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Non-Registration and Dropout Rates at the Federal University of Minas Gerais

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ABSTRACT – Non-Registration and Dropout Rates at the Federal University of Minas Gerais. Most public universities in Brazil select students using the National Exam of Secondary Education (ENEM) and the Unified Selection System (SiSU). Despite the expected advantages of using ENEM/SiSU to select higher education students, a sizable proportion of the selected students do not register at the universities and early dropout rates are high. This paper analyzes the determinants of non-registration and of early dropping out at the Federal University of Minas Gerais (UFMG) using logistic models. Then illustrative simulations propose the design of policies with two scenarios that would imply an enormous increase in the effectiveness of the selection process with a remarkable impact on costs.
Keywords: **ENEM. SiSU. UFMG. Dropout.**

RESUMO – Taxas de Não-Registro e Evasão na Universidade Federal de Minas Gerais. A maioria das universidades brasileiras seleciona seus alunos usando o Exame Nacional do Ensino Médio (ENEM) e o Sistema de Seleção Unificado (SiSU). Apesar das vantagens esperadas de se usar esse procedimento de seleção, uma proporção significativa dos estudantes aprovados não faz seu registro na universidade e as taxas de evasão nos anos iniciais do estudo terciário são elevadas. Esse artigo analisa os determinantes do não registro e das taxas de evasão precoce na Universidade Federal de Minas Gerais (UFMG) usando modelos logísticos. Depois, simulações ilustrativas propõem o desenho de políticas em dois cenários, que implicariam num enorme aumento na eficácia do processo de seleção, com um impacto notável nos custos.
Palavras-chave: **ENEM. SiSU. UFMG. Evasão.**

Introduction

The student selection process of public Higher Education Institutions (HEI) in Brazil has changed in many aspects in the last few decades. The National Exam of Secondary Education (ENEM) and the Unified Selection System (SiSU) began to be used in most institutions as the main tool for selecting students (Ariovaldo; Nogueira, 2018; Lima; Machado, 2016; Nogueira et al., 2017; Silveira et al., 2015; Vargas, 2019). In addition, many institutions in Brazil implemented affirmative action policies since the nineties to decrease opportunity inequalities between the different population strata. More recently, the national federally mandated quota system was implemented in 2012 in all federal HEI (Telles; Paixão, 2013) and is part of the ENEM/SiSU process. Besides, there was a remarkable increase in the number of university slots at federal HEI between 2008 and 2012, mostly due to the Program for Restructuring and Expansion of Federal Universities (REUNI) (Aranha et al., 2012; Lima; Machado, 2016).

All these policy changes influenced several features of the selection process of students at public HEI. A remarkable example was the noteworthy increase in the proportion of students from public secondary schools and from low-income households attending public HEI (Aranha et al., 2012; Francis; Tannuri-Pianto, 2012; Pedrosa et al., 2007; Telles; Paixão, 2013). A less studied topic is that these policy changes might have changed registration and early dropout rates at HEI. The ENEM/SiSU opens the possibility of choosing a course per occasion during the selection process and this can result in increased difficulties in adapting to life at the university if the process results in less satisfaction with the chosen course (Demenech et al., 2023), implicating lower registration rates and higher early dropout rates. Vargas (2019) presented the advantages of SiSU over the traditional entrance exam: the chances of entrance double; if unsuccessful in the preferred option, the student can opt for another career during the selection process. On the negative side, ENEM/SiSU significantly increased the non-enrollment of candidates, generating the need for successive calls, and of early dropout.

This paper has two main objectives. The first is to analyze the determinants of non-registration and of early dropping out at UFMG, which is one of the oldest, largest and best ranked among the Brazilian HEI. The paper applies logistic models to address this objective. Non-registration of selected students and high dropout rates lead to a loss of efficiency in the selection process and to the persistence of empty slots. The second main objective of the paper is to propose changes in the selection process that could significantly decrease the probability of having empty slots due to these two factors in two scenarios. In the first, all selection waves would be replaced by only one wave accounting for non-registration rates. In the second scenario, students would be selected in only one wave to account for non-registration and early dropout rates.

This empirical strategy is used to address the following research questions: i) What are the personal factors associated with non-registration of selected students and related to early dropout rates among those who registered?; ii) How are course features related to non-registration rates and to early dropout?; iii) How can HEI overcome the limitations of the costly process of successive selection waves resulting in a substantial number of empty slots?

Hence, the study shows direct applicability for the design of more effective selection process policies for UFMG and another Brazilian public HEI. The study of non-registration and of dropout rates at HEI is particularly important in the Brazilian context, a developing country that lacks resources for education and which suffers from low academic achievements and performances at all academic levels. To the best of my knowledge, this is the first analysis using this approach dealing with such issues.

Recently Implemented Policies Concerning the Selection Process at Public Higher Education Institutions in Brazil

Higher education expanded remarkably in Brazil in the last decades (Gomes; Moraes, 2012; Barros, 2015; Salata, 2018). Barros (2015) shows that the number of students participating in tertiary education in Brazil increased from slightly over 3 million in 2001 to over 6.3 million in 2010, and further increased afterwards at least until 2014 (Salata, 2018). This increase was mostly in private institutions, but public institutions also showed an impressive increase in the number of students.

Some recently implemented policies were partially responsible for this expansion. These include the Educational Loans Program (FIES), the University for All Program (ProUni), affirmative action policies and the Support Program for Restructuring and Expansion Plans of Federal Universities (Reuni). FIES was implemented in 1999 and provides low-interest loans for students in private HEI. ProUni was implemented in 2005 with the main purpose of giving scholarships to students from low-income households (Barros, 2015; Salata, 2018). These last two polices were implemented focusing the attendance expansion at private HEI and are not further discussed, as the focus here is public HEI. Affirmative action policies and the Reuni are detailed below.

