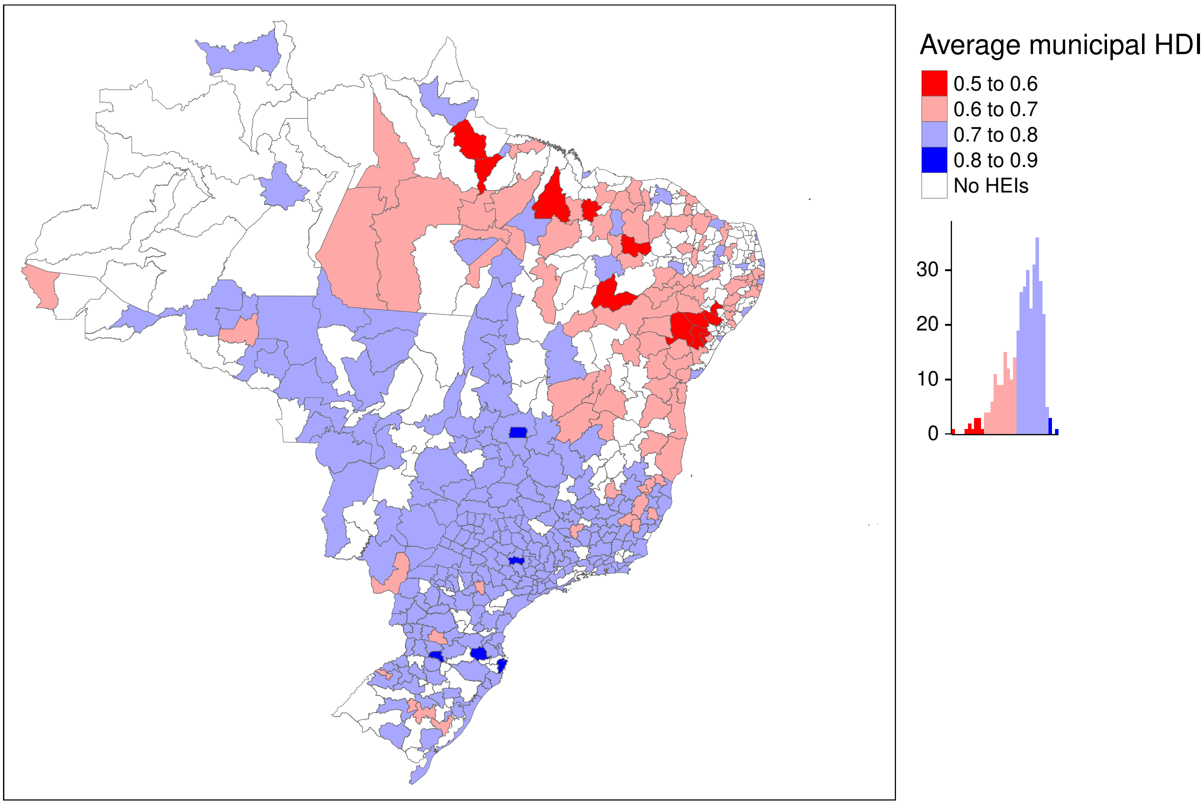
Table 2.11: Summary statistics, HDI in 0.8 range.

	Mean	SD	Min	Max	Obs.
$HDI \in [0.8, 0, 9)$					
HDI	0.809	0.011	0.800	0.824	15
Loans granted	5221	9453	28	29732	15
Admissions	14957	19801	541	44217	15
Evening	9289	11912	446	28383	15
Daytime	5668	7975	95	17363	15
For-profit	7092	9537	303	21010	15
Non-profit	7864	10368	233	25461	15
Public High Sch.	9930	12892	415	31519	15
Private High Sch.	5027	7054	127	16525	15
Enrollment ($t = 1$)	11592	15376	427	35101	15
Enrollment ($t = 2$)	8628	11322	381	27633	15
Enrollment ($t = 3$)	6866	8953	551	21417	15
Enrollment ($t = 4$)	5348	6879	487	17123	15
Enrollment ($t = 5$)	3654	4654	384	11864	15
Enrollment ($t = 6$)	1778	2311	152	5889	12
Graduation ($1 \leq t \leq 6$)	5867	7668	533	17569	12

Table 2.12: Number of observations with missing and non-missing information on region of birth.

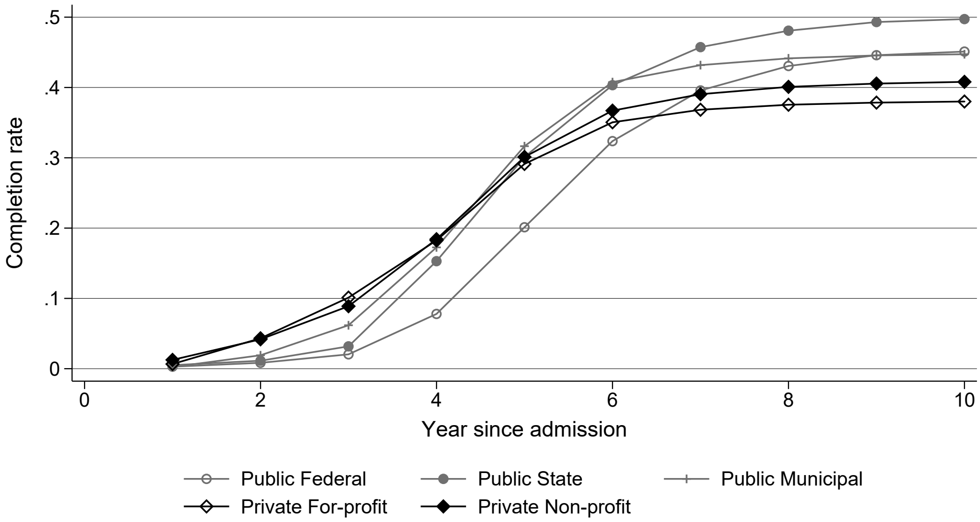
Year	Non missing	Missing	%
2013	1,234,464	498,141	0.288
2014	1,335,618	543,373	0.289
2015	1,208,259	513,403	0.298
2016	1,125,780	511,681	0.312
2017	1,074,457	575,674	0.349

Figure 2.6: Average HDI of the Brazilian microregions with (operating) higher education institutions in 2017.



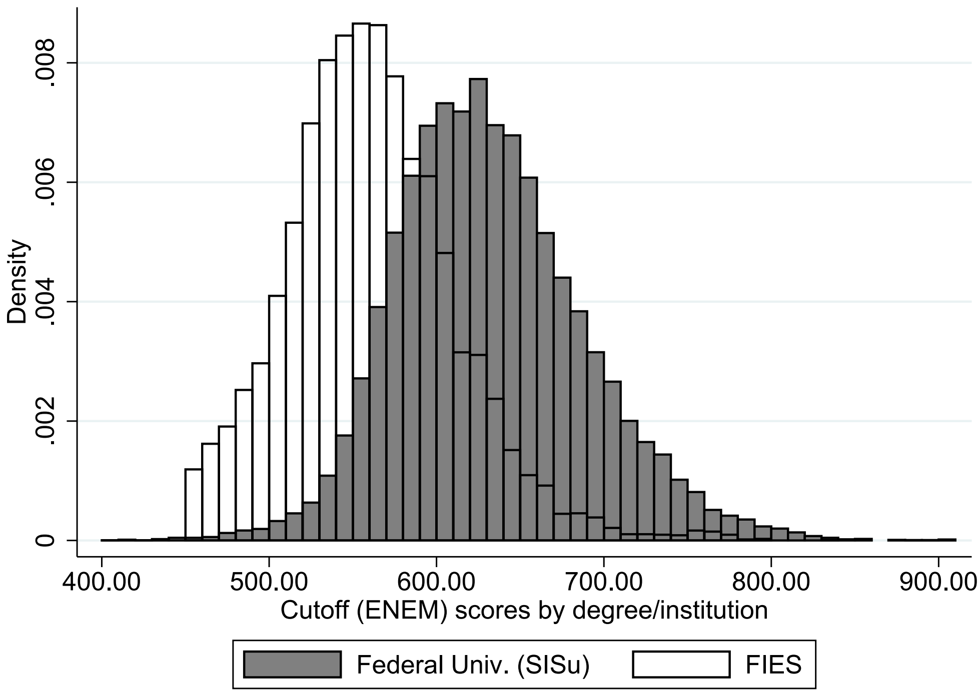
Data sources: Brazilian Institute of Geography and Statistics (IBGE) and United Nations Development Programme (UNDP).

Figure 2.7: Evolution of completion rates in higher education, by type of institution, for students admitted in 2011.



Data source: INEP.

Figure 2.8: Distribution of cutoff scores, by degree/shift/institution, for FIES and Federal Universities.



Data source: Ministry of Education.

2.E Diagnostics

Table 2.13 displays the first-stage results for the instrumental variables estimation outlined in Table 2.4. Instruments are jointly significant and present the expected signs in all cases, with positive coefficients for groups $[0.5, 0.6)$ and $[0.6, 0.7)$, and negative coefficients for group $[0.8, 0.9)$, considering group $[0.7, 0.8)$ as the baseline.

Table 2.13: First stage - IV.

Year of admission:	2013-2017	2013-2017^a	2013-2016^a
$Z_{2016}^{[0.5,0.6)}$	874.252***	1204.121***	1172.924***
	(286.303)	(350.885)	(358.381)
$Z_{2016}^{[0.6,0.7)}$	841.919***	1081.247**	1112.615***
	(311.223)	(426.461)	(420.425)
$Z_{2016}^{[0.8,0.9)}$	-4035.896	-5054.262	-5049.176
	(4091.217)	(5189.143)	(5183.755)
$Z_{2017}^{[0.5,0.6)}$	1515.631***	1871.106***	
	(392.906)	(471.136)	
$Z_{2017}^{[0.6,0.7)}$	1110.655**	1350.129**	
	(484.520)	(601.442)	
$Z_{2017}^{[0.8,0.9)}$	-5059.162	-6075.241	
	(5413.779)	(6512.200)	
N	1508	1203	892
Clusters	314	312	305
F(6, Clusters-1)	10.3484	9.7602	4.5561
Prob > F	0.0000	0.0000	0.0039

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
(a) 2015 not included.
Notes: The table presents the estimation results for the first stage of the panel IV model (DD), demonstrating that the instruments – dummies for each HDI range – affect the number of loans granted with the expected signs and in a statistically significant way, except for the HDI range of 0.8. Robust standard errors, clustered by region of birth, are presented in parentheses. All regressions include region and year fixed effects.

Table 2.14 presents a placebo test in which the treated period (2016-2017) is dropped and 2014-2015 are considered as "treated" years. Most estimates are not statistically significant, as expected, and signs.

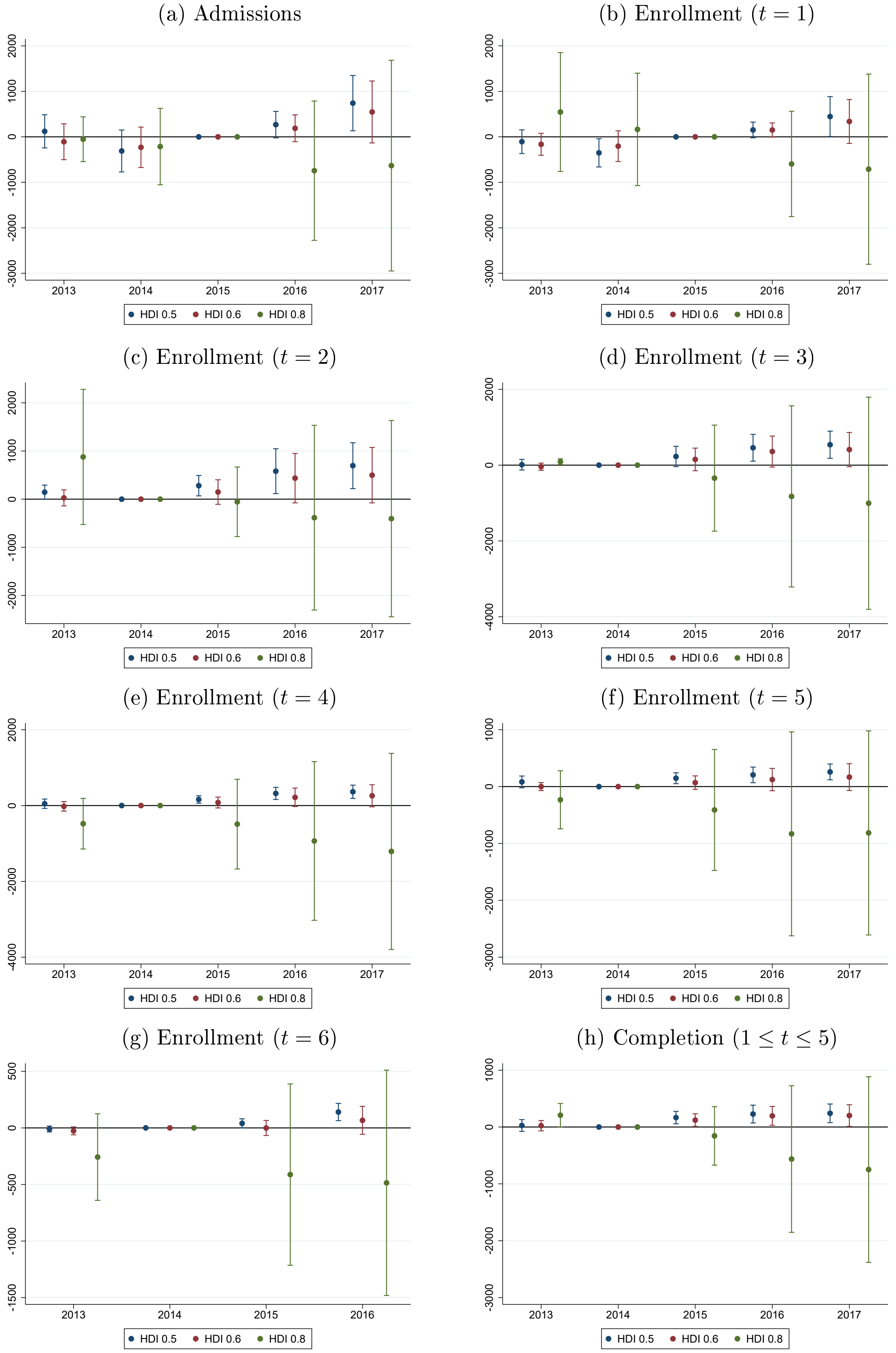
Table 2.14: Placebo test – 2013-2015.

Outcomes:	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$	$t=6$
			Panel A: *bandwidth = 0.01*			
Admissions	-5.969					
	(4.360)					
Enrollment	-1.536	0.020	0.873	1.541	-0.249	0.068
	(2.467)	(2.119)	(0.778)	(1.414)	(0.676)	(0.623)
Graduation	0.100	-0.559*	-0.314	-0.063	-0.439	-0.559*
	(0.160)	(0.328)	(0.321)	(0.267)	(0.385)	(0.328)
N	108	108	108	108	108	108
Bandwidth	0.01	0.01	0.01	0.01	0.01	0.01
			Panel B: *bandwidth = 0.03*			
Admissions	1.464					
	(1.894)					
Enrollment	0.744	1.151	0.715*	0.443	0.234**	-0.011
	(0.822)	(0.879)	(0.403)	(0.326)	(0.102)	(0.133)
Graduation	-0.009	-0.014	-0.015	0.141	0.367	-0.014
	(0.026)	(0.097)	(0.085)	(0.110)	(0.226)	(0.097)
N	445	445	445	445	445	445
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03
			Panel C: *bandwidth = 0.05*			
Admissions	1.233					
	(1.986)					
Enrollment	0.660	0.789	0.560*	0.187	0.148	0.055
	(0.905)	(0.651)	(0.308)	(0.177)	(0.111)	(0.129)
Graduation	-0.045	0.084	0.046	0.105	0.227	0.084
	(0.035)	(0.123)	(0.095)	(0.114)	(0.223)	(0.123)
N	890	890	890	890	890	890
Bandwidth	0.05	0.05	0.05	0.05	0.05	0.05

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents placebo estimates of the impact of loans on admissions, enrollment, and cumulative graduation, from years 1 to 6 since admission. The placebo test is conducted by focusing only on the pretreatment period (2013-2015) and using a two-year lag of the instruments. Hence, the years 2014 and 2015 are considered a placebo treatment. We observe, as expected, that most estimates are not statistically significant, and coefficient signs alternate. Robust standard errors, clustered by region of birth, are presented in parentheses. All regressions include region and year fixed effects, as well as RD polymials for each year and side of the closest cutoff.

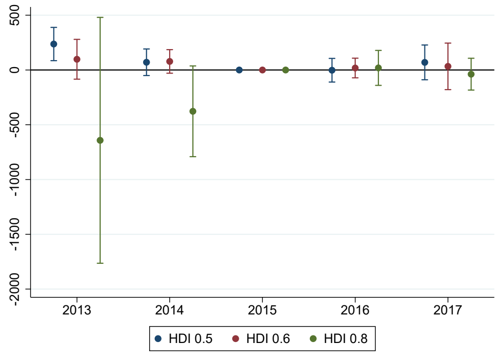
Figure 2.9: Event study for admissions, enrollment and completion.



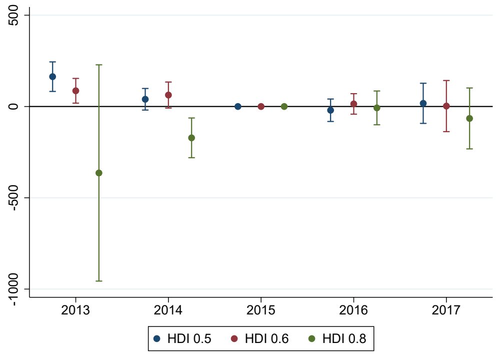
Note: Panel (a) to (h) present the event study estimation that measures the difference of admission, enrollment and completion levels of groups 0.5, 0.6 and 0.8, relative to group 0.7. For $t = 1$ variables, 2015 is the baseline year. For $t > 1$, we adopt 2014 as the baseline.

Figure 2.10: Event study for admissions, enrollment and completion for daytime programs.

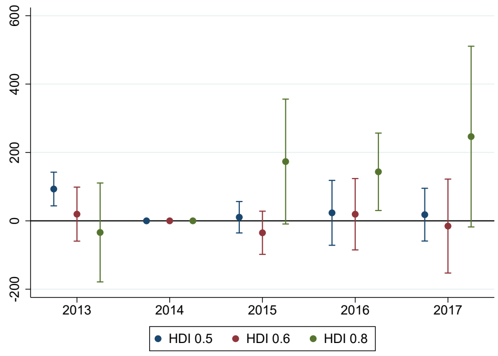
(a) Admissions



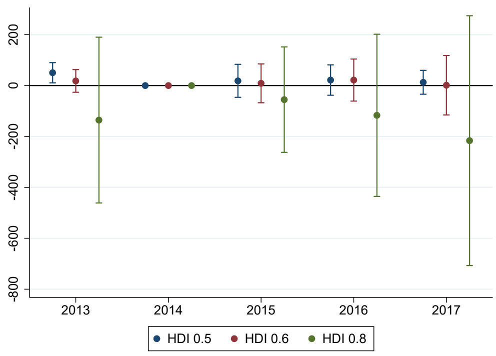
(b) Enrollment ($t = 1$)



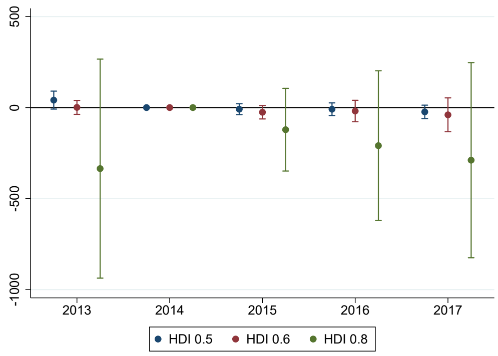
(c) Enrollment ($t = 2$)



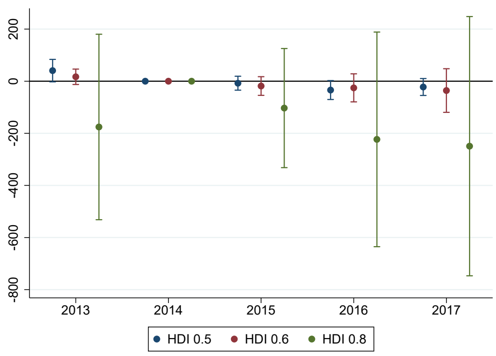
(d) Enrollment ($t = 3$)



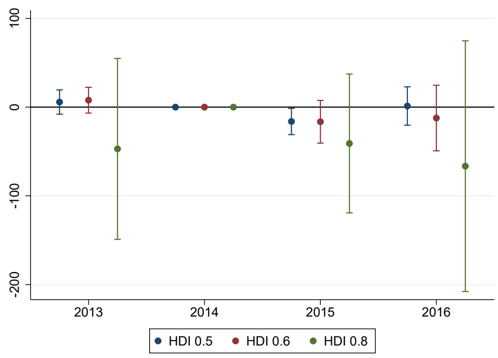
(e) Enrollment ($t = 4$)



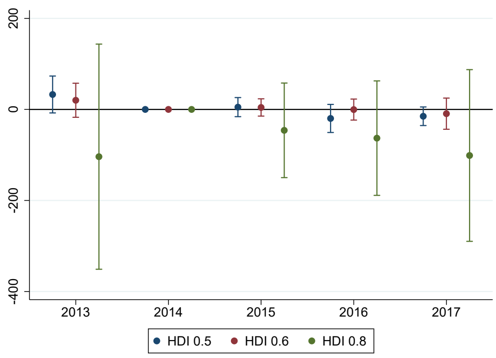
(f) Enrollment ($t = 5$)



(g) Enrollment ($t = 6$)



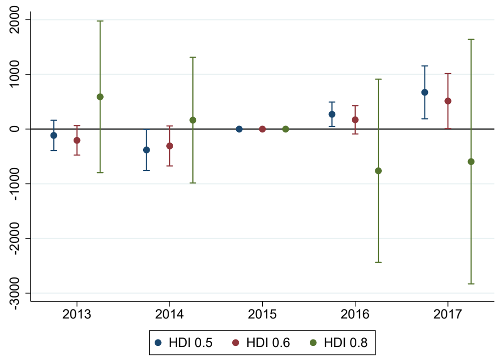
(h) Completion ($1 \leq t \leq 5$)



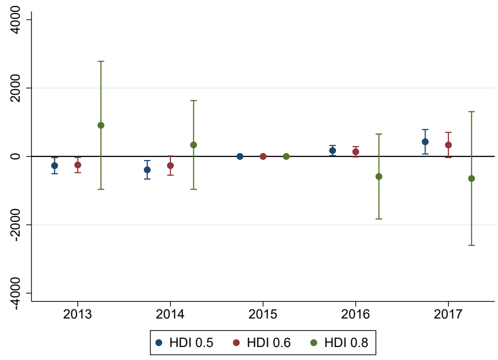
Note: Panel (a) to (h) present the event study estimation that measures the difference of admission, enrollment and completion levels of groups 0.5, 0.6 and 0.8, relative to group 0.7. For $t = 1$ variables, 2015 is the baseline year. For $t > 1$, we adopt 2014 as the baseline.

