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**THE EFFECTS OF SISU AND AFFIRMATIVE ACTION ON  
COMPETITION AND FIRST-YEAR STUDENTS IN BRAZILIAN HIGHER  
EDUCATION**

**Porto Alegre**

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Dissertação submetida ao Programa de Pós-Graduação em Economia da Faculdade de Ciências Econômicas da UFRGS, como requisito parcial para obtenção do título de Mestre em Economia.

Orientadora: Profa. Dra. Thais Waideman Niquito

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## **ABSTRACT**

In 2010's decade, Brazilian Higher Education experienced two extremely impactful policies. First was the implementation of the Unified Selection System (SiSU), one of the largest programs of Higher Education enrollment in the world that shifted the selection of higher education students from a decentralized matching system to a centralized one. The other is the Affirmative Action policy (AA), that reserved half of the vacancies of public institutions for vulnerable students. In this work we estimate the impacts of each policy in five different groups of students (females, students with disabilities, non-white students, students from public school and low-income ones). We find that, in general, SiSU have a negative impact for their enrolment and AA does not necessarily compensates it, these findings go against some of the literature. We provide some possible explanations why this the case is, but there is a huge limitation on the available data. We also relate this discussion to other relevant challenge that Brazil was facing, namely the lack of physicians.

**Keywords:** Education Market. SiSU. Affirmative action. Matching mechanisms.

## RESUMO

Na década de 2010, a Educação Superior brasileira vivenciou duas políticas extremamente impactantes. A primeira foi a implementação do Sistema de Seleção Unificada (SiSU), um dos maiores programas de matrículas no Ensino Superior do mundo, que mudou a seleção de estudantes do ensino superior de um sistema descentralizado para um centralizado. A outra é a política de Ações Afirmativas (AA), que reservou metade das vagas de instituições públicas para alunos vulneráveis. Neste trabalho estimamos os impactos de cada política em cinco diferentes grupos de alunos (mulheres, alunos com deficiência, alunos não brancos, alunos de escola pública e alunos de baixa renda). Concluimos que, em geral, o SiSU tem um impacto negativo na matrícula e a AA não necessariamente o compensa, esses achados vão contra parte da literatura. Fornecemos algumas possíveis explicações para isso, mas há uma enorme limitação na base de dados disponíveis. Também relacionamos essa discussão a outro desafio relevante que o Brasil enfrentava, a falta de médicos.

**Palavras-chave:** Mercados de educação. SiSU. Ações afirmativas. Mecanismos de pareamento.

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## 1 INTRODUCTION

The 2010 decade was extremely relevant for Brazilian education, it saw the implementation the two most impactful policies of its higher education, the Unified Selection System (SiSU) and an Affirmative Action (AA) policy. SiSU is a digital platform that allows students to apply to any public Higher Education Institution (HEI) that has joined the program using only his or hers scores of the National Exam of Secondary Education (ENEM); and, in 2012, was passed an AA law that reserved at least half of the vacancies of each federal HEI for students from public schools. Both were adopted at the national level and had a drastic impact on students' enrollment. In this work we analyze the effects of each policy on the composition of first year students.

Before SiSU, the student's selection by institutions<sup>1</sup> was only made via *vestibulares*<sup>2</sup>, a decentralized system where each institution elaborated its own test. This test's score is used only to enroll in this same institution, the application (of institution and degree's area) is done beforehand and the score cannot be used anywhere else. This meant that students would encounter different styles of test for each institution they apply to. Since there were no standardized guidelines, students would have to take this in consideration when studying for each test. More relevant is that, since students must be physically present to take the test, there is a little number of institutions that they can apply to. Students that wish to apply in other municipalities had to travel to do so. All these factors made prohibitively costly to apply to more than a few universities.

The adoption of SiSU represents a change, from a decentralized selection to a centralized one, using an algorithm of selection close to a deferred acceptance algorithm. It also equalized the costs of application and makes the marginal cost of applying for an extra institution zero. We can expect a change in behavior by the students, that may incur in strategic behavior by hiding their preferences over degree courses, which may affect their enrollment (WU; ZHONG, 2014). Also, and arguably more important, the competition for each HEI increases substantially, since now students from all over Brazil can apply to any HEI in the program, using the score of

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<sup>1</sup> Using institution is not the most accurate term, but, for the sake of readability, I use Higher Education Institution, HEI and institution interchangeably.

<sup>2</sup> The singular of *vestibulares* is *vestibular*.



only one test, the ENEM. Thus, students that previously had a comparative advantage by living near a renowned institution, no longer enjoys it.

Brazil is not the only country that had centralized its admission system, in fact, there are at least other 46 countries that have done so as well (KAPOR; KARNANI; NEILSON, 2022), thus, understanding the Brazilian situation sheds light on others' experiences. It also presents the opportunity to investigate the results of theoretical works.

The magnitude of SiSU cannot be overstated, more than 80 Federal and state level HEIs participate in the program and over 8 million students applying to ENEM. The number of papers in the subject does not do justice to SiSU's size, the three most prominent works in the topic are (MELLO, 2021; MACHADO; SZERMAN, 2021; DALCIN; STEIN; JALES, 2022), forma each studding different aspects of SiSU's effects on students, dependent on each student's characteristics. In the present work, we replicate the methodology used by (MELLO, 2021) replicating its model and interpretation for other groups of students. We also provide analyzes for the Medicine Program that's highly relevant for the Brazilian scenario.

The adoption of each policy was gradual. Institutions choose when and whether to adhere to SiSU, and, even when adhering, they did not have to commit all its vacancies to SiSU, but they may choose a fraction to commit. Similarly, prior to the 2012 law, there were state laws and there were some institutions voluntarily making Affirmative Actions programs. Even after the law, HEIs had at least three years to adjust to it. Thus, we exploit the gradual adoption by different institutions and used the proportion of seats in a given major's program destined to each policy as the treatment. That is, if a program offers all its vacancies through SiSU, then it is fully treated by the program, if offers no seat through it, then it is in the control group. The interpretation for the AA is similar.

We observe the proportion of five different groups of students (female, low-income, non-white, from public school and students with disabilities) of first-year students. We find that SiSU, in isolation, impacts negatively impact all groups except for public school students. The proportion of female students are reduced in 2%, low-income students are affected in 4,1%, non-whites are affected in 1,4% and students with disabilities are affected in 0,4%. The impact for students with disability is too small when considered in isolation. AA does not have an impact for females. AA benefits students with disabilities and students from public school, for these groups it more than

compensates SiSU's negative impact. The most surprising thing is that AA have a negative impact for low-income students and (close to) no impact for non-white students. This can be a result of the data collection, that we are not directly observing the group benefited from the AA (non-white students do not have reserved vacancy, only non-white students that came from a public school), that endogeneity is driving our finds, or a combination of them all.

When the policies are combined, other effects may prevail when this interaction occurs, this is most relevant for students with disability, the combined effect is 0,9\% positive. This is because they are able to take advantage of the AA policy thanks to the low costs and better structure provided by SiSU, as argued by (DALCIN; STEIN; JALES, 2022). The group with low-income also benefits by the combined effect, in 5,3\%, which indicates that information improvement plays a role for this group to enroll. For non-white and public-school students, the effect is negative, -1,1\% and -7,1\% respectively, going at odds with (MELLO, 2021). This can be for many reasons, different time span studied, different controls and access to different set of data. When considering both policies adopted at their mean level of adoption, AA does not offset the negative impacts of SiSU for all groups, except for students with disabilities and public-school students (the only group observed directly benefited by the AA).

We've realized the same analyzes to the medicine program in specific. It is consistently one of the most competitive programs to enter, and the profession of physician is one of highest return and highest social status. In addition, in the same decade, the federal government implemented the program *More Doctors* (PMM), that aim to provide more physicians to municipalities in need and to overall raise the supply of physicians in the country. One of the stated goals of the program was to expand majors' programs of medicine. Since Brazil have a shortage of physicians and are creating federal programs to expand the formation of such professionals it is important to see how different groups are represented in such efforts. Therefore, relating the two most impactful programs with the PMM's goals, we apply our analyzes to the medicine Program.

