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Affirmative action with no major switching

Evidence from a top university in Brazil

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Abstract: Affirmative action in higher education may lead to mismatch, a situation where students benefiting from preferential admission struggle with their college-level work because of poor pre-college academic preparation. In the United States, those students can switch majors if they underperform in the originally intended major. Only in the extreme may they drop out. What happens when major switching is not allowed? In this paper, we examine the margins of adjustment for beneficiaries of affirmative action in a top university in Brazil, where prospective students must choose a major prior to the entrance test, and cannot switch it while in college. Surprisingly, we do not find a larger effect on dropout rates relative to the United States, and also provide evidence of strong catching up for students who remain in school. Because they fail more courses early on, to successfully graduate students benefiting from preferential admission end up reducing the number of credit hours taken in the first and second college years, but compensate by taking more credit hours in the final years.

Key words: affirmative action, major switching, margins of adjustment, higher education, Brazil

JEL classification: I23, I24, I28, J15

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1 Introduction

Switching majors is common in education in the United States: about one-third of college graduates switch majors at least once. Misperceptions about the ability to perform well in a major and low grades in the first courses in college are among the top determinants of switching rates.[1] Because a key concern in the debate over affirmative action in college admissions is mismatch—a situation where students benefiting from preferential admission policies struggle with their college work due to poor pre-college academic preparation—major switching may help disadvantaged students graduate.[2] On the other hand, if minority students end up in less prestigious and lucrative majors after the switch, they may experience a lower return to college education.[3] What happens if major switching is not an option? How would students adjust to new information about their initial performance in college?

In this study, we examine the margins of adjustment used by students benefiting from affirmative action in a setting where switching majors is not allowed. In Brazil, prospective students usually take a university-specific entrance test—the so-called 'vestibular'—and must choose a major before the exam. Prospective students compete with others only within the chosen major, and admissions are solely based on the vestibular score. Once in college, students cannot switch majors. If their expectations about the major are not realized, they may decide to drop out. Dropping out is costly, however; it means forgone time in the labour market or in pursuing another major. But if they are interested in another major they must retake the vestibular, which is usually held only once per year. Students dropping out is also costly for universities; they will have a reduced cohort moving forward. If students decide to stay, they face another rigidity: the curriculum. In Brazil, students have relatively few options for elective courses; only about 6 per cent of the courses are elective. This reduces students' margins of adjustment when experiencing adversities in college.

The context of our study is the Federal University of Bahia (UFBA), which was the second federal university in Brazil to adopt affirmative action policies (quotas, hereafter), in 2005. This policy reserves 45 per cent of the available slots for students who attended public schools, usually from low-income households. Out of the reserved slots, 85 per cent must be filled by Black and mixed-race students. Besides the clarity of the eligibility rules, three other features contribute to make this setting unique and ideal for our analysis. First, UFBA is the second largest university in the Northeast region, and one of the top 15 universities in Brazil. The UFBA diploma is an attractive signal for employers. Second, UFBA is tuition-free, which enables students from low-income families to pursue a college degree. Third, Bahia is the Brazilian state with the highest share of Black and mixed-race population—almost 85 per cent of the state population—so the pool of potential beneficiaries is not small.

In order to assess the impacts of quotas on student progress at UFBA, we use a difference-in-differences strategy leveraging the pioneering implementation of the policy in 2005 and the formal rules of the affirmative action programme. Eligibility requires that students complete all years of high school and at least one year of elementary or middle school in a public institution, so students cannot manipulate the criterion in the short term. Notwithstanding, we restrict our sample to the period 2003–06, two years before and two years after the policy was put in place. This sample restriction may also avoid

[1] See, for example, Astorne-Figari and Speer (2019) and Stinebrickner and Stinebrickner (2014b).

[2] In a counterfactual analysis, Bordon and Fu (2015) find that allowing students to choose a major after enrolling in college disproportionately benefits female, low-income, and/or low-ability students.

[3] In the context of Duke University, for instance, Arcidiacono et al. (2012) show that, conditional on gender, African Americans were more likely than White students to have an initial major in the sciences. Nevertheless, over half of African American males finished in the humanities or social sciences compared to only 8 per cent of White males. A similar pattern of low persistence in science majors has been found among underrepresented minority students in the University of California system (Arcidiacono et al. 2016). For the return to different majors, see Kirkeboen et al. (2016).

issues related to the potential creation of new majors over time. New majors might change prospective students' choices, possibly changing the pool of candidates for each major. As usual with difference-in-differences approaches, our identification strategy relies on the parallel trends assumption, which seems supported by the empirical evidence we provide.

We leverage rich UFBA administrative data to assess the impacts of quotas and explore the mechanisms of adjustment used by quota students after they enrol in the university. The data set contains the history of each student in the university from the application process until graduation (or dropout), including entry exam scores, courses taken while in college and the respective grades, course failures, number of credits taken each term, and time to graduate (or to drop out). Besides the comparison between quota and non-quota students, our analysis also considers two distinct groups of quota students—the first consists of students who would have been admitted even without affirmative action, and the second consists of those who were only admitted because of the policy.

Our results indicate that UFBA's affirmative action policy succeeded in targeting disadvantaged students, increasing the share of former public school students from 0.27 to about 0.50. The estimation without controlling for initial ability—as measured by the entry exam score as in Bagde et al. (2016)— reveals that quota students obtained a lower grade point average (GPA) in the initial years in college, but the gap reduced by 50 per cent by the time they graduated, suggesting some catching up. Quota students also had about 8 per cent lower probability of graduating. Controlling for initial ability, however, this probability reduces to about 5 per cent. When the analysis distinguishes the two groups of quota students defined above, the results suggest that the difference in academic achievement is driven by students who were only admitted because of the affirmative action policy. Also, the difference is driven mostly by quota students in technology majors,[4] likely because they lack fluency in basic math skills.

When we look at the margins of adjustment, our analysis reveals that quota students failed more courses in their first few years in college, lowering their GPA in comparison to non-quota students. This seems to go on until the fifth college semester. They also reduced the number of credit hours in the first and second college years, probably to focus on fewer courses and improve their learning. Because we find no difference in time to graduate conditional on not dropping out, this means that quota students tended to successfully take more courses and credit hours than non-quota students in their last years in college. These margins of adjustment may explain the 50 per cent drop in the GPA gap by graduation.

This paper makes two main contributions to the literature and policy-making. First, to the best of our knowledge, this is the first study to explore the mechanisms of adjustment used by quota students in a college setting with no major switching. Prior studies have highlighted the usefulness of major switching to improve matching, performance, and the return to college education (e.g., Altonji et al. 2016, 2012; Arcidiacono 2004, 2005; Arcidiacono et al. 2012, 2016; Astorne-Figari and Speer 2018, 2019; Bordon and Fu 2015; Stinebrickner and Stinebrickner 2014a,b, 2012). Nevertheless, while major switching might improve the overall college experience of disadvantaged groups, it might lead to a decrease in the return to college education because of the potentially low labour market prospects of the ultimate graduating major (e.g., Arcidiacono et al. 2012, 2016; Astorne-Figari and Speer 2018, 2019; Griffith 2010; Ost 2010; Price 2010). Although we find a relatively small decline in graduation rates among quota students consistent with evidence from the United States (e.g., Hinrichs 2014), our results point to alternative mechanisms of adjustment to ultimately graduate in the originally intended major. This is an important finding because affirmative action has been shown to improve social mobility via access to more prestigious and lucrative majors (e.g., Alon and Malamud 2014; Estevan et al. 2019a).

[4] Technology majors are roughly equivalent to STEM majors in the United States. They encompass engineering, computer science, and math-related courses. The full list of technology majors can be seen in *Area I* at https://www.ufba.br/cursos?qt-cursos_quicktabs=0#qt-cursos_quicktabs.

The second contribution relates to the impacts of affirmative action in higher education regarding targeting and mismatch in a setting without major switching. When switching is allowed, most studies have found that the policy was successful in increasing diversity in higher education without much distortion, but the evidence on mismatch has been mixed.[5] Reassuringly, our results for targeting are similar to this broad literature, but for mismatch are mostly consistent with Rothstein and Yoon (2008a,b)—while we find no evidence of mismatch for quota students with moderate or strong entering credentials, there seems to be some mismatch for less-qualified students who would have not been admitted to the university without affirmative action. Once we control for initial ability, however, such a mismatch virtually disappears. The only other studies that have examined these issues in settings with no major switching—other universities in Brazil—are Francis and Tannuri-Pianto (2012a,b) and Estevan et al. (2019b), but they focus primarily on targeting.

The remainder of the paper is structured as follows. Section 2 sheds light on the context in which we examine the impacts of affirmative action in higher education. Section 3 introduces the analytical framework. Section 4 describes the data and some descriptive evidence of the impact of quotas on UFBA's students. Section 5 presents our empirical strategy. Section 6 reports the estimation results and discusses the mechanisms through which the quota students adjust to the reality of higher education at UFBA. Finally, Section 7 provides some concluding remarks.

2 Institutional background

UFBA is the best university in the state of Bahia and among the top universities in Brazil.[6] Until 2013, the university admitted students solely based on the performance on its annual entrance test—the 'vestibular'.

The vestibular was composed of two parts. The first part comprised five multiple-choice exams covering reading comprehension, humanities, natural sciences, math, and foreign language. Every year, all candidates would take the same exam, no matter the major they had chosen. Every student must choose a major before the test, and would compete only with other prospective students aiming at the same major.

Applicants were able to take the second part of the vestibular if they obtained a major-specific minimum score on the first part. This minimum score was determined so that there would be three candidates competing for each slot available in that major. In the second part, each student would take a specific exam on the courses related to the major chosen, and write an essay.[7] After completing the two parts of the vestibular, prospective students would be ranked based on the sum of the scores in both parts of the examination.

As mentioned above, an important characteristic of all Brazilian public, tuition-free, federal universities is that the students must choose a major before the vestibular, and cannot switch majors while in college.

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[5] See, for example, Long (2004a,b), Card and Krueger (2005), Krueger et al. (2006a,b), Bertrand et al. (2010), Howell (2010), Arcidiacono et al. (2011, 2012, 2015, 2016), Backes (2012), Frisancho and Krishna (2012), Hinrichs (2012), Antonovics and Backes (2014); Antonovics and Sander (2013), Arcidiacono and Lovenheim (2016), Bagde et al. (2016), Bleemer (2019), Black et al. (2020).

[6] See, for example, the ranking of Brazilian universities created by a major news outlet in Sao Paulo (*Folha de S.Paulo*) at https://ruf.folha.uol.com.br/2019/ranking-de-universidades/principal/. In relative terms, the position of UFBA in that ranking is equivalent to the position of the University of California–Davis or the University of Texas at Austin in the US news ranking of public universities: https://www.usnews.com/best-colleges/rankings/national-universities/top-public.

[7] For example, applicants for mechanical engineering would take three exams—mathematics, physics, and chemistry—and write an essay.

In some universities there is a specific exam that students can take to transfer majors, but this exam does not happen frequently and the number of slots for each major depends on administrative board decisions based on dropouts. At UFBA, only 3.18 per cent of all students switched majors between 2003 and 2012.

UFBA was the second federal university to adopt an affirmative action policy in Brazil.[8] According to the policy announced in 2004 and implemented from 2005 onward, 45 per cent of the available slots in each major must be filled by students who attended all years of high school in a public school, plus at least one year in a public elementary or middle school.[9] In general, Brazilian public schools are lower quality than private schools at the elementary, middle, and high school levels.[10] Public universities, on the other hand, are usually better than private universities.[11] Besides the public school requirement, out of the reserved slots under the UFBA quota policy, 85 per cent must be filled by Black or mixed-race students.[12]

Importantly, if a prospective student eligible for the quota policy achieved a sufficient vestibular score to be admitted regardless of the policy, they would still be ranked among the quota students. Therefore, after the implementation of the affirmative action policy there was no longer competition in the admission process between prospective students from public and private high schools.

Another feature that makes UFBA a unique setting for this study is its location in Salvador, the capital of the state of Bahia and the fourth largest city in Brazil, with a substantial non-White population. The majority of the 2.7 million population is Black or mixed-race —79 per cent in 2010—with a high level of poverty and inequality, even for Brazil. According to the 2010 Brazilian Census, 78 per cent of the population in Salvador earned less than three times the minimum wage, and 47 per cent earned the minimum wage or less (IBGE 2010).

3 Analytical framework

This section presents an analytical framework highlighting how students benefiting from affirmative action may perform in college. It also features the main components of the affirmative action programme in our Brazilian context.

