Does the Implementation of Affirmative Action in a Competitive Setting Incentivize Underrepresented Public School Applicants' performance?
Evidence from São Paulo

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Abstract

In 2011, the Federal University of São Carlos in São Paulo (UFSCar) created a 40% quota for Black and public school applicants. This study investigates whether the introduction of affirmative action at the university level creates an incentive for the targeted underrepresented applicants to perform better on their qualifying exam in a state where public universities admit one out of 25 students on average. Relying on data provided by the standard entrance exam (ENEM) and its mandatory socioeconomic survey from 2010 and 2011, I employ a differences-in-differences (DID) methodology in order to exploit the characteristics of this quasi-experiment to use the favored group's counterparts from comparable states that had not introduced any type of affirmative action during those years as a comparison group. In this process I find that, on average, Black students from public schools in São Paulo scored 1.54% higher on the ENEM as a result of the introduction of quotas in UFSCar admissions, and the estimate for all public school students (unconditional on race) was 1.16% on average. I find no change in private school test takers.

Introduction

In August 2012, the Brazilian government enacted one of the Western Hemisphere's most sweeping affirmative action (AA) laws, requiring public Universities to reserve half of their admission spots for public school students, who primarily come from lower income groups. This vastly increased the number of students of African descent in universities across the country.

This drastic measure, aimed at restoring equal opportunity for all Brazilian children, has provoked heated debates among the academic, political and public spheres. Some claim that these aggressive quotas will generate adverse incentives for the accumulation of human capital, and simply benefit a lower performing, poorer segment of the population. Others believe that with this large reduction in the marginal cost of their education, low-income and minority students will finally have the opportunity to succeed in Brazilian society and will perform just as well as their private school counterparts.

Since the 1960s, numerous countries have adopted affirmative action policies as a way to improve skill-acquisition and human capital accumulation among minority groups (Sowell 2004). The importance of Prop 209[1] in the United States today demonstrates the pervasive and controversial nature of AA. Consequently, literature regarding AA is vast and delivers insightful findings and theories on the important characteristics of the affected minority population (Milgrom & Oster 1987, Card 2001, Lang 1993). Analyzing how targeted and non-targeted groups are both affected by AA is the key to understand the impact of the Brazilian policy. Fryer and Loury (2005) argue that "confident *a priori* assertions about how affirmative action affects incentives are unfounded. Indeed, economic theory provides little guidance on what is ultimately a subtle and context-dependent empirical question."

In light of the Brazilian context, I will examine the introduction of a quota system that benefits Black and public school students in the admission procedure of the Federal

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[1] Proposition 209, approved in November 1996, prohibit California state government institutions from considering race, sex, or ethnicity, specifically in the areas of public employment, public contracting or public education

University of São Carlos in São Paulo, evaluating its incentive effect on applicants' performance on the entrance exam. Affirmative action was first introduced in Brazilian Federal Universities in 2002 but São Carlos was the only university that introduced quotas in 2011.

I will investigate whether affirmative action either enhances or undercuts incentive on the entrance exam. I document the impact of this quota system on the test performance through the Exame Nacional do Ensino Médio (ENEM) survey data from 2009 and 2010. I employ a differences-in-differences (DID) methodology, exploiting the characteristics of this quasi-experiment to use what would be the favored group in comparable states that had not introduced any type of affirmative action during those years. Because the number of students who leave their home states to attend an undergraduate program in Brazil is very low, these students are assumed to not be affected by the quotas implemented in the state of São Paulo.

My findings are that, in São Paulo, the test score of Black students and public school students was 1.4% and 1.16% higher, respectively, as a consequence of the introduction of these quotas. With an (unconditional) ENEM test score gap of approximately 15% between public school students and private schools students in São Paulo, a 1.16% increase in the performance of public school students indicates an approximately 6% closing of this gap.

The group most affected are the Black applicants, and that this pattern is reflected within public school applicants. Conditional on having been schooled in public establishments, the ENEM score of white test takers increases by 0.83%, the ENEM score of *pardo* (brown-skinned) test takers increases by 1.27%, while the ENEM score of Black test takers increases by 1.54%. This pattern reflects the desired effect by the University of São Carlos: incentivizing and providing higher education to social groups that are underrepresented in the state's Federal Universities.

However these results have to be interpreted carefully. São Paulo is different from the rest of the country on many levels. First of all, only 2.8% of its more than 10 million Blacks have a University diploma (Pnad/IBGE 2001). In addition, Public

Universities are extremely competitive, queuing an average of 25 people per available seat. Secondly UFSCar is one of the two universities in the State that use the National Entrance Exam, as São Paulo Universities resist adhering to the system while other states embraced this unified exam as of the early 2000.

In the final section I consider the limitations of attributing these results to UFSCar's quota implementation. I discuss how I would verify whether my main results are robust to a series of potential problems, including some of the usual concerns in DID models. First, I consider preexistent differential trends prior to the introduction of the quotas. I suggest the limitations of incorporation data from previous and following years in my analysis. Second, I address the size of the treatment considered and potential omitted variables and confounding effect from possible changes in state-level variables that might be correlated with the implementation of quota systems. I show that there were no effects for private school students who should have be equally affected by the state-level variables but less affected by the quotas. Third, I consider another potential pitfall due to my reliance on self-reported racial information. Although Francis and Tannuri-Pianto (2012) suggest that students might change their self-description under the quota system, it is highly unlikely in the context of this study. This is because students applying to universities could only benefit from the quota when their identity would be verified once admitted. Finally, I consider the possibility that my DID standard errors are underestimated given the potential intra-state and serial correlation of the residuals. If this were the case, my statistical inferences would be invalidated. As suggested by Bertrand, Duflo, and Mulainathan (2004), I consider the possibility of relying on robust standard errors clustered at the school level as well as an alternative statistical inference procedure for our main results that would be robust to intra-state correlation in residuals.