The results are that SiSU's effect are weaker for all groups, in fact, it's only significant for public school students and it is positive. This is probably because medicine already faced high competition prior, thus other effects from SiSU are more relevant. The AA effects are stronger for public School and low-income students, but

is no longer relevant for non-white students. This can indicate a blind spot of the policy<sup>3</sup>. For students with disabilities, the interaction of both policies was also stronger, corroborating the idea that, under high competition, other SiSU's aspects are more relevant, such information improvement and costs reduction.

All results are for the program level and must be taken with caution. We only had access to the data at the degree's program level, while considering effects that happens in the student level, that is, student's choices are the mechanism that alter the composition at the program level. Also, due to recent changes in Brazilian law, it is not possible to cross data from different data sources that would allow us to construct control variables with grater information, such as other intrinsic students' characteristics. We have utilized data only from SiSU and from the Brazilian Higher Education Census (CES) and were unable to cross it with data from ENEM.

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<sup>3</sup> Mello (2021) also speculate this lack of effectiveness for the targets of AA beyond only attending public school, but this was for all programs, here is only present when observing one in specific.

## 2 LITERATURE

The first strand of literature that our work contributes to is the theoretical of educational markets and matching mechanism design (GALE; SHAPLEY, 1962; ABDULKADIROGLU; SÖNMEZ, 2003; CHE; KOH, 2016). Gale and Shapley (1962) wrote the seminal theoretical article that offered the basis on how a match mechanism should evaluate matches and developed the deferred acceptance algorithm, that guarantees stable and optimal matches of students and institutions. Stable matches are ones that no two students would want to swap their institutions while the institutions would swap these students, in other words, there is no desired exchange by all parties. Optimality is simply that there is no other stable arrangement that one party would be strictly better off without worsening other's situation. This algorithm is arguably SiSU's mechanism, as will be presented section 3, the differences are due to the constraints that practical application imposes, since SiSU's takes only up to five days and students couldn't feasibly rank all degree courses, the algorithm would take a huge (finite) amount of iterations<sup>1</sup> to reach a halt.

Abdulkadiroglu and Sönmez (2003) and Abdulkadiroglu, Agarwal and Pathak (2015) further discuss how the mechanisms of selection effects school choices, and its interaction with locality<sup>2</sup>. They used a change in coordination in the centralized assignment on allocation of students to high schools in New York City to examine the allocation efficiency and welfare gains of students. Although there were perceivable gains and there were fewer unassigned students, the context of schools in the United States is quite different from Higher Education, especially from Brazil, there, locality plays a much bigger role, and costs on mobility are much more exacerbated.

Centralized admissions seem to be strictly preferred by the literature, it yields more efficient, more stable and fairer<sup>3</sup> results. Since the advantages are so ubiquitous, why many institutions still prefer to use decentralized matching? This phenomenon is

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<sup>1</sup> According to (GALE; SHAPLEY, 1962), it would take at maximum  $n^2 - 2n + 2$  iterations,  $n$  being the number of students.

<sup>2</sup> This is because schools in USA are usually assigned by district.

<sup>3</sup> Fairness is clearly defined in all of these works and is a topic of its own. The question is what should be considered by the mechanism, generally every student should have its preferences consider and the preferences of higher-ranking students should be attended first. Of course, that this is not strait forward as it seems, students can be multidimensional, and not only their scores should be weighted (CHE; KOH, 2016). Arguably, non-divisible goods, such school seats, are more fairly distributed by a lottery, or a combination of lottery and screening (ABDULKADIROGLU; PATHAK; ANGRIST, 2014; ABDULKADIROGLU; AGARWAL; PATHAK, 2015). In theory, fairness only weights scores, but the scores can be skewed due to prior advantages.

relevant, especially in SiSU's context, one might think that the costs of adoption or other real-world frictions are playing a role here, but even when institutions adhere the program, they don't always offer all their seats to the matching, some of them still offers seats via *vestibular*. Che and Koh (2016) offer a theoretical model to analyze what happens when students are multidimensional and enrolments are made under uncertainty. Under uncertainty, certain universities can exploit the strategy of students and, even if not fulfilling its total quota, are better off with students of higher quality than it would have otherwise. Even though centralized matching could be more desired by a social standpoint of view, given its fairness and efficiency, some players (institutions and students) might prefer the decentralized matching.

Empirical works in education markets usually study the role of application costs and dispersion of information. Some works in the area about reducing student's application costs, as financing programs or free application based on income, that reveals that such policies increase the enrollment of low-income students (PALLAIS, 2015; HOXBY; TURNER, 2015). Cost reduction and information improvement, especially when together, provides advantage to students from low socio-economic situations (DILLON; SMITH, 2017). This is to be expected when considering that the biggest barrier for application to be financial resources, but SiSU does not simply lower the costs for disadvantaged students, but it does so for all students. Other important factor is that SiSU does not add the cost reduction effect in isolation, the nature of SiSU is that it brings about three effects together – cost reduction, informational improvement, and higher competition due to its centralized selection – and they might be heterogeneous due to student's different characteristics.

The closest scenario from other country is Common Application (CA) Platform in the United States, analyzed by Knight and Schiff (2022). CA is a program under which students submit a single application to member schools. Just as it was in Brazil, United States' college admission is decentralized, so this CA facilitates college search and enrolment, and may contribute to reduce frictions in this decentralized market. The CA is not equivalent to the SiSU, since the admission still in charge of each college, but its results are in line from what we observe in SiSU, such as increased applications, increased enrolment of out-of-state and high-income students. This is observed by (MELLO, 2021; MACHADO; SZERMAN, 2021) and our findings.

The literature on Affirmative Action presents the same aspect, in the sense that most of its studies are restricted to institutions or to state level. Estevan, Gall and Morin (2019) and Francis and Tannuri-Pianto (2012) analyzes AA policies adopted before the nationwide 2012's law and find an increase in the enrolment of the groups targeted by the policy. The same is found by studies from the US and India (BAKES, 2012; BADGES; EPPLE; TAYLOR, 2016), but both countries have very different legal and institutional background. In the US many states prohibit affirmative action race-based, and in India they are based on the caste system.

## 2.1 EMPIRICAL LITERATURE ON SiSU

As stated early, there are three main works in different aspects of SiSU. The first one is work of Machado and Szerman (2021), their main findings where that SiSU raised the ENEM's cut-off score for entrance, that is, a raise in the necessary score for entering the program that just adhere to SiSU; a raise in the age of the first-year student; a negative impact in female students; and a raise in migration from out-of-state students. The first result reflects the raise in competition, therefore, only students that perform better enter the degree course. The raise in migration is due higher mobility, provided by the chance to apply from anywhere in the country. Machado and Szerman (2021) also speculates, given the raise in age, that the ones to benefit from this higher mobility are the ones with resource to do so, that is older students, probably males. Their results are strong and really interesting, it provides a mechanism to which SiSU is acting, the raise in cut-off score and to mobility for a specific student to benefit from it.

Dalcin, Stein and Jales (2022)'s work focus on students with disability. They argue that the costs applying to any additional institution under a decentralized system is comparatively higher to students with disability. Not only there is a higher cost of mobility, but they even may face other costs with institutions not prepared to attend their needs. Thus, although all students see their cost reduced, students with disability are more benefited by them. ENEM also provides you with the infrastructure that attend the needs of your disability. As expected, they found that SiSU is significant for the raise in the number of students with disability.

The last one in Mello (2021). Just as here, she interprets the proportion of seats destined to each policy as the treatment and run a regression where both interact. She

studied the three groups targeted the the AA, public school; public school non-white; and public-school low-income students. Her results appoint that SiSU lower the chances for these groups to enroll, but the AA is more than enough to offset this effect. The interaction between them even yields positive results for these groups, suggesting that the informational aspects of SiSU enhances the AA effects. She also provides suggestive evidence that occurred changes in behavior of all students, SiSU encourages students with high income to apply to more public HEIs, even if it means to apply to not preferred, less prestigious programs; and AA incentive public school students to apply, even for those programs where they are overrepresented.

### 3 INSTITUTIONAL BACKGROUND OF BRAZIL'S HIGHER EDUCATION

Education in Brazil is arranged in three levels, Primary, Secondary and Superior. Primary and Secondary are what we associate with standard schooling and, assuming no disapproval, students take it until 17 years old. The National Exam of Secondary Education (ENEM) was created, in 1998, to evaluate Secondary school performance. Rather than focusing on the content of secondary school, ENEM focused on problem solving, composed of 63 interdisciplinary questions. At the time, ENEM didn't play an important role in students' formation. Those who seek to continue studying and get a major's degree would join a Higher Education Institution, and thus, take part in the *vestibular* of the HEI of his or her choice.