Consider a continuum of individuals accumulating human capital in two time periods, $t \in \{1,2\}$. Assume the first period represents high school, and the second represents college. The following equations depict the human capital at the end of each time period:

$$h_i^1 = I_i^1 + a_i, \tag{1}$$

$$h_i^2 = h_i^1 + I^2 + e_i, \tag{2}$$

where h_i^t is individual i's human capital at the end of period t, a is her innate ability, and e is her effort while in college. I^t is the investment in human capital in period t, and represents all resources available

[8] The first one was the University of Brasilia. Its affirmative action policy, however, was solely focused on race and reserved only 20 per cent of the slots to Black and mixed-race students.

[9] The school must be run by municipalities, states, or the federal government.

[10] See, for example, OECD (2021: figures 3.13–3.15), comparing the quality of public and private school education in the OECD countries versus developing countries. The performance of public school students relative to private school students is unusually low in Brazil, even when compared to similar countries.

[11] In the ranking mentioned at the top of this section, created by the major news outlet *Folha de S.Paulo*, the first 15 universities are all public, and only 3 out of the first 30 universities in the ranking are private.

[12] This was the share of the Black and mixed-race population in the state of Bahia at the time.

at the school level that affect human capital accumulation, such as school infrastructure and teacher quality.

To mimic the situation in Brazil, where private high schools are usually of higher quality, assume that $I_i^1 = H$ if student i attended a private high school, and $I_i^1 = L < H$ if she attended a public high school. For simplicity, we also assume that once students have been admitted and enrolled in the university, the investment in human capital I^2 is the same regardless of whether they came from private or public high schools. The idea is that while school resources are different in high school, they are the same once students are attending the same university. Notwithstanding, the total investment in human capital at graduation will depend on student effort e_i while in college.

In order for a student to be admitted to a public, tuition-free university, she has to score at least $\underline{h}$ in the entry examination. For simplicity, assume each student scores h_i^1 in that exam. The affirmative action programme described in the previous section, implemented as a quota policy, is isomorphic to adding M to the entry examination score of the targeted students—those attending public school, primarily non-Whites. Hence, if $h_i^1 \geq \underline{h}$, then student i is admitted regardless of her eligibility to the affirmative action programme. If $h_i^1 < \underline{h}$, but the student is eligible for affirmative action and $h_i^1 + M = L + a_i + M \geq \underline{h}$, then she is also admitted.

Assume there is a minimum high school preparation h^* for a student to perform well in college—especially in the first semesters—and eventually graduate. If $h^* \geq \underline{h}$, then students who would not have been admitted without affirmative action would not likely graduate, and some of those admitted without the need for affirmative action might not succeed either. In other words, there would be some *mismatch*.

As competition for admission in public universities in Brazil is fierce, it is not unrealistic to assume that $h^* < \underline{h}$. That is, performance in the entry examination is likely above and beyond the preparation needed for admitted students not to fall behind in college courses. In such a case, students admitted without the push from the affirmative action policy would certainly succeed ($h_i^1 \geq \underline{h} > h^*$), but those benefiting from affirmative action may succeed if one of the following two conditions is satisfied.

The first condition is their ability being sufficiently high—that is, $h_i^1 = L + a_i \geq h^*$, or

$$a_i \geq h^* - L \tag{3}$$

The second condition is their being able to overcome the ability gap and relative deficiency in high school preparation with sufficiently high levels of effort while in college. That is, $h_i^1 = L + a_i^M < h^*$, but $(L + a_i^M) + I^2 + e_i^M \geq (H + a_j^N) + I^2 + e_j^N \geq \underline{h} + I^2 + e_j^N > h^* + I^2 + e_j^N$, or

$$\begin{aligned} e_i^M &\geq e_j^N + (a_i^N - a_i^M) + (H - L) && (4)\\ &> e_j^N + [h^* - (L + a_i^M)] && (5)\\ &> e_j^N, && (6) \end{aligned}$$

where a_i^M and e_i^M are the ability of and effort made by student i benefiting from affirmative action, respectively, and a_j^N and e_j^N are the ability of and effort made by student j *not* eligible for affirmative action, respectively.

Notice further that students who would have not been admitted without affirmative action might have a higher probability of dropping out even when their ability is comparable to the ability of some non-affirmative action students. That is, among admitted students of ability $a_i = a$, it is possible that $L + a < h^*$ and $H + a \geq h^*$. Indeed, that happens when ability is in the range $h^* - H \leq a < h^* - L$.

Lastly, observe that students benefiting from affirmative action might be able to outperform even non-affirmative action students of similar ability with higher levels of effort while in college. From inequality

(4) and $a_i^M = a_i^N = a$, the outperformance might happen when the effort made by affirmative action students is sufficiently high to close the initial gap in high school preparation:

$$e_i^M \geq e_j^N + (H - L) \tag{7}$$

To sum up, the four main takeaways from this analytical framework that will guide the interpretation of the empirical results are:

1. Students benefiting from affirmative action may disproportionately drop out of college, particularly those who would not have been admitted without the policy.

2. Students might be more likely to drop out even when their ability is similar to the ability of some non-affirmative action students.

3. Affirmative action students might be able to catch up with non-affirmative action students while in college as long as their level of effort is relatively higher.

4. Students might even outperform non-affirmative action students of similar ability with a sufficiently high level of effort.

4 Data description

In this study, we use UFBA administrative data. This data has two blocks. The first contains all records of students while in college, including major, credit hours, grades, failures, whether the course was mandatory or elective, graduation, and withdrawal. The second is the vestibular socioeconomic survey containing student information regarding the vestibular score, race, gender, age, whether the elementary and high school they attended are public, etc. We merge both data sets by a unique individual identifier at the university. The final sample contains students enrolled at UFBA between 2003 and 2006, accounting for 7,960 students, 349,021 courses taken, and 22 majors.[13]

To compare similar students before and after the policy, we restrict the sample of students from private high schools in 2003 and 2004 to only the best-ranked 55 per cent of students in the vestibular. Before the quotas there was no limit to the share of former private school students. After the quotas, the share needed to be up to 55 per cent. Restricting the private school group before the quotas guarantee that we compare the best 55 per cent students from private schools before and after the policy. Without this restriction, our estimates could be driven by composition effects, potentially biasing our results.

Table 1 presents the descriptive statistics for the non-quota students, for the quota students admitted only because of affirmative action, and for the quota students who would have been admitted without affirmative action. The last group is composed of students from public schools with a vestibular score high enough to obtain a slot in the university even without the policy. However, due to the policy rule, they compete against other quota students only. As expected, among quota students there is a higher share of individuals self-identified as Brown and Black. This group is also more likely to have work experience before college, lower parental income, and less-educated parents. This evidence suggests that the UFBA's affirmative action programme indeed provides access to the group intended by the policy.

[13] The full list of majors can be seen in Table A5 in Appendix A.

Table 1: Descriptive statistics and unconditional DiD estimates

	Before aff. action		After affirmative action			Difference in differences		
	(1) Non-quota (Top 55%) average	(2) Admitted via quota *difference* (std. error)	(3) Non-quota average	(4) Admitted via quota *difference* (std. error)	(5) Would have been admitted w/o quota	(6) Would *not* have been admitted w/o quota	(7) Admitted via quota	(8) Would have been admitted w/o quota	(9) Would *not* have been admitted w/o quota
Student characteristics									
Attended public school	0	1	0.11	0.89***	0.89***	0.89***	–0.11***	–0.11***	–0.11***
				(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Male	0.50	–0.06**	0.48	0.03*	0.02***	0.03	0.09***	0.08**	0.09***
		(0.02)		(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
White	0.47	–0.21***	0.31	–0.22***	–0.23***	–0.21***	0.00	–0.01	0.00
		(0.02)		(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Brown	0.42	0.10***	0.57	0.05***	0.04***	0.06***	–0.04*	–0.06*	–0.04
		(0.02)		(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Black	0.07	0.12***	0.10	0.15***	0.20***	0.12***	0.03	0.08***	0.00
		(0.01)		(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Asian	0.03	–0.01	0.02	–0.01	–0.01***	–0.01	0.00	0.00	0.00
		(0.01)		(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Indigenous	0.01	0.01	0.01	0.02***	0.00***	0.04***	0.02***	–0.01	0.03***
		(0.01)		(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Single	0.99	–0.06***	0.99	–0.04***	–0.05***	–0.03***	0.02**	0.01	0.03***
		(0.01)		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Have children	0.01	0.05***	0.02	0.03***	0.04***	0.03***	–0.02	–0.01	–0.02*
		(0.01)		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Took test prep course	0.53	0.24***	0.56	0.18***	0.21***	0.16***	–0.06**	–0.03	–0.07**
		(0.02)		(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Worked while in school	0.05	0.18***	0.06	0.22***	0.22***	0.22***	0.03*	0.04*	0.03*
		(0.01)		(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Plan to work since 1st year	0.34	0.16***	0.34	0.15***	0.18***	0.14***	–0.01	0.01	–0.02
		(0.02)		(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Age at College Admission	20.08	1.51***	18.92	1.57***	1.84***	1.43***	0.07	0.27**	–0.04
		(0.09)		(0.08)	(0.10)	(0.09)	(0.12)	(0.13)	(0.12)
Household income									
Up to 5 minimum wages	0.16	0.38***	0.30	0.44***	0.44***	0.44***	0.06**	0.06**	0.06**
		(0.02)		(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
5–10 minimum wages	0.31	–0.01	0.28	–0.08***	–0.09***	–0.07***	–0.07***	–0.08**	–0.06**
		(0.02)		(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
>10 minimum wages	0.53	–0.37***	0.42	–0.37***	–0.35***	–0.37***	0.01	0.02	0.00
		(0.02)		(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)

Table 1 continued

	Before aff. action		After affirmative action				Difference in differences		
	(1) Non-quota (Top 55%) average	(2) Admitted via quota *difference* (std. error)	(3) Non-quota average	(4) Admitted via quota *difference* (std. error)	(5) Would have been admitted w/o quota	(6) Would *not* have been admitted w/o quota	(7) Admitted via quota	(8) Would have been admitted w/o quota	(9) Would *not* have been admitted w/o quota
Parental education									
Father: high school	0.28	0.07***	0.30	0.03**	0.02***	0.04	–0.04	–0.05*	–0.04
		(0.02)		(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Father: some college	0.57	–0.38***	0.53	–0.39***	–0.38***	–0.4***	–0.01	0.00	–0.02
		(0.02)		(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Father: college graduation	0.47	–0.34***	0.42	–0.33***	–0.31***	–0.34***	0.01	0.02	0.00
		(0.02)		(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Mother: high school	0.33	0.1***	0.37	0.05***	0.02***	0.06***	–0.05*	–0.08**	–0.03
		(0.02)		(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Mother: some college	0.55	–0.38***	0.51	–0.38***	–0.38***	–0.39***	0.00	0.00	–0.01
		(0.02)		(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Mother: college graduation	0.46	–0.34***	0.41	–0.34***	–0.34***	–0.34***	–0.01	0.00	–0.01
		(0.02)		(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Vestibular performance									
Standardized score	0.49	–0.68***	0.55	–1.04***	–0.83***	–1.14***	–0.36***	–0.14**	–0.47***
		(0.04)		(0.03)	(0.05)	(0.04)	(0.05)	(0.06)	(0.06)
College performance									
Failure	0.1	0.01	0.08	0.05***	0.02***	0.06***	0.04**	0.01	0.05***
		(0.01)		(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
First semester GPA	6.82	–0.13	7	–0.63***	–0.22***	–0.85***	–0.5***	–0.1	–0.72***
		(0.09)		(0.07)	(0.1)	(0.08)	(0.12)	(0.14)	(0.12)
Cumulative GPA	6.7	–0.25**	6.8	–0.55***	–0.22***	–0.73***	–0.3**	0.03	–0.47***
		(0.1)		(0.07)	(0.11)	(0.08)	(0.12)	(0.15)	(0.13)
Finished graduation	0.76	–0.05**	0.78	–0.09***	–0.06***	–0.1***	–0.04	–0.01	–0.05**
		(0.02)		(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
Finished graduation on time	0.64	–0.05**	0.65	–0.12***	–0.06***	–0.15***	–0.07**	–0.01	–0.1***
		(0.02)		(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)

Note: this table presents unconditional difference-in-differences estimates of the quota policy for the average characteristics of students and main outcomes. Columns (1) and (3) present the average for the control group before and after the quota policy took place, respectively. Columns (2) and (4) present for each outcome Y_i in each period (before or after) the estimated β from the regression $Y_i = \alpha + \beta Q_i + e_i$, where Q_i is a dummy indicating whether the student would be eligible for the quota policy. Columns (5) and (6) present for each outcome Y_i in the post-policy period the coefficients β_1 and β_2 from the regression $Y_i = \alpha + \beta_1 Q_i W_i + \beta_2 Q_i(1 - W_i) + e_i$, where W_i is a dummy indicating whether the quota student would have been admitted even without quotas. Finally, columns (7), (8), and (9) report the *unconditional* difference-in-differences estimates from regressions similar to equations (8) and (9), but without control variables.