Since the nineties, many public HEI implemented different affirmative action policies (Francis; Tannuri-Pianto, 2012; Pedrosa et al., 2007; Telles; Paixão, 2013). Affirmative action policies are based on the notion that all citizens should be guaranteed their social rights, including the possibility of pursuing higher degrees of education. In addition, this type of policy is justified by the necessity to compensate for the historical disadvantage faced by Blacks, Pardos and the Indigenous in their path to HEI. Besides, it is argued that the remarkable increase in the proportion of students who are Black/Pardo/Indigenous or who come from public secondary schools and from low-income households attending public HEI in Brazil is a clear indicator that these policies are being successful (Francis; Tannuri-Pianto, 2012; Pedrosa et al., 2007;

Queiroz et al., 2015; Telles; Paixão, 2013). Conversely, a frequently raised argument against affirmative action policies is that they may decrease academic standards, particularly in more competitive courses (Pedrosa et al., 2007). Besides, these policies may present other problems: they raise the possibility of manipulation of self-declared skin color; they are not in accord with the principle of isonomy; they distract from the real problem of poverty; and they do not consider the history of racial blending in the Brazilian population (Guarnieri; Melo-Silva, 2017; Peixoto; Braga, 2012).

As summarized in box 1, affirmative action policies were implemented at UFMG in 2009, more specifically a bonus policy. This policy increased by 10% the grades obtained in the entrance exam by individuals who had attended public schools in the last seven years of elementary and secondary education. In addition, an extra 5% bonus was given to those who self-declared to be Blacks, Pardos, or Indigenous. This policy, with minor changes, remained in effect until the entrance exam of 2012.

In 2012 the national government approved a federal quota law which was implemented at Brazilian federal HEI over the course of four years (Telles; Paixão, 2013). Beginning with the entrance exam of 2013, at least 12.5% of the students in each course had to have received all their secondary schooling at a public institution. This number increased to 25%, 37.5%, and 50% respectively in 2014, 2015 and 2016. Between 2016 and 2018 this has been the implemented affirmative action policy in federal HEI in Brazil. The students covered by the quota were divided in four categories: those who attended secondary public school; those who attended secondary public school and self-declared Black/Pardo/Indigenous; those who attended secondary public school and were considered low-income (students living in households with a per capita income below 1.5 Brazilian minimum wages); and those who attended secondary public school, self-declared Black/Pardo/Indigenous, and were considered low-income. Since 2018, quotas for people with disabilities were implemented (Brasil, 2016).

The Reuni program was implemented in 2007 with the main objective of expanding access and retention of students at federal HEI undergraduate level (Gomes; Moraes, 2012). This program was also put into service because it was observed that most slots at public HEI remained concentrated in capitals and large urban centers and a spatial decentralization was needed (Vargas, 2019). For UFMG, and also presented in Box 1, there was a remarkable increase in the number of slots in the institution between 2009 and 2010, from 4,600 to 6,600 slots annually (Aranha et al., 2012; Lima; Machado, 2016).

Box 1 – Student selection policies at UFMG between 2008 and 2019

<table>
<tr><th>Year</th><th>Affirmative action policy</th><th>Number of slots</th><th>Exams</th></tr>
<tr><td>2008</td><td>No major policy</td><td>Approximately 4600</td><td rowspan="2">UFMG´s own exam in two stages</td></tr>
<tr><td>2009</td><td rowspan="4">Bonus policy: 10%/15%</td><td>Increased from approximately 4600 to 6600</td></tr>
<tr><td>2010</td><td rowspan="5">Approximately 6600</td><td rowspan="2">ENEM in the first stage and UFMG´s own exam in the second</td></tr>
<tr><td>2011</td></tr>
<tr><td>2012</td><td rowspan="2">Quota policy: 12.5%</td></tr>
<tr><td>2013</td><td rowspan="4">ENEM/SiSU as the main method</td></tr>
<tr><td>2014</td><td>Quota policy: 25%</td></tr>
<tr><td>2015</td><td>Quota policy: 37.5%</td></tr>
<tr><td>2016</td><td rowspan="4">Quota policy: 50%</td></tr>
<tr><td>2017</td></tr>
<tr><td>2018</td></tr>
<tr><td>2019</td></tr>
</table>

Source: Aranha et al. (2012); Lima e Machado (2016); Telles e Paixão (2013).

The implementation of ENEM/SISU in Brazil and at UFMG

The Brazilian federal government created the ENEM in 1998 as an instrument to evaluate the academic performance of students at the end of secondary education. Since 2009, however, the exam also began to be used as a tool in the selection process of HEI in Brazil (Nogueira et al., 2017; Silveira et al., 2015). This exam has five parts: mathematics, language, science and humanities and composition.

SiSU was implemented in 2018, and it provides an integrated system to use the ENEM of the previous year in the selection process of federal HEI (Vargas, 2019). The ENEM/SiSU provides the centralization of selection through a national exam and does not fix ex ante the choice of course or institution (Almeida et al., 2016).

The government predicted three positive results from using this exam (Nogueira et al., 2017). One was to be the increase in students' mobility, as the same exam could be used in all states and at most public universities in Brazil, so that students at secondary schools in one state could apply for tertiary education in another state with little cost. Another expected positive aspect was to be the lowering of costs and the increased efficiency of the selection process, with a decrease in the proportion of empty slots. Finally, there was to be an increase in the proportion of minorities in the university, particularly because of the quota policy, but also due to the lowering of costs of the selection process for individuals (Nogueira et al., 2017). Nonetheless, Nogueira et al. (2017) and Silveira et al. (2015) concluded that these expectations were not fulfilled. The effect on mobility was observed only partially and perversely, as students from higher socioeconomic status (SES) states,

which tend to have better secondary schools, occupied more slots at institutions in lower SES regions.