In Brazil, Higher Education Institutions have the legal authority to choose how they admit their students. Since there is no strict standard on how it should be, universities use to make their own exams called *vestibulares* as seen before. *Vestibulares* are (usually) executed once a year and students should apply to their degree of choice beforehand. Should be noted that, in Brazil, the public HEIs are generally regarded to be of high quality and their tuition are free, so their limited seats are really disputed. Therefore, it's not uncommon to students take in part in more than one *vestibular*. Students gain the seats according to their scores.

The *vestibulares* imposes a decentralized admission. The decentralization imposes serious costs for its applicants. When applying, students must pick a major degree in the institution of interest, competing for seats only in this degree course, this happens because institutions may use different weights and even different exams for each of its degree courses. Other source of constrain to student is that there is a season of the year that *vestibulares* are carried out, so taking part in more than one *vestibular*, other than being an exhausting experience, may even be impossible, since dates may conflict. Lastly, differences in exams and lack of coordination by the HEIs made the content which to be studied broader, adding difficulty for each extra *vestibular* taken.

In 2008, together with other policies that had the explicit intent of democratizing higher education, MEC announced that the 2009's ENEM would be completely reformulated, increasing its difficulty and making its content more curriculum based. Since then, Institutions saw it as a bad method of screening it's students, therefore relayed on its own *vestibular*. Very few institutions would allocate vacancies to ENEM's



scores, and the ones that did were mainly private, but since its reformulation, and especially after ENEM became mandatory to PROUNI (Programa Universidade Para Todos - University for All Program) students (PROUNI is a federal program that offers scholarships to students of lower income), created in 2004. This, combined with its reformulation and the creation of SiSU were the key factors that led this growth.

From the years 2009 and 2010, with the same democratizing intent, federal government started some crucial changes in the admission mechanisms of higher education. It created of the Law 12.089 (BRASIL, 2009) which prohibits a student to occupy two seats, simultaneously on public HEIs. Before the law, students could enroll in multiple courses. Therefore, the law broadened the supply of seats.<sup>4</sup>

### 3.1 THE SiSU

The 2009's change in ENEM made the HEIs more willing to accept it as a screening mechanism and, as a continued effort, System of Unified Selection<sup>5</sup> (SiSU) was implemented. An on-line platform of unified enrollment, run by MEC, where students choose their preferred degree's course on the preferred institution, and a centralized algorithm allocates students according to their ENEM's score and their preference.

Twice a year, at each academic semester, SiSU's enrollment begins. Participants apply to SiSU using the score of last year's ENEM (so that they already know their scores and can roughly assess their chances of being admitted). They choose two course-institution combinations offered by the program and inform if they are eligible for quotas of affirmative action policies.

The whole process takes up to four days and, at the end of each day the cutoff score of each course is calculated. In these four days, students can change their two choices at any time, so the cutoff scores are constantly changing. This is the time most propitious to strategic behavior by students. The last choice confirmed by the student is the valid one. At the end of the process, the system ranks all students inside their first option. The top scoring students are temporarily designated to their seats and all

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<sup>4</sup> I could not find any exact assessment of the impact that the law had. This argument is only based on logic and anecdotal evidence of students enrolling in multiple universities. Non the less, there is no shortage of this kind of evidence and this conclusion seems reasonable.

<sup>5</sup> In Portuguese, *Sistema de Seleção Unificada*.

the remaining students are discarded. After this turn, all of the second choices of the discarded students are allocated and a new cutoff score is calculated. All the seats are allocated according to the new rank and the new excess students are rejected. The results of the approved students are then announced.

Applicants who were approved and announced can then enroll in the program that they were designated. A waiting list begins with all other participants. Enrolled students cannot participate in this waiting list. The list exists to fill any vacancy, that for any reason, was not enrolled, so there is no seat empty.

Although these were explicit goals of MEC and federal government, the legally guaranteed autonomy of HEIs and the early skepticism on the selective quality of the first reformulated ENEM, made the adoption of the SiSU a gradual process, but, nonetheless, a large-scale one. The numbers of seats offered by institutions also grew in similar pace. The distinction between both is because universities can choose how to allocate their spots, choosing some combination of then designated to either *vestibular* or SiSU<sup>6</sup>. After ENEM's reformulation, in 2009, when announcing the procedures for its admission process, around 60 institutions decided to reserve seats for entry with ENEM's score.

### 3.2 AFFIRMATIVE ACTION

In August of 2012, the "*Quota Law for Higher Education*" (BRASIL, 2012) was approved, an affirmative action policy that reserved vacancies on Federal Higher Education Institutions for targeted groups of students. The law was created to tackle the inequality and lack of representation in Brazilian Higher Education. For instance, in 2010, around 53% of the population considered itself to be non-white, while only 17,4% incoming students in public HEIs were non-white. More than 85% of high-school students attended public school, but from first-year students in public HEIs, only 28,8% attended it.

By the time the law was approved, this lack of representation was already part of the public discussion and concern. In some states, such as Rio de Janeiro and Bahia, the matter was so relevant that they've implemented policies analogous to the AA law ten years prior (NAIFF; NAIFF; SOUZA, 2009). Some HEIs follow them, but

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<sup>6</sup> Some notable examples are USP and UFRGS, the latter only offers 30% of its seats to SiSU.

there was now wide adherence, and HEIs were reluctant. Thus the 2012 law was created. It determines that 50% of vacancies in majors' programs must be reserved for students that studied their whole high school on public schools, the remaining 50% still for open competition. From those reserved seats, 50% goes to students of families with income per capita less than 1.5 minimum wage. Additionally, from these reserved seats, there also must be a share reserved for ethnicity minorities groups - black, mixed ("*pardos*") and indigenous - according to their proportion in the state's population taken from the latest Census. Institutions had until 2016 to comply. They may opt to reserve 50% of the seats immediately, or 12.5% in 2013, 25% in 2014, 37,5% in 2015 and finally 50% in 2016.

### 3.3 PROGRAM MORE DOCTORS

Brazil faced a shortage of doctors and unequal distribution on its territory, with more than two thousand municipalities in vulnerability status. Within the same time frame of SiSU and the Affirmative Action policies, Federal government implemented the program *More Doctors* (PMM) (BRASIL, 2013) in order to cover the medical needs of these municipalities. The implementation of PMM has three action axes, to provide emergency care, to provide infrastructure where needed and to provide a "profound restructuring of medical education in the country"<sup>7</sup> in order to definitively end the problem.

The program was launched in July 2013, and in 2013 and 2014 to attend the first action of providing emergency care, contracted many Cuban doctor. This measure was heavily criticized by the Brazilian medical community and created tensions between the Federal Medical Board (Conselho Federal de Medicina) and the Federal government (RIBEIRO, 2015).

The program is concerned in end the problem of physician's supply and cites the expansion of higher education and changes in the medical residency. From 2013 to 2018, the program created incentives to expand existing degree programs of medicine and to ease the creation of private ones. It expanded or ease the creation of 11.511 new vacancies on medicine programs, 2.198 being in public HEIs. 37 public HEIs participated on the program.<sup>8</sup>

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<sup>7</sup> Free translation from the program's specific goals.

<sup>8</sup> Data provided by the Ministry of Education (MEC).

The program also created a Commission for Monitoring and Monitoring of Medical Schools (CAMEM) to accompany the implementation of this vacancies and provide aid to integrate de degree courses, residency and hospital.

There are very few empirical studies focusing on the educational aspect of the PMM, and most limits their analyzes to the residency or hospitals with students (MOURÃO; RODRIGUES; ARAGÃO, 2018). The majority of works are to assess the direct providence of medical care and whether PMM achieve its goals. There are some questions of its efficiency and some municipalities might have been over served, but the common understanding is the it was successful (SANTOS; COSTA; GIRARDI, 2015; OLIVEIRA; SANCHEZ; SANTOS, 2016).

