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Access to graduate education in Brazil: Predictors of choice and enrollment in master's degree programs

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Contents

Keywords
Brazilian education, graduate education, inequity of access, conditional logit

JEL Codes
C25, I23, I24

Abstract · **Resumo**

This paper assesses the factors associated with access to master's degree programs in Brazil, investigating potential evidence of inequity. The main findings are: (a) students are more likely to choose a master's degree program in the same university or close to where they graduated from college; (b) academic performance and activities during college are associated with an increase in the relative odds of progressing to graduate education; (c) male students and those with a higher household income are more likely to start a master's program; and (d) for most broad academic fields, no evidence that nonwhite students are less likely to start a master's program is found.

1. Introduction

Master's and Ph.D. programs in Brazil (the '*stricto sensu*' graduate education, or just 'graduate education')[1] have experienced an unprecedented growth in the last decades (CAPES, 2017a). Nevertheless, little is known about the factors that motivate and influence students to progress to graduate education in the country, and whether potential inequity problems exist that need to be addressed. The purpose of this paper is to provide insights into this topic, by investigating the factors associated

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[1] Graduate education in Brazil is divided into two groups: '*stricto sensu*' graduate education comprises master's and Ph.D. degree programs with an academic and scientific nature; and the '*lato sensu*' graduate education, with a clear practical approach and dedicated to professional training, and that awards a certificate, but not an academic degree. Throughout this paper, the term 'graduate education' refers exclusively to the first group, i.e., master's and Ph.D. programs.

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with students' choices and likelihood of starting a master's degree program after completing undergraduate college.[2]

During the last decades, many countries have experienced a substantial growth of graduate education, both in terms of number of students and the diversification of programs (Nerad & Evans, 2014). This expansion, however, does not appear to have solved inequity and diversity problems in different countries. As noted by Harvey and Andrewartha (2013), inequalities do not simply 'wash out' through the undergraduate level, and therefore socioeconomic, racial and gender features can substantially influence the composition of the graduate student body.

In the context of tertiary education, equity can be interpreted as 'fairness', meaning that innate abilities and individual study efforts should constitute the main criteria for accessing and benefiting from educational opportunities (OECD, 2017; Santiago, Tremblay, Basri, & Arnal, 2008). According to this definition, personal circumstances and socioeconomic factors should not be an advantage or obstacle to anyone intending to pursue a higher education degree (OECD, 2012). The main reasons for promoting equity and widening participation in graduate education presented in the literature include social justice, access to the widest possible 'talent pool' of candidates, efficient allocation of research funding, social mobility and reduction in inequalities (Santiago et al., 2008; Wakeling & Kyriacou, 2010).

Despite the relevance of the subject, the empirical literature on access to graduate education remains sparse, although the existing evidence suggests that inequity of access exists in different countries (Harvey & Andrewartha, 2013; Perna, 2004). In Brazil, only a small group of studies discussed the subject (Artes, 2016; CGEE, 2010, 2012, 2016; Cirani, Campanario, & Silva, 2015; Colombo, 2018; Durso, Cunha, Neves, & Teixeira, 2016), and no quantitative analysis has attempted to estimate how individual and socioeconomic features predict or are associated with the likelihood of enrollment for a large sample.

The main contribution of this paper is to fill this gap by presenting an econometric assessment of the predictors of participation of recent college graduates (up to three years after graduation) in master's degree programs in Brazil, along with the factors associated with their choice of program. The analysis focus on five groups of variables of interest that have been investigated and discussed in the international literature: (a) previous academic achievement and experience, (b) sex, (c) race and ethnicity, (d) household income, and (e) student mobility (i.e., whether students start a master's program at the same university or close to where they obtained the undergraduate college degree). For this analysis, identified microdata from distinct sources were merged, generating a rich and novel database with detailed information on Brazilian college graduates and new master's students. The decision to begin

[2]Based on different empirical studies cited throughout this paper (Bedard & Herman, 2008; Cole & Espinoza, 2011; Harvey & Andrewartha, 2013; Perna, 2004), the term 'college' is used here to refer exclusively to undergraduate education.

graduate education is divided into two steps for analytical purposes (Long, 2004; Skinner, 2019). In the first stage, students choose the university and program that maximize their utility; afterwards, they decide whether to enroll, considering the likelihood of acceptance in the admission process. Based on recent publications showing that graduate choice and returns are affected by major or academic field (Altonji, Arcidiacono, & Maurel, 2016; Bedard & Herman, 2008; Mertens & Röbken, 2013; Xu, 2014), graduate enrollment is estimated not only for all students in the sample, but also separating them by 'broad group or field of education', according to the International Standard Classification of Education (UNESCO, 1997).

The second section following this introduction reviews the theoretical literature on access to graduate education and discusses the main findings of previous empirical investigations; the third section examines the recent evolution of graduate education in Brazil; the fourth part describes the data and empirical strategy used for the analysis; the fifth section presents and discusses the results, and the sixth and last section summarizes the findings.

2. The Literature on Access to Graduate Education

In the last few decades, a substantial body of empirical literature was developed to estimate how different factors are associated with or affect students' choices and enrollment in higher education (Long, 2004; Perna, 2006; Skinner, 2019). The literature dedicated specifically to graduate education, however, is not so extensive (English & Umbach, 2016; Perna, 2004; Wales, 2013), as it has been developed recently, along with the international expansion of these programs.

Two theoretical frameworks have been commonly used as bases of these analyses. The sociological approach stresses the importance of the individual's social and cultural capital (Bills, 2003; Bourdieu, 1986). The human capital investment theory, on the other hand, understands schooling as similar to other types of investment, and the demand for education is modelled as a function of the costs and returns arising thereof (English & Umbach, 2016; Paulsen & Toutkoushian, 2008). A recent group of studies attempted to combine both approaches by developing econometric models that employ the maximization decision process of human capital theory, but allowing tastes, preferences and costs to be influenced by students' values and '*habitus*' (English & Umbach, 2016; Malcom & Dowd, 2012; Paulsen & John, 2002; Paulsen & Toutkoushian, 2008; Perna, 2000, 2004, 2006; Xu, 2014).

The empirical literature on access to graduate education is mostly recent (Wakeling, 2009), and nearly all empirical studies have analyzed graduate programs in the United States (U.S.) and United Kingdom (U.K.) (Bedard & Herman, 2008; Cole & Espinoza, 2011; English & Umbach, 2016; Wakeling, 2005), although a small number of papers considered other countries, such as Australia (Harvey & Andrewartha, 2013), China (Kong, 2011), Norway (Mastekaasa, 2006) and Canada

(Zarifa, 2012). The few studies that investigated this topic in Brazil have mainly presented descriptive statistics of aggregate data (Artes, 2016; CGEE, 2010, 2012, 2016; Cirani et al., 2015; Colombo, 2018; Durso et al., 2016; Paixão, Rossetto, Montovanele, & Carvano, 2010; Rosemberg & Madsen, 2011), and no quantitative analysis attempted to test and measure the associations of different factors with the likelihood of enrollment in graduate programs. For this reason, the findings of the international literature are used in this paper as a basis to compare and discuss the results presented herein.

