Does the Quota Law in Brazil Ensure the Enrollment and Graduation of Students with Disabilities in Universities?

Pamella Nogueira[1*], Zilania Mariano[2†] and Edward Costa[3†]

[1*]Federal University of Ceará (UFC) - CAEN, Ceará, Brazil.
[2]Federal University of Ceará (UFC) - CAEN, Ceará, Brazil.
[3]Federal University of Ceará (UFC) - PPGER, Ceará, Brazil.

*Corresponding author(s). E-mail(s): pamell4@live.com;
Contributing authors: zilania@ufc.br; edwardcosta@ufc.br;
†These authors contributed equally to this work.

Abstract

The enactment of Law No. 13,409 on 28 December 2016 reserved a percentage of university places for individuals with disabilities (PWDs). This study measures the causal impact of this legislation on new and graduating students, aiming to contribute to the educational literature, especially given the scarcity of empirical studies on public policies aimed at PWDs. Causal estimates at the level of institutions and courses were obtained using the Two-Way Fixed Effects (TWFE) model. We conducted robustness tests, including placebo tests and the exclusion of universities with internal policies regarding persons with disabilities (PWDs). Additionally, we performed an analysis of heterogeneous effects on Brazilian regions, considering institutional data, and by Area of Knowledge, based on course information. The primary findings indicate a positive and statistically significant impact of the legislation on overall enrollment in higher education, both at the level of IFES observation units and at the level of individual courses. This evidence supports the assertion that the law is an effective policy measure. These results maintained their robustness when undergoing the analyzed tests, including the parallel trends test. However, the same cannot be affirmed regarding the law's effect on total graduates. Heterogeneous effects by region were significant and positive in the North, Northeast, South, and Southeast, except for the the Central-West region. Among courses by area of knowledge, only Linguistics, Letters and Arts, Exact and Earth Sciences, Health Sciences, and Agricultural Sciences followed the main model's results in total enrollment of students with disabilities.

Keywords: Law's Quotas in Higher Education; Differences in Differences; People with Disabilities.

JEL Classification: I23 , J18 , C31

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1 Introduction

People with disabilities (PWD) constitute a significant segment of the population. The World Health Organization (WHO) estimated in 2021 that 1.3 billion people have some form of physical or intellectual disability, representing 16% of the global population (WHO, 2022). In the United States[1], for instance, the proportion in the same year was 27.2%, while in the European Union[2] it was 24.0% in 2019. In Brazil, data from the 2022 Annual Continuous National Household Sample Survey[3] (PNADC) indicated that 18.6 million Brazilians aged 2 and above had some disability, accounting for 8.9% of the total population.

Despite forming a substantial segment of the population, their participation in higher education worldwide remains significantly lower compared to those without disabilities. For example, in the European Union[4] in 2019, only 32.5% of PWD completed higher education. Similarly, in the United States[5]in 2016, only 19.4% of undergraduate students had disabilities. In Brazil, in 2022, a mere 0.8% of all students enrolled in higher education were PWD, highlighting a significant gap in educational inclusion (Higher Education Census, 2022). Furthermore, the Annual Continuous National Household Sample Survey (PNADC) of 2022 reveals that only 7.0% of people with disabilities completed higher education, compared to 19.2% without disabilities.

Various affirmative policies have emerged to promote more equitable and inclusive access to higher education. Countries adopt different approaches regarding access to higher education. Some governments, such as Australia, Canada, Colombia, Spain, and the United Kingdom, offer financial support, scholarships, and university housing. Other countries, including India, Pakistan, Sri Lanka, Malaysia, and Brazil, implement quota policies in higher education, reserving a percentage of seats exclusively for PWD (Salmi and D'Addio, 2021).

In 2012, the Brazilian government enacted Law No. 12,711, also known as the Quota Policy in Higher Education. This legislation reserves seats for individuals from public schools, low-income backgrounds, and those who are Black, mixed-race, or Indigenous. An amendment in 2016 (Law No. 13,409) included people with disabilities in the reserved seats (Brasil, 2012).

Since the quota policy for PWD in higher education is relatively recent, few studies directly address it, despite the progress made. The literature primarily focuses on issues related to infrastructure, accommodations, prejudice and discrimination, and students' personal experiences. Additionally, it emphasizes accessibility, the expansion of available seats, and improvements in the selection process (Januário, 2019; Reis and Melo, 2020).

Complementarily, some studies take a broader view on access to higher education, examining factors such as the admission of students from public schools, Black or mixed-race backgrounds, internal policies of state universities, and the performance of quota students (Feres et al., 2013; Estevan et al., 2019; Vieira and Arends-Kuenning, 2019; Otero et al., 2021; Mello, 2022; Pelegrini et al., 2022; Strifezzi Leal and Choi, 2023).

Given the scarcity of empirical studies evaluating Law No. 13,409, enacted on December 28, 2016, this research aims to contribute to the educational literature by measuring the causal effect of the quota policy for people with disabilities on their enrollment and graduation from higher education in federal universities in Brazil. Additionally, it intends to present a heterogeneity analysis for different Brazilian regions and major fields of study.

Since the law guarantees entry for PWD, understanding whether this target group is affected becomes necessary. Upon their entry, universities must implement improvements to ensure student retention, such as adequate infrastructure and proper training for professors

[1]Centers for Disease Control and Prevention (CDC)
[2]Eurostat
[3]Q3 2022
[4]Seventh Edition of the European Disability Forum's Human Rights Report
[5]2015–16 National Postsecondary Student Aid Study (NPSAS:16)

and administrative staff. Therefore, ensuring students graduate from higher education is crucial for the law's effectiveness.

To fulfill the proposed objectives, this study utilizes two distinct samples. The first sample considers the university as the unit of observation, while the second uses the course. Each dataset provides a panel with information on total admissions, graduates, and the characteristics of the universities and courses.

Data were obtained from multiple external databases, including the Higher Education Census, quality indicators from the National Institute for Educational Studies and Research Anísio Teixeira (Inep), and the Management Report of the Federal Court of Accounts (TCU), covering the period from 2013 to 2022[6].

The methodological choice is based on the study by Cerqueira et al. (2015), utilizing the differences-in-differences model, specifically the Two-Way Fixed Effects (TWFE) approach, which accounts for fixed effects (Clarke and Tapia-Schythe, 2021). This study performs estimations using data at the level of Federal Higher Education Institutions (FHEI) and individual courses. Following the primary model estimation, the study conducts two analyses of heterogeneous effects: one examining the Brazilian regions using FHEI data, and the other based on the CAPES Area of Knowledge, utilizing course-level data.

Justification for this choice stems from the following arguments: i) Since university quotas depend on the proportion of people with disabilities in each state, and given that this proportion varies across regions, investigating the impact of the policies in each region and their performance after the law's enactment is crucial; and ii) Selecting a specific field of study in higher education is essential for entering the job market, especially for PWD, as some professions are more inclusive and offer better employment opportunities.

Robustness tests and parallel trends tests are also conducted to capture the policy's effect more precisely. For Federal Higher Education Institutions (FHEI) and courses, robustness tests include: i) excluding universities that adopted internal quota policies before 2016; and ii) conducting a placebo test, using 2015 as the hypothetical start of the policy. Additionally, the event study analyzes parallel trends preceding the policy to observe how the treatment effect varies over time.

This work stands out for its originality, as the literature lacks studies evaluating the Law through a causal framework, where the actual effect is estimated using a robust and well-established methodology (differences-in-differences with fixed effects). Consequently, the results provide valuable tools for policymakers to use when proposing new policies or maintaining the current ones.

This study is divided into four sections, in addition to the introduction. The next section provides context about people with disabilities in Brazil, their inclusion in higher education, and affirmative policies at the national and international levels. The third section details the data and methodology, constructing the empirical strategy for analysis. The fourth section presents the results, followed by the conclusion which synthesizes the study and findings.

2 People with Disabilities in Brazil

In 2021, according to the World Health Organization[7], there were approximately 1.3 billion PWD worldwide, representing 16% of the total population. The number of people with disabilities has increased over the past decade due to demographic and epidemiological changes, such as population growth, the rise of non-communicable diseases, greater longevity, and aging with limitations. The United Nations Convention on the Rights of Persons with Disabilities (CRPD) describes PWD as "those who have long-term physical, mental, intellectual

[6]The selected period ensures information about the variables of interest before and after the enactment of the quota policy for people with disabilities.