The present work does not seek to evaluate this axis of the PMM, but we presented it to show that the supply and formation of physicians is a relevant issue in the Brazilian context. The Federal Government is exerting a great effort in both health and education, and the class of students will determine who get to participate in this process. Besides, medicine is a program with high competition and high investments required to students, since most of the time, the six year of the program they do not work, also it has a low risk high financial and social status return.

It is worth pointing out that the Healthcare system is Brazil is public, called the Unified Health System (SUS). It provides everything from primary care to complex procedures, emergency care, chronic treatments, vaccines, and many more, all for free. It is an obligation of the state to provide public healthcare and SUS attends basically all condition, that's why PMM is off so importance to the Federal Government and why the supply of physicians is such a challenge to fulfill its duties.

## 4 EMPIRICAL METHODOLOGY

Here we provide a brief description of the data, how the variables are constructed and some descriptive statistics of variables behavior. More details are present in Appendix A. Then we present the baseline model to capture each policies effect.

### 4.1 DATA

The data comes from two sources, the main one being the Brazilian Higher Education Census (CES), which is collected annually, and it's provided by INEP (National Institute for Educational Studies and Research). The second one is provided by the Ministry of Education (MEC) and compiles all programs seats offered via SiSU from its first year (2010) to 2018. From it we obtain the treatment variable, that ranges from zero to one, defined as the proportion of program's seats that are offered through SiSU or through others means (one being all seats destined to SiSU, zero otherwise and a number in between when only a portion is offered,  $SISU \in [0,1]$ ).

The CES collects information from all HEIs. We analyze a timeframe from 2009 to 2018<sup>1</sup>. It contains information of many student's characteristics from which we constructed our variables of interest. Unfortunately, due to recent changes in the law<sup>2</sup> and concerns with data privacy, INEP only releases the data aggregated to the program level, so it's not possible to observe student's full characteristics (e.g. we may know how many students are women and how many from a public school, but we don't know if there is any women from a public school). The variables of interest are the proportion of each student's characteristics, they are:

- a) **FEM** the proportion of students that are women on a given program;
- b) **NW** the proportion of nonwhite students on a given program;
- c) **PS** the proportion of students that have studied in a public high school;
- d) **DIS** the proportion of students that have a disability;

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<sup>1</sup> CES was collected before this timeframe, but in 2009 the questionnaire took its present form, much of its information wasn't collect before. Of all variables of interest, students from Public School are the only one not collected in 2009, starting observations in 2010.

<sup>2</sup> In specific, the LGPD, Lei nº 13.709/2018, about data protection.

e) *LI* the proportion of students that are benefited from a program of social support due to Low Income<sup>3</sup>.

From CES' data we also constructed the treatment variable for the affirmative action (AA) policy, as well as the SiSU variable, the variable *AA* ranges from one to zero and it is the proportion of seats, in a given program, occupied by students that participated in reserved seat program.

We can observe from the Table 1, with descriptive statistics, that the share of these for students' groups (NW, DIS, PS, LI) have increased in this time frame. the only exception is for female students, that had a slight decrease.

Since we are concerned with the impacts of centralization, we restrict the analyzes to first year students only, we also limit for public intuitions at federal and state level, following previous works in the same subject (MELLO, 2021; MACHADO; SZERMAN, 2021; DALCIN; STEIN; JALES, 2022) since they are the ones that adhere to the program, which the affirmative action laws fully applies, and, as early stated, public HEIs in Brazil are generally regarded as high quality.

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<sup>3</sup> This is supposed to capture Low Income as studied by Mello (2021), defined as those that have so little income as the be eligible to receive social support. She acquired this information from ENEM data, but, due to the new data format, this crossing of data is unfeasible, thus we can only see those that have actually received the support.

Table 1: Descriptive Statistics

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	$\Sigma$
Observations	4876	5573	5588	5880	5950	6522	6711	6629	6633	6856	61218
Offered Seats	290095	327379	343449	359604	436099	514874	517746	497198	493660	530280	4310384
Incoming Students	292400	338847	341654	364079	360492	379588	386051	383946	380567	393133	3620757
Programs in Capital cities	1853	2090	2117	2151	2237	2348	2424	2380	2351	2444	22395
Programs in Interior cities	3023	3483	3471	3729	3713	4174	4287	4249	4282	4412	38823
FEM	0,530	0,538	0,536	0,543	0,533	0,533	0,522	0,516	0,514	0,519	0,528
LI	0,094	0,120	0,122	0,120	0,172	0,132	0,135	0,154	0,149	0,168	0,138
DIS	0,004	0,005	0,003	0,005	0,006	0,008	0,009	0,008	0,008	0,011	0,007
NW	0,162	0,174	0,191	0,203	0,229	0,340	0,384	0,436	0,464	0,461	0,315
PS	0	0,288	0,262	0,392	0,577	0,568	0,591	0,606	0,602	0,601	0,467
Nº of programs in SiSU	0	926	1886	2328	2749	3636	4310	4766	4945	4751	30327
Nº of seat offered via SiSU	0	64486	109461	139108	169239	223168	261027	285164	289753	296987	1838393
Average proportion of seats offered via SiSU	0	0,130	0,242	0,282	0,304	0,342	0,404	0,444	0,461	0,379	0,312

Author

## 4.2 EMPIRICAL STRATEGY

Here, we want to replicate the methodology in Mello (2021)'s work and expand her analyzes for other groups, thus we are using a similar model:

$$Y_{ipt} = \beta_1 SISU_{ipt} + \beta_2 AA_{ipt} + \beta_3 SISU_{ipt} \times AA_{ipt} + \alpha_{ip} + \alpha_t + \alpha_s \times t + x_{ipt} + \varepsilon_{ipt}$$

an OLS regression where  $i$  is the institution,  $p$  is the program and  $t$  is time, therefore, as said earlier, the treatment  $SISU_{ipt}$  is the percentage of seats offered through SiSU in a given program in the year  $t$ . Similar for  $AA_{ipt}$ , the percentages of seats destined for affirmative action in a given program on year  $t$ . There is also the inclusion of the interaction of both policies when both are adopted at the same time.  $\alpha_{ip}$  and  $\alpha_t$  are, respectively, the program and time fixed effects; programs fixed effect also capture institution ones, since every program is tied to the same institution.  $\alpha_s \times t$  is the state linear trend in order to ensure that results are not driven by shocks in migration or other heterogeneous economic variables.  $Y_{ipt}$  are our variables of interest ( $FEM, DIS, NW, LI, PS$ ) measured in each institution, program and year, they are the proportion of students in each interest group.

$x_{ipt}$  is only present for  $NW$  and  $PS$  variables, it's the control for missing data. For this two information, students have the option to not declare it. Thus, when estimating  $NW$ ,  $x_{ipt}$  is the "race not declared", for  $PS$  it's  $x_{ipt}$  "no origin school". This is relevant because both policies, but specially  $AA$ , are an incentive for the student to better declare this information.



## 5 MAIN RESULTS

We start with our findings for all programs offered by HEI's, as a basis for our comparisons. We then proceed to investigate effects in the medicine program, that allows us to further understand how competition interferes with the policies effects. We conclude by examining potential problems that may interfere with our results.

### 5.1 ALL PROGRAMS

Tables 1 through 8 from Appendix B shows the impacts of SiSU and AA on each student type, considering all programs. Columns (1) contains programs and time fixed effects, Columns (2) add the control for growth of seats in each program and Columns (3) introduces the effects of local linear trend; Columns (4) are only present for Non-White students and public school students, this is because this column controls for those students that have not declared either status, other students' characteristics do not have this option to no declare.

For female students we observe that all three specifications yield similar results. In column (3), our preferred specification, SiSU reduces in 2% the enrolment of female students, going in accordance with Machado and Szerman (2021), that also found a reduction, but of 1.2% instead. This is to be expected since females are generally more risk-averse, have lower confidence and under-perform in more competitive settings (BOOTH; et. al., 2014; GNEEZY; et. al., 2003; SARSONS; XU, 2015), therefore the raise in competition might attract students with certain characteristics that are more correlated with men, to the detriment of women. Non the less, in Machado and Szerman (2021) work they also find a raise in the average age of enrolling students, since migration is an important mechanism for SiSU's effects and migration requires resources by the student, what might be happening is that SiSU cannot attract this female student that could exploit this higher competitiveness to her advantage due to lack of resources by gender inequality (SILVEIRA; LEÃO, 2020), or even due to gender associated social obligations (SINNOTT; SHIFREN, 2001).