This paper is organized as follows: Section 1 presents background information on the Brazilian educational system and affirmative action, followed by an introduction to admissions and affirmative action at the Federal University of São Carlos. Section 2 provides a literature review that explores the potential outcomes of such policy and ends with relevant findings about Brazil. Section 3 describes the data and provides summary statistics as well explaining the choice of the comparison group. Section 4

reports my empirical strategy. Section 5 presents the main empirical results. Section 6 considers specification tests that I would like to carry out in order to verify the robustness of my findings and broaden the scope of this research project.

I. Background information

While Brazil is known for its racial diversity, being the country that had received the greatest number of slaves during the Trans-Atlantic Slave trade (Eltis 2001), it is also, perhaps paradoxically, notorious for its racial inequality. Today, about half of the population is white, 44.2% is *pardo*, and 6.9% is Black (IBGE 2010). In addition, the majority of Black Brazilians are impoverished and attend public schools. Although *pardos* and Blacks represent 50% of the Brazilian population, they account for almost 75% of underperforming, poor students (Stahlberg 2010). In this way, it is clear how inequality in education translates into income inequality: Blacks and *pardos* represent 73% of the poor, and only 12% of the rich.[2]

a. Educational system in Brazil

The Brazilian educational system is split into two levels: basic education and higher education. Basic education has three stages: infantile education, from 0 to 6 years old; fundamental education, mandatory (and free), which lasts at least 8 years; and middle school, which lasts from 3 to 4 years.

The defeat of the Brazilian socialist movement in 1964 marked the beginning of the stagnation of the public higher education system, and not coincidentally, the growth of private institutions throughout basic and higher levels.[3] Brazil's abandonment of the educational sector is partially due to the fact that only 7.8% of the Brazilian population between ages 18 and 24 was enrolled at the University level in 1998 (Pnad/IBGE Sampaio, Limongi, Torres 2000).

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[2] A 2007 study found that White workers received an average monthly income almost twice that of blacks and *pardos*. Blacks and *pardos* earned on average 1.8 minimum wages, while whites had a yield of 3.4 minimum wages.

[3] The growth pattern of the private education sector and the recession of the public universities are analyzed by Cunha (1986). On the other hand, Barros, Henriques and Mendonca (2001) analyze international data and come to the conclusion that "Between the 60s and 80s, the Brazilian educational system expended at a much slower rate than the corresponding international mean."

The administrations that followed the 1960s military government[4] so continually disregarded the educational question that by 1990, the federal government provided higher education for a mere 19% of students, whereas in 1984 it had provided for 40% (Brasil 1999). Meanwhile the private sector, which already provided services to 59% of students in 1985, continued to expand in order to satisfy the needs of 62% of students in 1998 (Brasil 1999).

However, while the expansion of private education sustained high-quality provision for fundamental and middle school education, the same could not be said about private universities. Private institutions are unable to match the quality offered by federal universities because of the high fixed cost of higher education.

The outcome of these opposing movements is that the free public schools have decreased in quality. The competitiveness of the public university entrance exam and the lack of expansion of the public university system motivated upper and middle class families to demand high-quality schools in order to prepare their students for the highly competitive public university entrance exam.

Because the college admission process in Brazil considers only test scores and leaves personal information and background unknown, there is little chance that admission officials discriminate based on race. But this process leads to discrimination that is based on economic status. As poorer students cannot afford the higher quality of education provided at private schools, they tend to not perform as well on the college admission exams as the students with access to private education. Even as early as the mid 1970s some portion of Brazilian society – mainly comprised of middle class Black students – was already feeling the effect of these movements. As Santos (1985) says, in order to obtain a higher education, young Black students have to appeal to the private institutions that offer diplomas seen as holding less value in the job market. The Brazilian education literature blames the high cost of acquiring qualified academic faculty and finance scientific research for the failure of private higher education

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[4] Mainly the administrations led by Soarney, Collor, Itamar and Fernando Henrique

institutions to produce high quality education. But this alternative merely accentuates the restrictions placed upon these populations by Brazil's education system.

b. Affirmative action and racism in Brazil

Throughout the 1990s the Public University acceptance rate of public school applicants remained stagnate at approximately 33.8% of the entering class (Peixoto 2000). However, this figure is inconsistent, for the Ministry of Education's Secretary reports that of the 54.9 million students enrolled in public basic education system at the time, 87.6% attended public school.

While the concept of racial quotas was introduced at the start of the 1980s, it was not until 2000 that Brazilian public universities began to use racial quotas to influence their admission policies. The first law treating AA specifically was approved by the state of Rio de Janeiro, which established that 50% of state universitiy admissions would be reserved for public school applicants starting in 2003. The following year, in the same state, the law changed to guarantee 40% of its seats for *pardos* and Black students. That same year, the state of Bahia matched this guarantee for the two groups in its public universities. Since then many schools in other states have adopted some form of AA. Table 1 presents the evolution of the size of quotas at Public Higher Education Institutions, between 2004 and 2008. In 2004, the total number of spots reserved for minorities was only 3.1% in 9 states, while in 2008 this number went up to 11.2% in 21 states.

c. Admissions and Affirmative Action at UFSCar

My analysis will focus of the Federal University of São Carlos, also known as UFSCar, a public research university located in São Carlos in the state of São Paulo. UFSCar is located in a rural area, with 4 campuses spread across the state's countryside. It has approximately 14,000 students enrolled and 1,000 professors and researchers employed. Its researchers are Brazil's fourth most productive in terms of the quantity of articles published in indexed international journals of science.

Unlike the national trend, in 1994, almost half of Federal University of São Carlos admitted students came from public schools. This number, however, has been

decreasing over time. In the 2005 entrance exam, for example, 80% of approved students came from private schools. Similarly, while 35% of the population of Brazil's southeast region (IBGE 2001) is Black or *pardo*, UFSCar's 2005 entering class had less than 14% of students who are Black or *pardo*.