In this vein, Ariovaldo and Nogueira (2018) mapped studies that addressed the implementation of the ENEM/SiSU and divided them into three groups. The first group addressed how the candidate chooses his/her course, given the dynamic nature of SiSU, as the student can adjust preferences based on the ENEM´s results and on the real probabilities of approval. They concluded that the ENEM/SiSU interfered in the decision-making process, as the students make strategic choices that apart them from their original preference, potentially causing future frustration. A second set of studies focused on how the effects of ENEM/SiSU on the process of filling vacancies were. In general, these studies point to the increased probability of early and later dropping out, what is directly related to the dynamic and strategic decision-making process described above. In this vein, Almeida et al. (2016) also observed an increase in dropout rates at HEI and this occurred in all major areas of knowledge and in most and least popular courses. Nonetheless, a significant proportion of what is called evasion is mobility between different institutions or courses and it should be considered a student's investment rather than a failure (Vargas, 2019). The third group of studies analyzed the possible democratizing effects of ENEM/SiSU. In general, this process did not cause a considerable change in the level of elitism, as the selection process for HEI remained strongly meritocratic (Ariovaldo; Nogueira, 2018).

Vargas (2019) presented the advantages of SiSU over the traditional entrance exam: the chances of entrance double; and, if unsuccessful in the preferred option, the student can opt for another career during the selection process. On the negative side, as ENEM is a unique assessment in all parts of Brazil, it does not consider regional idiosyncrasies. Moreover, ENEM/SiSU significantly increased the non-enrollment of candidates, generating the need for successive calls (Souza, 2015; Vargas, 2019).

UFMG changed its selection process in different ways between 2008 and 2019, as also summarized in box 1. There were two main changes in the exams taken by applicants since 2008. Until 2010 there was a two-stage exam, which was unique to UFMG. From 2011 to 2013, four ENEM tests (mathematics, language, science and humanities) were used as the first stage, while the second stage continued to be UFMG´s own exam added to the composition score from ENEM. Since 2014, the five ENEM tests are used as the unique exam in most courses and later the SiSU was also implemented (Lima; Machado, 2016; Nogueira et al., 2017).

The increase in the number of applicants from other states due to the implementation of the ENEM/SiSU was remarkable, but this did not result in a significant increase in the number of registered students from these regions. That is, many students from other states who were selected by UFMG would not register at the institution (Nogueira et al., 2017). Regarding the gain in efficiency, Nogueira et al. (2017) observed that the

number of applicants to UFMG increased outstandingly since the university began to use the ENEM/SiSU, however, a sizable proportion of the selected students simply did not register at the university. Thus, other students with lower performances in the ENEM/SiSU were requested to occupy the empty slots, and many of these did not register either, creating the necessity of requesting more students, and so on. Due to this process, many slots continued to be empty at the beginning of the first semester. Besides, there was an astonishing increase in the dropout rates of registered students in their first semester, in particular because it is easy for students to use the same ENEM exam again in the SiSU in the second semester of the same year. This can be done at the same university or at another one, and many students simply change courses. Thus, more slots become idle in the second semester of the courses, and this problem only increases in later semesters (Vargas, 2019).

The Determinants of Dropout Rates

Aljohani (2016) presented a review of the major conceptual models and empirical studies dealing with student retention and dropout at HEI. Among them, the author described the institutional departure model developed by Tinto (1975). Tinto's model is probably the most widespread theory used explaining dropout in higher education (Melguizo, 2011).

The interactional model of Tinto (1975) considers that HEI are social systems and that the student's dropout can be directly linked to the student´s lack of integration with institutional values and with academic practices and communities. Later, Tinto further developed his model to include perspectives of social anthropology describing the initial process of the student's integration into academic institutions as rites of passage in tribal societies (Aljohani, 2016). In this vein, Daitx et al (2016) observed that a deficient freshman reception by colleagues, by teachers and/or by representative bodies was among the main factors related to dropout rates at HEI.

This potential mismatch between students and institutions may be partially caused by the construction of expectations about tertiary education life by the student without a real basis (Andriola et al., 2006). Silva et al (2006) observed that among the incoming students, many were totally unaware of the university context and lacked information about the profession they chose. According to Andriola et al. (2006), most non-dropout students interviewed declared that they had chosen a specific course due to taste, interest and personal affinity. Among the students who had dropped out, close to half declared that they had no information whatsoever about the future course. Similarly, Kipnis (2000) observed that those with a blurred perspective of their near future had higher dropout rates.

Thus, institutions that promote a diversity of actions to integrate students may show lower dropout rates and the dissemination of information associated with tertiary education for secondary school students through a variety of activities should be pursued (Aina et al. 2022;

Andriola et al., 2006). In this vein, students successfully integrated into the HEI´s environment, even with academic difficulties, may not drop out (Aljohani, 2016). Hence, it is a necessity to look beyond the student´s personal characteristics and include the student´s institutional and social context while discussing dropout rates (Aina et al., 2022).

Besides Tinto´s theory, Melguizo (2011) presented other approaches that deal with student's dropout at HEI, such as Bourdieu´s theory of social reproduction. This sociological theory states that education is successful in reproducing social inequalities, as dominant groups use subtle processes to perpetuate their privileged place in society.

Following this theory, in addition to economic capital, which can be defined as financial wealth, and academic capital, a set of academic skills accumulated by individuals, Bourdieu describes other types of capital that are put in place to promote the reproduction of social inequalities. One is cultural capital, which is the cultivation of skills valued in social interactions, such as foreign languages knowledge and acquaintance with specific forms of art and culture. Another is social capital, which is the enlargement of social network resources.