For low-income students that receives assistance and for students with disabilities all specification were similar. For LI students, both SiSU and AA had negative impacts (4.1% and 5.2%, respectively), while the interaction of both policies is positive in 5.3%. At first might seem odd that AA could present a negative impact in

this group, but it could be just a problem on how it was constructed, since here LI are the students that actually receive financial assistance by its institution, maybe it takes more than a year for the institution to give this assistance, or the program within institution did not grow in the same pace as AA did.<sup>1</sup> Since the interaction was positive, following Mello (2021) interpretation, it may represent another relevant effect of SiSU, that centralization might have informational effects that contributes to the efficacy of AA policies.

The case of students with disability becomes interesting when considering the interaction of policies. Just as Dalcin, Stein and Jales (2022), we've found that this period saw an increase in the number of students with disabilities entering higher education, and that both policies have played a critical role on it. Dalcin, Stein and Jales (2022) argues that the reduced costs of mobility, provided by SiSU's centralization, made more attractive to these students to enroll, since now they only have to take one exam and it is provided favorable conditions to take it<sup>2</sup>. Our set up hints toward another interesting interpretation. Once SiSU's effect is negative (-0.4%, what is to be expected since we see that higher competition hurts vulnerable groups disproportionately) and AA's effect is (positive) 0.3%; the interaction between both is, in magnitude, much higher, at 0,9%, and may be that there is another result from the interaction. What could be happening is not that SiSU alone have the potential to induce the enrolment of disabled students, but, through its relative costs reduction, it allows the AA policies to take place, otherwise the AA wouldn't have worked as well for these students, since they would still have to pay the costs of all the decentralized exams. Of course this analyzes does not contradicts the one of Dalcin, Stein and Jales (2022), but offers another insight on a new mechanism of action to be investigated.

Finally, the two remaining to explore are the non-white students (NW) and those from public school (PS). Their results were the ones that were most sensitive to the different specification, especially for state trends, and they both had "not declared" students, for both variables. The most stable of the two, for different specifications is the PS, AA is positive 16.6% and the interaction is negative, in 7.1%. SiSU's effect is not relevant when considering state linear trends. By far, AA's effect on PS is the

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<sup>1</sup> Remember, the variable was constructed this way in order to capture the students that came from a family with so low income as to be in the right and need of financial assistance. Mello (2021) could observe family's income directly, for each student, we do not have this luxury.

<sup>2</sup> ENEM offers the option to specify your disability and they provide you a location that attends to it, e.g. a school with ramps for wheelchairs.

greatest of all policies and in all variables, this is because this is the only group specifically target by the policy and directly observed by this work.

The most intriguing case is for Non-White students, we clearly observe in the descriptive data (Table 1), a raise in their participation, yet, both policies' effects were negative. Even AA, that explicitly has race as a characteristic that reserves vacancies. All effects drop to significance of 5%. Although the interaction of policies was positive, it is compensated by the negative effects, this combined with lower significance makes safe to assume that the policies had impact close to zero on this group. Why would this be? First, there is a clear incentive for a better reporting of information by non-white students, since their race is now relevant for their chances of entry, thus a non-white student, prior to 2012, had little to no incentive to report their race accurately, but now they do so. This can be observed in Table 8 Appendix B, columns (1) to (3) for not-declared race and (4) to (6) for not-declared school.

The second effect that is not so obvious and much more interesting is that what might be happening is a behavioral effect by the students. In her paper Mello (2021) presents suggestive evidence that AA increases the enrollment of vulnerable groups, even in programs that they represent more than half of students. There is the possibility that non-white students that now have been benefited by the AA are interested in applying to programs that they are already heavily represented, thus competing with students that are non-white, if it is the case, when controlling for area of study, we should observe the mechanical effects of AA and SiSU and control for this behavioral response. The next table (Table 2) presents the same specifications of Table 6, but all controlling for missing data and with linear effects of program's areas, as defined by UNESCO (International Standard Classification of Education).

The results of Table 2 are befitting with what we would expect from both policies, indicating that this behavioral effect is taking place. This is not direct evidence, a definitive answer would require individual level data on enrollments and application in SiSU program, non the less, is suggestive evidence.

Table 3 summarizes the numbers here discussed from the Appendix B's Tables. All columns control for program and time fixed effects, number of seats offered, State linear effects and the last two, (NW) and (PS), controls for missing data.

Table 2: Non-White students, control for programs' areas

	<i>Dependent variable:</i>		
	NW		
	(1)	(2)	(3)
$SISU_{ipt}$	-0.012** (0.005)	-0.012** (0.005)	-0.046*** (0.005)
$AA_{ipt}$	0.065*** (0.005)	0.065*** (0.005)	0.031*** (0.005)
$SISU_{ipt} : AA_{ipt}$	-0.026*** (0.007)	-0.026*** (0.007)	-0.012* (0.006)
Observations	61,218	61,218	61,218
Time FE	✓	✓	✓
Program-Institution FE	✓	✓	✓
Program number of Seats		✓	✓
States Linear Trends			✓
Control for missing data	✓	✓	✓
Areas of Education Linear trends	✓	✓	✓

*Note:*

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Source: Author

Table 3: Summary Table

	<i>Dependent variable:</i>				
	(FEM)	(LI)	(DIS)	(NW)	(PS)
$SISU_{ipt}$	-0.020*** (0.003)	-0.041*** (0.004)	-0.004*** (0.001)	-0.014*** (0.003)	0.008 (0.005)
$AA_{ipt}$	-0.003 (0.003)	-0.052*** (0.005)	0.003*** (0.001)	-0.007** (0.003)	0.166*** (0.006)
$SISU_{ipt} : AA_{ipt}$	0.007 (0.004)	0.053*** (0.006)	0.009*** (0.001)	0.011** (0.005)	-0.071*** (0.008)
Observations	61,218	61,218	61,218	61,218	56,342

*Note:*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

Source: Author

## 5.2 MEDICINE PROGRAM

In this section we examine the policies impacts on medicine programs.<sup>3</sup> Relating SiSU and AA to the health challenges faced off by Brazil and the PMM. Besides, medicine is a higher graduation that's highly seek after, with high competition for the tuition, if not the highest competition. Thus, it presents an opportunity to glimpse in the program's (SiSU and AA) effects when competition is already high.

We observe that, for all groups, the competition effects of SiSU are negligible, the only significant one is for PS and it is positive. A plausible explanation is that where competition is already high, another increase is not relevant for students' composition. If this is really the case, this would explain why AA's impact is bigger for PS students (37.1%, compared to 16.6% for all programs). For students with disability, as we've discussed why both policies might be essential, their combined effect is 2.5%, compared to 0.9%.

<sup>3</sup> Appendix C contains all the results.

For NW and LI, under all specifications (Tables 2 and 4, Appendix C) both policies have no impact, which gives us more certainty that results are not being driven by differences in mechanism and behavioral effects. Only at the significance level of 10% that AA benefits LI students. This lack of policies' impacts shows that, in places of high competition, they do not interfere in students' composition. This can be either due to the high costs of the program, even when tuition is free there is high opportunity costs, due to the high dedication required, or the presence of high competition makes policies ineffective.

One interesting result is that AA is negative for female students. AA is supposed to ease competition, if it is the case that women perform worst in high competition scenarios (SILVEIRA; LEÃO, 2020; PASERMAN, 2007), we should expect no effect<sup>4</sup> or at least a positive one. This is evidence that there is no significant difference in behavior of male and female students at Brazil's high school, hinting to the interpretation that, due to different gender roles, female students do not have the means to exploit advantages proportionate by the policies. This can be happening here, high costs of medicine tuition make enrollment prohibitively costly, even when there is opportunity to facilitate enrollment, such as AA. This hints to a different interpretation of Machado and Szerman (2021)'s paper, pointing that the new mechanisms created by SiSU, such as facilitated migration, are not exploited by female students.

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<sup>4</sup> Assuming that AA affects men and women at the same rate.