Figure 2.11: Event study for admissions, enrollment and completion for evening programs.

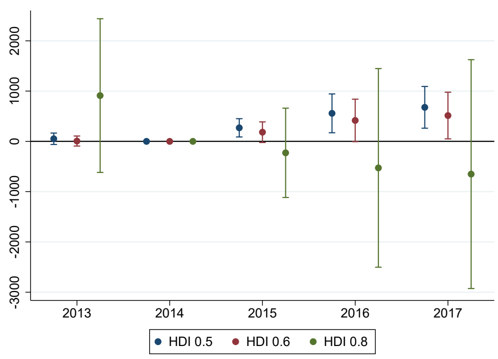
(a) Admissions



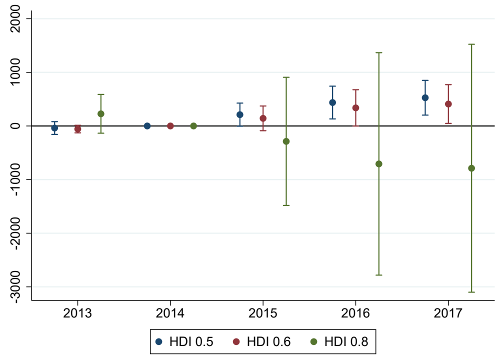
(b) Enrollment ($t = 1$)



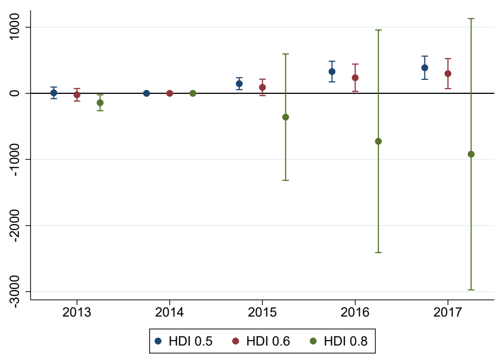
(c) Enrollment ($t = 2$)



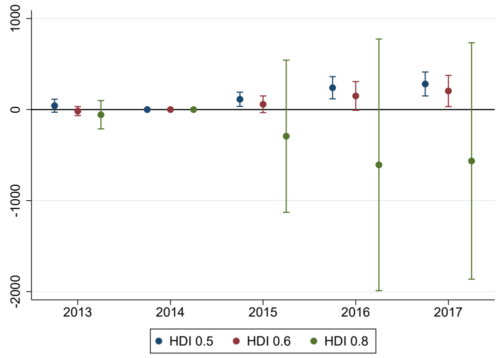
(d) Enrollment ($t = 3$)



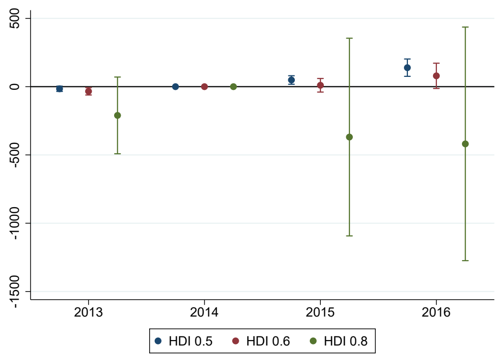
(e) Enrollment ($t = 4$)



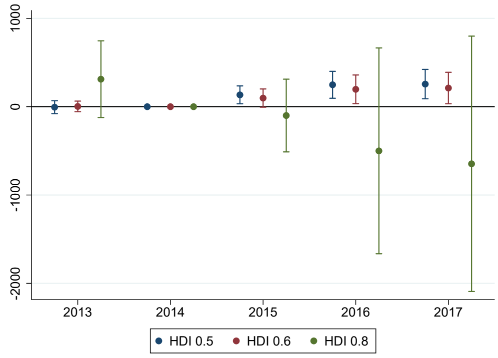
(f) Enrollment ($t = 5$)



(g) Enrollment ($t = 6$)



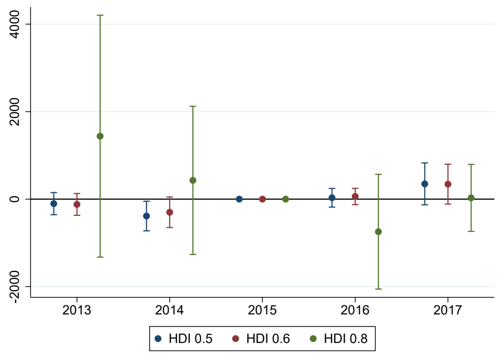
(h) Completion ($1 \leq t \leq 5$)



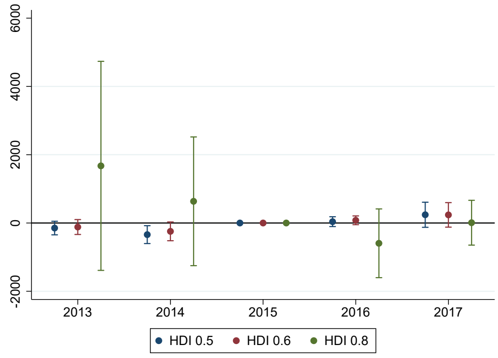
Note: Panel (a) to (h) present the event study estimation that measures the difference of admission, enrollment and completion levels of groups 0.5, 0.6 and 0.8, relative to group 0.7. For $t = 1$ variables, 2015 is the baseline year. For $t > 1$, we adopt 2014 as the baseline.

Figure 2.12: Event study for admissions, enrollment and completion for students that graduated in public high schools.

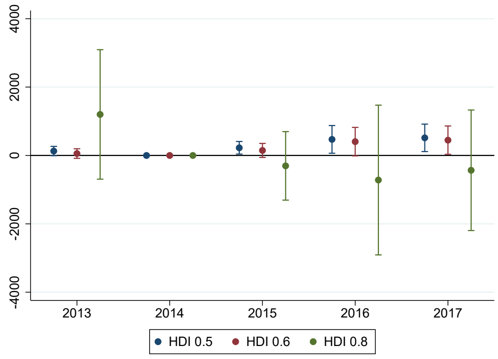
(a) Admissions



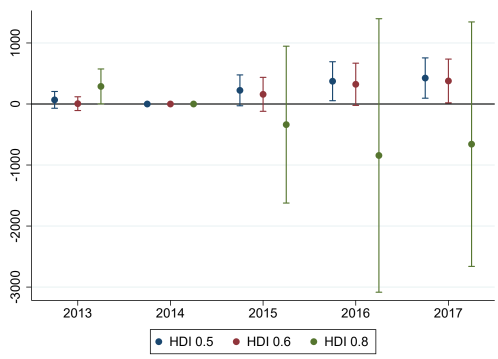
(b) Enrollment ($t = 1$)



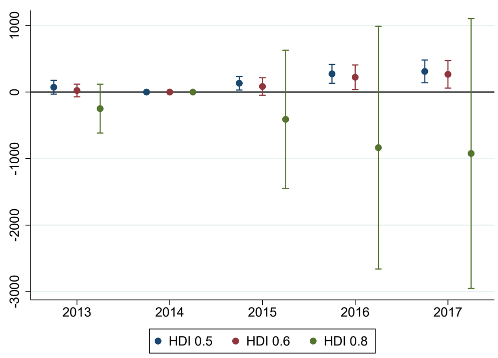
(c) Enrollment ($t = 2$)



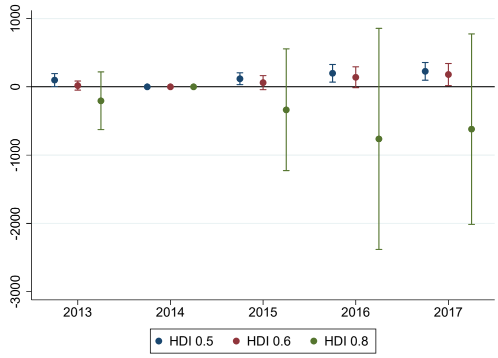
(d) Enrollment ($t = 3$)



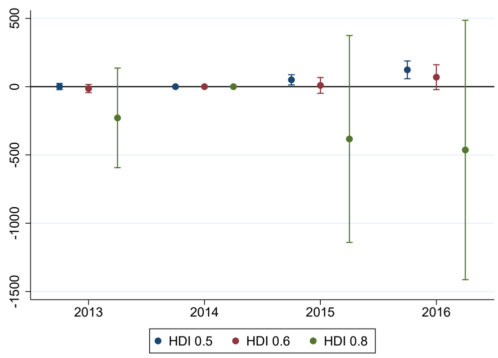
(e) Enrollment ($t = 4$)



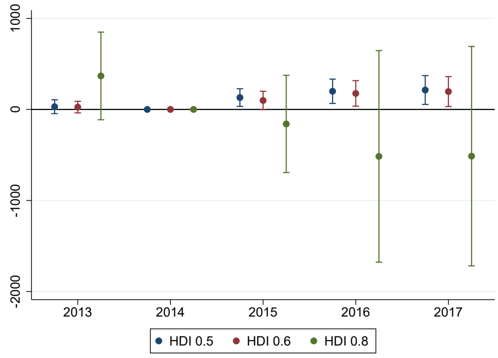
(f) Enrollment ($t = 5$)



(g) Enrollment ($t = 6$)



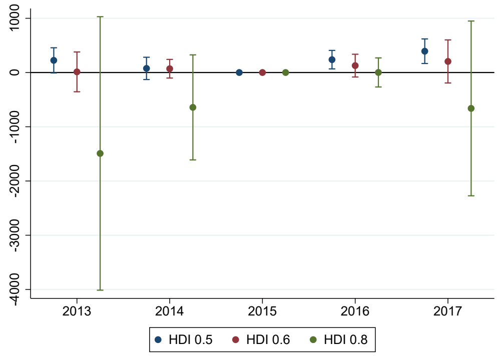
(h) Completion ($1 \leq t \leq 5$)



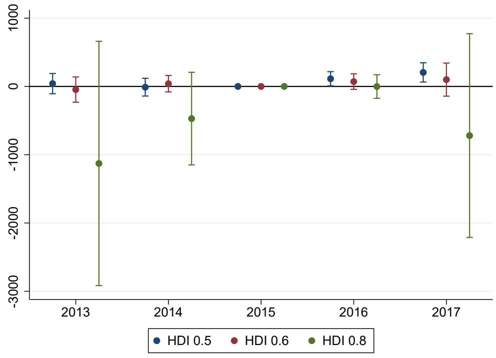
Note: Panel (a) to (h) present the event study estimation that measures the difference of admission, enrollment and completion levels of groups 0.5, 0.6 and 0.8, relative to group 0.7. For $t = 1$ variables, 2015 is the baseline year. For $t > 1$, we adopt 2014 as the baseline.

Figure 2.13: Event study for admissions, enrollment and completion for students that graduated in private high schools.

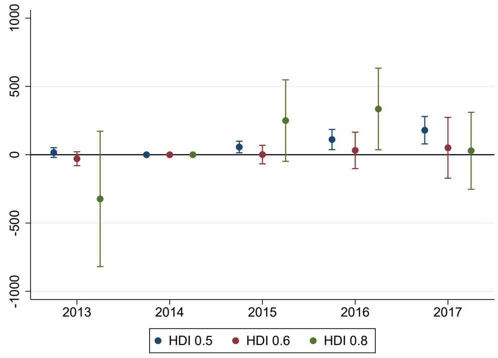
(a) Admissions



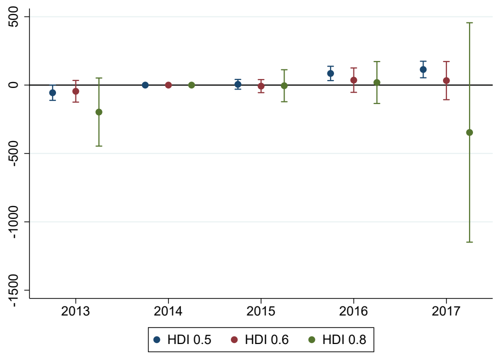
(b) Enrollment ($t = 1$)



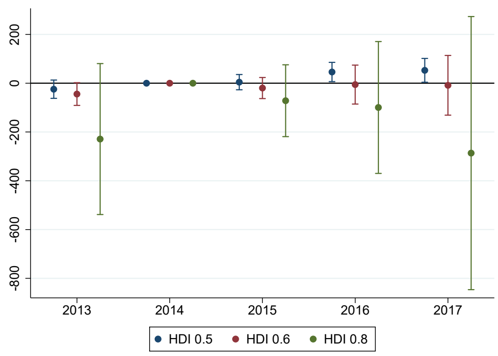
(c) Enrollment ($t = 2$)



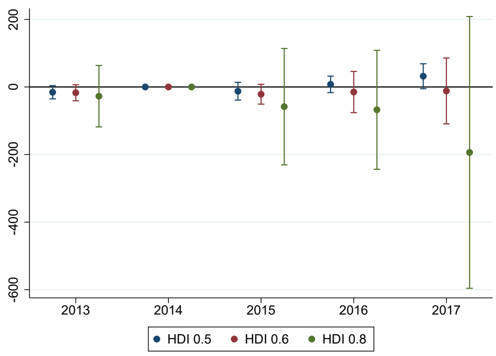
(d) Enrollment ($t = 3$)



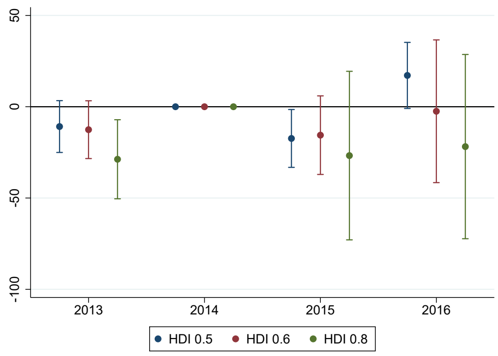
(e) Enrollment ($t = 4$)



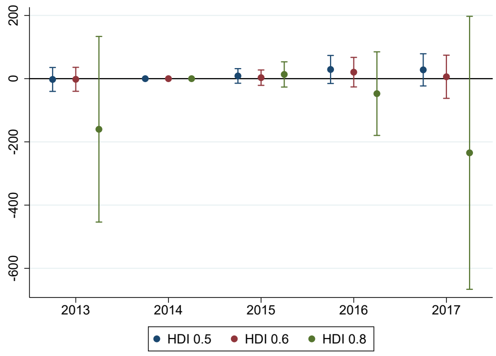
(f) Enrollment ($t = 5$)



(g) Enrollment ($t = 6$)



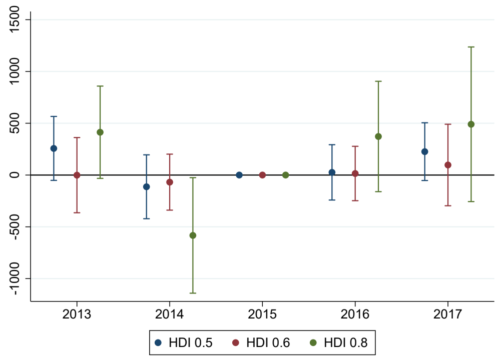
(h) Completion ($1 \leq t \leq 5$)



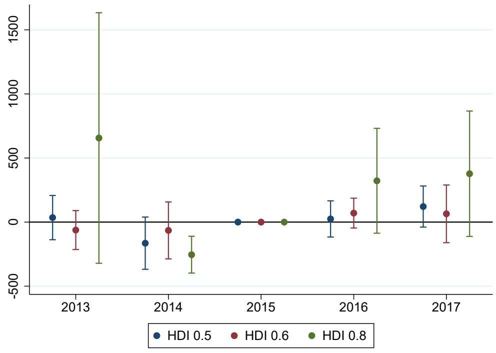
Note: Panel (a) to (h) present the event study estimation that measures the difference of admission, enrollment and completion levels of groups 0.5, 0.6 and 0.8, relative to group 0.7. For $t = 1$ variables, 2015 is the baseline year. For $t > 1$, we adopt 2014 as the baseline.

Figure 2.14: Event study for admissions, enrollment and completion for for-profit HEIs.

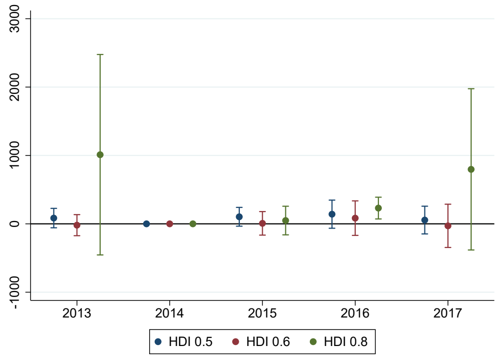
(a) Admissions



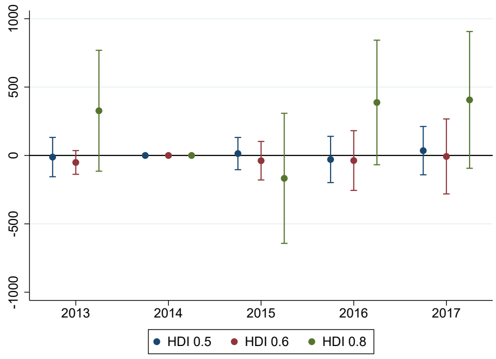
(b) Enrollment ($t = 1$)



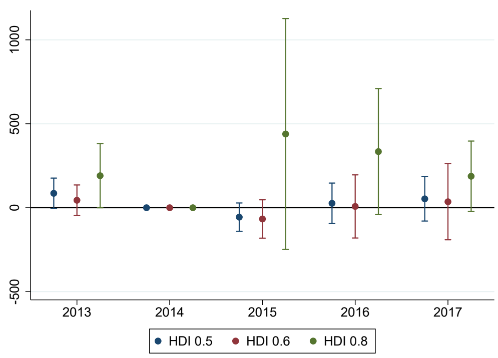
(c) Enrollment ($t = 2$)



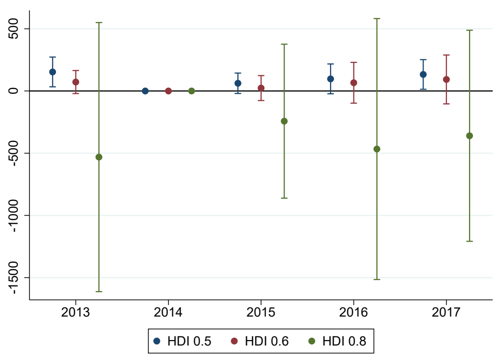
(d) Enrollment ($t = 3$)



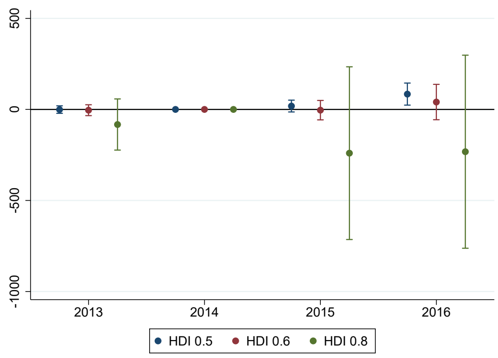
(e) Enrollment ($t = 4$)



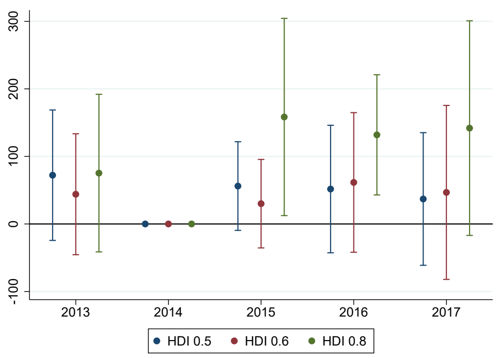
(f) Enrollment ($t = 5$)



(g) Enrollment ($t = 6$)

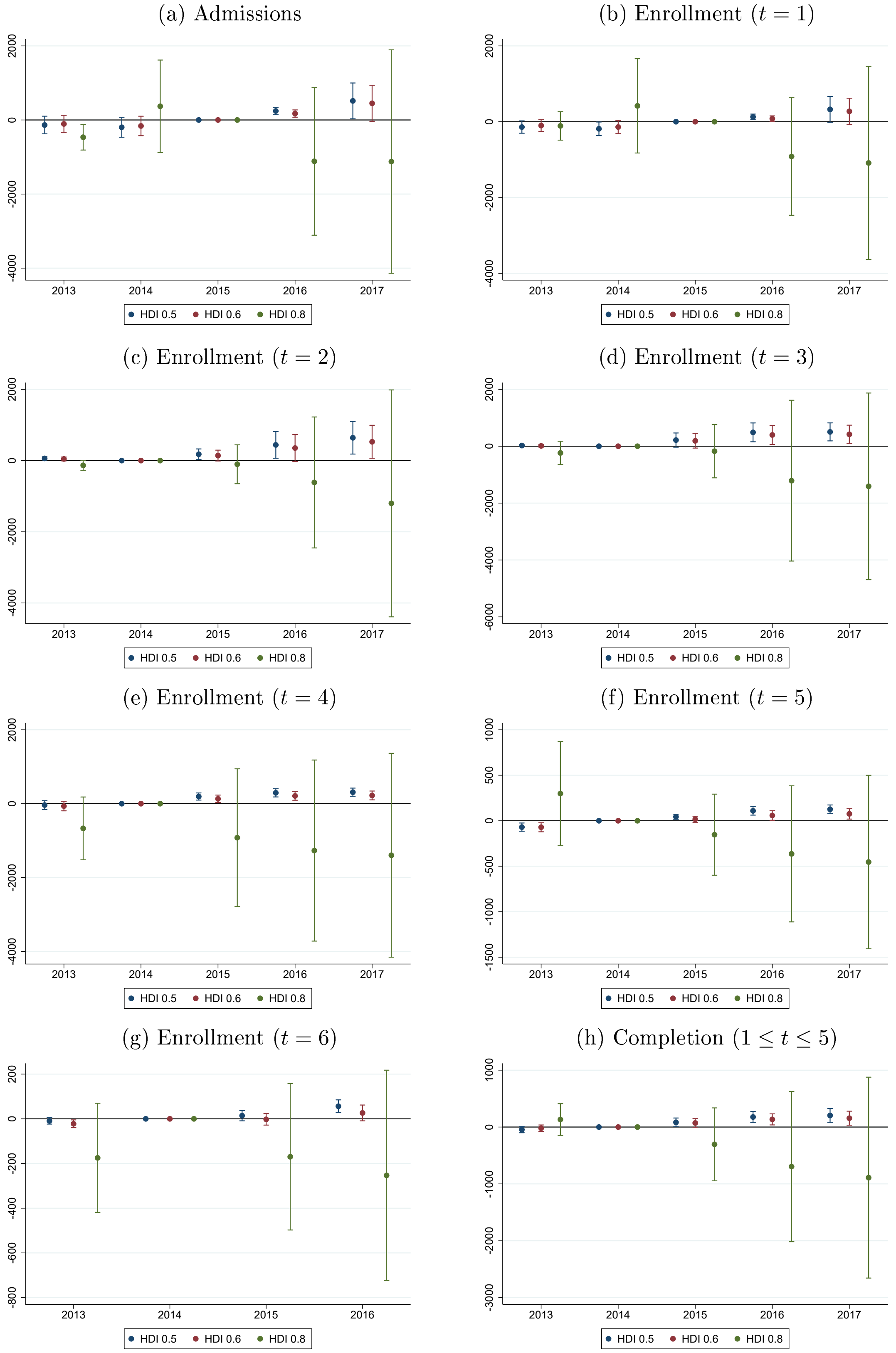


(h) Completion ($1 \leq t \leq 5$)