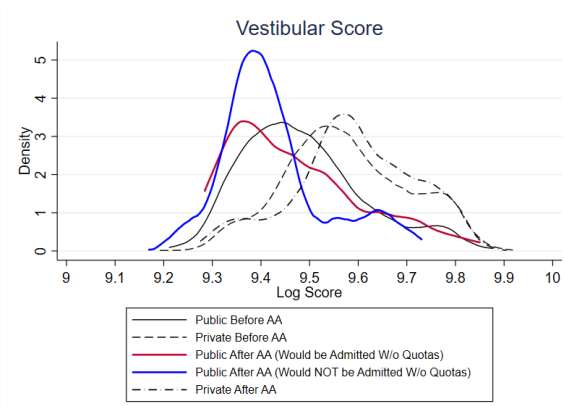
Source: authors' calculations based on UFBA data.

Columns (7), (8), and (9) report the main findings of Table 1. They present the unconditional difference-in-differences estimates. Except for characteristics directly affected by the policy,[14] there are no significant effects on other covariates, suggesting that the covariates are well balanced across groups. Table A1 also shows that there was an increase in the participation of former high school students from 27 per cent to about 50 per cent.

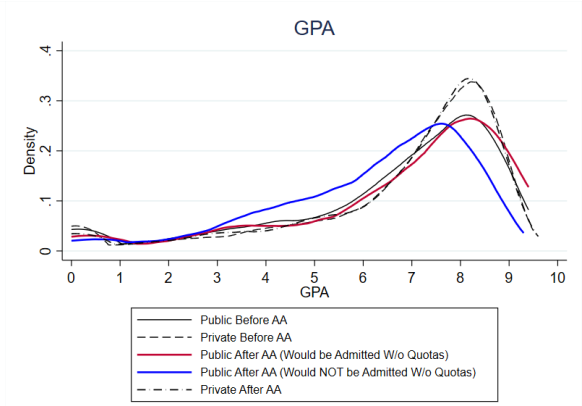
Figure 1(a) shows that the average vestibular score of public students enrolled at UFBA reduces after the quota policy, an expected result related to the policy goal of providing access to disadvantaged students. The scores of students from private high schools increased by a small amount. We can also see that this result is more substantial for technology- and health-related fields (Figures A1 to A3 in Appendix A), which suggests that they are more selective. Panels (b) and (c) show that the differences between groups are much smaller when we look at GPA, and almost non-existent when we look at the GPA conditional on the vestibular score. These panels suggest some catching up over time and almost no mismatch for the quota group.

Figure 1: Vestibular score among groups

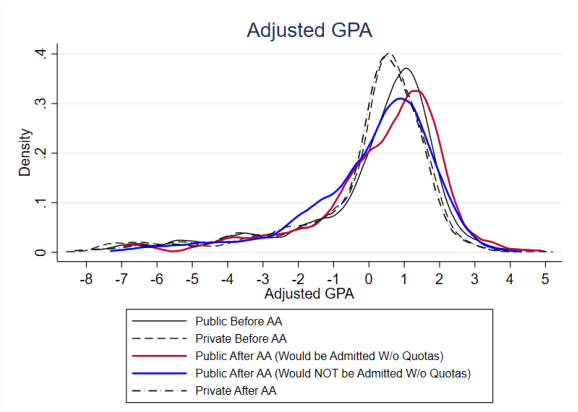
(a)



(b)



(c)



Note: this figure presents the distribution of: (a) vestibular score, (b) final GPA, and (c) final GPA conditional on vestibular score among all enrolled students from private and public high schools, before and after the quota policy.

Source: authors' compilation based on UFBA data.

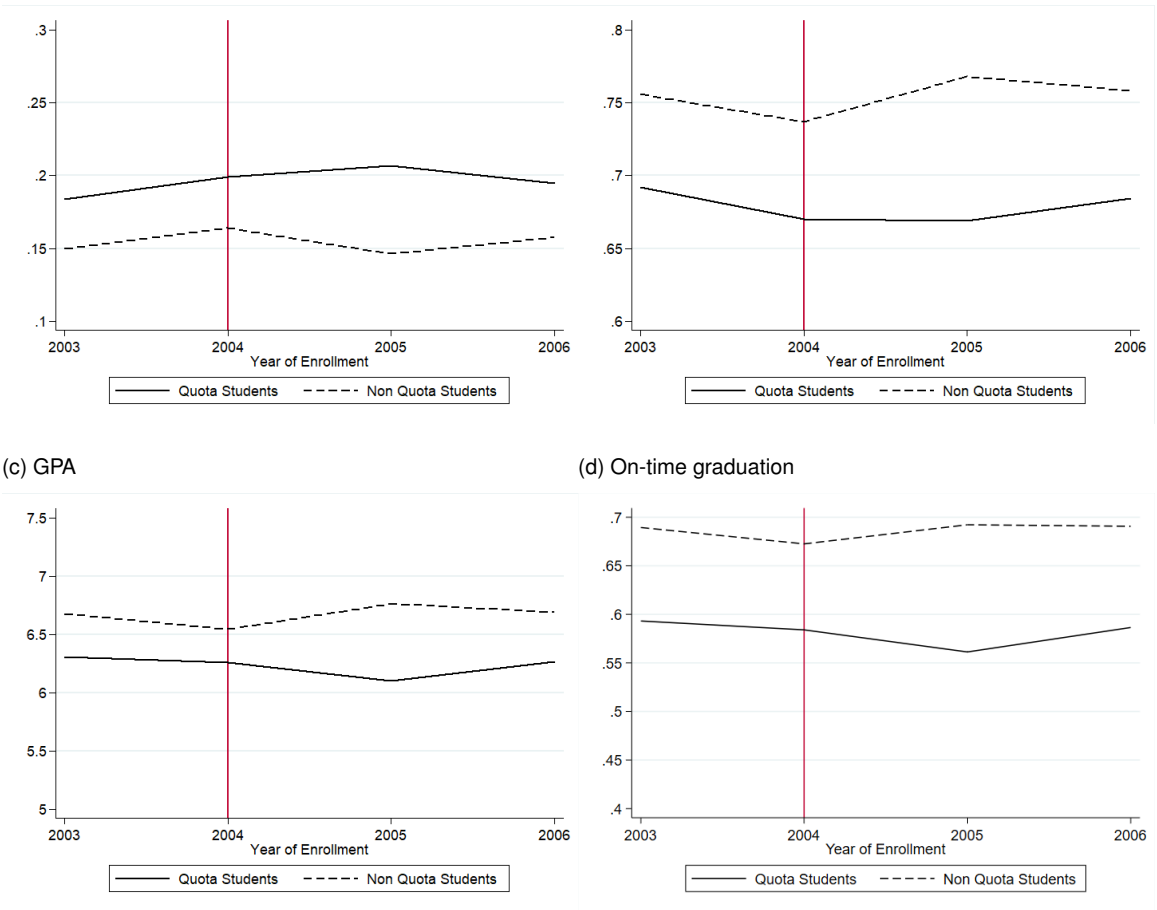
[14] One result worth discussing is for prep courses. If a student is not well-prepared for the vestibular, she might take extra lessons targeting the exam. Usually, they are private, but non-profit foundations offer lessons for disadvantaged students. With the quota policy, because eligible students did not have to compete with private students anymore, there was a reduction in the need for these prep courses.

5 Empirical strategy

In this study we use a standard difference-in-differences strategy, which requires that treated and control groups have similar trends before the treatment. Our sample consists of all students enrolled at UFBA in the two years after the quota policy was implemented (2005 and 2006), all students from public schools enrolled in the two years before the policy (2003 and 2004), and the 55 per cent best-ranked students from private schools enrolled in the two years before the policy. We restrict the control group to the 55 per cent best-ranked private school students because if we made comparisons including all private students before the policy, we would likely have some contamination arising from changes in the control group composition over time. Recall that the quota policy guaranteed 45 per cent of the UFBA slots for public school students.

To provide supportive evidence for the parallel trends assumption, Figure 2 depicts the outcomes of interest from 2003 to 2006, our period of analysis. This figure suggests no differences in the trends between treated and control groups before the treatment. Table A2 shows that in the period before the quota policy, treated and control groups behaved similarly except for some income characteristics of the families.

Figure 2: Evidence of parallel trends for the main outcomes



Note: this figure presents the trends in outcomes for the control group (dashed line) and the treatment group (solid line). Graph (a) shows the percentage of failed courses among all courses taken while in college, graph (b) graduation rates, measured as the percentage of students who eventually graduated, graph (c) the final GPA, measured as the credit-hour weighted course grades, and graph (d) the percentage of on-time graduation, defined as graduation up to two years after the regular duration for that major (see Table A5 for major regular duration).

Source: authors' compilation based on UFBA data.

The second main assumption is that students could not change *ex-ante* behaviour to be eligible for the quota policy. Restricting the sample to the period 2003–06 guarantees the comparison of similar individuals. High school in Brazil lasts for at least three years. Thus, unless students' families had information about UFBA's affirmative action before the policy started, they could not enrol their children in public schools to benefit from the policy. This sample period restriction also allows us to avoid changes in the number of slots available for some majors, and the creation of new majors over time.[15] These changes could modify the university profile and affect student preferences.

We estimate the impact of the quota policy using the following equation:

$$Y_{ict} = \alpha + \beta_0 Q_i + \beta_1 (Q_i \times Post_t) + X_i\gamma + \psi_c + \eta_t + \varepsilon_{ict} \tag{8}$$

where Y_{ict} is the outcome for student i in major c in year t. The main outcomes of interest are grades, failures, major completion, and dropouts. Q is a dummy variable equal to 1 if the individual is a potential (before the policy) or actual (after the policy) beneficiary of the quota policy. *Post* is a dummy variable indicating the years for which the policy is in place, X_i is a set of student characteristics, ψ_c is a set of major fixed effects, and η_t a set of year fixed effects. β_1 is the difference-in-differences coefficient of interest.

As we aim to identify the magnitude of the effect for quota students who were able to enrol at UFBA only because of the policy, and for students who would have been admitted even without the policy, we also estimate the following equation:

$$Y_{ict} = \alpha + \beta_0 Q_i + \beta_1 (Q_i \times Post_t \times W_i) + \beta_2 (Q_i \times Post_t \times (1 - W_i)) + X_i\gamma + \psi_c + \eta_t + \varepsilon_{ict} \tag{9}$$

where W is a dummy variable indicating whether a quota student would have been admitted at UFBA even if the quota policy was not in place. Recall that we can identify these students because they are from public schools and obtained a vestibular score high enough to earn a slot in the university even without the policy. We are interested in the parameters β_1 and β_2, which capture the heterogeneity of the impacts of the quota policy by performance in the entry examination.

6 Results

We present the results in three parts. First, we report the baseline evidence on the effects of affirmative action on the main outcomes for all students who enrolled at UFBA. Second, we present the results only for students who eventually graduated. Third, we investigate the mechanisms of adjustment for students who made it to graduation.

6.1 Results for all enrolled students

We start by studying the effect of quotas on failures[16] and graduation[17] for all students enrolled at UFBA. To deal with potential selection into graduation and achievement we present estimates with and without

[15] In 2008 there was a substantial change in the university. It created three broad majors, which increased the total number of slots by almost 30 per cent per year. These majors are called 'Interdisciplinary Majors' ('Bacharelados Interdisciplinares', or just BI). In the technology BI, for example, students take two years of calculus, introduction to engineering, physics, etc. After those two years they are ranked by the cumulative GPA and can choose their main major, for example, computer science or electrical engineering.

[16] Again, for each student we define failures as the proportion of failed courses among all courses taken while in college.

[17] Recall that we define graduation as an indicator equal to 1 if a student graduated up to two years after the regular duration for that major. While the typical duration of a major is four or five years, it could go up to six years for majors such as medicine (see Table A5 for major regular duration). In our sample, only 27 (0.43 per cent) out of 6,281 students had neither graduated nor dropped out by 2018. As this is a small portion of our sample, it is unlikely that it biases our main estimates.

control for initial ability, as measured by the score in the entry examination. Table 2, Panel A, reports the estimated difference-in-differences coefficient in equation (8). The result in column 1 suggests that after the policy implementation, the proportion of failures increased by 5.04 percentage points for students from public schools, primarily non-Whites. This means a 31.5 per cent increase in the proportion of course failures when compared to the control group. However, this effect disappears when we control for ability (column 3). Quota students are 8.13 percentage points less likely to graduate (column 2), but this effect drops to 4.63 percentage points when controlling by initial ability. Compared to the control group average, the estimated decrease in the probability of graduation reduces from 10.6 to 6.06 per cent.