[7]Global report on health equity for persons with disabilities

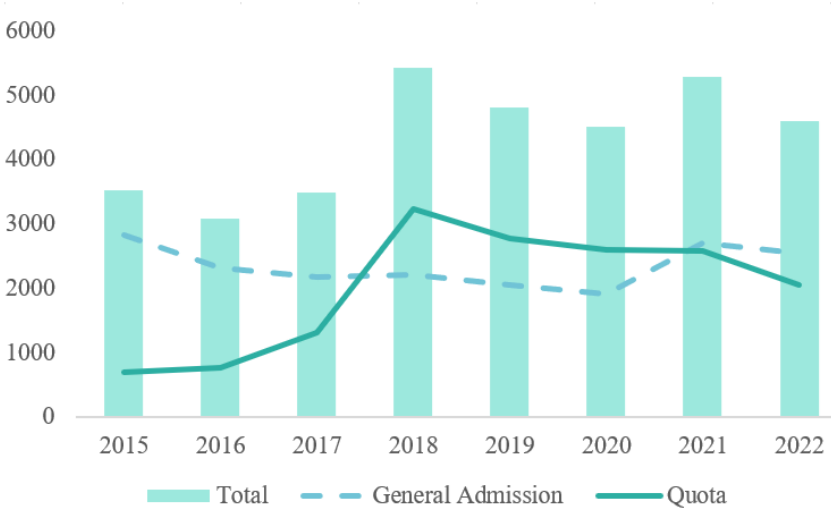
or sensory impairments that, in interaction with various barriers, may hinder their full and effective participation in society on an equal basis with others."

The 2022 Annual Continuous National Household Sample Survey by the Brazilian Institute of Geography and Statistics (IBGE) identified 18.6 million people older than two years with disabilities in Brazil, representing 8.9% of the Brazilian population older than two years. Regionally (Figure A1), the Northeast contains eight of the ten Federative Units (UFs) with the highest share of people with disabilities relative to the state population. In terms of PWD distribution by state, Sergipe (12.1%), Ceará (10.9%), Piauí (10.8%), Alagoas (10.5%), Bahia (10.4%), Rio Grande do Norte (9.8%), Maranhão (9.2%), Rio Grande do Sul (9.9%), and Pará (9.5%) have the highest proportion. Conversely, Amazonas (6.3%), Roraima (6.7%), Santa Catarina (6.9%), and Amapá (7.2%) show the lowest percentages of PWDs.

The National High School Exam (Enem) acts as the gateway for students accessing higher education, facilitating entry to public universities through the Unified Selection System (Sisu) or obtaining scholarships via the Student Financing Fund (Fies) and the University for All Program (ProUni). When registering for the exam, participants fill out an application form where they can indicate if they have a disability (or special need, as referred to in the registration). Based on the participant's request, they can ask for specialized assistance and accessibility resources, making the exam more equitable. Among those who report having a disability, the majority indicate attention-related disabilities (34.6%), low vision (18.3%), and physical disabilities (15.1%). Figure A2 shows the proportion of Enem registrants with special needs[8] by state. The Federative Units (UFs) with the highest concentration of registrants are the Federal District (1.5%), Acre (1.3%), Goiás (1.2%), and Minas Gerais (1.2%).

Graph 1 shows the trend of students with disabilities entering higher education through general admission and reserved quotas. The graph highlights the significant increase in the number of students with disabilities enrolling, especially following the enactment of the Law. It also indicates the number of new entrants admitted through the quota system.

Graph 1: Evolution of Total Enrollments of Students with Disabilities by General Admission and Quotas



[8]Inep defines people with disabilities as those with special needs, which include low vision, blindness, hearing impairment, physical disability, intellectual (mental) disability, attention deficit, dyscalculia, dyslexia, deafness, deaf-blindness, and monocular vision.

To develop a comprehensive understanding of the issues related to the low participation of people with disabilities in Brazilian education, it is essential to examine their educational profile. The 2022 Annual Continuous National Household Sample Survey (PNADC) revealed that among PWD aged 25 and older, 63.3% received no education or did not complete elementary school, 11.1% finished elementary school, 18.6% completed high school, and only 7% graduated from higher education. In contrast, among the total population without disabilities during the same period, 34% received no education or did not complete elementary school, while 12.8%, 34.0%, and 19.2% completed elementary school, high school, and higher education, respectively. This significant difference between the two groups highlights the need for targeted educational policies for PWD at all levels of education.

Shevlin et al. (2004) state that people with disabilities face challenges before and after entering university. These barriers include low expectations during schooling, unequal social structures, limited physical spaces, and low levels of awareness. With so many obstacles, young people often question their abilities and potential to attend university. Within the university, students with disabilities continue to encounter issues that affect their inclusion and autonomy. These issues include communication and personal barriers, physical barriers impacting mobility, and the availability and use of equipment and teaching resources (Borges, 2017).

External and adverse factors tend to have a deeper impact on students with disabilities. Contreras et al. (2023) studied the effects of the COVID-19 pandemic on the transition of high school students to higher education in Chile. The results, estimated using a differences-in-differences model, revealed a decrease in students with disabilities taking university entrance exams. While the pandemic affected the enrollment of all students in higher education, the impact was more significant for students with disabilities. Furthermore, when analyzing the data by type of institution, there was a noticeable reduction in the likelihood of students entering prestigious institutions.

The university environment plays a pivotal role for minority groups, particularly for individuals with disabilities (PWD). According to Riddell and Weedon (2014), universities provide a critical space for these young people to develop their adult identities, and earning a higher education degree can significantly boost their future job prospects. Higher educational attainment allows young people with disabilities to lessen the impact of their disabilities in the job market. However, they are still less likely to enroll in higher education compared to their peers without disabilities (Tansey et al., 2018)

3 Affirmative Policies in Higher Education for People with Disabilities

3.1 World

Affirmative action policies help people with disabilities access and stay in higher education. Quota systems are rare worldwide, especially for minority groups such as PWD. Instead, most global policies focus on providing financial support through scholarships and ensuring students can remain enrolled in universities.

In the United Kingdom, the government provides the Disabled Students Allowance (DSA) to help students with disabilities, mental health conditions, or chronic illnesses cover study-related expenses. Australia offers funding through the Higher Education Disability Support Program, enabling these individuals to access, participate in, and succeed in higher education. In Canada, the Canada Student Grant for Students with Disabilities provides scholarships to support full-time and part-time students with disabilities.

Salmi and D'Addio (2021) cites additional programs that assist people with disabilities in accessing higher education. In India, students with disabilities receive fee exemptions if they cannot secure financial aid, and each university receives a one-time grant of 1,000,000 rupees to encourage the enrollment of as many students with disabilities as possible. Additionally,

universities reserve 5% of their seats for students with disabilities. In Colombia, the ICETEX (Instituto Colombiano de Crédito Educativo y Estudios Técnicos en el Exterior) provides subsidized loans to students from low-income families, ethnic minorities, and those with disabilities.

In Pakistan, the Government Rules and Disability Act of 2014 introduced admission quotas for students with disabilities at all levels of education. In Spain, the Organic Law 4/2007 established measures to support these students in higher education, ensuring their right to free education, funding for personal assistance, and subsidized housing (Salmi and D'Addio, 2021).

3.2 Brazil

Law No. 12,711, enacted on August 29, 2012, regulates the admissions procedures for federal universities and federal technical secondary education institutions in Brazil. According to this law, 50% of the available seats must be reserved for students who have completed their entire high school education in public schools. Of the 50%, a minimum 25% are designated for public school students with a per capita family income of up to 1.5 minimum wages. Additionally, a minimum percentage corresponding to the sum of Black, mixed-race, and Indigenous students in the state, based on the latest demographic census, must be considered (Brasil, 2012).

In Brazil, Law No. 13,409, enacted on December 28, 2016, ensures access to higher education for people with disabilities. This law amended Law No. 12,711 from August 29, 2012, and requires federal educational institutions to reserve seats for students with disabilities in secondary and higher education programs. Additionally, these institutions must allocate seats for self-identified Black, mixed-race, and Indigenous students. The proportion of reserved seats must reflect the demographic composition of the state, based on the latest census. Figure A3 shows the distribution of seats according to student characteristics (Brasil, 2016).

In 2023, the legislation underwent revisions and was renamed Law No. 14,723, enacted on November 13, 2023. This law amends Law No. 12,711 from August 29, 2012, to "establish a special program for access to federal higher education institutions and technical secondary education for Black, mixed-race, Indigenous, and Quilombola students, as well as for people with disabilities. It also includes students who have completed their primary or secondary education in public schools." Another notable change was the reduction of the income threshold to one minimum wage (Brasil, 2023).