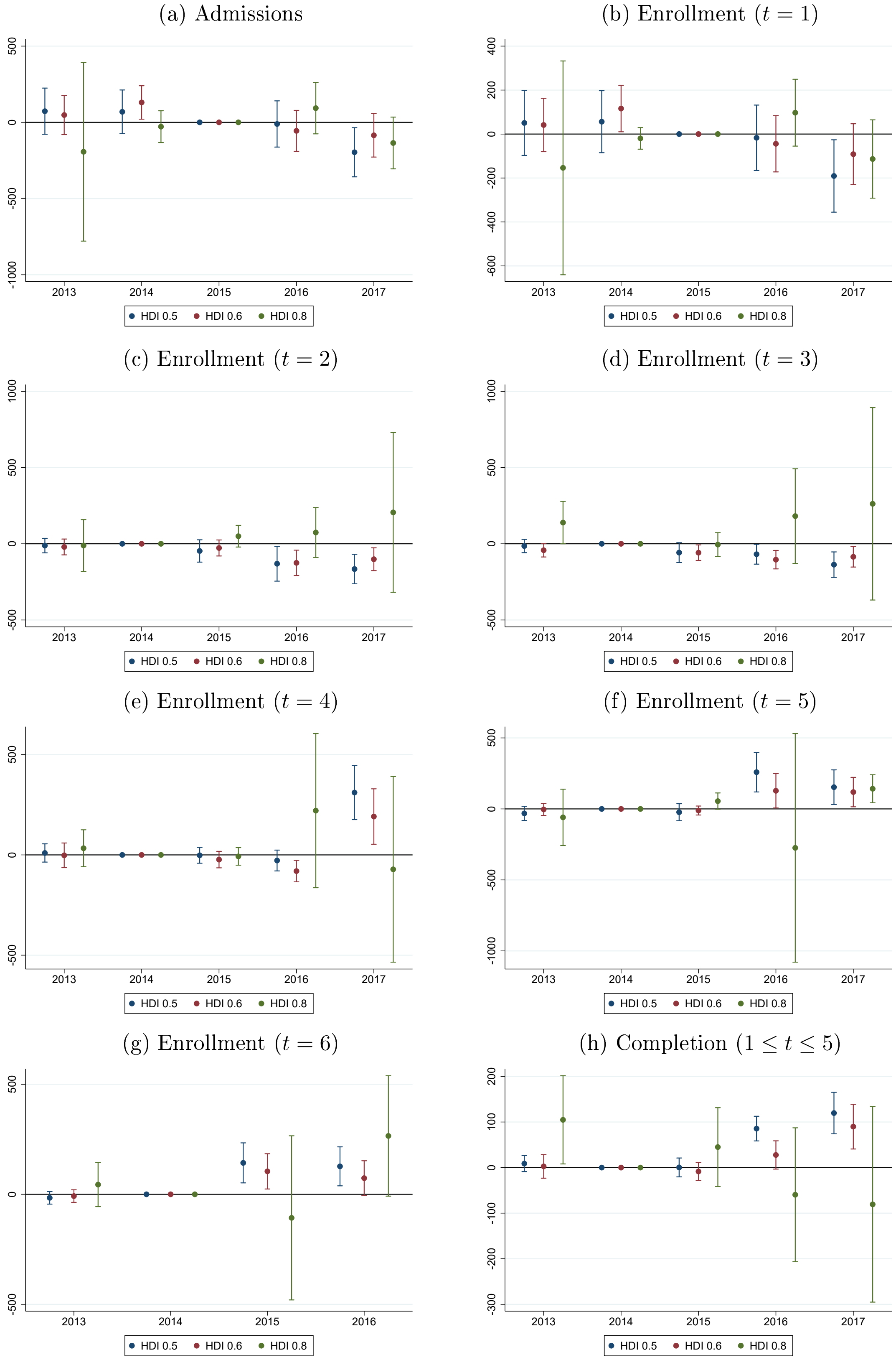
Note: Panel (a) to (h) present the event study estimation that measures the difference of admission, enrollment and completion levels of groups 0.5, 0.6 and 0.8, relative to group 0.7. For $t = 1$ variables, 2015 is the baseline year. For $t > 1$, we adopt 2014 as the baseline.

Figure 2.15: Event study for admissions, enrollment and completion for non-profit HEIs.



Note: Panel (a) to (h) present the event study estimation that measures the difference of admission, enrollment and completion levels of groups 0.5, 0.6 and 0.8, relative to group 0.7. For $t = 1$ variables, 2015 is the baseline year. For $t > 1$, we adopt 2014 as the baseline.

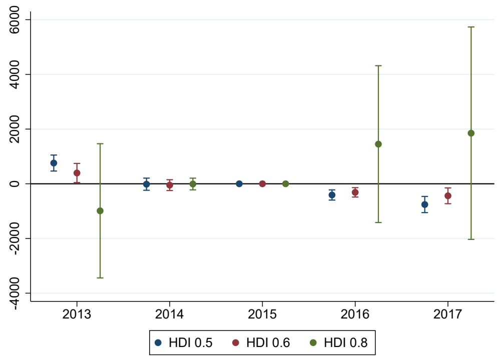
Figure 2.16: Event study for admissions, enrollment and completion in public universities.



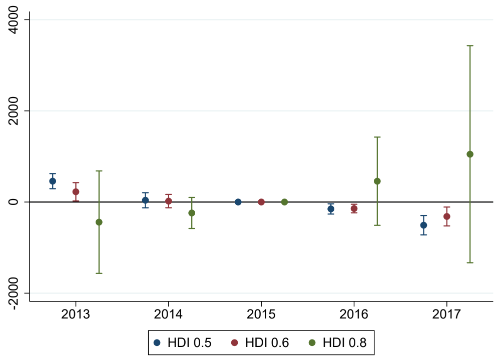
Note: Panel (a) to (h) present the event study estimation that measures the difference of admission, enrollment and completion levels of groups 0.5, 0.6 and 0.8, relative to group 0.7. For $t = 1$ variables, 2015 is the baseline year. For $t > 1$, we adopt 2014 as the baseline.

Figure 2.17: Event study for admissions, enrollment and completion in distance programs.

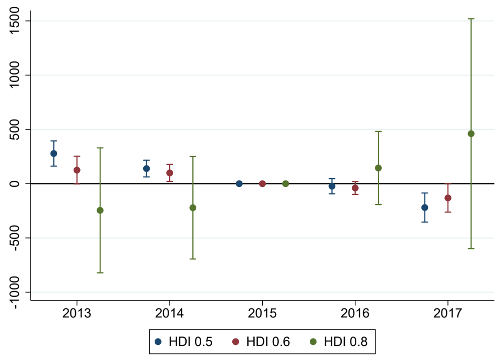
(a) Admissions



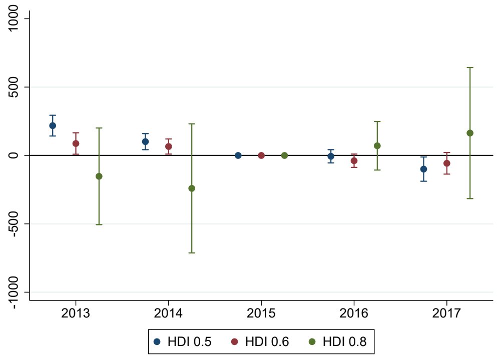
(b) Enrollment ($t = 1$)



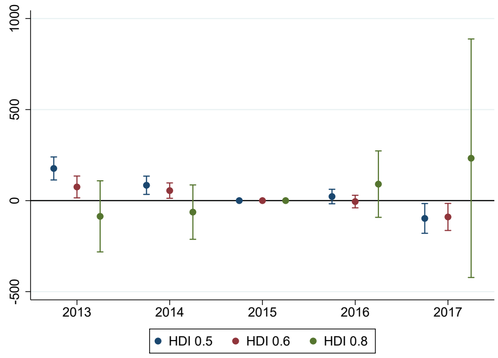
(c) Enrollment ($t = 2$)



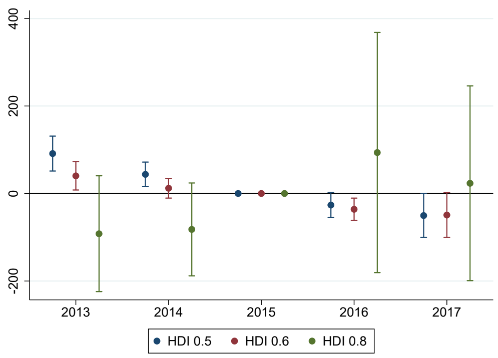
(d) Enrollment ($t = 3$)



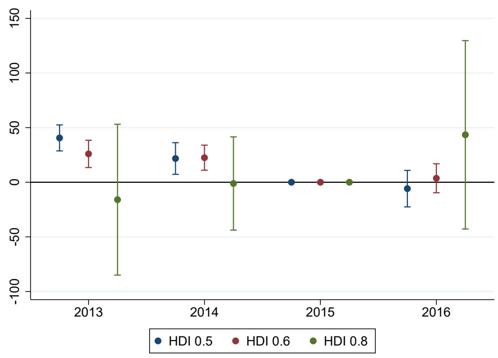
(e) Enrollment ($t = 4$)



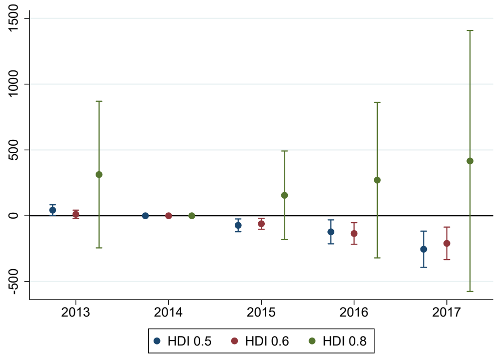
(f) Enrollment ($t = 5$)



(g) Enrollment ($t = 6$)



(h) Completion ($1 \leq t \leq 5$)



Note: Panel (a) to (h) present the event study estimation that measures the difference of admission, enrollment and completion levels of groups 0.5, 0.6 and 0.8, relative to group 0.7. For $t = 1$ variables, 2015 is the baseline year. For $t > 1$, we adopt 2014 as the baseline.

2.F Other results

Other sectors. Tables 2.15 to 2.17 present estimates of the effects of FIES on access to three other sectors of postsecondary education: fully online programs, public HEIs, and vocational education[37]. Public HEIs do not charge tuition and, therefore, do not participate in FIES. Fully online programs were not covered by FIES before 2022.

We observe that loans apparently do not affect enrollment in public higher education, with coefficients generally being not statistically significant and alternating signs. For distance higher education, effects appear to be negative, but usually not statistically significant. Remote degrees are typically more affordable than face-to-face education (Deming et al., 2015), but generally perceived as being of inferior quality, a notion supported by empirical evidence – see, for example, Xu and Jaggars (2013), Bettinger et al. (2017) and the literature reviewed in Dynarski et al. (2022)[38].

For vocational education, we also find seemingly negative effects for private institutions, but statistically significant only one case. It is important to note that the data for vocational education pertains to total enrollment, as we lack information on enrollment by year of entry. This limitation complicates the interpretation of the size of the effect. The evidence on how students change educational paths as a response to loans is very sparse. Bucarey et al. (2020) find, for the Chilean case, that loans induce students to forgo vocational educational in favor of universities, resulting in increased debt accumulation, despite similar labor market returns. Hence, further investigation is required to determine whether technical education would be

[37] We consider only postsecondary vocational educational enrollment.

[38] The evidence for "blended" learning (combining online and in-person instruction) tends to be more favorable (Dynarski et al., 2022).

are more promising path for these students.

Table 2.15: Effects on remote, public and vocational education – bandwidth 0.01.

Outcomes	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			Remote higher education			
Admissions	-0.105					
	(0.081)					
Enrollment	-0.092***	-0.051***	-0.046***	-0.046	-0.012*	-0.002
	(0.029)	(0.016)	(0.014)	(0.029)	(0.007)	(0.007)
Graduation	-0.001***	-0.004	-0.024***	-0.046*	-0.046**	-0.026
	(0.000)	(0.007)	(0.008)	(0.027)	(0.023)	(0.016)
N	180	180	180	180	180	144
			Public higher education			
Admissions	0.318					
	(0.461)					
Enrollment	0.241	0.016	0.345	0.538	0.570	1.344
	(0.381)	(0.257)	(0.403)	(0.342)	(0.487)	(2.660)
Graduation	-0.011	-0.024	-0.043	0.076	0.205	-0.716
	(0.009)	(0.021)	(0.034)	(0.154)	(0.231)	(1.747)
			Total enrollment in vocational education			
Public Inst.	0.048					
	(0.082)					
Private Inst.	-0.260***					
	(0.098)					
N	180					

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents loan impact estimates on remote higher education (top panel), public higher education (middle panel), and vocational education (bottom panel). For the top and middle panels, the outcomes are admissions, enrollment, and cumulative graduation, for years 1 to 6 since admission. The bottom panel presents estimates for the effect of loans on total enrollment at year t for public and private vocational educational institutions. We present effects on total enrollment due to the unavailability of data containing the year of admission in the case of vocational education. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff. For public education, we drop the outlier microregion of code 23016

Table 2.16: Effects on remote, public and vocational education – bandwidth 0.02.

Outcomes	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			Remote higher education			
Admissions	-0.089					
	(0.116)					
Enrollment	-0.061	-0.049*	-0.031*	0.004	-0.007	0.000
	(0.071)	(0.026)	(0.018)	(0.033)	(0.011)	(0.007)
Graduation	-0.001	-0.003	-0.013	-0.004	0.004	0.013
	(0.001)	(0.010)	(0.012)	(0.029)	(0.044)	(0.046)
N	427	427	427	427	427	336
			Public higher education			
Admissions	-0.057					
	(0.130)					
Enrollment	-0.055	-0.065	0.120	0.154	0.214	-0.025
	(0.110)	(0.094)	(0.138)	(0.108)	(0.131)	(0.073)
Graduation	-0.001	-0.006	-0.027**	0.032	0.083	-0.010
	(0.003)	(0.006)	(0.013)	(0.043)	(0.063)	(0.060)
			Total enrollment in vocational education			
Public Inst.	0.027					
	(0.064)					
Private Inst.	-0.342					
	(0.241)					
N	427					

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents loan impact estimates on remote higher education (top panel), public higher education (middle panel), and vocational education (bottom panel). For the top and middle panels, the outcomes are admissions, enrollment, and cumulative graduation, for years 1 to 6 since admission. The bottom panel presents estimates for the effect of loans on total enrollment at year t for public and private vocational educational institutions. We present effects on total enrollment due to the unavailability of data containing the year of admission in the case of vocational education. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff. For public education, we drop the outlier microregion of code 23016

Table 2.17: Effects on remote, public and vocational education – bandwidth 0.03.

Outcomes	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$	$t=6$
			Remote higher education			
Admissions	-0.128					
	(0.100)					
Enrollment	-0.072	-0.054**	-0.032*	-0.006	-0.010	-0.001
	(0.066)	(0.026)	(0.018)	(0.027)	(0.010)	(0.008)
Graduation	-0.001	-0.001	-0.008	0.000	0.005	0.030
	(0.001)	(0.012)	(0.016)	(0.030)	(0.041)	(0.055)
N	742	742	742	742	742	588
			Public higher education			
Admissions	-0.170*					
	(0.088)					
Enrollment	-0.146**	-0.147*	-0.047	0.038	0.053	-0.004
	(0.073)	(0.082)	(0.054)	(0.063)	(0.075)	(0.050)
Graduation	-0.004*	-0.005	-0.018**	0.005	0.033	0.011
	(0.002)	(0.003)	(0.008)	(0.017)	(0.030)	(0.040)
			Total enrollment in vocational education			
Public Inst.	-0.023					
	(0.044)					
Private Inst.	-0.231*					
	(0.138)					
N	742					

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents loan impact estimates on remote higher education (top panel), public higher education (middle panel), and vocational education (bottom panel). For the top and middle panels, the outcomes are admissions, enrollment, and cumulative graduation, for years 1 to 6 since admission. The bottom panel presents estimates for the effect of loans on total enrollment at year t for public and private vocational educational institutions. We present effects on total enrollment due to the unavailability of data containing the year of admission in the case of vocational education. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.18: Effects by type of secondary educational institution attended (public or private) – bandwidth 0.01.

Outcomes:	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$	$t=6$
			Public secondary education			
Admissions	0.105***					
	(0.034)					
Enrollment	0.108***	0.151***	0.201***	0.157***	0.112***	0.080***
	(0.028)	(0.031)	(0.033)	(0.019)	(0.010)	(0.009)
Graduation	-0.003*	-0.003	0.018***	0.030***	0.067***	0.103***
	(0.002)	(0.003)	(0.005)	(0.008)	(0.015)	(0.014)
Persistence	0.108***	0.149***	0.198***	0.175***	0.142***	0.134***
	(0.028)	(0.031)	(0.034)	(0.023)	(0.014)	(0.015)
N	180	144	144	144	144	107
Bandwidth	0.01	0.01	0.01	0.01	0.01	0.01
First Stage F	1.16	1.13	1.13	1.13	1.13	0.55
Prob > F	0.344	0.358	0.358	0.358	0.358	0.584
			Private secondary education			
Admissions	0.243***					
	(0.061)					
Enrollment	0.173***	0.158***	0.120***	0.084***	0.086***	0.053***
	(0.043)	(0.022)	(0.023)	(0.023)	(0.011)	(0.003)
Graduation	-0.001	0.002	0.007	0.006	0.022*	0.042***
	(0.001)	(0.004)	(0.007)	(0.009)	(0.013)	(0.008)
Persistence	0.173***	0.156***	0.122***	0.092***	0.092***	0.060***
	(0.043)	(0.023)	(0.026)	(0.029)	(0.016)	(0.008)
N	180	144	144	144	144	107
Bandwidth	0.01	0.01	0.01	0.01	0.01	0.01
First Stage F	1.16	1.13	1.13	1.13	1.13	0.55
Prob > F	0.344	0.358	0.358	0.358	0.358	0.584

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on admission, enrollment, cumulative graduation and persistence, from years 1 to 6 since admission, by type of secondary education institution attended by the student (public or private). Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.19: Effects by type of secondary educational institution attended (public or private) – bandwidth 0.02.

Outcomes:	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			Public secondary education			
Admissions	-0.019					
	(0.179)					
Enrollment	0.007	0.071	0.167***	0.153***	0.099***	0.083***
	(0.149)	(0.074)	(0.025)	(0.025)	(0.017)	(0.013)
Graduation	-0.001	-0.005	0.011	0.026**	0.059***	0.111***
	(0.002)	(0.005)	(0.007)	(0.011)	(0.013)	(0.014)
Persistence	0.007	0.072	0.162***	0.165***	0.125***	0.134***
	(0.149)	(0.072)	(0.027)	(0.025)	(0.018)	(0.023)
N	427	342	342	342	342	249
Bandwidth	0.02	0.02	0.02	0.02	0.02	0.02
First Stage F	9.12e+14	.	2.12e+14	3.29e+14	2.43e+14	.
Prob > F	0.000	.	0.000	0.000	0.000	.
			Private secondary education			
Admissions	0.324***					
	(0.082)					
Enrollment	0.245***	0.226***	0.167***	0.120***	0.105***	0.057***
	(0.067)	(0.063)	(0.039)	(0.028)	(0.025)	(0.010)
Graduation	-0.000	0.010*	0.024*	0.025**	0.048**	0.067***
	(0.001)	(0.006)	(0.012)	(0.012)	(0.020)	(0.025)
Persistence	0.245***	0.225***	0.177***	0.144***	0.131***	0.083***
	(0.067)	(0.063)	(0.044)	(0.038)	(0.035)	(0.024)
N	427	342	342	342	342	249
Bandwidth	0.02	0.02	0.02	0.02	0.02	0.02
First Stage F	9.12e+14	1.12e+16	.	.	1.89e+14	.
Prob > F	0.000	0.000	.	.	0.000	.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on admission, enrollment, cumulative graduation and persistence, from years 1 to 6 since admission, by type of secondary education institution attended by the student (public or private). Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.20: Effects by type of secondary educational institution attended (public or private) – bandwidth 0.03.

Outcomes:	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			Public secondary education			
Admissions	0.095					
	(0.080)					
Enrollment	0.101	0.123**	0.188***	0.166***	0.105***	0.086***
	(0.065)	(0.051)	(0.034)	(0.033)	(0.018)	(0.013)
Graduation	0.001	-0.008	0.012*	0.035**	0.081***	0.146***
	(0.003)	(0.007)	(0.007)	(0.016)	(0.031)	(0.037)
Persistence	0.101	0.126**	0.180***	0.178***	0.140***	0.169***
	(0.065)	(0.052)	(0.033)	(0.033)	(0.022)	(0.030)
N	742	594	594	594	594	440
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03
First Stage F	7.46	5.84	5.84	5.84	5.84	9.70
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
			Private secondary education			
Admissions	0.336***					
	(0.099)					
Enrollment	0.251***	0.206***	0.162***	0.118***	0.104***	0.053***
	(0.073)	(0.057)	(0.037)	(0.028)	(0.025)	(0.011)
Graduation	-0.001	0.007*	0.021**	0.022**	0.052**	0.065***
	(0.001)	(0.004)	(0.010)	(0.010)	(0.021)	(0.025)
Persistence	0.251***	0.205***	0.170***	0.139***	0.125***	0.078***
	(0.073)	(0.057)	(0.041)	(0.036)	(0.033)	(0.024)
N	742	594	594	594	594	440
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03
First Stage F	7.46	5.84	5.84	5.84	5.84	9.70
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on admission, enrollment, cumulative graduation and persistence, from years 1 to 6 since admission, by type of secondary education institution attended by the student (public or private). Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.21: Study shift (daytime or evening) – bandwidth 0.01.