Table 2, Panel B, reports the estimates of interest from equation (9), where we allow for heterogeneity according to whether the policy was crucial or not for the quota students to be admitted at UFBA. Panel B shows that the results in Panel A are driven mainly by students who would not be admitted without the affirmative action policy. Given the takeaways (1) and (2) from our analytical framework, it is not surprising that the estimated effects are larger for this group. Quota students who would not be admitted without the policy have 8.7 percentage points higher rate of course failures. They also have 12.7 percentage points less chance of graduating, which means a 16.6 per cent reduction compared to the control group. Although controlling for ability attenuates the negative impact on graduation rates, the policy still reduced the graduation rates of quota students admitted only because of the policy by about 12.2 per cent when compared to the control group average.

Table 2: Impacts of the quota policy for all enrolled students

Dependent variable	(1) Failures	(2) Graduation	(3) Failures	(4) Graduation
Panel A: Effects for all quota students				
Admitted via quota	0.0505***	-0.0813***	0.00694	-0.0463**
	(0.0117)	(0.0172)	(0.0148)	(0.0175)
Control group average	0.160	0.764	0.160	0.764
Panel B: By group of quota students				
Would be admitted w/o quotas	-0.00623	-0.00970	-0.0128	-0.00576
	(0.0143)	(0.0244)	(0.0150)	(0.0245)
Would *not* be admitted w/o quotas	0.0867***	-0.127***	0.0297	-0.0929***
	(0.0167)	(0.0264)	(0.0216)	(0.0275)
Control group average	0.160	0.764	0.160	0.764
Observations	6,094	6,094	6,094	6,094
Major FE	✓	✓	✓	✓
Age and gender	✓	✓	✓	✓
Ability			✓	✓

Note: this table reports the estimated impacts of the UFBA quota policy on two student outcomes—the proportion of failed courses among all courses taken ('Failures') and the proportion of students who eventually graduate ('Graduation'). The estimates in Panel A refer to the difference-in-differences coefficient β from equation (8), and the estimates in Panel B refer to the βs from equation (9). The unit of observation is a student-year, and the analysis includes the cohorts of students enrolling at UFBA in the years 2003–06. The first cohort of students benefiting from the UFBA quota policy is the cohort admitted in 2005. The policy reserved 45 per cent of the available slots in each major from public school students, 85 per cent of which must be filled with Black and mixed-race students. The control group consists of students from private schools who were ranked among the top 55 per cent prior to the policy, and the students who were *not* eligible for the policy after its implementation. 'Ability' refers to the initial ability as measured by the score obtained by the student in the entrance test—the overall vestibular score. Standard errors clustered at the major level are reported in parentheses. *** denotes statistical significance at the 1 per cent level, ** at the 5 per cent level, and * at the 10 per cent level.

Source: authors' calculations based on UFBA data.

This result for graduation rates is remarkably similar to Arcidiacono et al. (2016), who reported a 13.1 percentage-point reduction in graduation rates among minority students enrolled at the University of California (UC) system in the United States. The UC system might serve as a reasonable comparison to UFBA—both are public universities with good reputations in teaching and research, and which make

efforts to admit minority students. Different from the UC system, where students are able to switch majors, this option is not available at UFBA. Thus, we would have expected a large difference between graduation rates in the two universities, but surprisingly that is not the case. This evidence suggests a relatively low mismatch among quota students at UFBA.

Table 3 reports the results for broad fields of study. As mentioned earlier, our prior is that quota students have lower math and science background, which can impact their academic performance while in college. Besides, as is shown in Figures A1–A3, the distribution of vestibular scores and GPAs differ by fields of study. Table 3 shows that the increase in failure rates for quota students is driven mostly by students in technology fields, but the statistical significance disappears when controlling for initial ability. Without controlling for initial ability, those students have 7.16 percentage points higher failure rates, and are 14.3 percentage points less likely to graduate. While the percentage variation compared to the control group average for failures is quite similar to the findings in Table 2, it significantly differs for graduation rates. Quota students in technology fields are 21.8 per cent less likely to graduate, without controlling for ability, and 12.9 per cent less likely when controlling for it.

Table 3, Panel B, depicts a pattern similar to Table 2: the results for technology students are driven mainly by students who would not be admitted without the policy. Notwithstanding, the size of the estimates increases for all regressions, both with and without the ability control. As shown in Figure A1, the distribution of vestibular scores for quota students who would not be admitted without the policy differs significantly from the other groups. It also differs more when compared to health sciences and social sciences and humanities. This evidence also points to takeaways (1) and (2) from our analytical framework. Those students may disproportionately drop out of college, even when their ability is similar to the ability of some non-affirmative action students. Although the results for health sciences and social sciences and humanities have the same signal, they have lower magnitudes and/or lack statistical significance.

6.2 Results for students who graduated

This subsection presents the analysis only for students who made it to graduation. We report results for GPA in the beginning and at the end of the college experience, failed courses, and on-time graduation.

Table 4, Panel A, reports the estimated difference-in-differences coefficient of equation (8) only for students who eventually graduated. When comparing with previous results in Table 2, we observe a similar impact on failures: a 1.6 percentage-point increase, or a 30.7 per cent increase compared to the control group average. Like before, the effect is not statistically significant when controlling for initial ability. Columns (4) and (8) show that there are no effects of the quota policy on graduating on time, with and without the ability control.

The main result in Table 4 is the considerable reduction in the GPA gap between quota and non-quota students over time. In the first semester of the course (column 2), the policy reduces the average GPA by 0.385 points on a ten-point scale, or a 5 per cent reduction compared to the control group. But this difference drops by 50 per cent until graduation (column 3). Indeed, the policy reduces the average GPA at graduation by 0.187 points. This evidence points to catching up in learning over the college years, consistent with takeaway (3) of our analytical framework. It is important to point out that this result is driven only by quota students who would not be admitted without the policy.

While column (3) reports a negative effect of quotas on the final GPA, column (6) shows that this estimate becomes positive when controlling for ability. This means that among students with comparable initial ability, students from public schools earn better grades than those from private schools. Therefore, conditional on the accumulated human capital at the end of high school, they are likely of higher innate ability or exert more effort while in college. This finding is in line with takeaway (4) of our analytical framework. Besides, as can be seen in Figure A1 and Table A3, there is a negative relationship between vestibular score and being a quota student. In addition, the higher the vestibular score, the higher the likelihood of earning a high GPA, and the lower the probability of failing courses. These relationships could explain the sign of the omitted variable bias. Taken together, these results suggest no evidence of mismatch for quota students at UFBA once they enrol and complete college.

Table 5 presents the results for different fields of study for students who eventually graduated. For the three broad fields, the estimates without controlling for ability (columns 1–3) indicate that quota students who would not be admitted without the policy have higher failure rates, and lower GPA in the first semester and at graduation. The results also show that the size of the estimated parameters reduces with time, reinforcing the catching-up evidence. We do not find any significant results for graduation on time (columns 4 and 8).

When controlling for initial ability (columns 5–7), the estimates for health sciences and social sciences and humanities lose magnitude and statistical significance. More remarkably, for the technology field the results turn positive and are statistically significant. Indeed, without controlling for ability, quota students had a reduction in first GPA of 0.694 points, and a reduction in final GPA of 0.329 points. Controlling for ability, these parameters turn to 0.352 and 0.463, respectively. Once again, these results are consistent with takeaway (4) of our analytical framework. Interestingly, this pattern of results is driven by students who would not have been admitted without quotas.

Table 3: Results for all enrolled students by broad fields of study

Dependent variable	(1) Failures	(2) Graduation	(3) Failures	(4) Graduation
Technology				
Panel A: Effects for all quota students				
Admitted via quota	0.0716***	–0.143***	0.0137	–0.0849***
	(0.0178)	(0.0168)	(0.0206)	(0.0193)
Control group average	0.246	0.656	0.246	0.656
Panel B: Effects by group of quota students				
Would be admitted w/o quotas	0.00448	–0.0481	–0.00223	–0.0424
	(0.0298)	(0.0465)	(0.0285)	(0.0461)
Would *not* be admitted w/o quotas	0.113***	–0.201***	0.0308	–0.131***
	(0.0237)	(0.0298)	(0.0316)	(0.0299)
Control group average	0.246	0.656	0.246	0.656
Observations	1,878	1,878	1,878	1,878
Health sciences				
Panel C: Effects for all quota students				
Admitted via quota	0.0318	–0.0352	–0.00508	–0.0346
	(0.0255)	(0.0280)	(0.0307)	(0.0323)
Control group average	0.089	0.858	0.089	0.858
Panel D: Effects by group of quota students				
Would be admitted w/o quotas	–0.0428	0.0236	–0.0480	0.0214
	(0.0269)	(0.0608)	(0.0288)	(0.0608)
Would *not* be admitted w/o quotas	0.0512*	–0.0504	0.0178	–0.0646*
	(0.0251)	(0.0282)	(0.0333)	(0.0305)
Control group average	0.089	0.858	0.089	0.858
Observations	2,217	2,217	2,217	2,217
Social sciences and humanities				
Panel E: Effects for all quota students				
Admitted via quota	0.0496**	–0.0785**	0.0230	–0.0538
	(0.0136)	(0.0305)	(0.0262)	(0.0397)
Control group average	0.163	0.754	0.163	0.754
Panel F: Effects by group of quota students				
Would be admitted w/o quotas	0.0139	–0.0222	0.00957	–0.0205
	(0.0202)	(0.0376)	(0.0236)	(0.0401)
Would *not* be admitted w/o quotas	0.0989***	–0.156**	0.0573	–0.139
	(0.0236)	(0.0544)	(0.0455)	(0.0748)
Control group average	0.163	0.754	0.163	0.754
Observations	1,999	1,999	1,999	1,999
Major FE	✓	✓	✓	✓
Age and gender	✓	✓	✓	✓
Ability			✓	✓

Note: this table reports the estimated impacts of the UFBA quota policy on two student outcomes—the proportion of failed courses among all courses taken ('Failures') and the proportion of students who eventually graduate ('Graduation'). The estimates in Panels A, C, and E refer to the difference-in-differences coefficient β from equation (8), and the estimates in Panels B, D, and F refer to the βs from equation (9). Panels A and B show the results only for students in technology majors. Panels C and D show the results only for students in health science majors. Panels E and F show the results only for students in social science majors. The unit of observation is a student-year, and the analysis includes the cohorts of students enrolling at UFBA in the years 2003–06. The first cohort of students benefiting from the UFBA quota policy is the cohort admitted in 2005. The policy reserved 45 per cent of the available slots in each major from public school students, 85 per cent of which must be filled with Black and mixed-race students. The control group consists of students from private schools who were ranked among the top 55 per cent prior to the policy, and the students who were *not* eligible for the policy after its implementation. 'Ability' refers to the initial ability as measured by the score obtained by the student in the entrance test—the overall vestibular score. Standard errors clustered at the major level are reported in parentheses. *** denotes statistical significance at the 1 per cent level, ** at the 5 per cent level, and * at the 10 per cent level.

Source: authors' calculations based on UFBA data.