Table 4: Summary Table - Medicine

	<i>Dependent variable:</i>				
	(FEM)	(LI)	(DEF)	(NW)	(PS)
$SISU_{ipt}$	-0.036*	-0.054	-0.002	-0.019	0.097**
	(0.019)	(0.043)	(0.006)	(0.025)	(0.046)
$AA_{ipt}$	-0.085***	0.100*	-0.012	-0.024	0.371***
	(0.023)	(0.052)	(0.008)	(0.030)	(0.060)
$SISU_{ipt} : AA_{ipt}$	0.059*	-0.024	0.025**	-0.027	-0.254***
	(0.030)	(0.068)	(0.010)	(0.039)	(0.072)
Observations	869	869	869	869	802

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Source: Author

Table 5: Policies effects, all programs

	SiSU's effect	AA's effect
FEM	-0,020	0
LI	0,012	-0,035
DIS	0,003	0,006
NW	-0,003	-0,004
PS	-0,063	0,144

Source: Author

Table 6: Policies effects, medicine program

	SiSU's effect	AA's effect
FEM	0,023	-0,067
LI	0	0,100
DIS	0,025	0,008
NW	0	0
PS	-0,157	0,117

### 5.3 EXOGENEITY

The expansion of SiSU and AA are not exogenous and probably correlated with institutions characteristics. HEIs had the choice to adopt SiSU, and, prior to 2016, had control over the full or partial adoption of AA. Yet, students had no control over the choice of adoption and only respond to it, and institutions might have adopted such

policies aiming other effects than the ones here observed. Therefore, this fact alone does not invalidate the analyses.

Our setup is analogous to a difference-in-differences framework, but with continuous treatment, a key assumption for properly identifying the causal parameters  $\beta_1$ ,  $\beta_2$  and  $\beta_3$  is that the outcome variable's dynamics for treated and not treated programs are the same when the treatment is not present. This would be equivalent to the parallel trends' assumption in classical diff-in-diff. In this specification, program-institution fixed effect and time fixed effect might be enough to capture all unobserved.

The identification assumption is not directly testable, but we can run a placebo test to see if the trends in outcome are different between treated and not-treated when treatment is shifted. Again, this does not observe the trends, but suggests that the treatment is not substantially changing such trends, if, when shifted, are not significant. There for we run the experiment again, but including the lead variables of treatments ( $SISU_{ipt}$  and  $AA_{ipt}$ ). This test is in Table 1 and 2 Appendix D for two periods. Except for female students, lead variables were significant. This is not surprising, we have more observed years of units being treated, than being part of the control group, thus there are many times that  $SISU_{ipt} = SISU_{ipt+1}$  and  $AA_{ipt} = AA_{ipt+1}$ , because once the program adopts the treatment they don't become untreated again. To avoid this problem, we run the same placebo test, but now we assume that all units are treated at period 0 and restrict our observation for two periods prior and two after the treatment, in total we have 5 periods. We do this for both policies, all with full specification (Tables 7 and 8).

This exercise indicates us that there probably are some unobserved variables that are interfering with our causal interpretation. This is true for LI and PS when estimating AA, and true LI and NW when considering SISU.



Table 7: Placebo test for AA, five periods around treatment

	<i>Dependent variable:</i>				
	(FEM)	(LI)	(DIS)	(NW)	(PS)
SISU <sub>ipt</sub>	-0.026*** (0.005)	-0.018** (0.008)	-0.007*** (0.001)	0.019*** (0.005)	0.028*** (0.008)
AA <sub>ipt</sub>	-0.002 (0.007)	-0.097*** (0.011)	0.002 (0.001)	-0.024*** (0.007)	0.083*** (0.011)
AA <sub>ip,t+1</sub>	-0.002 (0.006)	0.067*** (0.009)	0.002 (0.001)	-0.0005 (0.006)	0.092*** (0.010)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	0.015* (0.008)	-0.012 (0.013)	0.017*** (0.001)	-0.007 (0.008)	-0.081*** (0.014)
Observations	19,188	19,188	19,188	19,188	19,188

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 8: Placebo test for SISU, five periods around treatment

	<i>Dependent variable:</i>				
	(FEM)	(LI)	(DIS)	(NW)	(PS)
SISU <sub>ipt</sub>	-0.022*** (0.005)	0.015** (0.007)	0.001 (0.001)	0.009* (0.005)	0.021** (0.009)
AA <sub>ipt</sub>	-0.003 (0.006)	0.023*** (0.007)	-0.001 (0.001)	0.021*** (0.006)	0.208*** (0.010)
SISU <sub>ip,t+1</sub>	0.009* (0.004)	0.038*** (0.005)	-0.001 (0.001)	0.014*** (0.004)	0.014* (0.007)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	0.009 (0.007)	0.019** (0.009)	0.002* (0.001)	-0.003 (0.007)	-0.130*** (0.012)
Observations	17,596	17,596	17,596	17,596	17,596

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Source: Author

## 6 FINAL CONSIDERATION

Here we analyze the two most impactful policies in Brazilian higher education of the last decade and how they impact five groups of students, belonging to vulnerable sectors of society. The policies are SiSU, that centralized the admission process to public higher education, and Affirmative Action policies, that reserve vacancies for students of low socio-economic status. We contribute to a small set of literature that does so (MELLO, 2021; MACHADO; SZERMAN, 2021; DALCIN; STEIN; JALES, 2022), using the same empirical strategy as Mello (2021). We also relate the policies with a problem faced by Brazil in its healthcare system, and how these policies will define future representation of said groups in the next generation of physicians. Also, studying the medicine program allow us to have a glimpse at the SiSU and AA in high competition scenarios. Results were counter intuitive and yield new possible interpretations for what's happening to these students. It is important to have in mind that we cannot rule out the possibility of endogeneity, nor problems with data collection from this work.

The impact on female students is the most consistent with prior works (MACHADO; SZERMAN, 2021). Centralization raises competition and hurts female enrollment (in -2%). This effect is not present when looking at the medicine program, where AA might hurt their chances of entering. This suggests that is not the competitive scenario *per se* that negatively impact them, but that there are some extra societal factors that do not allow them to exploit an advantage of a policy, while their male counterpart does so.

Students with disability are the only group to be benefited by both policies, this is also corroborated by Dalcin, Stein and Jales (2022). However, our setup suggests that the most relevant for them is the interaction of both policies, AA reserves their vacancies and SiSU is responsible for lowering costs that are only present for them, such as movement costs.

Students from public school where the most impacted by both policies, and in the medicine program the impacts were even greater. As to be expected, the raise in competition brought by SiSU have reduced their proportion, but AA more than compensates for this effect. This is the only group targeted by the AA directly observed in our data set. However, under the high competition of medicine, AA is not able to compensate, and the negative impact of SiSU holds.

Results for the medicine program indicates that, except for students with disability, AA and SiSU do not change the representation of these groups. It may represent a lack of effectiveness by AA.

The extended time period studied in the present work with some divergent results from other works also suggests that the exposure of SiSU and AA play a relevant to their final effects. It's also important emphasize one more time that we did not have the access to the student level data and to concatenate different data sets. The adoption of SiSU and AA was, in the most part, a choice by each institution therefore there is the concern that our model does not control for all unobserved factors. Indeed, placebo tests shows that endogeneity is playing a role in the causal interpretation in the treatment in some of the interest variables. Non the less, we present some new and relevant correlations that contributes to the understanding of SiSU and AA in Brazil, and their impact in the trajectory of new students. The results also hint to new explanations not explored in the literature.

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## APPENDIX A – DATA

The Higher Education Census' (CES) data, collected by the National Institute for Educational Studies and Research (INEP) was acquired in January of 2023.<sup>1</sup> From it we've constructed the variables of interest, **FEM** - the proportion of female students on a given program; **LI** - the proportion of low income students on a given program; **NW** - the proportion of non-white students on a given program; **DIS** - the proportion of students with disability on a given program; and **PS** - the proportion of students that studied their 3 years of high school in a public school on a given program.

All the variables provided by the CES used in this work are as table 7. The first two columns are the name of the variable and its description in Portuguese, the third is a free translation to English.