Following these aspects of the Sociology of Education, Daitx et al. (2016) and Lima Junior et al. (2012) highlighted that HEI may tend to reproduce society´s inequality, implicating that students with better socioeconomic and cultural backgrounds may have a lower propensity to dropout. That is, individuals in the privileged social classes possess more economic, academic, cultural and social capitals and gain educational credentials not to drop out from the educational system even if suffering from academic failure (Herbaut, 2021; Ontini et al., 2018). Likewise, following Herbaut (2021), advantaged students appear to be buffered against the impacts of academic failure at the tertiary level.

Based on the discussion above, socioeconomic status (SES) might be an important factor in determining dropout rates. Chen (2012) observed that low-SES students tended to have higher risks of dropping out in the USA. Costa and Picanço (2020) verified the same for Brazilian data. In this vein, Aina et al. (2022) argue that most studies describe that minorities show higher-than-average dropout rates. However, as emphasized by these last authors, the existing body of research is not sufficient to form a reliable set of conclusions, as many studies show that SES were not very correlated with dropout rates.

For instance, Vignoles and Powdthavee (2009) examined whether disadvantaged entrants to college in the UK had a higher probability of dropping out and they noticed that they had similar dropout rates to their advantaged peers. Likewise, Light and Strayer (2002) found that minority students in the US were less likely to drop out from college once the authors controlled for family income, test scores and other observable variables. Many studies analyzed dropout rates in Brazil and associations with SES. Kipnis (2000) and Pedrosa et al. (2007) observed that the socioeconomic profiles of those who dropped out were

like those who graduated respectively in UnB and in Unicamp. Similarly, Peixoto, Braga and Bogutchi (2003) and Nierotka et al. (2023) observed the inexistence of correlations between socioeconomic and cultural backgrounds and dropout rates respectively at UFMG and at the Federal University of Fronteira Sul (UFFS).

Other factors associated with SES, such as race/skin color, the type of secondary school attended and affirmative actions policies, might be correlated with dropout. Chen (2012) observed that differences for race in the USA were not significant after the other variables in the model were controlled. Francis and Tannuri-Pianto (2012) verified that Black students had similar college attrition to their lighter-skinned siblings at UnB. Costa and Picanço (2020) analyzed dropout rates for Whites and Blacks/Pardos at the Federal University of Rio de Janeiro (UFRJ). They observed that dropout rates did not differ between race/skin color. Differently, Nierotka et al. (2023) observed that Blacks/Pardos dropped out more frequently than Whites. Concerning the type of secondary education attended, Kipnis (2000) observed similarities in dropout rates at UnB when students who attended public secondary schools were compared to those who attended private ones. Concerning the effects of quota policies at UERJ, Bezerra and Gurgel (2011) observed that students covered by this affirmative action showed lower dropout rates. For UFMG, Aranha et al. (2012) analyzed students covered and not covered by a bonus policy and observed that the former were less likely to drop out. These results suggest that disadvantaged students in Brazil had similar or lower dropout rates to their more advantaged peers.

In contrast, the single most important factor in predicting persistence at HEI is early and recent academic performance, which is linked to previous schooling experiences and to expectations, motivations and commitment with educational goals at the tertiary level (Aina et al., 2022; Tinto, 1975). Scott-Clayton et al. (2014) found that approximately half of the college entrants in the US did not complete any type of degree within six years in part because freshmen lacked basic academic skills required for college coursework and failed at the initial disciplines. Similarly, Herbaut (2021) observed that academic failure in the first year at a HEI was an important determinant of dropout in France. Chen (2012) observed that GPA at tertiary education was a significant predictor of dropout rates in the USA. Nierotka et al. (2023), Peixoto, Braga and Bogutchi (2003) and Silva et al (2006) observed high early dropout rates caused by high failure rates in initial disciplines at Brazilian HEI. Peixoto, Braga and Bogutchi (2003) and Daitx et al (2016) emphasized that curricula modifications and adequacy of teaching methodologies to incoming freshmen would significantly reduce dropout.

Besides SES levels and academic performance, other factors might be also associated with dropout rates at HEI. Aina et al. (2022) argue that men tend to drop out more often than women do. There are different features that might explain this finding. Females show a stronger commitment to education, the value of higher education in

the labor and marriage markets has risen faster for females and there was a decline of gender discrimination. Likewise, Costa and Picanço (2020), Nierotka et al. (2023), Peixoto, Braga and Bogutchi (2003), Ontini et al. (2018) and Thaithanan et al (2021) observed that women had dropout rates lower than men did respectively at UFRJ, at UFFS, at UFMG, in Italy and at the Chiang Mai University in Thailand.

A relevant dropout determinant in many studies is the student´s age. The differences between older and younger students are in part explained by the fact that the opportunity costs of studding increase with age and overall benefits decrease. Moreover, older student may have greater difficult to integrate with their classmates. Thus, in general, older students are more likely to drop out (Aina et al., 2022). Students who work tend to spend less time dedicated to studying at the university and consequently the outcomes are poorer, and dropout rates are higher (Aina et al., 2022).

The availability of academic services and support at the HEI enhances retention, as students may benefit from scholarships, fee exemptions, publicly funded food and housing (Aina et al., 2022). In this vein, Chen (2012) analyzed whether financial aid at HEI were correlated with dropout rates and observed that four types of aid (subsidized loans, unsubsidized loans, work-study and merit aid) were negatively correlated with dropout rates.

The paragraphs above discussed the main determinants of dropout at HEI. However, before concluding this section, it should be emphasized that there are different types of dropouts. The student might have dropped out from a course to change to another one at the same institution; to enroll another HEI, or to temporarily or permanently withdraw from the educational system (Marques, 2020). This paper did not differentiate among the above possibilities.