Table 4: Results for students who graduated

Dependent variable	(1) Failures	(2) 1st GPA	(3) GPA	(4) Graduation on time	(5) Failures	(6) 1st GPA	(7) GPA	(8) Graduation on time
Panel A: Effects for all quota students								
Admitted via quota	0.0159***	–0.385***	–0.187***	–0.0219	–0.00798	0.0648	0.161**	0.0167
	(0.00491)	(0.103)	(0.0589)	(0.0201)	(0.00574)	(0.134)	(0.0646)	(0.0165)
Control group average	0.051	7.529	7.708	0.890	0.051	7.529	7.708	0.890
Panel B: Effects by group of quota students								
Would be admitted w/o quotas	–0.00466	–0.00548	0.0834	0.00634	–0.00869*	0.0702	0.143**	0.0131
	(0.00455)	(0.154)	(0.0614)	(0.0248)	(0.00468)	(0.161)	(0.0604)	(0.0238)
Would *not* be admitted w/o quotas	0.0297***	–0.643***	–0.370***	–0.0410	–0.00716	0.0585	0.180**	0.0208
	(0.00665)	(0.0881)	(0.0564)	(0.0245)	(0.00830)	(0.126)	(0.0840)	(0.0203)
Control group average	0.051	7.529	7.708	0.890	0.051	7.529	7.708	0.890
Observations	4,579	4,562	4,579	4,579	4,579	4,562	4,579	4,579
Major FE	✓	✓	✓	✓	✓	✓	✓	✓
Age and gender	✓	✓	✓	✓	✓	✓	✓	✓
Ability					✓	✓	✓	✓

Note: this table reports the estimated impacts of the UFBA quota policy on four student outcomes—the proportion of failed courses among all courses taken ('Failures'), the weighted-hours average grade in the first semester ('1st GPA'), the weighted-hours average grade in the end of the major ('GPA'), and a variable equal to 1 if the student graduated at most four semesters (two years) after their course's minimum duration ('Graduation on time'). The estimates in Panel A refer to the difference-in-differences coefficient β from equation (8), and the estimates in Panel B refer to the βs from equation (9). The unit of observation is a student-year, and the analysis includes the cohorts of students enrolling at UFBA in the years 2003–06. The first cohort of students benefiting from the UFBA quota policy is the cohort admitted in 2005. The policy reserved 45 per cent of the available slots in each major for public school students, 85 per cent of which must be filled with Black and mixed-race students. The control group consists of students from private schools who were ranked among the top 55 per cent prior to the policy, and the students who were *not* eligible for the policy after its implementation. 'Ability' refers to the initial ability as measured by the score obtained by the student in the entrance test—the overall vestibular score. Standard errors clustered at the major level are reported in parentheses. *** denotes statistical significance at the 1 per cent level, ** at the 5 per cent level, and * at the 10 per cent level.

Source: authors' calculations based on UFBA data.

Table 5: Results for students who graduated by broad fields of study

Dependent variable	(1) Failures	(2) 1st GPA	(3) GPA	(4) Graduation on time	(5) Failures	(6) 1st GPA	(7) GPA	(8) Graduation on time
Technology								
Panel A: Effects for all quota students								
Admitted via quota	0.0169	–0.308	–0.174	–0.0538	–0.0212*	0.368**	0.305***	0.00862
	(0.0106)	(0.182)	(0.0973)	(0.0718)	(0.00984)	(0.141)	(0.0792)	(0.0586)
Control group average	0.094	7.232	7.080	0.783	0.094	7.232	7.080	0.783
Panel B: Effects by group of quota students								
Would be admitted w/o quotas	–0.00799	0.336	0.0894	–0.0365	–0.0114	0.385	0.134	–0.0304
	(0.00959)	(0.286)	(0.117)	(0.0735)	(0.00895)	(0.273)	(0.121)	(0.0686)
Would *not* be admitted w/o quotas	0.0315*	–0.694***	–0.329**	–0.0639	–0.0302*	0.352**	0.463***	0.0448
	(0.0136)	(0.167)	(0.107)	(0.0812)	(0.0141)	(0.120)	(0.106)	(0.0635)
Control group average	0.094	7.232	7.080	0.783	0.094	7.232	7.080	0.783
Observations	1,177	1,165	1,177	1,177	1,177	1,165	1,177	1,177
Health sciences								
Panel C: Effects for all quota students								
Admitted via quota	0.0174*	–0.426**	–0.201*	–0.0160	–0.00232	0.0656	0.148	0.0170
	(0.00831)	(0.121)	(0.0997)	(0.0201)	(0.00925)	(0.157)	(0.107)	(0.0189)
Control group average	0.027	7.474	7.921	0.948	0.027	7.474	7.921	0.948
Panel D: Effects by group of quota students								
Would be admitted w/o quotas	–0.00694	0.0626	0.104	0.0348	–0.0102	0.150	0.166	0.0399*
	(0.00872)	(0.180)	(0.114)	(0.0183)	(0.00900)	(0.182)	(0.115)	(0.0188)
Would *not* be admitted w/o quotas	0.0240**	–0.559***	–0.283**	–0.0298	0.00200	0.0197	0.138	0.00454
	(0.00880)	(0.108)	(0.0904)	(0.0278)	(0.00980)	(0.152)	(0.104)	(0.0323)
Control group average	0.027	7.474	7.921	0.948	0.027	7.474	7.921	0.948
Observations	1,864	1,862	1,864	1,864	1,864	1,862	1,864	1,864

Table 5 continued

Dependent variable	(1) Failures	(2) 1st GPA	(3) GPA	(4) Graduation on time	(5) Failures	(6) 1st GPA	(7) GPA	(8) Graduation on time
Social sciences and humanities								
Panel E: Effects for all quota students								
Admitted via quota	0.00968	–0.379	–0.125	–0.00718	–0.00294	–0.174	0.0956	0.0101
	(0.00845)	(0.234)	(0.122)	(0.0152)	(0.00881)	(0.291)	(0.130)	(0.0280)
Control group average	0.047	7.872	7.961	0.903	0.047	7.872	7.961	0.903
Panel F: Effects by group of quota students								
Would be admitted w/o quotas	–0.00542	–0.285	0.0915	0.0140	–0.00764	–0.234	0.134	0.0169
	(0.00556)	(0.261)	(0.0836)	(0.0352)	(0.00673)	(0.284)	(0.101)	(0.0371)
Would *not* be admitted w/o quotas	0.0349*	–0.538**	–0.487**	–0.0425	0.0108	0.00299	–0.0182	–0.0100
	(0.0164)	(0.159)	(0.189)	(0.0286)	(0.0196)	(0.345)	(0.249)	(0.0246)
Control group average	0.047	7.872	7.961	0.903	0.047	7.872	7.961	0.903
Observations	1,538	1,535	1,538	1,538	1,538	1,535	1,538	1,538
Major FE	✓	✓	✓	✓	✓	✓	✓	✓
Age and gender	✓	✓	✓	✓	✓	✓	✓	✓
Ability					✓	✓	✓	✓

Note: this table reports the estimated impacts of the UFBA quota policy on four student outcomes—the proportion of failed courses among all courses taken ('Failures'), the weighted-hours average grade in the first semester ('1st GPA'), the weighted-hours average grade in the end of the major ('GPA'), and a variable equal to 1 if the student graduated at most four semesters (two years) after their course's minimum duration ('Graduation on time'). The estimates in Panels A, C, and E refer to the difference-in-differences coefficient β from equation (8), and the estimates in Panels B, D, and F refer to the βs from equation (9). Panels A and B show the results only for students in technology majors. Panels C and D show the results only for students in health science majors. Panels E and F show the results only for students in social science majors. The unit of observation is a student-year, and the analysis includes the cohorts of students enrolling at UFBA in the years 2003–06. The first cohort of students benefiting from the UFBA quota policy is the cohort admitted in 2005. The policy reserved 45 per cent of the available slots in each major for public school students, 85 per cent of which must be filled with Black and mixed-race students. The control group consists of students from private schools who were ranked among the top 55 per cent prior to the policy, and the students who were *not* eligible for the policy after its implementation. 'Ability' refers to the initial ability as measured by the score obtained by the student in the entrance test—the overall vestibular score. Standard errors clustered at the major level are reported in parentheses. *** denotes statistical significance at the 1 per cent level, ** at the 5 per cent level, and * at the 10 per cent level.

Source: authors' calculations based on UFBA data.

6.3 Margins of adjustment

In the last two subsections we provided evidence suggesting no difference in graduation rates between UFBA (without major switching) and the plausibly comparable UC system (with major switching), and that UFBA quota students who graduated have similar GPA or even outperform non-quota students. It is important to understand the mechanisms behind these results, or more specifically, what explains that those outcomes are not worse in the UFBA case, where switching majors is not allowed. In this subsection, we turn to margins of adjustment among the quota students who eventually graduate.

Although there are majors with a minimum length of 10 or 12 semesters, we focus on the period between the first and the eighth semester. This period comprises the minimum time required to complete an undergraduate major at UFBA. Looking beyond that we might capture some composition effects, which we aim to avoid. We also present the estimates separately for quota students who were admitted only because of the affirmative action policy and those who would have been admitted even without the policy.

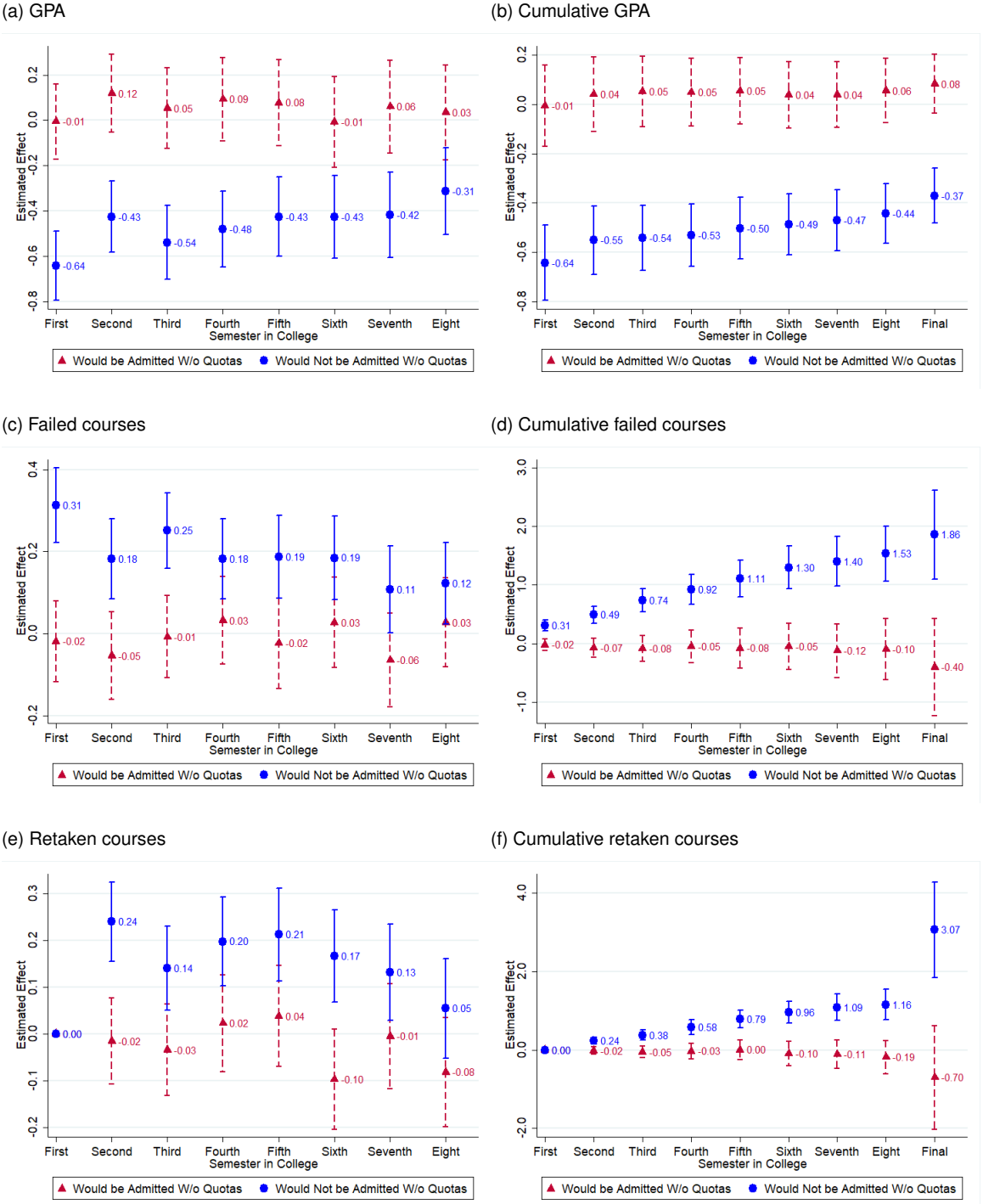
Figure 3 shows that there is no difference between non-quota students and quota students who would have been admitted even without the policy (red), or β_1 in equation (9). Therefore, the adjustment process occurs only for those who would not have been admitted without the policy (blue), or β_2 in equation (9). While the evidence suggests that lower grades predict major switching in the United States (Astorne-Figari and Speer 2019), in our setting it seems to affect the learning pattern within the major.

We present the margins of adjustment without the ability control in the text and with it in Figures A4 and A5.[18] Figure 3(a) displays the average grades by semester. It is possible to see that there is a process of adjustment in the beginning of the college experience. The difference between groups is the highest in the first semester, reducing in the second semester and increasing again in the third. Nevertheless, the difference decreases from the fourth semester onward. Figure 3(b) presents the cumulative GPA. The difference between groups drops semester by semester until graduation.