Inequity in graduate education largely remains an open debate. Nevertheless, performance at the undergraduate level is generally accepted to be an important predictor of graduate enrollment in different countries (Choy & Carroll, 2000; Lang, 1987; Mullen, Goyette, & Soares, 2003; Xu, 2014; Zhang, 2005; Zimdars, 2007). The idea of equity as fairness discussed previously (OECD, 2017; Santiago et al., 2008) suggests that it should be a key factor, as students who achieved better results during college are more likely to be approved in admissions processes, also indicating their readiness for graduate education (Xu, 2014). On the other hand, a higher level of college achievement should not be interpreted in a straightforward manner as a sign of equity and fairness, as it is substantially affected by personal features and social background (Ethington & Smart, 1986; Mullen et al., 2003; Schwartz, 2004), concealing or 'crystallizing' their effects (Zhang, 2005). Nonetheless, controlling for this factor is relevant to isolate the indirect effects of personal and socioeconomic variables, thus ensuring that the direct effects of these factors can be assessed at the graduate level.

Quantitative analyses in the U.S., U.K. and Canada have found that women are less likely to attend graduate school (Wales, 2013; Zarifa, 2012; Zhang, 2005) or are less likely to be attracted to top-tier institutions (Millett, 2003; Montgomery, 2002; Zhang, 2005). Common explanations for these gaps are a lack of parental support and role models, structural barriers, and, in some cases, an 'unwelcoming pedagogy in science' (Qian & Blair, 1999; Sax, 2001). However, Perna (2004) argued that sex differences in enrollment may also be caused by the indirect effects of other factors, as she did not find a significant association between gender and enrollment likelihood in the U.S. In a recent study, English and Umbach (2016) also did not find gender to be a significant predictor of enrollment in graduate education, and the authors interpreted this result as a sign of a potential closure of the educational gap between men and women at this educational level in the U.S.

Race is also assessed as a potential factor that affects the relative odds of starting a graduate program, as nonwhite and racial or ethnic minority students are underrepresented in different countries, including Brazil (Artes, 2016; Malcom & Dowd, 2012; Perna, 2004; Wakeling & Kyriacou, 2010). However, the results reported in the literature generally do not support the claim of discrimination against these students. Most quantitative analyses did not find that racial/ethnic minority

students are less likely to progress to graduate education (English & Umbach, 2016; Johnson, 2013; Perna, 2004). In fact, some studies found that when personal and socioeconomic features are controlled for, these students have a higher likelihood of applying to and enrolling in a graduate programs in both the U.S. (English & Umbach, 2016; Johnson, 2013; Millett, 2003; Perna, 2004) and the U.K. (Wales, 2013).

Family income and socioeconomic background affect the progression to graduate education through different channels, such as the availability of resources to finance a better and more selective education at previous levels, student loan debts, the formation of educational aspirations, and influence of family educational background on children's academic performance (Mullen et al., 2003). As a result, researches in different countries have found that students from wealthier families or with higher socioeconomic backgrounds are more likely to enroll in graduate programs (Garibay, Hughes, Eagan, & Hurtado, 2013; Wakeling, 2005; Wales, 2013; Zarifa, 2012; Zhang, 2005).

The mobility of students starting graduate education is another topic of debate in this literature, although mobility rates vary substantially by country. The share of graduate students enrolling at a different institution from the one they attended earlier are as high as 90% for doctoral students in the U.S. (Nettles, Millett, & Millett, 2006), 64% in the U.K. (Wakeling & Kyriacou, 2010) and as low as 12% in Australia (Kiley & Austin, 2008). The main arguments used to explain low student mobility are ease of access to local institutions, moving costs, personal relationships or social ties, and a lack of awareness of the benefits of studying at a different institution (Kiley & Austin, 2008). Although there is an open debate on how mobility affects quality and efficiency of academic research, it is generally accepted that more mobility is desirable, mostly because it contributes to diversity in the student body (Neumann, 2002).

Other features suggested by and tested in previous studies as potential factors explaining graduate enrollment and choice are parental education, age¸ quality of the undergraduate college and student debt (English & Umbach, 2016; Malcom & Dowd, 2012; Millett, 2003; Mullen et al., 2003; Xu, 2014; Zarifa, 2012; Zhang, 2005). The effects exerted by these factors may vary depending on the country and on the academic field. Returns arising from a graduate degree may be distinct (Altonji et al., 2016), and students pursuing degrees in each field are likely to face different costs and have their own motivations and deterrents for enrollment. Acknowledging that these differences may play an important role in graduate choice, this empirical study considers not only the entire sample, but it also separates students by broad academic fields, as described in section 4.

3. Brief Overview of and Recent Developments in Graduate Education in Brazil

The Brazilian experience with graduate education is fairly recent, as this educational level only started to experience a significant development as from the 1970s (Brazilian Ministry of Education, 1974), when master's and Ph.D. programs began to expand and gain relevance within the country's educational system. By 1985, universities awarded approximately 4,000 master's degrees annually, and ten years later, this figure had more than doubled (Brazilian Ministry of Education, 2004). The expansion accelerated throughout the 1990s and thereafter, following the aforementioned international trend (Nerad & Evans, 2014). The number of functioning graduate programs increased to approximately 4.5 thousand in 2016, with approximately 80 thousand degrees awarded annually (CAPES, 2017a). Between 2000 and 2010,[3] the ratio of individuals with a master's or a Ph.D. degree per thousand residents in the country increased from 1.79 to 4.11 (IBGE, 2000, 2010).

Explaining the reasons and forces behind this growth is beyond the scope of this paper, but a summary of trends and facts will help the reader understand this development. First, most of the expansion occurred in public institutions. Although private universities have increased the number of graduate degrees awarded in the last few decades, they still represented less than 20% of the total degrees awarded in 2016 (CAPES, 2017a). Another recent development is the creation and expansion of professional master's programs, that are designed to promote the collaboration between firms and universities, to facilitate the transfer of knowledge between these organizations, and to train professionals to meet the demands of both society and the market.[4] In 2016, approximately 10 thousand students successfully completed a professional master's degree, representing approximately 18% of all master's degrees awarded by Brazilian universities (CAPES, 2017a).

Virtually all fields of knowledge experienced an expansion of graduate programs, but such expansion was unevenly distributed. As a result, the balance between academic fields shifted substantially, as presented in Figure 1. However, the country followed a different path from most OECD nations: while STEM fields gained importance in these countries (OECD, 2017), the broad fields of 'Engineering, Manufacturing and Construction' and 'Science, Mathematics and Computing' have lost ground in Brazil, currently accounting for a smaller share of all graduate degrees than they did two decades ago.

The available data on graduate students[5] indicate that their profile has changed throughout the years. There is a larger proportion of graduate programs and students outside the Southeast region, although the state of Sao Paulo remains the largest

[3] Most recent available data.

[4] Ordinance MEC 389, of March 23rd, 2017.

[5] See Table 1 below with descriptive statistics on the variables used in the empirical analysis.