Additionally, quota candidates will first compete in the general admission pool. If they do not meet the minimum required admission score, they will then compete for the reserved quota seats. If the reserved seats remain unfilled based on these criteria, the remaining seats will be distributed to self-identified Black, mixed-race, Indigenous, Quilombola students, or individuals with disabilities (PWD). Following this, any remaining seats will go to students who have completed their entire high school education in public schools.

4 Data and Econometric Strategy

4.1 Data

The samples include enrolled and graduating students, with and without disabilities, in higher education in Brazil. These samples are classified by Federal Higher Education Institutions (FHEI) and specific courses. The data come from the Higher Education Census, conducted by the National Institute for Educational Studies and Research Anísio Teixeira[9] (Inep) and covers all higher education institutions in the country. The census gathers information on institutions, undergraduate courses, institutional characteristics, students, and

[9] "Inep is responsible for collecting data and evaluating the Brazilian educational systems at a national level."

faculty. FHEI submits their data to the Higher Education Census System (Censup), where the information is subsequently analyzed in conjunction with data from the e-MEC system. This research supports analysis, planning, and decision-making processes for stakeholders.

As the law applies to federal public universities, the focus is on their on-campus undergraduate programs. Although signed in 2016, the law took effect in 2017, and the data spans from 2013 to 2022 to assess the law's impact on the variables of interest. Additional data includes the Average Graduation Concept [10] (CMG), indicators from the Management Report of the Federal Court of Accounts (TCU), the total number of seats (QTV) per FHEI, and the total number of courses (QTC) per FHEI. The selection of these variables was based on their impact on student enrollment and graduation rates, and their relevance in assessing the effect of increased student numbers on course quality.

The Management Report provides annual accountability for universities to the Federal Court of Accounts (TCU). It includes university performance indicators, calculated based on student characteristics, faculty qualifications, and available facilities. The key indicators used are the Graduation Success Rate[11] (TSG), Student Participation Rate[12] (GPE), and Faculty Qualification Index [13](IQCD).

The study categorized students into two groups: enrolled and graduated, further dividing them into those with and without disabilities. The analysis excludes universities established during the period, considering only those present throughout all years. This approach supports the hypothesis of a balanced sample, allowing for accurate model estimation.

The analysis will use two datasets with different units of observation: Courses and Federal Higher Education Institutions (FHEI). Both datasets include enrolled and graduated students, with and without disabilities. The FHEI dataset aggregates the total number of students at each university, based on data provided for each course. The Courses dataset utilizes course-specific data, considering the academic field of each course.

4.2 Empirical Strategy

To assess the impact of the quota policy on students with disabilities, the Differences-in-Differences (DID) method will be applied. Two distinct analysis will be conducted - one to evaluate the policy's effect on total enrollments and another to measure its impact on total graduations. For each analysis, these effects will be estimated using datasets from Higher Education Institutions and their respective courses.

Given its federal nature, Law No. 13,409 of December 28, 2016, universally applies to all Federal Higher Education Institutions (FHEI). Therefore, the universal impact of the quota policy on all universities complicates the construction of a control group for model application. To address this, the identification strategy in this study utilizes the group of students without disabilities to represent the counterfactual scenario for the group of interest, assuming the policy had not been enacted. This approach follows the methodology of Cerqueira et al. (2015), developed by the Institute for Applied Economic Research (IPEA), which used the group of men as a control to estimate the effect of Law No. 11,340/2006, known as the Maria da Penha Law (LMP), on the rate of homicides occurring within residences.

A study by Vieira and Arends-Kuenning (2019) conducted a similar analysis, examining the enactment of quota policies in universities and their impact on the enrollment of disadvantaged students in Brazil. The researchers compared the demographic and socioeconomic characteristics of students enrolled in colleges that adopted their quota policies (treated)

[10] "The average of continuous scores for Preliminary Course Concepts (CPC), weighted by the number of enrollments in the respective undergraduate courses, and considering the most recent valid CPC for each course."

[11] "Calculated as the ratio of graduates to new entrants, adjusted for the year of entry and the expected duration of study as specified by SESu/MEC for each course."

[12] "Measures the proportion of full-time undergraduate students relative to the total undergraduate enrollment."

[13] "Evaluates the quality of the faculty on a scale from 1 to 5."

and those that did not (control). Using the Differences-in-Differences model, they found that universities with quota policies experienced a significant increase in the enrollment of students from vulnerable groups, including those from low-income backgrounds and Black students (Vieira and Arends-Kuenning, 2019).

To measure the causal impact of implementing the quota policy for people with disabilities on total enrollments and graduations in higher education over time, a panel data estimation approach is employed. As a generalized extension of the 'Differences-in-Differences' or Two-Way Fixed Effects (TWFE) models, this approach accounts for fixed factors usually in space and time (Clarke and Tapia-Schythe, 2021). The TWFE model evaluates the law's impact by regressing the outcome variable while considering the fixed effects of universities and time, along with the policy enactment (de Chaisemartin and D'Haultfœuille, 2020). It is important to note that the equation for the enrollment model does not include covariates, as the law guarantees entry regardless of other factors. However, this does not hold for the graduation model, as retention and graduation rates are influenced by additional factors beyond the scope of the law.

$$Enrollments_{it} = \alpha_i + \alpha_t + \beta_1 D_{it} + u_{it} \quad (1)$$

$$Graduates_{it} = \alpha_i + \alpha_t + \beta_1 D_{it} + X_{it}\gamma + u_{it} \quad (2)$$

In the FHEI and course datasets, the analysis focuses on the outcome variables: Total Enrollments and Total Graduations for FHEI or Course i at time t. The treatment variable is specified as $D_{it} = \text{treatment}_i \times \text{post}_{it}$, where treatment is a binary indicator equal to 0 for individuals without disabilities and 1 for individuals with disabilities. The post-treatment indicator, post_{it}, equals 1 for $t \geq 2017$ and 0 for $t < 2017$. The model includes α_i as the fixed effect for university or course, α_t as the fixed effect for time, and u_{it} as the error term. Where Y_{it} denotes the outcome variable (Total Enrollments or Total Graduations) for FHEI or Course i at time t. The coefficient β represents the causal effect of the quota policy on the specified outcome.

The model equation for graduates considers factors that may affect a student's likelihood of graduating from higher education. Therefore, the model incorporates covariates, represented by X_{it}, a vector comprising the following variables: Average Graduation Score, Total Seats per FHEI, Total Courses per FHEI, Graduation Success Rate, Student Participation Rate, and Faculty Qualification Index.

5 Descriptive Statistics

The descriptive statistics summarize the average enrollments and graduations before (2013 to 2016) and after (2017 to 2022) the policy enactment. The results in Table 1 show a 29.8% increase in the number of enrollments and a 1.2% decrease in the number of graduations for students with disabilities at the universities. Conversely, the number of enrollments for students without disabilities remained nearly unchanged, suggesting that the quota policy for students with disabilities did not affect this group over time. However, these values are merely descriptive and thus require more robust econometric techniques to evaluate the policy's impact.

A crucial point in Table 1 is the disparity between the number of students enrolling and those graduating. On average, among universities, regardless of the group analyzed, enrollment numbers exceed graduation numbers. This result suggests a potential issue within federal public universities, likely stemming from factors such as inadequate faculty and administrative preparation, financial difficulties, a hostile university environment, or the need to balance study hours with work commitments.

When analyzing the descriptive results by course, the findings align with the institutional results, showing a 34% increase in the number of enrollments for students with disabilities

Table 1: Descriptive Statistics of Enrollments and Graduations – IES

	Control				Treatment				
	Pre		Post		Pre		Post		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	t-test
Enrollments	4632.65	2475.80	4342.64	2398.46	44.53	115.96	57.80	61.38	4.588***
Graduates	1969.28	1247.23	1986.88	1264.48	15.76	37.97	15.57	30.97	1.953***
% Enrollments	0.0087	0.0188	0.9865	0.0110	0.0087	0.0188	0.0135	0.0110	0.982***
% Graduates	0.0068	0.0171	0.9922	0.0141	0.0068	0.0171	0.0078	0.0141	0.986***
Observations									1.540

Note: The t-test compares the means of the control and treatment groups before and after the intervention. Significance levels: *p<0.1; **p<0.05; ***p<0.01.

Table 2: Descriptive Statistics of Enrollments and Graduations – Courses

	Control				Treatment				
	Pre		Post		Pre		Post		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	t test
Enrollments	54.94	55.07	53.09	51.57	0.53	1.79	0.71	1.58	54.41
Graduates	23.36	31.77	24.29	30.32	0.19	0.84	0.19	0.72	23.17
Observations									125.912

per course, on average. It is also evident that, at the course level, the disparity between enrollments and graduations persists.