UFSCar took action to adjust this disproportion by maintaining a 20% quota for students from Public School. UFSCar has accepted 2577 students every year since 2009. There were 40547 applicants in 2010 (pre-quota) and 71439 applicants in 2011 (post-quota). Then in 2011 the university implemented a more drastic measure by reserving 40% of seats for public school students who were educated exclusively in public institutions. Of that percentage, 35% were reserved for Black students. This last quota will be the main focus of my analysis.

II. The Effects of the Introduction of Quotas on Student Performance
a. Theoretical Channel

There are many mechanisms through which quotas can affect students' performance on the Public University entrance exam. First, market imperfections can affect access to universities. Specifically, liquidity constraints may prevent access to universities for minorities, who are usually overrepresented in the poorest part of the population. Andrade (2004), for example, builds a theoretical model in order to study how quotas affect the economic efficiency of Brazilian society from the perspective of total expenditure (government and households), considering the coexistence of public and private universities. Starting from the assumption that basic education is available and equally enjoyed by and for all, he shows that depending on the difference in quality between public and private institutions and the size of the liquidity constraint faced by beneficiaries of the quotas, there can be an increase in the efficiency of total investment (public and private).

These findings are relevant in the Brazilian context given the lower level of public basic education relative to private education. If public school students were already giving their best effort, meaning the gap between the scores of public and private schools is purely due to the difference in quality of education, no increase in performance should be visible. On the other hand with the implementation of 40%

quotas at UFSCar, perhaps qualified public school students who previously would not have applied (because in the past they didn't have the means to pay for private education or judged public universities as too competitive) will now find it worthwhile to apply, increasing the mean score of the pool of public school applicants.

A second possible factor that may discourage these otherwise potentially higher performing students is their anticipation of future discrimination in the job market, in which case minority students might be less motivated to accumulate human capital during their academic career (Lundberg & Startz 1983, Milgrom & Oster 1987, Lundberg & Startz 1998). In this case quotas can alter minorities' beliefs and affect their investment decisions. Models of race-based cultural norms (Ogbu & Forham 1986, Ogbu 2003) assert that Black children have lower norms of achievement than otherwise similar white children. This discrepancy could be due to a lack of opportunities given and then expected by Black students over time. In either case, quotas could increase opportunity, and this opportunity being known and believed in could then trigger a shift in realistic norms of achievement for minority students.

Finally, since the Brazilian selection process is based solely on a seemingly objective exam grade, perhaps quotas can improve the selection efficiency of the exam. An efficient selection process would select qualified students from diverse backgrounds since tests scores provides nothing about an applicant's qualitative characteristics. This could have a mixed effect on entrance exam performance. According to Coate and Loury (1993), the effort level may decrease in the presence of quotas and thus diminish the incentives for investment in human capital. Specifically addressing the issue of the cost of the effort, a 1987 study by Bull et al. looks at the behavior of individuals in tournaments where the cost of the effort to achieve a certain goal is different. The results show that the behavior of individuals is dependent on the size of the asymmetry of cost and effort. In general, individuals who face higher costs demonstrate less effort than others. Given the high competition at UFSCar, it is interesting to consider whether the quota will change applicants' beliefs regarding their cost of effort.

b. Previous evidence of introduction of quotas in Brazil

Although the total number of spots reserved for minorities was 11.2% in 21 states by 2008, only the most prominent cases have received serious empirical analysis – those of Rio de Janeiro in 2000, Bahia in 2003, and Brasilia in 2004.

It seems that the conclusions of these cases show that students who receive special treatment, such as preferred admission, may actually perform worse that before the policy was implemented (D' Souza 1991 and Murray 1994). Francis and Tannuri-Pianto (2009) show that this difference may be small. Studying the University of Brasilia (UNB) applicants accepted under the quota system, the authors estimate that the differential performance of the favored students compared to the unfavored students is only 20% of the standard deviation of their standardized scores. On the other hand, Ferman and Asuncion (2006) say the data provided by the national evaluation exam shows that the adoption of racial and socioeconomic quotas in the state universities of Rio de Janeiro and Bahia actually reduced incentives for high school students. However, Francis and Tannuri-Pianto (2009) argue that the conclusions of this study are unreliable since it is not possible to identify those who actually paid for the Public University entrance exam.

In this paper I will focus on ENEM exam score used by UFSCar, which in 2009 was already used by 42 of 55 Federal Universities in the country. This unique and rich dataset will shed light on the controversial empirical results presented above.

III. Data Source and Population overview
a. ENEM

To be admitted to a public university in Brazil, the student must pass an admission test called 'vestibular'. Each university offers its own 'vestibular'. Until 2009, some universities also considered the ENEM as part their selection process, but these were isolated cases.

My empirical analysis relies on the ENEM micro-dataset. ENEM data provides complete test information for over 4 million test takers for the years of 2009-2010, as well as a mandatory socioeconomic survey providing family background characteristics and high school identifiers for students applying to Public Universities. The 40% quota

at UFSCar was introduced in 2011, and in order to account for the one-year lag, they use the 2010 ENEM results as a unique process in the selection of the entering class, similar to how they used the 2009 exam to select the entering class of 2010. Hereinafter, all observations made in 2009 refer to the 2010 application process (pre-quota) and all 2010 observations refer to the 2011 application process (post-quota).