The previous evidence is complemented by Figure 3(c). This graph shows a higher number of failed courses in the first semester, which reduces in the second semester but increases again in the third. This pattern leads to a higher cumulative number of failed courses, as shown in Figure 3(d). Complementary evidence is reported in Figure 3(e) and (f) regarding the number of retaken courses by semester, and the cumulative number of retaken courses, respectively. Figure 3(e) shows that the number of retaken courses reduces over time, suggesting that quota students retake more courses along their graduation path, but this happens primarily in the first few semesters in college.

[18] As Tables 2 and 4 show, quota students do not fare worse compared to non-quota students when controlling for initial ability. Figures A4 and A5 show that there is no difference in adjustment either.

Figure 3: Effects of admission via quotas by college semester



Note: these graphs present the estimated impacts of the UFBA quota policy on (a) semester GPA, (b) accumulated GPA, (c) number of failed courses in the semester, (d) accumulated failed courses, (e) number of retaken courses in the semester, and (f) accumulated retaken courses. The estimates refer to the difference-in-differences coefficients β_1 (red) and β_2 (blue) from equation (9) for each student outcome by semester. The unit of observation is a student-year, and the analysis includes the cohorts of students enrolling at UFBA in the years 2003–06.

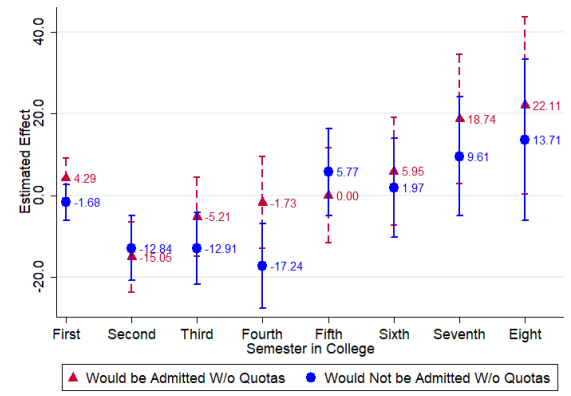
Source: authors' compilation based on UFBA data.

Figure 4(a) shows that between the second and fourth semesters in college, quota students decrease their total number of credit hours in each period, compensating for this reduction in the final college years. This implies that they spend more hours in classes, which is shown in Figure 4(b). At the same time, they also reduce the number of mandatory courses until the fifth semester (Figure 4(c)).

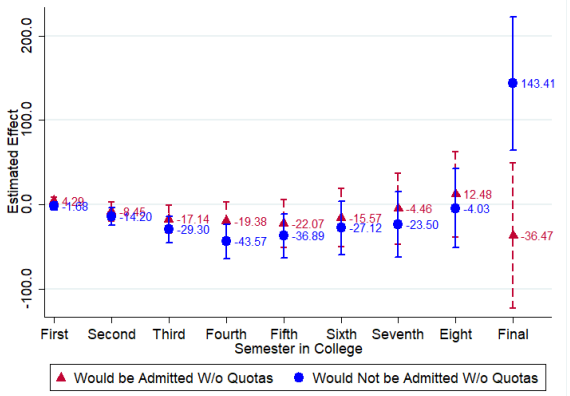
One possible explanation for such a pattern is that as quota students fail relatively more courses in the first few semesters in college, they need to retake them. However, some of those failed courses are prerequisites for other courses. In that case, if a student is not approved in course 'A' in the second semester, they cannot enrol in course 'B' in the third semester. Another explanation could be that to catch up with former private school students, or to improve their learning, quota students need to enrol in fewer courses at the beginning of their college experience. Although suggestive, this evidence indicates that quota students may behave rationally using university rules to their favour. Because it may be more difficult for them to follow the courses initially, they might adjust in the margins they are able to—the number of mandatory courses per semester—considering the setup, with no major switching allowed.

Figure 4: Effects of admission via quotas by college semester

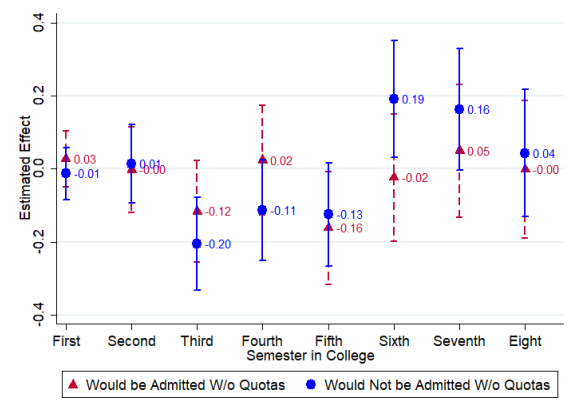
(a) Credit hours



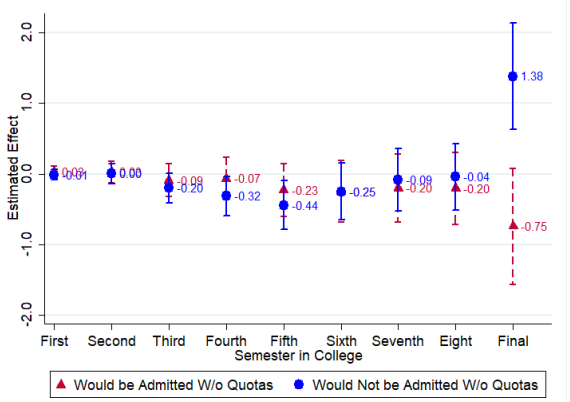
(b) Cumulative credit hours



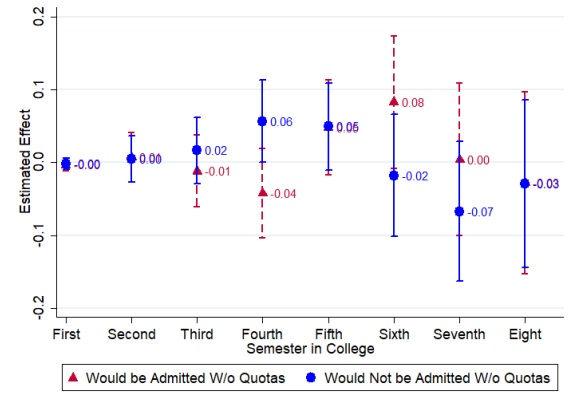
(c) Mandatory courses



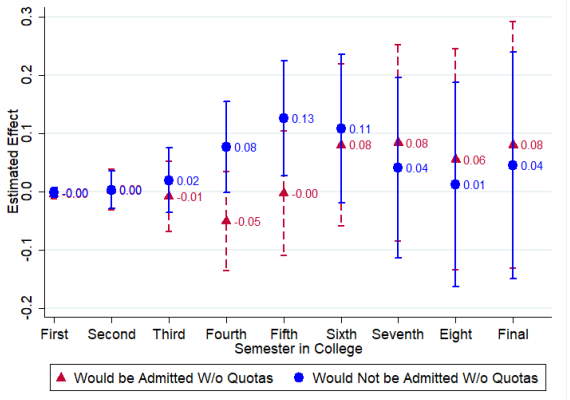
(d) Cumulative mandatory courses



(e) Elective courses



(f) Cumulative elective courses



Note: these graphs present the estimated impacts of the UFBA quota policy on (a) credit hours, (b) accumulated credit hours, (c) mandatory courses, (d) accumulated mandatory courses, (e) elective courses, and (f) accumulated elective courses. The estimates refer to the difference-in-differences coefficients β_1 (red) and β_2 (blue) from equation (9) for each student outcome by semester. The unit of observation is a student-year, and the analysis includes the cohorts of students enrolling at UFBA in the years 2003–06.

Source: authors' compilation based on UFBA data.

7 Concluding remarks

This paper studies the effects of the affirmative action policy at UFBA, Brazil, on student academic performance in a setting with no major switching. We leverage administrative records from the aforementioned university within a difference-in-differences approach.

The main contribution of the paper is to provide evidence of a relatively low mismatch among affirmative action students at UFBA, and of relatively strong catch-up. Also, even without major switching, most students who benefit from affirmative action exploit any margins of adjustment available to them to make it to graduation. Curriculum rigidity, a typical feature of the higher education system in Brazil, does not seem to preclude disadvantaged students from successfully completing their undergraduate programmes.

At the end of the day, the UFBA affirmative action policy allows students from disadvantaged families to attend a prestigious university and obtain a high-quality education. In this sense, the policy contributes towards achieving the United Nations development goals of reducing inequalities and promoting a quality education.

A natural further step in our research agenda is to assess whether affirmative action in higher education closes the racial gap in employment and income in the post-college years. This is an ongoing project that involves linking the UFBA records used in this study to the administrative labour market data from the Brazilian Ministry of the Economy.

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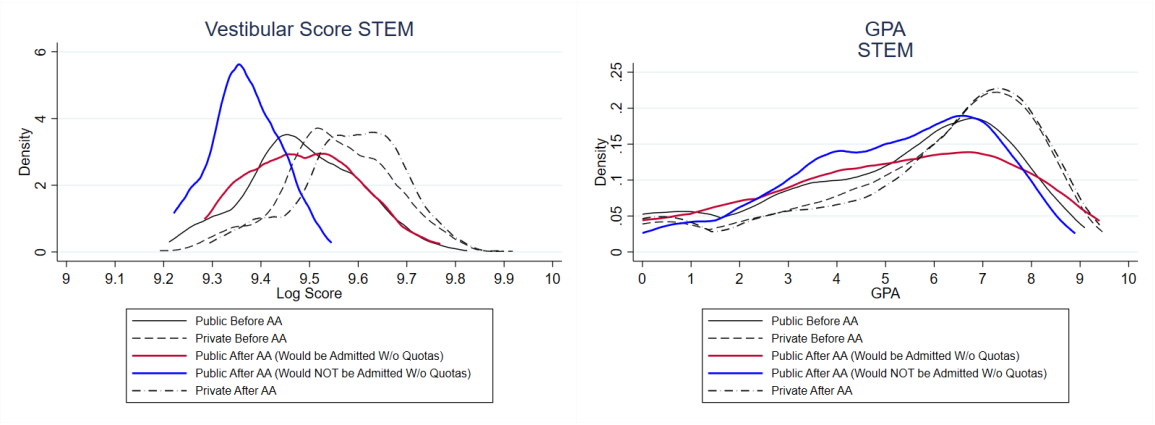
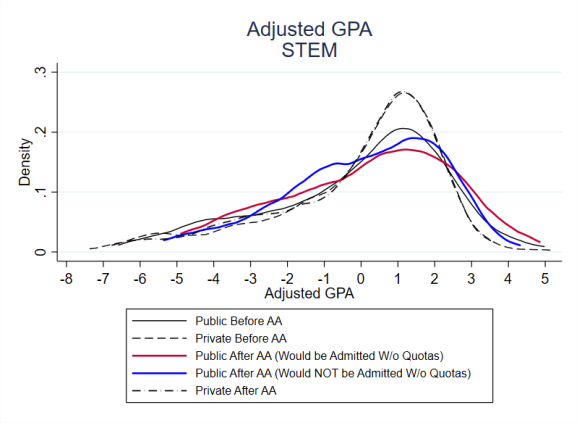
Appendix A: Figures and tables

Figure A1: Outcomes among groups of students in STEM majors

(a) (b)



(c)

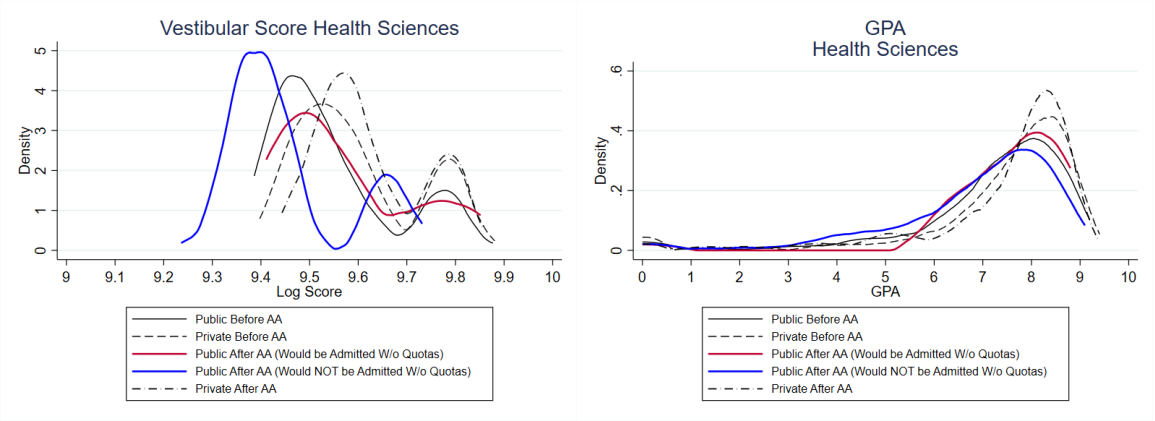


Note: this figure presents the distribution of: (a) vestibular score, (b) final GPA, and (c) final GPA conditional on the vestibular score among technology students from private and public high schools before and after the quotas policy.