Table A1 presents the descriptive statistics for the selected covariates. On average, available seats increased by 4.6%, despite a 5.7% reduction in courses. Course grades, assessed by the Average Graduation Score (CMG), show improved student performance and enhanced faculty qualifications. Student participation remained stable, likely due to the consistent number of full-time students. Additionally, the Graduation Success Rate (TSG) slightly decreased, reflecting the higher number of enrollments compared to graduations.

6 Results

6.1 Federal Higher Education Institutions (FHEI)

Before presenting the results of the main model, it is necessary to conduct a parallel trends test[14] , using event study[15] estimates to examine the relationship between total enrollments and the enactment of the quota policy for students with disabilities. Figures A4 and A5 display the estimates of equations (1) and (2), using the event study for each year. The blue points represent the estimated parameters for each post-treatment year, while the red points represent the parameters for each pre-treatment year, along with their respective 95% confidence intervals. The year 2017 was used as a reference year and was excluded from the sample to avoid collinearity.

The figures indicate no pre-existing trends for total enrollments, suggesting that the quota policy for students with disabilities was likely the main factor driving changes in this variable over time. This finding supports the validity of the parallel trends assumption and strengthens our identification strategy. Pre-treatment effects on total graduations were significant, except in 2016, which calls for cautious interpretation of the results.

Table 3 presents the Average Treatment Effects on the Treated (ATT). The table displays causal effect estimates for total enrollments under two specifications: (1) without fixed effects for time and FHEI, and (2) with fixed effects for time and FHEI. The models reveal a positive and significant increase in the enrollment of students with disabilities, and this result

[14]The parallel trends test is essential to validate causal identification and ensure that the causal effects are indeed attributable to the Quota Law intervention, excluding the influence of other uncontrolled factors.

[15]The parallel trends test is conducted within a confidence interval, based on the estimated effect for each group and each year. If zero lies within the interval, the hypothesis is not rejected, indicating an absence of parallel trends.

persists even when accounting for fixed effects. Standard errors, provided in parentheses, are calculated with a 99% confidence interval.

This result supports the effectiveness of the policy in increasing enrollments for these students, providing a strong justification for maintaining this law. Additionally, the findings align with those of Estevan et al. (2019); Vieira and Arends-Kuenning (2019); Otero et al. (2021); and Mello (2022), which also reported increased enrollments through affirmative action policies in higher education. Furthermore, this outcome adds to the educational literature by addressing the gap in empirical studies evaluating the policy's impact on this target group. It also highlights the importance of affirmative policies, demonstrating that minority and disadvantaged groups are now gaining access to areas that were previously challenging to access due to various barriers.

Table 3: The effect of the policy on enrollments – FHEI

	(1)	(2)
ATT	303.283	303.283***
	(211.612)	(47.600)
Observations	1,100	1,100
Time-fixed effect	No	Yes
University-fixed effect	No	Yes
F Statistic	603.407***	40.596***
	(df = 3; 1096)	(df = 1; 980)

Note: Table 3 presents the effect of the quota policy on enrollments at the FHEI level. (1) without fixed effects for time and FHEI, and (2) with fixed effects for time and FHEI. Robust standard errors are reported in parentheses. Significance levels *p<0.1; **p<0.05; ***p<0.01.

Even though we cannot validate the causal effect estimates for total graduations due to the lack of parallel trends, the regression results are presented in Table A3. Three models were estimated: (1) without fixed effects for time and IFES; (2) with fixed effects for time and IFES; and (3) with fixed effects for time and IFES, including covariates. The first two models yielded negative but not statistically significant result. However, the inclusion of covariates along with fixed effects yielded a significant but still negative result. Since graduations did not meet the parallel trends assumption, careful interpretation of this result is necessary. Nevertheless, it suggests that although the policy increased enrollments, the number of graduations for students with disabilities did not rise.

Additionally, it is essential to emphasize the importance of policies that not only promote the enrollment of students with disabilities in higher education but also ensure the implementation of inclusive measures by universities to facilitate their retention and graduation. These policies should address not only physical accessibility issues, such as ramps and elevators, but also pedagogical and social aspects, providing academic, technological, and emotional support. The availability of resources such as sign language interpreters, accessible educational materials, adapted classrooms, and personalized tutoring programs is essential.

In this regard, Anache and Cavalcante (2018) examined the retention of students with disabilities at a federal public university. Their findings indicate that university infrastructure for students with disabilities remains inadequate. The curriculum, information systems, and faculty and administrative training lack inclusivity. Consequently, although students with disabilities receive incentives to enroll in higher education, they lack support to ensure their retention and graduation. Ensuring inclusion requires adequate infrastructure, accessible curricula and information, and properly trained faculty and administrative staff.

Additionally, to ensure the effectiveness of the policy, it is crucial to promote awareness and sensitivity within the academic community to address stigmas and prejudices. Creating

an inclusive environment that values diversity and fosters the educational success of all students, regardless of their abilities or limitations, is essential.

6.1.1 Robustness – IFES

The enrollment model included two robustness tests: (1) excluding universities that adopted quota policies before the official enactment, and (2) conducting a placebo test to measure the effect in a different year, specifically 2015. The first model, which excludes universities that implemented internal quota policies before 2016, examines institutions that had already adopted measures to facilitate the enrollment of students with disabilities. After excluding these universities, the model was re-estimated, and the results remained positive and significant.

For the placebo test, 2015 served as the policy start year. Selecting a random period before the actual enactment allows us to observe the behavior of the results. The results are expected to be insignificant or show a smaller effect since the policy year is anticipated by two periods. Table 4 corroborates this expectation, displaying a positive and significant impact, albeit smaller than the results of the main model.

Table 4: Robustness Tests for Enrollments – FHEI

	(1)	(2)
ATT	283.167***	170.661***
	(51.609)	(59.243)
Observations	866	1,100
Time-fixed effect	No	Yes
University-fixed effect	No	Yes
F Statistic	30.104***	8.298***
	(df = 1; 766)	(df = 1; 980)

Note: Table 4 presents the effect of the quota policy on enrollments at the FHEI level. (1) excluding universities that had adopted quota policies before the official enactment, and (2) performing a placebo test to measure the effect in a different year, specifically 2015. Robust standard errors are reported in parentheses. Significance levels *p<0.1; **p<0.05; ***p<0.01.

6.1.2 Heterogeneity – FHEI

With 27 Federative Units and a vast territory, Brazil naturally exhibits significant regional differences. Therefore, it is crucial to investigate the policy's effect in each region and examine their response following the law's enactment. Since the number of quotas at each university corresponds to the proportion of people with disabilities in the state, this analysis is crucial. Based on the event study shown in Figure A6, only the Central-West region failed the parallel trends test. Table 5 indicates that in all other Brazilian regions—Northeast, North, Southeast, and South—there was an increase in the number of enrollments. The North region experienced the highest growth. It is important to note that all the estimated coefficients were positive and significant, aligning with our hypothesis.

Although the Northeast has the highest percentage of PWD (10.3%), with eight of the ten states having the highest proportions, it shows the lowest proportion of people with disabilities completing higher education. Furthermore, it does not have the highest proportion of individuals with special needs registered for the Enem exam. This discrepancy manifests in the results, with the Northeast exhibiting the second lowest effect on the total enrollments of students with disabilities in federal universities.

Several factors may explain these results. First, inadequate educational infrastructure and accessibility in schools might hinder students with disabilities from completing basic education, resulting in low enrollment rates in the Enem exam. Second, insufficient awareness

and knowledge about rights and educational inclusion programs likely contribute to this issue. Without proper information, many individuals with disabilities may not register for the Enem or seek out programs like Sisu, Fies, and ProUni, which help provide access to higher education.

Table 5: The effect of the policy on enrollments – FHEIS – Regions

	Northeast	North	Central-West	South	Southeast
ATT	278.756***	351.292**	610.533***	331.509***	206.917***
	(99.250)	(153.498)	(210.828)	(117.252)	(54.795)
Observations	280	160	100	180	380
Time-fixed effect	Yes	Yes	Yes	Yes	Yes
University-fixed effect	Yes	Yes	Yes	Yes	Yes
F Statistic	7.888***	5.238**	8.386***	7.994***	14.259***
	(df = 1; 242)	(df = 1; 134)	(df = 1; 80)	(df = 1; 152)	(df = 1; 332)

Note: Table 5 presents the effect of the quota policy on enrollments at the FHEIS level across all regions. Robust standard errors are reported in parentheses. Significance levels *p<0.1; **p<0.05; ***p<0.01.