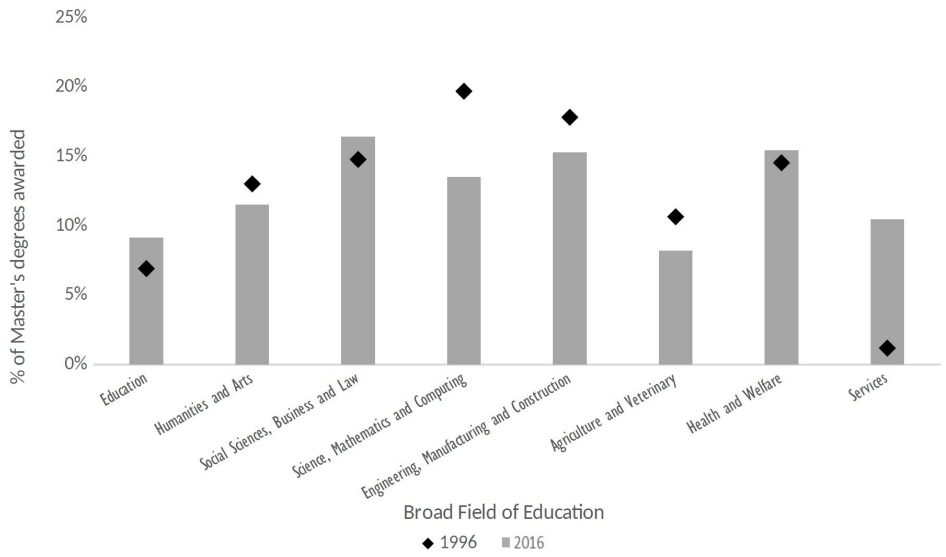

Figure 1. Percentage of master's degrees awarded in each broad field of education (1996 and 2016), according to the International Standard Classification of Education (UNESCO, 1997).

contributor to new master's and Ph.D. degrees in the country (CAPES, 2017a). Women currently represent majority of master's students (which was not the case two decades ago), although their participation varies substantially by academic field (CAPES, 2017a). On the other hand, there are signs that access to graduate education is restricted or more difficult to certain groups: black and brown individuals are still a small group among new master's students (around 11%, according to our sample),[6] although they represent more than half of the Brazilian population (IBGE, 2018). Finally, student mobility is still low if compared to the standards of the U.S. and U.K. mentioned previously, as around 65% of new master's students in the sample enrolled at the same university where they attended college, and more than 90% did not leave the state.

Graduate education is mostly regulated by CAPES (Coordination for Improvement of Higher Education Personnel), a government agency under the Ministry of Education. There are no strict mandatory rules for the admission of master's students, giving universities the flexibility to decide the design, timeline and criteria of the admission processes. One of the few general rules on the subject is that proposals for new programs submitted to CAPES must clearly state the selection criteria for new students (without detailing what these criteria should include).[7] Admission processes of different programs and universities are usually independent from each other, and students must search and apply to each one separately. Common procedures used

[6]See Table 1 below.

[7]Ordinance CAPES 161, of August 22nd, 2017.

to select new students are exams,[8] assessment of résumé, qualifications and past experience, presentation of research project, and assessment of fluency in a foreign language.

The increase in the number of graduate degrees has allowed other challenges and problems to emerge in the national debate on graduate education, including issues of diversity and inequity of access. These topics have been discussed in studies that generally have found indications of inequality by comparing graduate students with other population groups (mostly undergraduate college students and the country's general population), maintaining that progression to master's and Ph.D. programs is restricted or more challenging to some students because of race, sex, geographic location and other factors (Artes, 2016; CGEE, 2010, 2012, 2016; Cirani et al., 2015; Colombo, 2018; Durso et al., 2016; Paixão et al., 2010; Rosemberg & Madsen, 2011). However, no quantitative model-based evidence on the subject has been presented to date. The empirical analysis described in the next sections contributes to this debate by investigating the Brazilian case, adding to the international literature discussed in section 2.

4. Empirical Strategy and Data

This quantitative analysis aims to empirically assess the associations of different factors with the decisions and choices of recent college graduates to pursue graduate education. Using the idea of equity as fairness (OECD, 2012; Santiago et al., 2008), the main goal is to investigate the predictors of access to and choice of master's degree programs in Brazil, focusing on the variables of interest discussed in section 2, i.e., previous academic achievement and experience, sex, race/ethnicity, household income and student mobility. A 95% confidence interval is used to assess the statistical significance of the parameters.

Theoretical models of higher education choice usually divide decisions into multiple stages, based on the complexity and competitiveness in the market (DesJardins, Ahlburg, & McCall, 2006; Furquim & Glasener, 2017. Due to data availability, this analysis considers only two steps ('choice between programs' and 'decision and odds of enrollment'), according to the empirical model suggested by Long (2004) and Skinner (2019). After completing undergraduate education, a student either enters the labor market full time or continues studying to earn a master's degree. The model presents two stages, as students first choose the graduate program that provides highest utility, and then they compare it with the option of not pursuing graduate education.

The costs and returns of a master's program are expected to vary according to the respective academic field. For this reason, along with an estimate considering

[8] In most cases, such exams are prepared independently by each program.

all students in the sample, probabilistic models are also estimated separately for each 'broad group or field of education' (UNESCO, 1997), with the exception of the Services' broad field (OECD area 8), that was not analyzed because the number of available observations was too small and did not provide a reliable basis for the quantitative analysis.[9]

4.1 Estimation Strategy

4.1.1 First stage: Choice between master's programs

At the first stage of the decision-making process, each college graduate is faced with a complete, discrete and known set of available master's programs, and he or she decides on one that maximizes his or her expected utility. A probabilistic model is used to assess the influence of different factors on this decision, assuming that prospective students search and choose among all graduate programs within one 'knowledge subfield'.[10]

Students' choices at this stage are driven by the features and attributes of each graduate program, along with 'student-program' interaction terms that assess student mobility. For this reason, the estimation strategy follows Long (2004) and Skinner (2019), applying a conditional logit or the McFadden's discrete choice model (Greene, 2011; McFadden, 1973), that uses a similar likelihood function of the multinomial logit model, but does not include invariant individual-specific attributes, as they are differenced out of the estimation equation. The conditional logit model is considered a more appropriate estimator when the individual is faced with a great number of potential alternatives, as it exploits the variation across attributes and accounts for interaction terms (Long, 2004).

In the conditional logit framework, an individual i chooses a graduate program j ($j = 1, 2, \ldots, J$) based on a vector of attributes X_{ij}, that vary across the alternatives for each individual (as mentioned, features of students and of their undergraduate college cannot be used in the conditional logit model). The probability (P) that a randomly drawn prospective student i chooses a graduate program j ($choice_i = j$) with attributes x_{ij} is (Greene, 2011)

$$P_{ij} = \Pr\left(choice_i = j \,|\, X_{ij}\right) = \frac{\exp\left(\beta' x_{ij}\right)}{\sum_{k=1}^{J} \exp(\beta' x_{ik})}, \tag{1}$$

where X_{ij} comprises the variables related to 'student mobility' and 'features of the master's program' displayed in Table 1 below, and the β parameters inform how

[9] The sample contains only 33 college students in this broad field who enrolled in a master's program.

[10] A subfield (or sub-level) is defined by CAPES as a partition of each knowledge field based on the object of study or methodological procedures (CAPES, 2017b). For the estimation, I use the subfield of the master's program in which each student in the sample actually enrolled.

program attributes and interaction terms are associated with the likelihood of a student choosing a particular program.