In 2009 the ENEM was methodologically reformulated in order to standardize the admissions process for Federal Universities. In 2009, according to the Ministry of Education, 541 of the 2252 higher education institutions used the ENEM score, either as unique or partial selection criterion. Of these, 42 were public universities[5]. Universities can use the ENEM in several ways: to allocate only a percentage of the vacancies to ENEM test takers; as a unique selection process; as the first phase of admission; to supplement applicant data, or as part of the entrance exam score.[6]

It is important to note that the ENEM is open to anyone who wants to take it. For example some people will use it to apply for a ProUni scholarship to attend a private HEI, while others use it as an evaluation of their capacities when applying for jobs. I am unable to determine which university students are applying to. But in order to remedy this lack of specification, my analysis relies on the students who reported their reason for taking the ENEM was in order to apply to a university and those who obtained a score greater than 0[7] (schools will not accept a score of 0 in one of the subjects). In addition, the number of ProUni scholarships offered between 2009 and 2011 increased by 3% while the comparison group had a 12% increase, which could lead to underestimates. However, the volume of scholarships offered in São Paulo was greater,[8] which would have increased the number of black students. This presents an omitted variable bias that must be accounted for. I attempt to examine the validity of my findings given this constraint in section 6.

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[5] There are 55 Federal Universities in the country

[6] Table 4 shows how Universities in treatment and comparison group use the exam. I elaborate on this further in this section.

[7] Appendix 1 (available online) shows the grade distribution for the whole population versus those who intend to go to university.

[8] 87568 scholarships offered in Sao Paulo versus 60546 between the 3 control states in 2011

The ENEM evaluates students in Natural Science, Human Sciences, Portuguese, Mathematics, Critical Thinking, and Essay Writing. The proficiency measure is presumably comparable over time as it is calibrated using "item response theory" methodology. Unlike simpler alternatives for creating scales, this methodology does not assume that each item is equally difficult and treats the difficulty of each item as information to be incorporated in scaling items. My analysis is based on the cumulative score of these 6 sections. The score distribution is available in appendix one.

The 2009 survey contains a wide variety of information on student and school characteristics that are, unfortunately, only partially replicated in 2010. Taking this into consideration, the control variables used are gender, age, household size, indicator for rural schools, and parent schooling.

b. Summary Statistics

In selecting the comparison group for São Paulo, two constraints had to be taken into consideration. First, the states being compared needed to have universities that used the ENEM consistently in both the 2010 and 2011 selection process. Table 4 indicates how the ENEM is used in each state during both years of interest. Though the number of seat offered varies slightly in the compared universities, since there is no critical change, my results should not be skewed.

Secondly, the demographics of the comparison group had to be comparable to São Paolo. São Paolo is the economic capital of Brazil, making the state both more wealthy and white-dominated than the rest of the country. It follows that schooling levels are also higher. Two other states of the Southeast subdivision of Brazil, Minas Gerais and Rio de Janeiro, are comparable to São Paulo in wealth and education level despite the lower percentage of whites and larger percentage of *pardos*. I also include Rio Grande du Sul, the south most state of Brazil, which is wealthy and white-dominated but with lesser quality education. As can be seen in table 5, treatment and comparison group are very comparable at baseline with the exception that São Paulo is 80% white and 12% *pardo* while the control group is 70% white and 22% *pardo*. I consider this constraint in section 6 but will assume until then that this characteristic does not play a key role. In addition, according the Telles (2004) and Magnoli (2008) self-reporting of *pardos* is not entirely reliable as it depends on whether or not people consider themselves as such.

At a first glance, I note from columns A and C of table 5 that at the baseline, the score gap between private schools and public schools in our treatment group (São Paulo) is 404.78 points while the control group has a substantially smaller gap of 349.37 points. We would expect that the implementation of a quota in São Paulo would lead to an improvement in public school performance relative to the control group[9]. This result can be seen in the post-quota score gap, found using column (E) and (G. The score gap after the implementation of the quota becomes 383.45 points for São Paulo and 370.58 points for the control group. Therefore, the dynamic in São Paulo is opposite that of our control group.

As a final descriptive exercise, Figure 1 shows the correlation across São Paulo's municipalities between the number of test takers before and after the quota was implemented. The gray circles are proportional to the number of white test takers in that given municipality after the quota was implemented while the black dots are proportional to the number of Black test takers after the quota was implemented. Figure 2 provides a close up representation for municipalities with less than 25,000 thousand applicants, respectively. The number of test takers by municipality is very comparable from one year to the next; however, a small increase in participation rate is visible in Figure 1 for municipalities with approximately 25,000 test takers. These municipalities also seem to have a greater rate of Black applicants.

IV. Methodology

To identify the impact of quota systems on the performance of favored applicants on the ENEM, I exploit certain characteristics of this quasi-experiment to use applicants from the states that had not implemented a quota in 2010 or 2011 as a comparison group. In a difference-in-difference (DID) framework, I compare the difference in performance between the treatment and comparison groups after this

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[9] According to the Brazilian annual household survey (PNAD), 15% of the undergraduate students in Brasilia are originally from another state. The corresponding figures are only 5% in Sao Paolo. Therefore, it is reasonable to assume that favored students in Brasilia faced stronger competition for the reserved spots than black students in Rio de Janeiro.

quota system was implemented in 2011 with the same difference before these quotas were implemented in 2010.

The basic DID estimate of the quota's effect on the performance of favored students is obtained from the following least squares regression:

$$\ln(y_i) = c + \alpha \cdot d_i^{2011} + \beta \cdot d_i^{Treat} + \gamma \cdot d_i^{2011} \cdot d_i^{Treat} + \delta' \mathbf{X}_i + \varepsilon_i$$

where i indexes the students in the sample which is pooled for the exam years 2009 and 2010; y_i refers to the proficiency variable; d_i^{2011} indicates whether student i took the exam in 2009 or 2010; d_i^{Treat} indicates whether student i belongs to the treatment group; $\mathbf{X}_i$ is a vector of student characteristics which is broadly divided into demographic characteristics, parental education and school municipality; and ε_i reflects unobserved variables that affect students' proficiency. Different pairs of treatment and comparison groups are considered in the next section. The coefficient of interest is related to the interaction between d_i^{2011} and d_i^{Treat}, γ, which can be interpreted as the average impact of the treatment on the treated – the percentage variation in the performance of favored students due to the introduction of the quota system.