Interestingly, the results of the event study for graduates showed an opposite trend, with only the Central-West region passing the parallel trends test (Figure A7). Nevertheless, the result for this region was not significant (Table A3), indicating the policy's ineffectiveness in increasing the number of graduates.

6.2 Courses

Considering the course-level analysis, estimations were conducted only for enrollments, as there were no parallel trends for graduates. Since only the enrollment data indicated the absence of pre-existing trends (Figure A8), we infer that the law impacted the enrollment of students with disabilities in courses. Therefore, only two models were estimated: (1) without fixed effects for time and course, and (2) with fixed effects for time and course. Both models indicate a significant increase in enrollment in federal public university courses.

The model without fixed effects shows an average increase of two students per course. However, with the inclusion of fixed effects, this number rises to nearly five students per course. These findings indicate that, on average, courses enroll more students with disabilities following the law's enactment. These results align with the findings from the FHEIS estimations and the existing literature on the impact of affirmative action policies in higher education. The observed impact across all courses suggests a widespread effect of the law, rather than a concentration in a select group of courses.

Table 6: The effect of the policy on enrollments – Courses

	(1)	(2)
ATT	2.034***	4.604***
	(0.506)	(0.189)
Observations	91,090	91,090
Time-fixed effect	No	Yes
Course-fixed effect	No	Yes
F Statistic	15,280.090***	595.290***
	(df = 3; 91086)	(df = 1; 80414)

Note: Table 6 presents the effect of the quota policy on enrollments at the course level. (1) without fixed effects for time and course, and (2) with fixed effects for time and course. Robust standard errors are reported in parentheses. Significance levels *p<0.1; **p<0.05; ***p<0.01.

6.2.1 Heterogeneity – Courses

The impact of the law across different academic disciplines was examined through a heterogeneous effects analysis for each Area of Knowledge[16]. The choice of a higher education course likely considers professions that are more inclusive and offer opportunities for people with disabilities. Among the eight Areas of Knowledge, Biology, Humanities, Social Sciences, and Engineering did not pass the parallel trends test (Figure A9). Exact and Earth Sciences, Health Sciences, Agricultural Sciences, and Linguistics, Letters, and Arts passed the tests and showed a significant increase in the number of enrollments for students with disabilities.

Linguistics, Letters and Arts, Exact and Earth Sciences, and Health Sciences yielded statistically significant results only when fixed effects were included. In contrast, Agricultural Sciences exhibited a significant increase in enrollments across both estimation models. The findings indicate that the policy's impact is broad and significant across diverse fields of study. Although some areas did not pass the parallel trends test, the law still had a substantial impact on all fields.

[16]The areas defined by CNPq are: Exact and Earth Sciences, Biological Sciences, Engineering, Health Sciences, Agricultural Sciences, Social Sciences, Humanities, Linguistics, Literature, and Arts.

Table 7: The effect of the policy on enrollments – Courses – Area of Knowledge

	Engineering		Agricultural Sciences		Biology		Health Sciences	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
ATT	5.610***	5.627***	6.374***	6.466***	2.091	3.984***	1.746	2.941***
	(1.194)	(0.456)	(1.489)	(0.630)	(1.309)	(0.558)	(1.220)	(0.440)
Observations	13,656	13,656	5,140	5,140	4,164	4,164	9,568	9,568
Time-fixed effect	No	Yes	No	Yes	No	Yes	No	Yes
Course-fixed effect	No	Yes	No	Yes	No	Yes	No	Yes
F Statistic	3,221.570***	152.400***	2,559.107***	105.225***	1,484.876***	50.941***	4,218.007***	44.660***
	(df = 3; 13652)	(df = 1; 12092)	(df = 3; 5136)	(df = 1; 4566)	(df = 3; 4160)	(df = 1; 3674)	(df = 3; 9564)	(df = 1; 8500)

	Exact and Earth Sciences		Humanities		Applied Social Sciences		Linguistics, Letters, and Arts	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
ATT	2.612	4.696***	1.413	6.334***	3.265**	5.280***	−0.931	2.028***
	(1.719)	(0.463)	(1.096)	(0.621)	(1.448)	(0.548)	(0.855)	(0.411)
Observations	15,512	15,512	14,512	14,512	13,090	13,090	15,220	15,220
Time-fixed effect	No	Yes	No	Yes	No	Yes	No	Yes
Course-fixed effect	No	Yes	No	Yes	No	Yes	No	Yes
F Statistic	1,275.638***	102.826***	2,343.709***	104.141***	3,548.666***	92.991***	1,859.856***	24.382***
	(df = 3; 15508)	(df = 1; 13698)	(df = 3; 14508)	(df = 1; 12674)	(df = 3; 13086)	(df = 1; 11592)	(df = 3; 15216)	(df = 1; 13338)

Note: Table 7 presents the effect of the quota policy on enrollments at the course level across all areas of knowledge. (1) without fixed effects for time and course, and (2) with fixed effects for time and course. Robust standard errors are reported in parentheses. Significance levels *p<0.1; **p<0.05; ***p<0.01.

Higher education is essential for enabling people with disabilities to enter the labor market and achieve higher earnings. Barbosa Filho and Moura (2015) analyzed the impact of education level and informality using data from the National Household Sample Survey (PNAD) and the Monthly Employment Survey (PME). They found that higher levels of education, specifically the completion of higher education, significantly reduce the degree of informality in employment.

Costa et al. (2022) evaluated the effect of occupational mobility on the wages of rehabilitated workers in Brazil. Their analysis showed that, although workers experienced an increase in hourly wages after rehabilitation, this effect did not persist over time. This outcome is explained by workers seeking higher educational qualifications, and prioritizing activities requiring more specific knowledge. These findings highlights the importance of policies that ensure access to education, including schools, higher education, and vocational training programs.

Regarding workers with disabilities employed in the formal labor market, an analysis of microdata from the Annual Social Information Report (RAIS) reveals their distribution across economic sectors[17] and occupations[18]. In 2022, among formal employees with disabilities who had completed higher education, 21.8% held positions in Public Administration. Other sectors with a significant number of workers with disabilities include Education (10.4%), Financial Services (10.1%), Health (6.9%), Office and Administrative Support Services (5.9%), Information Technology (3.8%), and Retail and Wholesale Trade (3.3%).

Within occupations with the highest prevalence of workers with disabilities who have completed higher education, RAIS data show that 13.8% worked as Administrative Assistants, 6.0% as Office Assistants, and 4.2% as Bank Clerks. Other notable professions include Administrators (3.1%), Systems Development Analysts (2.6%), Nurses (2.2%), and Teachers of Youth and Adult Education in Elementary Schools (2.0%). These professions differ from the fields of study most impacted by the law.

Given the results showing the areas most impacted by the quota policy for students with disabilities in higher education and the occupations employing the most people with disabilities, a more robust analysis is necessary. Future research should examine whether there is a matching between supply and demand. Specifically, it would be valuable to determine if university education aligns with labor market needs.

Additionally, it is essential to consider policies that support individuals with disabilities across all sectors, including education, health, and employment. Education opens doors for PWD to enter higher education and integrate into the formal labor market. Merely encouraging higher qualifications is insufficient; policymakers must develop proposals to make education more equitable and accessible. It is crucial to ensure that students not only enroll but also persist and graduate.

Based on the findings of this study, the law has positively influenced the enrollment of students with disabilities. This increase spans multiple academic disciplines, rather than being confined to a few courses. However, areas for improvement remain, such as addressing the fact that over 60% of the population with disabilities has not completed elementary education (PNADC Annual, 2022). It is crucial to find ways to encourage high school students to take the Enem, highlighting the attainable pathways available. Most importantly, education must be inclusive at all levels.

[17]The economic activities were analyzed according to the divisions of the National Classification of Economic Activities (CNAE).

[18]The analysis utilized the Occupational Codes from the Brazilian Classification of Occupations (CBO).

7 Conclusion

This study aimed to contribute to the education literature by evaluating the impact of Law No. 13,409, dated December 28, 2016, on the total enrollments and graduation rates of students with disabilities in higher education. Additionally, it presented a heterogeneous effects analysis for different Brazilian regions and major academic disciplines.