Methodology

Databases and variables

The paper uses as databases official records of UFMG that were developed by the UFMG´s Entrance Exam Permanent Committee (COPEVE) and by the Department of Academic Registration and Control (DRCA). COPEVE is responsible for supervising the execution of all activities related to the UFMG´s Entrance Exams. The DRCA primary activity is to ensure that academic records and controls are carried out correctly, in accordance with educational legislation and UFMG's internal rules. Access to these databases was kindly granted for research purposes in a way that preserved the anonymity of the students.

The database contains data for those who were selected by UFMG in 2016 and 2017. Thus, all the main changes presented in box 1 had already occurred, so this study reflects current conditions. It contains information about those who registered at UFMG and for those who did not register. It also contains a few academic, demographic and geographic variables and the students' eligibility for affirmative action.

There are 23,940 observations in the database for those selected at UFMG´s two campuses in Belo Horizonte and in Montes Claros.

Concerning the situation of the students in a specific semester, they were classified into three groups. The first group is composed of those who were selected, but did not register at UFMG at the beginning of their course. I named this group as "not registered". The second group is composed of those who were selected and registered at UFMG at the beginning of their course, that is, they became active students at the university, but who were not officially active after the first two semesters. They became inactive in their first year at UFMG due to reasons, such as: they formally withdrew from UFMG; they did not register for the second or for the third semester; they were infrequent; or they had extremely low grades and were excluded from the official records of the university. Some of these students might have changed to other HEI or may have altered courses in UFMG. That is, as Vargas (2019) emphasized this mobility between different institutions or courses should be considered an investment rather than a failure. Those who became inactive while in the first year at the university make up the "became inactive" group. The "active" students are those who officially remained at UFMG after the first two semesters, even though they may have become inactive after this. Notice that those who were officially temporarily not attending classes at UFMG are among the active. Dummies indicating each of these three groups (1- Yes, 0 – No) were created. Among the 23,940 observations in the database, 10691 (44.7%) did not register and 13249 (55.3%) registered. Among the registered, 11043 (83.3%) were still active after the first year, while 2206 (16.7%) became inactive. Notice that those who graduated were not included in the sample.

Regarding the individual explanatory variables, dummies were created for sex (1- Male, 0 –Female) and for previous place of residence (1 – Lived in Minas Gerais State, 0 – Other state). These two variables may have an influence on registration and dropout rates. It was initially expected that males and those who lived in other states might have lower registration and/or higher dropout rates (Nogueira et al., 2017; Peixoto; Braga; Bogutchi, 2003; Soares et al., 2015).

Information for race and for whether the student attended a private or public secondary school were considered important to address the topics discussed here, however, information on them was not available for a sizable minority of the students. Nonetheless, the information about these topics can be assessed by the variable regarding affirmative action policies, which is a categorical variable with five categories: for those not covered by any quota (no quota); for those who attended secondary public school (SPS); for those who attended secondary public school and self-declared Black/Pardo/Indigenous (SPS/BPI); for those who attended secondary public school and were considered low-income (SPS/Low); and for those who attended secondary public school, self-declared Black/Pardo/Indigenous, and were considered low-income (SPS/BPI/Low). Although the variable may affect registration and dropout rates, there is no a priori expectation

(Aranha et al., 2012; Bezerra; Gurgel, 2011; Francis; Tannuri-Pianto, 2012; Pedrosa et al., 2007; Souza, 2015).

The database also contains information about the courses for which students were selected. Some variables that might impact registration and dropout rates were built with this information. First, four dummies were created: whether the course was held in the evening (1 – Yes, 0 – No); whether the course was non-SiSU (1 – Yes, 0 – No); whether the course was created by Reuni (1 – Yes, 0 – No); and whether the course was in Montes Claros (1 – Yes, 0 – No). Non-SiSU courses demand extra ability tests in addition to the ENEM exam in the selection process, such as courses related to music and arts. It is initially expected that dropout rates will be higher for courses in the evening. Those who attend evening courses have a higher propensity to work, have more financial responsibility in the household and have a more complicated routine due to studying/working arrangements and because of family and labor market issues. It is initially expected lower dropout rates in courses with ability exams. Students who do extra exams are expected to be more focused and motivated by their choice. It is expected to have higher dropout rates in courses created by Reuni, as some of them are very specific and non-traditional with a less clear absorption by the labor market. It is expected that dropout rates will be higher for courses in Montes Claros, which is a medium size urban center, located in the very north of the state, that may at least initially represent a less interesting environment for many students than Belo Horizonte, the state´s capital and a large urban metropolis, located closer to other large urban centers. For instance, Vargas (2019) observed for the Fluminense Federal University (UFF) that dropout rates at secondary Campus were greater than in the main Campus.

A continuous variable with the minimum score in the ENEM to be selected in the no quota group in each course was also included in the analysis for all individuals of the specific course, irrespective of their classification in the quota variable. The initial expectation is that courses that require greater scores to be selected may have larger registration rates and/or lower dropout rates, given that they have a greater propensity of being the student's first choice in the decision-making process and not a result of a dynamic and strategic choice (Demenech et al., 2023). Nonetheless, Almeida et al. (2016) observed an increase in dropout rates due to the use of ENEM/SiSU in most and least popular courses.

Empirical strategy

The paper has two initial objectives that are addressed by two logistic models. In the first one, the dependent variable is whether the student had enrolled or not. The objective is to address the determinants of non-registration. The second model is estimated with the students who enrolled at UFMG, and the dependent variable is whether the student remained active or not after its first year. The objective is to address the determinants of early dropout. These models include the

student´s personal characteristics and course features mentioned above as explanatory variables.