Data from college graduates who actually progressed to a master's program are used to estimate the values and statistical significance of the parameters. The dataset is expanded to cover all possible pairwise combinations of every student *i* and all potential master's programs *j* that he or she could choose (within the respective knowledge subfield), and thus each observation represents a 'student-program' pair. A dummy variable ($choice_i$) constitutes the outcome variable of the probabilistic model, and it is assigned a value of one for the program in which the student actually enrolled and zero for all others.

The main shortcoming of the conditional logit model is that its consistency depends on the strong assumption of independence of irrelevant alternatives, IIA (Train, 2003). However, following the arguments presented by Skinner (2019) in his study of college choice in the U.S., there are good reasons to maintain that the IIA assumption should not pose a threat of bias to this analysis, i.e.: the completeness of the choice set; the independence of admissions processes; and the specific features of each master's program, that minimize the problem of 'close substitutes'.

4.1.2 Second stage: Decision and odds of enrollment

In the second stage, the prospective student decides whether to progress to graduate education. This stage encompasses not only the decision but also the program's admission process and the probability of acceptance and enrollment, as data on these procedures are not available. This research strategy is based on the argument that students are aware of the competitive nature of admission processes and they tend to apply to institutions where people with similar characteristics and levels of achievement study, so they increase their probability of acceptance (DesJardins et al., 2006). One of the few empirical studies that considered both 'application' and 'attendance conditional on application' provide support to this research strategy, as it found that parameters in probabilistic models for both outcomes were 'remarkably similar in direction, size and significance' (Skinner, 2019).

The graduate program that a student views as his or her best option is expected to affect the student's utility, impacting the decision to enroll. Therefore, the estimation of this stage must consider the choice between programs made by college graduates at the previous stage. As the choice of those students that did not progress to a master's program is unknown, each college graduate *i* in the sample is paired with the program that he or she has the highest probability (P_{ij}) of choosing (using the parameters and the specification of the first stage),[11] which is considered his or her 'most likely' master's program. In the case of actual master's students, the 'most likely' program may not be the one in which he or she actually enrolled.

[11] No minimum probability cutoff was used for this estimation, so every college graduate in the sample is paired with the master's program with the highest P_{ij}.

For estimation, the response variable of this stage is a dummy that indicates whether student i actually progressed to graduate education in any master's program ($enrollment_i = 1$) or not ($enrollment_i = 0$). Considering the categorical and binary nature of the dependent variable, a standard logistic regression analysis is used to estimate the associations of different factors with the likelihood of the outcome. The conditional probability that student i with a 'most likely' program j decides to enroll in a master's program is (Greene, 2011)

$$\Pr\left(enrollment_i = 1 \,\middle|\, choice_i = j, z_{ij}\right) = \frac{\exp\left(\beta' z_{ij}\right)}{1 + \exp\left(\beta' z_{ij}\right)}, \tag{2}$$

where z_{ij} is the vector of all variables presented in Table 1, that are assumed to be correlated with students' decision and odds of enrollment at this stage, according to the β coefficients to be estimated.

4.2 Data, Sample and Descriptive Statistics

For this analysis, confidential microdata from three databases were merged, resulting in a rich and novel dataset designed to investigate access to graduate education in the country: (a) the 'Higher Education Census' (INEP, 2017a), that comprises the identification and personal information on students graduating from undergraduate college; (b) the National Students' Performance Exam (ENADE) and the 'Students' Questionnaire' database is the source of information on undergraduate performance and students' personal and socioeconomic features;[12] and (c) the record of all master's students (CAPES, 2017a).

The sample used in this study is limited to students who (a) graduated between 2011 and 2013,[13] (b) took the ENADE exam, and (c) completed the Students' Questionnaire. The sample does not include a great number of college graduates who were exempted from taking the ENADE exam because their programs and academic fields was not under evaluation when they graduated, following the cycle of the National System of Higher Education Evaluation (SINAES). However, there is also a number of students who did not take the ENADE exam or did not respond to

[12] The ENADE test is part of the National System of Higher Education Evaluation (SINAES), that evaluates all undergraduate programs in Brazil in a scale from one to five points, based on their pedagogical framework, teaching staff and university infrastructure (INEP, 2016a). Within this system, academic fields are divided in three groups and assessed once every three years (one group per year). All college students graduating in the year of evaluation of his or her program are expected to take the ENADE exam and to complete the 'Students' Questionnaire' with information on family background, socioeconomic status and experiences during undergraduate college. For this analysis, students who took the same test were grouped and their grades were standardized using a z-score, to ensure that the score were comparable (Urdan, 2016).

[13] The 2011–2013 period was chosen in light of the three-years evaluation cycle of the SINAES, so as to ensure that students from all fields are included in the sample.

the relevant items of the Students' Questionnaire for unspecified reasons, indicating a problem of missing data. This problem has been subject of a large debate in the literature (Hughes, Heron, Sterne, & Tilling, 2019; Seaman & White, 2013), that distinguishes between different causes of missingness, their implications for consistency of empirical estimates, and methods to solve or minimize potential biases.[14] A complete case analysis (CCA) is used in this analysis, meaning that the investigation is limited to individuals for which full information on the covariates is available. The implications of this choice for the strength of the evidence and generalization of findings are discussed below.

The dependent variables of the model are dummies that indicate the program in which new master's students actually enrolled (first stage), and whether college graduates progressed to a master's degree program or not (second stage). In light of the available data, progress to graduate education is considered only if students enrolled in a master's program up to three years after college graduation.[15]

Independent variables used for estimation of both stages of the model are presented in Table 1, that displays descriptive statistics for all college graduates in the sample (column 1) and only for those who enrolled in a master's program (column 2). The main predictors of interest are displayed at the top of the table, and the additional control variables are presented below. Academic performance and activities during college are measured using the student's standardized ENADE score, along with dummy variables that indicate whether he or she reported to have performed teaching assistant, research or extension activities. Sex and race[16] are also indicated through dummy variables for female, Black or Brown,[17] Asian and Indigenous students. And mobility is assessed through variables that indicate whether the master's student enrolled at the same institution and in the same state where he or she earned an undergraduate degree, along with the distance between the college and the master's program institution.

The estimated income in the household is calculated based on students' responses in the ENADE questionnaire survey, and measured in number of minimum

[14] Multiple imputation and inverse probability weighting are not feasible in this analysis, in light of the large number of missing information and the lack of data to build a meaningful missingness model (Hughes et al., 2019).

[15] The empirical literature used different time limits to assess such progress: English and Umbach (2016) considered only one year after the student's completion of the baccalaureate degree, while Zarifa (2012) considered five years and Perna (2004) considered from four to five years.

[16] The racial classification adopted by INEP is the one that has been used by IBGE since the 2000 National Census (INEP, 2005). It uses the heading 'color or race' ('*cor ou raça*') and comprises five categories based on racial self-identification: white ('*branco*'), black ('*preto*'), Asian ('*amarelo*'), and indigenous (*indígena*) (IBGE, 2016).

[17] It is a common practice among Brazilian researchers to consider 'black' and 'brown' individuals jointly under a single category 'black' (*negro*), because of the similar socioeconomic features and discrimination faced by these groups (Osorio, 2013).