This analysis employed data from the Higher Education Census on enrollments and graduations, educational quality indicators from Inep, and management indicators from the TCU Report, spanning 2013 to 2022. The observations were categorized into a treatment group of students with disabilities and a control group of students without disabilities. Estimations were conducted at the institutional and course levels using the TWFE model, incorporating fixed effects.

The estimated model for FHEIS showed a significant increase in the number of students with disabilities enrolling in higher education. These results remained robust, passing the parallel trends test and the robustness checks. The robustness tests simulated two scenarios: one excluded universities that had implemented any policy before 2016, and the other used a placebo test with the policy start year set to 2015. Regional analysis also confirmed robustness, except for the Central-West region, which did not exhibit parallel trends in the pre-treatment period. Other regions displayed positive and significant enrollment effects. The Northeast, where 10.3% of the population has disabilities and eight of the ten states have the highest proportions, shows the lowest rate of people with disabilities completing higher education. Additionally, it does not have the highest proportion of individuals with disabilities registered for the Enem. This discrepancy appears in the results, with the Northeast showing the second-lowest effect on total enrollments of students with disabilities in federal universities.

The course dataset included models with and without fixed effects. The analysis revealed a positive and significant increase in the enrollment of PWD during the period, consistent with the results found for higher education institutions. The heterogeneous effects were estimated by Field of Study, given the importance of this choice for entering the labor market, especially for individuals with disabilities, as some occupations offer better employment opportunities and are more inclusive. Among the 8 fields, only Linguistics, Letters and Arts, Exact and Earth Sciences, Health Sciences, and Agricultural Sciences showed significant results. The results for graduates generally showed negative and significant effects, and in some cases, insignificant effects. These findings require caution, as they did not pass the parallel trends test at the FHEIS and course levels.

Highlighting the importance of measures for admitting students with disabilities to higher education is crucial. Universities must adopt comprehensive policies to facilitate their retention and graduation. These policies should address physical accessibility issues, such as ramps and elevators, and pedagogical and social aspects, providing academic, technological, and emotional support. Resources such as sign language interpreters, adapted learning materials, accessible classrooms, and personalized tutoring programs play a crucial role. Additionally, promoting awareness and sensitivity within the academic community is essential to combat stigmas and prejudices. Creating an inclusive environment that recognizes diversity and promotes the educational success of all students, regardless of their abilities or limitations, is vital.

Another critical issue involves the lack of preparation among university faculty to teach inclusive classes to students with disabilities. Many educators enter academia without adequate training in inclusive pedagogical strategies, accessible technological resources, and approaches to address the specific needs of students with disabilities.

The lack of preparation causes difficulties in modifying the curriculum, implementing differentiated teaching practices, and effectively communicating with students with disabilities. These challenges create unequal learning experiences, undermine students' academic

potential, and compromise the goals of inclusion in higher education, thus hindering retention and graduation. Therefore, investing in professional development and training programs for faculty is vital. These programs should equip teachers with the skills and knowledge necessary to effectively address the diverse needs of students with disabilities and promote a more inclusive and equitable educational environment.

Based on the results of this study, further research can explore why these students struggle to persist and graduate. Future studies could measure their academic performance and examine how they integrate into the labor market. Investigating the paths they take and the long-term effects of the policy is challenging but necessary to integrate this group into society better and understand their role.

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Appendix A

Figure A1: Proportion of People with Disabilities in Brazilian States - 2022

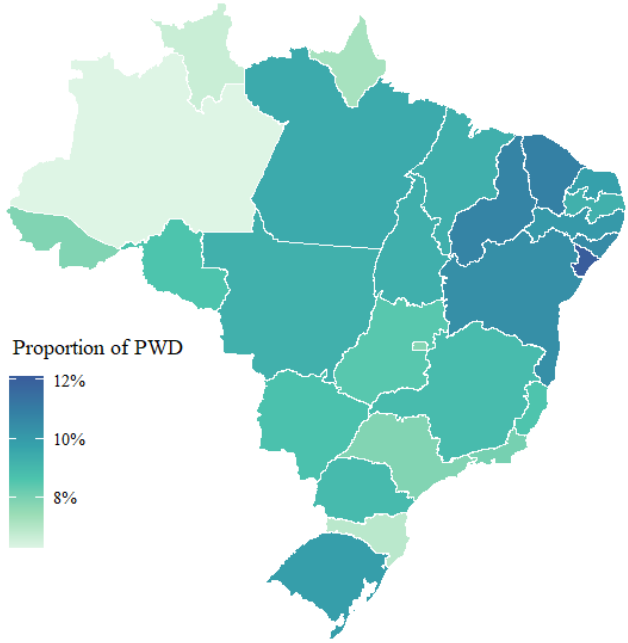

Figure A2: Proportion of Enem Applicants with Disabilities by Brazilian State - 2022

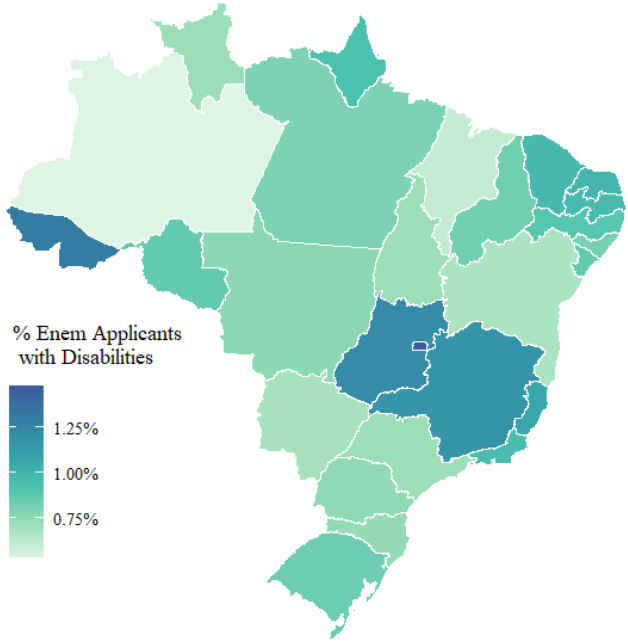

Figure A3: Quota System in Higher Education – FHEIS

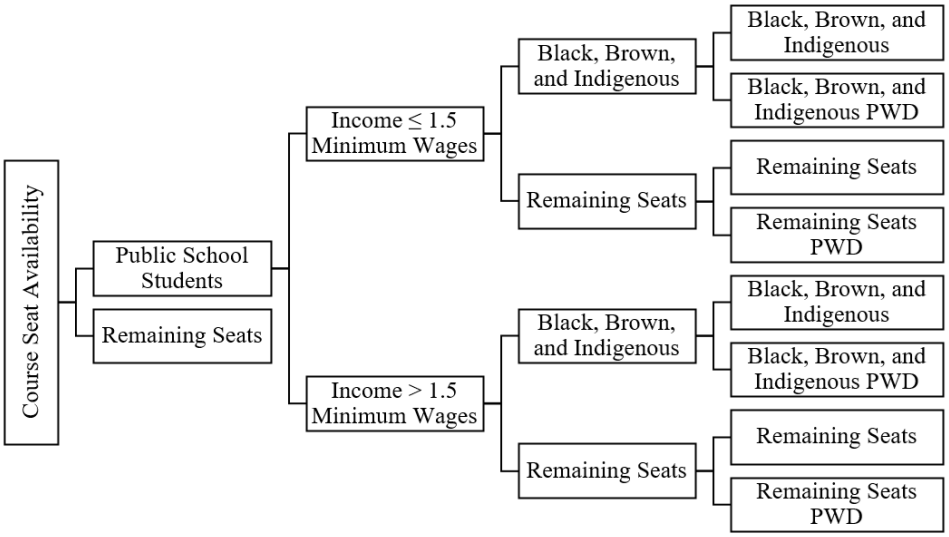

Table A1: Descriptive Statistics of Covariates

	Pre-Treatment		Post-Treatment	
	Mean	SD	Mean	SD
QTC	112.73	43.25	106.35	39.86
QTV	71.58	67.30	74.77	70.45
CMG	0.01	0.05	0.01	0.04
GPE	0.73	0.13	0.73	0.20
IQCD	4.23	0.35	4.50	0.28
TSG	42.99	20.43	41.05	18.53