Outcomes:	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$	$t=6$
			Classes during the day			
Admissions	0.043					
	(0.046)					
Enrollment	0.047	0.064***	0.082***	0.067***	0.072***	0.042***
	(0.039)	(0.012)	(0.006)	(0.013)	(0.005)	(0.006)
Graduation	-0.002**	-0.005***	-0.006*	-0.009**	0.013***	0.028***
	(0.001)	(0.002)	(0.003)	(0.004)	(0.005)	(0.004)
Persistence	0.047	0.062***	0.078***	0.061***	0.063***	0.036***
	(0.039)	(0.013)	(0.007)	(0.015)	(0.006)	(0.008)
N	180	144	144	144	144	107
Bandwidth	0.01	0.01	0.01	0.01	0.01	0.01
First Stage F	1.16	1.13	1.13	1.13	1.13	0.55
Prob > F	0.344	0.358	0.358	0.358	0.358	0.584
			Classes in the evening			
Admissions	0.305***					
	(0.053)					
Enrollment	0.234***	0.245***	0.239***	0.175***	0.127***	0.091***
	(0.038)	(0.030)	(0.025)	(0.012)	(0.010)	(0.004)
Graduation	-0.003	0.004	0.031***	0.045***	0.075***	0.117***
	(0.002)	(0.003)	(0.004)	(0.005)	(0.009)	(0.018)
Persistence	0.234***	0.243***	0.242***	0.206***	0.171***	0.158***
	(0.038)	(0.030)	(0.025)	(0.015)	(0.012)	(0.016)
N	180	144	144	144	144	107
Bandwidth	0.01	0.01	0.01	0.01	0.01	0.01
First Stage F	1.16	1.13	1.13	1.13	1.13	0.55
Prob > F	0.344	0.358	0.358	0.358	0.358	0.584

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on admissions, enrollment, cumulative graduation and persistence, from years 1 to 6 since admission, by the shift in which the courses are taught (evening or day). Graduation is cumulative. Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.22: Study shift (daytime or evening) – bandwidth 0.02.

Outcomes:	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			Classes during the day			
Admissions	0.084***					
	(0.031)					
Enrollment	0.092***	0.088***	0.109***	0.110***	0.099***	0.056***
	(0.022)	(0.020)	(0.027)	(0.040)	(0.032)	(0.011)
Graduation	-0.002	-0.004***	-0.006*	-0.007*	0.021	0.042**
	(0.001)	(0.002)	(0.003)	(0.004)	(0.014)	(0.017)
Persistence	0.092***	0.086***	0.104***	0.104***	0.092***	0.052***
	(0.022)	(0.019)	(0.026)	(0.038)	(0.031)	(0.014)
N	427	342	342	342	342	249
Bandwidth	0.02	0.02	0.02	0.02	0.02	0.02
First Stage F	9.12e+14	2.12e+14	.	.	.	.
Prob > F	0.000	0.000	.	.	.	.
			Classes in the evening			
Admissions	0.221**					
	(0.102)					
Enrollment	0.160*	0.210***	0.226***	0.163***	0.106***	0.084***
	(0.093)	(0.040)	(0.025)	(0.020)	(0.029)	(0.015)
Graduation	0.000	0.009	0.041***	0.058***	0.086***	0.137***
	(0.003)	(0.007)	(0.012)	(0.017)	(0.014)	(0.019)
Persistence	0.160*	0.211***	0.235***	0.204***	0.163***	0.165***
	(0.093)	(0.038)	(0.027)	(0.022)	(0.021)	(0.023)
N	427	342	342	342	342	249
Bandwidth	0.02	0.02	0.02	0.02	0.02	0.02
First Stage F	9.12e+14	2.12e+14	.	2.12e+14	2.12e+14	.
Prob > F	0.000	0.000	.	0.000	0.000	.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on admissions, enrollment, cumulative graduation and persistence, from years 1 to 6 since admission, by the shift in which the courses are taught (evening or day). Graduation is cumulative. Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.23: Study shift (daytime or evening) – bandwidth 0.03.

Outcomes:	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			Classes during the day			
Admissions	0.094**					
	(0.041)					
Enrollment	0.098***	0.077***	0.100***	0.096***	0.089***	0.050***
	(0.030)	(0.022)	(0.022)	(0.026)	(0.024)	(0.011)
Graduation	-0.002	-0.006*	-0.006	-0.011	0.020*	0.035***
	(0.002)	(0.003)	(0.004)	(0.007)	(0.011)	(0.013)
Persistence	0.098***	0.075***	0.094***	0.089***	0.079***	0.043***
	(0.030)	(0.021)	(0.020)	(0.024)	(0.020)	(0.013)
N	742	594	594	594	594	440
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03
First Stage F	7.46	5.84	5.84	5.84	5.84	9.70
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
			Classes in the evening			
Admissions	0.338***					
	(0.071)					
Enrollment	0.253***	0.253***	0.250***	0.188***	0.119***	0.088***
	(0.052)	(0.043)	(0.038)	(0.029)	(0.018)	(0.013)
Graduation	0.002	0.005	0.039***	0.067***	0.114***	0.176***
	(0.004)	(0.007)	(0.011)	(0.023)	(0.037)	(0.047)
Persistence	0.253***	0.256***	0.255***	0.228***	0.186***	0.204***
	(0.052)	(0.047)	(0.041)	(0.038)	(0.025)	(0.038)
N	742	594	594	594	594	440
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03
First Stage F	7.46	5.84	5.84	5.84	5.84	9.70
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on admissions, enrollment, cumulative graduation and persistence, from years 1 to 6 since admission, by the shift in which the courses are taught (evening or day). Graduation is cumulative. Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.24: Effects by type of HEI (for-profit or non-profit) – bandwidth 0.01.

Outcomes:	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$	$t=6$
			For-profit institutions			
Admissions	0.297***					
	(0.062)					
Enrollment	0.222***	0.225***	0.259***	0.190***	0.159***	0.102***
	(0.039)	(0.020)	(0.033)	(0.026)	(0.019)	(0.012)
Graduation	-0.006***	-0.005*	0.018***	0.029***	0.066***	0.103***
	(0.002)	(0.003)	(0.003)	(0.006)	(0.014)	(0.033)
Persistence	0.222***	0.219***	0.254***	0.208***	0.188***	0.140***
	(0.039)	(0.020)	(0.032)	(0.028)	(0.024)	(0.036)
N	180	144	144	144	144	107
Bandwidth	0.01	0.01	0.01	0.01	0.01	0.01
First Stage F	1.16	1.13	1.13	1.13	1.13	0.55
Prob > F	0.344	0.358	0.358	0.358	0.358	0.584
			Non-profit institutions			
Admissions	0.050					
	(0.035)					
Enrollment	0.059**	0.084***	0.062***	0.051**	0.040**	0.030***
	(0.025)	(0.022)	(0.019)	(0.021)	(0.017)	(0.008)
Graduation	0.001	0.004	0.007	0.008	0.023	0.042**
	(0.002)	(0.003)	(0.005)	(0.007)	(0.014)	(0.019)
Persistence	0.059**	0.086***	0.066***	0.058***	0.047**	0.054**
	(0.025)	(0.023)	(0.020)	(0.021)	(0.021)	(0.022)
N	180	144	144	144	144	107
Bandwidth	0.01	0.01	0.01	0.01	0.01	0.01
First Stage F	1.16	1.13	1.13	1.13	1.13	0.55
Prob > F	0.344	0.358	0.358	0.358	0.358	0.584

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on admission, enrollment, cumulative graduation and persistence, from years 1 to 6 since admission, by type of higher education institution (for-profit or non-profit). Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.25: Effects by type of HEI (for-profit or non-profit) – bandwidth 0.02.

Outcomes:	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$	$t=6$
			For-profit institutions			
Admissions	0.289***					
	(0.062)					
Enrollment	0.202***	0.228***	0.288***	0.231***	0.181***	0.117***
	(0.068)	(0.032)	(0.074)	(0.068)	(0.037)	(0.015)
Graduation	-0.003*	-0.006	0.021***	0.041***	0.093***	0.136***
	(0.002)	(0.004)	(0.006)	(0.015)	(0.034)	(0.030)
Persistence	0.202***	0.225***	0.282***	0.252***	0.222***	0.170***
	(0.068)	(0.032)	(0.071)	(0.072)	(0.050)	(0.032)
N	427	342	342	342	342	249
Bandwidth	0.02	0.02	0.02	0.02	0.02	0.02
First Stage F	9.12e+14	3.29e+14	2.12e+14	3.29e+14	1.89e+14	2.40e+15
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
			Non-profit institutions			
Admissions	0.016					
	(0.092)					
Enrollment	0.050	0.070*	0.046	0.042	0.024	0.024**
	(0.046)	(0.039)	(0.043)	(0.035)	(0.024)	(0.010)
Graduation	0.002	0.011	0.014	0.010	0.014	0.042
	(0.002)	(0.008)	(0.010)	(0.014)	(0.019)	(0.027)
Persistence	0.050	0.072*	0.057	0.056	0.034	0.047*
	(0.046)	(0.038)	(0.040)	(0.036)	(0.032)	(0.027)
N	427	342	342	342	342	249
Bandwidth	0.02	0.02	0.02	0.02	0.02	0.02
First Stage F	9.12e+14	1.89e+14	2.12e+14	1.89e+14	.	5.66e+14
Prob > F	0.000	0.000	0.000	0.000	.	0.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on admission, enrollment, cumulative graduation and persistence, from years 1 to 6 since admission, by type of higher education institution (for-profit or non-profit). Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.26: Effects by type of HEI (for-profit or non-profit) – bandwidth 0.03.

Outcomes:	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			For-profit institutions			
Admissions	0.305***					
	(0.094)					
Enrollment	0.216***	0.212***	0.245***	0.195***	0.156***	0.106***
	(0.075)	(0.055)	(0.071)	(0.066)	(0.042)	(0.022)
Graduation	-0.002	-0.010	0.011	0.026	0.081**	0.127***
	(0.001)	(0.008)	(0.013)	(0.016)	(0.033)	(0.040)
Persistence	0.216***	0.210***	0.235***	0.206***	0.182***	0.158***
	(0.075)	(0.055)	(0.072)	(0.074)	(0.056)	(0.046)
N	742	594	594	594	594	440
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03
First Stage F	7.46	5.84	5.84	5.84	5.84	9.70
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
			Non-profit institutions			
Admissions	0.127					
	(0.094)					
Enrollment	0.135	0.118*	0.105*	0.089*	0.053*	0.032**
	(0.084)	(0.064)	(0.061)	(0.051)	(0.027)	(0.013)
Graduation	0.002	0.010	0.022	0.030	0.053	0.084
	(0.003)	(0.008)	(0.017)	(0.028)	(0.043)	(0.057)
Persistence	0.135	0.121*	0.115*	0.111*	0.083	0.089*
	(0.084)	(0.066)	(0.065)	(0.065)	(0.052)	(0.054)
N	742	594	594	594	594	440
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03
First Stage F	7.46	5.84	5.84	5.84	5.84	9.70
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on admission, enrollment, cumulative graduation and persistence, from years 1 to 6 since admission, by type of higher education institution (for-profit or non-profit). Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.27: Effect on gender composition – bandwidth 0.01.

Outcomes:	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			Female minus male students			
Admissions	0.051					
	(0.031)					
Enrollment	0.020	0.074***	0.079***	0.035	0.034**	0.022
	(0.038)	(0.023)	(0.011)	(0.027)	(0.014)	(0.014)
Graduation	0.000	0.004	0.009***	0.002	0.005	0.007
	(0.002)	(0.002)	(0.003)	(0.005)	(0.015)	(0.027)
Persistence	0.020	0.074***	0.082***	0.044	0.035**	0.014
	(0.038)	(0.022)	(0.011)	(0.027)	(0.017)	(0.031)
N	180	180	180	180	180	144
Bandwidth	0.01	0.01	0.01	0.01	0.01	0.01

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on the of women in relation to men in admission, enrollment, cumulative graduation, and persistence, for years 1 to 6 since admission. The dependent variables are calculated as the number of women minus the number of men. Thus, a coefficient of 0.1, for example, implies that one extra loan increases female admissions by 0.1 relative to men. Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.28: Effect on gender composition – bandwidth 0.02.

Outcomes:	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			Female minus male students			
Admissions	0.113*					
	(0.058)					
Enrollment	0.081**	0.120***	0.091***	0.059***	0.052**	0.043***
	(0.040)	(0.042)	(0.018)	(0.018)	(0.023)	(0.015)
Graduation	-0.001	0.003	0.003	-0.007	0.008	0.025
	(0.001)	(0.003)	(0.008)	(0.017)	(0.018)	(0.019)
Persistence	0.081**	0.119***	0.095***	0.062***	0.046**	0.041**
	(0.040)	(0.042)	(0.018)	(0.019)	(0.018)	(0.020)
N	427	427	427	427	427	337
Bandwidth	0.02	0.02	0.02	0.02	0.02	0.02

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on the of women in relation to men in admission, enrollment, cumulative graduation, and persistence, for years 1 to 6 since admission. The dependent variables are calculated as the number of women minus the number of men. Thus, a coefficient of 0.1, for example, implies that one extra loan increases female admissions by 0.1 relative to men. Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.29: Effect on gender composition – bandwidth 0.03.

Outcomes:	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$	$t = 6$
			Female minus male students			
Admissions	0.142**					
	(0.072)					
Enrollment	0.112*	0.129***	0.104***	0.073***	0.052**	0.040**
	(0.058)	(0.046)	(0.023)	(0.023)	(0.023)	(0.016)
Graduation	0.001	0.004	0.007*	0.007	0.035*	0.059*
	(0.002)	(0.003)	(0.004)	(0.008)	(0.019)	(0.032)
Persistence	0.112*	0.130***	0.108***	0.080***	0.059***	0.076**
	(0.058)	(0.047)	(0.024)	(0.023)	(0.023)	(0.037)
N	742	742	742	742	742	591
Bandwidth	0.03	0.03	0.03	0.03	0.03	0.03

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans on the of women in relation to men in admission, enrollment, cumulative graduation, and persistence, for years 1 to 6 since admission. The dependent variables are calculated as the number of women minus the number of men. Thus, a coefficient of 0.1, for example, implies that one extra loan increases female admissions by 0.1 relative to men. Persistence in year T denotes the number of graduates in years $t < T$, along with those currently enrolled in year T. Robust standard errors, clustered by region of birth, are reported in parentheses. All regressions include region and year fixed effects and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.30: Effect on future ($t+1$) exam participation - bandwidth 0.01.

Dep .var:	Applicants	Takers	Score ≥ 450	HS Seniors	Past HS grad.
	$t+1$	$t+1$	$t+1$	$t+1$	$t+1$
Loans	2.887***	2.065***	1.445***	-0.035	1.093***
	(0.526)	(0.354)	(0.184)	(0.078)	(0.156)
			Effect on scores		
Dep. var.:	Writing	Reading	Natural Sc.	Humanities	Mathematics
Ano:	$t+1$	$t+1$	$t+1$	$t+1$	$t+1$
Loans	0.001	0.002	0.001	0.001	0.001
	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)
			Number of takers by score range		
Dep. var.:	Nota $\in [0, 450)$	$[450, 500)$	$[500, 550)$	$[550, 600)$	Nota ≥ 600
Ano:	$t+1$	$t+1$	$t+1$	$t+1$	$t+1$
Loans	0.549***	0.673***	0.544***	0.246***	0.053**
	(0.181)	(0.115)	(0.061)	(0.022)	(0.021)
N	180	180	180	180	180
Bandwidth	0.01	0.01	0.01	0.01	0.01

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Note: The table presents estimates of the effects of loans on future participation in ENEM, a high school exit exam required to apply for FIES loans. Students react to an increase in aid availability by increasing their participation in ENEM in the following year. Average scores are not affected. Robust standard errors in parenthesis, clustered by region. All regressions include region and year fixed effects, and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.31: Effect on future ($t+1$) exam participation - bandwidth 0.02.

Outcomes	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$	$t=6$
Loans	3.737***	2.637***	1.645***	-0.117	1.336***	
	(0.704)	(0.519)	(0.215)	(0.188)	(0.343)	
			Effect on scores			
Dep. var.:	Writing	Reading	Natural Sc.	Humanities	Mathematics	
Ano:	$t+1$	$t+1$	$t+1$	$t+1$	$t+1$	
Loans	0.002	0.002	0.002	0.002	0.001	
	(0.005)	(0.002)	(0.002)	(0.003)	(0.002)	
			Number of takers by score range			
Dep. var.:	Nota $\in [0, 450)$	$[450, 500)$	$[500, 550)$	$[550, 600)$	Nota ≥ 600	
Ano:	$t+1$	$t+1$	$t+1$	$t+1$	$t+1$	
Loans	0.854***	0.821***	0.656***	0.279***	0.028	
	(0.268)	(0.165)	(0.093)	(0.032)	(0.032)	
N	427	427	427	427	427	
Bandwidth	0.02	0.02	0.02	0.02	0.02	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Note: The table presents estimates of the effects of loans on future participation in ENEM, a high school exit exam required to apply for FIES loans. Students react to an increase in aid availability by increasing their participation in ENEM in the following year. Average scores are not affected. Robust standard errors in parenthesis, clustered by region. All regressions include region and year fixed effects, and first-order RD polynomials for each year and side of the closest cutoff.

Table 2.32: Effect on future ($t+1$) exam participation - bandwidth 0.03.

Dep .var:	Applicants	Takers	Score ≥ 450	HS Seniors	Past HS grad.
	$t+1$	$t+1$	$t+1$	$t+1$	$t+1$
Loans	3.806***	2.550***	1.454***	-0.152	1.346***
	(0.712)	(0.455)	(0.216)	(0.194)	(0.325)
			Effect on scores		
Dep. var.:	Writing	Reading	Natural Sc.	Humanities	Mathematics
Ano:	$t+1$	$t+1$	$t+1$	$t+1$	$t+1$
Loans	0.001	0.002	0.002	0.003	0.001
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
			Number of takers by score range		
Dep. var.:	Nota $\in [0,450)$	$[450,500)$	$[500,550)$	$[550,600)$	Nota ≥ 600
Ano:	$t+1$	$t+1$	$t+1$	$t+1$	$t+1$
Loans	0.943***	0.817***	0.589***	0.208***	-0.007
	(0.324)	(0.149)	(0.077)	(0.074)	(0.054)
N	742	742	742	742	742
Bandwidth	0.03	0.03	0.03	0.03	0.03

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the effects of loans on future participation in ENEM, a high school exit exam required to apply for FIES loans. Students react to an increase in aid availability by increasing their participation in ENEM in the following year. Average scores are not affected. Robust standard errors in parenthesis, clustered by region. All regressions include region and year fixed effects, and first-order RD polynomials for each year and side of the closest cutoff.

3. The impact of student loans on the behavior and finances of higher education institutions

3.1 Introduction

The rising cost of postsecondary education and its impact on student debt levels are pressing concerns in contemporary society. However, the rise in college prices is not a recent development, as noted in the classical paper of Baumol (1967). In his analysis, this trend is attributed to the absence of productivity growth in college teaching, leading tuition prices to outpace average inflation to compensate for productivity growth in the rest of the economy — a phenomenon known as the "Baumol Effect" or "Baumol's cost disease".

In response to this trend, governments around the world have expanded financial aid to students through grants and increasingly through student loans. In the United States, student loans now constitute nearly two-thirds of federal financial aid (Ma and Pender, 2022)[1]. However, despite the increased availability of grants and loans, some argue that tuition prices tend to "catch up" to aid, reducing or even neutralizing the effect of funding policies. This is known as the "Bennet hypothesis", which, unlike Baumol (1967), posits a causal effect of aid on tuition prices.

Private for-profit institutions are often pointed out as the "culprits" of this trend. Critics argue that these institutions prioritize profits over quality, charging higher tuition fees. On the other hand, some argue that they are more responsive to labor market demands, playing a significant role in workforce qualification, but the evidence on this subject is mixed (Cellini, 2021). It should also be noted that for-profit colleges usually serve a different student population, focusing on working adults, and offer flexible schedules to increase work-study compatibility. They also

[1] According to Ma and Pender (2022), federal grants accounted for \$39.6 billion and federal loans for \$88.7 billion in 2020/21.

target populations that receive government incentives to attend college, such as military personnel in the United States or school teachers in Brazil.

There is a growing body of evidence suggesting that for-profit institutions tend to increase tuition in response to more aid, but estimates vary widely. Moreover, research has yet to examine how these additional funds are spent. For instance, more funding may cause students to demand quality improvements, leading to higher costs and higher tuition prices. Therefore, raising tuition prices in response to more aid could not necessarily result from market inefficiency[2]. This paper sheds light on this subject by studying not only the effects of aid on revenue, but also how additional resources are allocated by Brazilian for-profit Higher Education Institutions (HEIs) across various expenditure categories and profits. To the best of our knowledge, this is the first paper to estimate in detail the effects of aid on HEI resource allocation.

Brazil provides a valuable context for examining the effects of student aid due to the size and diversity of its higher education system, which encompasses public, for-profit, and non-profit private institutions. This diversity is also reflected in the funding sources available, which include gratuity, grants, and loans. Brazil's higher education market is ranked as the fourth largest globally, with 8.7 million enrollments in 2018, following China, India, and the United States[3]. The private sector, including both for-profit and non-profit institutions, comprises nearly 80% of total higher education enrollment in Brazil. This substantial participation of the private sector in postsecondary education provision distinguishes Brazil from other countries (Lovenheim and Smith, 2022).

In this context, we investigate how Brazilian for-profit higher education institutions (HEIs) respond to the availability of government funding in the form of

[2]In addition, education differs from most markets because the consumer is also an input in production, as argued by Rothschild and White (1995). They show that, in this setting, efficient prices should discriminate based on net benefits of attending college, including peer effects. Thus, it may be optimal, for example, to charge higher prices from higher-income students and lower prices from students with higher ability. As a result, students who benefit from financial aid could end up paying higher prices due to cross-subsidization.

[3]According to World Bank data, available in `https://databank.worldbank.org/indicator/SE.TER.ENRL?id=c755d342&report_name=EdStats_Indicators_Report`.

student loans. The identification strategy relies on a reform of FIES, the main program for postsecondary education funding in Brazil, which introduced regional quotas for loans granted. The quotas depend on regional Human Development Index (HDI) values in a discontinuous way, allowing for a quasi-experimental design. Therefore, we employ a Difference-in-Discontinuities approach, leveraging both the policy change and the discontinuities introduced by the new loan allocation rule to study the effects of student aid on the resource allocation of for-profit HEIs[4].

We observe substantial effects of student loans on institutional revenue, with a \$0.73-\$0.78 increase in revenue for every \$1 in additional loan disbursements by the federal government. Interestingly, the effect is not driven by an increase in revenue per student, but rather by a rise in enrollment. Specifically, we find that each additional loan results in more than 2 additional students enrolling in the same institution.

We find that government aid to students is quite profitable for HEIs, with each \$1 in additional revenue contributing \$0.4 to profits (measured as revenue minus expenses)[5], while the remaining amount is allocated towards increased expenditures, particularly in the form of labor costs. Despite the increase in profits, our findings indicate that loans incentivize HEIs to enhance quality by hiring more permanent instructors with advanced credentials. We also find indicative evidence that these improvements not only enhance faculty qualifications but also result in increased institutional scores in the annual assessments conducted by the Ministry of Education.

We observe a significant markup size, with marginal revenue surpassing marginal costs by 64%. Furthermore, markups tend to be lower for lower quality HEIs, more selective HEIs, and HEIs that face competition from public universities in the same region. The finding of higher markups for *less* selective institutions is at odds with

[4]Recent papers employing this method include Grembi et al. (2016), Corbi et al. (2019), and Bennedsen et al. (2022).

[5]Our results indicate that profit margins also grow for institutions that are able to increase revenue.

the existing literature (Epple et al., 2019; Fillmore, 2023). However, this finding is consistent with peculiarities of the Brazilian market. In Brazil, selective private institutions face the competition of public universities, which are completely free of charge. Since all public universities are gratuitous, they tend to be very selective, implying that Brazil lacks non-selective public HEIs, resulting in less competition for non-selective private institutions.