Table 1. Descriptive statistics of variables used in the empirical analysis

Variables	(1) All college graduates Mean (Std. Dev.)	(2) College graduates who enrolled in a Master's program Mean (Std. Dev.)
Enrollment in master's program[a]	0.04 (0.19)	1.00 (0.00)
Predictors of Interest		
Student's features and previous academic achievement and experience		
Standardized ENADE score	0.01 (0.99)	0.57 (1.04)
Teaching assistant during college (dummy)	0.25 (0.43)	0.41 (0.49)
Research activities during college (dummy)	0.38 (0.48)	0.68 (0.47)
Extension activities during college (dummy)	0.37 (0.48)	0.51 (0.50)
Female student (dummy)	0.59 (0.49)	0.53 (0.50)
Black or brown student (dummy)	0.12 (0.32)	0.11 (0.31)
Asian student (dummy)	0.01 (0.10)	0.01 (0.10)
Indigenous student (dummy)	0.00 (0.04)	0.00 (0.04)
Household per capita income[b]	2.26 (2.71)	2.79 (3.34)
Student mobility		
Undergraduate and master's program at the same institution (dummy)		0.65 (0.48)
Undergraduate and master's program in the same state (dummy)		0.93 (0.25)
Distance (per 100 km)		0.81 (2.06)
Control Variables		
Undergraduate program features		
SINAES score for the program[c]	2.39 (0.70)	2.96 (0.68)
Private college (dummy)	0.87 (0.34)	0.34 (0.47)
Night shift program (dummy)	0.75 (0.43)	0.34 (0.48)
Other Personal traits		
Student with disability (dummy)	0.00 (0.05)	0.00 (0.06)
Foreign student (dummy)	0.00 (0.04)	0.00 (0.04)
Age	28.03 (7.38)	24.74 (4.58)
Socioeconomic factors		
Student funding (dummy)	0.28 (0.45)	0.13 (0.34)
Working student (dummy)	0.65 (0.48)	0.32 (0.47)
Parental education (dummies for highest educational level)[b]		
Father: primary education	0.30 (0.46)	0.18 (0.39)
Father: lower secondary education	0.14 (0.35)	0.12 (0.32)
Father: upper secondary education	0.29 (0.45)	0.32 (0.47)
Father: undergraduate education	0.16 (0.37)	0.24 (0.43)
Father: graduate education	0.06 (0.23)	0.11 (0.32)
Mother: primary education	0.26 (0.44)	0.14 (0.34)
Mother: lower secondary education	0.14 (0.35)	0.11 (0.31)
Mother: upper secondary education	0.31 (0.46)	0.33 (0.47)
Mother: undergraduate education	0.16 (0.37)	0.26 (0.44)
Mother: graduate education	0.08 (0.27)	0.15 (0.36)
Features of master's programs		
CAPES score for the program[e]		4.42 (1.24)
Student-faculty ratio (within the program)		6.14 (3.13)
Department also offers Ph.D. degree (dummy)		0.66 (0.47)
Average standardized ENADE score of new master's students		0.58 (0.69)
Private graduate school (dummy)		0.16 (0.37)
Professional program (dummy)		0.05 (0.22)
No. of obs.	435,867	16,121

Notes: [a]Progress to graduate education considered only if the student enrolled in a master's program up to three years after college graduation. [b]Variable based on students' responses in the ENADE questionnaire survey and measured as the number of minimum wages. [c]The SINAES evaluates all undergraduate programs in Brazil in a scale from one to five points. [b]The reference case for these variables (no dummy included) is father/mother who had not attained primary education. [e]Graduates programs are evaluated by CAPES on a scale of one to seven points (CAPES, 2018).

Source: CAPES (2017a), INEP (2016b), INEP (2017a) and INEP (2017b) (confidential information).

wages.[18] Other studies have used the total family income in their analyses (Long, 2004; Skinner, 2019), but such choice does not consider the number of people living on such income, or the average available value for each household member. For this reason, the 'estimated income in the household' was divided by the number of residents also reported by students, obtaining the 'estimated per capita income in the household'.[19]

5. Results of the Empirical Analysis

The estimated parameters for the first (choice between programs) and second (decision and odds of enrollment) stages are presented in tables 2 and 3, respectively. They are reported as odds ratios, that are interpreted as the extent to which a unit increase in the respective independent variable is associated with a modification in the odds that the event represented by the binary outcome occurs (i.e., the choice of program in first stage, and the decision and odds of enrollment in the second stage), holding all other variables constant. In both tables, column 1 presents the estimated parameters for the entire sample, and columns 2 to 8 breaks down the analysis per broad academic field.

The analysis confirms the scenario of low mobility of Brazilian master's students discussed previously. The estimates for the first stage present clear evidence that the institution where students graduated from college and the distance from its location are highly associated with the choice of a master's program. Students are around 18 times more likely to try to attain a master's degree at the same university where they graduated from college, and nearly nine times more likely to continue in the same state, and the parameters are also positive and statistically significant in all fields individually considered. Similarly, students seem to prefer master's programs located close to where they studied previously, as the likelihood of choosing a program decreases approximately 20% for each one-hundred-kilometer increase in distance from their undergraduate college location (the magnitude of the parameter varies by broad field, but it is significant for all estimates). This is an important topic be addressed. As discussed previously, mobility of students is believed to contribute to

[18] This item of the Students' Questionnaire presented seven options for income range: (a) up to 1.5 minimum wages (MW), (b) 1.5 to 3 MW, (c) 3 to 4.5 MW, (d) 4.5 to 6 MW, (e) 6 to 10 MW, (f) 10–30 MW, and (g) above 30. The 'estimated income in the household' is calculated as the (unweighted) median of the range group informed by the student (lower bound plus upper bound divided by two), except for the last option 'income above 30 minimum wages', in which case the lower bound (30) is used. For reference, the MW in Brazil in 2012 was R$ 622.00 (around US$ 305.00, considering the exchange rate of the last day of the year). The medium wage measured by the Brazilian Institute of Geography and Statistics in the same year was around 3 MW = R$ 1,943,00 (IBGE, 2019).

[19] The questionnaire presented eight options for the number of additional people residing with the student in the household, from zero to 'more than seven' (in this last case, the lower bound (7) is used in the analysis).

Table 2. Results of the first stage – choice between graduate programs. Conditional Logit Model (with robust variance-covariance matrix). Dependent variable: dummy variable for chosen master's degree program.