Figure A4: The effect of the policy on enrollments – FHEIS

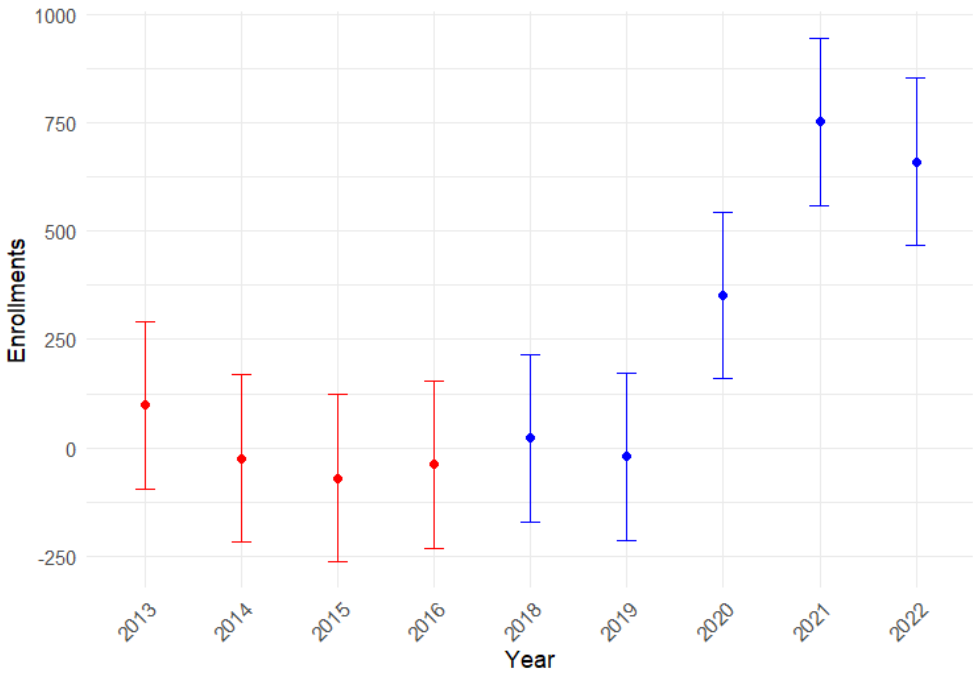

Figure A5: The effect of the policy on graduates – FHEIS

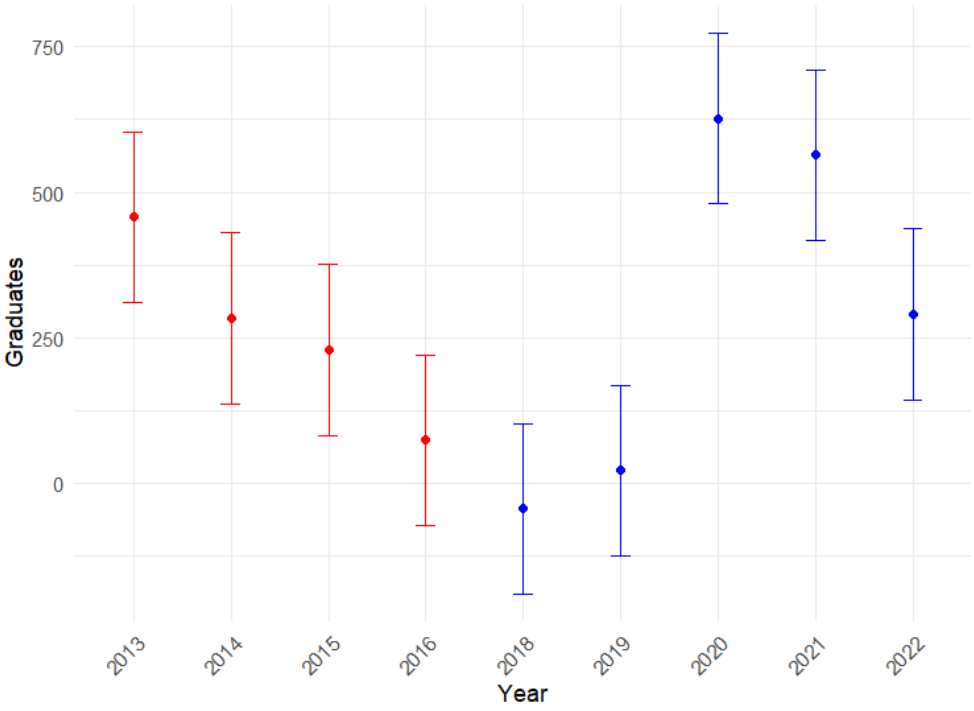

Table A2: The effect of the policy on graduates – FHEIS

	(1)	(2)	(3)
ATT	−17.791	−17.791	−119.963***
	(109.501)	(37.107)	(34.539)
TSG			3.263***
			(1.026)
IQCD			−218.839**
			(85.447)
GPE			89.675*
			(50.437)
CMG			−6.340
			(87.185)
QTC			0.874
			(1.252)
QTV			0.003
			(0.010)
CA			24.218
			(119.754)
Observations	1,100	1,100	864
Time-fixed effect	No	Yes	Yes
University-fixed effect	No	Yes	Yes
F Statistic	446.903***	0.230	5.057***
	(df = 3; 1096)	(df = 1; 980)	(df = 8; 741)

Note: Table A2 presents the effect of the quota policy on graduates at the FHEIS level. (1) without fixed effects for time and course, (2) with fixed effects for time and course, and (3) with fixed effects for time and course and with covariates. Robust standard errors are reported in parentheses. Significance levels *p<0.1; **p<0.05; ***p<0.01.