This paper contributes to multiple strands of literature. Our initial analyses are related to the literature on the "Bennett hypothesis". However, unlike most papers in this literature, our focus is not on tuition prices but rather on institutional revenue. By doing so, we measure effects that are net of cross-subsidization. Secondly, we also contribute to the literature dedicated to examining outcomes for students attending for-profit HEIs – see Cellini (2021) for a recent review, in the context of the United States. Thirdly, this paper is also related to the educational accountability literature (Deming and Figlio, 2016), as we observe that the regulatory environment shapes incentives for resource allocation within HEIs.

This paper relates to a theoretical literature studying pricing behavior and market competition in higher education (Rothschild and White, 1995; Epple et al., 2006; Fu, 2014; Epple et al., 2017, 2019; Fillmore, 2023; Gordon and Hedlund, 2022). These studies stress the role of price discrimination based on characteristics such as income, ability, and minority status, but also the effects of funding on the behavior of HEIs.

Finally, this paper is also related to a incipient literature dedicated to measure the costs and productivity of HEIs (Altonji and Zimmerman, 2019; Hemelt et al., 2021). Hoxby (2019) measures the productivity of several institutions in the United States, finding that market forces induce an allocation of educational resources that is mostly efficient in the case of selective institutions. In other words, for these institutions, higher tuition costs tend to be accompanied by proportionally higher labor market returns. However, they are not able to determine if the same applies to non-selective institutions. In the Brazilian case, we find that non-selective institutions apparently face less competition, presenting higher markups, while more selective institutions present relatively low markups, also indicating that the higher education market is relatively efficient for this group.

The paper is organized as follows: Section 2 reviews the related literature. Section 3 provides a brief overview of the institutional characteristics of the higher education sector in Brazil. Section 4 outlines the empirical strategy and dataset construction. Section 5 presents the results of the empirical analysis. Finally, Section 6 concludes.

3.2 Related Literature

In many countries, the higher education sector encompasses public institutions as well as non-profit and for-profit private institutions. However, the role of for-profit institutions in higher education is often a subject of controversy. Several studies have examined the impact of attending a for-profit college on labor market outcomes (Deming et al., 2012; Darolia et al., 2015; Denice, 2015; Barr et al., 2021; Gurantz, 2022), with findings generally indicating comparable or poorer outcomes compared to students from other sectors (Cellini, 2021). The literature also examines the effect on student debt, often revealing higher levels of debt and a greater probability of default in the for-profit sector – see Looney and Yannelis (2015) and Armona et al. (2022), for example.

On the positive side, these institutions exhibit higher flexibility and typically experience growth when public and non-profit HEIs are unable to meet the increasing demand. For instance, Blair and Smetters (2021) emphasize that elite colleges in the US barely increased supply since 1970, while total college enrollment has more than doubled since then. They explain this phenomenon through a model where colleges compete in prestige, as measured by relative selectivity. This setting leads to an inefficient equilibrium in which non-profit colleges concentrate resources on improving academic standards but not in increasing supply. Although the authors do not explore this implication, the lack of expansion in elite colleges helps explain why low-quality HEIs often survive competition and even manage to expand faster than higher quality HEIs.

Given these differing incentives[6], it is natural to assume that aid should have varying effects for profit-maximizing institutions, relatively to non-profit and public institutions. The existing evidence, primarily focused on grants, points in this direction – see Cellini (2021), for example. Nevertheless, estimates on the percentage of aid captured by educational institutions vary widely, ranging from minimal to nearly complete crowding out.

Empirical literature. Long (2004) finds that colleges, mostly private, recouped around 30 percent of scholarship values, providing indicative evidence that some colleges increased tuition prices while reducing institutional aid. Baird et al. (2022) examines the effects of financial aid on tuition prices by leveraging changes in reimbursement rates of a program dedicated to funding postsecondary education for veterans in the United States. The study finds that a \$100 increase in disbursements led to a \$1 increase in tuition. Cellini and Goldin (2014) finds that for-profit schools eligible to receive federal aid charge significantly higher tuition than similar institutions that are not eligible for federal aid. Turner (2017), using a combined RD/RK approach, estimates that 11-20 percent of Pell Grant aid is passed through to schools. Turner (2012) finds that tax-based aid crowds out institutional aid almost completely. Lucca et al. (2019) find that increases in borrowing limits for subsidized and unsubsidized loans lead to a 60% and 20% increase in advertised tuition prices, respectively. Even for public universities, increases in the generosity of grant and loan programs seem to lead to higher tuition levels (Rizzo and Ehrenberg,

[6]Income-contingent loans, for example, may be unsuitable for financing education in for-profit institutions due to incentive distortions. Linking costs to future returns, for instance, could decrease the cost of low-quality education while reducing students' sensitivity to tuition prices, potentially contributing to higher markups and poorer outcomes.

2004).

For Brazil, De Mello and Duarte (2020) show that the expansion of FIES in the period 2009-2013 increased advertised tuition in eligible institutions by 4.7%, relative to institutions that were not part of the program.

Structural models. In addition to the empirical literature, there is a growing body of structural models seeking to represent the higher education market, and especially the price setting behavior of HEIs (Rothschild and White, 1995; Epple et al., 2006; Fu, 2014; Epple et al., 2017, 2019; Fillmore, 2023; Gordon and Hedlund, 2022).

Jones and Yang (2016) focus on the role of Baumol's cost disease in a model featuring skill biased technological change, which further increases the cost of teaching. They document that expenditure per student and net tuition has grown at the same rate as per capita GDP in the United States since the 1960s, while most of this growth seems to result from increasing instructional spending, especially in the form of higher wages.

Cai and Heathcote (2022) present a model featuring perfect competition in which colleges vary in quality. They show that increases in average income and income inequality can explain all the increase in average net tuition occurred since 1990 in the United States, with income inequality responding for more than 50% of the effect. Therefore, they present an alternative explanation for rising tuition prices based on richer students demanding more quality, which is also associated with more instructional spending.

Dobbin et al. (2022) investigate the equilibrium effect of loans on tuition costs, enrollment, and student welfare, calibrating their model to Brazilian data in order to analyze the impacts of FIES. They estimate that the program leads to a mere 1.6% increase in sticker price tuition compared to a counterfactual scenario with no loans. However, effective tuition prices are significantly higher with loans, as they find that the reduction in loans granted was followed by a drastic expansion in tuition discounts/institutional grants. While they cannot directly estimate the effect of loans on the number of grants, they document that degrees that were previously more dependent on federal loans showed a larger increase in grants after the downscale of FIES. Dobbin et al. (2022) also find that receiving loans reduces the price elasticity of demand for benefited students. However, they estimate that low-income students with loans are still more price-sensitive than higher-income students without loans, indicating that loans targeted to the former group could even lead to lower prices.

Gordon and Hedlund (2022) build a comprehensive model of the higher education market, encompassing imperfect competition, heterogeneous households, incomplete markets, peer effects, and price discrimination, in order to test competing demand-side and supply-side explanations of rising tuition prices. They find that multiple forces are important to explain higher education inflation during 1987-2010 in the United States. Expansion in student aid is found to be the main factor behind the increase in tuition, accounting for 46% to 57%, mostly coming from the expansion of borrowing limits. Baumol's cost disease accounts for 13% to 31% of the observed rise in tuition. Income growth is also an important factor, such as in Cai and Heathcote (2022), and so are the increasing returns to college. Importantly, they argue that pass-through rates of student loans expansion to net tuition are not unique, varying depending on the tightness of credit constraints, available funding sources, and eligibility criteria.

Epple et al. (2019) argue that colleges exploit idiosyncratic preferences by charging a premium to high-income students. Colleges then use these additional resources to cross-subsidize low-income, high-ability students and increase instructional expenditures. Therefore, particularly in a context where financial aid is relatively limited, colleges could treat aided students as "high income", thereby capturing a portion of financial aid.

Other. Kargar and Mann (2023) study is the closest to ours in the literature.

They also examine the effects of loans on revenue and expenditure of private HEIs, finding that both revenue and spending increase as a result of higher loan availability. They find a positive but not statistically significant effect of loans on institutional profits. However, our analysis differs from theirs as we study the effects on detailed expenditure categories and how increased spending relates to input utilization and outcomes in quality assessments. Moreover, Kargar and Mann (2023) take a different approach from the previous literature by studying the incidence of loan subsidies through the framework proposed by Weyl and Fabinger (2013). They estimate that, due to high markups, students capture less than 60 cents of each dollar spent by the government on loans.

On the other hand, the effects of higher tuition may not be all negative, especially depending on the starting point. In some cases, increased tuition has allowed institutions to expand their aid programs, effectively increasing the enrollment of low-income students. Andrews and Stange (2019) examine the effects of the deregulation of tuition prices in Texas public universities. They find that tuition prices increased substantially, but the enrollment of low-income students in higher-quality programs also increased due to the expansion in need-based aid and improvements in program quality. Another example where higher tuition resulted in increased enrollment and potentially improved program quality is the introduction of income-contingent loans in formerly tuition-free British universities, as studied by Murphy et al. (2019)[7]. All these cases refer, however, to public HEIs and, due to differing incentives, may not directly apply to private institutions.

Competition may also be an important factor. Deming et al. (2019) finds that online education increases competition, especially for private non-selective institutions. Additionally, public HEIs may also represent an important competitive pressure over private HEIs, as argued by Kargar and Mann (2023), although few studies

[7] Deming and Walters (2017) present the related finding that increasing spending is more effective than lowering tuition prices as a means of increasing postsecondary attainment in public universities.

have focused on this matter[8].

The effects of funding on prices may also depend on the regulatory environment and competition. Rezende (2010) and Machado et al. (2022) study accountability effects in the context of Brazilian higher education, finding that the assessments carried out by the Ministry of Education affect the behavior of HEIs. In particular, Machado et al. (2022) find that the threat of punishment induces Brazilian HEIs to improve quality standards.

Summing up. Despite the importance of empirical studies examining the effect of aid on tuition prices, they are usually unable to distinguish whether these effects arise from market power or increased demand for quality. The structural approach can differentiate the sources of rising prices, but different studies seem to point to different culprits[9]. Therefore, understanding how colleges allocate funds obtained from student loans can shed additional light on the "higher order" effects of financial aid.

As discussed by Rothschild and White (1995), education differs from most markets because the consumer is also an input in production. In this setting, efficient prices should discriminate based on net benefits of attending college, including peer and reputational effects. Thus, it may be optimal, for example, to charge higher prices from higher-income students and lower prices from higher-ability or minority students, if peers benefit from their presence. There is strong evidence of pricing by income, ability, and minority status (Epple et al., 2019)[10].

In summary, HEIs compete in prices and quality/reputation. This competition takes place within a context of diverse institutional objectives, with some institutions

[8] Jardim (2023) estimate an empirical model of demand for higher education in Brazil, finding that, in the absence of public HEIs, tuitions in the private sector would be 7 percent higher.

[9] It should also be noted that most models evaluate specific channels, accounting just for one or two possible causes of rising tuition prices, with Gordon and Hedlund (2022) being an exception, as their model tests simultaneously many of the channels mentioned in the literature.

[10] Charging higher tuition from international students (Bound et al., 2020) or out-of-state students (Knight and Schiff, 2019) is also a widely adopted form of cross-subsidization in American public research universities. However, these forms of price discrimination are unlikely to be efficient.

maximizing profits while others prioritize alternative outcomes such as quality, reputation, or research output. Quality and reputation are influenced by per-student expenditure and the average ability of the student body. Price discrimination is widespread, particularly in terms of income, ability, and minority status. HEIs possess considerable market power, which is expected to be greater for higher quality and more selective HEIs, but lower for those facing more competition.

In this context, the impact of financial aid on institutional behavior can vary depending on student and institutional characteristics, which could account for the large discrepancy in estimates found in the literature regarding the percentage of aid captured by institutions. In addition, students who receive financial aid may be less price sensitive, thereby increasing the market power of HEIs, but this effect may be dampened if loan policies are properly targeted to lower-income students. Receiving financial aid impacts not only one's own tuition prices but also the prices paid by other students, given the prevalence of cross-subsidization in higher education markets. Additionally, the effects of financial aid may also vary depending on whether it is merit-based or means-tested, since institutions also tend to charge lower prices to high-ability students.

3.3 Background

Brazil is characterized by a large private higher education sector, which represented 75.5% of enrollment in on-campus degree-granting institutions in 2017. The for-profit sector is notably large compared to other countries, accounting for 43.4% of total enrollment in the same year. The expansion of private institutions occurred primarily after 1997, following the legal recognition of the for-profit status (Kinser and Levy, 2007). Since then, the private sector as a whole has shown consistent growth, after two decades of stagnant college admissions relative to population size. The trend of higher growth in online programs offered by for-profit institutions is also observed in Brazil (Deming et al., 2012)[11].

Figure 3.1 presents the evolution of total enrollment in on-campus private post-secondary education during 2010-2018, decomposed by whether the student is a FIES beneficiary – panel (a) – and by institution type – panel (b). FIES exhibited a substantial increase in participation during 2010-2015 but decreased afterwards. For-profit HEIs showed increasing enrollment throughout the whole period, while non-profit HEIs displayed relatively constant enrollment during 2010-2015, followed by a decrease in 2015-2018.

In the United States, tuition fees at for-profit HEIs are generally regarded as high, particularly when compared to those of public community colleges (Cellini, 2021). In Brazil, public universities are fully subsidized, while average tuition fees are slightly higher in non-profit institutions compared to for-profit institutions. (as can be seen in Table 3.11 in Appendix 3.B). For-profit and non-profit institutions also exhibit similar average quality scores in assessments conducted by the Ministry of Education. Program cutoff scores in FIES are, on average, slightly lower in for-profit institutions when compared to non-profit institutions, although the difference is not substantial, especially when compared to public universities (see Figure 3.4 in Appendix 3.B). This indicates that, on average, non-profit HEIs are slightly higher quality and slightly more expensive than for-profit HEis in Brazil. On the other hand, students attending for-profit institutions in Brazil tend to be lower income, older and more likely to be part of a minority group[12].

Hence, in Brazil, the distinctions between the non-profit and the for-profit sectors are not as pronounced as in the case of the US[13]. Another important distinction between both countries is that Brazil lacks non-selective public institutions (all public HEIs are research-oriented and very selective), which could result in for-profit

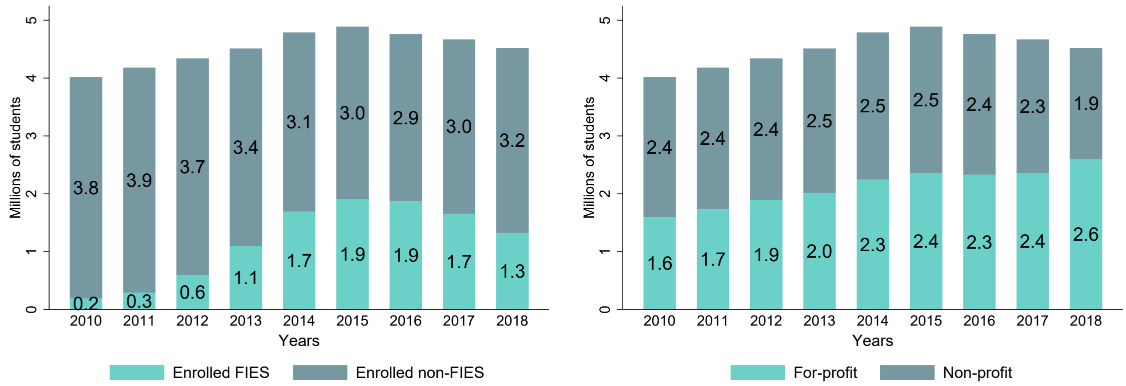
[11] Salto (2018) provides an overview of the for-profit higher education sector in Brazil.

[12] The only exception are federal public universities, which have the highest percentage of minority students due to affirmative action in the form of admission quotas by race. Lower income is proxied by attending a public high school.

HEIs facing less competition.

Figure 3.1: Evolution of total enrollment in on-campus postsecondary education in private HEIs, 2010-2018 – millions.

(a) FIES and non-FIES beneficiaries. (b) For-Profit and Non-Profit HEIs.



Note: Panel (a) displays enrollment figures for FIES beneficiaries and non-FIES beneficiaries. Panel (b) presents enrollment figures for For-Profit and Non-Profit HEIs. *Data sources*: Ministério da Fazenda (2017), Brasil (2020) and the Higher Education Census (INEP).

3.4 Data and empirical strategy

Our identification strategy relies on the introduction of regional quotas for FIES loans. Prior to 2011, FIES loans required students to provide a guarantor with sufficient income to cover potential defaults. However, in that year, the federal government established a guarantor fund (FGEDUC), which replaced the need for a personal guarantor. As a result, the program experienced rapid expansion, particularly benefiting lower-income students who were previously limited by the guarantor requirement (Brasil, 2020). During this period, there were no restrictions on the number of approved FIES loans, and all qualified applicants received funding.

[13] Although this similarity could be partly attributed to non-profit institutions behaving similarly to for-profit ones. In Brazil, the fundamental distinction between for-profit and non-profit HEIs is that the latter are exempt from certain federal taxes but cannot pay dividends to shareholders. Consequently, growth-focused institutions could choose to operate in the non-profit sector, as they are more likely to reinvest profits rather than distributing dividends.

However, due to a fiscal crisis and high default rates, the Brazilian government implemented a nationwide limit on loan approvals, along with loan quotas for each region of the country, starting in 2016. These quotas were established at the level of "microregions" (*microrregiões*), which consist, on average, to a group of about 10 municipalities, usually within driving distance of each other[14]. For brevity, from now on, we use the terms microregion and region interchangeably.

The allocation of loans to each region is determined by an relative demand index and by weights based on ranges of regional Human Development Index (HDI) values. Regions with lower levels of development were assigned higher weights, but these weights vary discontinuously with HDI values, as shown in Table 3.1. This setting enables the comparison of regions that were affected differently by the reform. Appendix 3.A presents a brief description of the allocation rule, while Ávila and Terra (2024b) provide a more detailed analysis of the reform and its effects, using a similar identification strategy to measure the effect of loans on higher education enrollment and completion.

Table 3.1: Microregion weights and HDI ranges

HDI Level	HDI Range	Weights
Low	0.500 to 0.599	1.2
Middle	0.600 to 0.699	1.1
High	0.700 to 0.799	0.9
Very high	0.800 to 1	0.7

Data sources: Ministry of Education *Portarias* of number 13/2015, 9/2016, 25/2016, and 12/2017. The table shows weight values assigned to each HDI range.

The reform was implemented in two stages. The limitation on the number of loans started in the second semester of 2015, while the regional allocation rule, central to our analysis, began in the first semester of 2016. Following Ávila and

[14] It is important to note that microregions do not serve as administrative or political divisions, but rather represent regional classifications established by the Brazilian Institute of Geography and Statistics (IBGE).

Terra (2024b), our investigation focuses on the period 2013-2017, using the 2016 reform, as well as the discontinuous rule, to identify the effects of funding on HEI finances and behavior. Our specification for the first stage is:

$$FS : F_{it} = \alpha_0 + \beta Z_Y^j + P'_{bt}(HDI_m) + \eta'_i + \iota'_t \tag{3.1}$$

where F_{it} is the number of FIES loans received by students attending the institution i in year t; α_0 is the intercept; Z_Y^j are the (excluded) instruments; $P'_{bt}(HDI_m)$ is a set of first-order RD polynomials of the distance to the closest cutoff, one for each combination of year t and side of the closest cutoff b; η'_i are institution fixed effects; and ι'_t are year fixed effects.

Our baseline specification for the second stage is:

$$FS : R_{it} = \alpha_1 + \tau \hat{F}_{it} + P_{bt}(HDI_m) + \eta_i + \iota_t \tag{3.2}$$

where α_1 is the intercept, F_{it} is the number of loans predicted by the first stage; P_{bt} is a set of first-order RD polynomials of the distance to the closest cutoff, one for each combination of year t and side b of the closest cutoff; η_i are institution fixed effects; and ι_t are year fixed effects.

At the regional level, the number of loans granted is determined by FIES rules, which underwent changes in 2016. The allocation rule assigns a maximum number of loans to be granted in region m. This value is further divided by major/degree area and by quality of the program in assessments carried out by the Ministry of Education[15]. We define the excluded instruments Z_{mt} as:

$$Z_Y^j = \begin{cases} 1, & \text{if t} = Y \text{ and } HDI = j \\ 0, & \text{otherwise} \end{cases} \tag{3.3}$$

[15] Quality levels are categorized as 5, 4, 3, or "none" for new programs undergoing evaluation. Programs that receive a score below 3 are ineligible for loans.

where $j \in \{[0.5, 0.6), [0.6, 0.7), [0.7, 0.8), [0.8, 0.9)\}$ are the HDI_m ranges and $Y \in \{2016, 2017\}$ refer to the treated years.

In the second semester of 2015 only, an temporary rule was in effect, which consisted in allocating 55% of loans to the North (NO), Northeast (NE), and Center-West (CO) regions of Brazil (except the federal capital, Brasília), while the remaining 45% was allocated to the South and Southeast regions, plus Brasília[16]. Hence, we also include a dummy variable that is equal to 1 if the year is 2015 and the regions are North (NO), Northeast (NE), or Center-West (CO), and 0 otherwise. The inclusion of this control does not qualitatively affect the results.

Our setup is similar to Ávila and Terra (2024b), but there are two main differences. Firstly, we estimate the effects at the HEI level, whereas their analysis is conducted at the regional level. Secondly, our explanatory variables are total loans and total disbursements, whereas they focus on the effects of new loans (loans granted in a given year) and disbursements from new loans.

Data: To examine the financial effects of FIES on HEIs, we rely on two primary data sources. The first data source is the Brazilian Census of Higher Education for the years 2013 to 2017, compiled by the *Instituto Nacional de Estudos e Pesquisas Educacionais* (INEP). This dataset provides information on students and HEIs, including data on revenue, expenditures, enrollment, and faculty characteristics. The second data source, provided by the *Fundo Nacional de Desenvolvimento da Educação* (FNDE), includes information on FIES recipients and granted loans, such as tuition cost and program attended.

The raw data covers degree-granting private HEIs, providing on-campus education, ranging from 2,085 institutions with 4.37 million enrollments in 2013 to 2,147 institutions and 4.65 million enrollments in 2017. The participation of for-profit and non-profit institutions in enrollments is fairly similar throughout the period, as show by Figure 3.1. Institutions focused on vocational and technical education are not

[16]Previously the latter regions received around 60% of total loans, according to FNDE (2015).

included in the analysis. Public universities are also excluded since they generally do not charge tuition or fees, and thus are not part of FIES. Appendix 3.B details the construction of the dataset.

The revenue data includes own revenue, transfers from the government, and other revenue, while expenditure data provide a detailed breakdown of expenses, including teaching and non-teaching staff salaries and benefits, other running costs, investments, research, and other expenses. Throughout the paper, we refer to the difference between revenue and expenses as "profits". However, it should be noted that the data is self-reported and may not necessarily coincide with the financial statements of the HEIs. The profit margin is calculated in the typical manner, as the share of profits over revenue.