	Broad Groups or Fields of Education[a]							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	All Fields	Education	Humanities and Arts	Social Sciences, Business and Law	Science, Mathematics and Computing	Engineering, Manufacturing and Construction	Agriculture and Veterinary	Health and Welfare
Predictors of Interest								
Student mobility								
Undergraduate and master's program at the same institution (dummy)	18.24***	19.93***	19.92***	13.02***	18.93***	19.01***	21.73***	18.85***
	(0.69)	(1.47)	(4.40)	(1.34)	(1.70)	(1.51)	(3.09)	(3.34)
Undergraduate and master's program in the same state (dummy)	8.90***	5.87***	10.85***	13.63***	10.96***	10.79***	4.35***	7.31***
	(0.48)	(0.67)	(5.42)	(1.94)	(1.32)	(1.21)	(0.71)	(1.59)
Distance (per 100 km)	0.82***	0.75***	0.81*	0.83***	0.85***	0.85***	0.85***	0.82***
	(0.01)	(0.02)	(0.08)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Control Variables								
Features of master's programs								
CAPES score for the program	1.22***	1.12***	1.16	1.02	1.25***	1.51***	1.10	0.99
	(0.02)	(0.04)	(0.12)	(0.05)	(0.04)	(0.05)	(0.07)	(0.07)
Student-faculty ratio (within the program)	1.06***	1.04**	1.11**	1.08***	1.07***	1.04***	1.05**	1.12***
	(0.01)	(0.01)	(0.04)	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)
Department also offers Ph.D. degree (dummy)	0.96	1.02	0.94	0.94	1.29*	0.80*	1.18	0.97
	(0.04)	(0.08)	(0.29)	(0.09)	(0.13)	(0.07)	(0.16)	(0.17)
Average standardized ENADE score of new master's students	1.03	1.08*	1.07	1.02	0.94	0.97	0.90	1.30***
	(0.02)	(0.03)	(0.11)	(0.04)	(0.04)	(0.04)	(0.06)	(0.08)
Private graduate school (dummy)	0.81***	0.80**	0.91	0.91	0.62***	0.84*	0.81	0.78
	(0.03)	(0.06)	(0.21)	(0.08)	(0.06)	(0.07)	(0.17)	(0.14)
Professional program (dummy)	1.20***	0.75*	1.57	1.16	0.79	1.49***	1.44	2.33***
	(0.07)	(0.10)	(0.70)	(0.13)	(0.14)	(0.15)	(0.38)	(0.49)
Chi-squared	17,389.29	5,030.91	434.89	2,736.60	3,081.78	3,908.21	1,584.44	1,066.56
Prob > chi2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Log pseudolikelihood	−15,193.16	−4,062.70	−299.75	−2,577.03	−2,615.32	−3,340.85	−1,279.33	−799.89
Pseudo R^2	0.69	0.74	0.74	0.59	0.68	0.68	0.69	0.73
No. of obs.	508,734.00	173,948.00	12,800.00	65,739.00	83,277.00	99,618.00	49,318.00	23,237.00

Notes: [a]According to the classification of UNESCO (1997). Progress to graduate education is only considered up to three years after college graduation. Odds ratios are reported. Robust standard errors in parentheses. *p < 0.05, **p < 0.01, ***p < 0.001.

Table 3. Results of the second stage – enrollment decision. Logistic regression (with robust variance-covariance matrix). Dependent variable: dummy for enrolling in any master's degree program.

	Broad Groups or Fields of Education[a]							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	All Fields	Education	Humanities and Arts	Social Sciences, Business and Law	Science, Mathematics and Computing	Engineering, Manufacturing and Construction	Agriculture and Veterinary	Health and Welfare
Predictors of Interest								
Student's features and previous academic achievement and experience								
Standardized ENADE score	1.39***	1.36***	1.41***	1.67***	1.52***	1.35***	1.44***	1.75***
	(0.01)	(0.03)	(0.11)	(0.04)	(0.05)	(0.03)	(0.07)	(0.08)
Teaching assistant during college (dummy)	1.37***	1.46***	0.86	1.32***	1.41***	1.22***	1.33***	1.37***
	(0.03)	(0.06)	(0.14)	(0.08)	(0.09)	(0.06)	(0.11)	(0.10)
Research activities during college (dummy)	3.23***	3.54***	5.10***	1.96***	3.27***	3.58***	4.18***	2.99***
	(0.07)	(0.15)	(0.82)	(0.11)	(0.21)	(0.16)	(0.36)	(0.24)
Extension activities during college (dummy)	1.21***	1.30***	1.06	1.57***	1.26***	1.19***	0.91	1.11
	(0.03)	(0.05)	(0.16)	(0.08)	(0.08)	(0.06)	(0.07)	(0.08)
Female student (dummy)	0.76***	0.47***	0.73*	0.93	1.24***	1.20***	1.58***	0.95
	(0.02)	(0.02)	(0.11)	(0.04)	(0.08)	(0.06)	(0.13)	(0.08)
Black or brown student (dummy)	1.03	0.98	1.01	1.06	0.94	1.31***	1.14	0.88
	(0.03)	(0.06)	(0.24)	(0.09)	(0.08)	(0.10)	(0.15)	(0.10)
Asian student (dummy)	0.83	1.34	1.91	0.50*	0.63	0.70*	1.54	0.55
	(0.08)	(0.27)	(0.79)	(0.16)	(0.18)	(0.12)	(0.67)	(0.22)
Indigenous student (dummy)	1.08	1.85	8.81***	1.00	1.26	0.56	1.00	2.40
	(0.28)	(0.78)	(5.42)	(.)	(1.40)	(0.41)	(.)	(1.29)

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Table 3. (*continuing*)

	Broad Groups or Fields of Education[a]							
Variables	(1) All Fields	(2) Education	(3) Humanities and Arts	(4) Social Sciences, Business and Law	(5) Science, Mathematics and Computing	(6) Engineering, Manufacturing and Construction	(7) Agriculture and Veterinary	(8) Health and Welfare
Household per capita income	1.01**	1.07***	0.98	1.04***	0.97**	0.98**	0.99	1.02
	(0.00)	(0.01)	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Student mobility								
Undergraduate and 'most likely' master's program[b] at the same institution (dummy)	5.71***	4.77***	12.56***	4.70***	5.31***	5.28***	3.20***	7.18***
	(0.15)	(0.26)	(3.48)	(0.33)	(0.42)	(0.35)	(0.41)	(0.78)
Undergraduate and 'most likely' master's program[b] in the same state (dummy)	1.52***	0.90	5.59***	1.95***	0.72*	1.47***	0.49***	1.03
	(0.07)	(0.07)	(2.62)	(0.27)	(0.09)	(0.15)	(0.08)	(0.16)
Distance (per 100 km)	0.90***	0.86***	0.93	0.82***	0.86***	0.94***	0.91***	0.96
	(0.01)	(0.02)	(0.14)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Control Variables								
Undergraduate program features								
Undergraduate program's SINAES' score for the program	1.38***	1.40***	1.66***	1.29***	1.01	1.06	1.11	1.31***
	(0.02)	(0.04)	(0.19)	(0.04)	(0.05)	(0.04)	(0.08)	(0.08)
Private college (dummy)	0.30***	0.26***	0.51*	0.34***	0.44***	0.56***	0.29***	0.50***
	(0.01)	(0.02)	(0.14)	(0.02)	(0.03)	(0.04)	(0.04)	(0.06)
Night shift program (dummy)	0.66***	0.81***	0.98	0.63***	0.51***	0.67***	0.39***	0.75*
	(0.02)	(0.03)	(0.18)	(0.03)	(0.04)	(0.04)	(0.11)	(0.10)

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Table 3. (*continuing*)