Figure A6: Event-study analysis of enrollments – FHEIS and Regions

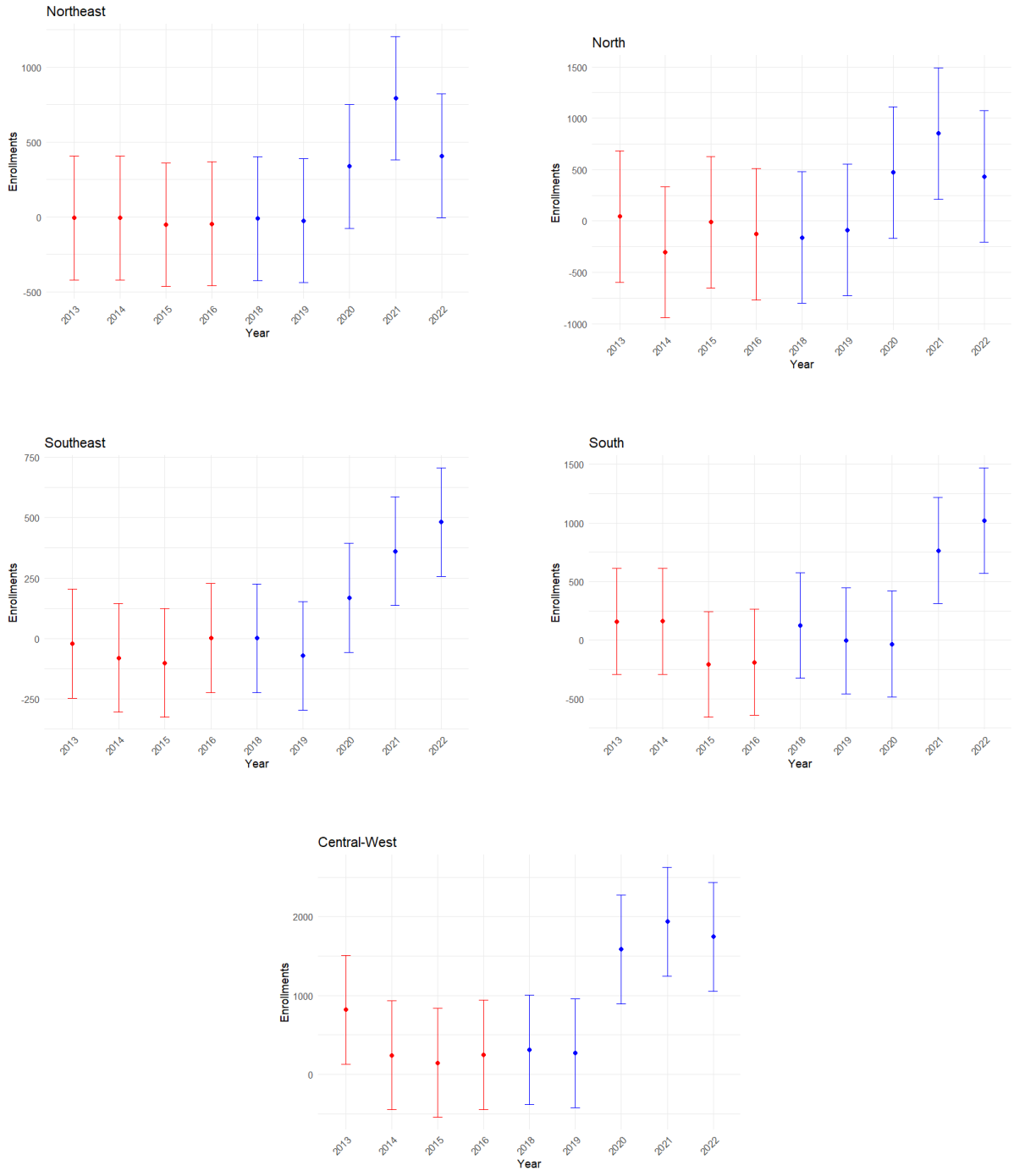

Figure A7: The effect of the policy on graduates – FHEIS – Regions

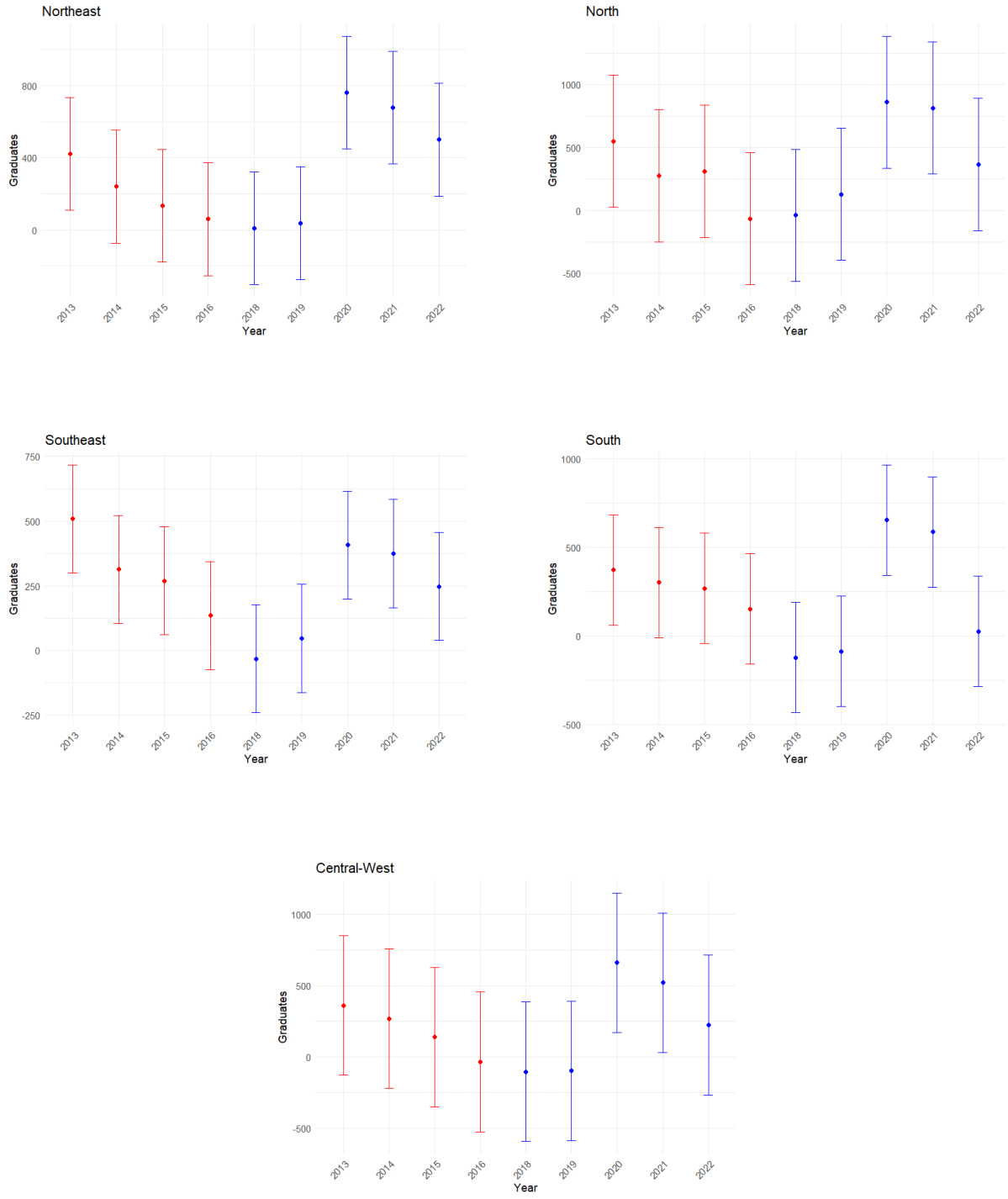

Table A3: The effect of the policy on graduates – FHEIS – Regions

	Northeast	North	Central-West	South	Southeast
ATT	−33.018	−42.062	−103.750	−179.444**	−196.972***
	(63.716)	(124.325)	(124.254)	(76.004)	(49.620)
TSG	3.437**	1.594	0.667	8.065**	2.148
	(1.702)	(3.048)	(12.102)	(3.740)	(1.724)
IQCD	−170.418	−297.621	−63.315	−164.621	−103.553
	(208.590)	(281.022)	(473.681)	(342.243)	(113.384)
GPE	−30.429	958.772***	928.642	527.102	53.453
	(76.507)	(271.012)	(1,049.196)	(348.405)	(66.798)
CMG	−135.306	435.191	405.150	−260.023	3.391
	(165.703)	(324.232)	(444.458)	(258.477)	(140.882)
QTC	3.145	−7.126**	9.969**	0.435	5.774*
	(2.570)	(3.405)	(3.801)	(3.727)	(3.311)
QTV	−0.008	0.079	−0.049	0.003	−0.002
	(0.024)	(0.055)	(0.042)	(0.023)	(0.015)
CA		−3.937			192.899
		(228.726)			(178.947)
Observations	224	128	80	144	288
Time-fixed effect	Yes	Yes	Yes	Yes	Yes
University-fixed effect	Yes	Yes	Yes	Yes	Yes
F Statistic	0.948	2.804***	1.446	3.584***	3.348***
	(df = 7; 182)	(df = 8; 97)	(df = 7; 56)	(df = 7; 112)	(df = 8; 237)

Note: Table A3 presents the effect of the quota policy on graduates at the FHEIS level across all regions. Robust standard errors are reported in parentheses. Significance levels *p<0.1; **p<0.05; ***p<0.01.

Figure A8: Event-study analysis of enrollments - Courses

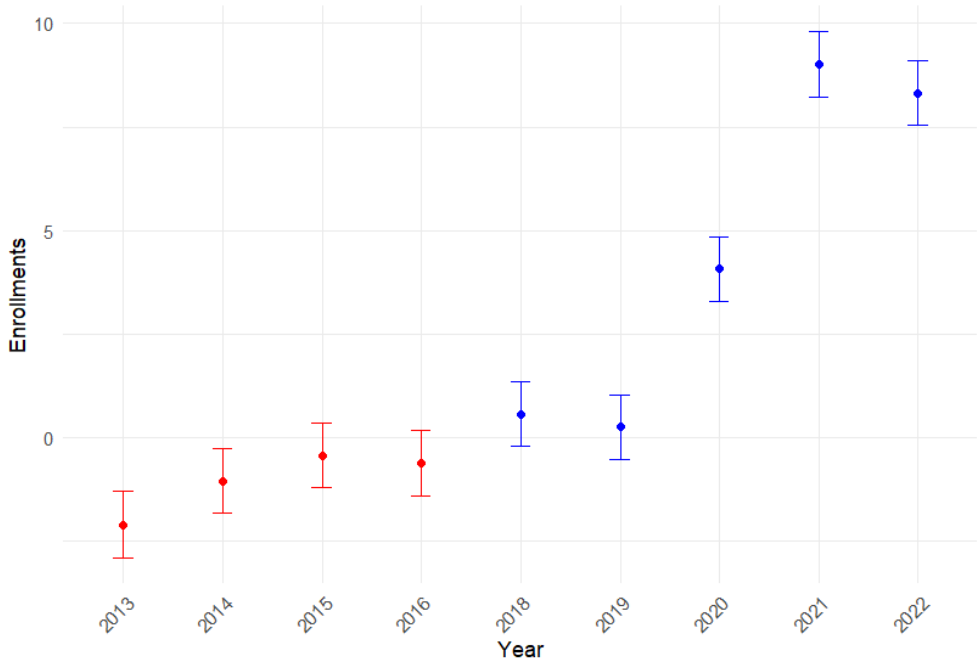

Figure A9: Event-study analysis of enrollments – Courses – Areas of Knowledge