V. Main empirical results

I will first present my DID estimates for the most affected group: Black students and students who were exclusively educated in public schools. While UFSCar's quota was limited to public school applicants who had only attended public schools, there was no restriction on Black students – any Black student was eligible. Therefore I begin by estimating the quota effect on all Black test takers, followed by the effect on all test takers that were schooled in public institutions. I then estimate the DID for different races within the pool of public school applicants who attended public school only. Finally, I look at the DID estimate for São Paulo's private school applicants who might have been negatively impacted by the implementation of this quota system.

The models in columns E through F of Table 6A present estimates of the DID equation using Black test takers as the treatment group and their counterparts in comparison states. In column E no demographic, parental education, or school municipality control variables were included. The estimated effect of being favored by

the system of quotas is a 1.1% increase in test score (significant at 5%). These results reflect the difference in the difference between the mean test score of the treatment and comparison groups after quotas were implemented, compared to the same difference before these systems of quotas were implemented. These results must be analyzed carefully because they may reflect changes in the composition of the groups or changes in factors other than the quota incentive.

Column F of table 6A presents the same regression but includes a vector of characteristic (age, gender, household size, rural/urban indicator). Controlling for students' characteristics does not significantly change the estimated effect of being favored by the quota. The estimated effect is a score improved by 1.13% (significant at 5%). In Column G, I add parental education level to the control vector, which does not change the size or the significance of the estimate. In column H, I account for the school municipality, which results in a higher estimated effect of a 1.4% increase in test score (significant at 5%). However, this last estimate reduced the number of observation used from 245,736 to 81,884. Perhaps the subpopulation differs from the aggregate Black test takers. One could interpret reporting of the non-mandatory high school code on the ENEM as an indicator of "overachievement" or wanting to perform well, which could increase the likelihood of them wanting to perform better on the ENEM in order to benefit from UFSCar's quota system.

The models in Column A through D of table 6A contain estimates of the DID equation using public school test takers as the treatment group and their counterparts in comparable states. In column A, no demographic control variables (parental education or school municipality) were included. For students favored by the quota system, the estimated effect is a 1.09% increase in test score (significant at 5%). When adding controls in columns B & C the effect estimated is still significant but reduced to slightly less than a 1% increase in test score. Again we can use our "overachiever" subgroup to note a slightly larger estimate of a 1.16% increase in test score, which is 0.24% lower than the increase estimated for Black test takers in column H of table 6A.

It seems that Black students were slightly more affected by the quota policy; this hypothesis is further supported by the estimates presented in table 6B. In table 6B I

estimate the difference in differences equation for white public school test takers (column A), *pardo* public school test takers (column B), and Black public school test takers (column C). All three estimates were done using full specification, even though these results are significant without specifications. We find in column A that white public school students are least incentivized by the UFSCar quota with an estimated 0.83% increase in test scores. Followed by, in column B, an estimated 1.27% increase in test scores for *pardo* public school students. Finally Black public school students, the most affected group, the estimated impact is of 1.54% increase in test scores. All of these figures are significant at the 5% level.

Finally, Table 6C presents results for no control (column A) and complete specifications, including all control variables (column B) for private school test takers. Neither estimate exhibits an effect from quotas that is significantly different from zero. We note that the number of observations is only 6% less than in the model without controls in the complete specification estimate, whereas the number of observations for the Black test takers model and public school test taker is a loss of 67% and 62%, respectively (table 6A). This supports the hypothesis that reporting school municipality is associated with higher scores and could be a sign of overachievement given that private school students are more successful.

Despite the significance of all the results, it is important to note that the effect of the quota estimated by the DID model is small. Black and public school students' scores increased by approximately 1%, which could be due to factors completely unrelated to the quota implementation. In the next section I will address some of the issues already mentioned and further potential concerns such as time trends, selection bias, omitted variables, serial correlation, and within state correlation in the residuals as well as the comparability of São Paulo with the rest of the country and the size of the treatment.

VI. Specification Consideration

In this section I consider the potential concerns in attributing the estimated 1% increase in Black and public school test scores to the implementation of 40% quotas at UFSCar.

The first issue we should consider is whether the increase in proficiency among the favored students occurred strictly after the implementation of these quota systems, or if there was already a positive trend occurring in student performance before the implementation of the quota system. Despite the comparability established by the summary statistics in Table 5, the baseline score difference is disconcerting because it could be that relative to the 2010 comparison group, the score gap between public and private school average test score, Sao Paulo's gap was much larger. Therefore we cannot dismiss that São Paulo, being Brazil's white-dominated, economic center, has a different time trend than the rest of the country.

In order to address this problem we could estimate a DID model with data from previous ENEM years. The complications involved with such procedure are 1) ENEM became prominent in 2009, and 2) in previous years different states implemented forms of affirmative action, but such estimates would still provide trend evidence if São Paulo's pattern was strikingly different from the rest of the country. In addition, considering ENEM data from the post treatment years could further cement a distinctive trend if one were to be found.

A second concern is the size of the treatment. UFSCar offers admission to only 2577 students every year, and there were 40547 applicants in 2010 (pre-quota) and 71439 applicants in 2011 (post-quota). While the queuing nearly doubled from 15.73 to 27.72, it is unlikely that all 507,185 ENEM test takers in the state of São Paulo – 7 times the number of UFSCar applicants – intended to apply to UFSCar when they decided to take the test initially. This leads us to consider the potential of omitted variables bias. Also, we should consider the fact that the ENEM became prominent in 2009. Perhaps the growing popularity of the exam combined with ProUni scholarship opportunities is what drove the results, but this remains difficult to analyze for the lack of ProUni data.

Another possible confounding effect is that the system of quotas in UFSCar may have been implemented in conjunction with other, statewide, changes in educational policy, which would bias the estimators. Table 6C revealed non-significant effects for private school students who should be equally affected by state-level policies, but there is no evidence suggesting that they are less affected by the quotas. Nonetheless, even if

there are no state-level omitted variables that correlate with the implementation of quotas, serial correlation, and within state correlation in the residuals of DID modes could lead to underestimated standard errors and, therefore, incorrect statistical inferences, as suggested by Bertrand, Duflo, and Mullainathan (2004).