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<sup>1</sup> <https://www.gov.br/inep/pt-br/acesso-a-informacao/dados-abertos/microdados/censo-da-educacao-superior>



Table 1: CES Variables; Dictionary

Variable	Dictionary	Translation of the Dictionary
NU_ANO_CENSO	Ano de referência do Censo da Educação Superior	Year of CES
CO_UF	Código do IBGE da Unidade da Federação do local de oferta do curso	State where the program is provided
IN_CAPITAL	Informa se o local de oferta do curso está localizado em capital de Estado	Informs if the program is in a capital city
TP_CATEGORIA_ADMINISTRATIVA	Tipo da Categoria Administrativa da IES	HEI's type of administration
CO_CINE_ROTULO	Código de identificação do curso, conforme adaptação da Classificação Internacional Normalizada da Educação Cine/Unesco	Code for program identification, Cine/Unesco
QT_VG_TOTAL	Quantidade total de vagas oferecidas nos cursos	Total quantity of vacancies
QT_ING	Quantidade de ingressantes nos cursos	Number of incoming students
QT_ING_FEM	Quantidade de ingressantes do sexo feminino nos cursos	Number of female incoming students
QT_ING_PRETA	Quantidade de ingressantes nos cursos - Cor/Raça Preta	Number of black incoming students
QT_ING_PARDA	Quantidade de ingressantes nos cursos - Cor/Raça Parda	Number of 'mixed race' incoming students
QT_ING_AMARELA	Quantidade de ingressantes nos cursos - Cor/Raça Amarela	Number of asian incoming students
QT_ING_INDIGENA	Quantidade de ingressantes nos cursos - Cor/Raça Indígena	Number of native incoming students
QT_ING_CORND	Quantidade de ingressantes nos cursos - Cor/Raça Não Declarada	Number of 'race not declared' incoming students
QT_ING_DEFICIENTE	Quantidade de ingressantes nos cursos - alunos com deficiência, transtorno global do desenvolvimento ou altas habilidades/superdotação	Number of students with disabilities
QT_ING_RESERVA_VAGA	Quantidade de ingressantes nos cursos - alunos que participam do programa de reserva de vagas	Number of incoming students that participated in an AA program
QT_ING_PROCESCPUBLICA	Quantidade de ingressantes que terminaram o ensino médio em escolas públicas	Number of incoming students that studied their high school in a public school
QT_ING_PROCNAOINFORMADA	Quantidade de ingressantes que não informaram o tipo de escola que terminaram o ensino médio	Number of incoming students that did not inform their high school
QT_ING_APOIO_SOCIAL	Quantidade de ingressantes que recebem algum tipo de apoio social	Number of incoming students that receive social support

: Author

Each of the interest variable (FEM, LI, PS, NW, DIS) were constructed as Table 10.

Table 2: Variables of interest

FEM	$QT\_ING\_FEM/QT\_ING$
LI	$QT\_ING\_APOIO\_SOCIAL/QT\_ING$
DIS	$QT\_ING\_DEFICIENTE/QT\_ING$
NW	$(QT\_ING\_PRETA + QT\_ING\_PARDA + QT\_ING\_AMARELA + QT\_ING\_INDIGENA) /QT\_ING$
PS	$QT\_ING\_ PROCESCPUBLICA /QT\_ING$

Source: Author

Since we studied the effects on public HEIs, we excluded all observations except from Federal or State level administration, that is  $TP\_CATEGORIA\_ADMINISTRATIVA = 1$  or  $= 2$ .

Information about SiSU is provided by Ministry of Education (MEC) in its archive repository (RAMEC).<sup>2</sup> It gives us the total number of vacancies offered through SiSU by each program. The treatment  $SISU_{ipt}$  is created by dividing all vacancies of SiSU by the total vacancies of the program (as provided by CES, i.e.  $QT\_VG\_TOTAL$ ).

The treatment  $AA_{ipt}$  is acquired from the replication package of (MELLO, 2021).<sup>3</sup> Treatment beyond 2015 was assumed 1 for  $TP\_CATEGORIA\_ADMINISTRATIVA = 1$  and was assumed to be equal of the treatment in 2015 otherwise. We have decided to use this data provided by Mello (2021) because this data is not readily available and require cooperation and communication with all HEIs.

<sup>2</sup> <http://ramec.mec.gov.br/sisu-sistema-de-selecao-unificada>

<sup>3</sup> <https://www.openicpsr.org/openicpsr/project/139001/version/V1/view>

## APPENDIX B - ALL PROGRAMS

Table 1: Proportion of Female students

	<i>Dependent variable:</i>		
	FEM		
	(1)	(2)	(3)
$SISU_{ipt}$	-0.020*** (0.003)	-0.021*** (0.003)	-0.020*** (0.003)
$AA_{ipt}$	0.0001 (0.003)	0.0004 (0.003)	-0.003 (0.003)
$SISU_{ipt} : AA_{ipt}$	0.0001 (0.004)	-0.0002 (0.004)	0.007 (0.004)
Observations	61,218	61,218	61,218
Time FE	✓	✓	✓
Program-Institution FE	✓	✓	✓
Program number of Seats		✓	✓
States Linear Trends			✓

*Note:*

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

Source: Author

Table 2: Proportion of Students with disabilities

	<i>Dependent variable:</i>		
	DIS		
	(1)	(2)	(3)
SISU <sub>ipt</sub>	-0.002*** (0.001)	-0.002*** (0.001)	-0.004*** (0.001)
AA <sub>ipt</sub>	0.003*** (0.0005)	0.003*** (0.0005)	0.003*** (0.001)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	0.009*** (0.001)	0.009*** (0.001)	0.009*** (0.001)
Observations	61,218	61,218	61,218
Time FE	✓	✓	✓
Program-Institution FE	✓	✓	✓
Program number of Seats		✓	✓
States Linear Trends			✓

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 3: Proportion of Non-White Students

	<i>Dependent variable:</i>			
	NW			
	(1)	(2)	(3)	(4)
SISU <sub>ipt</sub>	-0.015*** (0.005)	-0.015*** (0.005)	-0.049*** (0.005)	-0.014*** (0.003)
AA <sub>ipt</sub>	0.059*** (0.005)	0.059*** (0.005)	0.029*** (0.005)	-0.007** (0.003)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	-0.023*** (0.007)	-0.022*** (0.007)	0.013** (0.006)	0.011** (0.005)
Observations	61,218	61,218	61,218	61,218
Time FE	✓	✓	✓	✓
Program-Institution FE	✓	✓	✓	✓
Program number of Seats		✓	✓	✓
States Linear Trends			✓	✓
Control for missing data				✓

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Source: Author

Table 4: Proportion of Low Income Students

	<i>Dependent variable:</i>		
	LI		
	(1)	(2)	(3)
SISU <sub>ipt</sub>	-0.019*** (0.004)	-0.020*** (0.004)	-0.041*** (0.004)
AA <sub>ipt</sub>	-0.034*** (0.004)	-0.033*** (0.004)	-0.052*** (0.005)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	0.031*** (0.006)	0.030*** (0.006)	0.053*** (0.006)
Observations	61,218	61,218	61,218
Time FE	✓	✓	✓
Program-Institution FE	✓	✓	✓
Program number of Seats		✓	✓
States Linear Trends			✓

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 5: Students from Public School

	<i>Dependent variable:</i>			
	PS			
	(1)	(2)	(3)	(4)
SISU <sub>ipt</sub>	0.038*** (0.006)	0.037*** (0.006)	-0.015** (0.006)	0.008 (0.005)
AA <sub>ipt</sub>	0.291*** (0.006)	0.292*** (0.006)	0.242*** (0.007)	0.166*** (0.006)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	-0.114*** (0.008)	-0.115*** (0.008)	-0.079*** (0.009)	-0.071*** (0.008)
Observations	56,342	56,342	56,342	56,342
Time FE	✓	✓	✓	✓
Program-Institution FE	✓	✓	✓	✓
Program number of Seats		✓	✓	✓
States Linear Trends			✓	✓
Control for missing data				✓

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Source: Author

Table 6: Non-White Students models controlled for not declared

	<i>Dependent variable:</i>		
	NW		
	(1)	(2)	(3)
SISU <sub>ipt</sub>	0.022*** (0.003)	0.022*** (0.003)	-0.014*** (0.003)
AA <sub>ipt</sub>	0.018*** (0.003)	0.018*** (0.003)	-0.007** (0.003)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	0.002 (0.005)	0.002 (0.005)	0.011** (0.005)
Observations	61,218	61,218	61,218
Time FE	✓	✓	✓
Program-Institution FE	✓	✓	✓
Program number of Seats		✓	✓
States Linear Trends			✓
Control for missing data	✓	✓	✓

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 7: Public school students with control for not declared