Concerning the last main objective of the paper, all courses in UFMG were classified in four groups based on the proportion of selected students who registered in them and on the proportion of registered students who continued active after their first year in the university. These four groups are: i) high enrollment rates, defined as more than the UFMG course´s average, and high proportion of active student at the third semester, defined as more than the UFMG course´s average; ii) low enrollment rates and low proportion for active students, both defined as less than the UFMG course´s average; iii) high enrollment rates and low proportion for active students; and iv) low enrollment rates and high proportion of active student. One course in each group was selected to present a diversity of examples, all with a reasonable large number of students: Computer Science, Language and Linguistics, International Economic Relations and Pharmacy.

In addition, a logistic model was estimated having as explanatory variable the student´s personal characteristics and dummies for courses. First, the predicted probability of enrolling and of remaining active were estimated for each student in each course. With both probabilities, the probability of being active if selected was estimated assuming independence between these first two probabilities. Based on these probabilities, illustrative simulations representing two selection policies scenarios are depicted for the selected courses. The simulations were done for all the quota categories separately.

The current procedure for students' selection is that there is a first wave of selection. Part of the students register. For the remaining empty slots there is a second wave, only a proportion of them register, and the procedure continues in many waves until the number of slots are nearly or totally fulfilled. The number of slots is a specific number for each course in each quota category, which are the students who registered at the beginning of the course.

The more conservative policy is the one that would select in only one wave enough students to achieve the desired number of registered students like the number of registered students in the specific course after several waves. That is, all selection waves would be replaced by only one with similar results. This objective was achieved by equalizing the sum of the predicted probabilities of registering in the specific course to the number of students who registered. The more aggressive policy is the one that would select in only one wave enough students to achieve the desired number of active students at the beginning of the third semester like the actual number of registered students in the beginning of the specific course. Concluding: in only one wave, the selection process would account for non-registration (scenario 1) and for non-registration and early dropout (scenario 2). This would imply an enormous increase in the effectiveness of the selection process with a remarkable effect on costs (Almeida et al., 2016).

All procedures were done with Stata 12.

Results

Preliminary data analysis

Table 1 shows the results for individuals who registered and for those who did not. Comparisons of each variable use t-tests and differences that were statistically significant are shown with asterisks. First, it is worth noting again the number of observations. There are 23,940 observations, 44.7% did not register and 55.3% registered.

The first two variables in the table are about individuals. Concerning sex, it is worth noting that 50% of all selected individuals were male, while the values for unregistered and for registered were respectively 49% and 51%, apparently a small difference. Notice, however, that this small difference was statistically significant at 5%, as shown by the asterisk. Thus, males tend to register in greater proportion than females.

The next comparison is for whether the individual lived in MG. Eighty-four percent of all students who were selected at UFMG had previously lived in MG. Among those who did not register, the number was 72%, a value significantly smaller than for those who registered, 94%. As observed by Nogueira et al. (2017), individuals from other states were less likely to register at UFMG. That is, the mobility claimed by the federal government as an advantage of the ENEM/SiSU process was not actually occurring as expected.

The next four variables refer to the course for which the person was selected. Thirty-three percent of the selected students chose a course in the evening. The proportions among those who did not register was 34% and among those who registered was 32%, a small difference, although statistically significant. A small minority of the selected students, 3.3%, chose a non-SiSU course. Among the students who registered the proportion was much larger, 5.5%, than for those who did not, 0.7%. Among the registered, the value for individuals who remained active was much greater than for those who became inactive. These results also indicate that, once it is more difficult to change courses that are non-SiSU, registration rates are higher, as expected. 20% of the selected students chose a Reuni course. The values for individuals who did and did not register were quite similar, although the difference was statistically significant. The students who selected a course in Montes Claros corresponded to 5.2% of the total. The value for those who did not register, 7.4%, was much greater than that observed for those who registered, 3.5%. That is, courses in Montes Claros tended to show much greater proportions of students who did not register.

Table 1 – Percentage of students among the students selected in the 2016 and 2017 UFMG entrance exams

Variable	All (%)	Not registered (%)	Registered (%)
Male	50	49*	51*
Lived in Minas Gerais	84	72*	94*
Evening courses	33	34*	32*
Non-SiSU courses	3.3	0.7*	5.5*
Reuni courses	20	21*	20*
Courses in Montes Claros	5.2	7.4*	3.5*
Proportion of observations	100	44.7	55.3

Note: * There was a statistically significant difference at 5% between the groups. Number of observations: 23940. Source: Own elaboration.

Table 2 presents similar comparisons, but only for those who registered. Notice that the last column in table 1 is equal to the first in table 2 to facilitated comparisons. First, it is worth noting that the number of observations is 13249, those who registered. Among those, 83.3% were still active after the first year, while 16.7% became inactive.

Male had a greater propensity of being among those who became inactive, as 57% of those who became inactive at UFMG were male, a number significantly greater than the 50% for those who continued active, as expected. Differences for place of previous residence were not significant. That is, students from other states did not differ from students who previously lived in MG after registering for early dropout rates. Courses in the evening, without the ability extra exams, created by the Reuni policy and in Montes Claros tended to show much greater proportions of students who became inactive in their first year, also as expected.

Table 2 – Percentage of students among the registered students in the 2016 and 2017 UFMG entrance exams

Variable	All (%)	Became inactive (%)	Active (%)
Male	51	57*	50*
Lived in Minas Gerais	94	94	93
Evening courses	32	43*	30*
Non-SiSU courses	5.5	2.4*	6.0*
Reuni courses	20	26*	19*
Courses in Montes Claros	3.5	6.1*	3.0*
Proportion of observations	100	16.7	83.3

Note: *There was a statistically significant difference at 5% between the groups; Number of observations: 13249. Source: Own elaboration.

Concluding, the results presented in Tables 1 and 2 show that those who did not previously live in MG, and those who had applied for a SiSU course or a course in Montes Claros were less likely to register. Moreover, students who were male, who applied for a course in the

evening, for a SiSU or a Reuni course or a course in Montes Claros tended to be become inactive at higher rates.