But within this issue, there is still the need to evaluate whether this potential downward bias in standard error is leading us to incorrectly reject the null hypothesis – that the quota system had no effect on student performance of Black and public school students in São Paulo. The strategy I would like to adopt is one that uses the same data structure of the main regression to estimate placebo regressions for states that had not implemented quota systems during this period as the treatment group. Otherwise, an alternative will be to rely on robust standard errors clustered by municipality, since the school level data remains incomplete because students do not consistently report this information.

My last concern is that the composition of the treatment group may have changed due to the implementation of the quota system. First, a system of quotas that benefit Black students would likely change the way in which students describe themselves. However, this is unlikely because upon admission the candidate has to submit a transcript demonstrating they attended public school and documentation proving their ethnicity. In an attempt to measure the quantitative relevance of potential selection bias, we could use DID models in which each of the students' observable characteristics are dependent variables. If the system of quotas truly changed the composition of the treatment group, this would have likely changed the observable characteristics of this group. A more relevant problem of composition is the difference in the percentage of white test takers in São Paulo relative to the comparison group, for which I would have to construct an adequate test to verify if this aspect is driving my findings.

Conclusion

I provide empirical evidence justifying the claim that the implementation of affirmative action policies in a competitive setting can have positive effect on the performance of students applying to universities. My estimate shows that, on average,

the ENEM test score of Black students from public schools in São Paulo was 1.54% higher as a result of the introduction of quotas in university admission policies. The estimate, on average, for public school students (unconditional on race), was 1.16% increase in test scores after the implementation of the UFSCar quota. Private school students were not affected, which reflects that the quota system is encouraging public schools applicants to perform better as their odds of entering university is increased. The robustness of these results is a project I hope to undertake in the future.

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Figure 2: Correlation between Pre & Post-Treatment ENEM Participation across Sao Paulo Municipalities
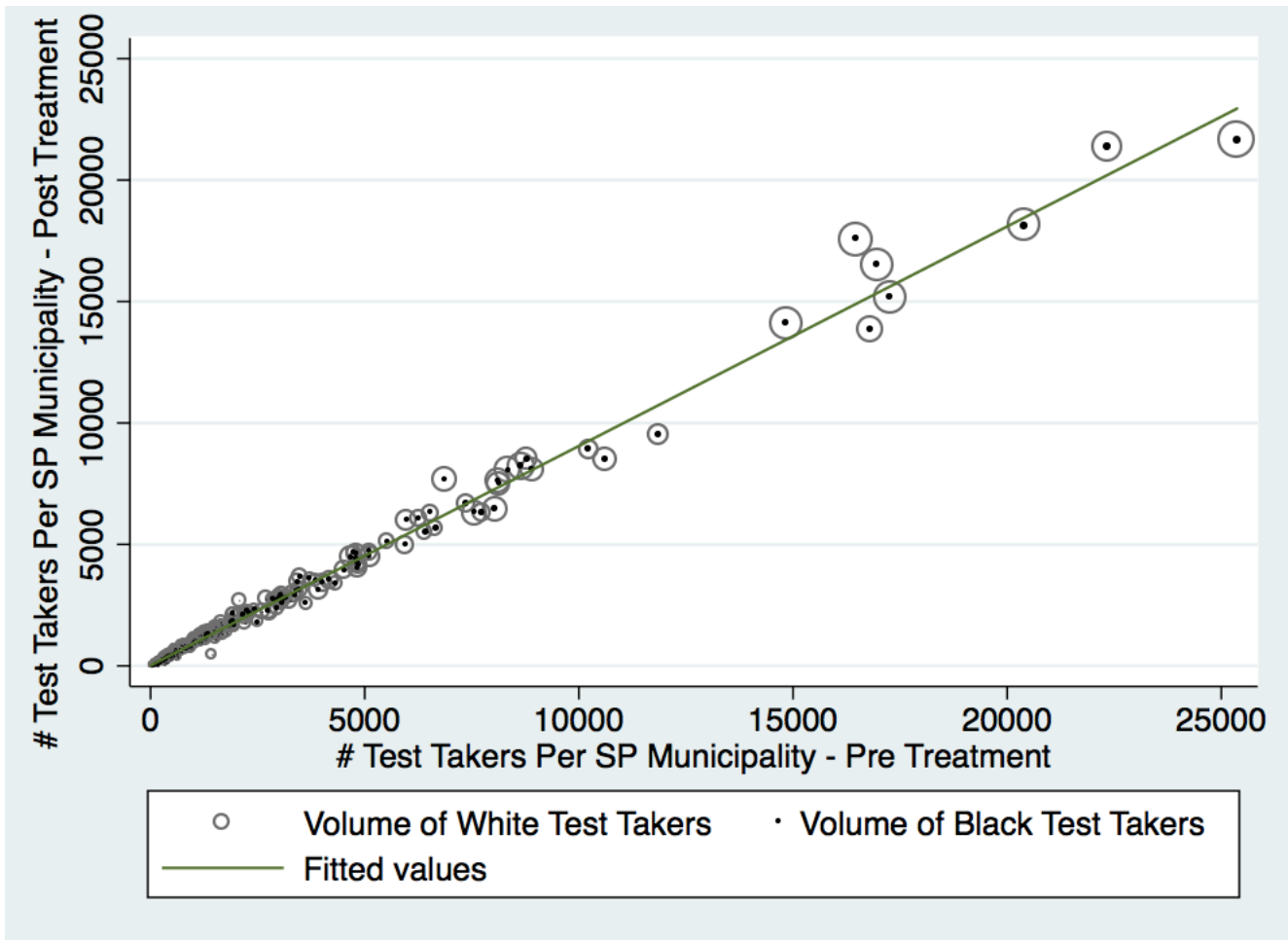
Note: In this second figure the municipality of Sao Paulo (city) has been omitted