	<i>Dependent variable:</i>		
	PS		
	(1)	(2)	(3)
SISU <sub>ipt</sub>	0.018*** (0.005)	0.017*** (0.005)	0.008 (0.005)
AA <sub>ipt</sub>	0.170*** (0.005)	0.171*** (0.005)	0.166*** (0.006)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	-0.059*** (0.007)	-0.060*** (0.007)	-0.071*** (0.008)
Observations	61,218	61,218	61,218
Time FE	✓	✓	✓
Program-Institution FE	✓	✓	✓
Program number of Seats		✓	✓
States Linear Trends			✓
Control for missing data	✓	✓	✓

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Source: Author

Table 8: Proportion 'Race Not Declared (ND)' and 'school not known (SNK)' students

	<i>Dependent variable:</i>					
	ND			SNK		
	(1)	(2)	(3)	(4)	(5)	(6)
$SISU_{ipt}$	0.076*** (0.007)	0.077*** (0.007)	0.078*** (0.007)	-0.008 (0.006)	-0.007 (0.006)	0.065*** (0.006)
$AA_{ipt}$	-0.085*** (0.007)	-0.085*** (0.007)	-0.082*** (0.007)	-0.192*** (0.006)	-0.194*** (0.006)	-0.100*** (0.006)
$SISU_{ipt} : AA_{ipt}$	0.051*** (0.010)	0.051*** (0.010)	-0.004 (0.010)	0.075*** (0.008)	0.076*** (0.008)	-0.010 (0.008)
Observations	61,218	61,218	61,218	61,218	61,218	61,218
Time FE	✓	✓	✓	✓	✓	✓
Program-Institution FE	✓	✓	✓	✓	✓	✓
Program number of Seats		✓	✓		✓	✓
States Linear Trends			✓			✓

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Source: Author

## APPENDIX C - MEDICINE PROGRAM

Table 1: Proportion of Female students on Medicine Program

	<i>Dependent variable:</i>		
	FEM		
	(1)	(2)	(3)
SISU <sub>ipt</sub>	-0.026* (0.015)	-0.025* (0.015)	-0.036* (0.019)
AA <sub>ipt</sub>	-0.049*** (0.017)	-0.054*** (0.017)	-0.085*** (0.023)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	0.033 (0.022)	0.037* (0.022)	0.059* (0.030)
Observations	869	869	869
Time FE	✓	✓	✓
Program-Institution FE	✓	✓	✓
Program number of Seats		✓	✓
States Linear Trends			✓

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 2: Proportion of Low Income Students on Medicine Program

	<i>Dependent variable:</i>		
	LI		
	(1)	(2)	(3)
SISU <sub>ipt</sub>	0.037 (0.036)	0.038 (0.036)	-0.054 (0.043)
AA <sub>ipt</sub>	0.078* (0.042)	0.069* (0.042)	0.100* (0.052)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	-0.071 (0.053)	-0.065 (0.053)	-0.024 (0.068)
Observations	869	869	869
Time FE	✓	✓	✓
Program-Institution FE	✓	✓	✓
Program number of Seats		✓	✓
States Linear Trends			✓

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Source: Author



Table 3: Proportion of Students with disabilities on Medicine Program

	<i>Dependent variable:</i>		
	DIS		
	(1)	(2)	(3)
$SISU_{ipt}$	0.004 (0.005)	0.004 (0.005)	-0.002 (0.006)
$AA_{ipt}$	0.007 (0.006)	0.009 (0.006)	-0.012 (0.008)
$SISU_{ipt} : AA_{ipt}$	0.009 (0.007)	0.008 (0.007)	0.025** (0.010)
Observations	869	869	869
Time FE	✓	✓	✓
Program-Institution FE	✓	✓	✓
Program number of Seats		✓	✓
States Linear Trends			✓

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Source: Author

Table 4: Proportion of Non-White Students on Medicine Program

	<i>Dependent variable:</i>			
	NW			
	(1)	(2)	(3)	(4)
$SISU_{ipt}$	0.030 (0.031)	0.030 (0.031)	-0.056 (0.036)	-0.019 (0.025)
$AA_{ipt}$	0.003 (0.036)	0.005 (0.036)	-0.039 (0.044)	-0.024 (0.030)
$SISU_{ipt} : AA_{ipt}$	-0.076* (0.046)	-0.078* (0.046)	0.010 (0.057)	-0.027 (0.039)
Observations	869	869	869	869
Time FE	✓	✓	✓	✓
Program-Institution FE	✓	✓	✓	✓
Program number of Seats		✓	✓	✓
States Linear Trends			✓	✓
Control for missing data				✓

*Note:* \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

Table 5: Proportion of students from Public School on Medicine Program

	<i>Dependent variable:</i>			
	PS			
	(1)	(2)	(3)	(4)
$SISU_{ipt}$	0.178*** (0.038)	0.175*** (0.038)	0.103** (0.049)	0.097** (0.046)
$AA_{ipt}$	0.470*** (0.046)	0.479*** (0.047)	0.412*** (0.064)	0.371*** (0.060)
$SISU_{ipt} : AA_{ipt}$	-0.268*** (0.055)	-0.274*** (0.056)	-0.276*** (0.077)	-0.254*** (0.072)
Observations	802	802	802	802
Time FE	✓	✓	✓	✓
Program-Institution FE	✓	✓	✓	✓
Program number of Seats		✓	✓	✓
States Linear Trends			✓	✓
Control for missing data				✓

*Note:* \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

Source: Author

## APPENDIX D - PLACEBO

Table 1: Placebo Test with Lead Variables

	<i>Dependent variable:</i>				
	FEM	LI	DIS	NW	PS
	(1)	(2)	(3)	(4)	(5)
SISU <sub>ipt</sub>	-0.025*** (0.003)	-0.049*** (0.005)	-0.003*** (0.001)	-0.015*** (0.004)	0.015** (0.006)
AA <sub>ipt</sub>	-0.010** (0.004)	-0.021*** (0.006)	0.0003 (0.001)	-0.012*** (0.004)	0.149*** (0.008)
SISU <sub>ip,t+1</sub>	0.001 (0.003)	0.021*** (0.004)	-0.002*** (0.0005)	-0.007*** (0.003)	0.002 (0.005)
AA <sub>ip,t+1</sub>	0.001 (0.003)	-0.010** (0.005)	0.003*** (0.001)	0.020*** (0.003)	0.043*** (0.006)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	0.010** (0.005)	0.027*** (0.007)	0.009*** (0.001)	0.001 (0.005)	-0.096*** (0.008)
Observations	50,130	50,130	50,130	50,130	46,055

\*p&lt;0.1; \*\*p&lt;0.05; \*\*\*p&lt;0.01

*Note: all results here are presented in our preferred specification, that is, with controls for fixed effects of time and program, for number of seats, state linear trends, and control for missing data for NW and PS.*

Source: Author

Table 2: Placebo Test with Lead Variables (two periods)

	<i>Dependent variable:</i>				
	FEM	LI	DIS	NW	PS
	(1)	(2)	(3)	(4)	(5)
SISU <sub>ipt</sub>	-0.024*** (0.003)	-0.034*** (0.005)	-0.004*** (0.001)	-0.015*** (0.004)	0.014** (0.006)
AA <sub>ipt</sub>	-0.012*** (0.004)	0.021*** (0.005)	0.003*** (0.001)	-0.009** (0.004)	0.173*** (0.008)
SISU <sub>ip,t+2</sub>	0.002 (0.003)	0.036*** (0.004)	-0.001** (0.001)	-0.004 (0.003)	0.027*** (0.005)
AA <sub>ip,t+2</sub>	0.002 (0.003)	-0.028*** (0.004)	0.004*** (0.001)	-0.018*** (0.003)	0.002 (0.006)
SISU <sub>ipt</sub> : AA <sub>ipt</sub>	0.013** (0.005)	0.011 (0.007)	0.011*** (0.001)	0.007 (0.006)	-0.109*** (0.010)
Observations	50,130	50,130	50,130	50,130	46,055

\*p&lt;0.1; \*\*p&lt;0.05; \*\*\*p&lt;0.01

*Note: all results here are presented in our preferred specification, that is, with controls for fixed effects of time and program, for number of seats, state linear trends, and control for missing data for NW and PS.*

Source: Author