Econometric models

Table 3 shows the results of two logistic models. The analysis resembles tables 1 and 2 with two comparisons: i) registered versus not registered; ii) active versus became inactive among those who registered. The same set of explanatory variables was used in both models to make comparisons more insightful.

The coefficient for male was not significant for those who registered as opposed to not registered and was negative and significant for active as opposed to became inactive. Thus, being a male was not correlated with registration, but decreased the probability of being an active student among those who registered, conditioned on the presence of the other variables in the model. The odds-ratio of this significant variable is around 0.69 ($e^{-0.371}$), a value reasonably smaller than one, indicating that males had a chance approximately 30% smaller of continuing active when compared to females. This result corroborates the initial expectations, as higher dropout rates of males are commonly observed in many settings (Peixoto; Braga; Bogutchi, 2003; Soares et al., 2015). This result points to the question of whether UFMG should tackle gender differences with a particular policy directed toward males at the beginning of the course.

For state of residence, the coefficient for the registered model was positive and significant, and the coefficient for the active model was non-significant. The odds-ratio in the first model was above six, indicating that, conditioned on the presence of the other variables, being a previous resident of MG remarkably increased the probability of registering. This point corroborates the discussion presented by Nogueira et al. (2017), contrary to the predicted increase in mobility because of using the ENEM/SiSU as the main tool of the selection process. After registration, differences are not significant.

Students are selected for the first or second semesters of the year. For those who were selected for the second, the probability to register is smaller, possibly because they are registering elsewhere. Once registered, the probability of continuing active is greater, probably because they cannot migrate to another institution using the same entrance exam.

For the variable for affirmative action policy, it is worth noting that all coefficients in the model for active versus became inactive were non-significant. This suggests that, among those who have registered, no group is significantly more or less likely to become inactive, as suggested in by other authors (Aranha et al., 2012; Bezerra; Gurgel, 2011; Francis; Tannuri-Pianto, 2012; Light; Strayer, 2002; Pedrosa et al., 2007; Vignoles; Powdthavee, 2009). That is, early dropout rates are similar across all affirmative action policy groups, which is a point in favor of those policies. In contrast, some of the coefficients for registered against non-registered were significant. Non-low-income students

from public schools showed a greater propensity to register than those in the no-quota or open-competition group, which is the reference. This trend was especially pronounced among those self-classified as Black/Pardo/Indigenous. These results suggest that students who graduated in public secondary schools and that are non-low-income are more prone to register, in part because they might be more focused in pursuing higher education level in non-paid institutions. However, for the low-income Black/Pardo/Indigenous students from public schools, the propensity to register was smaller than for the no-quota group. Possibly, this may suggest a lack of sense of belonging felt by disadvantaged students concerning the prospective university environment. Following aspects of the Sociology of Education, Daitx et al. (2016) and Lima Junior et al. (2012) highlighted that higher education institutions may tend to reproduce the society´s inequality, implicating that students with worst socioeconomic and cultural backgrounds may have a higher propensity not to register. A focused policy could be implemented to address this last point. For instance, institutions that promote a diversity of actions to integrate students and to disseminate information associated with tertiary education for secondary school students through a variety of activities may enhance registration rates (Andriola et al., 2006).

Students who were selected for courses that require greater scores to be selected showed a greater propensity to register and a lower propensity to become inactive. Notice that the odds-ratio refers for each point in the minimum ENEM score to be selected. Golgher (2020) observed that the results in the entrance exam at UFMG were positive correlated with academic undergraduate GPAs, and consequently was negatively correlated with dropout rates.

Those who were selected for an evening course showed a similar propensity to register to those who were selected for daytime courses, but once registered, they had a lower propensity of remaining active. Those who attend evening courses have a higher propensity to work, have more financial responsibility in the household and have a more complicated routine due to studding/working arrangements and because of family and labor market issues and are expected to have higher dropout rates.

Those selected for a non-SiSU course showed a much greater propensity to register, with an odds-ratio of more than eight, and a much higher propensity of being active, with an odds-ratio of over two. These last results suggest that the requirement of extra ability courses implicate in more focused students and a larger value given to the chosen course, as the decision-making process cannot be a strategic choice that corresponds less to their original preference (Ariovaldo; Nogueira, 2018).

Those who were selected for a Reuni course tended to show a lower propensity to register, and, once registered, they were less likely to remain active. These courses tend to be very specific with a less clear absorption by the labor market and might be less valued than traditional courses.

Students in courses held in Montes Claros showed greater propensity not to register, but after registration, dropout rates were lower. Montes Claros is a medium size urban center that may show a *a priori* less interesting environment than Belo Horizonte, the state´s capital and a large urban metropolis, for many students, but this may not be the case for the *a posteriori* impressions. Differently, Vargas (2019) observed for the Fluminense Federal University (UFF) that dropout rates at secondary Campus were greater than in the main Campus.

Table 3 – Estimates of the parameters of the two adjusted logistic regression models for the study of the probabilities of selected students enrolling and enrolled students remaining active - UFMG, 2016 and 2017