Table 1 – Fraction of seats reserved for quotas in Public Institutions of Higher Education by State and year

State	Quota for black or brown					Quota for public school students					Total Quota				
	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
Acre	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Alagoas	–	.138	.100	.231	.228	–	–	–	–	–	–	.138	.100	.231	.228
Amapa	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Amazonas	–	–	.010	.000	–	.121	.126	.273	.196	.24	.211	.183	.394	.289	.278
Bahia	–	.10	.097	.123	.156	.136	.118	.138	.147	.165	.136	.376	.253	.332	.388
Ceara	–	–	–	.020	–	–	–	–	–	–	–	.000	–	.002	–
Distrito Federal	.096	.146	.148	.144	.158	–	.008	–	.007	.007	.096	.153	.148	.151	16.7
Espirito Santo	–	–	–	–	–	–	–	–	–	.178	–	–	–	–	.178
Goias	–	.003	.030	.059	.045	–	.003	.055	.065	.075	–	.006	.088	.144	.129
Maranhao	–	–	–	.065	.054	.004	–	–	.065	.053	.004	–	.006	.150	.112
Mato Grosso	–	.008	.062	.062	.087	–	–	–	–	.006	–	.013	.062	.062	.093
Mato Grosso do Sul	.114	.077	.084	.065	.061	.114	–	–	–	–	.114	.116	.122	.099	.103
Minas Gerais	–	.017	.026	.031	.024	–	.020	.037	.052	.057	–	.042	.069	.091	.098
Para	–	–	–	.062	.009	–	–	–	–	–	–	–	–	.062	.009
Paraiba	–	–	–	–	–	–	–	–	.039	.054	–	–	–	.042	.057
Paraná	–	.059	.046	.079	.054	–	.063	.067	.077	.094	.000	.123	.116	.164	.148
Pernambuco	–	–	–	.032	.035	–	.033	.026	.036	.047	–	.033	.026	.110	.131
Piaui	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rio Grande do Norte	–	–	–	.001	–	.218	.244	.232	.210	.198	.218	.244	.232	.221	.202
Rio Grande do Sul	–	–	–	–	.065	–	.001	–	–	.096	.066	.012	.044	.001	.172
Rio de Janeiro	.064	.060	.056	.042	.056	.063	.060	.056	.042	.056	.143	.137	.129	.105	.129
Rondonia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Roraima	–	–	–	–	–	–	–	–	–	–	–	–	–	.001	.002
Santa Catarina	–	–	–	.008	.015	–	–	–	.004	.028	–	–	–	.029	.043
Sergipe	–	–	–	–	–	–	–	–	–	–	–	.002	–	–	–
São Paulo	–	.005	.002	.015	.027	–	–	.002	.015	.027	–	.006	.008	.034	.059
Tocantins	–	–	.002	.075	.010	–	–	–	–	.010	–	.011	.033	.087	.034
Brazil	**.007**	**.022**	**.023**	**.039**	**.041**	**.018**	**.029**	**.038**	**.042**	**.052**	**.031**	**.065**	**.070**	**.096**	**.112**

Source: Higher Education Census (INEP)

Table 4: Treatment and comparison states Public Universities use of ENEM

Federal Universities (A)		How FU selects students (B)	Seats for/require ENEM	
			Pre-Quota (C)	Post-Quota (D)
São Paulo (Treatment)				
UFABC	Federal University (FU) of ABC	only ENEM	1700	1700
UFSCAR	FU of Sao Carlos	only ENEM	2577	2577
Rio Grande Sul (Comparison)				
UFPEL	FU Pelotas	ENEM mandatory first phase	3125	3076
FURG	FU Rio Grande	ENEM mandatory first phase	2361	2441
UFFS	FU Fronteira Sul	only ENEM	2160	2160
UFCSPA	FU Health Science of Porto Alegre	328 seats for ENEM	328	328
UNIPAMPA	FU Pampa	only ENEM	2465	2725
Rio de Janeiro (Comparison)				
UFRRJ	Rural FU Rio de Janeiro	only ENEM	3480	3470
UFF	FU Fluminense	ENEM mandatory first phase	1601	1601
UNIRIO	FU State of Rio de Janeiro	only ENEM	1121	1165
UFRJ	FU Rio de Janeiro	ENEM mandatory first phase	8274	9000
Minais Gerais (Comparison)				
UNIFEI	FU Itajuba	ENEM required for most fields	2906	3148
UFVJM	FU Vales do Jequitinhonha e Mucuri	50% of seats for ENEM	488	500
UFLA	FU Lavras	60% of seats for ENEM	1794	1556
UFSJ	FU Sao Joao Del Rei	~10% of seats for ENEM	78	166
UFOP	FU Ouro Preto	ENEM mandatory first phase	1268	1218
UNIFAL	FU Alfenas	ENEM mandatory first phase	1529	1500
UFTM	FU Triangulo Mineiro	ENEM counts 20% of first phase	844	844
UFU	FU Uberlandio	ENEM mandatory first phase	281	312