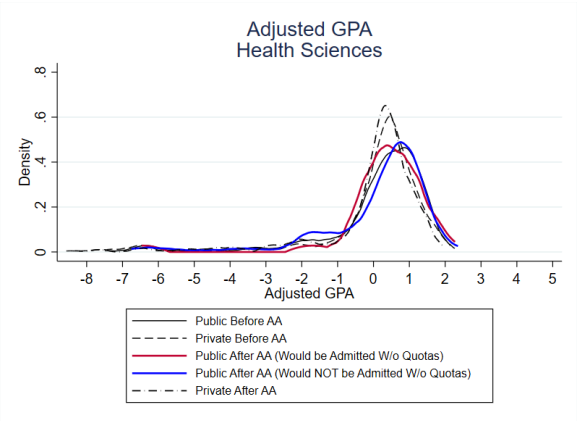
Source: authors' compilation based on UFBA data.

Figure A2: Outcomes among groups of students majoring in health sciences

(a) (b)



(c)

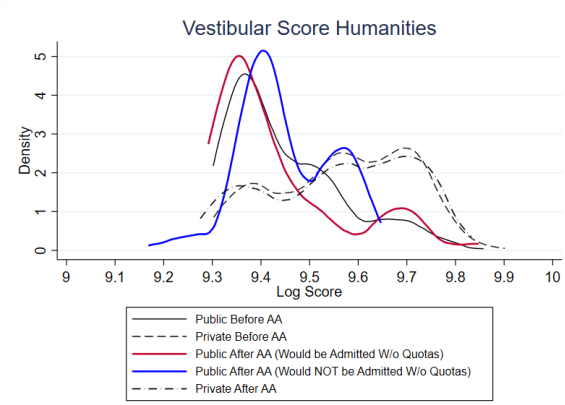


Note: this figure presents the distribution of: (a) vestibular score, (b) final GPA, and (c) final GPA conditional on the vestibular score among health sciences students from private and public high schools before and after the quotas policy.

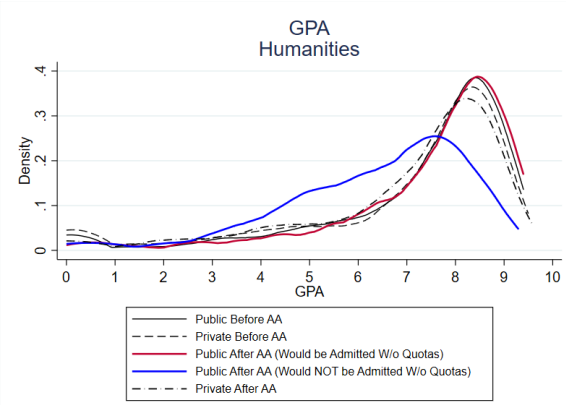
Source: authors' compilation based on UFBA data.

Figure A3: Outcomes among groups of students majoring in social sciences and humanities

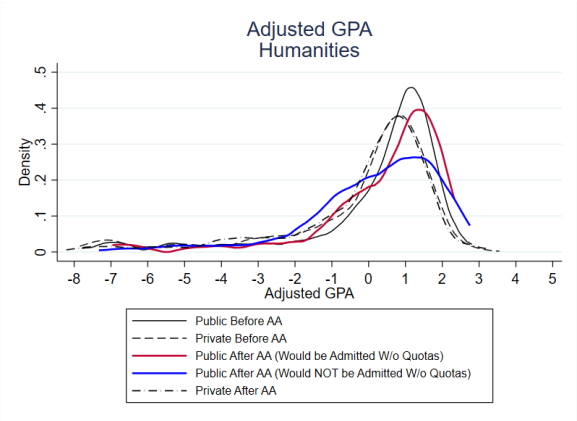
(a)



(b)



(c)

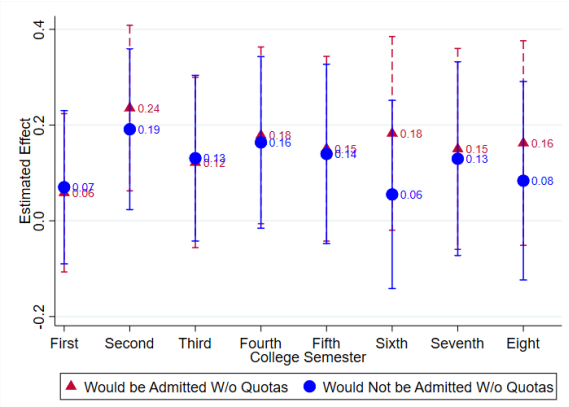


Note: this figure presents the distribution of: (a) vestibular score, (b) final GPA, and (c) final GPA conditional on the vestibular score among social sciences and humanities students from private and public high schools before and after the quotas policy.

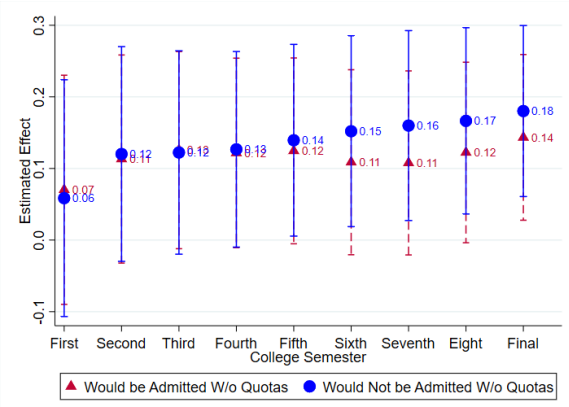
Source: authors' compilation based on UFBA data.

Figure A4: Effects of admission via quotas by college semester

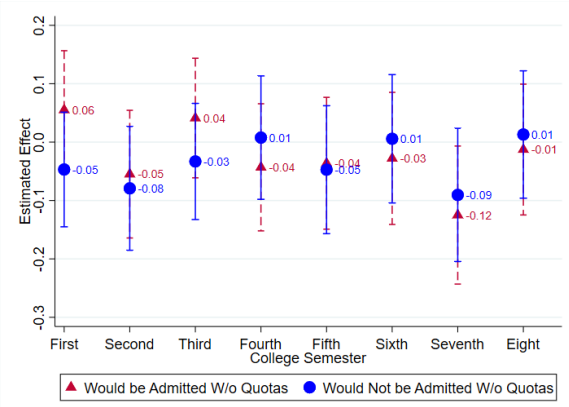
(a) GPA



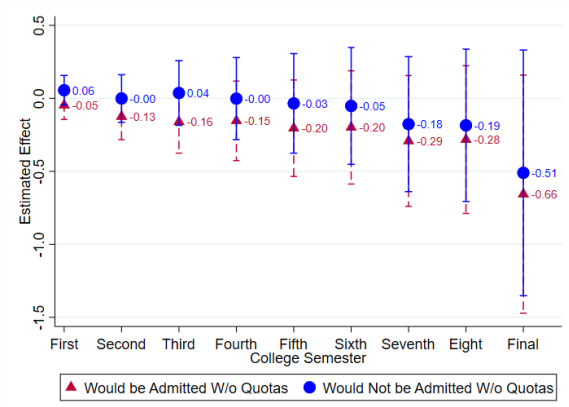
(b) Cumulative GPA



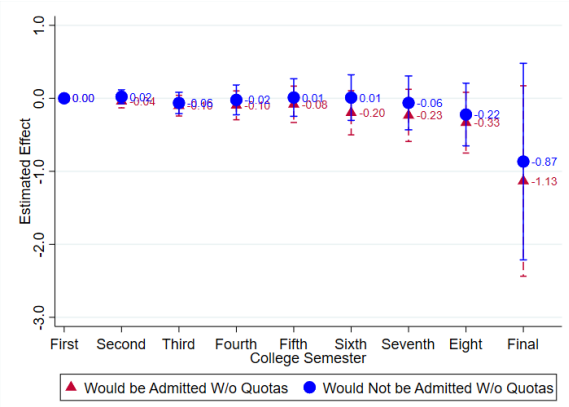
(c) Failed courses



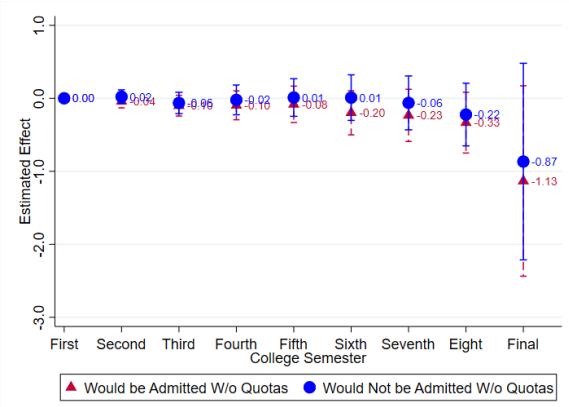
(d) Cumulative failed courses



(e) Retaken courses



(f) Cumulative retaken courses

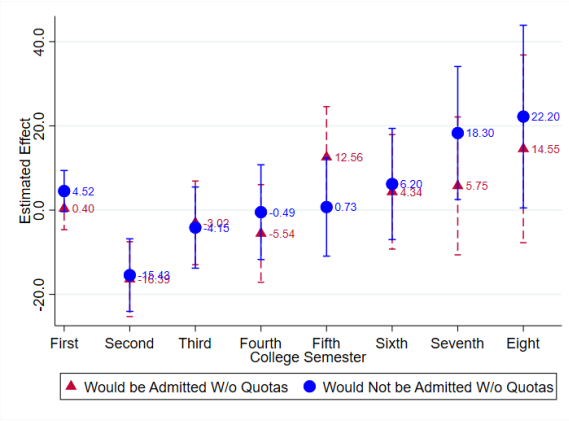


Note: these graphs present the results of estimating equation (9) for several outcomes and different time periods: (a) semester GPA; (b) accumulated GPA; (c) number of failed courses in the semester; (d) accumulated failed courses; (e) number of retaken courses in the semester; (f) accumulated retaken courses. The estimates refer to the difference-in-differences coefficients β_1 (red) and β_2 (blue) from equation (9) for each student outcome by semester. The unit of observation is a student-year, and the analysis includes the cohorts of students enrolling at UFBA in the years 2003–06.

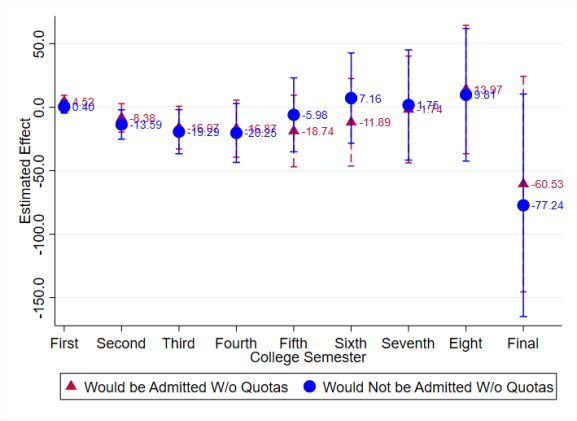
Source: authors' compilation based on UFBA data.