	Registered		Active	
Variables	Not registered		Became inactive	
	Coefficient	Odds-ratio	Coefficient	Odds-ratio
Male	0.00621	-	-0.371***	0.69
	(0.0283)		(0.0525)	
State of residence	1.898***	6.67	0.0691	-
	(0.0445)		(0.112)	
Second semester	-0.337***	0.71	0.458***	1.58
	(0.0288)		(0.0545)	
No quota	Ref.	Ref.	Ref.	Ref.
Secondary public school	0.148***	1.16	0.0667	-
	(0.0480)		(0.0871)	
Secondary public school and B/P/I	0.255***	1.29	-0.0987	-
	(0.0451)		(0.0749)	
Secondary public school and low-income	-0.0543	-	0.136	-
	(0.0457)		(0.0889)	
Secondary public school, B/P/I and low-income	-0.0951**	0.91	0.0538	-
	(0.0416)		(0.0779)	
Minimum in SiSU	0.00561***	1.0056	0.00806***	1.0081
	(0.000273)		(0.000512)	
Evening course	-0.0307	-	-0.243***	0.78
	(0.0321)		(0.0570)	
Non-SiSU	2.096***	8.13	1.022***	2.78
	(0.128)		(0.160)	
Reuni	-0.161***	0.85	-0.331***	0.72
	(0.0375)		(0.0640)	
Montes Claros	-0.142*	0.87	0.460***	1.58
	(0.0743)		(0.131)	
Constant	-4.676***	-	-3.978***	-
	(0.203)		(0.379)	
Observations	23,940		13,249	
Pseudo-R^2	0.100		0.0520	

Notes: B/P/I = Blacks/Pardos/Indigenous; Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Source: Own elaboration.

Simulations

All courses in UFMG were classified in four groups, as already detailed. One course in each group was selected to present a diversity of examples in the simulations: Computer Science; Language and Linguistics; International Economic Relations; and Pharmacy. Notice that the simulations are illustrative. Other courses in any of the four groups could be used for similar objectives. Those with more students tend to present less statistical variability.

The number of individuals at each course that should be selected was estimated in two scenarios. In the first, the objective is not to have empty slots at the beginning of the first year at UFMG after just one wave of selection. By doing this procedure, UFMG would need only one wave and not several of them to achieve the desired final number of registered students. In a second scenario, the objective is not to have empty slots at the beginning of the second year at UFMG. In only one wave, the selected students would ensure that the number of initially registered students is greater than the number for actual registered students to compensate for those who will become inactive in their first year.

Two simulations were done for each scenario for each course for each quota category to verify whether the values varied much from one simulation to the other. The results were remarkably robust and differed only slightly and I present the results for one only of the simulations. Nonetheless, it is important to emphasize that a rigorous analysis of robustness should encompass many more simulations. The results are for students in two years, 2016 and 2017. Thus, the number of slots is for two years.

Table 4 shows the results. First, it is worth noting that the benchmark for comparisons is the number of students who registered in each course in each affirmative action modality in each of the four selected courses. In the first scenario, more individuals than slots would be selected in the first and only wave in order not to have empty slots in the beginning of first year due to non-registration. For Computer Science, if 80 students of the no-quota group are wanted to be registered, 110 should be selected in the first and only wave, as around 30 will simply not register. Note that the number of students who should be selected to fill 81 slots for the no quota modality in Pharmacy, a course with much lower registration rates, would be 188. It is worth noting that the numbers in the first scenario are greater than the registered in all categories, being relatively greater when non-registration rates are larger.

In the second scenario, the number of students at the beginning of the first year of the course would be greater than the number finally wanted. For Computer Science, 113 students should be selected in the first and only wave to account for non-registration and early dropout rates to have 80 no-quota students in the beginning of the second year. The number for pharmacy would be 230, a much greater number because of the higher non-registration and early dropout rates.

Table 4 – Number of students to be selected – estimated through illustrative simulations – so that there are no vacancies in each of the categories defined in the affirmative action policy adopted at UFMG, for the courses considered

Affirmative action	Actually registered	No empty slots in the beginning of the first year	No empty slots in the beginning of the second year
Computer Science			
No quota	80	110	113
Secondary Public school	18	24	24
Public school/BPI	22	30	31
Public school/low-income	17	24	25
Public school/BPI/low-income	22	30	30
Language and Linguistics			
No quota	162	286	331
Public school	36	59	68
Public school/BPI	45	64	77
Public school/low-income	37	69	78
Public school/BPI/low-income	44	74	85
International Economic Relations			
No quota	47	88	123
Public school	9	14	21
Public school/BPI	14	21	31
Public school/low-income	12	22	29
Public school/BPI/low-income	14	25	34
Pharmacy			
No quota	81	188	230
Public school	18	38	47
Public school/BPI	22	42	54
Public school/low-income	18	43	53
Public school/BPI/low-income	20	46	55

Source: Own elaboration.

Conclusion

Nowadays, most public universities in Brazil use the ENEM/SiSU as the main tool for selecting students. The federal government predicted three positive results from using this selection process (greater mobility for students, increased efficiency of the selection process, and increased proportions of minorities attending these institutions), but none of the expectations was reasonably fulfilled. In part this occurred after the implementation of the ENEM/SiSU because a sizable proportion of the selected students do not register at the university, and because of the astonishing increase of early dropout rates of registered students (Lima; Machado, 2016; Nogueira et al., 2017; Silveira et al., 2015).

Vargas (2019) proposes some policies that potentially could decrease non-enrollment and dropout rates: institutions should actively contact the selected students; institutions should enhance its propaganda about ENEM, SiSU and tertiary education environment for secondary level students; institutions should clearly present the student assistance mechanisms at the time of registration on the SiSU platform; and institutions should produce analyzes on dropout rates based on courses, location, institutions and public origin.

In this vein, this paper analyzes the determinants of non-registration and of early dropping out at UFMG. The results can be the basis for the implementation of policies aiming at increasing registration rates and decreasing dropout rates, as depicted by Vargas (2019). The paper also proposes changes in the selection process that could significantly decrease the probability of having empty slots at the beginning of the first year and/or at the beginning of the second year due to non-registration and early dropout. All selection waves would be replaced by only one wave accounting for non-registration rates and/or non-registration and dropout rates. Thus, this study shows direct applicability for the design of more effective selection policies for UFMG and other Brazilian public HEI and would implicate in an enormous increase in the effectiveness of the selection process with a remarkable impact on costs.

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