As is often required with self-reported data, we drop observations with extreme values by trimming based on revenue, expenditure, and the discrepancy between them. Specifically, we exclude observations that fall under at least one of the following cases: revenue or expenditure below R$ 500,000 (in 2022 prices)[17]; revenue or expenditure above R$ 100,000,000 (in 2022 prices)[18]; profit margins below the 5th percentile or above the 95th percentile. All financial variables are expressed in thousands of Brazilian *reais* – except otherwise stated – and converted to July 2022 prices using the official Consumer Price Index (IPCA), provided by the *Instituto Brasileiro de Geografia e Estatística* (IBGE).

Table 3.2 presents the descriptive statistics of the main variables in the paper. On average, institutions generate revenue of approximately R$ 18.2 million, mostly from operating revenue. Personnel costs account for more than half of total expenditure, but other running expenses are also significant. Average loan disbursement per institution exceeds R$ 8 million but exhibits substantial variation. Research

[17]R$ (*Reais*) is the symbol for the Brazilian currency.

[18]Some larger institutions do have revenues greater than this amount. However, excluding them prevents the results from being influenced by a small number of very large HEIs. Given the average revenue per student of 12,264 *reais* in the sample, a revenue of 100 milliion would correspond to an institution with 8,154 students.

expenditure is limited, as most private institutions, particularly for-profit ones, are not research-oriented[19].

Table 3.2: Summary statistics – 2013-2017.

	Mean	SD	Min	Max	N
Financial variables (values in R$ 1,000)					
Revenue	18,833	21,816	508	99,972	5,211
Operating	17,612	20,787	0	99,972	5,211
Transfers	196	1,142	0	25,886	5,211
Other revenue	1,025	2,689	0	41,872	5,211
Expenditure	15,932	18,705	500	99,070	5,211
Personnel	9,285	10,892	0	74,101	5,211
Faculty	4,654	5,665	0	40,786	5,211
Other staff	2,041	2,669	0	21,472	5,211
Benefits	2,590	3,439	0	31,637	5,211
Running expenses	3,373	5,565	0	60,066	5,211
Investments	1,002	2,535	0	42,553	5,211
Research	188	661	0	21,308	5,211
Other expenses	2,083	4,292	0	49,339	5,211
Earnings	2,902	6,363	-18,416	55,868	5,211
Earnings margin (%)	12.6	18.4	-36.3	57.1	5,211
For-profit	16.4	18.8	-36.2	57.1	2,749
Non-profit	8.3	17.0	-36.3	57.0	2,462
FIES variables					
Loans	334	512	0	4,164	5,211
Disbursement (R$ 1,000)	9,228	15,239	0	163,039	5,211

Note: all monetary variables are in 2022 prices. *Data source*: Higher Education Census and FNDE (*National Educational Development Foundation*).

As expected, average profit margins are higher in the for-profit sector (16.4% versus 8.3%). For comparison, the five HEIs listed on the Brazilian Stock Exchange had an average EBITDA margin of approximately 24% in the period of 2012-2017, significantly exceeding the observed sample mean[20].

[19] In 2017, only 12.7% of faculty in for-profit HEIs and 14.7% in non-profit HEIs reported engagement in research.

[20] According to calculations by the authors based on public financial statements. We compare with EBITDA margin because we are not sure if interest, taxes and depreciation is included by the HEIs in “other expenses”.

Table 3.3 presents the evolution of profit margins over time, as well as the estimated percentage of institutional revenue derived from FIES. These percentages capture most of HEIs' dependency on federal aid[21]. However, it is important to note that federal scholarship programs (PROUNI and CEBAS) operate through tax benefits, and specific values per HEI are not publicly available due to tax confidentiality.

Table 3.3: Dependency on FIES and institutional profitability – average by year and sector.

	Disbursement/revenue (%)			Earnings margin (%)		
Years	All	For-profit	Non-profit	All	For-profit	Non-profit
2013	23.65	29.16	18.21	12.34	15.79	8.53
2014	33.53	40.94	26.72	12.92	16.67	8.82
2015	33.88	39.55	28.19	12.96	17.00	8.31
2016	34.83	40.75	29.15	12.56	16.43	8.23
2017	29.47	35.32	23.38	12.22	16.27	7.66

Note: The table presents annual averages of the percentage of revenue derived from FIES and earnings margin across different HEI sectors. *Data source*: Higher Education Census and FNDE (National Educational Development Foundation).

3.5 Results

3.5.1 Effects on financial variables

Table 3.6 presents the effects of loans on total revenue and revenue components for HEIs in the for-profit sector. We present results for three different models: Difference-in-Differences (DD), including all observations, and Difference-in-Discontinuities (RD) estimates, for bandwidths of sizes 0.01 and 0.02. Each additional loan granted to attending students is associated with an annual increase of 19,420-23,719 *reais* in total revenue. This effect slightly surpasses the average tuition covered by FIES over the period, which ranged from R$ 15,000 to R$ 18,000 per

[21] In the United States, for example, 70% of the revenue of for-profit colleges comes from federal student aid (Cellini and Koedel, 2017).

year, as shown in Table 3.11 in the Appendix. As expected, this effect results from an increase in operating revenue. When disbursement is used as the instrumented explanatory variable, we observe that each \$1 in additional loan disbursement increases revenue by \$0.73-0.78.

Table 3.5 examines the channels through which loans affect institutional revenues. The number of vacancies and program applicants are not significantly affected by the number of loans or disbursement values. However, we observe a substantial effect of loans on on-campus enrollment. Surprisingly, each additional loan increases total enrollment by approximately 2.3 students, indicating a more than proportional effect.

This outcome is likely a combination of two factors: firstly, institutions with more loans may attract more students due to increased investment or lower prices, and secondly, programs receiving fewer loans may face closure, prompting students to transfer to other institutions. In this context, for Regression Discontinuity (RD) estimates, we also observe a small effect of FIES loans on online enrollment, despite the program not covering online education at the time. Therefore, this positive impact is consistent with the idea the institutions receiving more loans can attract more students.

Revenue per student remains unaffected by loans, whether considering all students or only on-campus enrollments. It should be noted, however, that, aside from the loan allocation rules, FIES is a merit-based program. As a consequence, high-achieving students, who are more likely to apply to higher-cost programs, would qualify for the loan even in a more restrictive situation. Thus, an expansion in aid would benefit students with lower scores, who would be more likely to enroll in cheaper programs. Consequently, we could expect revenue per student to decline when more loans are granted. The absence of this decline could suggest that this effect is being counteracted by raising tuition prices.

Table 3.4: Effect on revenue and components – for-profit institutions.

	Revenue			Operating			Transfers			Other		
Model	DD	RD		DD	RD		DD	RD		DD	RD	
Bandwidth	No	0.01	0.02	No	0.01	0.02	No	0.01	0.02	No	0.01	0.02
Loans	20.741***	20.321***	20.303***	20.145***	17.376***	20.691***	-0.933	-0.339**	-1.241**	1.530*	3.284*	0.854
	(5.041)	(5.217)	(4.282)	(5.100)	(3.697)	(3.768)	(0.935)	(0.137)	(0.574)	(0.906)	(1.978)	(1.030)
N	3198	423	817	3198	423	817	3198	423	817	3198	423	817
First-stage F	25.91	1.33	3.69	25.91	1.33	3.69	25.91	1.33	3.69	25.91	1.33	3.69
Prob > F	0.000	0.287	0.010	0.000	0.287	0.010	0.000	0.287	0.010	0.000	0.287	0.010
Disbursement	0.782***	0.732***	0.745***	0.776***	0.629***	0.767***	-0.039	-0.014**	-0.047**	0.045	0.117	0.025
	(0.163)	(0.165)	(0.158)	(0.167)	(0.104)	(0.138)	(0.036)	(0.006)	(0.022)	(0.032)	(0.074)	(0.039)
N	3198	423	817	3198	423	817	3198	423	817	3198	423	817
First-stage F	23.48	2.94	4.56	23.48	2.94	4.56	23.48	2.94	4.56	23.48	2.94	4.56
Prob > F	0.000	0.042	0.003	0.000	0.042	0.003	0.000	0.042	0.003	0.000	0.042	0.003

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents Difference-in-Differences (DD) and Difference-in-Discontinuities (RD) estimates, for bandwidths of size 0.01 and 0.02, of the impact of loans and loan disbursement on total revenue, operating revenue, transfers and other revenues, for for-profit HEIs. The results show that loans increase total revenue through operating revenue, as expected. Robust standard errors clustered by region are shown in parentheses. All regressions include HEI and year fixed effects. RD estimates include first-order polynomials of the distance to the closest cutoff for each year and side of the closest cutoff.

Table 3.5: Channels for the effect of loans on revenue – for-profit institutions.

Explanatory Variable	Model [Bw]	Supply: Vacancies	Demand: Applicants	Enrollment: Campus	Enrollment: Online	Revenue/student: All st.	Revenue/student: Campus
Loans	DD	0.268	-0.581	2.160***	-0.017	-0.006	-0.006
	[No]	(0.812)	(0.761)	(0.317)	(0.023)	(0.009)	(0.009)
	RD	-0.362	0.780	2.426***	0.032***	0.007*	0.006*
	[0.01]	(2.070)	(0.859)	(0.321)	(0.007)	(0.004)	(0.004)
	RD	0.771	0.299	2.562***	0.035***	0.004	0.004
	[0.02]	(0.931)	(0.877)	(0.220)	(0.009)	(0.004)	(0.004)
Disburserment	DD	0.008	-0.027	0.077***	-0.001	-0.000	-0.000
	[No]	(0.029)	(0.025)	(0.014)	(0.001)	(0.000)	(0.000)
	RD	-0.022	0.028	0.087***	0.001***	0.000	0.000
	[0.01]	(0.080)	(0.032)	(0.015)	(0.000)	(0.000)	(0.000)
	RD	0.025	0.013	0.094***	0.001***	0.000	0.000
	[0.02]	(0.034)	(0.033)	(0.010)	(0.000)	(0.000)	(0.000)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of the number of loans and loan disbursement on vacancies, applicants, enrollment and revenue per student, showing that loans do not affect vacancies, applicants and revenue per student, but has a more than proportional effect on enrollment. Robust standard errors clustered by HEI are shown in parentheses. All regressions include HEI and year fixed effects. First stage statistics are similar to those presented in Table 3.6.

We now examine the impact of loans on resource allocation. Table 3.6 presents the effects of revenue on HEI expenditure and its components. The results indicate that 56-76% of the additional revenue generated from loans is allocated towards spending, with approximately half of this increment attributed to labor costs, particularly teaching staff wages. Benefits, primarily comprising mandatory employee benefits and social security contributions, also experience an increase. The category "other expenses" is also affected by the additional revenue.

The effect on profits is noteworthy, with each additional $1 in revenue leading to a $0.24-0.44 increase in net earnings. In two cases, we also find a positive effect on profit margins. These results confirm the prevailing notion that FIES is highly profitable for HEIs.

Table 3.6: Effect on expenditure and components – for-profit institutions.

	Total Expenses			Personnel: Total			Personnel: Faculty			Personnel: Other		
Model	DD	RD		DD	RD		DD	RD		DD	RD	
Bandwidth	No	0.01	0.02	No	0.01	0.02	No	0.01	0.02	No	0.01	0.02
Revenue	0.613***	0.760***	0.563***	0.319***	0.554***	0.305***	0.165***	0.261***	0.135***	0.060**	0.098**	0.006
	(0.078)	(0.176)	(0.169)	(0.071)	(0.104)	(0.090)	(0.037)	(0.069)	(0.046)	(0.025)	(0.044)	(0.029)
N	3198	423	817	3198	423	817	3198	423	817	3198	423	817
First-stage F	37.55	2.04	6.70	37.55	2.04	6.70	37.55	2.04	6.70	37.55	2.04	6.70
Prob > F	0.000	0.122	0.000	0.000	0.122	0.000	0.000	0.122	0.000	0.000	0.122	0.000

	Personnel: benefits			Other operating			Investiment			Research		
Model	DD	RD		DD	RD		DD	RD		DD	RD	
Bandwidth	No	0.01	0.02	No	0.01	0.02	No	0.01	0.02	No	0.01	0.02
Revenue	0.095**	0.195***	0.164***	0.110**	0.090*	-0.009	0.059	0.083	0.067	0.006	0.018***	0.020*
	(0.038)	(0.026)	(0.036)	(0.047)	(0.047)	(0.088)	(0.053)	(0.124)	(0.059)	(0.008)	(0.005)	(0.012)
N	3198	423	817	3198	423	817	3198	423	817	3198	423	817
First-stage F	37.55	2.04	6.70	37.55	2.04	6.70	37.55	2.04	6.70	37.55	2.04	6.70
Prob > F	0.000	0.122	0.000	0.000	0.122	0.000	0.000	0.122	0.000	0.000	0.122	0.000

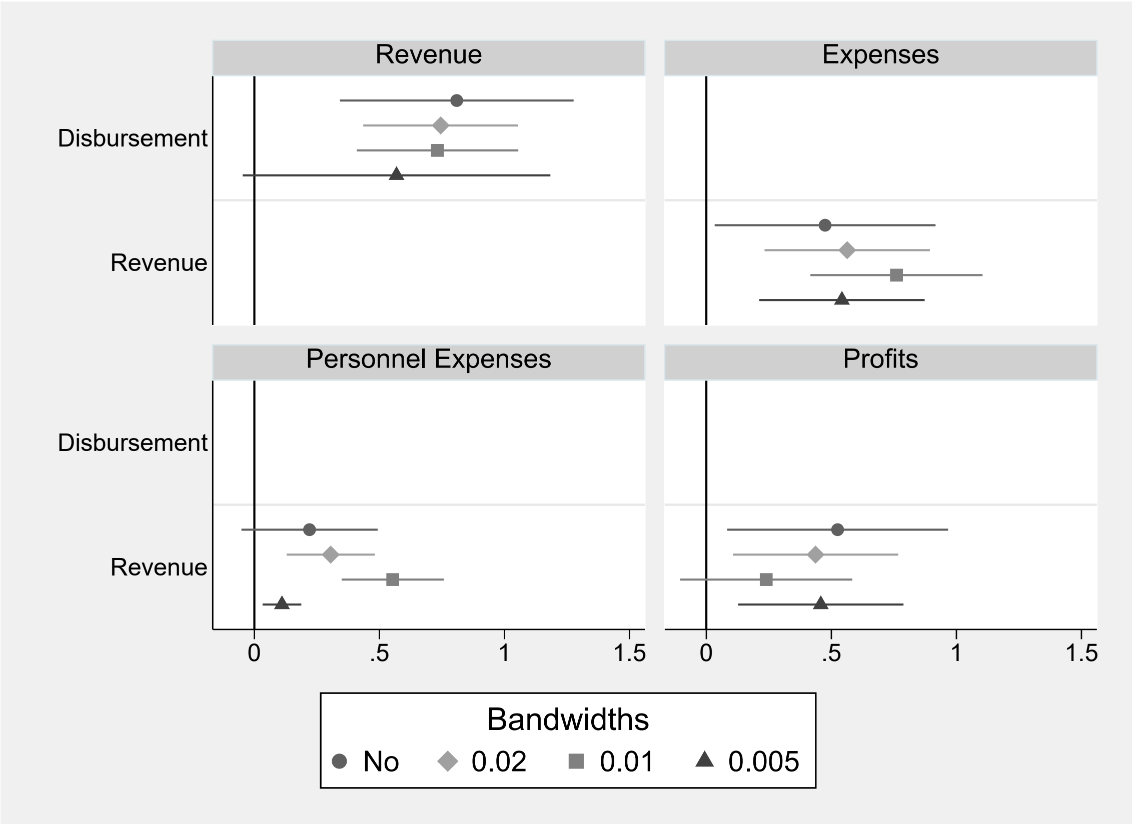
	Other expenses			Profits			Profit margin		
Model	DD	RD		DD	RD		DD	RD	
Bandwidth	No	0.01	0.02	No	0.01	0.02	No	0.01	0.02
Revenue	0.118***	0.016	0.179***	0.387***	0.240	0.437***	0.001***	0.001	0.001
	(0.046)	(0.091)	(0.058)	(0.078)	(0.176)	(0.169)	(0.000)	(0.002)	(0.001)
N	3198	423	817	3198	423	817	3198	423	817
First-stage F	37.55	2.04	6.70	37.55	2.04	6.70	37.55	2.04	6.70
Prob > F	0.000	0.122	0.000	0.000	0.122	0.000	0.000	0.122	0.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents Difference-in-Differences (DD) and Difference-in-Discontinuities (RD) estimates, for bandwidths of size 0.01 and 0.02, of the impact of revenue on total expenditure and its components for for-profit HEIs. Robust standard errors clustered by region are shown in parentheses. All regressions include HEI and year fixed effects. RD estimates include first-order polynomials of the distance to the closest cutoff for each year and side of the closest cutoff.

Figure 3.2 tests the robustness of the main estimates in relation to varying bandwidth sizes. The "No bandwidth" scenario corresponds to the Dif-in-Dif estimates.

Figure 3.2: Estimates with varying bandwidths and 95% confidence intervals.



Notes: The graph presents Difference-in-Differences estimates ("No Bandwidth" scenario), along with RD estimates for decreasing bandwidth sizes around closest cutoff. The estimates refer to the effect of disbursement on revenue and of revenue on total expenses, personnel expenses, and profits. The lines represent the 95% confidence intervals.

3.5.2 Extensions

Labor inputs and educational quality. The Brazilian Ministry of Education conducts annual assessments of higher education programs based on four dimensions: student performance, added value, faculty credentials, and student perception. Student performance is evaluated through the administration of a mandatory test (ENADE) that graduating students are required to take. Added value is calculated as the discrepancy between students' performance on the ENADE and their predicted performance based on their scores in the high school exit exam (ENEM). Faculty credentials are evaluated based on the proportion of faculty members holding master's or doctoral degrees, as well as the percentage of permanent faculty members. Student perception is evaluated through a questionnaire administered to the graduating students who take the ENADE, covering various topics such as teaching quality, infrastructure, and opportunities for research, internships, and participation in scientific events. These dimensions are weighted at 20%, 35%, 30% (7.5% + 15% + 7.5%) and 15% (7.5% + 5% + 2.5%), respectively, to determine the final indicator. Further information on the ENADE data can be found in De Mello and Duarte (2020).

Undergraduate program evaluations in Brazil take place on an annual basis. Knowledge areas are categorized into three groups, with one group being assessed each year. As a result, each program undergoes evaluation once every three years. All dimensions are standardized, measured, and consolidated into an indicator known as CPC (*Conceito Preliminar de Curso*, or Preliminary Course Concept). The UAS (Undergraduate Average Score) is computed annually for each Higher Education Institution (HEI), representing the average CPCs (weighted by enrollment) of the evaluated programs in that year. We link the annual UAS scores, provided by the Ministry of Education, to our dataset at the HEI level.

Many aspects evaluated in the quality indicator are associated to expenditures. Therefore, we can examine whether short-term revenue shocks affect quality indicators and through which channels. The dimensions most critical to quality are those related to student performance. ENADE scores account for 20% of the quality score (CPC), while value added carries the greatest weight, at 35%. However, improving these dimensions in the short term is challenging as they rely on enhancing students' performance in an exam administered solely at graduation. In contrast, faculty credentials can be promptly enhanced by recruiting more qualified (and higher-paid) permanent professors, as these are the two attributes rewarded in the evaluation. Investments in amenities, facilities and research could impact quality scores through student responses to the questionnaire, yielding short-term benefits if they improve final-year students' perceptions.

Firstly, we investigate whether the expansion of loans contributes to enhancing the quality and quantity of labor inputs. In Table 3.7, we present the effect of loans on workforce size, taking into account factors that may be associated with quality, such as academic credentials, contract type, and research involvement. Research involvement is measured by two indicators: the number of faculty members engaged in research and members receiving research grants. The latter is a more rigorous measure, since receiving research grants probably signals higher research effort.

Results indicate that FIES has a significant impact on the number of professors with a master's or doctoral degree hired by HEIs, but not for professors without these qualifications[22]. Additional faculty hired also tend to be permanent as opposed to temporary. Most estimates for full-time professors are statistically significant, but coefficients for part-time seem to be higher, despite exhibiting great variation between models. Hence, there is no clear preference for the higher quality option (full-time) in this case. This is interesting because the assessment rules reward programs with a higher proportion of doctors, masters, and permanent teachers, but not full-time[23]. We do not find statistically significant effects on research engagement or non-teaching staff hires.

[22] In Brazil, teaching in higher education requires, at least, a *lato sensu* specialization.

[23] There are 4 contract types for teachers, in increasing order of commitment to the institution: 1) instructors paid by the hour, 2) part-time, 3) full-time, non-exclusive, and 4) full-time, exclusive. Permanent teachers correspond to the sum of groups 2, 3, and 4, while full-time teachers correspond to the sum of groups 3 and 4.

Table 3.7: Effect on labor inputs – for-profit institutions.

	Doctor/Master			Lower qualification			Permanent			Temporary		
Bandwidth	No (DD)	0.01	0.02	No (DD)	0.01	0.02	No (DD)	0.01	0.02	No (DD)	0.01	0.02
Revenue (R$ mil.)	1.733***	4.682***	2.205**	0.680*	0.468	0.419	1.997***	3.552***	1.284	0.416	1.598	1.339
	(0.613)	(1.148)	(1.117)	(0.348)	(0.448)	(0.760)	(0.697)	(1.116)	(1.015)	(0.449)	(1.010)	(1.019)
N	3198	423	817	3198	423	817	3198	423	817	3198	423	817
First-stage F	37.55	2.04	6.70	37.55	2.04	6.70	37.55	2.04	6.70	37.55	2.04	6.70
Prob > F	0.000	0.122	0.000	0.000	0.122	0.000	0.000	0.122	0.000	0.000	0.122	0.000
Personnel Exp. (R$ mil.)	5.481***	8.841***	6.547***	1.850*	0.657	0.953	6.261***	6.874***	3.908*	1.070	2.624*	3.591
	(1.555)	(1.596)	(2.206)	(1.084)	(0.668)	(2.216)	(1.826)	(1.914)	(2.222)	(1.500)	(1.499)	(2.816)
N	3198	423	817	3198	423	817	3198	423	817	3198	423	817
First-stage F	28.13	154.96	27.88	28.13	154.96	27.88	28.13	154.96	27.88	28.13	154.96	27.88
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Full-time			**Part-time**			**Engages in research**			**Research grant**		
Bandwidth	No (DD)	0.01	0.02	No (DD)	0.01	0.02	No (DD)	0.01	0.02	No (DD)	0.01	0.02
Revenue (R$ mil.)	0.812**	0.354	0.633**	1.601**	4.796***	1.990	0.550	1.863**	0.175	0.188	-0.378	-0.643
	(0.343)	(0.221)	(0.262)	(0.698)	(1.227)	(1.488)	(0.438)	(0.950)	(0.906)	(0.195)	(0.449)	(0.487)
N	3198	423	817	3198	423	817	3198	423	817	3198	423	817
First-stage F	37.55	2.04	6.70	37.55	2.04	6.70	37.55	2.04	6.70	37.55	2.04	6.70
Prob > F	0.000	0.122	0.000	0.000	0.122	0.000	0.000	0.122	0.000	0.000	0.122	0.000
Personnel Exp. (R$ mil.)	2.792***	0.595	2.005***	4.539**	8.903***	5.494	1.870	3.972*	1.205	0.406	-1.058	-1.058
	(1.002)	(0.415)	(0.679)	(2.060)	(1.260)	(3.492)	(1.553)	(2.085)	(2.143)	(0.600)	(1.392)	(1.392)
N	3198	423	817	3198	423	817	3198	423	817	3198	423	423
First-stage F	28.13	154.96	27.88	28.13	154.96	27.88	28.13	154.96	27.88	28.13	154.96	27.88
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents Difference-in-Differences (DD) and Difference-in-Discontinuities (RD) estimates, for bandwidths of size 0.01 and 0.02, of the impact of revenue on total expenditure and its components for for-profit HEIs. Robust standard errors clustered by region are shown in parentheses. All regressions include HEI and year fixed effects. RD estimates include first-order polynomials of the distance to the closest cutoff for each year and side of the closest cutoff.