Figure A5: Effects of admission via quotas by college semester

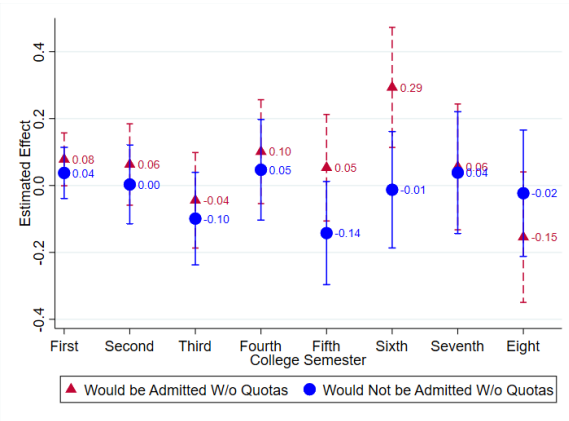
(a) Credit hours



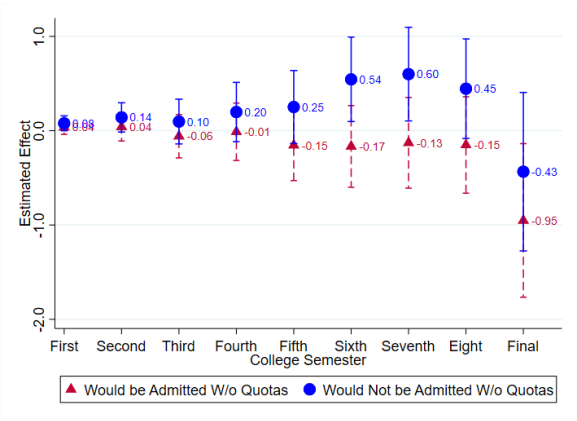
(b) Cumulative credit hours



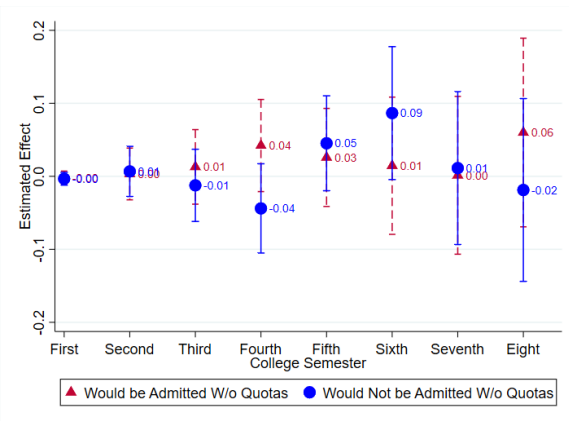
(c) Mandatory courses



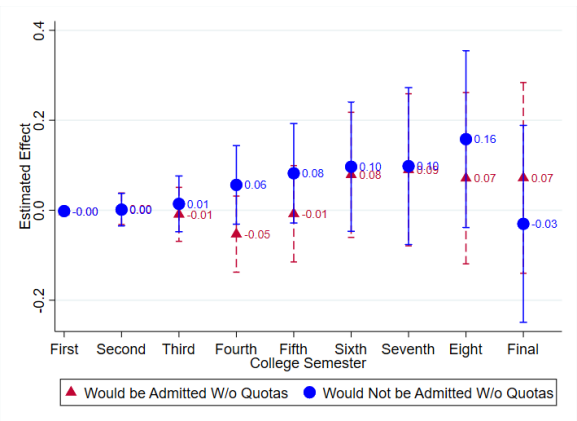
(d) Cumulative mandatory courses



(e) Elective courses



(f) Cumulative elective courses



Note: these graphs present the estimated impacts of the UFBA quota policy on (a) credit hours, (b) accumulated credit hours, (c) mandatory courses, (d) accumulated mandatory courses, (e) elective courses, and (f) accumulated elective courses. The estimates refer to the difference-in-differences coefficients β_1 (red) and β_2 (blue) from equation ((9)) for each student outcome by semester. The unit of observation is a student-year, and the analysis includes the cohorts of students enrolling at UFBA in the years 2003–06.

Source: authors' compilation based on UFBA data.

Table A1: Descriptive statistics: enrolled students

	Before AA			After AA				
	Average	Standard deviation	Observations	Average	Standard deviation	Observations	Change	*p*-value
Public school	0.270	0.444	3,753	0.498	0.500	3,724	0.228	0.000
Age	20.566	2.192	3,842	19.728	2.616	3,798	–0.838	0.000
Men	0.489	0.500	4,001	0.500	0.500	3,959	0.010	0.349
White	0.415	0.493	3,747	0.211	0.408	3,698	–0.204	0.000
Pardo	0.440	0.496	3,747	0.592	0.492	3,698	0.152	0.000
Preto	0.108	0.311	3,747	0.164	0.370	3,698	0.056	0.000
Asian	0.026	0.158	3,747	0.015	0.123	3,698	–0.010	0.002
Indigenous	0.011	0.104	3,747	0.018	0.132	3,698	0.007	0.012
Single	0.961	0.193	3,736	0.961	0.192	3,687	0.000	0.995
Has child	0.035	0.183	1,865	0.047	0.211	3,724	0.012	0.039
Fez Cursinho	0.586	0.493	3,749	0.630	0.483	3,721	0.044	0.000
Worked during school	0.097	0.296	3,735	0.157	0.364	3,723	0.060	0.000
Intends to work since first year	0.389	0.488	3,747	0.420	0.494	3,725	0.030	0.007
Income								
1–5 minimum wages	0.251	0.434	3,745	0.483	0.500	3,716	0.232	0.000
5–10 minimum wages	0.311	0.463	3,745	0.249	0.432	3,716	–0.062	0.000
>10 minimum wages	0.438	0.496	3,745	0.268	0.443	3,716	–0.169	0.000
Parent's education								
Father: complete high school	0.305	0.460	3,753	0.307	0.461	3,720	0.003	0.800
Father: some higher education	0.465	0.499	3,753	0.364	0.481	3,720	–0.102	0.000
Father: complete higher education	0.383	0.486	3,753	0.280	0.449	3,720	–0.104	0.000
Mother: complete high school	0.355	0.479	3,750	0.390	0.488	3,717	0.034	0.002
Mother: some higher education	0.447	0.497	3,750	0.343	0.475	3,717	–0.104	0.000
Mother: complete higher education	0.367	0.482	3,750	0.266	0.442	3,717	–0.102	0.000
Vestibular performance								
Second round standardized score	0.291	1.009	4,001	0.104	1.084	3,959	–0.187	0.000

Note: this table presents the descriptive statistics of all former students who enrolled at UFBA over the period 2003–06. The affirmative action (AA) policy was implemented in 2005. Change is the difference between the group characteristics before and after the policy. The *p*-value is for change.

Source: authors' calculations based on UFBA data.

Table A2: Parallel trends before the affirmative action policy

	2003			2004				
	Mean public	Mean private	Difference	Mean public	Mean private	Difference	Change	*p*-value
Age	21.644	20.263	1.380	21.588	20.218	1.369	–0.011	0.945
Men	0.474	0.478	–0.005	0.504	0.517	–0.013	–0.008	0.818
White	0.300	0.518	–0.219	0.236	0.429	–0.194	0.025	0.474
Brown	0.484	0.376	0.108	0.532	0.456	0.077	–0.031	0.379
Black	0.186	0.066	0.121	0.194	0.083	0.110	–0.011	0.628
Asian	0.020	0.028	–0.008	0.020	0.025	–0.005	0.003	0.773
Indigenous	0.009	0.012	–0.003	0.018	0.007	0.011	0.014	0.062
Single	0.915	0.978	–0.063	0.911	0.987	–0.076	–0.013	0.328
Entry exam preparation course	0.721	0.515	0.206	0.742	0.539	0.203	–0.003	0.924
Worked during school	0.238	0.044	0.193	0.237	0.041	0.196	0.003	0.898
Plan to work since first year	0.517	0.344	0.173	0.503	0.338	0.165	–0.007	0.831
Income								
1–5 minimum wages	0.461	0.142	0.318	0.565	0.162	0.403	0.085	0.004
5–10 minimum wages	0.345	0.282	0.063	0.294	0.331	–0.037	–0.100	0.003
>10 minimum wages	0.194	0.576	–0.382	0.141	0.507	–0.366	0.016	0.647
Parents' education								
Father:L complete high school	0.371	0.276	0.095	0.355	0.290	0.065	–0.030	0.368
Father: some college	0.192	0.578	–0.386	0.188	0.564	–0.377	0.009	0.797
Father: college graduation	0.144	0.487	–0.343	0.131	0.467	–0.336	0.006	0.847
Mother: complete high school	0.437	0.341	0.095	0.399	0.325	0.074	–0.021	0.537
Mother: some college	0.177	0.535	–0.358	0.171	0.570	–0.398	–0.040	0.237
Mother: college graduation	0.130	0.446	–0.316	0.121	0.475	–0.354	–0.038	0.254
Vestibular performance								
Second round standardized score	–0.077	0.557	–0.635	–0.190	0.419	–0.609	0.026	0.716
College performance								
Failures	0.183	0.149	0.033	0.198	0.164	0.034	0.001	0.953
First semester GPA	6.550	6.818	–0.267	6.712	6.780	–0.068	0.199	0.264
GPA	6.310	6.679	–0.369	6.256	6.544	–0.288	0.081	0.666
Finished graduation	0.692	0.755	–0.063	0.670	0.736	–0.066	–0.003	0.929
On-time graduation	0.568	0.637	–0.068	0.561	0.625	–0.063	0.005	0.891

Note: this table presents the values of characteristics and outcomes for the treated and control group before the affirmative action policy. Change accounts for the difference between the trends in the groups in the pre-policy years. The *p*-value is for change.

Source: authors' calculations based on UFBA data.

Table A3: Association between being a quota student and the standardized vestibular score

	(1) Vestibular score
Quota student	–0.683***
	(0.0812)
Observations	6,094
Major FE	✓
Time FE	✓
Other controls	✓

Note: this table reports the association between an indicator variable for whether a student is a quota student and the standardized vestibular score. The unit of observation is each student enrolled at UFBA over the period 2003–06. The estimated coefficient was obtained by an OLS estimation of the following equation: $Y_{ict} = \beta Q_i + X_i\gamma + \psi_c + \eta_t + \varepsilon_{ict}$, where Y_{ict} is the outcome for student i in major c in year t, Q is a dummy variable equal to 1 if the individual is a potential (before the policy) or actual (after the policy) beneficiary of the quota policy, X_i is a set of student characteristics, ψ_c is a set of major fixed effects, and η_t is a set of year fixed effects. Robust standard errors (in parentheses) are clustered at the major level. The dependent variable, vestibular score, is the standardized score of the entrance admission exam. *** denotes statistical significance at the 1 per cent level, ** at the 5 per cent level, and * at the 10 per cent level.

Source: authors' calculations based on UFBA data.

Table A4: Unconditional estimations

	(1) Failures	(2) Graduation	(3) Failures	(4) Graduation	(5) Failures	(6) Graduation	(7) Failures	(8) Graduation
Effects for all quota students								
Admitted via quota	0.0190	–0.0371	0.0543***	–0.0886***	0.0505***	–0.0813***	0.00694	–0.0463**
	(0.0240)	(0.0376)	(0.0123)	(0.0177)	(0.0117)	(0.0172)	(0.0148)	(0.0175)
Control group average	0.160	0.764	0.160	0.764	0.160	0.764	0.160	0.764
Observations	6,281	6,281	6,281	6,281	6,094	6,094	6,094	6,094
Major FE			✓	✓	✓	✓	✓	✓
Age and gender					✓	✓	✓	✓
Ability control							✓	✓

Note: this table reports the estimated impacts of the UFBA quota policy on two student outcomes—the proportion of failed courses among all courses taken ('Failures') and the proportion of students who eventually graduate ('Graduation'). The estimates refer to the difference-in-differences coefficient β from equation (8). The unit of observation is a student-year, and the analysis includes the cohorts of students enrolling at UFBA in the years 2003–06. The first cohort of students benefiting from the UFBA quota policy is the cohort admitted in 2005. The policy reserved 45 per cent of the available slots in each major from public school students, 85 per cent of which must be filled with Black and mixed-race students. The control group consists of students from private schools who were ranked among the top 55 per cent prior to the policy, and the students who were *not* eligible for the policy after its implementation. 'Ability' refers to the initial ability as measured by the score obtained by the student in the entrance test—the overall vestibular score. Standard errors clustered at the major level are reported in parentheses. *** denotes statistical significance at the 1 per cent level, ** at the 5 per cent level, and * at the 10 per cent level.

Source: authors' calculations based on UFBA data.

Table A5: List of majors included in the study

Major	Broad field of study	Number of slots per year	Minimum number of semesters to graduate
Business	Social science and humanities	155	8
Economics	Social science and humanities	90	8
Law	Social science and humanities	200	10
Pedagogy	Social science and humanities	120	8
Executive assistant	Social science and humanities	80	6
Architecture and urbanism	Technology	120	10
Computer science	Technology	70	8
Civil engineering	Technology	160	10
Mechanical engineering	Technology	80	10
Environmental engineering	Technology	40	10
Statistics	Technology	40	8
Physics	Technology	40	7
Geophysics	Technology	15	8
Geology	Technology	50	10
Physical education	Health sciences	45	8
Nursing	Health sciences	80	10
Pharmacy	Health sciences	120	10
Phonoaudiology	Health sciences	30	10
Medicine	Health sciences	160	12
Veterinary science	Health sciences	110	10
Nutrition	Health sciences	80	8
Dentistry	Health sciences	120	10

Note: this table presents the list of majors included in our study, as well as the broad field of study. We have excluded majors that require any subjective evaluation besides the vestibular score, such as music and industrial design. We have also excluded majors where students could choose between a bachelor degree or a 'licenciatura' degree, in which the main goal is to prepare the student to become teachers. For these majors, it is not possible to identify the type of degree in different years due to changes in the major unique identifiers. Many of these majors have also changed names through the years, making comparisons inaccurate.

Source: authors' compilation.