Source: MEC/ http://educacao.uol.com.br/ and University Websites

Table 5: Summary Statistics

	Pre-Quota				Post-Quota			
	Sao Paulo		Comparison		Sao Paulo		Comparison	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
Private School Applicants								
N	36373		46376		47828		61515	
Fraction Female	.56	.50	.58	.49	.55	.50	.56	.50
Fraction White	.80	.40	.70	.46	.82	.38	.71	.45
Fraction Brown	.12	.32	.22	.41	.09	.29	.18	.39
Fraction Black	.02	.15	.05	.23	.02	.15	.05	.23
Mean Age	18.5	2.79	18.6	2.10	17.7	3.18	17.91	3.05
Mean Mother schooling	3.58	.99	3.52	1.08	3.51	1.02	3.40	1.09
Mean Father schooling	3.49	1.10	3.29	1.21	3.40	1.14	3.19	1.21
Mean Household Size	3.87	.95	3.73	1.01	----	----	----	----
ENEM Test Score								
All Students	2980.92	518.96	2950.52	494.25	2981.26	464.22	2976.98	463.01
White	2998.32	512.81	2988.28	491.70	2992.81	457.85	3005.97	454.52
Mulatto	2868.15	526.59	2890.37	487.39	2856.55	487.57	2901.02	464.73
Black	2780.68	532.44	2782.40	472.06	2815.03	460.24	2815.98	476.53
Public School Applicants								
N	308680		416022		459357		697697	
Fraction Female	.59	.49	.62	.49	.58	.49	.60	.49
Fraction White	.58	.49	.50	.50	.62	.49	.52	.50
Fraction Brown	.29	.45	.34	.47	.25	.44	.30	.46
Fraction Black	.09	.29	.12	.33	.09	.28	.12	.33
Mean Age	23.42	7.31	23.43	7.26	22.3	7.70	23.1	8.02
Mean Mother schooling	2.22	1.23	2.22	1.26	2.25	1.20	2.18	1.21
Mean Father schooling	2.06	1.28	1.94	1.25	2.08	1.25	1.92	1.22
Mean Household Size	3.89	1.23	3.81	1.24	----	----	-----	-----
ENEM Test Score								
All Students	2576.14	563.60	2601.15	526.70	2597.76	535.47	2606.40	527.86
White	2635.37	571.57	2658.82	532.49	2643.41	535.45	2647.20	529.88
Mulatto	2486.21	533.44	2558.53	516.19	2506.68	514.92	2570.36	515.96
Black	2461.40	522.91	2515.30	501.41	2480.54	511.53	2520.39	517.28

Note: Unfortunately the household size measure is different on the 2010 ENEM. Broad adjustments were made so that it could be added as a control in the regression but not as informative.

Table 6A: Quota System effect on Public School & Black Applicants

	Dependent Variable is ln(test score)							
	Treatment Group: Applicants from Sao Paulo's Public Schools				Treatment Group: Black Applicant			
	Comparison Group: Applicants from RS/RJ/MG's Public Schools				Comparison Group: Black Applicants in RS/RJ/MG			
	(A)	**(B)**	**(C)**	**(D)**	**(E)**	**(F)**	**(G)**	**(H)**
$d_i^{2011} \cdot d_i^{Treat}$	1.09	0.96	0.93	1.16	1.11	1.13	1.13	1.4
	(0.08)	(0.08)	(0.08)	(0.12)	(0.23)	(0.23)	(0.23)	(0.37)
d_i^{2011}	0.39	0.64	0.78	1.48	0.5	0.73	0.78	1.45
	(0.05)	(0.05)	(0.05)	(0.08)	(0.13)	(0.14)	(0.14)	(0.22)
d_i^{Treat}	-1.97	-1.65	-2.1	-3.23	-2.55	-2.49	-2.52	3.56
	(0.06)	(0.06)	(0.08)	(0.09)	(0.18)	(0.18)	(0.18)	(0.28)
Control Variables								
Demog. Charact.	N	Y	Y	Y	N	Y	Y	Y
Parental Education	N	N	Y	Y	N	N	Y	Y
School Municipality	N	N	N	Y	N	N	N	Y
N	1874126	1869524	1863125	707205	247763	246788	245736	81884
R-squared Adjusted	0.023	0.031	0.107	0.115	0.015	0.55	0.102	0.116
p-value, $d_i^{2011} \cdot d_i^{Treat} = 0$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Results have been multiplied by 100 for legibility purposes. In addition, these coefficients can be interpreted, ceteris paribus, as an estimate of the percentage variation in test score associated with the variable.

Table 6B: Quota System effect on Applicants from Public School Students by Race

	Dependent Variable is ln(test score)		
	Treatment Group: Applicants who were schooled in Sao Paulo's Public Schools		
	Comparison Group: Applicants who were schooled in RS/RJ/MG Public Schools		
	White	Pardos	Black
	(A)	(B)	(C)
$d_i^{2011} \cdot d_i^{Treat}$	0.83	1.27	1.54
	(0.16)	(0.22)	(0.4)
d_i^{2011}	1.54	1.46	0.97
	(0.11)	(0.14)	(0.24)
d_i^{Treat}	-0.33	-3.97	-3.53
	(0.12)	(0.16)	(0.3)
Control Variables			
Demographic Characteristics	Y	Y	Y
Parental Education	Y	Y	Y
School Municipality	Y	Y	Y
N	383101	230345	69761
R-squared Adjusted	0.137	0.138	0.137
p-value, $d_i^{2011} \cdot d_i^{Treat} = 0$	0.00	0.00	0.00

Note: Results have been multiplied by 100 for legibility purposes. In addition, these coefficients can be interpreted, ceteris paribus, as an estimate of the percentage variation in test score associated with the variable.

Table 6C: Quota System effect on Applicants who attended Private school

	Dependent Variable is ln(test score)	
	Treatment Group: Applicants who were schooled in Sao Paulo's Public Schools	
	Comparison Group: Applicants who were schooled in RS/RJ/MG Public Schools	
	(A)	(B)
$d_i^{2011} \cdot d_i^{Treat}$	0.28	0
	0.18	0.169
d_i^{2011}	3.31	2.79
	0.12	0.12
d_i^{Treat}	-0.085	-0.67
	0.12	0.12
Control Variables		
Demographic Characteristics	N	Y
Parental Education	N	Y
School Municipality	N	Y
N	257148	242048
R-squared Adjusted	0.023	0.109
p-value, $d_i^{2011} \cdot d_i^{Treat} = 0$	0.11	0.696

Note: Results have been multiplied by 100 for legibility purposes. In addition, these coefficients can be interpreted, ceteris paribus, as an estimate of the percentage variation in test score associated with the variable.