Table 3.8: Effect on quality indicators, undergraduate programs – for-profit institutions.

Explanatory variable:	Model [Bw]	Undergrad. Score	Student Performance	Value Added	Student Perception: Teach. Quality	Student Perception: Infrastruc.	Student Perception: Opportun.	Faculty: Mast./Doc.	Faculty: Permam.
Revenue (R$ mil.)	DD	0.018*	0.008	0.023	0.040***	0.004	0.002	0.040***	-0.012
	[No]	(0.009)	(0.018)	(0.027)	(0.015)	(0.019)	(0.020)	(0.015)	(0.018)
	RD	0.066***	0.094***	0.136**	0.021*	0.013	-0.050	0.065*	0.041*
	[0.01]	(0.023)	(0.027)	(0.062)	(0.013)	(0.026)	(0.073)	(0.035)	(0.023)
	RD	0.042***	0.063**	0.086**	0.069***	0.031	-0.024	0.030	0.006
	[0.02]	(0.015)	(0.031)	(0.035)	(0.019)	(0.021)	(0.047)	(0.037)	(0.023)
Pers. Exp. (R$ mil.)	DD	0.060**	0.045	0.067	0.126**	0.048	0.034	0.105**	-0.002
	[No]	(0.030)	(0.053)	(0.080)	(0.049)	(0.053)	(0.054)	(0.051)	(0.053)
	RD	0.117**	0.177***	0.255**	-0.007	-0.052	-0.153	0.146	0.064*
	[0.01]	(0.047)	(0.043)	(0.119)	(0.030)	(0.078)	(0.165)	(0.115)	(0.039)
	RD	0.153	0.253**	0.379	0.186**	0.102	-0.054	0.057	-0.003
	[0.02]	(0.095)	(0.125)	(0.245)	(0.093)	(0.067)	(0.144)	(0.094)	(0.073)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents estimates of the impact of loans, disbursement and revenue on quality scores obtained in the annual assessments by the Ministry of Education. Depedent variables are standardized, with coefficients representing standard deviation impacts. All regression include controls for the 2015 rule and for the loans to enrollment ratio. Robust standard errors clustered by HEI are shown in parentheses. All regressions include HEI and year fixed effects.

Table 3.8 presents the effects of FIES on HEI average scores obtained in the quality assessments, considering two explanatory variables: revenue and personnel expenditure. Although each program is evaluated only once every three years, we still observe a positive effect on the undergraduate score. However, results do not indicate a clear channel through which the additional revenue increases quality scores. Most estimates for student perception on teaching quality are statistically significant, but the most obvious channel would be through faculty credentials, which do present positive coefficients, but only two estimates are statistically significant at 5%.

It is worth mentioning that student perception, student performance and value added refer only to graduating students. Hence, these dimensions are not directly influenced by new entrants, as they refer to an older cohort of students. Consequently, institutions would not be able to contemporaneously improve their student performance, for instance, by admitting more high-achieving students. This implies that the mentioned statistics could be contemporaneously influenced by an expansion in loans only through an externality, such as improvements in faculty and infrastructure[24].

Our results suggest that revenue shocks can encourage quality improvements in for-profit universities. Still, the effects we observe appear to be shaped by a context in which improving faculty credentials can generate short-term prestige returns to the institution through improvements in quality scores. These scores are widely advertised by institutions as a means of attracting more students (Machado et al., 2022), indicating their importance to potential applicants. FIES itself may also be an incentive, since programs with higher scores are prioritized in the distribution of loans[25].

[24]Despite this, as a conservative measure, we include the percentage of questionnaire respondents who were FIES beneficiaries as an additional control, although results are not sensitive to this inclusion.

[25]In practice, loans are allocated first for higher quality programs: 35% of loans or each region/knowledge area are allocated to Grade 5 programs, 30% to Grade 4 programs, and 25% to Grade 3 programs.

Markups. Table 3.9 presents markup estimates for for-profit HEIs. We calculate the markup as Marginal Revenue divided by Marginal Cost, where both are derived from estimating equations similar to those previously presented, but with total enrollment in HEIs replacing FIES loans as the endogenous variable. In this context, marginal revenue and marginal cost are determined by the resulting coefficient of the regression of revenue and expenditure on (instrumented) enrollment. We opt to use marginal revenue instead of prices due to the challenge in constructing an appropriate price estimate, as HEIs often employ grants and discounts to discriminate prices. In addition, as observed earlier, not all enrollments induced by FIES at the institution level are attributable to loan recipients, given the finding that loans induce enrollment to increase more than proportionately[26].

In Table 3.9, we present estimates using the Difference-in-Differences approach, since the number of observations is relatively small for some groups[27].

Table 3.9: Marginal revenue, marginal cost and markup estimates.

Variable	All HEIs	Quality		Selectivity		Competition	
		Higher	Lower	Higher	Lower	Yes	No
Marginal Revenue	9.984***	6.006**	12.984***	7.908**	12.405***	7.501***	9.099**
	(2.078)	(2.514)	(2.664)	(3.164)	(3.173)	(2.026)	(3.535)
Marginal cost	6.095***	3.124	7.868***	6.338***	6.307***	5.175***	5.597**
	(1.472)	(2.124)	(1.937)	(2.391)	(1.998)	(1.694)	(2.546)
Markup	0.638	0.922	0.650	0.248	0.967	0.449	0.626
Revenue/Enroll.	12.268	12.757	11.369	12.997	11.044	12.066	13.010
Cost/Enroll.	9.757	10.089	9.170	10.341	8.773	9.660	10.109
Profit margin	16.237	17.553	15.482	17.294	15.347	15.681	17.483
N	3,292	1,366	1,649	1,505	1,787	2,276	1,016

Note: The table presents marginal revenue, marginal cost and markup estimates, as well as average revenue and costs for for-profit HEIs.

It should be noted that these markup estimates are not necessarily represen-

[26]In a similar analysis, Kargar and Mann (2023) report comparable findings whether using prices (revenue per student) or marginal revenue. However, in our dataset, using revenue per student or average tuition for FIES beneficiaries would yield higher markups compared to those obtained when using marginal revenue.

[27]For comparison, we include the RD estimates in Table 3.14 in Appendix 3.D.

tative of the sector average. Angrist et al. (2000) discusses the interpretation of instrumental variables estimates when assumptions of linearity and error additivity are relaxed, with a focus on estimating supply and demand parameters. They show that the estimated parameters represent a weighted average, with higher weights given to units that are more responsive in the first stage, that is, institutions that are more responsive to loans. However, this markup is relevant for the policy, as it gives an indication of how much revenue in HEIs increase in "excess" of additional spending.

As show in Table 3.9, considering all HEIs, we observe a substantial markup of 63.8%. As a comparison, Kargar and Mann (2023), also exploring the expansion of a loan program, find a markup of 42% in the case of American private (for-profit and non-profit) HEIs, while the calibrated model in Epple et al. (2019) yields markups ranging from 3.5% to 33.5% for the United States. For Brazil, the demand elasticities estimated by Dobbin et al. (2022) imply an average markup of 42.9% for the Brazilian private higher education market as a whole (including non-profit institutions).

In the remaining columns of Table 3.9, we split our data in two parts, by whether the HEI has quality above of below the median, is relatively more selective or not, and face the competition of a public university (located in the same microregion) or not. In Figure 3.9 of Appendix 3.D, we present bootstrap distributions of the estimated markups. "Higher quality" institutions are those with above median UAS, while below median institutions are classified as "lower quality". More selective institutions are those who had, on average at least one applicant per vacancy (which corresponds to the 55th percentile), while less selective are the ones below that value. Hence, this is a relative classification, since most institutions in our dataset are actually low quality and not selective. In addition, our measure of selectivity is relatively uncommon in the literature, since most studies measure selectivity by the minimum score level necessary for admission or by admit rates (number of admissions divided by the number of applicants), with the latter being closer to our measure (applicants divided by vacancies).

We find that markups are higher for higher-quality HEIs and for HEIs that do not face the competition of public universities. However, we find *higher* markups for *less* selective institutions, a finding that contrasts with the previous literature (Epple et al., 2019; Fillmore, 2023). In most contexts, selectivity and quality tend to be closely related[28], but in our data the correlation between the UAS and the applicant per vacancy ratio is basically zero (0.08). This lack of correlation explains why we can find opposite results for selectivity and quality.

Moreover, the market power of more selective private HEIs may me severely diminished by the fact that public universities in Brazil are completely free of charge, explaining the relatively low (but imprecisely estimated) markup we find for more selective institutions. On the other hand, less selective institutions would attend students that cannot make the cut in public universities, which are generally very selective. As mentioned earlier, Brazil does not have non-selective public institutions, such as community colleges in the United States, which may contribute to less selective private institutions having more market power in the former case. For instance, in the United States, Fillmore (2023) finds evidence that price discrimination is primarily a phenomenon of selective colleges, interpreting this as indication that nonelite colleges lack the market power to discriminate prices. Hence, although more research is needed to understand this discrepancy, this result is not inconsistent with the features of the Brazilian higher education market.

The finding that higher quality institutions have higher markups is consistent with Epple et al. (2019). Furthermore, as argued by Kargar and Mann (2023), the presence of public HEIs can increase competition, reducing the market power of private institutions and, consequently, reducing the portion of financial aid they capture. We present indicative evidence supporting this prediction, observing that

[28]In fact, selectivity is often seen as an outcome of quality.

institutions that operate in the same region as a public university tend to have, on average, lower market power compared to those in regions without public universities.

3.6 Final Remarks

This paper offers insights on the behavior of for-profit institutions, focusing on how they respond to changes in financial aid availability in the form of loans. We find that these responses are influenced by competition for students and the institutional environment, including the incentives it generates. For-profit universities supply a differentiated product – higher education – and have considerable market power. Hence, they greatly benefit from student aid, with more than one third of additional revenue turning into profits. While prior research has focused on the effects of aid on tuition prices, our findings reveal a broader range of institutional reactions. More precisely, we observe that financial aid not only affects revenue but also shapes resource allocation within HEIs.

More precisely, we observe that institutions also take advantage of this revenue shock to improve quality standards by hiring more permanent faculty with better credentials (master and doctoral degrees). Oversight of higher education programs by the Ministry of Education seems to have a role in this improvement, since expenditure increases exactly in the areas included in yearly quality assessments. In Brazil, institutional assessment scores are frequently used by HEIs for marketing purposes. Thus, our paper shows that accountability systems may have positive effects, especially in the for-profit sector, not only through the threat of punishment, but also by rewarding positive behavior. One take away is that institutions seem to care about improving quality, but these improvements must yield short term results.

Further research is necessary to understand how the improvements in quality evaluations we observe affect future student outcomes, how to improve competition between private higher education institutions, among other issues that emerge from our findings. In this sense, the Brazilian higher education sector is an important source of information, allowing research designs that may not be feasible in other markets, due to small sample sizes. Many papers are devoted to understanding the labor market effects of postsecondary education, but costs are equally important in determining actual returns to college. In this sense, understating how context shapes competition in the higher education sector is a key factor to improve cost effectiveness of financial aid.

Since the creation of FIES, numerous regulatory changes have been implemented to ensure that beneficiaries do not pay more in tuition and fees than other students. In particular, the cost covered by the loans must be net of all broad discounts offered by the institution, whether permanent or temporary. In practice, however, HEIs still have considerable leeway to discriminate prices by dosing the usage of their own scholarships and loans. Therefore, understanding the determinants of market power in higher education has important policy implications, leading to potential improvements in the design of student aid programs.

3.A Loan allocation rules

To allocate the loans, the total number of available slots for the FIES program is determined on an annual basis, taking in account the budget allocated to program[29]. Once total slots are established, they are distributed among different regions according to the following formula:

$$F_{mt} = \frac{SRC_{mt}\sigma_m}{\sum_{m' in \mathcal{M}} SRC_{m't}\sigma_{m'}}\mathcal{F}_t \tag{3.4}$$

where SRC is the Social Relevance Criteria, described in the Appendix, σ_m is the weight assigned to region m; and $\mathcal{F}_t = \sum_m F_{mt}$ is the total number of slots available in year t. The weights are presented in Table 3.1.

1. The "Social Relevance Criteria" (SRC) is calculated through the formula:

   $$SRC = 0,7 \times CDHE + 0,3 \times CDSF$$

   where:

   - CDHE is the Coefficient of Demand for Higher Education, given, in year t, by the share of the region in the country-wise total of individuals that scored at least 450 points in ENEM in year $t-2$ and/or registered to take ENEM in year $t-1$.
   - CDSF is the Coefficient of Demand for Student Financing, given by the share of the region in the total number of applicants for FIES in year $t-1$.

2. To prioritize less developed regions, the distribution implied by the SRC is

[29] Although the selection processes occur twice a year, the number of slots is determined annually. Furthermore, any unfilled slots from the first semester are carried over and made available in the second semester. Therefore, the analysis is conducted on an annual basis.

recalculated based on weights depending on HDI ranges. Table 3.1 presents the weights for each of these ranges.

3.B Data sources and summary statistics

Brazilian higher education institutions are organized in two hierarchical levels. The upper level, called Maintainer (*Mantenedora*), is generally responsible for financial and asset management, while the HEI itself is responsible for the academic dimension. The distinction between Maintainers and HEIs is important because HEIs under the same Maintainer may share financial resources even if located in different parts of the country. The Higher Education Census editions from 2012 to 2017 include data from 2,763 HEIs, which are linked to 2,053 maintainers, with 1,703 of those being unique links (the Maintainer serves only one HEI). Financial data reported in the Higher Education Census can be presented at any of these aggregation levels, but the Census includes a variable that indicates whether financial data was reported at the HEI level or at the Maintainer level.

Some observations are indicated as reported at the maintainer level, but correspond to a unique Mainteiner/HEI combination (6,043 observations). Therefore, these observations can be regarded as reported at the HEI level. On the other hand, a few observations are indicated as reported at the HEI level, but the same revenue and expenditure values were reported for different HEIs under the same maintainer. Thus, we adjust the indicator accordingly in each situation. Hence, our dataset includes observations that satisfy one of the following criteria: a) information reported at the HEI level; b) information reported at the maintainer level, but the maintainer serves only one HEI; c) information is not the same for HEIs under the same maintainer.

Table 3.10 presents the sources of the data used in the paper.

Table 3.10: Data sources.

Variables	Sources	Years
Municipal Human Development Index - HDI	UNDP - United Nations Development Programme[30]	2010
FIES loans	Dados abertos FIES – FNDE	2013 a 2021
National high school exam takers and applicants	Microdados do ENEM - INEP	2013 a 2018
Higher education admissions, enrollment and conclusion	Censo da Educação Superior - INEP[31]	2013 a 2021

Table 3.11 presents average tuition values and average covered tuition for FIES beneficiaries, as well as the number of loans per year.

Table 3.11: Tuition costs for FIES beneficiaries.

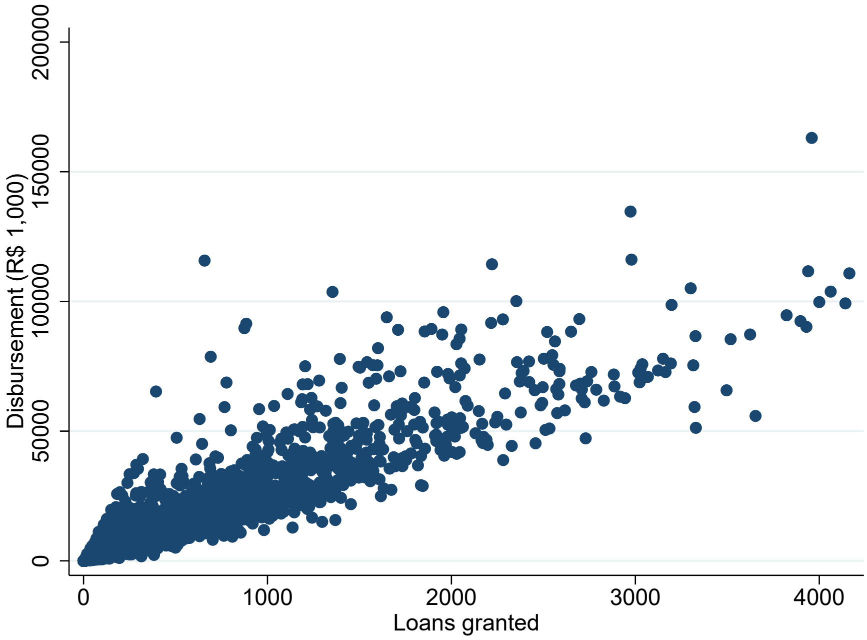
Year	Average covered tuition	Average tuition	Average percentage covered	Number of loans
2012	15,150.11	16,346.32	89.64	899,054
2013	15,555.65	16,521.03	91.86	1,742,221
2014	15,769.77	16,586.74	93.24	2,701,382
2015	15,834.50	16,613.16	93.63	2,273,331
2016	16,408.85	17,334.26	92.40	2,602,632
2017	17,884.42	18,930.45	92.12	1,877,639

Note: Values are in Brazilian *reais* in constant prices of July 2022. *Data source*: FNDE.

3.B.1 Parallel Trends

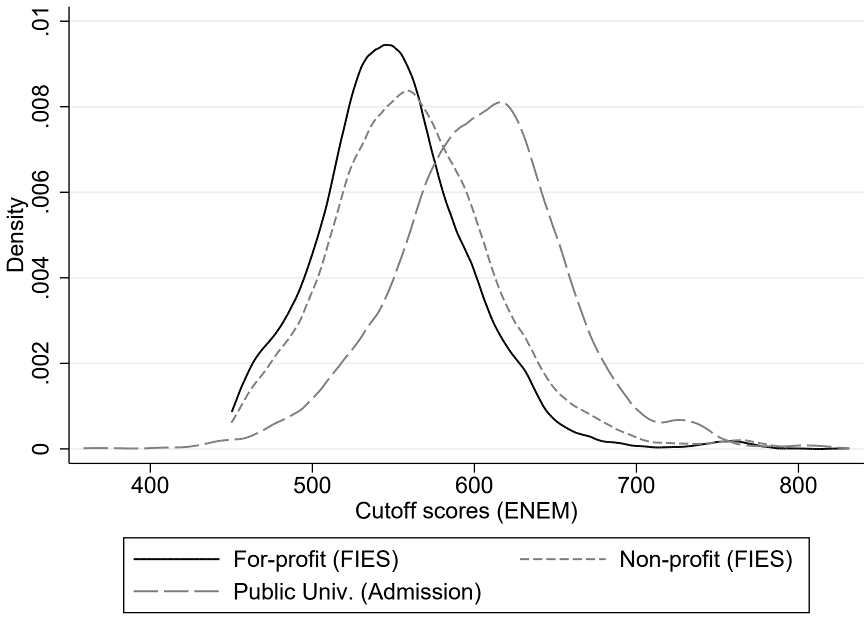
We begin by testing whether the pre-treatment trends differ for the HDI groups by conducting a placebo test, presented in Table 3.12. The test is conducted by dropping the "treated" years (2016-2017) from the data and considering 2015 as a placebo treatment year.

Figure 3.3: Comparison between number of loans and disbursement values per HEI/year.



Data source: FNDE (*National Educational Development Foundation)*.

Figure 3.4: Distribution densities for higher education programs cutoff scores in FIES, by sector of the institution, and for admission cutoffs in federal universities.



Note: FIES requires a minimum score of 450 in the National High School Exam (ENEM). *Data source*: FNDE.

Table 3.12: Placebo test – 2013-2015.

Model	Outcomes		
[Bw]	Revenue	Expenses	Profits
Panel A: Explanatory variable: *Number of loans*			
DD [No]	4.194	4.848*	-0.653
	(4.388)	(2.926)	(3.282)
RD [0.01]	-1.403	7.201	-8.604
	(8.615)	(9.170)	(7.521)
RD [0.02]	11.198*	13.522***	-2.323
	(6.232)	(4.995)	(4.323)
Panel B: Explanatory variable: *Disbursement*			
DD [No]	0.152	0.162*	-0.010
	(0.151)	(0.097)	(0.113)
RD [0.01]	-0.015	0.360	-0.375
	(0.355)	(0.330)	(0.324)
RD [0.02]	0.487**	0.589***	-0.102
	(0.243)	(0.187)	(0.185)
Panel C: Explanatory variable: *Revenue*			
DD [No]		0.765*	0.235
		(0.460)	(0.460)
RD [0.01]		0.355	0.645
		(1.599)	(1.599)
RD [0.02]		1.210***	-0.210
		(0.454)	(0.454)

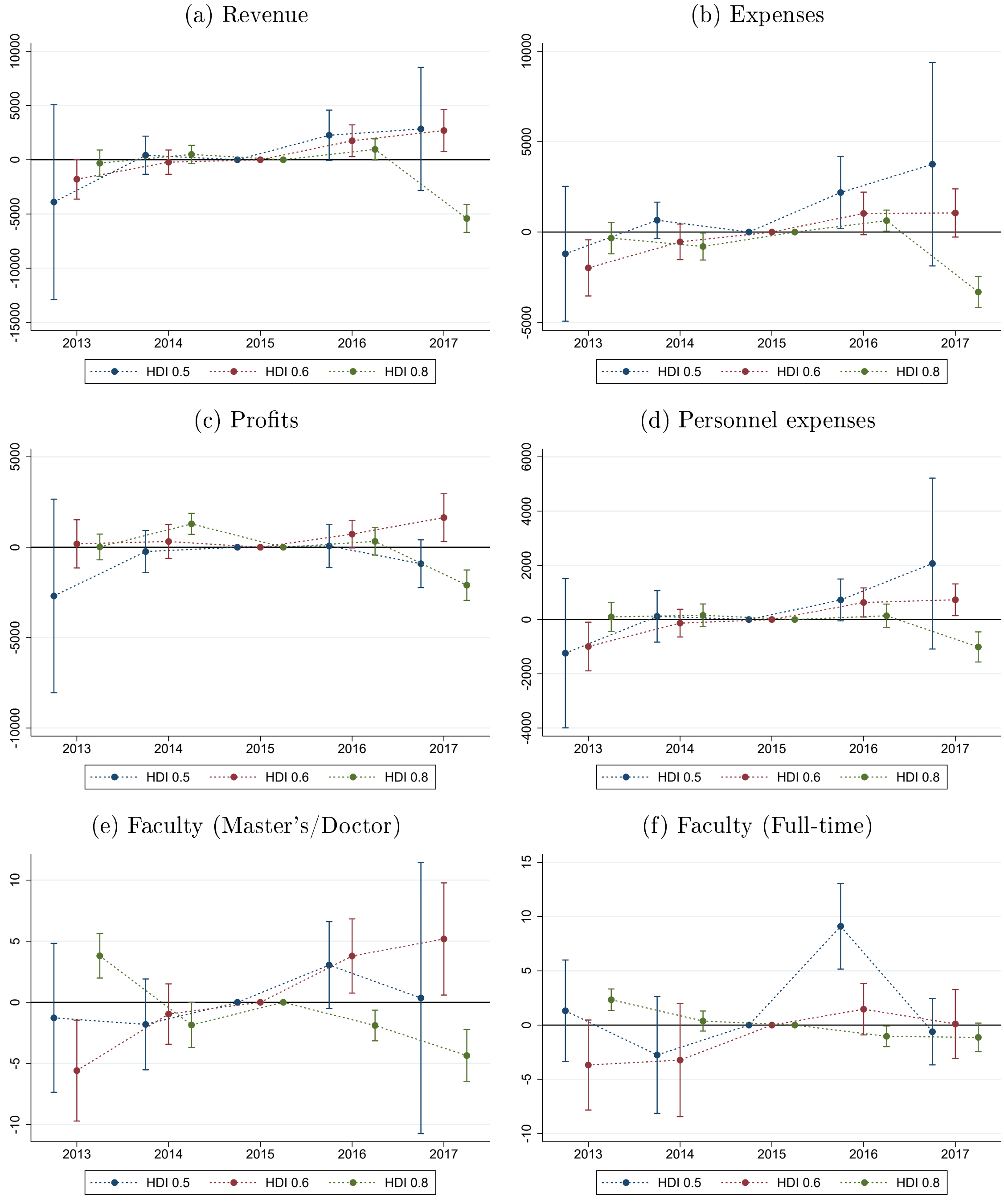
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents placebo estimates of the impact of the number of loans and disbursement values on revenue, expenses, and profits. We also present placebo estimates for the effects of revenue on expenses and profits. The placebo test is carried out by dropping the years (2016-2017) from the data and considering 2015 as the . Robust standard errors clustered by region. We observe, as expected, that none of the estimates are statistically significant at 5% and coefficient signs alternate. All regressions include region and year fixed effects.