Variables	Broad Groups or Fields of Education[a]							
	(1) All Fields	(2) Education	(3) Humanities and Arts	(4) Social Sciences, Business and Law	(5) Science, Mathematics and Computing	(6) Engineering, Manufacturing and Construction	(7) Agriculture and Veterinary	(8) Health and Welfare
Personal traits								
Student with disability (dummy)	0.97	1.18	0.56	1.24	1.02	0.52	2.89*	0.40
	(0.16)	(0.34)	(0.48)	(0.50)	(0.32)	(0.28)	(1.36)	(0.33)
Foreign student (dummy)	1.05	0.98	1.00	2.15*	0.93	0.75	3.56	1.86
	(0.25)	(0.76)	(.)	(0.79)	(0.38)	(0.34)	(2.88)	(1.16)
Age	0.94***	0.93***	1.00	0.98***	0.94***	0.95***	0.95***	0.92***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Socioeconomic factors								
Student funding (dummy)	1.14***	1.29***	1.37	1.13*	1.02	1.11	1.37	1.21
	(0.03)	(0.08)	(0.33)	(0.06)	(0.08)	(0.07)	(0.29)	(0.14)
Working student (dummy)	0.55***	0.47***	0.79	0.64***	0.44***	0.68***	0.96	1.00
	(0.01)	(0.02)	(0.12)	(0.03)	(0.03)	(0.03)	(0.11)	(0.11)
Parental education (dummies for highest educational level)								
Father: primary education	1.01	1.03	2.40	0.95	1.12	0.86	0.87	0.83
	(0.06)	(0.09)	(1.23)	(0.18)	(0.26)	(0.18)	(0.22)	(0.22)
Father: lower secondary education	0.99	1.14	2.22	0.73	1.18	0.69	0.81	0.74
	(0.07)	(0.11)	(1.22)	(0.15)	(0.28)	(0.15)	(0.22)	(0.20)
Father: upper secondary education	1.03	1.20	2.39	0.85	1.12	0.83	0.65	0.84
	(0.07)	(0.11)	(1.27)	(0.16)	(0.26)	(0.18)	(0.17)	(0.22)

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Table 3. (*continuing*)

	Broad Groups or Fields of Education[a]							
Variables	(1) All Fields	(2) Education	(3) Humanities and Arts	(4) Social Sciences, Business and Law	(5) Science, Mathematics and Computing	(6) Engineering, Manufacturing and Construction	(7) Agriculture and Veterinary	(8) Health and Welfare
Father: undergraduate education	0.98	1.48***	1.65	0.95	1.18	0.67	0.75	0.68
	(0.07)	(0.16)	(0.90)	(0.19)	(0.28)	(0.15)	(0.20)	(0.19)
Father: graduate education	1.14	1.47**	3.20	1.32	1.44	0.78	0.90	0.68
	(0.08)	(0.20)	(1.91)	(0.27)	(0.36)	(0.17)	(0.26)	(0.20)
Mother: primary education	1.07	1.02	0.83	1.13	0.71	0.94	0.95	1.70
	(0.09)	(0.11)	(0.44)	(0.27)	(0.19)	(0.23)	(0.35)	(0.73)
Mother: lower secondary education	1.26**	1.17	0.97	1.50	0.83	1.08	0.88	1.87
	(0.10)	(0.14)	(0.54)	(0.37)	(0.22)	(0.27)	(0.33)	(0.82)
Mother: upper secondary education	1.32***	1.27*	1.04	1.67*	0.74	1.06	1.01	1.85
	(0.11)	(0.15)	(0.56)	(0.41)	(0.19)	(0.26)	(0.37)	(0.80)
Mother: undergraduate education	1.34***	1.43**	0.95	1.90**	0.87	1.03	0.87	2.11
	(0.11)	(0.18)	(0.53)	(0.47)	(0.23)	(0.25)	(0.32)	(0.92)
Mother: graduate education	1.63***	1.55***	1.00	2.75***	0.88	1.33	0.86	2.57*
	(0.14)	(0.20)	(0.60)	(0.68)	(0.24)	(0.33)	(0.33)	(1.13)
Features of the 'most likely' master's program[b]								
CAPES score for the program	1.12***	1.15***	1.35**	1.13**	0.99	1.02	0.86*	1.15**
	(0.01)	(0.03)	(0.15)	(0.05)	(0.03)	(0.03)	(0.05)	(0.05)
Student-faculty ratio within the program	0.90***	0.90***	1.01	0.91***	0.92***	0.92***	0.93***	0.86***
	(0.00)	(0.01)	(0.05)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)

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Table 3. (*continuing*)

	Broad Groups or Fields of Education[a]							
Variables	(1) All Fields	(2) Education	(3) Humanities and Arts	(4) Social Sciences, Business and Law	(5) Science, Mathematics and Computing	(6) Engineering, Manufacturing and Construction	(7) Agriculture and Veterinary	(8) Health and Welfare
Department also offers Ph.D. degree (dummy)	1.06	0.76***	0.58*	1.24*	1.11	1.12	1.35*	1.85***
	(0.03)	(0.04)	(0.14)	(0.12)	(0.11)	(0.08)	(0.16)	(0.20)
Average standardized ENADE score of new master's students	0.84***	0.93**	0.76*	0.88***	0.77***	0.94*	0.76**	0.94
	(0.01)	(0.02)	(0.11)	(0.03)	(0.02)	(0.02)	(0.07)	(0.05)
Private graduate school (dummy)	0.64***	1.36***	0.35***	0.65***	1.13	0.95	0.96	1.55***
	(0.02)	(0.11)	(0.10)	(0.04)	(0.13)	(0.08)	(0.24)	(0.19)
Professional program (dummy)	1.14**	6.28***	5.80***	0.96	14.14***	2.73***	1.55	1.58**
	(0.05)	(1.02)	(2.59)	(0.09)	(5.15)	(0.26)	(0.47)	(0.23)
Chi-squared	38,976.51	8,092.19	769.06	5,573.23	4,444.92	4,922.69	928.16	2,538.02
Prob > χ^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Log pseudolikelihood	−41,409.18	−10,808.82	−679.83	−9,302.60	−4,538.64	−7,964.88	−1,994.06	−2,929.40
Pseudo R^2	0.40	0.39	0.48	0.24	0.47	0.32	0.30	0.35
No. of obs.	435,867.00	65,180.00	5,473.00	268,545.00	25,288.00	38,693.00	4,924.00	23,288.00

Notes: [a] According to the classification of UNESCO (1997). [b] The 'most likely graduate program' is the one with highest probability to be chosen by each student, using the parameters of the probabilistic model estimated at the first stage. Progress to graduate education is only considered up to three years after college graduation. Odds ratios are reported. Robust standard errors in parentheses. *p < 0.05, **p < 0.01, ***p < 0.001.

diversity and research quality, and it may yield different benefits for both students and educational institutions (Kiley & Austin, 2008; Neumann, 2002). Some of the proposed explanations for why students prefer to 'stay at home' are ease of access to local institutions, moving costs, personal relationships or social ties, and a lack of awareness of the benefits of studying at a different institution (Kiley & Austin, 2008).

The study also presents evidence that previous academic performance and participation in academic and scientific activities are important factors explaining access to graduate education. The estimates in Table 3 inform that a student is more likely to progress to a master's degree program if he or she obtained a higher score on the ENADE exam (relative odds for the entire sample increase around 40% per additional unit of standard deviation of the distribution), and such positive association is also significant for all broad fields—the magnitude of the coefficient is even greater in some cases. Participation in any extra academic or scientific activities—i.e., teaching assistantship, research and extension activities—is also associated with a higher likelihood of enrollment, particularly in the case of undergraduate research, as the relative odds of starting a master's program are 3.2 times higher for students who took part in such projects (considering the estimate for the entire sample). The descriptive statistical analysis presented in Table 1 already suggested such association, as the mean value for these variables is considerably higher for the group of new master's students than for the entire sample of college graduates. These findings are not surprising, as they are in line with previous studies in different countries that have reached similar conclusions (Choy & Carroll, 2000; Lang, 1987; Mullen et al., 2003; Xu, 2014; Zhang, 2005; Zimdars, 2007). The main arguments used to interpret these results are that students with higher performance are more likely to be accepted in admission processes, and that their previous knowledge and skills prepare them for the activities and challenges of a graduate program (Xu, 2014).