3.C First-stage estimates

In Table 3.13, we present the results for the first stage in the IV estimation, using the number of loans and disbursement values per year as the instrumented

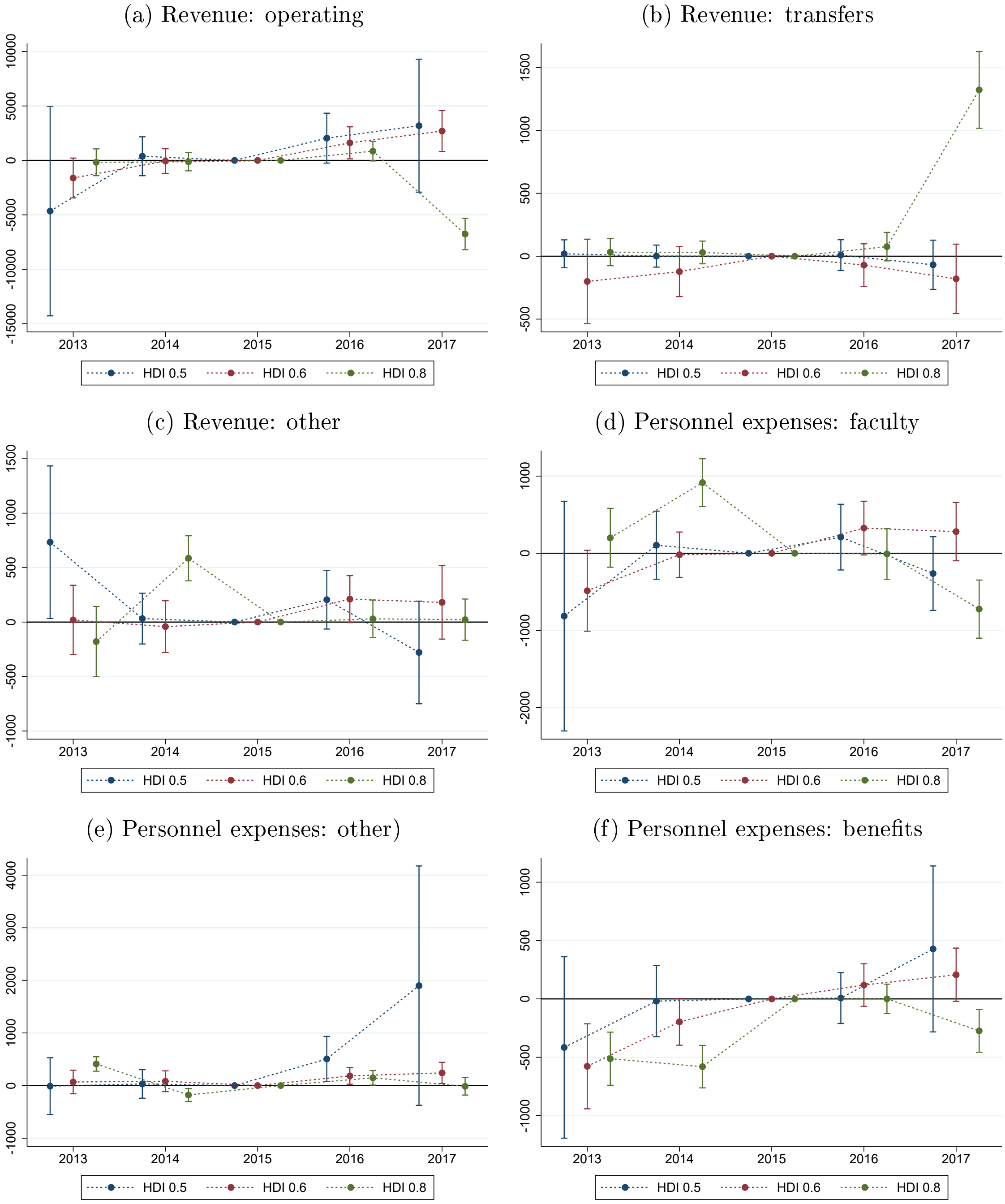
Figure 3.5: Event studies – part 1.



Note: Panels display the event study for HDI groups 0.5, 0.6 and 0.8, relative to group 0.7, for different outcomes included in the paper.

variables. We also include results for revenue since we later use it to understand how institutions allocate additional funds across spending categories. In the for-profit sector, the coefficients are mostly statistically significant and exhibit the expected signs, with positive values for the higher weight region ($Z_{2016}^{[0.6,0.7)}$ and $Z_{2017}^{[0.6,0.7)}$) and

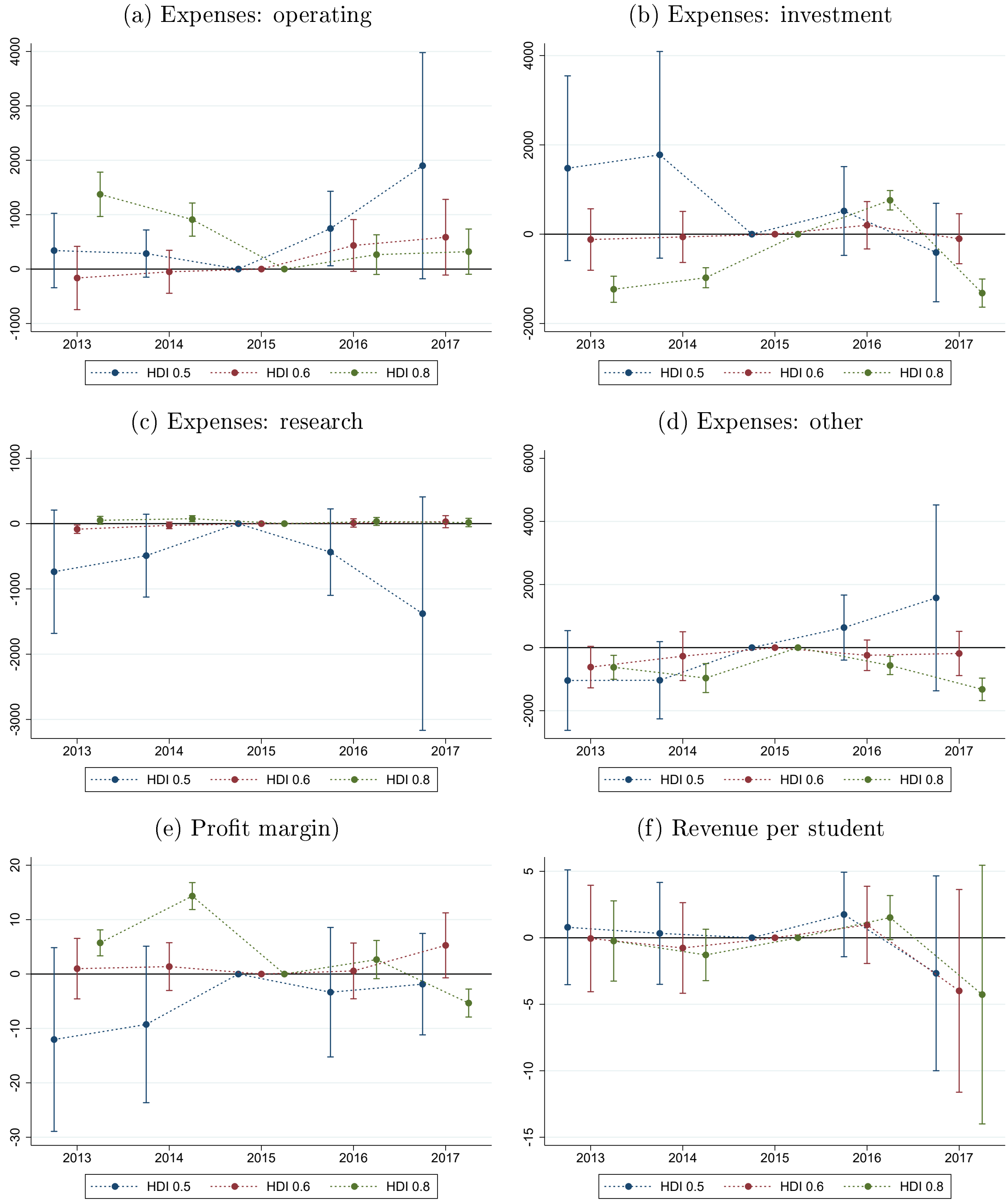
Figure 3.6: Event studies – part 2.



Note: Panels display the event study for HDI groups 0.5, 0.6 and 0.8, relative to group 0.7, for different outcomes included in the paper.

negative values for the lower weight region ($Z_{2016}^{[0.8,0.9)}$ and $Z_{2017}^{[0.8,0.9)}$). Coefficients for the non-profit sector (not included in the Table) are not statistically significant. Therefore, we focus exclusively on the for-profit sector for the remainder of the paper.

Figure 3.7: Event studies – part 3.

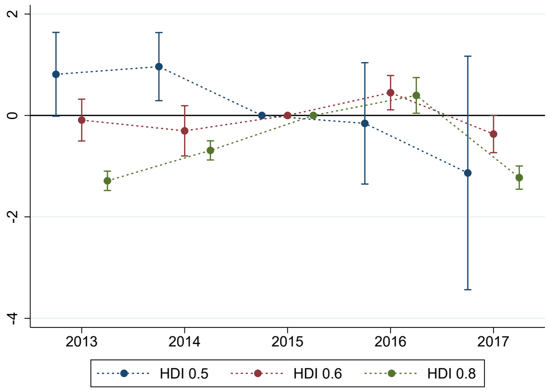


Note: Panels display the event study for HDI groups 0.5, 0.6 and 0.8, relative to group 0.7, for different outcomes included in the paper.

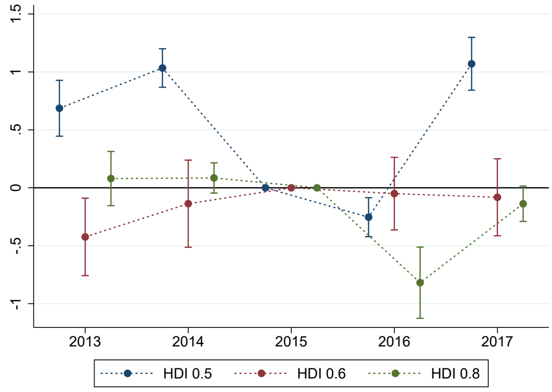
Our identification strategy relies on the assumption that HEIs in different regions exhibited similar trends prior to the intervention. Figures 3.5 to 3.8 in the Appendix presents event studies for the main outcomes in the paper, confirming the similarity of previous trends.

Figure 3.8: Event studies – part 4.

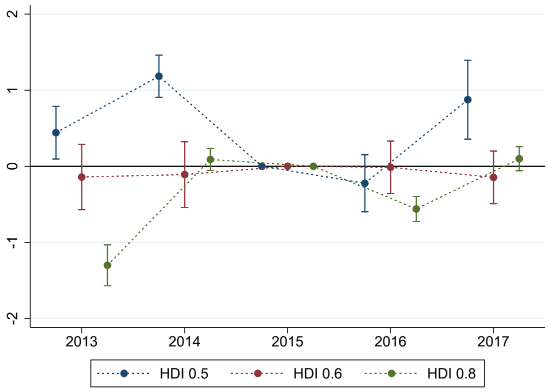
(a) Score: value added



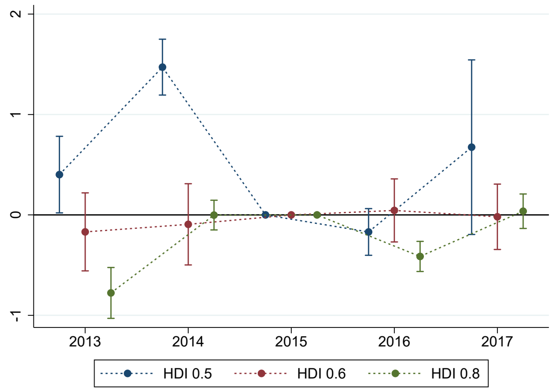
(b) Score: teaching quality



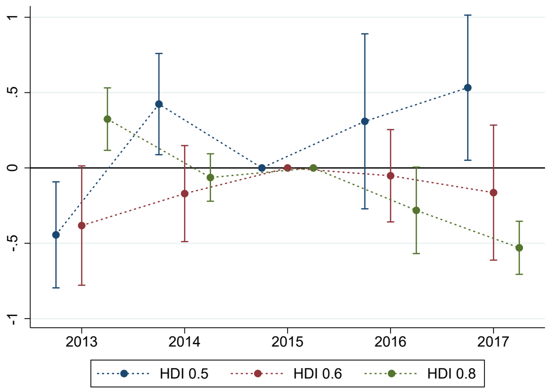
(c) Score: infrastructure



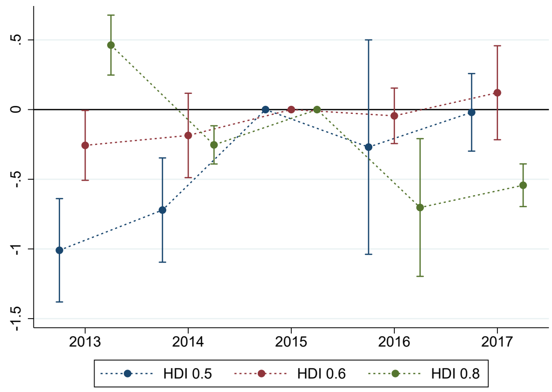
(d) Score: opportunities



(e) Score: master's/doctors)



(f) Score: permanent



Note: Panels display the event study for HDI groups 0.5, 0.6 and 0.8, relative to group 0.7, for different outcomes included in the paper.

3.D Markup bootstrap distributions

Table 3.14 presents RD estimates of marginal revenue, marginal costs and markups, considering bandwidths of size 0.01 and 0.02 to the closest cutoff. Figure 3.9 displays

Table 3.13: First stage - IV.

Dep. variable:	Loans	Disbursement	Revenue
$Z_{2016}^{[0.5,0.6)}$	309.9	10,550.2	5,620.1
	(208.7)	(9,207.4)	(5,516.3)
$Z_{2017}^{[0.5,0.6)}$	60.8**	9,728.8	7,650.8
	(24.6)	(7,002.7)	(6,663.0)
$Z_{2016}^{[0.6,0.7)}$	148.9***	3,576.5***	2,347.4***
	(41.2)	(1,102.8)	(870.3)
$Z_{2017}^{[0.6,0.7)}$	138.9***	3,724.2***	3,050.6***
	(29.1)	(818.6)	(1,095.4)
$Z_{2016}^{[0.8,0.9)}$	-48.9	-1,633.5	563.8
	(58.7)	(1,710.4)	(2,293.1)
$Z_{2017}^{[0.8,0.9)}$	-130.1*	-4,123.6**	-6,117.3***
	(69.9)	(2,017.0)	(1,887.1)
N	3198	3198	3198
Clusters	662	662	662
F(6, Clust.-1)	5.230	4.821	3.952
Prob > F	0.0000	0.0001	0.0007

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The table presents the estimation results for the first stage of the panel IV model, for three diferent explanatory variables: number of loans, amount disbursed and HEI revenue, demonstrating that the instruments – dummies for each HDI range – jointly affect the variables in a statistically significant way and with the expected signs. Robust standard errors, clustered by HEI, are presented in parentheses. All regressions include HEI and year fixed effects.

bootstrap distribuitions for markups, clustered at the HEI level, and stratified by HDI range.

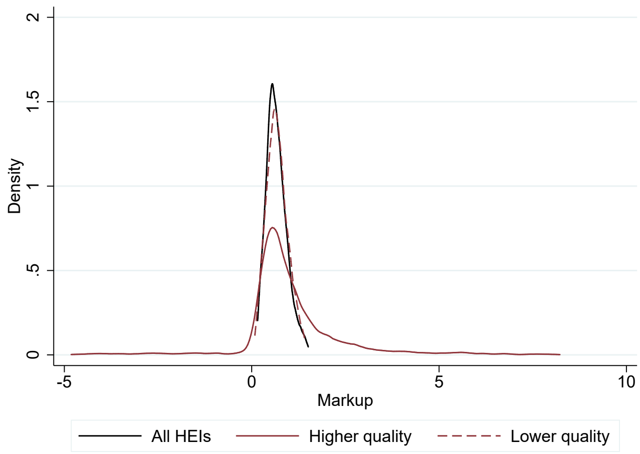
Table 3.14: Marginal revenue, marginal cost and markup estimates – RD.

Variable	All HEIs	Quality		Selectivity		Competition	
		Higher	Lower	Higher	Lower	Yes	No
			Panel A: *Bandwidth 0.01*				
Marginal Revenue	8.235***	7.872***	13.935***	3.966**	13.455***	10.863***	15.214***
	(1.633)	(1.024)	(0.462)	(1.917)	(1.790)	(0.875)	(4.617)
Marginal cost	6.281***	7.662***	3.938**	4.393***	-10.565	8.651***	7.236*
	(1.882)	(0.987)	(1.658)	(1.296)	(10.189)	(0.335)	(3.735)
Markup	0.311	0.027	2.538	-0.097	-2.274	0.256	1.102
Revenue/Enroll.	12.268	12.757	11.369	12.997	11.044	12.066	13.010
Cost/Enroll.	9.757	10.089	9.170	10.341	8.773	9.660	10.109
Profit margin	16.237	17.553	15.482	17.294	15.347	15.681	17.483
N	3,292	1,366	1,649	1,505	1,787	2,276	1,016
			Panel B: *Bandwidth 0.02*				
Marginal Revenue	7.811***	6.078***	19.668	6.434***	9.961	6.939***	5.858
	(1.674)	(1.674)	(22.764)	(0.718)	(6.826)	(0.907)	(7.538)
Marginal cost	4.387***	4.849***	-12.060	6.004***	-11.488	4.708***	-2.262
	(1.271)	(1.551)	(47.863)	(0.496)	(26.254)	(0.890)	(6.979)
Markup	0.781	0.254	-2.631	0.072	-1.867	0.474	-3.590
Revenue/Enroll.	12.268	12.757	11.369	12.997	11.044	12.066	13.010
Cost/Enroll.	9.757	10.089	9.170	10.341	8.773	9.660	10.109
Profit margin	16.237	17.553	15.482	17.294	15.347	15.681	17.483
N	3,292	1,366	1,649	1,505	1,787	2,276	1,016

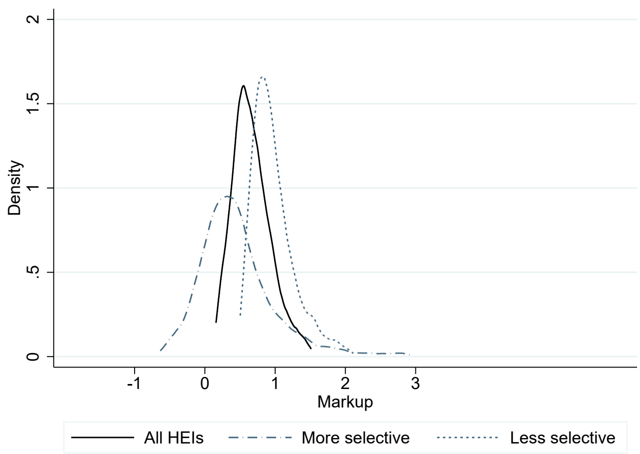
Note: The table presents marginal revenue, marginal cost and markup estimates, as well as average revenue and costs for for-profit HEIs.

Figure 3.9: Markup bootstrap distributions.

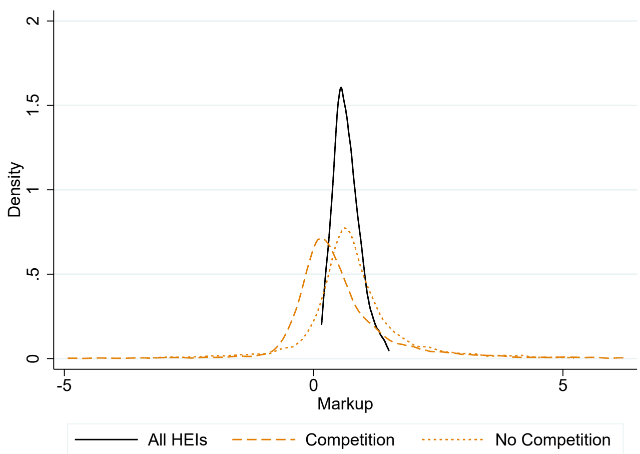
(a) Quality



(b) Selectivity



(c) Competition from public HEI



Note: Figures (a), (b) and (c) display the bootstrapped distributions (5,000 replications) of the markups presented in Table 3.9, clustered at the HEI level. We plot only percentiles between 2.5 and 97.5.

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