A more difficult question, however, is whether these parameters should be interpreted as a sign of equity in access. As discussed in section 2, one can argue that these variables represent students' dedication and success throughout college, a 'meritocratic view of higher education' (Mullen et al., 2003) consistent with the idea of fairness (OECD, 2017; Santiago et al., 2008). However, grades and academic experience may also conceal or be strongly influenced by social and economic statuses and personal features (Ethington & Smart, 1986; Schwartz, 2004); therefore, performance could represent the indirect effect of these factors, and for this reason it does not necessarily indicate an equitable system. Investigations and assessments of these arguments are beyond the scope of this paper. Nevertheless, the results reinforce the general idea in the literature that performance and academic activities are relevant predictors of graduate enrollment.

One of the most important debates on access to graduate education is whether race affects participation. In general, the results of this analysis do not support

the idea that nonwhite students are less likely to progress to a master's program. According to the estimates, relative odds for these students are not significantly lower (at a 95% confidence level) considering the entire sample and most broad fields (with the exception of Asian students in 'Social Sciences, Business and Law' and 'Engineering, Manufacturing and Construction'). This finding is in accordance with studies performed in other countries, that also failed to find a negative and significant association of minority students with progression to graduate education (English & Umbach, 2016; Johnson, 2013; Perna, 2004).

On the other hand, a higher likelihood of access is found for black and brown college graduates in the 'Engineering, Manufacturing and Construction' field, and for indigenous students in 'Humanities and Arts'. Although unexpected, this result is not unprecedented: Cole and Espinoza (2011) reported a similar effect on racial minority female students in STEM fields in the U.S.; and Lang (1987) and Montgomery (2002) found that nonwhite U.S. students attended higher ranked graduate schools. An explanation for this result is that racial minority students may view graduate education as a means of mitigating prejudice against them or ensuring professional success (Montgomery, 2002).

Despite the fact that women represent more than half of the group of new master's students (as shown in Table 1), the results for the entire sample indicate that they are 24% less likely to pursue graduate education than men. But a negative and significant association with access is not found for most broad fields individually considered, with the exception of 'Education' and 'Humanities and Arts'. Previous studies in different countries have also found a lower likelihood for female students (Wales, 2013; Zarifa, 2012; Zhang, 2005), although this conclusion is not unanimous in this literature, as discussed in section 2. It is not possible to check whether the cause of this problem in the Brazilian case lies in the academic environment, in the lack of family support or societal barriers for the academic development of women (Millett, 2003; Qian & Blair, 1999; Sax, 2001), and this constitutes an important agenda for future studies.

The study also shows that female students are more likely to progress to master's programs if they study within the broad fields of 'Science, Mathematics and Computing', 'Engineering, Manufacturing and Construction' and 'Agriculture and Veterinary'. The reason behind such positive association is not clear, but it is worth noticing that these fields present the lowest proportion of women among college graduates in the sample.[20]

A higher per capita income in the student's household is associated with an increase in the relative odds of progress to a master's program (estimate for the entire sample). Again, this result is in line with previous researches in the U.S., U.K. and

[20] In the sample, women accounted for approximately 28% of college graduates in the 'Engineering, Manufacturing and Construction' broad field, 31% in 'Science, Mathematics and Computing', and 43% in 'Agriculture and Veterinary'.

Canada (Mullen et al., 2003; Wales, 2013; Zarifa, 2012). The importance of such factor as a predictor of access, however, is reduced by the small magnitude of the parameter (only a 1% increase in odds ratio for an additional per capita income of one minimum wage), and also because a negative and significant association is found for two fields ('Science, Mathematics and Computing' and 'Engineering, Manufacturing and Construction'). There are no obvious explanations for such results, but an argument commonly suggested by the literature is that socioeconomic factors may affect undergraduate college so strongly that their effects on graduate education are mostly indirect, as represented by undergraduate performance and credentials (Ethington & Smart, 1986; Millett, 2003).

Finally, the empirical analysis also evidences that other features of the student and of its undergraduate college (considered here as control variables) are significant predictors of access to graduate education, suggesting potential inequity problems to be investigated in future studies. Older or 'non-traditional' college graduates and those who reported to be working at the time of graduation are found to have a lower likelihood of enrolling in master's programs. The educational attainment of the students' mother is also found to be a significant predictor. And in the case of undergraduate program features, lower quality, night shift and private institutions are negatively associated with the likelihood that a student will start a master's program in different academic fields.

Missing data is an important limitation of this study that weakens the strength of the presented evidence. The problem is not only caused by the SINAES evaluation cycle (that limits data collection to students of programs under evaluation), but also because there is incomplete data on subjects expected to have taken the ENADE exam and completed the Students' Questionnaire. The reasons for such lack of information are not known, and therefore missingness can be correlated with some of the explanatory and dependent variables—a case of 'missing not a random' (Hughes et al., 2019). Because of this problem, generalization of the findings presented in this paper should be made with caution. Future studies that use additional and more complete data (as it becomes available) or that apply methods to correct for any potential bias caused by missingness can improve this analysis and present further evidence on the topic.

6. Conclusions

This paper presents a first quantitative analysis of the predictors of choice and odds of enrollment in master's degree programs in Brazil. Inequity of access to graduate education is currently a topic of debate, and the literature has not reached a consensus on whether personal and socioeconomic factors actually affect participation at this level or whether these effects are expended at previous stages. The empirical analysis presented here contributes to this debate by providing evidence of the Brazilian case

that adds to the international literature, and that can be used to recommend policies and improvements to fight inequity and widen participation in graduate education in Brazil.

The analysis is based on a rich and novel dataset with microdata from undergraduate and graduate students, and a two-stage approach is applied to model the progression to a master's degree. Academic achievement and activities during college are found to be positively associated with the relative odds of enrollment. But the analysis also presents important evidence of inequity in the transition to graduate education, as female and economically disadvantaged students are less likely to start a master's program (although such findings are not applicable to all broad fields individually considered). On the other hand, no significant evidence of lower likelihood of progress to graduate education is found for nonwhite students in nearly all estimates, including the one for the entire sample. Finally, the results indicate a scenario of low student mobility, as college graduates are far more likely to choose a master's program at the same university or in an institution located close to where they earned their undergraduate degrees.

As a last remark, it is worth reminding that this research did not try to evidence a causal effect of the variables of interest on graduate access, and that it only assessed the direct association with such outcome. The positive correlation found for students' previous performance and the absence of significant parameters for racial variables and other students' features should be interpreted accordingly. As an advanced educational level, graduate education is expected to be influenced by inequity problems at earlier stages, so it is likely that the aforementioned factors are associated to access to the master's degree but operate through indirect channels, including by improving academic achievement and credentials attained at previous stages (Zhang, 2005).

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